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Firm: Korea kwang Nyun Co  
210-44 Kumi-3-dong  
Kwangjin-gu  
SEOUL  
143-822  
Korea

For the attention of: Her Myung

## Technical Services Report

Subject: TESTING OF SIX TYPES  
OF RETROREFLECTIVE TAPE

Firm: Korea kwang Nyun Co  
Our ref: 44891 0349 SPC-0 ACS BT  
Your ref:  
Date: 18 February, 2004

### Conditions of Issue:

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Results given in this report refer only to the samples submitted for analysis and tested by SATRA. Comments are for guidance only and are not part of the reported results. All comments and interpretations are outside the scope of UKAS accreditation and are based on current SATRA knowledge.

A satisfactory test report in no way implies that the product tested is approved by SATRA and no warranty is given as to the performance of the product tested. SATRA shall not be liable for any subsequent loss or damage incurred by the client as a result of information supplied in the report.

Tests marked † are not UKAS accredited.

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# Technical Services Report



## INTRODUCTION.

Samples of a retroreflective tape were received by SATRA on the 5<sup>th</sup> December 2003 for testing in accordance with EN 471: 1994. Testing was carried out between 26<sup>th</sup> January and 10<sup>th</sup> February 2004.

### Samples Received

- Sample A – Orange tape with triangular pattern
- Sample B – Orange tape with triangular pattern
- Sample C – Yellow tape with triangular pattern
- Sample D – Yellow tape with square pattern
- Sample E – Silver tape with square pattern
- Sample F – Silver tape with square pattern

Note 1: Please note that all of these samples are considered to be orientation sensitive and have therefore been assessed in both the x and y direction.

## REQUIREMENTS

Table 1: Minimum coefficients of retroreflection in cd/(lx.m<sup>2</sup>) for separate – performance material, class 1.

Observation angle	Entrance angle			
	5°	20°	30°	40°
12'	250	220	135	50
20'	120	100	75	30
1°	25	15	12	10
1° 30'	10	7	5	4

Table 2: Minimum coefficients of retroreflection in cd/(lx.m<sup>2</sup>) for separate – performance material, class 2.

Observation angle	Entrance angle			
	5°	20°	30°	40°
12'	330	290	180	65
20'	250	200	170	60
1°	25	15	12	10
1° 30'	10	7	5	4

Note 2: Please note that as these samples are considered to be orientation sensitive, samples must meet the specified requirements in both the x and y direction in order to comply with the standard.



# Technical Services Report



## TEST RESULTS: MATERIAL AS RECEIVED

Reference: Sample A – Orange tape with triangular pattern

Observation angle	Entrance angle							
	5°		20°		30°		40°	
	X	Y	X	Y	X	Y	X	Y
12°	51.6	65.4	34.8	57.8	27.2	45.4	20.2	17.2
20°	36.6	50.2	21.0	44.0	19.0	35.8	15.8	14.6
1°	20.6	33.8	10.2	33.2	4.8	20.4	2.6	3.6
1° 30'	5.2	11.4	3.0	7.8	3.6	9.6	3.4	3.4

Reference: Sample B – Orange tape with triangular pattern

Observation angle	Entrance angle							
	5°		20°		30°		40°	
	X	Y	X	Y	X	Y	X	Y
12°	66.0	90.6	42.6	91.8	32.2	72.8	23.4	30.4
20°	46.0	68.8	24.8	65.6	21.4	55.2	17.8	19.0
1°	17.6	33.8	9.2	32.2	5.2	22.8	2.6	4.4
1° 30'	6.6	9.6	3.2	5.8	3.4	6.4	2.6	2.8

Reference: Sample C – Yellow tape with triangular pattern

Observation angle	Entrance angle							
	5°		20°		30°		40°	
	X	Y	X	Y	X	Y	X	Y
12°	630.0	1114.0	532.0	874.0	710.0	646.0	422.0	236.0
20°	772.0	720.0	393.0	512.0	294.0	316.0	239.0	115.0
1°	39.4	35.4	31.8	40.0	38.6	41.6	31.2	21.2
1° 30'	11.6	17.4	11.2	12.4	12.2	9.2	15.6	3.8

Reference: Sample D – Yellow tape with square pattern

Observation angle	Entrance angle							
	5°		20°		30°		40°	
	X	Y	X	Y	X	Y	X	Y
12°	610.0	1022.0	528.0	812.0	538.0	606.0	466.0	222.0
20°	772.0	670.0	374.0	490.0	302.0	309.0	272.0	114.0
1°	47.2	36.8	36.4	38.2	43.4	39.2	38.2	21.2
1° 30'	18.2	18.8	15.0	15.6	14.6	11.4	18.2	5.0





# Technical Services Report



Reference: Sample E – Silver tape with square pattern

Observation angle	Entrance angle							
	5°		20°		30°		40°	
	X	Y	X	Y	X	Y	X	Y
12°	546.0	584.0	312.0	524.0	218.0	416.0	146.0	148.0
20°	538.0	428.0	209.0	294.0	<b>131.0</b>	309.0	91.6	111.4
1°	58.8	53.6	45.6	47.0	40.4	62.2	21.2	33.8
1° 30'	30.0	21.8	18.8	17.8	16.2	13.2	15.4	7.0

Reference: Sample F – Silver tape with square pattern

Observation angle	Entrance angle							
	5°		20°		30°		40°	
	X	Y	X	Y	X	Y	X	Y
12°	498.0	518.0	312.0	476.0	232.0	390.0	164.0	136.0
20°	496.0	402.0	200.0	360.0	<b>134.0</b>	269.0	99.8	110.6
1°	63.6	54.2	45.4	50.2	42.0	63.0	25.2	34.4
1° 30'	36.0	19.8	17.0	16.6	15.6	12.0	15.6	7.8

## CONCLUSIONS

The retroreflective tape samples received by SATRA on 5<sup>th</sup> December 2003 were tested in accordance with EN 471: 1994 Clause 6.1, and achieved the following results

SAMPLE REFERENCE	CLASS 1 RESULT	CLASS 2 RESULT	OVERALL RESULT
A Sample A – Orange tape with triangular pattern	FAIL	FAIL	FAIL
Sample B – Orange tape with triangular pattern	FAIL	FAIL	FAIL
Sample C – Yellow tape with triangular pattern	FAIL	FAIL	FAIL
Sample D – Yellow tape with square pattern	PASS	PASS	PASS, Level 2
Sample E – Silver tape with square pattern	PASS	FAIL	PASS, Level 1
Sample F – Silver tape with square pattern	PASS	FAIL	PASS, Level 1

\*\*\*\*\* END OF REPORT \*\*\*\*\*

# VARTEST LABORATORIES INC

Specializing in Fiber, Yarn, Fabric & Apparel Testing

Textile Testing Services Division

19 West 36th Street  
New York, N.Y. 10018  
Phone: (212) 947-8391  
(212) 947-8392  
Fax: (212) 947-8719

## REPORT OF TEST

DATE: December 16, 2003 FILE: NOVABF.A110703A1  
CLIENT: Korea Kwang Nyun Co. ATTN: Myung Her  
210-44 KUN1-3-DONG  
Kwangjin-GU, Seoul, Korea 143-822

SAMPLE IDENTIFIED BY CLIENT AS:  
Fabric Submitted  
Per ANSI/ISEA-107 Standard  
Color Fl. Yellow

### EXECUTIVE SUMMARY:

PASS

FAIL

The fabric from the submitted garment **MEETS** the requirements of ANSI/ISEA 107-1999 Specification for the tests conducted in this report covering high visibility background material, CHROMATICITY TESTING, AS RECEIVED & AFTER 40X XENON LIGHT EXPOSURE PASSES WHEN TESTED WITH A DOUBLE LAYER OF FABRIC.

TEST PROCEDURES:	TEST RESULTS:	REQUIREMENTS:
MULLEN BURSTING STRENGTH (ASTM D3786):	129.0 psi	60.0 lbs. MIN.
WATER VAPOR TRANSMISSION (ASTM E96), PROCEDURE B, WATER METHOD, 70°F 50% rh: AS RECEIVED:	3139.2 g/sq meter/24 hrs	600g/m <sup>2</sup> /24 hrs MIN.
- AFTER 5X MWPP W TDM:	3445.5 g/sq meter/24 hrs	600 g/m <sup>2</sup> /24 hrs MIN.
COLORFASTNESS TO CROCKING (AATCC 8, Flat) GRAY SCALE:	Dry: Class 4.5 Wet: Class 4.5	4.0 MIN. 4.0 MIN.
COLORFASTNESS TO LAUNDERING (AATCC 61-2A):	Shade Change: Class 4.5 Staining: Acetate Class 4.0 Cotton Class 4.5 Nylon Class 3.5 Polyester Class 4.5 Acrylic Class 4.5 Wool Class 4.5	4.0 MIN. 3.0 MIN.
COLORFASTNESS TO WATER (AATCC 107):	Shade Change: Class 4.5 Staining: Acetate Class 4.5 Cotton Class 4.5 Nylon Class 4.0 Polyester Class 4.5 Acrylic Class 4.5 Wool Class 4.5	4.0 MIN. 4.0 MIN.
COLORFASTNESS TO PERSPIRATION (AATCC 15):	Shade Change: Class 4.5 Staining: Acetate Class 4.5 Cotton Class 4.5 Nylon Class 4.5 Polyester Class 4.5 Acrylic Class 4.5 Wool Class 4.5	4.0 MIN. 3.0 MIN.

KEY TO DEGREE OF ALTERATION  
IN SHADE AND STRENGTH:

- Class 5, Negligible or no change
- Class 4, Slightly changed
- Class 3, Noticeably changed
- Class 2, Considerably changed
- Class 1, Much changed



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## REPORT OF TEST

FILE: NOVABR.A110703A  
SAMPLE IDENTIFIED BY CLIENT AS:  
Fabric Submitted  
Per ANSI/ISEA-107 Standard  
Color Fl. Yellow

### TEST PROCEDURES:

COLORFASTNESS TO HEAT,  
HOT PRESSING (AATCC 133):

TEST TYPE - DRY <TEMP.: 230°F>: Immediate Shade Change: Class 5.0  
Shade Change After 4 Hours: Class 5.0  
Staining Onto White Fabric: Class 5.0

- DRY <TEMP.: 300°F>: Immediate Shade Change: Class 5.0  
Shade Change After 4 Hours: Class 5.0  
Staining Onto White Fabric: Class 5.0

- DRY <TEMP.: 390°F>: Immediate Shade Change: Class 5.0  
Shade Change After 4 Hours: Class 5.0  
Staining Onto White Fabric: Class 5.0

KEY TO DEGREE OF ALTERATION  
IN SHADE AND STRENGTH:

Class 5, Negligible or no change  
Class 4, Slightly changed  
Class 3, Noticeably changed  
Class 2, Considerably changed  
Class 1, Much changed

FABRIC DIMENSIONAL CHANGE  
(AATCC 135):

(Machine Wash Warm, Permanent Press,  
Tumble Dry Medium)

	FIRST CYCLE	FIFTH CYCLE
LENGTH:	-1.4%	-3.1%
WIDTH:	-1.0%	-1.5%

L: 4.0 MAX.  
W: 2.0 MAX.

SPECTROPHOTOMETRIC ANALYSIS  
CHROMATICITY COORDINATES  
(ASTM E1164/ANSI107 Sect. 8.2)

TEST	x	y	B
As Received	0.388	0.539	0.790
After 40X Xenon Light Exposure	0.385	0.530	0.769

SEE ATTACHED GRAPH

**COMMENT:** Test conducted with a double layer of fabric.  
The submitted sample does not pass chromaticity coordinate  
requirements when tested as a single layer of fabric.

### FINDINGS:

As Received sample **PASSES** the chromaticity coordinate  
requirements for ANSI/ISEA-107.

After light exposure sample **PASSES** the chromaticity coordinate  
requirements for ANSI/ISEA-107.

Signed For The Company By

Adam R. Vanley  
Technical Director

RT/11/115



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