GEORGIA INSTITUTE OF TECHNOLOGY
Engineering Experiment Station

PROJECT INITIATION

Date: June 23, 1969

Project Title: Salt Fog Tests

Project No.: A-760-067

Project Director: W. R. Tooke, Jr.

Sponsor: Office of the Coordinator of Highway Safety

Effective June 23, 1969 Estimated to run until: Open

Type Agreement: Letter dated June 13, 1969 Amount: $ 200.00

Reports: None required

Contact Person: Mr. S. G. Wager
Roadway Aspects Manager
Office of the Coordinator of Highway Safety
State of Georgia
528 Hartford Building
100 Edgewood Avenue, N. E.
Atlanta, Georgia 30303

*To be terminated upon completion of salt spray tests and invoicing. No termination sheet will be issued. No charges accepted after invoicing.

Assigned to Chemical Sciences & Materials Division

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ENGINEERING
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December 18, 1969

Office of the Coordinator of Highway Safety
State of Georgia
7 Hunter Street, S. W.
Atlanta, Georgia 30334

Attention: Mr. Tom Gresham

Subject: Final Report - Salt Fog Tests
Project No. A-760-067

Gentlemen:

Salt fog tests conducted in accordance with ASTM B-117-64 have been completed on license tags and tag materials as submitted to us at the direction of your office.

Purpose

These studies were undertaken to provide some of the technical data required to draw appropriate specifications for retroreflective license tags suitable for five-year service.

Test Methods

Each tag or stock for testing was sheared in half vertically to form two pieces about 6 x 6 inches square. The left half of each piece was scheduled for salt fog exposure while the right half was reserved as an unexposed control.

The nature of the salt fog test is such that only one side (the top side) of an object receives severe corrosive attack. For this reason, sets of two identical tags were exposed together--one front side up, the other back side up. The exposure period was 240 hours.

Prior to placing tags on exposure, each piece was subjected to an impact test and a scribe test. The impact test is performed with the Gardner Impact Tester which consists of a graduated guide tube through which a round-nosed two-pound weight falls from specified heights onto a panel on an anvil with a bored-out hole to permit impact deformation of the panel (tag). Three impact impressions at 16, 22 and 28 inch-pounds are developed on the front and back of each panel. These appear as hemispherical depressions or domes respectively.

The scribes are also applied both to front and back of panels and are produced with a tungsten carbide cutting tip designed especially for this purpose. The scribes are approximately 1 to 2 inches long, and are cut through to base metal.

Following the exposure period, the tags were removed from the salt fog chamber, examined and carefully graded for discoloration and corrosion, and mounted on a panel for photographs and for photometric evaluation. Details of evaluation methods are covered in the next section.

Results

Reflectance

The sets of exposed and unexposed tag pieces were assembled on a large board and illuminated with a slide projector lamp. A Honeywell $1^{o}/21^{o}$ exposure meter was used to determine retroreflective intensities. Readings of tags are reported as a percentage of the retroreflectance of a special high-intensity retro-reflective sheeting. In Table I, the data has been organized to present individual observations and averages of unexposed tags and of exposed tags oriented front and back.

The general effect of exposure is to reduce the reflectance of tags, and the effect of front exposure is more severe than back exposure. The test data form two distinctive groupings on the basis of reflectance. The first comprises the exterior beaded panels 111, 112, 117, 118, 123 and 124 exhibiting reflectance in the range 3 -10%. The second comprises the balance of the tags which are fabricated from retroreflective sheeting and exhibit reflectance in the range 20 - 70%.

Among the first group, tags 111 and 123 are notable for their high loss of reflectance on exposure; and among the second group, tags 130, 135, and 152 exhibit greatest losses.

Other Properties

As previously described, the Impact Test procedure places six small spherical impressions on each test piece. An unbroken film in an impression is graded one, so that a perfect score for a single test piece is six. Of the whole series of tests only tags 111 and 112, unexposed, rated sixes. Top overall performance was by tags 129 and 130 and poorest (all zeros) by panels 117, 118 and 139, 140.

Best corrosion and discoloration resistance were exhibited by 117, 118 and 145, 146. Tags 111, 112 and 151, 152 were poorest.

Conclusions

1. Reflectance. The laminated sheeting tag formats are at least 3 times as reflective as the beaded paint formats.

2. Impact Resistance. Steel exhibits less impact deformation than aluminum and squeeze-applied sheeting is superior to vacuum-applied.

3. Corrosion and Discoloration. Aluminum is superior to steel, but satisfactory performance is attainable on galvanized steel.

Recommendations

1. License tag formats should be selected which exhibit a relative retroreflective intensity of not less than 30% of high intensity sheeting.

2. Consistent with embossing requirements, a slightly heavier gage aluminum stock and a harder temper would be recommended. Galvanized steel could be used as an alternate, other steels are not recommended.

Supplemental Comments

1. The stroke and figure size of tags 129, 130 and 145, 146 are definitely more legible than the other formats.

2. The generally superior legibility of beaded-paint tags in the photograph is not a real credit factor for these tags if total reflectance of all tag areas is a requirement. The figures of these tags are essentially non-reflective.

Respectfully submitted:

W. R. Tooke, Jr.,
Project Director

WRT:sm
4 Enclosures

Approved:

Dr. Frederick Bellinger,
Chief, Chemical Sciences and Materials Division

TABLE I

RELATIVE RETROREFLECTIVE INTENSITY
(Percent of Standard Sheeting)

Tag Number		Exposure Position		Exposed Tag	Unexposed Tag	Averages		
Test I. D.	Embossment	(Front	Back)	(Left Side)	(Right Side)	Front	Back	Set
111	14D4576	X		3.3 -	6.7	5.0		
112	14D4576		X	6.7	9.0		7.8	
Set Average				5.0 -	7.8			6.4
117	1E25X8J$\frac{A}{IT}$		X	6.0	6.0		6.0	
118	1E25X8J$\frac{A}{IT}$	X		6.2	8.3	7.2		
Set Average				6.1	7.2			6.6
123	12345678	X		3.1	9.0	6.0		
124	12345678		X	8.3	9.4		8.8	
Set Average				5.7	9.2			7.4
129	1A8027		X	36.8	32.2		34.5	
130	1A8027	X		24.6	36.8	30.7		
Set Average				30.7	34.5			32.6
133	12345678		X	40.2	46.7		43.4	
135	12345678	X		23.0	43.7	33.4		
Set Average				31.6	45.2			38.4
139	1E25X8J$\frac{A}{IT}$		X	46.7	40.2		43.4	
140	12J$\frac{A}{IT}$5X8	X		32.2	49.4	40.8		
Set Average				39.4	44.8			42.1
145	1A8027		X	46.7	52.9		49.8	
146	1A8027	X		28.3	52.9	40.6		
Set Average				37.5	52.9			45.2
151	14D4576		X	40.2	36.8		38.5	
152	14D4576	X		21.2	46.7	34.0		
Set Average				30.7	41.8			36.2
Grand Average				23.3	30.4	27.9	29.0	26.9
157	Blank	X		26.4	65.1	45.8		
158	Blank		X	65.1	71.3		68.2	
159	Blank	X		32.2	61.0	46.6		
160	Blank		X	56.4	49.4		52.9	
161	Blank	X		30.4	49.4	39.9		
162	Blank		X	65.1	71.3		68.2	
163	Blank	X		30.4	49.4	30.4		
Set Average				43.7	59.6	40.7	63.1	51.6

TABLE II

IMPACT, CORROSION AND DISCOLORATION EFFECTS

Test I. D.	Impact: Exposure Position		Impact: Panel Grade		Impact: Averages		Corrosion	Discoloration
	Front	Back	Exposed	Unexposed	Front	Back		
111	Front		1	6	3.5		5	4
112	Back		1	6		3.5	7	6
Set Average			1	6			6	5
117	Back		0	0		0	10	9
118	Front		0	0	0		9	9
Set Average			0	0			9.5	9
123	Front		3	0	1.5		6	9
124	Back		2	1		1.5	7	9
Set Average			2.5	.5			6.5	9
129	Back		6	4		5	8	10
130	Front		4	4	4		5	9
Set Average			5	4			6.5	9.5
133	Back		2	1		1.5	7	10
135	Front		2	2	2		5	9
Set Average			2	1.5			6	9.5
139	Back		0	0		0	8	10
140	Front		0	0	0		7	10
Set Average			0	0			7.5	10
145	Back		1	2		1.5	9	10
146	Front		1	1	1		7	9
Set Average			1	1.5			8	9.5
151	Back		1	1		1	7	8
152	Front		1	2	1.5		5	6
Set Average			1	1.5			6	7
Grand Average			1.56	1.88	1.69	1.75	7	8.6
157	Front		5	4	4.5		4	6
158	Back		4	4		4	9	7
159	Front		5	3	4		5	8
160	Back		3	3		3	6	9
161	Front		4	4	4		5	8
162	Back		5	4		4.5	6	10
163	Front		2	2	2		5	9
Set Average			4	3.4	3.6	3.8	5.7	8.1

TABLE III

SUMMARY OF PERFORMANCE OF FRONT EXPOSED PANELS

Test I. D.	Substrate	Retroreflectance (% of standard)	Impact Grade (Possible 6)	Corrosion Grade (Possible 10)	Discoloration grade (Possible 10)
140	Aluminum Pre-embossed Vacuum Applied	32.2	0	7	10
146	Aluminum Sheeting Squeeze Applied	28.3	1	7	9
130	Galvanized steel sheeting Squeeze Applied	24.6	4	5	9
135	Phosphatized Steel Pre-embossed Vacuum Applied	23.0	2	5	9
152	Cold Rolled Steel Pre-embossed Vacuum Applied	21.2	1	5	6
118	Aluminum	6.2	0	9	9
111	Steel	3.3	1	5	4
123	Steel	3.1	3	6	9