

EVALUATION OF THERMOPLASTIC PAVEMENT MARKINGS  
APPLIED IN THE LANSING AREA IN 1968 AND 1969

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MICHIGAN DEPARTMENT OF STATE HIGHWAYS

EVALUATION OF THERMOPLASTIC PAVEMENT MARKINGS  
APPLIED IN THE LANSING AREA IN 1968 AND 1969

A. J. Permoda  
A. R. Gabel

Research Laboratory Section  
Testing and Research Division  
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Research Report No. R-813

Michigan State Highway Commission  
Charles H. Hewitt, Chairman; Louis A. Fisher, Vice-Chairman  
Claude J. Tobin; E. V. Erickson; Henrik E. Stafseth, Director  
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Prior to the subject tests, the only sizeable Department evaluation of thermoplastic pavement markings (heat-liquefied plastic containing pre-mixed glass beads and pigments applied at about 1/8 in. thickness) was on the W. P. Chrysler Freeway in Detroit. About 40,000 ft of white striping was applied mostly on the concrete roadway plus some edge lines on the bituminous shoulders in June 1964, just before official opening of the roadway. The striping was supplied by the Perma Line Corporation. At the two-year level, about 10 percent of the lane lines were rated as deteriorated to inadequacy; these plus additional footage totaling 5,700 lin ft were replaced at the three-year level by the contractor under a guarantee clause in the specifications. At the five-year level, the majority of the lane lines on the concrete roadway had deteriorated to inadequacy and all lane lines were replaced by conventional striping. The final evaluation coverage appeared in Research Report No. R-706 (June 1969). Most of this service occurred before legalization of winter use of studded tires beginning in the fall of 1967.

#### Application in 1968

In Summer 1968, the Department approved additional evaluation of the thermoplastic pavement markings to be applied on new bituminous resurfacing of US 27 in North Lansing, scheduled for completion in Fall 1968. The roadway was south of State Rd and was 2.2 miles long. It was to be divided into quarter-lengths for evaluation of products from four producers; Cataphote, Perma Line, Prismo, and Phillips Petroleum. The latter was a sulfur-based material, which was also cross-indexed as New Materials project 67 NM-207. All products were to be evaluated as white 4-in. wide broken lane-lines and 6-in. wide solid left-turn lane lines.

Before the resurfacing was completed, the Phillips Company notified the Department that it was suspending additional cooperative field testing due to complaints of poor color for its white striping, and Prismo Corporation stated it would be unable to meet the developing tight scheduling and requested a transfer to future tests.

Because of this, the test areas originally assigned to the two remaining products were increased to about 0.8 mile lengths, while the remaining 0.6 mile length at the south end of the resurfacing was scheduled to receive the standard fast-dry striping. In addition, personnel from the Traffic and Safety Division received approval to extend the evaluation to lane lines on the old bituminous roadway of M 143 (Michigan Ave) in the Frandor area, and the old concrete roadway of M 43 (Saginaw St) in the vicinity of the Research Laboratory.

TABLE 1  
WHITE TEST MARKINGS APPLIED IN 1968

| Map Coding | Test Area  | Surface        | Type of Line              | Length, lin ft | Stripe Width   |
|------------|--|----------------|---------------------------|----------------|----------------|
| CATAPHOTE  | (a) US 27 from Chilson St to Coleman Rd                    | New bituminous | Solid left-turn Lane line | 7,200<br>2,900 | 6-in.<br>4-in. |
|            | (c) M 43 (Saginaw) from Washington Ave to Pennsylvania Ave | Old concrete   | Lane line                 | 4,200          | 4-in.          |
|            | (d) WB M 143 (Michigan) from Foster St to E of Harrison Rd | Old bituminous | Lane line                 | 2,100          | 4-in.          |
| PERMALINE  | (b) US 27 from Coleman Rd to State Rd                      | New bituminous | Solid left-turn Lane line | 7,600<br>3,000 | 6-in.<br>4-in. |
|            | (e) EB M 143 (Michigan) from Foster St to E of Harrison Rd | Old bituminous | Lane line                 | 2,100          | 4-in.          |

In summary, the footages in Table 1 were applied in indicated locations, as excerpted from W. J. Hitchens' Traffic and Safety Division interim report TSD-0-117 (I) - 69, dated July 1969.

The test area locations are indicated on the map in Figure 1, while the striping layouts are presented in the sketches in Figure 2.

Perma Line applied its striping on October 8 and 9, 1968 while Cataphote applied its striping on October 11 and 12, 1968. Perma Line applied a so-called epoxy primer before striping with its small operator-propelled machine, though the primer was deleted on the new bituminous roadway of US 27. Cataphote applied the primer under all of its striping by a spray-gun attached to the front-end of its truck-propelled stripe applicator. Both producers applied overlay beads on top of their markings.

Both markings had good daytime appearance after application. The initial night visibility of the Perma Line was only fair except for a bright spot usually at the leading end of the lane segments. The initial night visibility of the Cataphote product was good to excellent and about equivalent to that of the new fast-dry paint striping; however, the night visibility of both of the latter decreased rapidly with service time.

The performance of the markings during the first winter of service was given by W. J. Hitchens in his report. In summary, the solid left-turn lane lines on US 27 showed almost no loss of material, while the broken lane-lines showed loss of material along the long edges and along the leading end of some segments. As an odd behavior, Perma Line lost five consecutive 20-ft segments on a slight incline on southbound US 27. It is estimated that Perma Line lane segments lost about 15 percent of their striping area that first winter on US 27. At other locations, the loss was noticeably smaller for the Perma Line, and for all Cataphote striping.

#### Application in 1969

Because arrangements could not be made to apply the Prismo Corp. product in 1968, the Department approved evaluation in 1969 on an extension of bituminous resurfacing of US 27 scheduled for 1969, proceeding northward from State Rd to Clark Rd. The major central portion of this roadway, about 1.2 miles long, was reserved for the Prismo product tests; it was a standard four-lane undivided roadway.

Because Perma Line was assigned a little less test footage than Cataphote in the 1968 tests, it was invited to lay-down small footages of striping in two locations in 1969; about 1,400 ft of lane and edge striping at the US 27 (Cedar St) interchange with I 496, and about 1,400 ft of primarily lane line on M 43 (Saginaw St) in the vicinity of the Research Laboratory. Perma Line also replaced the five lane segments on southbound US 27 that had been completely eradicated during the prior first winter of service and contributed striping on almost a mile length of roadway on westbound M 43 west of Waverly Rd by applying its markings over residual paint striping on one lane line.

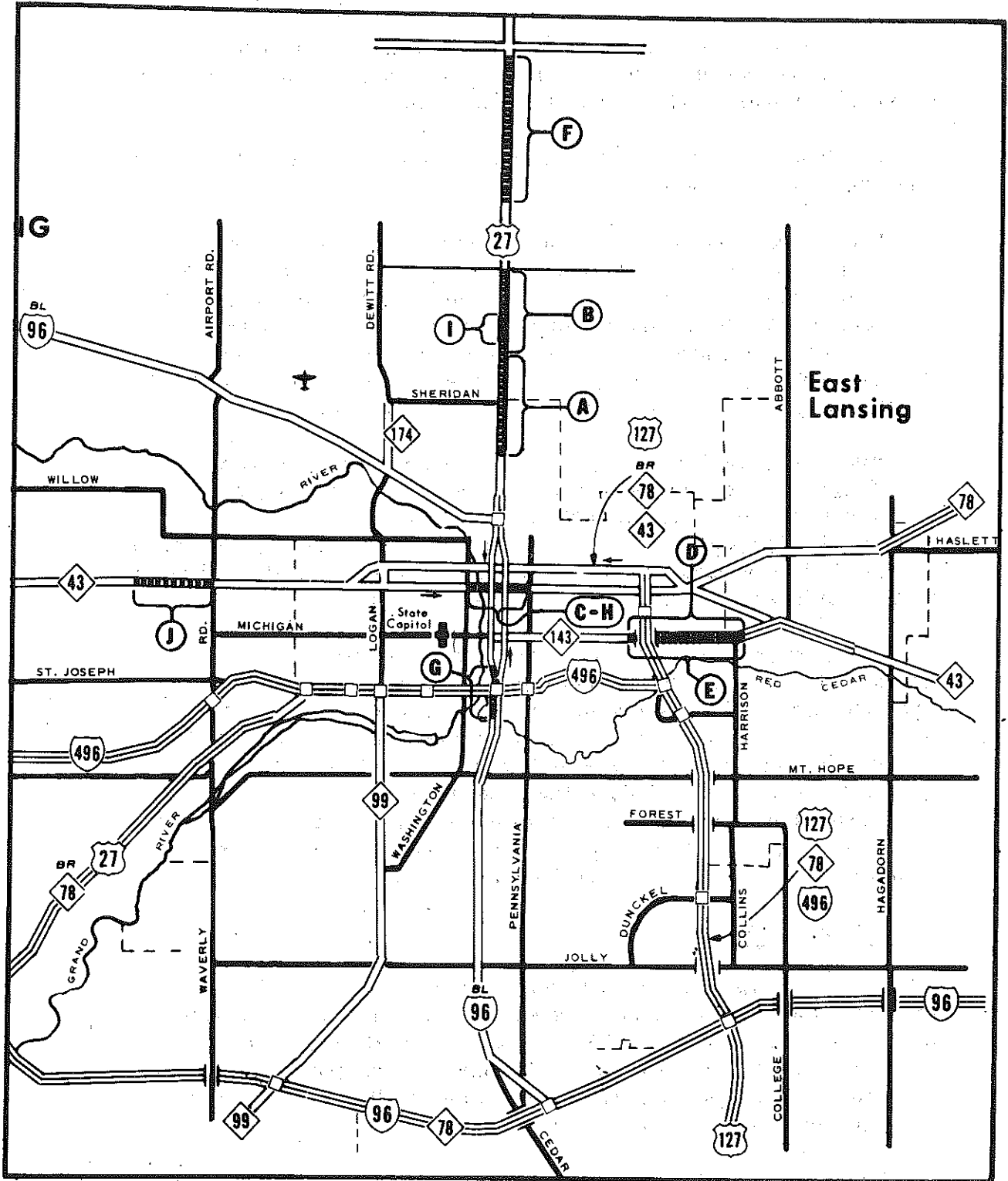


Figure 1. Lansing-area map showing locations of thermoplastic striping. Identifying letter codings correspond with those in the report's tabulations and sketches.

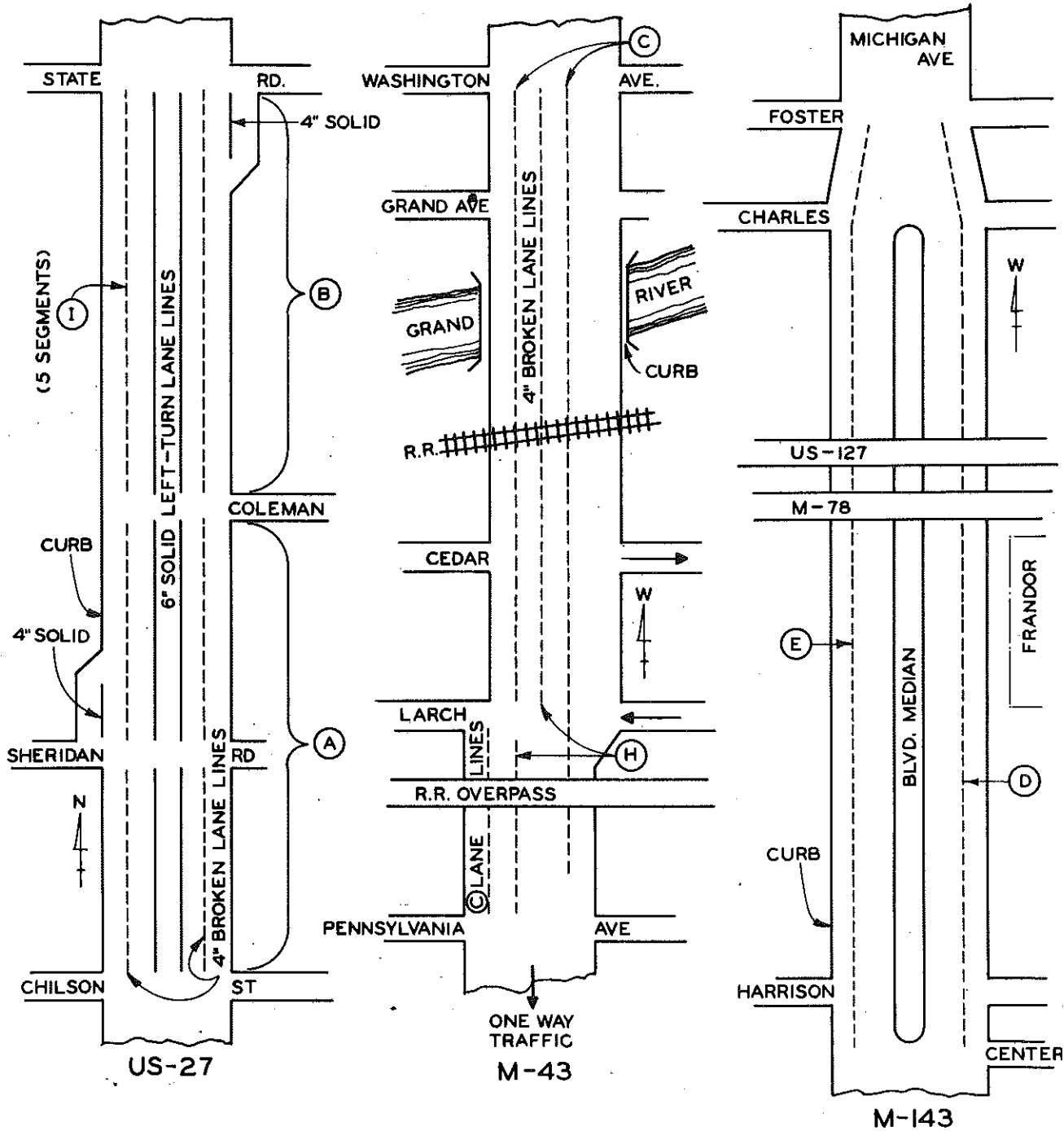


Figure 2. Sketches showing markings of indicated producers in test locations. Except for (h) and (i), all are 1968 applications.



TABLE 2  
 WHITE AND YELLOW TEST MARKINGS APPLIED IN 1969  
 (Asterisk (\*) in "Type of Line" column indicates yellow paint)

| Map Coding              | Test Area  | Surface        | Type of Line             | Length, lin ft          | Stripe Width            |
|-------------------------|--|----------------|--------------------------|-------------------------|-------------------------|
| PRISMO <sup>1</sup>     | US 27 north of State Rd                                | New bituminous | Edge line                | 12,000                  | 4-in.                   |
|                         |  |                | Lane line                | 5,000                   | 4-in.                   |
|                         |  |                | *Double centerline       | 12,000                  | 4-in.                   |
| PERMA LINE <sup>2</sup> | SB Cedar St under I 496                                | New bituminous | Lane line                | 650                     | 4-in.                   |
|                         |  |                | SB Cedar St at I 496     | New bituminous          | Gore edgeline           |
|                         | M 43 (Saginaw) from Washington Ave to Pennsylvania Ave | Old concrete   | Lane line                | 1,400                   | 4-in.                   |
|                         |  |                | US 27 SB near Hickory St | One-year old bituminous | Lane line (replacement) |
|                         | M 43 (Saginaw) WB W of Waverly Rd                      | Old bituminous | Lane line                | 2,000                   | 4-in.                   |

<sup>1</sup> Hot-Spray Plastix

<sup>2</sup> Thermoplastic (Improved)

The markings applied in 1969 are recorded in Table 2.

The test area locations are indicated on the map in Figure 1, while the striping layouts are presented in sketches in Figure 2 and 3.

Prismo Corp., experiencing delay in arrival of some material, applied its product by hot-spray rather than hot-extrusion, on July 22, 23, and 24, 1969. The markings were applied by a truck-propelled stripe applicator; no primer was applied under the markings on the new black-top. The stripe thickness was about 1/10 in., a little thinner than the other thermoplastics, and had a good cover of Corning overlay beads. The top surface was apt to have a convex contour.

Perma Line applied its improved product (having some coarse pigment for better night visibility retention) on August 28 and 29, 1969. The markings were applied by a small operator-propelled machine; with no primer under the markings on the black-top surfacings, but applied on old concrete before marking. Overlay glass beads were applied to the markings

The Perma Line and Prismo white markings had a good daytime appearance after application, but the Prismo yellow centerline was not a strong yellow in color. The Perma Line did have an improved initial night visibility to that applied last year and lost it at a slower rate. The Prismo Plastix had excellent initial night visibility which decreased but slowly until the five-inch snowfall of November 19, 1969 when snow plows removed beads off about an inch width along the centerline of the convex-topped markings.

The performance over the first winter of the markings was good and considered about equivalent to those applied in 1968, though the loss-of-markings area was different. In this group, the loss was greatest on the Prismo edge lines where portions, varying from inches to 10 ft in length were occasionally removed, presumably by snow plows. The 1,000 lin ft of Perma Line markings on M 43 west of Waverly Rd, applied over residual striping on reflection-cracked old black-top (not a recommendable procedure) shortly exhibited such variable performance that they were deleted from further observation.

#### Continuing Observations

Longitudinal roadway striping is difficult to rate on an absolute numerical scale for several reasons; the principal ones being the extended distances involved with changes in condition of roadway surface and topography, and the rater's difficulty in fairly assigning numbers--depicting performance--to sections of striping over long distances under pressure of traffic. (For the above reasons, users have developed the comparative testing of several paints as sets of transverse stripes when absolute quantitative ratings are desired.)

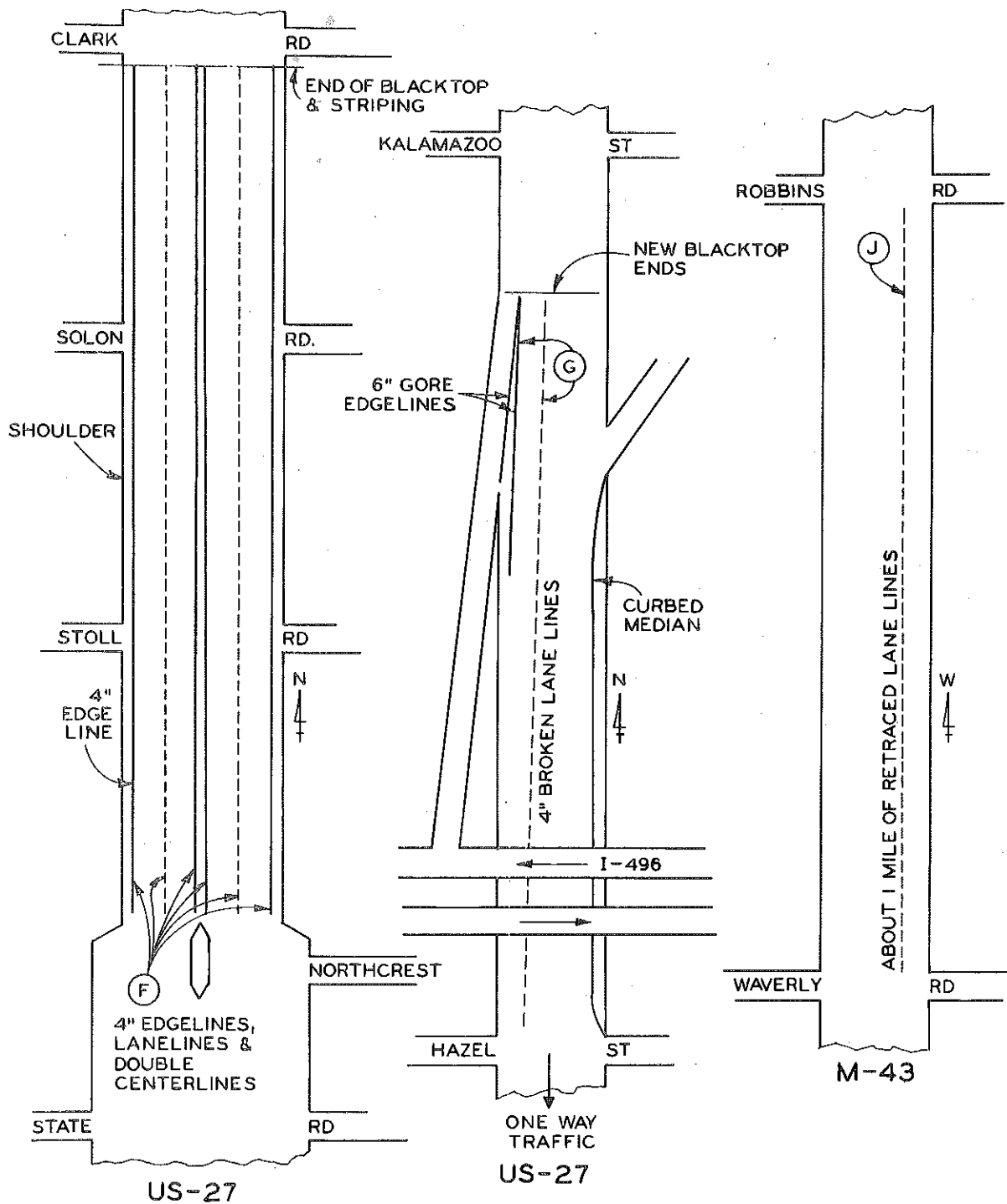


Figure 3. Sketches showing markings of indicated producers in test locations--1969 applications.

Because of the difficulties cited above, the performance of the test, longitudinal thermoplastic road markings during the major part of their service was followed by use of non-numerical word ratings, to depict the average condition of the striping. These were also used, earlier in this report, when noting the initial appearance and performance over the first winter of service.

### Markings Applied in 1968

The 1968 markings had a markedly different performance whether applied as solid left-turn lane lines, or broken lane-striping on north US 27. The solid lane lines lost stripe area and thickness very slowly and retained about 85 percent of the original area at the minus three-year level, when rated quantitatively (Table 3).

The broken lane-lines on US 27 lost striping area progressively and much faster than did the solid left-turn lines, especially in front of business place driveways and, in one case, on an ascending incline. At the minus three-year level only about 25 percent (Table 3) of the original stripe area remained.

The broken lane-markings on old concrete of Saginaw St and old bituminous of Michigan Ave performed about the same as on the new bituminous of US 27. For information purposes, all three of these test areas were comparatively straight, with little horizontal or vertical curving.

Before deciding on how best to rate the test markings last summer and fall, when they were possibly approaching the end of their service life, we thought that aerial photography had potential and made arrangements for the Photography Laboratory to snap a few photos for us. Figure 4 is one of the photos. It did not yield the desired detail and we dropped the method; though realizing it has much promise, especially since detailed photos are now being taken from orbiting satellites. So, we turned to the mundane method of walking and rating each test segment, separately. The ratings are given in Table 3, for only one test area for reasons of brevity. The table ends with an average rating for the striping, on the indicated date, i. e., the left-turn lane lines had durability ratings of 89 and 81 percent, which incidentally was referred to in an earlier paragraph, above.

The average ratings at the minus three-year service level of all test markings laid down in 1968 are given in Table 4. Incidentally, the progressively developing shrinkage cracking and opening of gas inclusions in the markings, apparently did not adversely affect durability.

TABLE 3  
 EXAMPLE OF MINUS 3-YR DURABILITY RATINGS ON  
 TEST MARKINGS, REPRESENTING PRODUCT (b) ON US 27<sup>1</sup>

| Segment<br>Number<br>S to N | 4-in.<br>Lane Lines |     | 6-in.<br>Solid Lines* |     | Segment<br>Number<br>(Cont.) | 4-in.<br>Lane Lines |     | 6-in.<br>Solid Lines |     |
|-----------------------------|---------------------|-----|-----------------------|-----|------------------------------|---------------------|-----|----------------------|-----|
|                             | NB                  | SB  | NB                    | SB  |                              | NB                  | SB  | NB                   | SB  |
| 1                           | 1.0                 | 8.0 | 8.0                   | 9.0 | 41                           | 4.5                 | 0   | 8.5                  | 5.0 |
| 2                           | 0                   | 9.0 |                       |     | 42                           | 7.5                 | 0   |                      |     |
| 3                           | 1.5                 | 5.5 | 9.5                   | 9.0 | 43                           | 0.5                 | 0   | 8.0                  | 8.0 |
| 4                           | 6.0                 | 7.0 |                       |     | 44                           | 0.5                 | 0   |                      |     |
| 5                           | 2.5                 | 6.5 | 9.5                   | 9.0 | 45                           | 4.5                 | 0   | 9.0                  | 7.5 |
| 6                           | 6.5                 | 6.0 |                       |     | 46                           | 2.0                 | 0   |                      |     |
| 7                           | 2.0                 | 6.0 | 9.0                   | 6.0 | 47                           | 1.0                 | 0.5 | 9.0                  | 9.0 |
| 8                           | 6.5                 | 4.5 |                       |     | 48                           | 3.0                 | 2.5 |                      |     |
| 9                           | 7.5                 | 5.0 | 9.0                   | 7.5 | 49                           | 5.5                 | 3.5 | 7.5                  | 9.0 |
| 10                          | 6.0                 | 1.5 |                       |     | 50                           | 0                   | 1.5 |                      |     |
| 11                          | 6.0                 | 0.2 | 9.5                   | 9.0 | 51                           | 1.0                 | 1.5 | 8.0                  | 9.0 |
| 12                          | 7.5                 | 0   |                       |     | 52                           | 5.5                 | 0.5 |                      |     |
| 13                          | 5.5                 | 0.5 | 9.5                   | 9.0 | 53                           | 0.5                 | 1.5 | 9.0                  | 3.5 |
| 14                          | 7.5                 | 1.0 |                       |     | 54                           | 7.5                 | 1.0 |                      |     |
| 15                          | 4.0                 | 1.5 | 9.5                   | 8.5 | 55                           | 6.0                 | 0   | 9.5                  | 4.5 |
| 16                          | 8.0                 | 0   |                       |     | 56                           | 6.5                 | 0   |                      |     |
| 17                          | 6.5                 | 0   | 9.0                   | 9.0 | 57                           | 7.0                 | 0.5 | 8.5                  | 7.5 |
| 18                          | 0.5                 | 0   |                       |     | 58                           | 6.5                 | 0.2 |                      |     |
| 19                          | 5.0                 | 0   | 9.5                   | 9.0 | 59                           | 4.0                 | 1.0 | 9.0                  | 8.5 |
| 20                          | 5.5                 | 0   |                       |     | 60                           | 7.0                 | 4.5 |                      |     |
| 21                          | 7.5                 | 0   | 8.5                   | 9.0 | 61                           | 1.0                 | 4.5 | 9.5                  | 7.0 |
| 22                          | 7.0                 | 0   |                       |     | 62                           | 1.5                 | 2.0 |                      |     |
| 23                          | 7.0                 | 0   | 9.5                   | 9.0 | 63                           | 3.0                 | 2.5 | 9.5                  | 9.0 |
| 24                          | 4.5                 | 0   |                       |     | 64                           | 4.0                 | 0   |                      |     |
| 25                          | 0.5                 | 0   | 9.0                   | 9.0 | 65                           | 6.5                 | 0   | 9.5                  | 8.0 |
| 26                          | 4.5                 | 0   |                       |     | 66                           | 6.0                 | 0.2 |                      |     |
| 27                          | 1.0                 | 0   | 9.5                   | 8.5 | 67                           | 4.0                 | 0   | 9.5                  | 8.5 |
| 28                          | 4.0                 | 0   |                       |     | 68                           | 0                   | 0   |                      |     |
| 29                          | 2.5                 | 0   | 6.0                   | 8.0 | 69                           | 0.5                 | 0   | 9.5                  | 9.0 |
| 30                          | 2.5                 | 0   |                       |     | 70                           | 1.5                 | 0   |                      |     |
| 31                          | 2.5                 | 0   | 8.5                   | 8.5 | 71                           | 1.0                 | 0.2 | 9.0                  | 9.0 |
| 32                          | 2.0                 | 0   |                       |     | 72                           | 2.0                 | 0   |                      |     |
| 33                          | 0                   | 0.5 | 9.0                   | 9.5 | 73                           | 6.0                 | 0.5 | 9.5                  | 8.5 |
| 34                          | 3.0                 | 0   |                       |     | 74                           | 7.0                 | 0   |                      |     |
| 35                          | 4.0                 | 0   | 7.5                   | 9.0 | 75                           | 6.5                 | 0   | 9.0                  | 8.0 |
| 36                          | 2.5                 | 0   |                       |     | 76                           | 7.0                 | 0   |                      |     |
| 37                          | 6.0                 | 0   | 8.5                   | 7.0 | 77                           | 7.0                 | 0   | 9.5                  | 8.5 |
| 38                          | 6.0                 | 0   |                       |     | 78                           | 7.0                 | 0   |                      |     |
| 39                          | 7.0                 | 0   | 9.0                   | 8.0 | 79                           | 6.5                 | 0   | 9.5                  | 5.0 |
| 40                          | 5.0                 | 0.2 |                       |     | Avg                          | 4.3                 | 1.2 | 8.9                  | 8.1 |

\*Ratings represent a 100 ft length of left-turn lane markings.

<sup>1</sup> Ratings made July 21 and 28, 1971, on a scale: 10 = 100 percent area intact,  
 0 = 0 percent remaining.

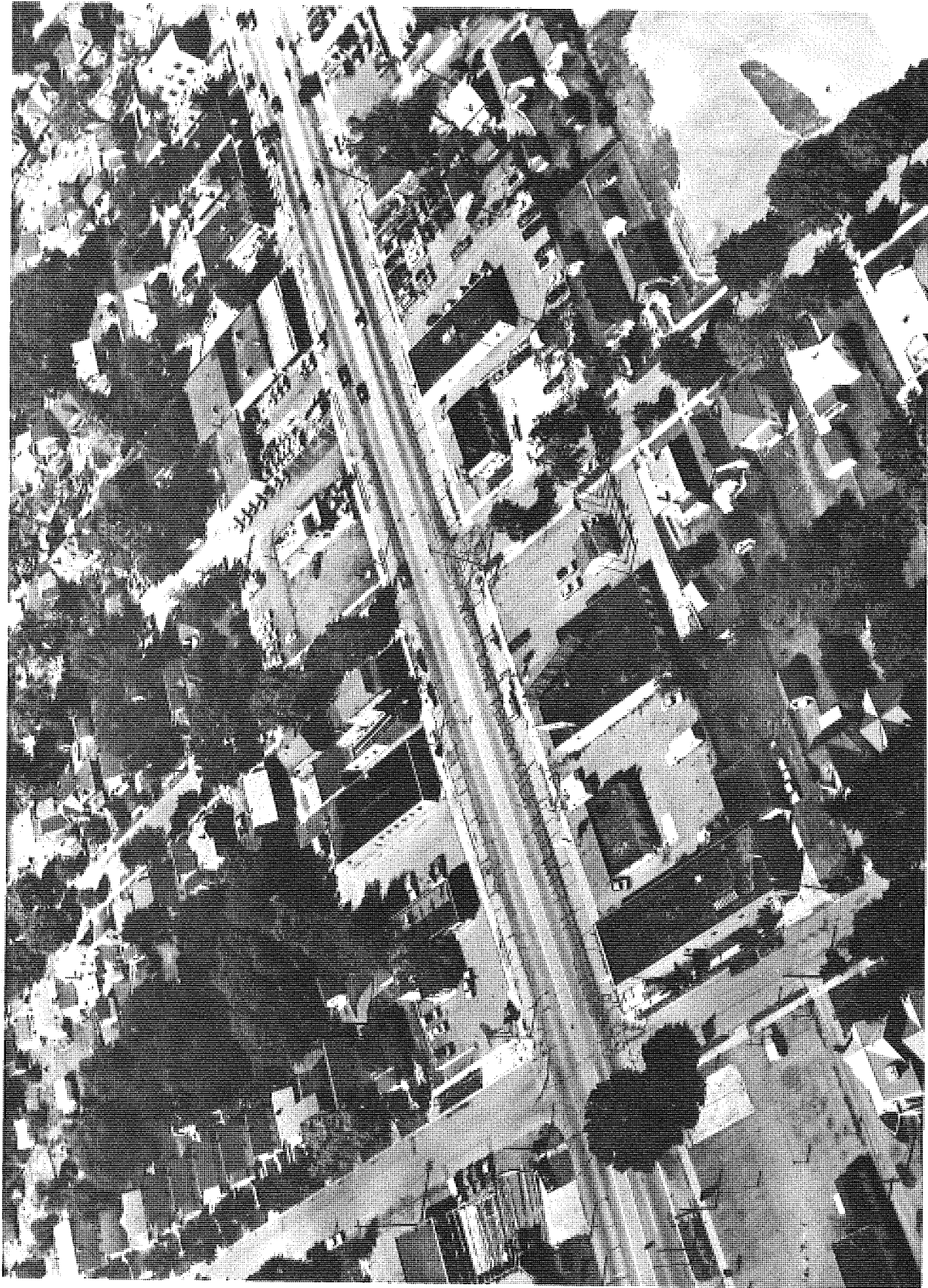


Figure 4. Aerial view of W end of test section on Michigan Ave (areas (d) and (e)). Extensive crack sealing, especially on lower (WB) roadway, shortens effective service life of markings (8-12-71).

TABLE 4  
 AVERAGE DURABILITY RATINGS AT MINUS 3-YR SERVICE  
 LEVEL FOR TEST MARKINGS APPLIED IN 1968 (WHITE)<sup>1</sup>  
 (Values in parentheses denote range of ratings for lane segments)

| Map Coding     | Lane | Type of Line     | Stripe Width | Rating     | Rating Date | Remarks  |
|----------------|------|------------------|--------------|------------|-------------|--|
| Ⓐ              | NB   | Lane line        | 4-in.        | 2.3(0-6.5) | 8-19-71     | These ratings dropped perceptibly in the next several months.      |
|                | SB   | Lane line        | 4-in.        | 5.0(0-8.0) | 8-19-71     |  |
|                | NB   | Solid left-turn  | 6-in.        | 8.6        | 8-19-71     |  |
|                | SB   | Solid left-turn  | 6-in.        | 9.2        | 8-19-71     |  |
| Ⓐ <sup>2</sup> | SB   | Solid right-turn | 4-in.        | 6.0        | 8-19-71     | See Figure 6.  |
| Ⓑ              | NB   | Lane line        | 4-in.        | 4.3(0-7.5) | 7-21, 28-71 | See first Remark above.  |
|                | SB   | Lane line        | 4-in.        | 1.2(0-8.0) | 7-21, 28-71 |  |
|                | NB   | Solid left-turn  | 6-in.        | 8.9        | 7-21, 28-71 |  |
|                | SB   | Solid left-turn  | 6-in.        | 8.1        | 7-21, 28-71 |  |
| Ⓑ <sup>3</sup> | NB   | Solid right-turn | 4-in.        | 8.0        | 7-28-71     | See Figure 5.  |
| Ⓒ              | EB   | N. Lane line     | 4-in.        | 1.8(0-5.5) | 8-25-71     |  |
|                | EB   | S. Lane line     | 4-in.        | 2.0(0-6.5) | 8-25-71     |  |
| Ⓓ              | WB   | N. Lane line     | 4-in.        | 2.1(0-7.0) | 8-24-71     | Average was lowered by extensive joint and crack sealing (Fig. 4). |
| Ⓔ              | EB   | S. Lane line     | 4-in.        | 1.8(0-7.0) | 8-24-71     |  |

<sup>1</sup> Thinning of markings by wear was evident, especially in lane segments. Measurement was tried, but accuracy was difficult to attain.

<sup>2</sup> About 200 lin ft at Sheridan Rd.

<sup>3</sup> About 300 lin ft at State Rd.

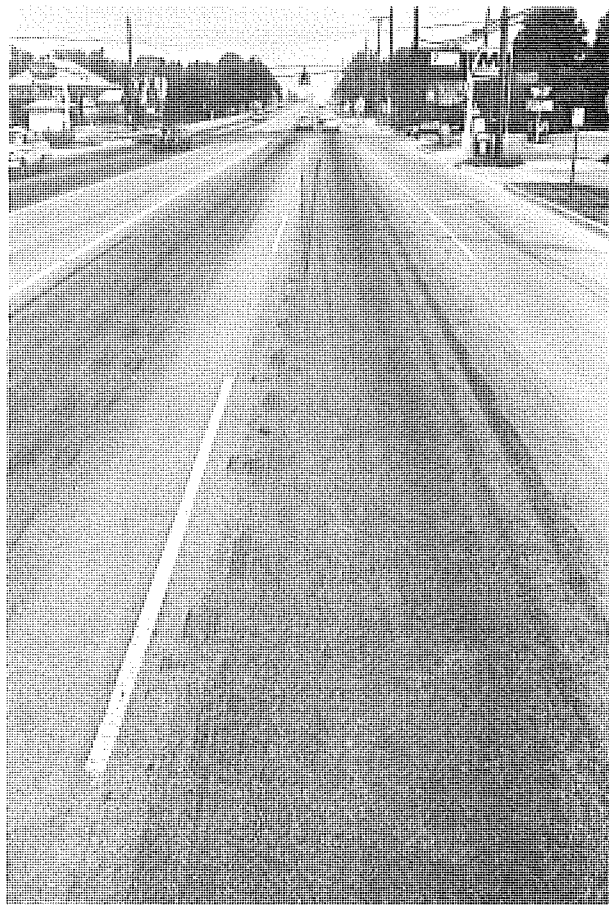
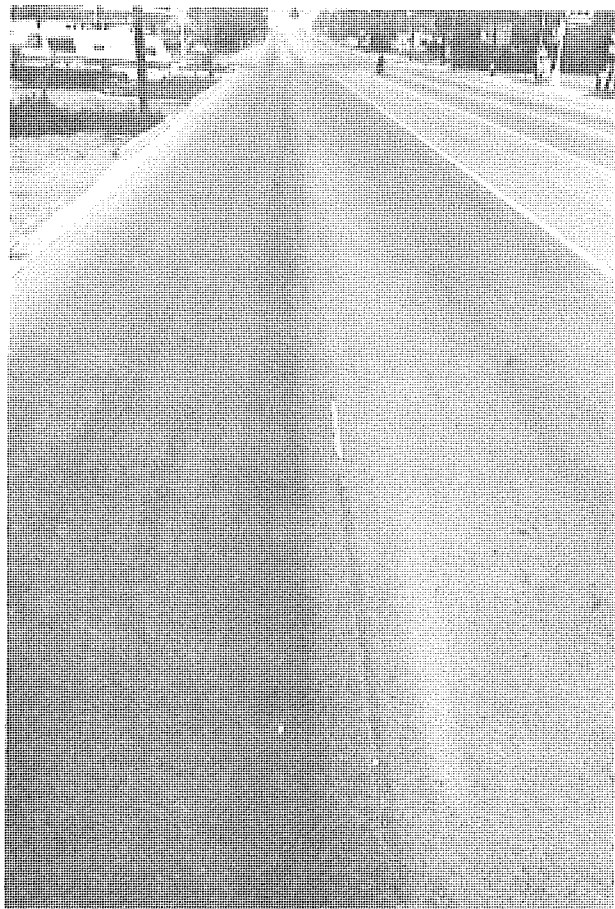


Figure 5. Markings ( (b) type) shown looking N on US 27 just S of State Rd after minus three years service. Left-turn lane lines and right-turn lane lines are still good. SB lane segments (left) are ostensibly gone, while NB lane segments are still present and effective: note shrinkage cracking in foreground segment (7-23-71).

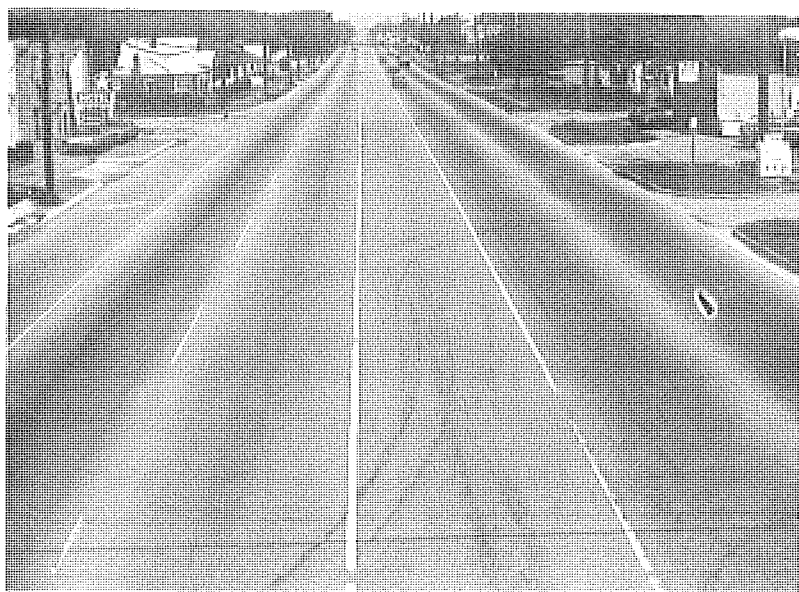


Figure 6. Markings ( (a) type) looking N on US 27 off Sheridan St overpass after minus three years service. The solid right- and left-turn lines are generally still good, as are the SB broken lane lines. The NB lane lines are eroded. The right left-turn lane line (foreground) shows some erosion by traffic making left-turns off Sheridan St onto NB US 27 (8-26-71).



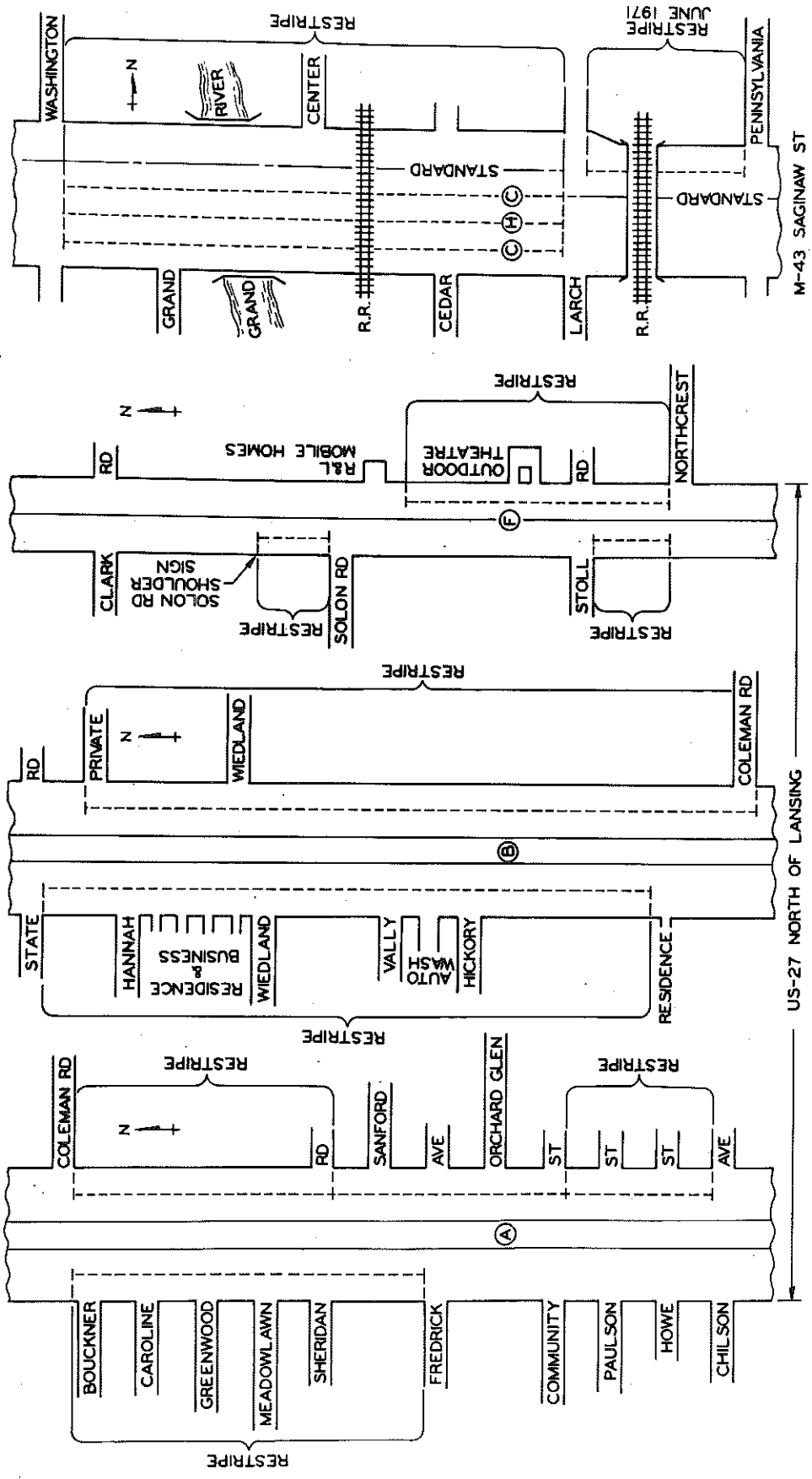


Figure 7. Sketches showing broken lane-lines that were partially restriped with paint in the fall of 1971 because they were eroded. Markings were about three-years old, except for (f) and (h) that were about two-years old.

Subsequent to ratings in Table 4, a supplemental inspection was made in early October 1971 which showed additional loss of the lane segments (see "Remarks" in Table 4). It was decided that most areas of the lane lines would provide poor delineation over the 1971-72 winter and these should be restriped. This included all of lane lines on Codes (d) and (e) on Michigan Ave; and major portions of (a), (b) and (c) as shown in Figure 7. The solid 6-in. lines (left-turn) were still in good condition and would not need restriping.

#### Markings Applied in 1969

The 1969 markings had their first, over-winter performance described earlier in the report. Subsequently, they showed a varying rate of deterioration, which can, perhaps, be best described by a compilation of the durability ratings (averages and ranges) given in Table 5. These differ from Table 4 in being two-year ratings.

Subsequent to above ratings, a supplemental inspection was made in early October 1971 which indicated that some areas of broken lane-lines would provide poor delineation over the 1971-72 winter and these should be restriped with paint. These are shown in the "Remarks" column in Table 5 and Figure 8. All of the solid (f) type edge lines and (f) type double yellow centerlines and (g) type gore lines) and broken (g) type lane lines) lines were still providing adequate delineation and were not to be touched-up with paint restriping.

### SUMMARY

Before summarizing the performance of the thermoplastic markings in the subject tests, we wish to emphasize that, a) they were applied on Department highways in metropolitan Lansing, b) when winter use of studded tires was legalized in Michigan, and c) on roadways that were generally straight and without marked vertical curves. Therefore the results differ somewhat from those obtained earlier in Detroit.

The three producers participating in the tests received contracts that did not require follow-up touch-up of the markings. The pricing on the markings was not obtained by us, though it was believed to be about 30 cents per foot of 4-in. wide markings for the extruded type, and 25 cents for the hot-spray type.

In addition, the comments are classified into groupings, (A) covering 1968 applications, and (B) covering 1969 applications.

#### A. 1968 applications covering Codes (a) through (e).

1. The 4-in. broken lane-lines lost striping area progressively with service time. Some area and segments were lost during the first year, some more the second and more the third, leaving about 25 percent of the original area at that time. Accordingly, the service life of the marking system was three years, when major portions were replaced with paint.

TABLE 5  
 AVERAGE DURABILITY RATINGS AT 2-YR SERVICE LEVEL <sup>1</sup>  
 FOR TEST MARKINGS APPLIED IN 1969 (WHITE AND YELLOW)  
 (Asterisk (\*) in "Type of Line" column indicates yellow paint)  
 (Values in parentheses denote range of ratings for lane segments)

| Map Coding | Lane | Type of Line    | Stripe Width | Rating                  | Rating Date | Remarks   |  |
|------------|------|-----------------|--------------|-------------------------|-------------|---|--|
| f          | NB   | Edge line       | 4-in.        | 6.8(0.5-8.5)            | 9-14-71     | Partially restriped with paint in October 1971. Low ratings due in part to reflection cracking (Fig. 8) |  |
|            | SB   | Edge line       | 4-in.        | 6.5(0.5-9.0)            | 9-14-71     |   |  |
| f          | NB   | Lane line       | 4-in.        | 2.2(0.0-7.0)            | 9-1-71      |   |  |
|            | SB   | Lane line       | 4-in.        | 2.7(0.0-7.0)            | 9-1-71      |   |  |
| g          | NB   | *Centerline     | 4-in.        | 8.4(5.0-9.0)            | 9-14-71     |   |  |
|            | SB   | *Centerline     | 4-in.        | 8.0(6.0-9.0)            | 9-14-71     |   |  |
| g          | SB   | Lane line       | 4-in.        | 5.7(3.5-7.5)            | 8-25-71     |   | See Figure 9.                                      |
|            | SB   | Solid gore line | 6-in.        | 7.6(6.5-8.5)            | 8-25-71     |   |  |
| h          | EB   | Lane line       | 4-in.        | 3.1(0.0-8.0)            | 8-25-71     |   | Partially restriped with paint in October 1971.    |
| i          | SB   | Lane line       | 4-in.        | 0.0                     | 7-21-71     |   | Five segments replaced with paint in October 1971. |
| j          | WB   | Lane line       | 4-in.        | Inspection discontinued |             | Mentioned earlier in report.  |  |

<sup>1</sup> Thinning of markings by wear was evident, especially in lane segments. Measurement was tried, but accuracy was difficult to attain.



Figure 8. Markings ( (f) type) looking S on US 27, S of Clark Rd after two years of service. The NB lane lines (left) are affected by reflection cracking of the bituminous surface (9-14-71).



Figure 9. Markings ( (g) type) looking N on Cedar St after two years of service. Durability is still good; which is a plus for the lane lines on the most curved area in the tests (8-26-71).

2. The durability of the individual broken lane segments was most variable. Some disappeared the first year, while at the other extreme some retained 80 percent of the original area at the end of three years. See ranges in Table 4 and photos of Figures 5 and 6. (This variability has probably been a drawback in use of these markings).

3. Loss of lane markings was attributed primarily to traffic wear, compounded by studded tires, as evidenced by thinning of the markings. Loss was also due to acceleration and turning movement, as noticed by loss in front of business-place driveways.

4. Loss from snow plow damage was considered as a minor deteriorating factor, as evidenced by the good condition, after three years of service, of the left-turn lane lines. See values in Table 4 and photos of Figures 5 and 6. There is some indication that the solid markings are more resistant to snow plow damage than the broken lane lines, and perhaps that 6-in. lines are more resistant than 4-in. lines.

5. The 6-in. solid left-turn lane markings have a known service life of four winters (per inspection of March 1972) which can probably be extrapolated to two more. Minor repair or replacement may be required in a few spots before then, see photo in Figure 5.

6. The service life of the markings was about the same on new bituminous resurfacing of US 27 as it was on old black-top or old concrete. Regarding the old bituminous of M 143, it was fortunate that the longitudinal reflection cracking generally missed the markings.

7. Sealing of reflection cracking of bituminous resurfacing, can shorten the effective service life of the markings (Fig. 4).

8. The test thermoplastic markings lost their night visibility due to glass beads at a faster rate than painted lines.

9. Code (a) markings (Cataphote) were slightly superior to Code (b) markings (Perma Line's old formula) in night visibility and retention of that due to glass beads, and in durability. On north US 27, Code (a) markings were closer in town with its higher traffic count and still earned slightly higher final ratings (Table 4). The same was true on M 143 despite the higher incidence of sealing of transverse reflection cracking (Fig. 4).

B. 1969 applications covering Codes (f) through (i) .

1. Codes (i), (h) and (j) were marked with Perma Line's improved product. Code (i) replacement lane segments (five) were completely eroded within two years, probably by snow plows on an inclined surface. Code (h) markings on concrete of Saginaw St were deteriorated to a point that a major portion was replaced with paint at the end of two-plus

years. In contrast, Code (g) markings as broken lane-lines and solid gore lines were still in good condition on Cedar St after two years of service, despite being on a curved roadway, considered tough because of wandering traffic. The night visibility retention was an improvement over the original product. In summary, the performance was most variable, regarding durability.

2. Codes (f) were marked with Prismo hot-spray Plastix. Almost half the broken lane-lines were deteriorated and replaced with paint striping after two-plus years of service, see ratings in Table 5 and instructions in Figure 7. As a follow-up, a recent cursory inspection showed that all broken lane-lines will have to be replaced this spring, after three winters and minus three years of service. The poorer than expected service of these markings, in a location furthest from town's heavy traffic, was partially due to reflection cracking of the black-top surface as noted in "Remarks" in Table 5. The Prismo Plastix edge line also performed poorer than expected since about one-third was removed after two-plus years of service, as rated in Table 5; presumably this damage was due to snow plowing. More edge line was removed during the 1971-72 winter. The Prismo double yellow center-line was still in good condition when rated after two-plus years of service (Table 5), but a little poorer than expected. In summary, the Prismo markings performed somewhat poorer than the Cataphote material applied in 1968 because of an apparent poorer resistance to snow plowing damage.

3. Regarding other qualities such as reduction of thickness of markings and loss of night visibility due to glass beads, the comments are the same as for test markings laid down in 1968.

#### ADDENDUM TO INFORMATION PROVIDED IN RESEARCH REPORT NO. R-706

On a recent inspection trip in Detroit, we made a fast, cursory inspection of the thermoplastic edge lines on the Chrysler Freeway. The portion that we saw was in remarkably good condition after eight winters of service. It should be noted, that the edge lines on the Chrysler are laid on a bituminous shoulder adjoining the concrete roadway, while the Prismo Plastix edge lines on north US 27 (see above) are laid on black-top resurfacing of the roadway itself, next to seal coat shoulders.

#### Recommendations

Other than presenting test data on the performance of subject markings, we make no recommendations on whether to use these markings or not, in standard road markings.

However, gleaned from this and the previous study we wish to make a recommendation for Department review. Reserve a sizeable urban roadway for marking tests. Contract to have a broken 20-ft lane segment of thermoplastic applied, say every 200 ft (instead of the customary 50 ft). Then, stripe the area with fast-dry paint, as is customary. Hopefully, and statistically, some part of most thermoplastic segments should remain for three to four winters and give traffic some measure of guidance and delineation (Fig. 10). Currently, with use of studded tires during the winter, our painted lines are quite often worn away on urban highways during the February, March, and April period. This experiment would have merit even if studded tires were banned in the future by legislative action.

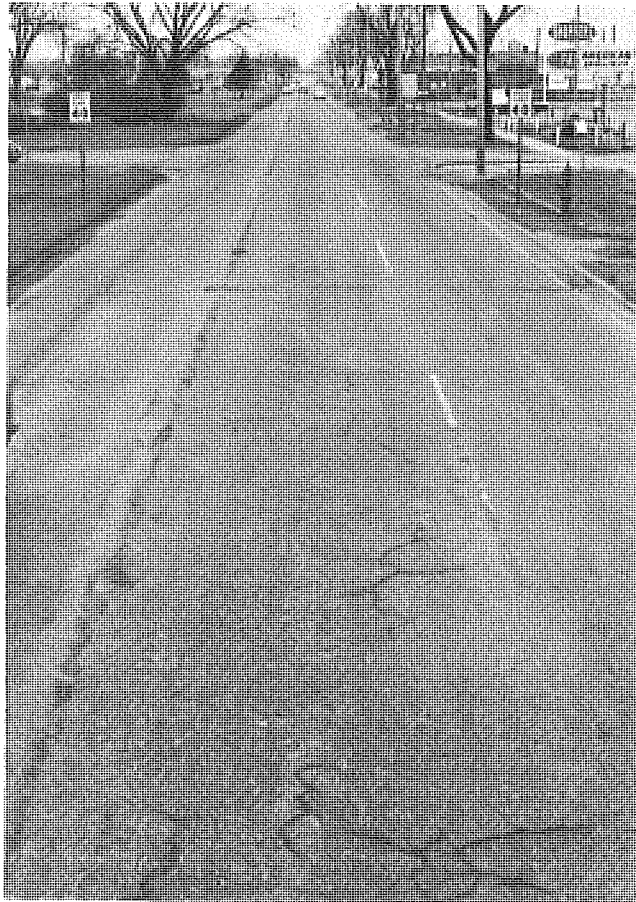


Figure 10. Looking W on M 143 (Michigan Ave) near Shopper's Fair. The residue from the broken thermoplastic lane segments (right) still guides traffic after four winters of service. The left lane segments striped with paint in October 1971 are completely worn away before one winter's service. The thermoplastic based line was also overstriped with paint at the same time for the first time (3-21-72).