

CATATHERM THERMOPLASTIC STRIPING

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Research Laboratory Division
Office of Testing and Research
Report No. 312
Research Project 47 G-36(10a)
Progress Report 1

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Michigan State Highway Department
John C. Mackie, Commissioner
Lansing, April 1959

CATATHERM THERMOPLASTIC STRIPING
in 1957 Performance Tests

This progress report presents information on the experimental performance of a pavement marking plastic, Catatherm, designed to be hot-applied on roadways to then function as a traffic paint or lane delineator. This material is being evaluated as a supplement to the 1957 performance tests.

The white Catatherm material contained no solvents and was a solid mixture of thermoplastic resins, opacifying pigments and glass beads. Deposition of this material is effected by softening to a liquid consistency at elevated temperatures, about 375° F, in special striping equipment which flows out the liquid mixture onto the roadway to shortly congeal to a solid stripe at ambient temperatures (Figure 1).

The Catatherm striping is recommended to be applied at about 1/8 inch thickness, which is roughly 10 times that of a standard traffic paint. Because of the heavy thickness, Catatherm and similar striping materials are advertised as being semi-permanent.

A laboratory evaluation of a similar striping material was reported in Research Laboratory Report No. 273, under Highway Research Project 50 G-52(1).

DEPOSITION DETAILS

Personnel and equipment of Cataphote Corporation, producers of Catatherm striping, applied this material as three transverse stripes of 1/8-in. thickness and also as three transverse stripes of 1/16-in. thickness across one concrete and one bituminous roadway of the 1957 performance test areas. The striping was applied on October 2, 1957 in test areas 3C and 4B on US-127 between Lansing and Holt.

As previously mentioned, the Catatherm material was a prebeaded mixture which, according to W. J. Larkin of Cataphote, contained glass beads of standard index of refraction plus high index beads considered surplus from their sign bead production. Gradation of the beads was given as ranging from the No. 20 to the No. 320 sieves.

In each series of three stripes, two received an overlay of beads equivalent to the Department ratio of 2 pounds per gallon of paint, while the third stripe received no overlay beads. Mr. Larkin stated that the overlay beads were of standard refractive index (1.50+) with a gradation range between the No. 40 and No. 80 sieves.

RESULTS OF FIELD EXPOSURE

These experimental stripes were rated for the standard factors of general appearance, durability, and night visibility at regular intervals as was done for other stripes in the 1957 performance tests. The average

values from the four observers for these factors are listed in Table I. Weighted Rating and Service Factor values were not calculated.

Overlaying of the prebeaded Catatherm striping with glass beads materially increased the night visibility ratings for the initial evaluation, but this effect was mostly lost by the time the stripes became 59 days old, as shown by values in Table I.

The performance of the striping can be deduced from Table I and the photographs of Figures 2 and 3. Figure 2 shows the initial appearance of the striping on concrete, as well as its condition after 150 days of exposure, and after 447 days of exposure. An examination of the values of Table I and of the photographs in Figure 2 shows that the striping failed completely in the traffic lane on concrete in the period December 1, 1957 to February 25, 1958, or in the period of 59 to 150 days exposure, respectively. However, striping in the passing lane was in fairly good condition after 150 days of exposure and did not worsen materially in an additional 300 days of exposure, up to January 21, 1959.

Photos of Figure 3 illustrate the performance of the thermoplastic striping on the bituminous surface. These photos show that the striping performed much better on the black-top surface than on the concrete surface shown in Figure 2. The striping, however, is subject to a "cracking" type of deterioration with subsequent progressive fraying and loss of small segments under attrition of traffic, as shown in the photos.

Night visibility values as recorded in Table I for this striping require comment. The values as shown are averaged for the four observers. However, it was noted by all observers that the night visibility (visual and therefore subjective evaluation) is of a different type than on standard paint stripes since it seems more subdued, and therefore may very well have been over-rated. The heavy thickness of the stripes may contribute to this apparently illusory night visibility; the low protrusion of beads above the surface (Figure 4) and the use of some high-index premixed beads in striping of substandard whiteness and reflectivity may account for the subdued, halo-type of retro-reflection.

PROXIMATE ANALYSIS OF STRIPING

An infrared spectrum of binder and proximate analysis of striping is presented in Figure 5 and Table II. The infrared spectrum was made on plastic binder extracted from Catatherm striping. The spectral absorption bands at 3.26, 3.30, 5.12, 5.33, 5.52, 5.72, 6.23, 6.70, 9.73, 13.2 and 14.3 microns are generally interpreted as being characteristic of phenyl groups; whereas those at 3.42, 3.50, and 6.88 microns are due to CH₂ groups.

The identified chemical groupings and the general spectrum indicate a polystyrene type of plastic in the striping.

CONCLUSION

The Catatherm thermoplastic striping presently under evaluation appears to be in a development stage since it has a number of shortcomings. The material applied as transverse stripes, whether 1/8 in. or 1/16 in. thick, had a variable and unpredictable durability ranging from poor (3 months) to good (more than 18 months) when applied on a concrete roadway, and showed an unsightly cracking and fraying of edges within a year when applied on black-top. The striping seems to fail on concrete because of inadequate adhesion for the heavy thickness. This is in accord with our own experience which shows that standard traffic paints are subject to scaling and peeling when the stripe thickness builds up. It was also noted that the Catatherm striping had very poor adhesion when laid over MSHD No. 26A black paint in the test areas.

The striping is subject to cumulative yellowing and dirtying on exposure which may be expected to decrease its effectiveness. The fresh striping had substandard whiteness and reflectivity.

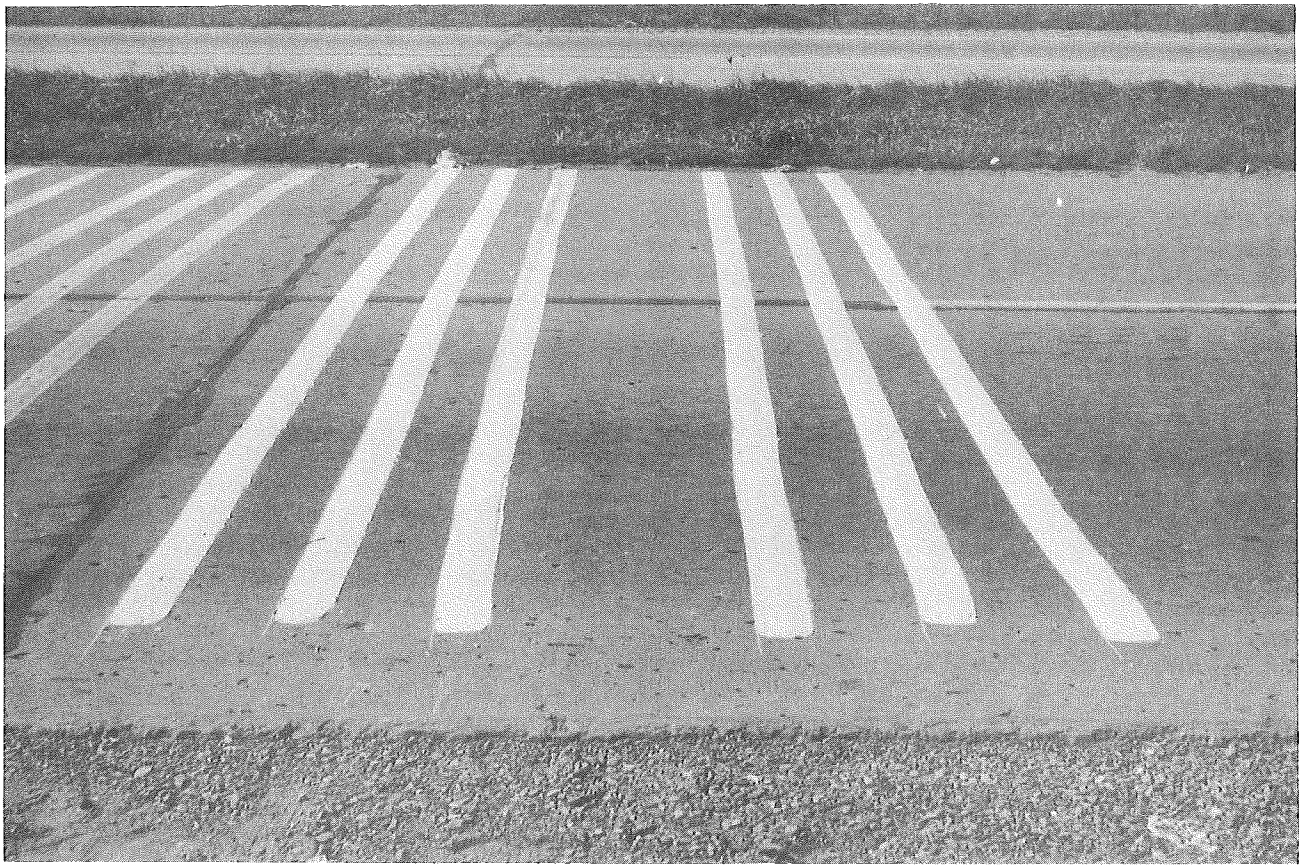
The material is known to be expensive since it costs 30 to 40 cents per lineal foot of 1/8-in. thick striping, which is about 10 times what it costs the Department to lay traffic paint striping.

The applied striping dried to no pick-up in less than 5 minutes, which is a desirable feature.

The performance of this heavy striping may have been hurt by damage from snowplow blades performing winter maintenance in the highway test areas.



Figure 1. Producer's Equipment applying stripes in Test Area.



▲ Initial appearance of striping, October 2, 1957.

Appearance of striping
on February 25, 1958
after 150 days of exposure. ▶

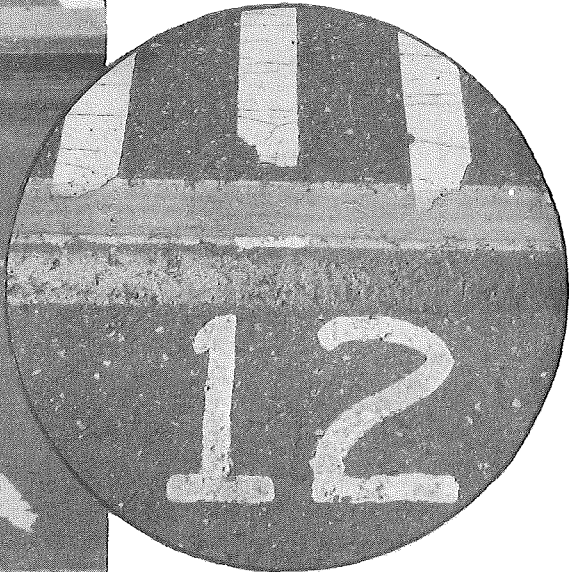


◀ Appearance of striping
on January 21, 1959
after 447 days of exposure.

Figure 2. Catatherm Thermoplastic experimental striping on concrete of US-127, Lansing - Holt Test Area.



Initial appearance of striping, October 2, 1957.



Appearance of striping on August 28, 1958 after 320 days of exposure.

Left - general appearance. Right - close-up, showing cracking.

Appearance of striping on January 21, 1959 after 447 days of exposure.

Figure 3. Catatherm Thermoplastic experimental striping on black top of US-127, Lansing - Holt Test Area.

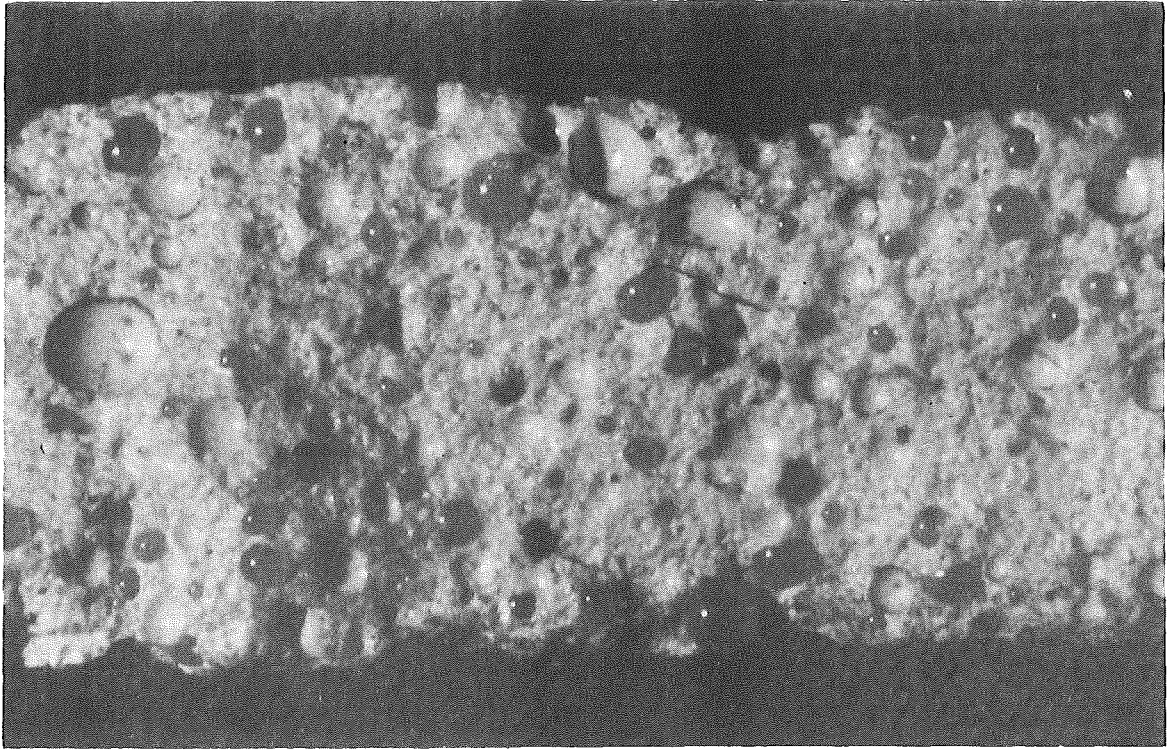


Figure 4. Side view of used Catatherm striping showing low protrusion of beads above top surface.

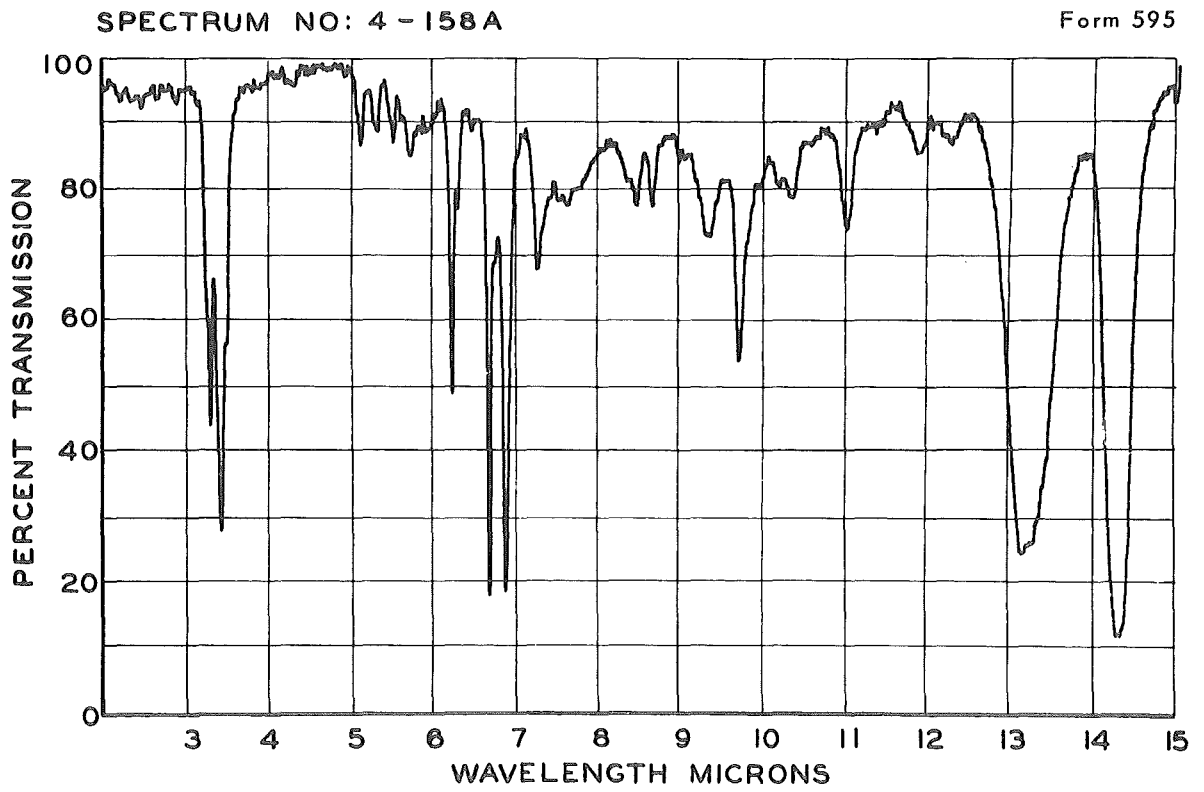


Figure 5. Infrared Absorption Spectrum for Catatherm binder.

TABLE I
PERFORMANCE DATA
WHITE THERMOPLASTIC STRIPING

Exposure Days	Factor Evaluated	Stripe Thickness, inches							
		Concrete Road				Bituminous Road			
		1/16		1/8		1/16		1/8	
		Unb*	B**	Unb	B	Unb	B	Unb	B
3	General Appearance	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7
	Durability	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
	Night Visibility	4.0	9.7	4.0	9.7	4.0	9.7	4.0	9.7
59	General Appearance	9.0	8.5	9.0	9.0	7.0	7.0	7.3	7.3
	Durability	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
	Night Visibility	6.5	7.8	6.5	7.8	6.0	6.0	6.0	6.0
150	General Appearance	0.0	0.0	0.0	0.0	4.5	4.5	4.5	4.5
	Durability	0.0	0.0	0.0	0.0	9.4	9.4	9.4	9.4
	Night Visibility	0.0	0.0	0.0	0.0	6.3	6.3	6.3	6.3
225	General Appearance					7.0	7.1	5.7	5.0
	Durability					8.5	8.5	8.0	6.8
	Night Visibility					5.0	5.0	3.8	3.2
320	General Appearance					6.8	6.8	6.1	5.1
	Durability					8.5	8.5	7.8	7.0
	Night Visibility					7.0	7.0	6.5	6.5
510	General Appearance					5.0	5.0	3.6	4.8
	Durability					6.8	6.8	4.1	6.8
	Night Visibility					5.0	5.5	3.3	5.5

* Unb = Unbeaded with overlay beads

** B = Beaded with overlay beads.

Note: Above ratings represent performance of striping in traffic lane only, in line with rating other performance paints.

TABLE II
COMPOSITION AND PROPERTIES
WHITE THERMOPLASTIC STRIPING

Striping Composition, approximate percent by weight:

Resins -----	26
Pigment -----	24
Glass Beads -----	51

Color, daylight illumination

chromaticity coordinate x -----	0.323
chromaticity coordinate y -----	0.333

Luminous Direction Reflectivity, percent ----- 72.1

Field Drying Time to no pick-up ----- Less than 5 minutes

OFFICE MEMORANDUM



MICHIGAN
STATE HIGHWAY DEPARTMENT
JOHN C. MACKIE, COMMISSIONER

July 6, 1961

To: E. A. Finney, Director
Research Laboratory Division

From: A. J. Permoda

Subject: Up to Date Summary of Durability of Catatherm Thermoplastic Striping under Departmental Evaluation. Attachment to Report 312, Research Project 47 G-36(10a).

The attached Figures 1 and 2 are snapshots showing the condition of subject striping after various times of exposure in two 1957 traffic paint performance areas on US 127.

This material was deposited as test transverse stripes by producer's special equipment which hot extruded it as striping onto roadway to set up track-free within 10 minutes. Striping was reflectorized and about 1/8 inch thick. The quoted price was 30 to 40 cents per lineal foot which is about 10 times what it costs Department to deposit traffic paint striping.

The tested striping failed completely in traffic lane on concrete during first winter of exposure as shown in photo. Partial reason for failure may have been due to snowplow damage to this thick striping. The performance of striping on passing lane of concrete and on black-top in test area was better, as shown in photos, but hardly in relation to its high cost.

OFFICE OF TESTING AND RESEARCH

A handwritten signature in cursive script that reads "A. J. Permoda".

A. J. Permoda, Supervisor
Materials Research Section
Research Laboratory Division

AJP:js



▲ Appearance as applied on October 2, 1957.



▲ February 25, 1958, after 150 days exposure, showing complete loss of striping in traffic lane.

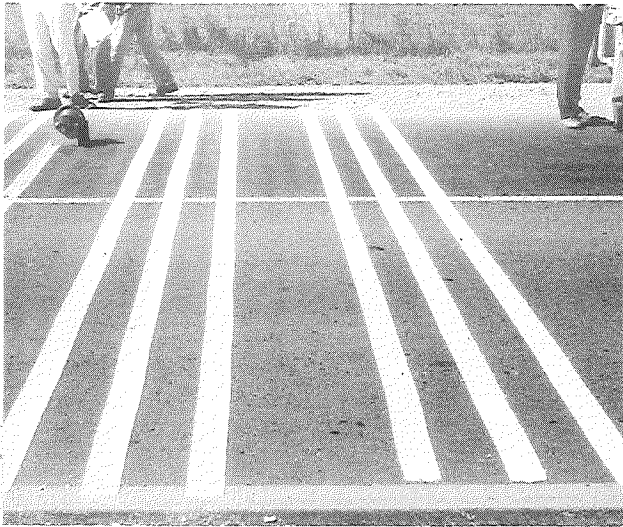


▲ January 21, 1959, after 447 days exposure, with passing lane striping exhibiting much better service than traffic lane striping.

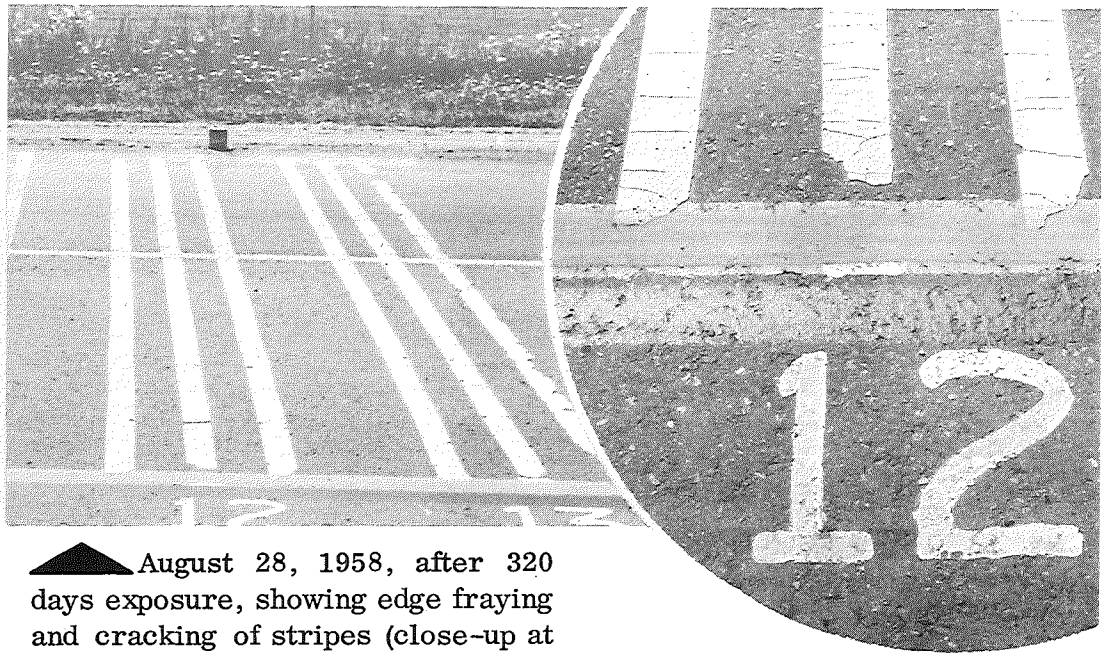


▲ February 27, 1961, after 3.4 years exposure, showing further loss of striping in passing lane.

Figure 1. Progressive weathering of Catatherm thermoplastic striping being evaluated as experimental transverse stripes on concrete of US-127, south of Lansing.



▲ Appearance as applied on October 2, 1957.



▲ August 28, 1958, after 320 days exposure, showing edge fraying and cracking of stripes (close-up at right).



◀ January 1, 1959, after 447 days exposure, showing progressive fraying.

February 27, 1961, after 3.4 years exposure showing progressive fraying and loss of striping. ▶

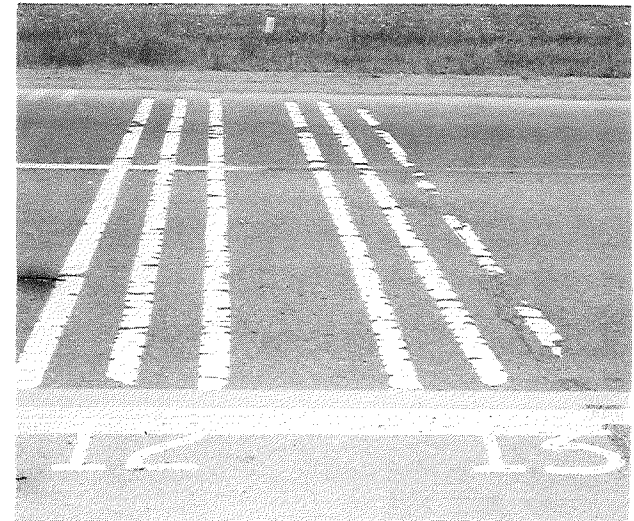


Figure 2. Progressive weathering of Catatherm thermoplastic striping being evaluated as experimental transverse stripes on black-top of US-127, south of Lansing.