Report No. 031008-03B

TEST REPORT

Report Date: 19 February 2004

Test Component: Korea Kwang Nyun Co. Reflective PVC Trim Material With Hexagon Pattern (White and Fluorescent Yellow-Green)

Submitted by: Korea Kwang Nyun Co.
Seoul, Korea 143-822

Test Laboratory: Calcoast - ITL
Emeryville, CA 94608

Products: White and Fluorescent Yellow-Green

SUMMARY

Specification: ANSI/ISEA 107-1999
American National Standard for High-Visibility Safety Apparel
Retroreflective Material, Level 1 or 2

Color and Luminance, Initial (Yellow-Green)	Passed
Colorfastness After Xenon	Passed
Photometric Performance (White – Level 1 & 2))	Passed
Photometric Performance, (Yellow/Green – Level 1 Only)	Passed
Abrasion	Passed
Flexing	Passed
Folding at Cold Temperatures	Passed
Exposure to Temperature Variation	Passed
Domestic Washing (50X)	Passed
Dry-cleaning	Not Applicable
Retroreflective Performance in Rainfall	Passed

Signature of Responsible Laboratory Official:

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TEST DATA SHEET

Material Tested: Korea Kwang Nyun Co. Reflective PVC Trim Material – With Hexagon Pattern
(White and Fluorescent Yellow-Green)

Color, Combined-performance Reflective Material

Requirement: ANSI/ISEA 107-1999 6.1.2

Test Method: ASTM E1164:1994 (D65, 45/0, 2° Observer)

Each test specimen shall fulfill the colorimetric requirements of Table 3.

Chromaticity and Luminance (Initial)							
Orientation	ε = 0°			ε = 90°			
Product	x	y	β	x	y	β	β required
Yellow-Green	0.3878	0.5764	0.886	0.3859	0.5773	0.873	≥0.70

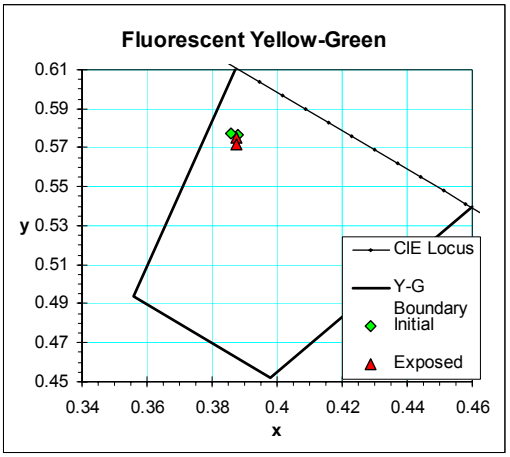
Colorfastness After Xenon Exposure

Requirement: ANSI/ISEA 107-1999 6.1.

Test Method: ISO 105-B02:1994 Method 1
ASTM E1164:1994 (D65, 45/0, 2° Observer)

After exposure each test specimen shall fulfill the colorimetric requirements of Table 3.

Chromaticity and Luminance (Post Xenon Exposure)							
Orientation	ε = 0°			ε = 90°			
Product	x	y	β	x	y	β	β required
Yellow-Green	0.3875	0.5752	0.860	0.3876	0.5716	0.814	≥0.70



Comments: Samples meet all requirements.

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(White and Fluorescent Yellow-Green)

Retroreflective Performance, Initial

Requirement: ANSI/ISEA 107-1999 7.1

Test Method: ASTM E808/E809

Measured Coefficient of Retroreflection in cd/(lx*m^2)

Product	White							
Observation Angle	Entrance Angle (ε_1 = 0°)				Entrance Angle (ε_2 = 90°)			
	5°	20°	30°	40°	5°	20°	30°	40°
12′	402.6	385.3	318.3	118.4	368.8	303.1	290.4	239.7
20′	285.6	230.3	174.6	72.4	328.3	178.4	168.2	156.1
1°	34.0	29.7	34.4	20.8	59.6	46.7	42.0	27.7
1°30′	11.4	10.9	8.8	4.1	24.2	15.0	15.4	17.0

Product	Combined Performance Fluorescent Yellow-Green							
Observation Angle	Entrance Angle (ε_1 = 0°)				Entrance Angle (ε_2 = 90°)			
	5°	20°	30°	40°	5°	20°	30°	40°
12′	319.4	284.3	235.8	86.8	272.2	225.3	194.9	128.0
20′	205.2	177.2	147.7	59.1	167.5	128.1	116.7	84.8
1°	29.0	34.5	33.0	17.4	64.8	39.0	33.0	21.4
1°30′	14.7	11.1	9.6	3.7	30.5	17.4	16.0	13.9

Level 1 Requirements for Coefficient of Retroreflection in cd/(lx*m^2)

Observation Angle	Entrance Angle (ε_1 = 0°)				Entrance Angle (ε_2 = 90°)			
	5°	20°	30°	40°	5°	20°	30°	40°
12′	250	220	135	50	187.5	165.0	101.3	37.5
20′	120	100	75	30	90	75	56.3	22.5
1°	25	15	12	10	18.8	11.3	9.0	7.5
1°30′	10	7	5	4	7.5	5.3	3.8	3.0

Level 2 Requirements for Coefficient of Retroreflection in cd/(lx*m^2)

Observation Angle	Entrance Angle (ε_1 = 0°)				Entrance Angle (ε_2 = 90°)			
	5°	20°	30°	40°	5°	20°	30°	40°
12′	330	290	180	65	247.5	217.5	135.0	48.8
20′	250	200	170	60	187.5	150.0	127.5	45.0
1°	25	15	12	10	18.8	11.3	9.0	7.5
1°30′	10	7	5	4	7.5	5.3	3.8	3.0

Comments: White Sample meets level 1 & 2 retroreflective performance requirements. Yellow-Green sample meets Level 1 requirements.

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Material Tested: Korea Kwang Nyun Co. Reflective PVC Trim Material – With Hexagon Pattern
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Abrasion

Requirement: ANSI/ISEA 107-1999 7.2.1

Test Method: ANSI/ISEA 107-1999 8.4.1
EN 530:1994, Method 2 (Wool Abradent / 5000 Cycles / 9kPa)

After exposure each test specimen shall fulfill the photometric requirements of Section 7.2.1.

Post Exposure Coefficient of Retroreflection (R_A) - cd/(lx*m^2)				
Observation Angle = 12′				
Entrance Angle = 5°				
	ε_1 = 0°		ε_2= 90°	
Product	Measured	Required	Measured	Required
White	266.0	100	230.9	75
Fluor. Yellow-Green	190.3	100	163.8	75

Comments: Samples meet all requirements.

Flexing

Requirement: ANSI/ISEA 107-1999 7.2.1

Test Method: ANSI/ISEA 107-1999 8.4.2
ISO 7854:1995 Method A (7500 Cycles)

After exposure each test specimen shall fulfill the photometric requirements of Section 7.2.1.

Post Exposure Coefficient of Retroreflection (R_A) - cd/(lx*m^2)				
Observation Angle = 12′				
Entrance Angle = 5°				
	ε_1 = 0°		ε_2= 90°	
Product	Measured	Required	Measured	Required
White	325.2	100	276.1	75
Fluor. Yellow-Green	266.9	100	223.8	75

Comments: Samples meet all requirements.

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Material Tested: Korea Kwang Nyun Co. Reflective PVC Trim Material – With Hexagon Pattern
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Folding at Cold Temperatures

Requirement: ANSI/ISEA 107-1999 7.2.1

Test Method: ANSI/ISEA 107-1999 8.4.3
ISO 4675:1990 (-20°C)

After exposure each test specimen shall fulfill the photometric requirements of Section 7.2.1.

Post Exposure Coefficient of Retroreflection (R_A) - cd/(lx*m^2)				
Observation Angle = 12′				
Entrance Angle = 5°				
	ε_1 = 0°		ε_2= 90°	
Product	Measured	Required	Measured	Required
White	317.0	100	293.7	75
Fluor. Yellow-Green	284.8	100	235.2	75

Comments: Samples meet all requirements.

Exposure to Temperature Variation

Requirement: ANSI/ISEA 107-1999 7.2.1

Test Method: ANSI/ISEA 107-1999 8.4.4
12 Hours at 50°C / 20 Hours at -30°C / 2 Hours at 20°C

After exposure each test specimen shall fulfill the photometric requirements of Section 7.2.1.

Post Exposure Coefficient of Retroreflection (R_A) - cd/(lx*m^2)				
Observation Angle = 12′				
Entrance Angle = 5°				
	ε_1 = 0°		ε_2= 90°	
Product	Measured	Required	Measured	Required
White	340.5	100	294.3	75
Fluor. Yellow-Green	284.6	100	247.0	75

Comments: Samples meet all requirements.

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Material Tested: Korea Kwang Nyun Co. Reflective PVC Trim Material – With Hexagon Pattern
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Washing (Domestic)

Requirement: ANSI/ISEA 107-1999 7.2.1

Test Method: ANSI/ISEA 107-1999 8.4.6
ISO 6330:1984 Method 2A

Number of Wash Cycles:

After exposure each test specimen shall fulfill the photometric requirements of Section 7.2.1.

Post Exposure Coefficient of Retroreflection (R_A) - cd/(lx*m^2)				
Observation Angle = 12′				
Entrance Angle = 5°				
	ε_1 = 0°		ε_2= 90°	
Product	Measured	Required	Measured	Required
White	169.8	100	164.7	75
Fluor. Yellow-Green	132.2	100	118.8	75

Comments: Samples meet all requirements.

Dry-cleaning

Requirement: ANSI/ISEA 107-1999 7.2.1

Test Method: ANSI/ISEA 107-1999 8.4.7
ISO 3175:1995 Method 9.1

Number of Dry-cleaning Cycles: N/A

After exposure each test specimen shall fulfill the photometric requirements of Section 7.2.1.

Post Exposure Coefficient of Retroreflection (R_A) - cd/(lx*m^2)				
Observation Angle = 12′				
Entrance Angle = 5°				
	ε_1 = 0°		ε_2= 90°	
Product	Measured	Required	Measured	Required
White	N/A	100	N/A	75
Fluor. Yellow-Green	N/A	100	N/A	75

Comments: Not Applicable

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Material Tested: Korea Kwang Nyun Co. Reflective PVC Trim Material – With Hexagon Pattern
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Retroreflective Performance in Rainfall

Requirement: ANSI/ISEA 107-1999 7.2.1

Test Method: ANSI/ISEA 107-1999 8.4.8

After exposure each test specimen shall fulfill the photometric requirements of Section 7.2.1.

Post Exposure Coefficient of Retroreflection (R_A) - cd/(lx*m^2)				
Observation Angle = 12′				
Entrance Angle = 5°				
	ε_1 = 0°		ε_2= 90°	
Product	Measured	Required	Measured	Required
White	203	100	195	75
Fluor. Yellow-Green	165	100	161	75

Comments: Samples meet all requirements.

PHOTOGRAPHS OF PRODUCTS