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Test Report No.07-007(E)

Issued on April 16, 2007



TEST REPORT

ON

SMOKE AND TOXICITY TEST

Reference Number: No.81655

Name of Specimen: FIRE-PROOF MATERIAL (FIRE RETARDING MATERIAL)
HI-MACS (Acrylic Solid Surface)

Name and Address of Applicant: LG Chem, Ltd
150-721 LG Twin Towers, 20 Yeouido-dong, Yeongdeungpo-gu, Seoul, Korea

The test result described in this report is the result obtained only from the specimen submitted.
Cover 1 sheet, text 8 sheets and attachment 2 sheets (total 11 sheets) are included.

Tested and Reported by

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1 . Date of testing : March 30 and April 2, 2007

2 . Test specimen

- (1) Date of supply of specimen : March 27, 2007
- (2) Name of specimen : FIRE-PROOF MATERIAL(FIRE RETARDING MATERIAL)
- (3) Product name of specimen : HI-MACS (Acrylic Solid Surface)
- (4) Type of specimen : S06 (Pattern Name: Artic White)
- (5) Name of manufacturer : LG Chem, ltd
(Address: 150-721 LG Twin Towers, 20 Yeouido-dong, Yeongdeungpo-gu, Seoul, Korea)
- (6) Construction and components : Refer attached "Specification of test specimen" for detail.

Specimen is a fire retardant surface material, thickness about 12.6 mm .(specification: 12 mm)
Nothing was applied for the substrate of test specimens.

Specimen submitted from the manufacturer was tested. Research Institute of Marine Engineering did not concern for the sampling of the test specimen. Color was "White".

(7) Description of the specimen

- a) Trade name of the material : HI-MACS
- b) Type of the material : Surface of bulkheads, linings or ceilings
- c) Description of the material : Refer attached "Test Specification" for detail.
- d) Dimension : These tests were carried out on 75mm square specimens.
- e) Number : Three specimens were tested for each type of exposure.
- f) The specimen face tested was the face of FIRE RETARDING MATERIAL.

3 . Test method

These tests were carried out in accordance with 「SMOKE AND TOXICITY TEST」 (Part2 of 「INTERNATIONAL CODE FOR APPLICATION OF FIRE TEST PROCEDURES」 IMO MSC 61(67)). Smoke generation test was conducted in accordance with ISO 5659:1994, Part2.

Toxic gases were analyzed with FTIR (Fourier transform infrared spectroscopy).

4 . Test results

Test results and the criteria specified in the above test procedures are shown in Table 1. The criteria of smoke for materials used as surface of bulkheads, linings or ceilings is shown in Note 2. Test results of each condition are shown in Table 2,3,4. Measured specific optical density of smoke (Ds) is shown in Fig. 1. The graph of light transmission against time is shown in Fig. 2.

On the basis of these results, the specimen satisfied the criteria specified in Part 2 of 「INTERNATIONAL CODE FOR APPLICATION OF FIRE TEST PROCEDURES」 .

5 . Remarks

The test result related only to the behaviour of the test specimen of material under the particular conditions of the test; they are not intended to be the sole criterion for assessing the potential fire hazard of the material in use.

Table 1. Test results

Irradiance to the specimen	25(kW/m ²)	25(kW/m ²)	50(kW/m ²)	Criteria
Pilot flame	Absence	Presence	Absence	surface of bulkheads, linings or ceilings ≤ 200
Average of the maximum specific optical density (Dm)	34.34	1.38	65.27	
Specific optical density Ds10 at 10 min.	8.43	0.47	47.89	No criteria
Gas concentrations (ppm)				Toxicity Criteria
CO	1225	86	230	≤ 1450
HCN	N.D.	N.D.	N.D.	≤ 140
HCl	N.D.	N.D.	N.D.	≤ 600
HBr	N.D.	N.D.	N.D.	≤ 600
HF	N.D.	N.D.	N.D.	≤ 600
NO _x	N.D.	N.D.	N.D.	≤ 350
SO ₂	N.D.	N.D.	N.D.	≤ 120

Note 1. Table 1.

N.D. The gas was not detected with FTIR.

Detection Limits

The concentration which were able to be detected, is shown blow.

CO 50ppm, HCN 20ppm, HCl 75ppm, HBr 50ppm, HF 40ppm, NO_x 50ppm SO₂ 19ppm

The values of detection limits are less than above values. The actual detection limits are not clear at the present time (April 2007). If the lowest values mentioned above are the same as the detection limits, the decision of "pass or fail" has no problem.

Note 2. Criteria of smoke

An average(Dm) of the maximum of Ds of three tests condition shall be calculated.

- 1 For materials used as surface of bulkheads, linings or ceilings, the Dm shall not exceed 200 in any test condition.
- 2 For materials used as primary deck covering, the Dm shall not exceed 400 in any test condition.
- 3 For materials used as floor covering, the Dm shall not exceed 500 in any test condition.
- 4 For plastic pipes and electric cables, the Dm shall not exceed 400 in any test condition.



Table 2 Test results of each condition
(Irradiance 25(kW/m²) in the absence of pilot flame)

condition: 25 (kW/m²) pilot flame: no/yes
 date: 2007/4/2 temp: 18 °C
 specimen: HI-MACS humidity: 44 %

specimen	No.	1	2	3	Average
thickness(mm)	-	12.6	12.6	12.6	-
mass (g)	before	123.6	124.0	122.8	123.5
	before(with holder)	399.7	399.9	398.0	-
	after(with holder)	388.0	389.0	385.7	-
	after	111.8	113.2	110.5	-
	loss	11.7	10.9	12.3	11.7
smoke	smoke Ds max. *	37.02	34.91	31.09	34.34
	Time(sec.) **	1200	1200	1192	1197
	Ds10	9.43	8.23	7.63	8.43
	Dc	-	-	-	-
	test duration(min)	20	20	20	-
gases(ppm)	CO	-	-	1225	1225
	HCN	-	-	N.D.	N.D.
	HCl	-	-	N.D.	N.D.
	HBr	-	-	N.D.	N.D.
	HF	-	-	N.D.	N.D.
	NOx	-	-	N.D.	N.D.
	SO2	-	-	N.D.	N.D.
ignition	Time(sec)	N.I.	N.I.	N.I.	-
remarks	* Maximum specific optical density **Time to maximum specific optical density Concentration of gases was not measured at Test 1 and Test 2.	Dc is less than 5% of smoke Ds max.	Dc is less than 5% of smoke Ds max.	Dc is less than 5% of smoke Ds max.	

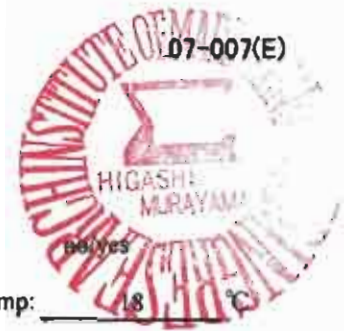


Table 3 Test results of each condition
(Irradiance 25(kW/m²) in the presence of pilot flame)

condition: 25 (kW/m²) pilot flame: no/yes
 date: 2007/4/2 temp: 18 °C
 specimen: HI-MACS humidity: 44 %

specimen	No.	1	2	3	Average
thickness(mm)	-	12.6	12.6	12.6	-
mass (g)	before	123.7	125.0	124.2	124.3
	before(with holder)	398.9	400.2	399.4	—
	after(with holder)	383.4	385.1	384.2	—
	after	108.2	110.0	109.0	—
	loss	15.5	15.1	15.2	15.3
smoke	smoke Ds max. *	1.64	1.34	1.16	1.38
	Time(sec.) **	358	392	1182	644
	Ds10	0.46	0.54	0.41	0.47
	Dc	-	-	0.40	—
	test duration(min)	10	10	10	—
gases(ppm)	CO	-	-	86	86
	HCN	-	-	N.D.	N.D.
	HCl	-	-	N.D.	N.D.
	HBr	-	-	N.D.	N.D.
	HF	-	-	N.D.	N.D.
	NOx	-	-	N.D.	N.D.
	SO2	-	-	N.D.	N.D.
ignition	Time(sec)	342	383	358	361
remarks	* Maximum specific optical density **Time to maximum specific optical density Concentration of gases was not measured at Test 1 and Test 2.	Dc is less than 5% of smoke Ds max.	Dc is less than 5% of smoke Ds max.		



Table 4 Test results of each condition
(Irradiance 50(kW/m²) in the absence of pilot flame)

condition: 50 (kW/m²) pilot flame: no/yes
 date: 2007/3/30 temp: 22 °C
 specimen: HI-MACS humidity: 50 %

specimen	No.	1	2	3	Average
thickness(mm)	-	12.6	12.6	12.6	-
mass (g)	before	124.0	125.1	124.1	124.4
	before(with holder)	400.1	401.0	399.8	-
	after(with holder)	372.3	372.3	372.2	-
	after	96.1	96.4	96.5	-
	loss	27.8	28.7	27.6	28.0
smoke	smoke Ds max. *	68.69	71.60	55.52	65.27
	Time(sec.) **	798	740	702	747
	Ds10	38.69	58.03	46.95	47.89
	Dc	18.99	17.81	13.88	-
	test duration(min)	20	20	20	-
gases(ppm)	CO	-	-	230	230
	HCN	-	-	N.D.	N.D.
	HCl	-	-	N.D.	N.D.
	HBr	-	-	N.D.	N.D.
	HF	-	-	N.D.	N.D.
	NOx	-	-	N.D.	N.D.
	SO2	-	-	N.D.	N.D.
ignition	Time(sec)	415	140	165	240
remarks	<p>* Maximum specific optical density **Time to maximum specific optical density Concentration of gases was not measured at Test 1 and Test 2.</p>				

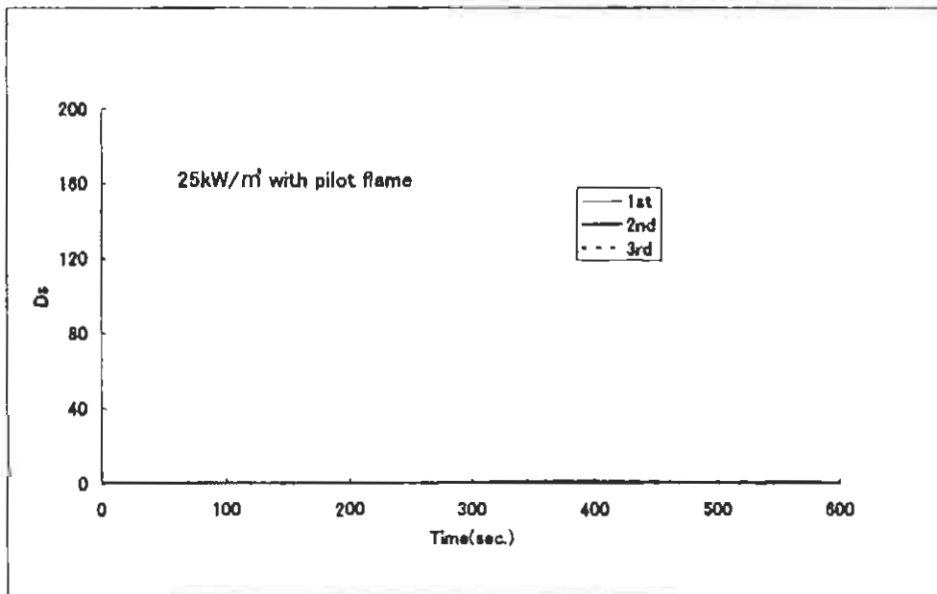
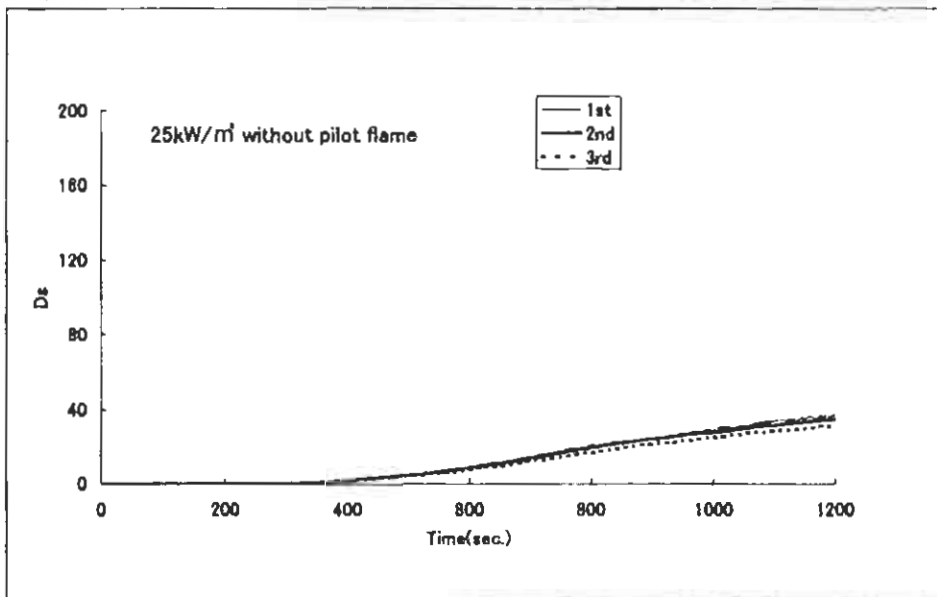
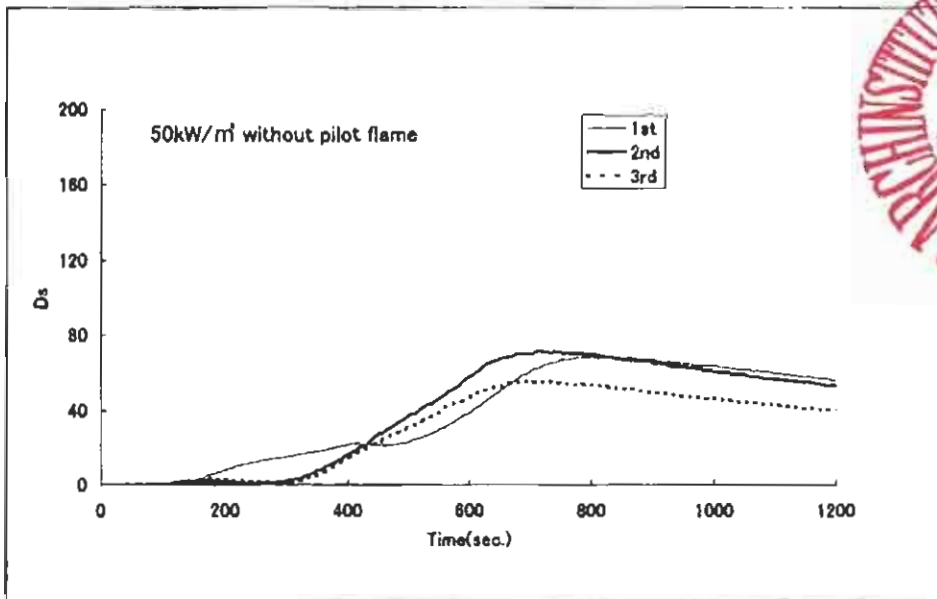


Fig1. Specific Optical Density of Smoke (Ds)

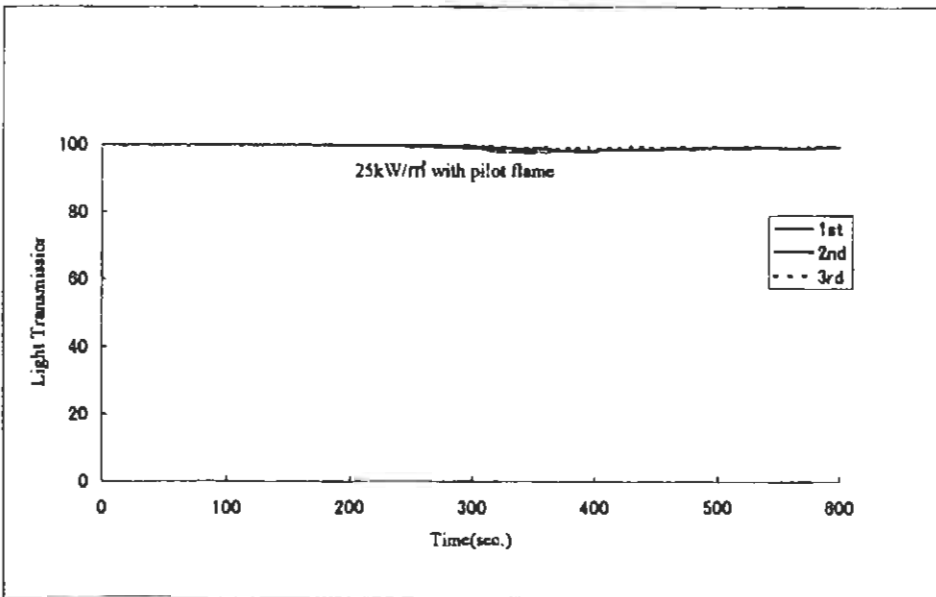
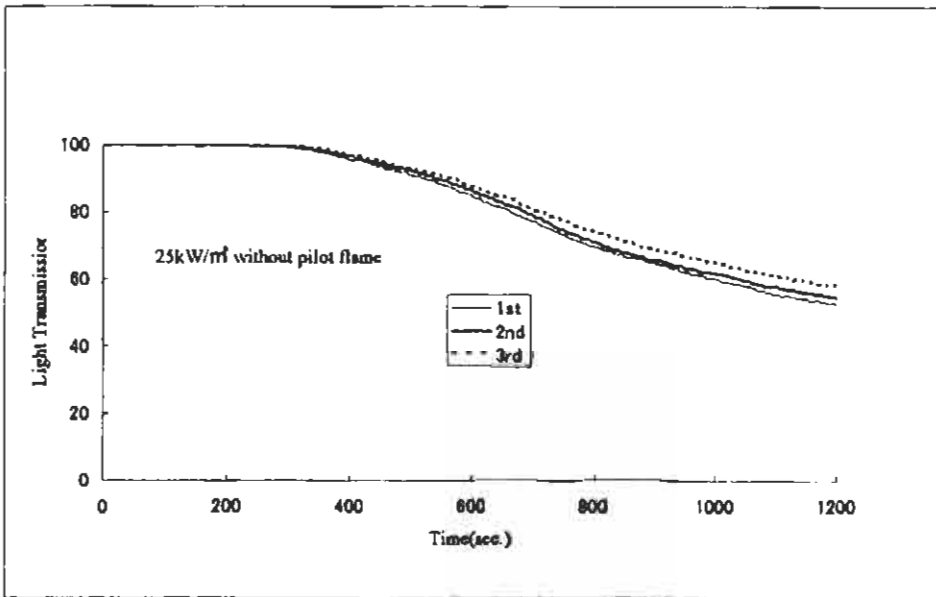
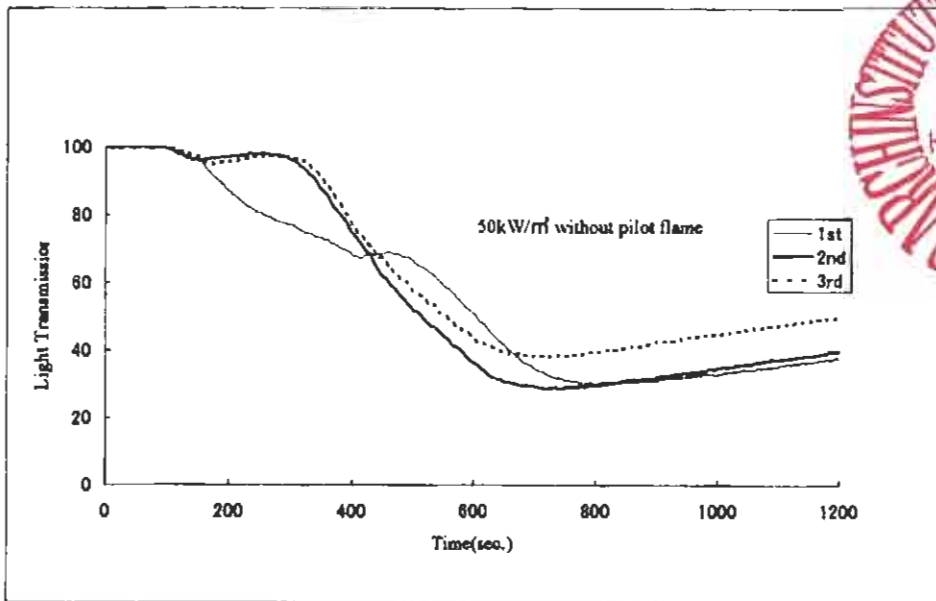


Fig. 2 Light Transmission



Photo 1 Appearance of the testing

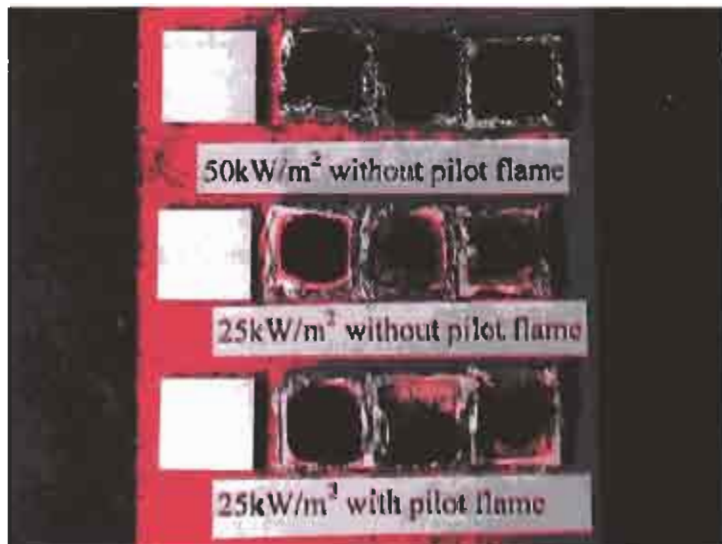


Photo 2 Appearance of specimen before and after testing

The information of this attachment was submitted by the applicant.



Specification of Test Specimen

1. Name of the Test : Test of smoke and Toxicity (FTP code, Annex-Part2)
2. Applicant ; LG Chem, Ltd
3. Address ; 150-721 LG Twin Towers, 20 Yeouido-dong,
Yeongdeungpo-gu, Seoul, Korea
4. Name of the Specimen ; FIRE-PROOF MATERIAL
(FIRE RETARDING MATERIAL)
5. Product name of the Specimen ; HI-MACS (Acrylic Solid Surface)
6. Trade name of the Specimen ; HI-MACS
7. Type of the Specimen ; S06 (Pattern Name: Artic White)
8. Manufacturer ; LG Chem, Ltd
9. Manufacturer Address; 150-721 LG Twin Towers, 20 Yeouido-dong,
Yeongdeungpo-gu, Seoul, Korea

10. Construction

*Composition

Specification

Products Name : HI-MACS

Manufactured and sold by : LG Chem,LTD.

Materials : MMA Solid Surface with resin contents

Nature and Shape : Non - Porous sheet Chemical Composition



Composition	WI %	Note
PMMA, MMA Solution	30 ~ 45	Matrix Resin
Inorganic Filler	45 ~ 55	AL(OH)3
Cross Linking Agent	0.5 ~ 1.5	
Initiator	0.05 ~ 0.2	Peroxida system
Additives	0.5 ~ 1.0	

* Standard Size of HI-MACS: 12mm(T) x 760mm(W) x 3680mm(L)

→ Weight 60.69kg

→ Density: 0.063Lbs/in3(ASTM D792)

* Sample Size for the test: 12mm(T) x 75mm(W) x 75mm(L)

Surface color ; White, Reverse color ; White

Please refer to below.

1. Standard Size:

Thickness	Width	Length	Colors
6	760	2490	* Limited to Solid colors
12	760	3680	* All Patterns are available

2. Properties: Please refer to below.

Properties	Unit	Result		Test Method	
		Solids	Granite		
Density	Lbs/in ³	0.063	0.060	ASTM D 792	
Tensile strength	Lbs/in ²	5,500	5,200	ASTM D 638	
Modulus	Lbs/in ²	1.35x10 ⁶	1.1x10 ⁶		
Flexural strength	Lbs/in ²	11,500	10,500	ASTM D 790	
Modulus	Lbs/in ²	1.4x10 ⁶	1.1x10 ⁶		
ZOD Impact Strength	Notched	Lbs-in/in	1.47	1.47	ASTM D 256 A
	1/8 in	In/1/2 lbs	31.5	29.5	
Impact Resistance	3/8 in	In/1 lbs	31.5	29.5	JIS K 6718
(Ball Drop)	1/2 in	In/1 lbs	47.2	43.3	7211
	1/2 in	In/2 lbs	27.5	25.5	NEMA-LDI-2.1
	Rockwell('M' scale)	-	90	88	ASTM D 785
Hardness	Barcol	-	63	61	ASTM D 2583
	Pencil	H	5	5	JIS K 5400 (2.2 lbs)
Heat Distortion Temperature	°F	221~230	219~226	ASTM D 648	
Thermal Expansion	X 10 ⁻⁶ in/in/°F	1.02	1.21	ASTM D 696	
Water Absorption Sheet	1/8 in	%	0.05	0.05	
	1/3 in	(73.4/°F, 24hrs)	0.05	0.05	ASTM D 570
	1/2 in		0.04	0.05	
Weathering resistance	E(1,000hrs)	&	No change	No change	ASTM D 1499
	1/8 in		1.14	1.08	
Weight per ft 2	1/3 in	lbs	2.27	2.16	
	1/2 in		4.55	4.32	
Resistance in Cigarette burn	-		Yellow stain can removed by abrasive cleaner		
Resistance to dry heat	-		Very slight change in lundry; no other visible change		