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FASIGN REFLECTIVE SHEETING

TESTING AND RESEARCH DIVISION
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Summary

'Fasign' reflective sheeting samples have been evaluated in the laboratory. Sheeting samples of white, red, orange, yellow, green, and blue, with both pressure sensitive and heat-activated adhesive, were submitted by the U. S. Standard Sign Co. Avery International submitted their laboratory tests for the samples and in addition submitted a Certification of Compliance with Federal Specifications LS-300C and FP79. Tests applicable to Type 2 reflective sheeting in the 1979 MDOT Standard Specifications were performed; the results are discussed in this report and presented in tabular form. Testing showed some discrepancies but the manufacturer can produce sheeting conforming with specification requirements. Sign shop evaluation of handling and screening characteristics along with field evaluation of experimental signs is recommended.

Introduction

The Department has a policy of approving reflective sheeting products from manufacturers that can demonstrate an ability to conform with specifications. In the past, Fasign sheeting has not shown satisfactory compliance with Department specifications and it was concluded after a number of sample evaluations that Avery International would have some difficulty in routinely producing sheeting that would comply with specifications. Subsequently, Avery International requested that the laboratory test improved sheetings. The requests were countered with a provision that independent laboratory or even company laboratory test results showing specification compliance would be necessary before the photometric laboratory would conduct further tests. Two sheets of white, red, orange, yellow, green, and blue with pressure sensitive and heat-activated adhesive were received on August 8, 1980. The samples were submitted by the U. S. Standard Sign Co. and were accompanied by Avery's laboratory test results. Tests applicable to Type 2 reflective sheeting in the 1979 Standard Specifications were performed including the artificial weathering tests. Results of tests for adhesion, cold shock, flexibility, luminance wet, impact, shrinkage, solvent resistance, peeling, initial luminance, and initial reflectance showed compliance with specification requirements by all samples.

On some samples, results of the tests for color, liner removal, and artificial weathering showed discrepancies. Color test results, and liner removal test results are described below along with observations on post-water immersion and post-weathering surface appearance. Results of all tests are summarized in Table 1.

Color Test

Spectrophotometric evaluation of the samples before and after weathering gave the following results:

1) Hues of yellow samples were at the green limit. Lightness was satisfactory before and after weathering.

2) Hues of red samples with each adhesive were more yellow than the yellow limit before and after weathering. Lightness on each sample was satisfactory before and after weathering.

3) Orange samples with each adhesive had a satisfactory hue and lightness both before and after artificial weathering.

4) Green with pressure sensitive adhesive was at the blue hue limit.

5) White samples with each adhesive had a satisfactory hue and lightness both before and after artificial weathering.

6) Blue samples with each adhesive had a satisfactory hue and lightness before weathering. The samples were not weathered.

Liner Removal

Some difficulty was noted in removing the liner paper from the blue sample with pressure sensitive adhesive.

Surface Appearance

Appearance of samples after weathering was considered satisfactory. Samples with pressure sensitive adhesive had a smoother surface than samples with heat-activated adhesive.

Water Immersion

After water immersion the white, red, and blue samples with heat-activated adhesive had a mottled appearance. The white sample also showed considerable darkening. The orange sample blistered. Pressure sensitive adhesive samples were satisfactory.

Discussion

Color discrepancies noted on the red Fasign samples have been observed on samplings from other sources. Red colors that are more yellow than the yellow limit before and after artificial weathering are typical of reds supplied by other manufacturers. Yellows that are more green than the green hue limit are also found with other sheeting manufacturers.

Specific luminance before and after artificial weathering was satisfactory. Results are given in Tables 2 and 3.

The darkening and mottled appearance of samples after water immersion is acceptable but similar reactions upon field exposure would be considered unsatisfactory.

Avery International's laboratory test data on specific luminance and color showed, with a few exceptions, good agreement with the MDOT data. At the -4° entrance angle, MDOT specific luminance values were usually higher than Avery but at the 30° entrance angle Avery reported higher values. MDOT measurements on green and blue sheeting gave hue values that were more green than the Avery values.

Avery did not report post-weathering measurements but did indicate that the sheeting passed.

On the basis of laboratory tests, it does appear that Avery International can fabricate reflective sheeting that conforms with Department specifications.

Significance of Avery International's Certificate of Compliance remained questionable. The certificate stated that Fasign reflective sheeting (engineer grade) complies with MDOT specifications. As noted, laboratory tests did show conformance but lack of detailed product identification along with durability failures in Lenawee County became an important concern.

Avery International representatives claimed that the materials submitted represented a formulation change and was the only material in production. Infrared examination verified that the sheeting was different from materials previously submitted and from the sheeting supplied to Lenawee County. However, it was learned that a short life material identified as Series 5100 and 5300 is produced for barricades. The material is currently used in Michigan on MDOT projects.

Avery representatives recommended that Nazdar and Advance (Rex series) black screening inks be used on their sheeting and that transparent inks from these companies as well as Sinclair Valentine be used.

Recommendations

Since handling and application characteristics are not easily evaluated in the laboratory, it is recommended that sufficient sheeting be obtained to evaluate handling characteristics under sign shop conditions. Depending

upon a satisfactory sign shop evaluation, it is recommended that signs be prepared and evaluated in the field for at least one year.

TABLE 1
TEST RESULTS SUMMARY

Tests	White		Yellow		Orange		Red		Green		Blue	
	80 RD-268 PS	80 RD-269 HA	80 RD-270 PS	80 RD-271 HA	80 RD-272 PS	80 RD-273 HA	80 RD-274 PS	80 RD-275 HA	80 RD-276 PS	80 RD-277 HA	80 RD-278 PS	80 RD-279 HA
Adhesion	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
Cold shock	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
Flexibility	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
Liner removal	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass but difficult	Pass
Luminance wet	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
Impact	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
Shrinkage	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
Solvent resistance	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
Peeling	11.6	14.9	11.1	14.0	11.8	14.2	11.4	14.2	10.8	11.7	10.7	13.5
Initial luminance	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
Initial color	Pass	Pass	Pass just inside green limit	Just outside green limit	Pass	Pass	Too yellow	Too yellow	On blue limit	Pass	Pass	Pass
Initial reflectance, %	57.3	57.1	39.5	41.6	23.0	21.7	11.8	11.9	8.8	9.28	4.74	4.73
1150 Hr. luminance	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	*	*	*
1150 Hr. color	Pass	Pass	Pass	Pass	Pass	Pass	Too yellow Too gray	Too yellow	Pass	*	*	*
1150 Hr. reflectance	55.3	57.4	38.6	40.5	22.7	22.6	11.2	10.6	10.2	*	*	*
Water immersion	Pass	Mottled	Pass	Pass	Pass	3/4 in. blister	Pass	Mottled	Pass	Pass	Pass	Mottled

* Artificial weathering not completed.

TABLE 2
INITIAL SPECIFIC LUMINANCE
candlepower/ft candle/sq ft

Sample No.	Divergence Angle			
	0.2°		0.5°	
	Entrance Angle		Entrance Angle	
	-4°	30°	-4°	30°
80 RD-268 PS White	107.0	67.5	51.8	42.8
80 RD-269 HA White	111.0	76.3	55.5	46.2
80 RD-270 PS Yellow	73.6	47.4	27.6	27.0
80 RD-271 HA Yellow	69.1	43.5	35.6	27.0
80 RD-272 PS Orange	32.9	16.6	17.5	10.3
80 RD-273 HA Orange	37.6	20.8	18.0	13.0
80 RD-274 PS Red	22.3	15.4	10.6	8.8
80 RD-275 HA Red	18.2	13.1	7.3	7.0
80 RD-276 PS Green	27.1	16.8	9.5	9.4
80 RD-277 HA Green	30.1	17.1	11.9	9.7
80 RD-278 PS Blue	7.1	3.8	3.3	2.2
80 RD-279 HA Blue	8.1	4.9	3.8	2.8

TABLE 3
SPECIFIC LUMINANCE AFTER WEATHERING 1150 HOURS
candlepower/ft candle/sq ft

Sample No.	Divergence Angle			
	0.2°		0.5°	
	Entrance Angle		Entrance Angle	
	-4°	30°	-4°	30°
80 RD-268 PS White	71.4	46.5	36.6	30.0
80 RD-269 HA White	60.5	44.4	34.8	29.8
80 RD-270 PS Yellow	47.3	31.6	19.1	18.1
80 RD-271 HA Yellow	44.8	28.8	24.3	18.5
80 RD-272 PS Orange	24.7	13.2	13.4	8.8
80 RD-273 HA Orange	25.4	14.9	13.2	9.5
80 RD-274 PS Red	14.3	9.7	7.1	5.8
80 RD-275 HA Red	10.0	7.2	4.5	4.1
80 RD-276 PS Green	19.4	12.2	7.4	6.9
80 RD-277 HA Green	*	*	*	*
80 RD-278 PS Blue	*	*	*	*
80 RD-279 HA Blue	*	*	*	*

* Artificial weathering not completed.