Report No.: 210107-07Ar2

TEST REPORT

Report Date: 17 February 2021
Revision Date: 22 May 2023 *[company name change, updated CSA Z96 version]*

Project Name:

Submitted by:

Test Laboratory: Calcoast - ITL
San Leandro, CA 94577

Sample submitted: One (1) roll 50 mm (2") wide retroreflective trim on 100 mm wide Fl. Yellow/Green Background material submitted 07 January 2021

SUMMARY

Specifications:

ANSI/ISEA 107-2020	American National Standard for High-Visibility Safety Apparel and Accessories
CSA Z96-22	High-visibility Safety Apparel (designed to be in technical harmony with ANSI/ISEA 107)

Retroreflective Performance Prior to Test Exposure ..... Passed

Retroreflective Performance after Test Exposure
- Abrasion..... Passed
- Flexing..... Passed
- Folding at Cold Temperatures..... Passed
- Exposure to Temperature Variation..... Passed
- Washing (25X)..... Passed
- Dry-cleaning (0X)..... Not Tested
- Retroreflective Performance in Rainfall..... Passed

Written by:
Douglas G. Cummins
Photometric Engineer

Approved by:
Mark A. Evans
Laboratory Director

TEST DATA SHEET

Project Name:

Retroreflective Performance Prior to Exposure

Requirement: ANSI/ISEA 107 9.1 Table 4 / CSA Z96 6.1 Table 5 (Level 2)
Test Method: ANSI/ISEA 107 10.3 / CSA Z96 7.3
ASTM E808, E809
Projector: Hoffman GPS-102 (Illuminant A, 10 Lux, 750 mm diameter)
Sample Area: 200 mm x 200 mm, 0.040 m²
equivalent to the average of four (4) 10 cm x 10 cm samples

Test sample created by cutting submitted material into 200 mm strips, removing excess background material, and mounting 4 strips side-by-side on a 200 mm x 200 mm black mounting surface. Measured sample at orientations of $\varepsilon_1 = 0°$ and $\varepsilon_2 = 90°$ where ε_1 mounting orientation is with the strips parallel to the projector/detector plane.

Coefficient of Retroreflection, Candela/(Lux·m²)

Observation Angle	Entrance Angle	Minimum Requirement ($\varepsilon_1/\varepsilon_2$)	Measured	
			ε_1	ε_2
0.20° (12')	5°	330 / 248	349.9	348.1
	20°	290 / 218	398.8	391.2
	30°	180 / 135	408.2	401.8
	40°	65 / 47	367.3	372.8
0.33° (20')	5°	250 / 188	257.2	255.1
	20°	200 / 150	289.5	283.7
	30°	170 / 128	297.6	292.9
	40°	60 / 45	273.4	274.4
1.00°	5°	25 / 18.8	30.4	30.7
	20°	15 / 11.3	30.3	30.2
	30°	12 / 9	28.2	27.7
	40°	10 / 7.5	28.4	28.6
1.50° (1°30')	5°	10 / 7.5	17.3	16.7
	20°	7 / 5.25	16.8	16.8
	30°	5 / 3.75	14.4	14.2
	40°	4 / 3	14.6	14.4

Samples meet requirements for Retroreflective Performance Prior to Test Exposure.

TEST DATA SHEET

Project Name:

Abrasion

Requirement: ANSI/ISEA 107 9.2 / CSA Z96 6.2
Performance at 0.20° Observation / 5° Entrance Angle only
Test Method: ANSI/ISEA 107 10.4.1 / CSA Z96 7.4.1
ISO 12947-2:2016, (Wool Abradent / 5000 Cycles / 9 kPa)
Average of 3 samples
Abrasion lab: SGS, Test Report No. 4731915TX-01
Sample Area: Circle 32 mm diameter, 0.0008 m²

Coefficient of Retroreflection, Candela/(Lux·m²)

Sample	ε_1 = 0°		ε_2= 90°	
	Measured	Required	Measured	Required
A1	343.6	100	330.3	75
A2	383.0	100	374.7	75
A3	358.5	100	342.5	75
Average	361.7	100	349.2	75

Samples show minor wear from abrasion.

Samples meet Abrasion requirements.

Flexing

Requirement: ANSI/ISEA 107 9.2 / CSA Z96 6.2
Performance at 0.20° Observation / 5° Entrance Angle only
Test Method: ANSI/ISEA 107 10.4.2 / CSA Z96 7.4.2
ISO 7854:1995 Method A
7500 Cycles at 5 cycles per second with 57 mm stroke length
Average of 3 samples
Sample Area: 50 mm x 120 mm, 0.006 m²

Coefficient of Retroreflection, Candela/(Lux·m²)

Sample	ε_1 = 0°		ε_2= 90°	
	Measured	Required	Measured	Required
FL1	311.5	100	309.8	75
FL2	328.2	100	326.2	75
FL3	362.1	100	358.1	75
Average	333.9	100	331.4	75

Samples do not show any damage from flexing.

Samples meet Flexing requirements.

TEST DATA SHEET

Project Name:

Folding at Cold Temperatures

Requirement: ANSI/ISEA 107 9.2 / CSA Z96 6.2
Performance at 0.20° Observation / 5° Entrance Angle only
Test Method: ANSI/ISEA 107 10.4.3 / CSA Z96 7.4.3
ISO 4675:2017 (-20°C for a minimum of 4 hours)
Sample folded with reflective side around 3 mm diameter mandrel
Average of 3 samples
Sample Area: 50 mm x 100 mm, 0.005 m²

Coefficient of Retroreflection, Candela/(Lux·m²)

	ε_1 = 0°		ε_2= 90°	
Sample	Measured	Required	Measured	Required
CF1	375.6	100	359.4	75
CF2	392.3	100	387.7	75
CF3	353.5	100	339.0	75
Average	373.8	100	362.0	75

Samples do not show any damage from cold folding.

Samples meet Folding at Cold Temperatures requirements.

Exposure to Temperature Variation

Requirement: ANSI/ISEA 107 9.2 / CSA Z96 6.2
Performance at 0.20° Observation / 5° Entrance Angle only
Test Method: ANSI/ISEA 107 10.4.4 / CSA Z96 7.4.4
12 Hours at 50°C immediately followed by 20 Hours at -30°C
Average of 3 samples
Sample Area: 50 mm x 100 mm, 0.005 m²

Coefficient of Retroreflection, Candela/(Lux·m²)

	ε_1 = 0°		ε_2= 90°	
Sample	Measured	Required	Measured	Required
T1	328.1	100	324.8	75
T2	360.4	100	337.1	75
T3	369.7	100	368.5	75
Average	352.7	100	343.5	75

Samples do not show any damage from temperature variation.

Samples meet Exposure to Temperature Variation requirements.

TEST DATA SHEET

Project Name:

Washing

Requirement: ANSI/ISEA 107 9.2 / CSA Z96 6.2
Performance at 0.20° Observation / 5° Entrance Angle only
Test Method: ANSI/ISEA 107 10.4.5.2 / CSA Z96 7.4.6
ISO 6330:2012, Method 6N
IEC Reference Detergent A, 20 g / load
Each wash cycle includes drying the samples at 50°C
Average of 3 samples
Sample Area: Two (2) strips, 50 mm x 250 mm, 0.025 m²

Number of Wash Cycles: 25

Coefficient of Retroreflection, Candela/(Lux·m²)

Sample	ε_1 = 0°		ε_2= 90°	
	Measured	Required	Measured	Required
W1	419.8	100	418.3	75
W2	412.7	100	412.3	75
W3	405.9	100	407.3	75
Average	412.8	100	412.6	75

Samples do not show any damage from washing.

Samples meet Washing requirements.

Dry-cleaning

Requirement: ANSI/ISEA 107 9.2 / CSA Z96 6.2
Performance at 0.20° Observation / 5° Entrance Angle only
Test Method: ANSI/ISEA 107 10.4.5.3 / CSA Z96 7.4.7
ISO 3175-2:2017
Average of 3 samples
Sample Area: Two (2) strips, 50 mm x 250 mm, 0.025 m²

Number of Dry-cleaning Cycles: Not Applicable

Coefficient of Retroreflection, Candela/(Lux·m²)

Sample	ε_1 = 0°		ε_2= 90°	
	Measured	Required	Measured	Required
DC1	-	100	-	75
DC2	-	100	-	75
DC3	-	100	-	75
Average	-	100	-	75

No samples tested.

TEST DATA SHEET

Project Name:

Retroreflective Wet Performance

Requirement: ANSI/ISEA 107 9.2 / CSA Z96 6.2
Performance at 0.20° Observation / 5° Entrance Angle only
Test Method: ANSI/ISEA 107 10.4.6, Appendix B / CSA Z96 7.4.8
Rainfall flow rate: 284 mm/hour
Retroreflection measured after 2 minutes exposure
while maintaining water spray
Projector: Hoffman GPS-102 (Illuminant A, 10 Lux, 750 mm diameter)
Sample Area: 200 mm x 200 mm, 0.040 m²
equivalent to the average of four (4) 10 cm x 10 cm samples

Sample from Retroreflective Performance Prior to Exposure used for Retroreflective Wet Performance.

Coefficient of Retroreflection, Candela/(Lux·m²)

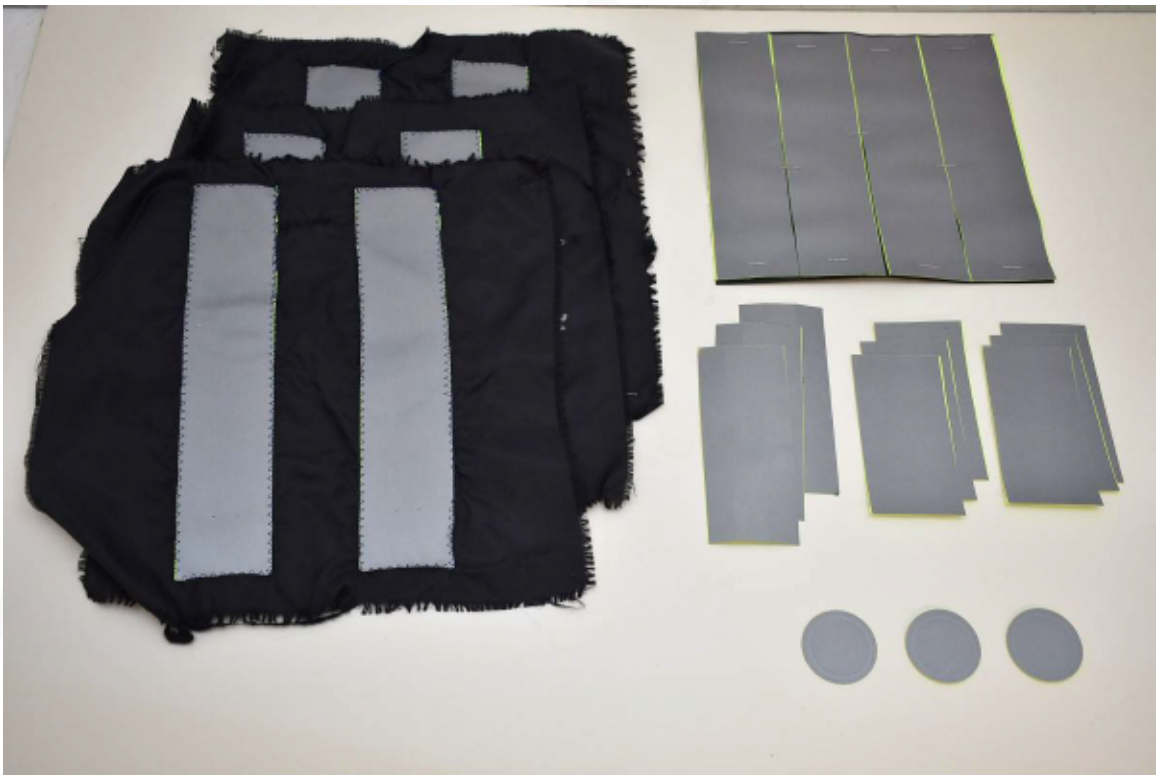
Sample	ε_1 = 0°		ε_2= 90°	
	Measured	Required	Measured	Required
R1	134.8	100	147.9	75

Samples meet Retroreflective Wet Performance requirements.

PHOTOGRAPH SHEET

Project Name:

Roll, as received



Test Samples