

Final Report
PERFORMANCE OF PREFORMED PLASTIC TAPES

by

Frank D. Shepard
Research Scientist

(The opinions, findings, and conclusions expressed in this report are those of the author and not necessarily those of the sponsoring agencies.)

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SUMMARY

This study was initiated to investigate the overall performance of preformed pavement marking tapes with respect to their appearance, durability, and night visibility, and to recommend criteria for the selection of such materials based on their performance.

The durability of each material varied with the location and pavement type. Compared with that of traffic paint, the night visibility of the materials evaluated was very poor. Also, problems that made the installation process inefficient and sometimes dangerous were noted for centerline application procedures.

It is thought that if the problems cited in this report can be remedied, preformed tape could be used effectively for pavement marking.

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INTRODUCTION

The state of Virginia uses a variety of pavement marking materials, the type depending on a number of conditions such as location, traffic volume, and the situation to be marked. Of these materials, cold preformed plastic tapes are used for center-lines and edgelines, stop bars, and pavement marking messages because of their durability, along with the fact that they can be inlaid in new bituminous pavement surfaces. Recent problems encountered with the durability and visibility of these tapes, however, prompted the Maintenance Division to request an evaluation of their performance.

PURPOSE AND SCOPE

Consequently, this study was undertaken (1) to field test the performance of preformed pavement marking tapes with respect to their appearance, durability, and night visibility, and (2) to establish criteria for the selection of such materials based on their performance.

After the project was started, it was requested that it be expanded to include an investigation of the process for applying each material, which was done.

The study was limited to the testing of cold-applied plastic marking tapes 60 mils in thickness. The tapes were supplied by the Prismo Corporation, the 3M Company, and the Safety Lab Products Company.

PROCEDURES

Test Sections

Each marking tape was applied transversely at the following locations in the Richmond area.

Interstate Highway

- I-95 southbound, just south of the Rte. 301 exit (concrete and bituminous surfaces). The pavement in this area transitions from concrete to bituminous and thereby allowed placement of materials on both surface types under almost identical traffic conditions. Six lines of each material, 4 in. wide, were applied transversely across the right lane of the roadway as shown in Figure 1. This site has an average annual daily traffic volume of approximately 28,000 vehicles in the southbound direction (3 lanes). Truck traffic accounted for approximately 24% of the traffic volume.

Intersections

- Intersection of Patterson Ave. and Parham Rd. (bituminous surface). Stop bars were installed on Patterson Ave., eastbound and westbound, as shown in Figure 2. It is noted that the 24 in. wide stop bars were fabricated using 8 in. wide strips of each material placed side by side. Also, the sequence in which the materials were placed was different.
- Intersection of Patterson Ave. and Gayton Rd. (bituminous surface). A stop bar was placed on the eastbound Patterson Ave. approach to Gayton Rd. as shown in Figure 3. The marking procedure was the same as that for the Patterson Ave.-Parham Rd. intersection.
- Intersection of Rte. 60 and Byrd Airport exit from I-64 (concrete surface). A stop bar was placed in the southbound approach to Rte. 60 as shown in Figure 4. The marking procedure was the same as that for the Patterson Ave.-Parham Rd. intersection.

Representatives from the manufacturers of the materials were asked to observe placement of their products to ensure compliance with recommended procedures as shown in the Appendix. Department personnel made the installations.

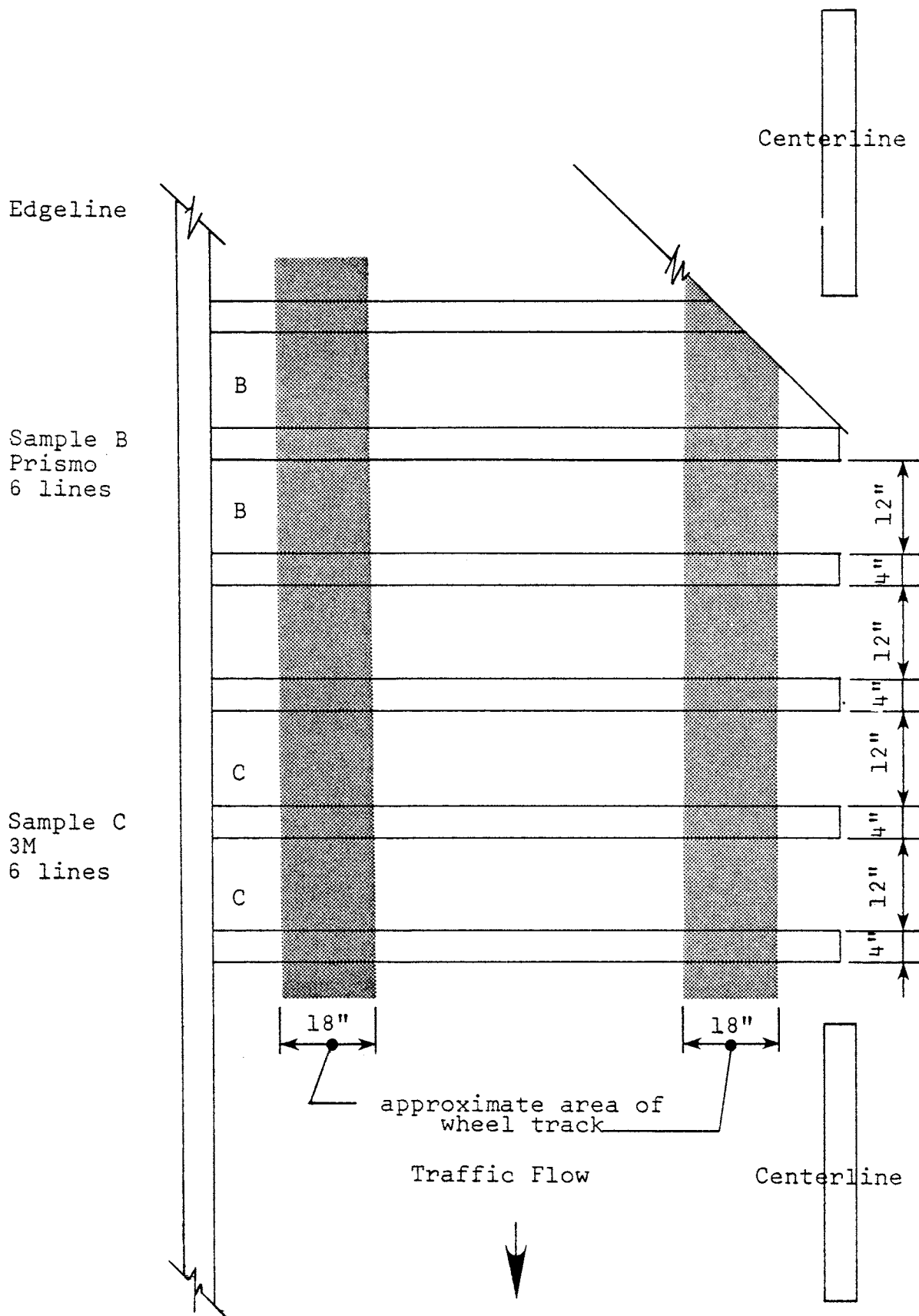
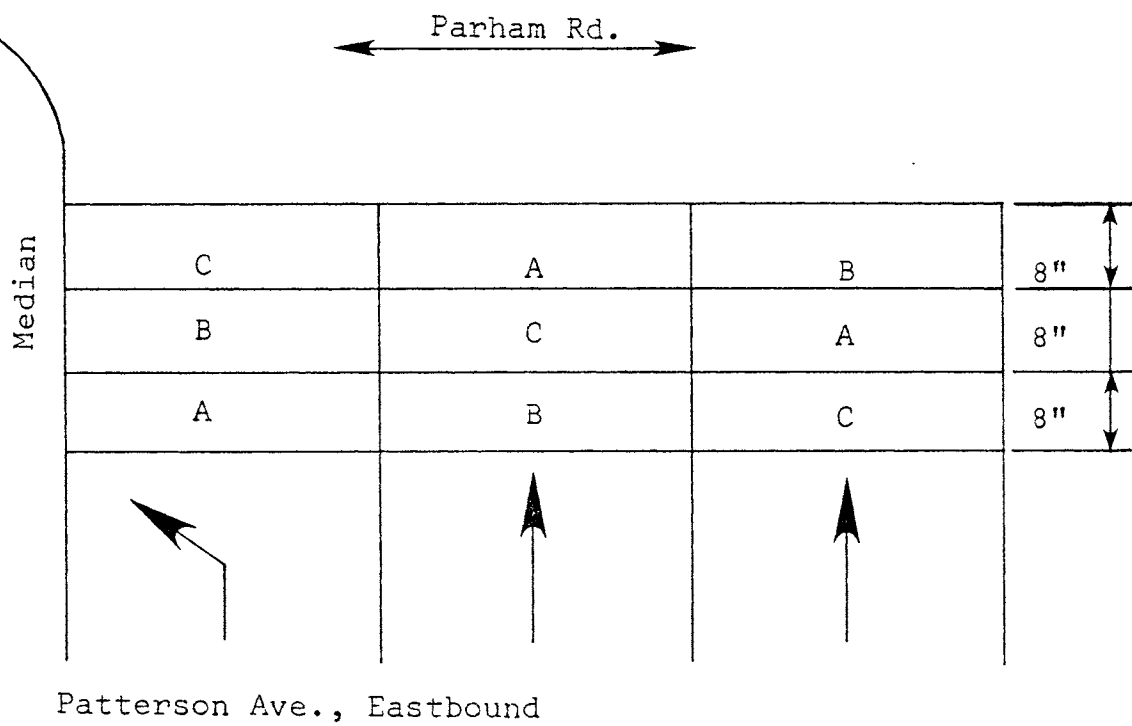


Figure 1. Placement of test materials on I-95 site (concrete and bituminous surfaces).



LEGEND:

- A — Press Lab
- B — Prismo
- C — 3M

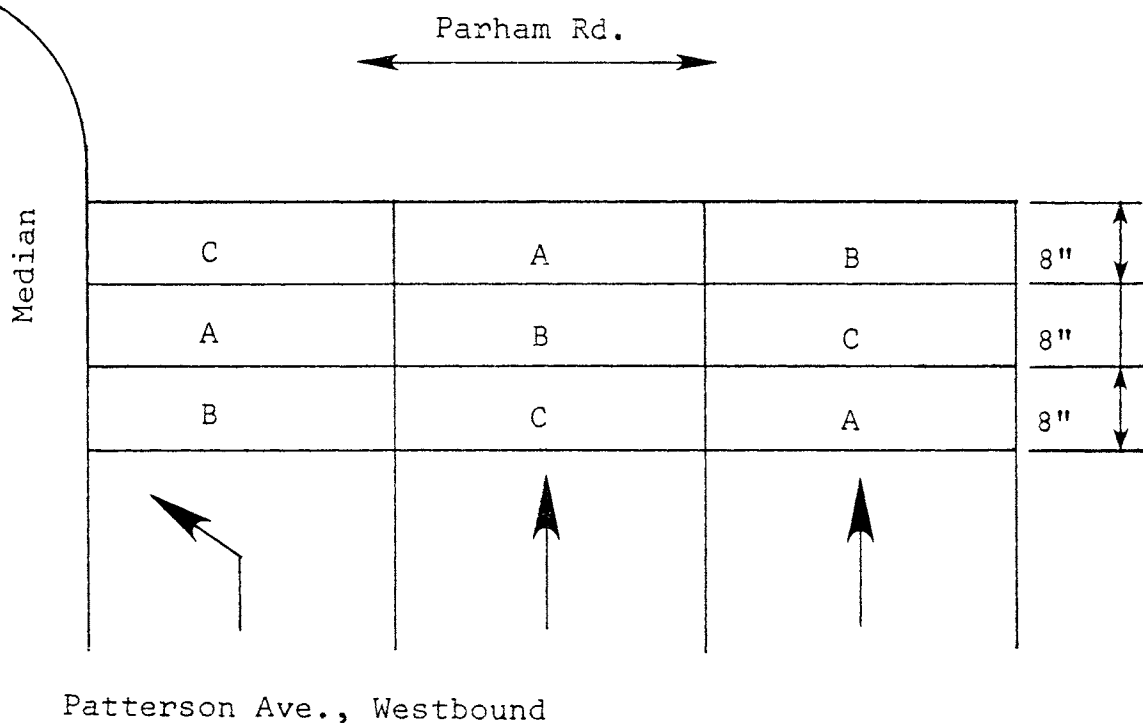


Figure 2. Placement of test materials at intersection of Patterson Ave. and Parham Rd. (bituminous)

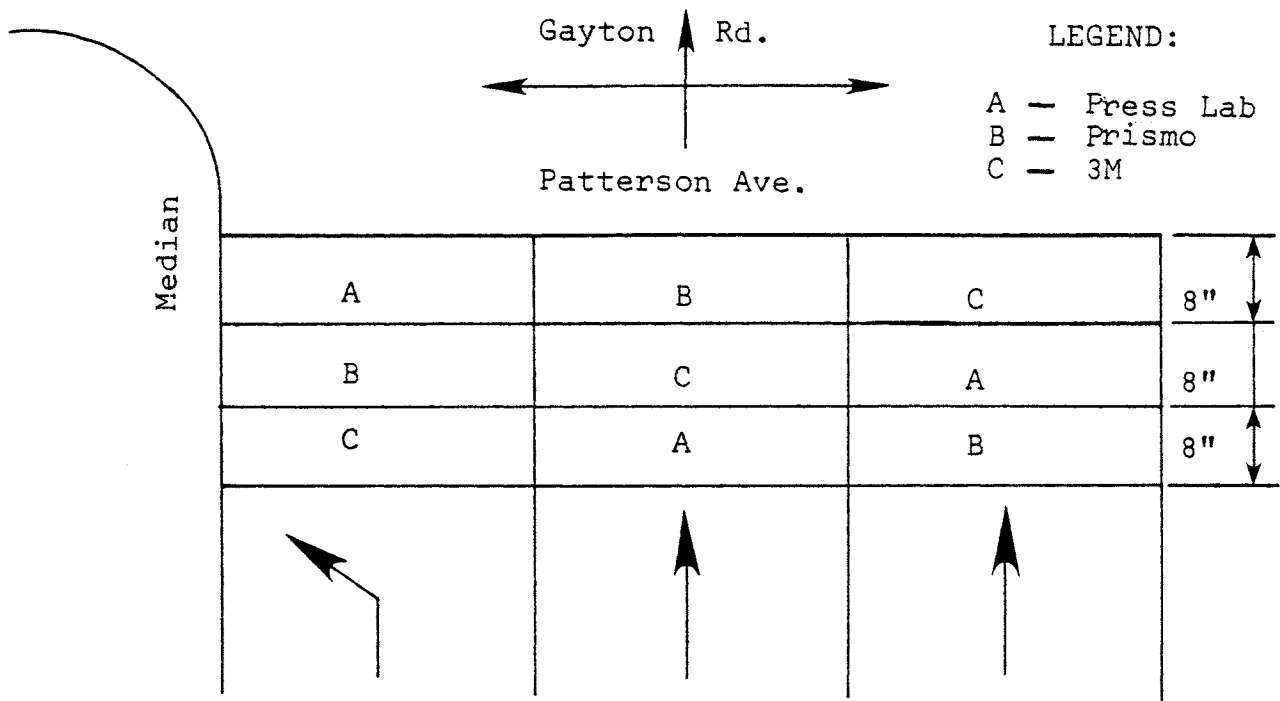


Figure 3. Placement of test materials at intersection of Patterson Ave. and Gayton Rd. (bituminous).

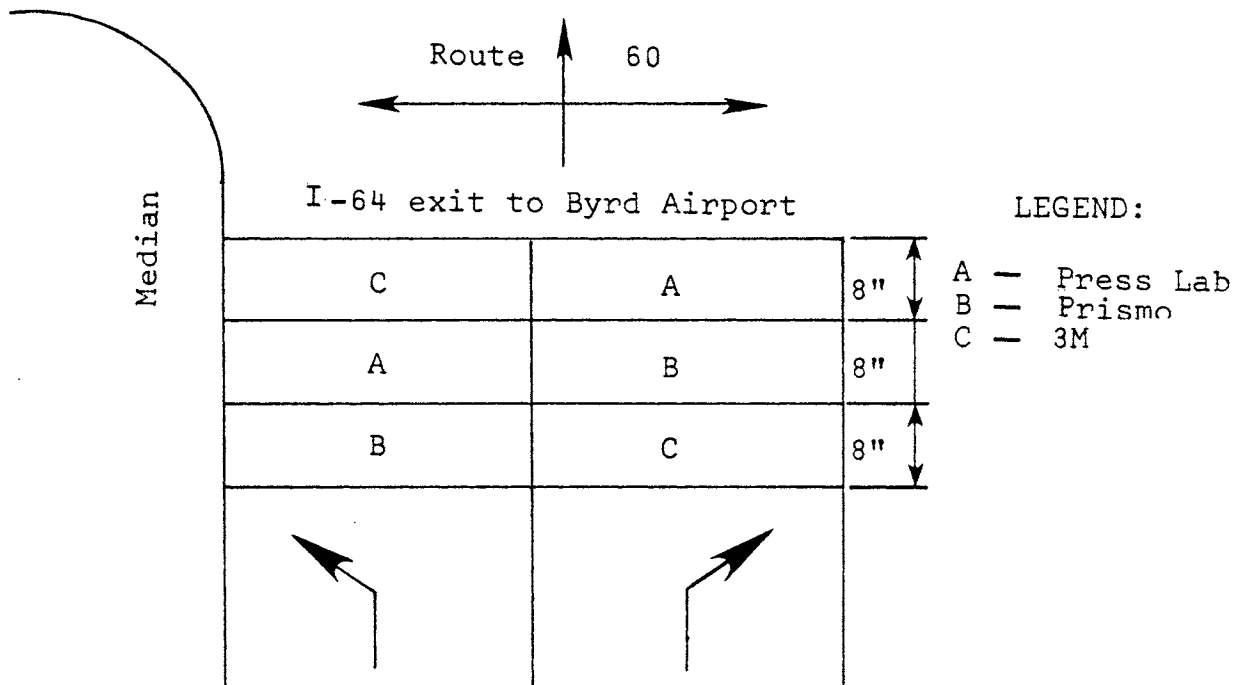


Figure 4. Placement of test materials at intersection of Route 60 and I-64 exit to Byrd Airport (concrete).

Evaluation

The lines were evaluated through observations made by the author and a representative of the Maintenance Division periodically from August 1980 until July 1982. Ratings were decided upon through consultation of the observers. The characteristics evaluated were (1) general appearance, A, (2) durability, D, and (3) night visibility, N.

General Appearance

The general appearance was judged by viewing the lines from the side of the road, taking into account such factors as fading, yellowing, darkening, and dirt accumulation. This feature was rated on a scale of 0 (complete failure) to 10 (good).

Durability

The durability was rated by estimating, by eye, the percentage of line remaining in the wheel tracks, which is the portion of the wheel track area in which the pavement is not exposed. These ratings were made on a scale of 0 (no line remaining) to 10 (no film loss). For these ratings, ASTM designations D 821-47 (abrasion resistance) and D 913-51 (chipping resistance) were used. Details of the rating scale are shown in Table 1. The term "wheel track" is defined as the area of greatest wear caused by the tire and the 9 in. on each side. Therefore, each line had two wheel tracks approximately 18 in. wide as shown in Figure 1.

Table 1

Durability Rating Scale

<u>Scale</u>	<u>Percentage Intact</u>	<u>Description</u>
10	100%	perfect condition
9		
8	97%	
7		
6	92%	intermediate failure
5		
4	77%	
3		
2	60%	requires restriping
1		
0		complete failure

Night Visibility of Materials

The night visibility designates the brightness of the materials obtained by utilizing photometric readings taken with a retroreflectometer⁽¹⁾ placed on each line in the wheel tracks. The night visibility rating is on a scale of 0 (complete failure or no beads remaining) to 10 (highest or initial reading). A rating of 4 is taken as the point at which a material no longer performs its function. A reading of 170 as determined by a portable retroreflectometer was established as the upper limit or 10. The 170 reading is in the range of the highest observed values for new preformed tape. It was difficult to pick a lower limit; however, a value of 110 was assigned a rating of 4, the point at which a material no longer performs its function. It is noted that the 110 reading is slightly lower than the minimum night visibility readings observed for each material. Also, at a reading of 110 beads still remain visible in the tape; therefore, the material has not failed. Normally, the point of complete failure, or 0 rating, is taken as that condition in which the material has no beads remaining for retroreflection. The night visibility of the preformed tapes relative to values observed for other pavement marking materials is discussed later under RESULTS.

Night visibility determinations were made on the areas used for rating durability.

Weighted Rating

The appearance, durability, and night visibility were combined to give an overall rating, R, by the formula

$$R = 0.30A + 0.30D + 0.40N,$$

where

R = overall rating,
A = appearance rating (30%),
D = durability rating (30%), and
N = night visibility rating (40%).

(1) F. D. Shepard. Evaluation of Portable Retroreflectometer for Use on Pavement Marking Materials. Virginia Highway and Transportation Research Council. November 1981.

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Whenever a material is rated below 4 in one or more of the service factors (A,D,N), it is considered to have failed; a rating of 0 denotes complete failure.

RESULTS

The results are presented as ratings of the appearance, durability, and night visibility, as well as the overall ratings. Although all the test strips have not deteriorated to failure, it is believed that the results to date warrant reporting. It is noted that the material supplied by the Safety Lab Products Company failed within a short period of time at all locations and was eliminated from consideration.

Appearance

Figure 5 shows the appearance ratings for all the installations. With the exception of the first 2 months, there was very little difference in the appearance values for the concrete and bituminous intersections. Appearance ratings for the interstate concrete were higher for the 3M tape for the first 7 months, and for the Prismo tape for the following 8 months. The ratings were equal for the remaining 5 months.

The trend in the appearance ratings for the tapes on the interstate bituminous surface was similar to that for the tapes on the interstate concrete, with the ratings being close for the last observation periods.

Both materials tended to become increasingly dirty throughout the summer months; however, they were relatively clean after the winter months. Also, both tapes had higher ratings after a rain due to the cleaning action of the water and tires. In many instances, the 3M tape had the whiter surface; however, tire marks were more noticeable on it than on the Prismo tape.

Durability

Plots of the durability ratings for the bituminous and concrete intersections are shown in Figure 6. The durability of the 3M tape was superior to that of the Prismo tape for over most of the testing period on both types of pavement. The primary reason for the loss in durability for the Prismo tape was spalling due to failure of the adhesive backing at one intersection and moving or creeping observed at most of the intersections. Figures 7 and 8 show examples of the movement and cracking for concrete and bituminous pavements.

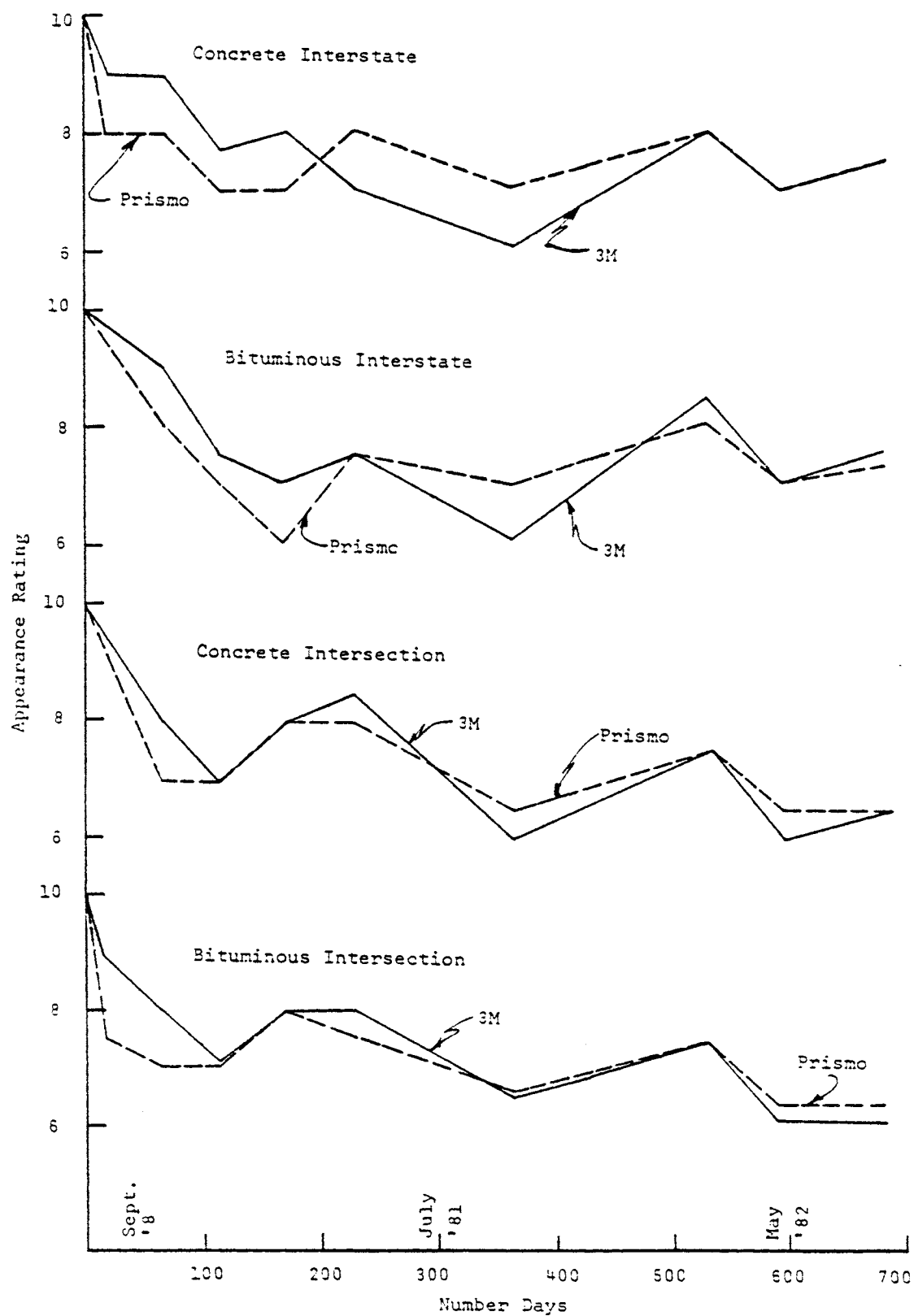


Figure 5. Appearance ratings all locations.

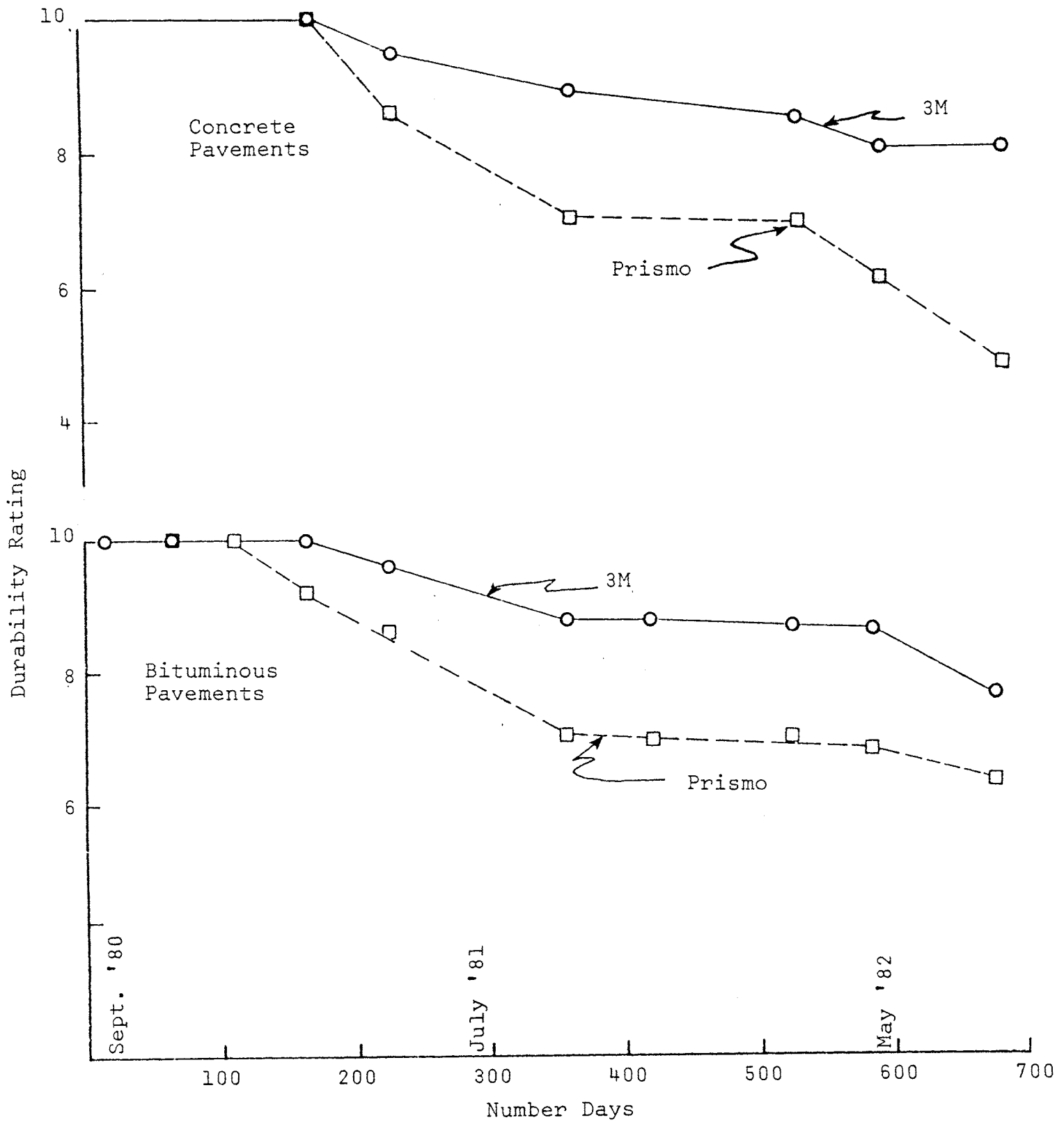


Figure 6. Durability ratings for intersections.

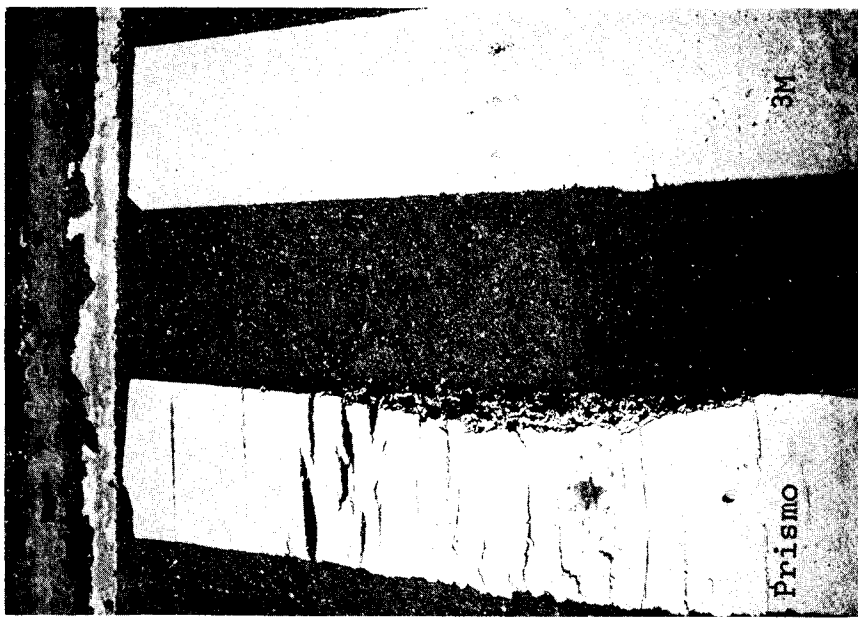


Figure 7. Example of tape movement on concrete pavement at intersection.

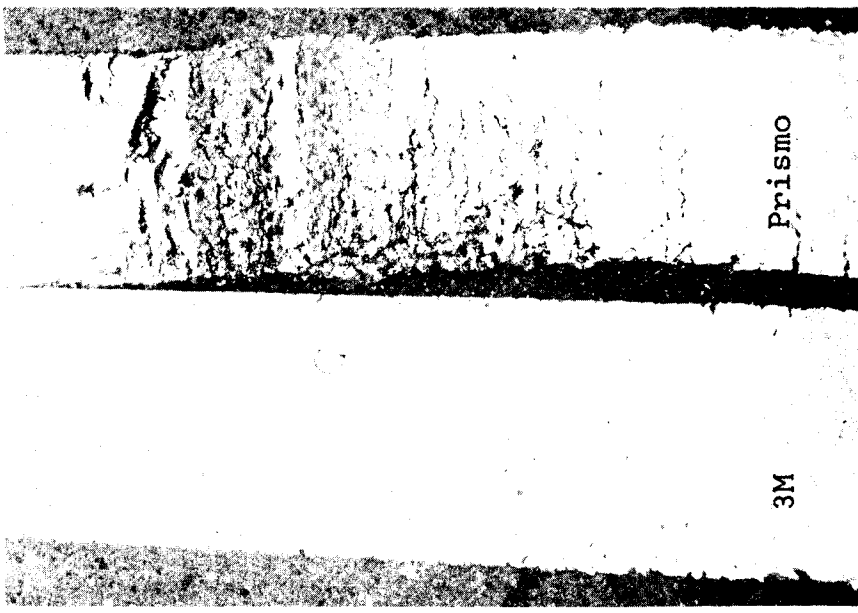


Figure 8. Example of tape movement and cracking on bituminous pavement at intersection.

The durability ratings for the lines placed transversely across the interstate concrete pavement are shown in Figure 9. For the 3M tape, there was an early failure of the bond between the tape and the concrete surface. The Prismo tape showed similar problems; however, the spalling lagged that of the 3M tape by 13 to 15 months.

The durability ratings in Figure 10 show that after 112 days the Prismo tape on the interstate bituminous surface started to deteriorate, with the rate of deterioration increasing with time. The deterioration is in the form of spalling caused by a bond failure between the tape and pavement; however, there is some evidence of delamination of the plastic tape from the adhesive. The 3M tape looked good with a slight loss of material along the edges. Figures 11 and 12 show the tapes on the concrete and bituminous pavements, respectively.

Night Visibility

Retroreflectometer readings were taken on those lines remaining intact, which did not include tapes that were partially gone. A calibration standard was used to adjust all readings to a common basis.

Referring to the plots of retroreflectivity readings for concrete and bituminous intersections in Figures 13 and 14, respectively, it is noted that during the first part of the evaluation period, the 3M tape was much brighter than Prismo, primarily because of its higher (174 vs. 146) initial reading. During the middle of the study, Prismo was brighter than 3M, during the last part the reverse was true. It is thought that the fluctuations in the retroreflectometer readings are partly a function of dirt accumulation on the tapes.

Figure 15 is a plot of the retroreflectometer readings for tapes placed on interstate concrete pavement. Again, the 3M tape was much brighter than Prismo during the first observation periods because of the high initial readings. Prismo was brighter during the middle and latter part of the study, or until readings could not be obtained because of failures in durability.

Figure 16 shows basically the same trend as Figure 15; however, the readings are very close for the last three observations.

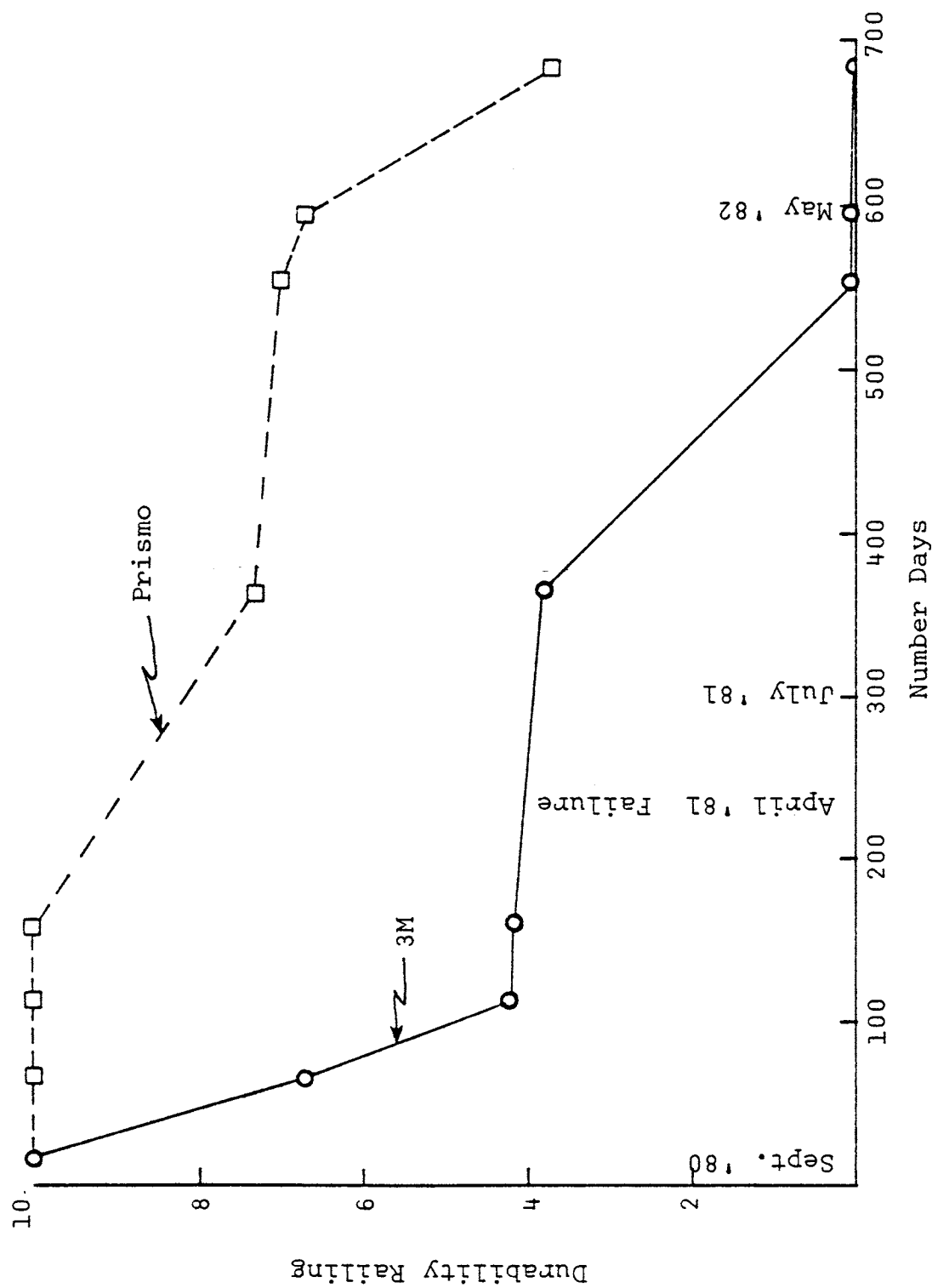


Figure 9. Durability ratings for concrete interstate pavement.

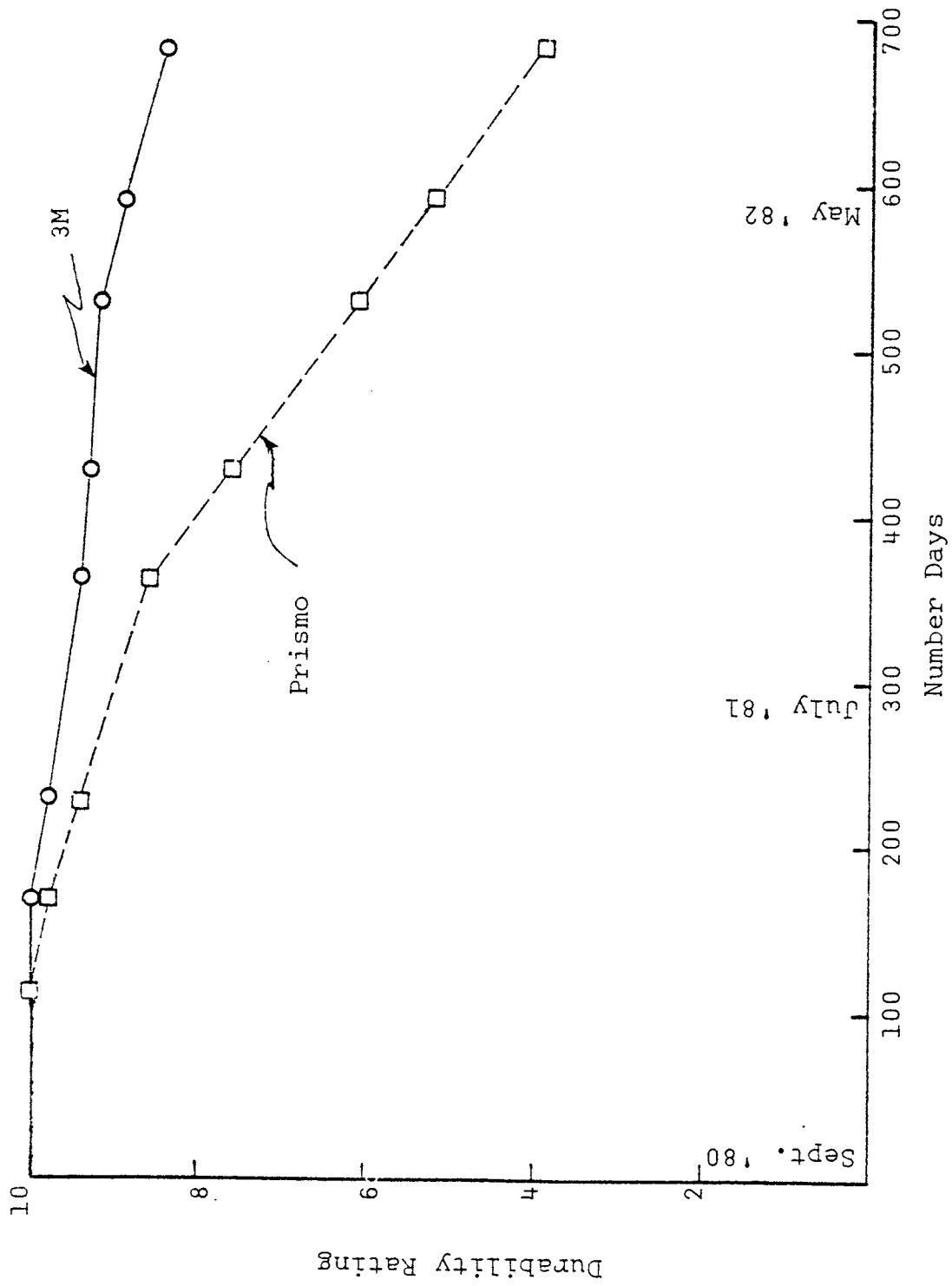


Figure 10. Durability rating for bituminous interstate pavement.



Figure 11. Tape placed on concrete pavement at interstate.



Figure 12. Tape placed on bituminous pavement at interstate.

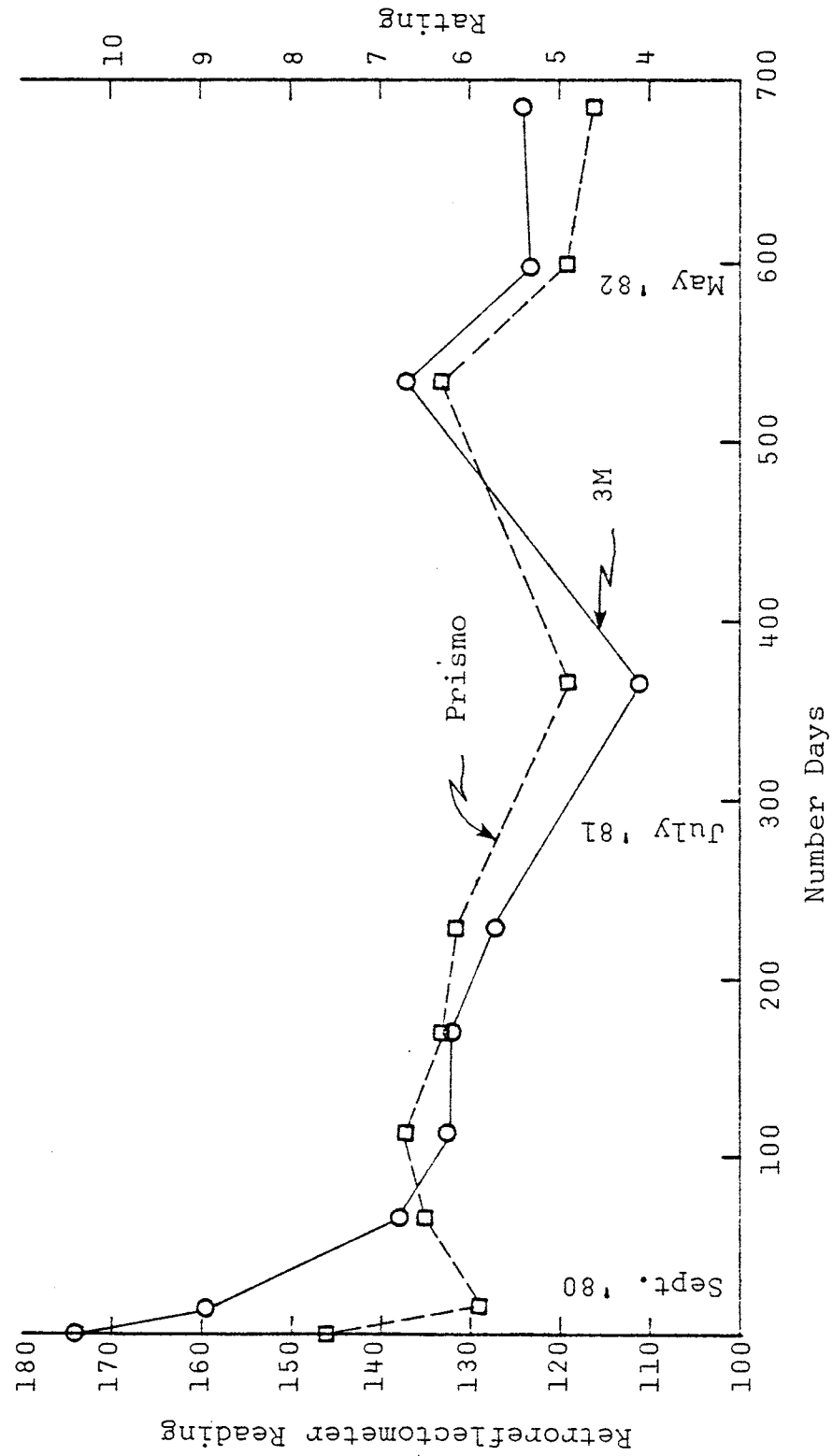


Figure 13. Retroreflectometer readings for concrete intersection.

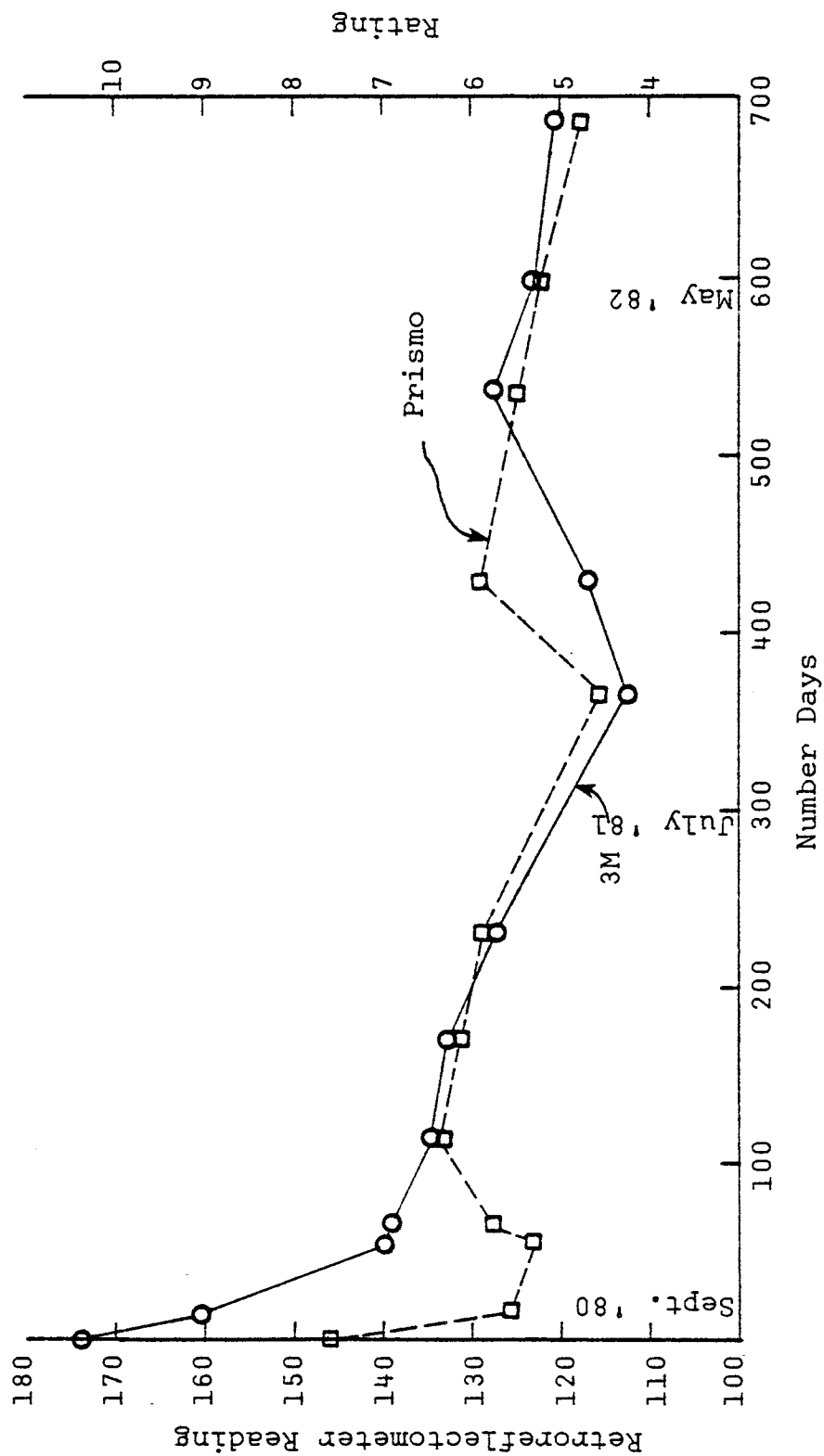


Figure 14. Retroreflectometer readings for bituminous intersections.

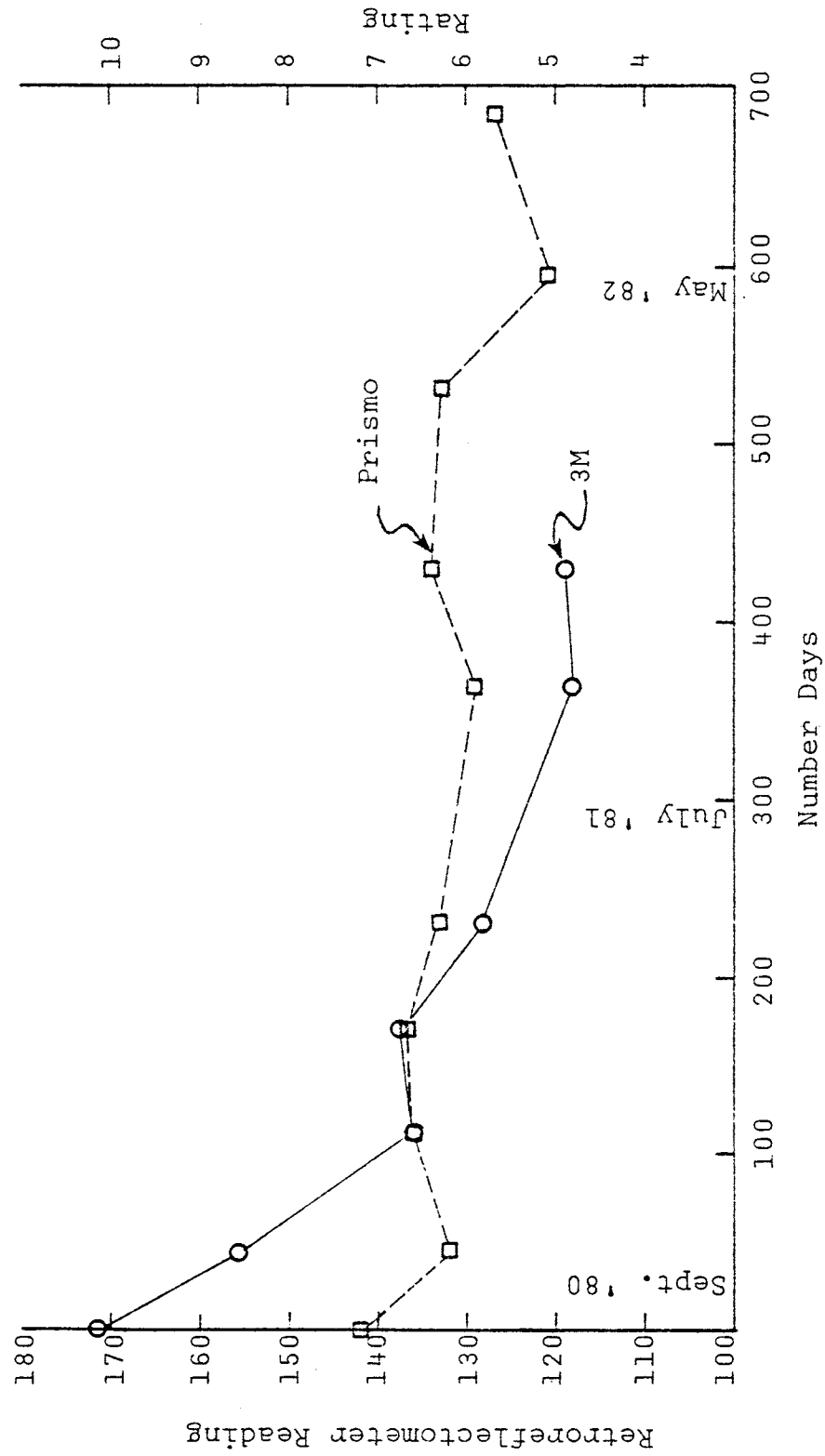


Figure 15. Retroreflectometer readings for concrete interstate pavement.

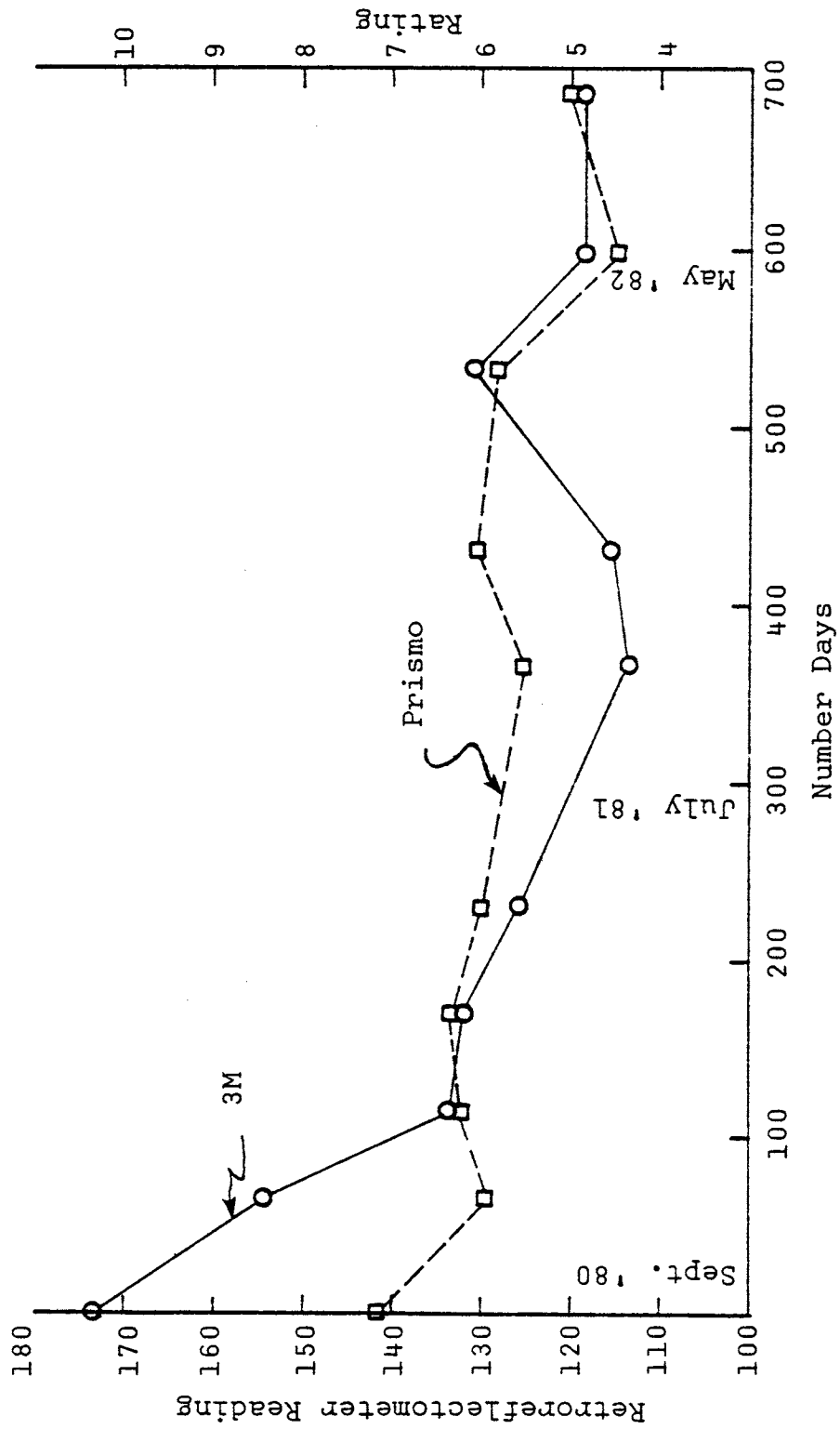


Figure 16. Retroreflectometer readings for bituminous interstate pavement.

Discussion of Night Visibility

For the purpose of discussing the night visibility of the materials, the average of the retroreflectometer readings for the 3M and Prismo materials on the intersections and interstate pavements are shown in Figures 17 and 18. Also shown are retroreflectometer readings for unbeaded paints along with visibility ratings using the maximum observed values for preformed tape representing a rating of 10 and unbeaded paint representing a 0 rating.

Of particular interest is the line for unbeaded paint, which represents an average of retroreflectometer readings taken on 25 transverse paint stripes placed for the Department's 1982 traffic paint performance evaluation. This value of 126 represents a lower limit or failure point for traffic paint, or zero on the rating scale. Normally, when a material reaches a rating of 4 (0-10 scale) it is assumed to have reached the end of its useful life. Taking the initial retroreflectometer reading as a maximum value for each tape — i.e. a 10 rating — it is estimated that the point at which the material has reached the end of its useful life, a 4 rating, would be readings of 145 for 3M tape and 134 for Prismo tape. These would equate to failure at 65 days for 3M tape and 45 days for Prismo tape, which are extremely short periods. These values are based on the above assumptions and provide a basis for comparing the relative brightness of the tapes with that of typical paints. By comparison, based on the 1981 traffic paint evaluation, the paint chosen for use by the Department lasted for 178 days (8,000 vehicles/lane) before reaching a night visibility rating of 4 in the tire tracks.

Figure 19 shows new tapes and dirty samples taken from the road. Microscopic observation of the 3M and Prismo tape surfaces, as shown in Figure 20, revealed dirt accumulation on the tape surface, in cracks, and under most of the remaining beads. It is apparent that most of the beads were loose and had an accumulation of dirt under them that reduced their ability to reflect light. Although the tapes still retained some of the beads, the extremely low retroreflectivity readings limited their usefulness for night delineation, especially for unlighted rural areas.

Overall Rating

As noted previously, in computing the overall rating, appearance and durability were given a weighted value of 30% each and night visibility a value of 40%.

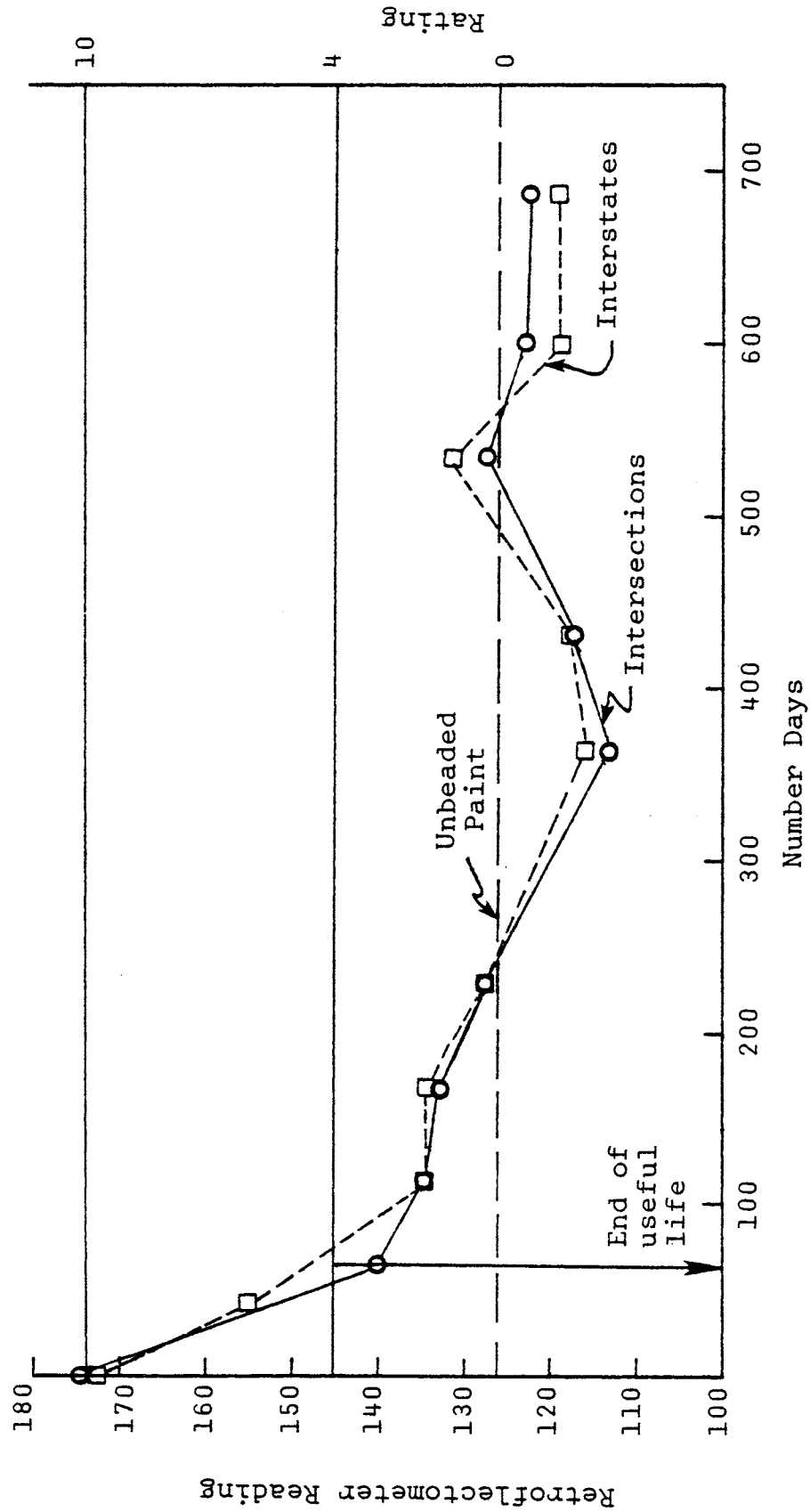


Figure 17. Average retroreflectometer readings for 3M tape.

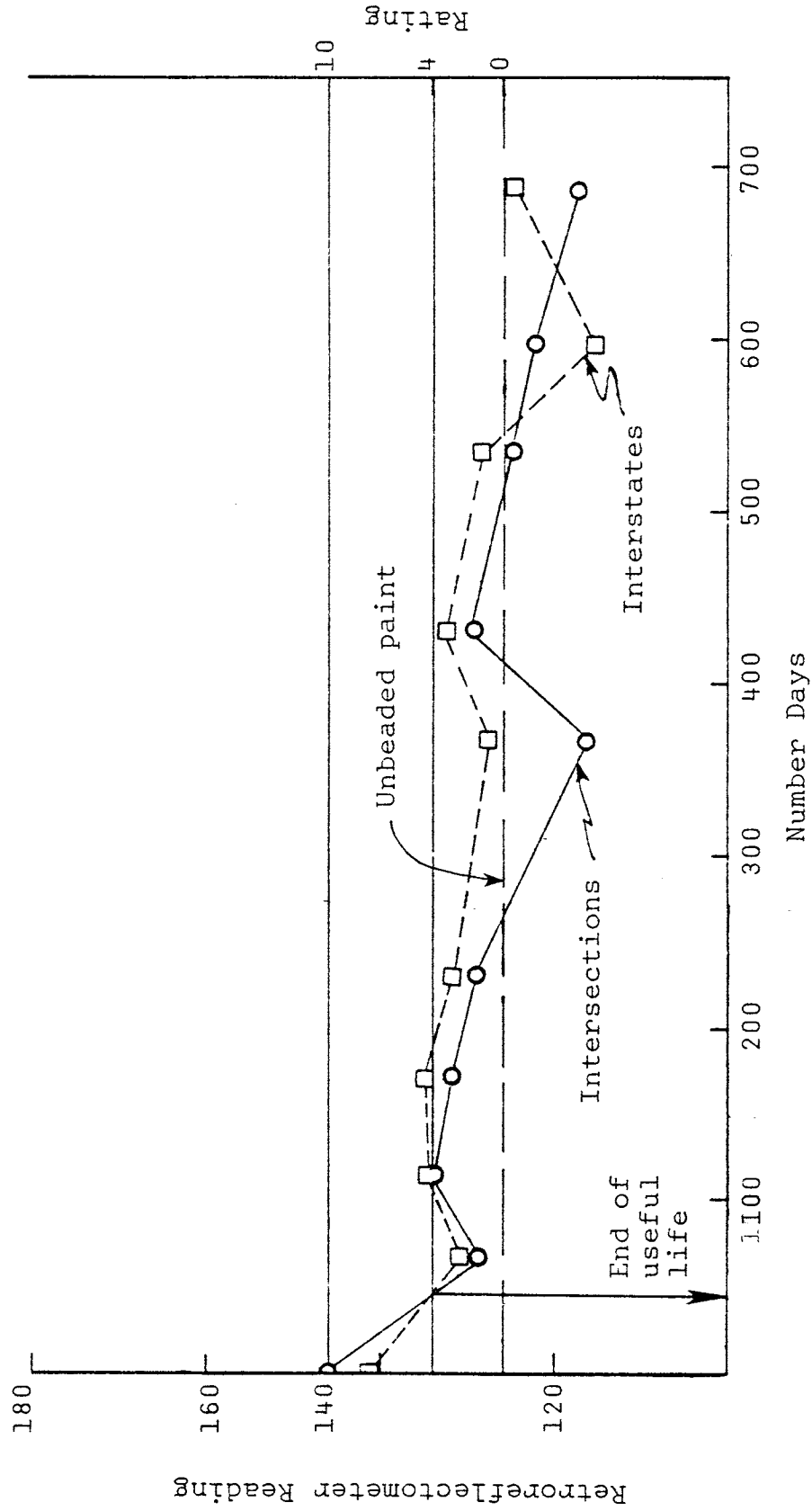


Figure 18. Average retroreflectometer readings for Prismo tape.

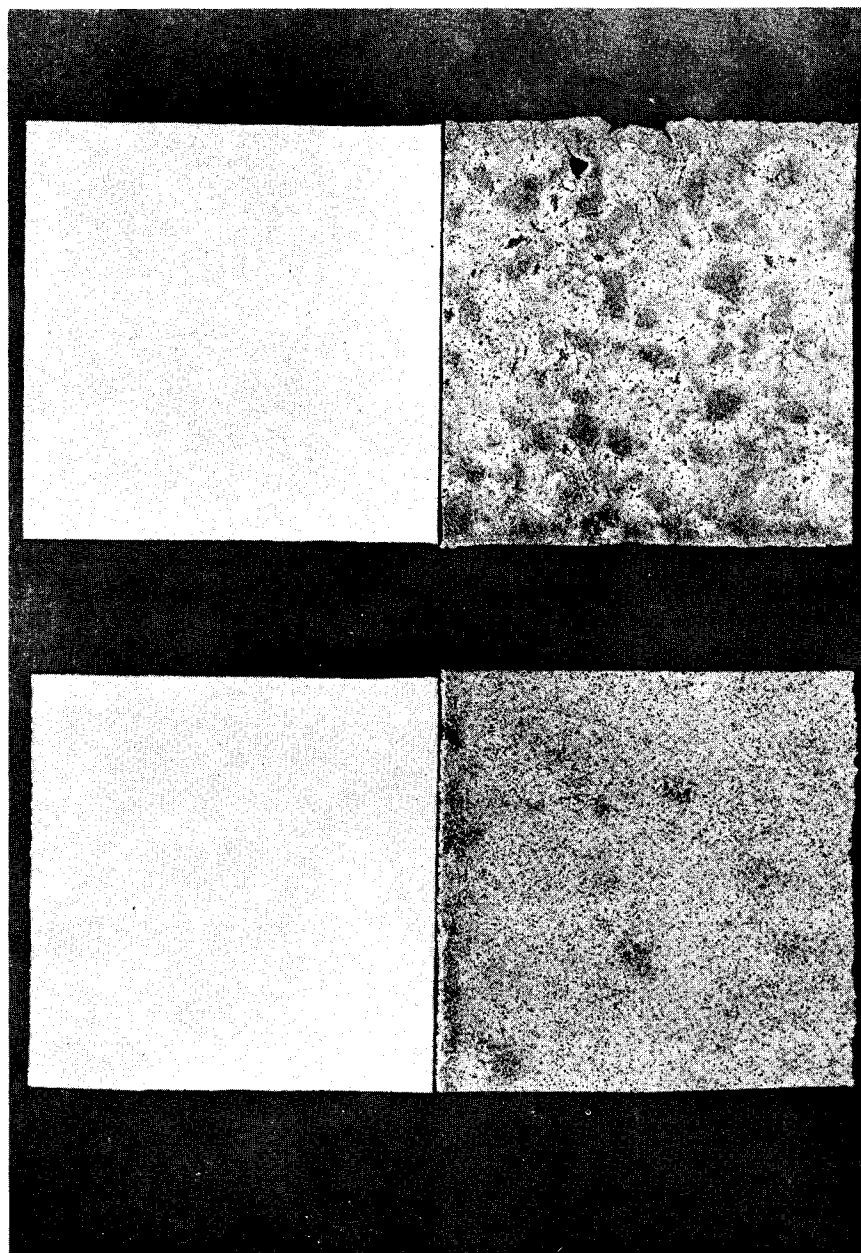


Figure 19. Top. 3M new on left and after 16 months in test section.
Bottom. Prismo new and after 10 months.

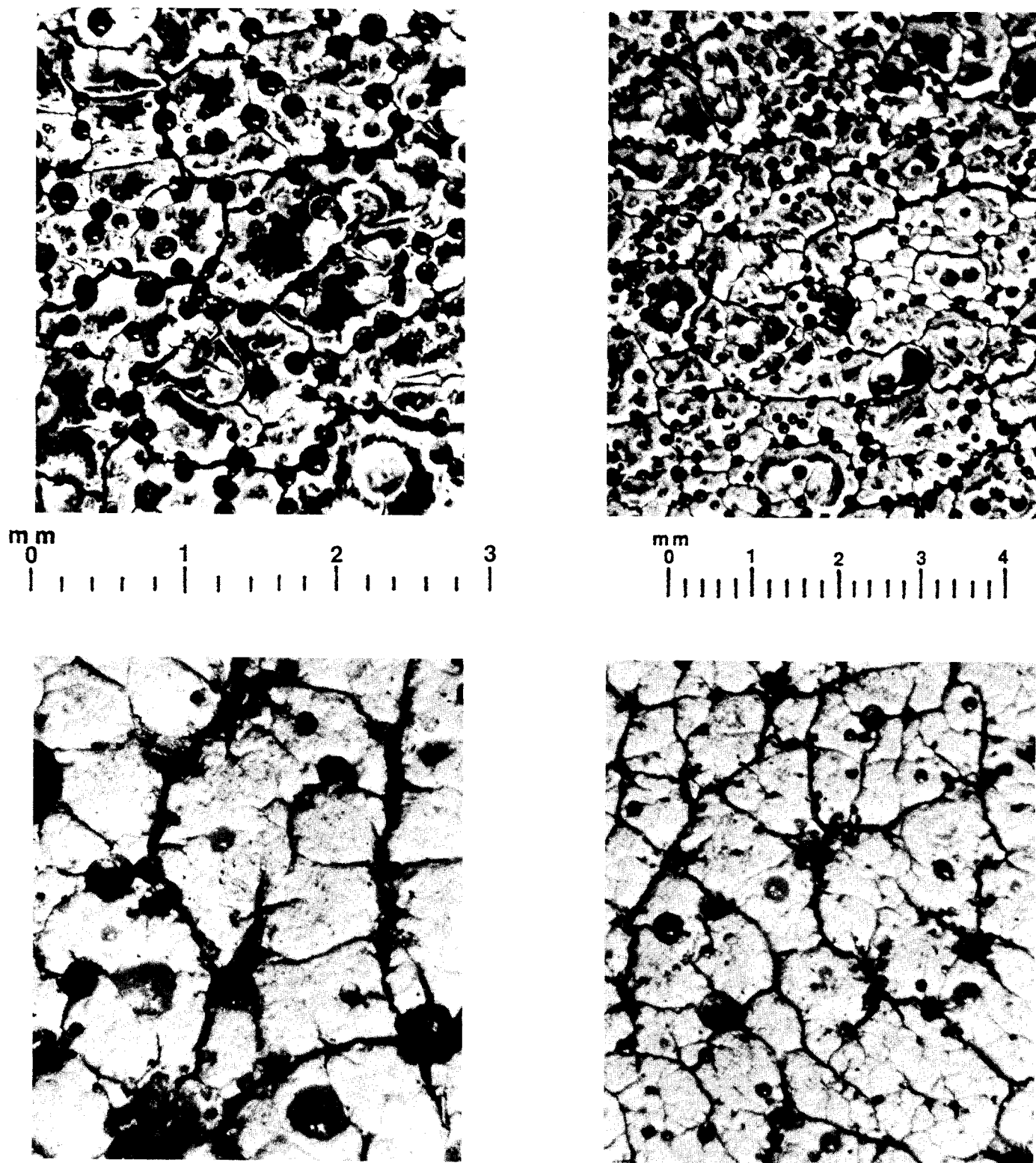


Figure 20. Photomicrographs of 3M (top) and Prismo tapes.

Figure 21 gives the overall ratings for the tapes on the intersections and Figure 22 those for the interstate pavements. Ratings for both intersection pavements were similar; however, the 3M tape had a higher rating for the last part of the observation period, especially for the concrete pavement. The primary reason for the difference is the lower durability rating for the Prismo tape caused by the material moving, cracking, and chipping.

For the interstate concrete pavement, the Prismo tape ratings were much higher because of the early durability failure of the 3M tape. For bituminous pavement, 3M had a significantly higher rating for the last three observations, primarily because of its superior durability.

CRITERIA FOR EVALUATION

Normally, the criterion used to rate night visibility is the loss of retroreflectivity, using the initial reading as the maximum rating of 10 and the 0 rating for complete failure with no beads remaining for retroreflection. However, the difference in the initial retroreflectivity (174 for 3M vs. 146 for Prismo) and the difference in the rate of loss, coupled with the very low retroreflectivity readings when compared with that of traffic paint, leads to the conclusion that this criterion is not a good predictor of the effectiveness of the tapes in providing delineation of the roadway. It is felt that the criterion for evaluating preformed tape should take maximum/minimum values into consideration. A maximum value would be established and the initial retroreflective reading of all tapes would be required to meet it. The minimum (0) value, or point of failure, would be a function of traffic paint without beads or any criterion of the ASTM, FHWA, or other states that have determined realistic minimum values for night visibility.

It is believed that field performance criteria could be set up for preformed tape; however, experience from this project and others indicate that the durability of preformed tapes would require that the testing period be excessively long. It is, therefore, necessary that the durability be predicted. This may be accomplished by predicting the durability based on the percentage of material remaining on the pavement after any interval of time. It is recommended that maximum/minimum values be set for night visibility to ensure that the material performs its function. For evaluations, materials should be placed on high volume intersections and highways.

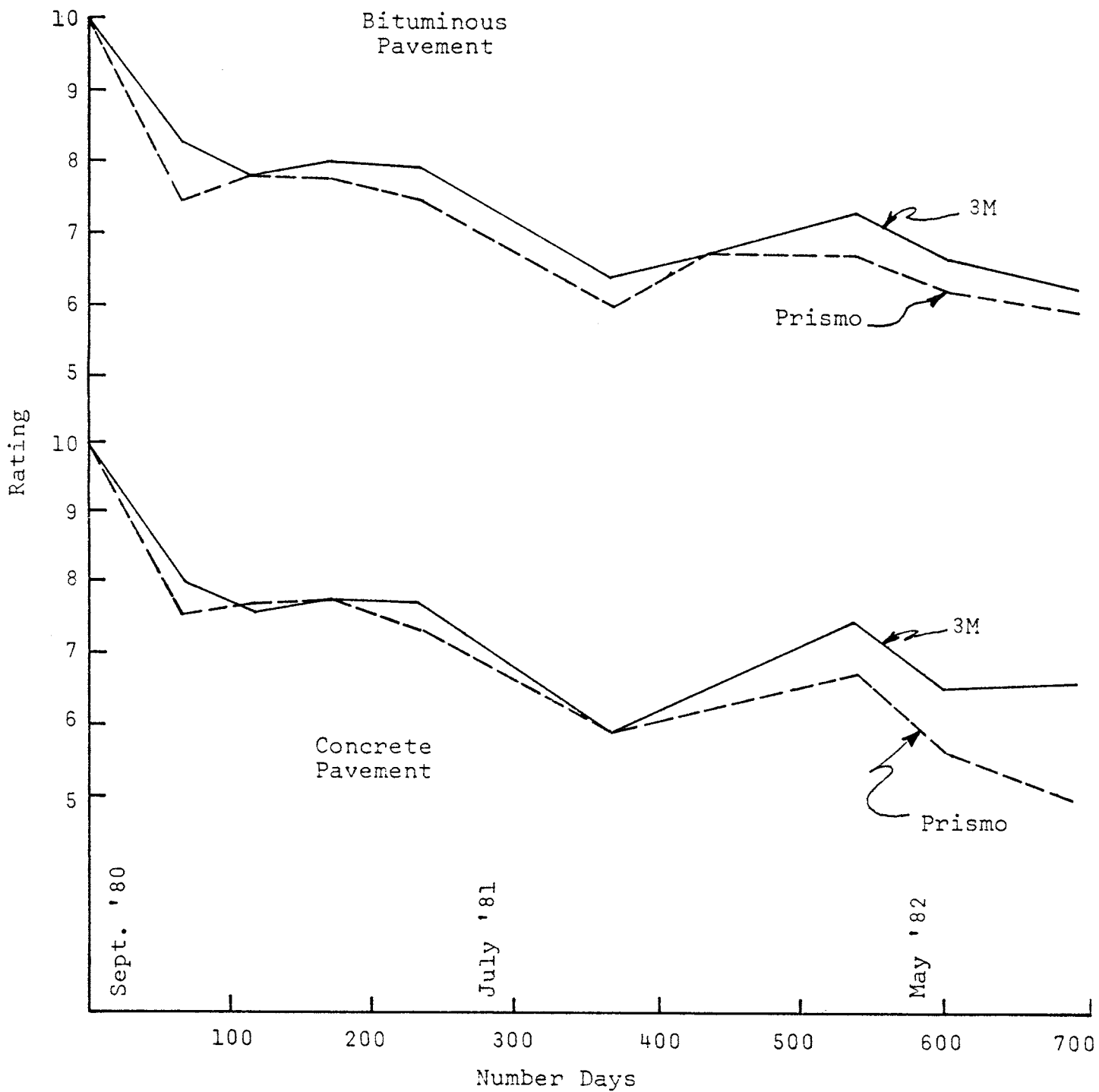


Figure 21. Overall ratings for intersections.

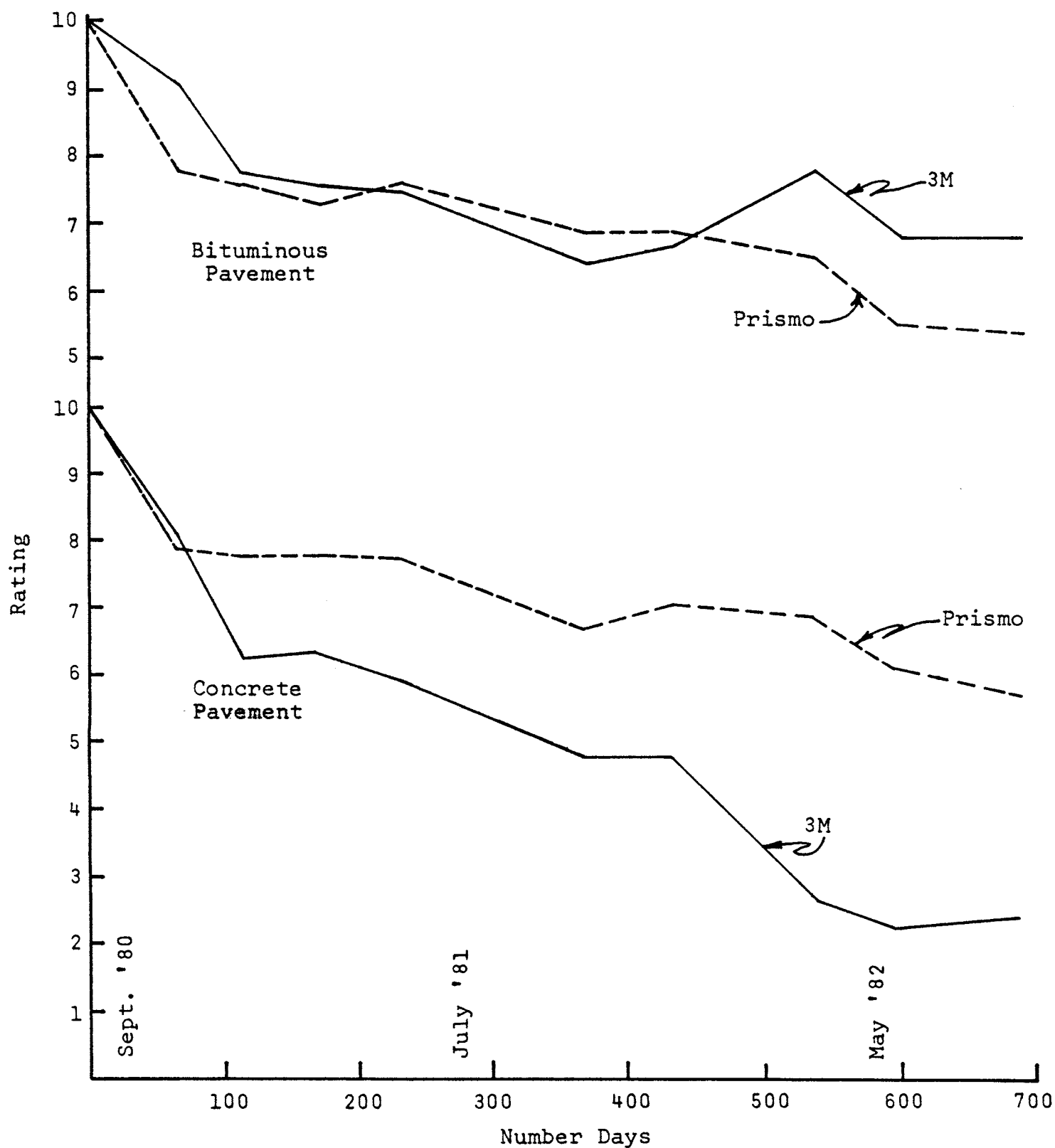


Figure 22. Overall rating for interstate pavements.

FIELD APPLICATION OF PREFORMED TAPE

After the project had started, the Department requested that an evaluation be made of the process for installing cold preformed plastic tape, especially the 4 in. material used for centerline and edgeline striping. Personnel of the Research Council, with the Maintenance Division and the Richmond, Salem, and Staunton districts, observed the preparation of the material and applications on stop bars, pavement arrows, centerlines, and edge lines.

For the pavement arrows and stop bars, there was little difference between the times required for hand applying materials without priming the surface.

The 4-in. centerlines and edge lines were applied with machines. Observations of these applications in the Salem and Staunton districts revealed a number of items of interest.

Several problems were experienced with the Prismo applicator that resulted in the process being labor intensive and dangerous. The backing paper on the Prismo tape tore and required realignment, splicing, etc. This caused delays and required additional personnel. Also, when the Prismo tape was being inlaid on new, hot asphalt, the delays caused the application to fall behind the paver, which resulted in an inefficient operation since the pavement temperature had dropped and the roller was unavailable for rolling or inlaying the tape into the pavement. These problems offset two of the main advantages of preformed tape, namely, (1) the ability to inlay the tape, and (2) the ease of application.

For various reasons, a person is sometimes required to work on the side of the Prismo machine; for example, when loading from the side and splicing and realigning the tape and backing paper. When working under traffic in narrow lanes, the person has to work in the active traffic lane, which creates a hazardous situation.

Few problems were noted with the 3M applicator, primarily because the 3M tape does not have a backing paper and the machine is smaller and simpler to operate.

CONCLUSIONS

General Appearance

Although there were fluctuations in the general appearances of the tapes, with each tape appearing whiter than the other at times, the overall appearances of the two were basically in the same range, especially during the latter part of the observation period.

Durability

The durability of the 3M tapes on the interstate concrete pavement was poor, with failure 240 days after installation. Prismo remained 677 days prior to failure. The primary cause of the poor durability was the failure of the adhesive, which resulted in large portions of the tape being lost. The durability of the 3M tape on concrete intersections was good; however, Prismo was nearing failure at the end of the test. Deterioration of the Prismo tape was in the form of wearing and cracking, especially where there was turning traffic. Compared to the 3M tape, the durability of the Prismo was poor on bituminous pavement for both the intersections and interstate. The Prismo tape was prone to move or creep on the pavement, whereas the 3M showed no evidence of this.

Night Visibility

The night visibility of both materials decreased with time; however, there were periods when the tapes would show increased brightness, probably as a result of the cleaning action of rain and traffic and the exposure of premixed beads in the tapes from abrasion. The 3M tapes showed higher night visibility during the first part of the observation period, primarily due to the high initial readings. However, this situation was reversed during the middle part of the study, with Prismo being brighter. The night visibilities were close for the latter part of the test periods with 3M being brighter. It is important to note that the night visibility of both tapes decreased to levels below that of unbeaded paint.

Overall Rating

The 3M tape exhibited higher overall ratings for all conditions, with the exception of the interstate concrete pavement where it failed early in durability.

Performance Criteria

The procedures used in this study can be used to evaluate the field performance of preformed tapes. Because of the durability of preformed tape, at least 12 to 18 months of testing may be necessary for predicting the overall performance. Any testing procedure should include a durability rating based on the amount by weight or volume of material remaining on the road, since using the percentage of line remaining on the road, based on the amount of pavement exposed, is not realistic. Also, any criteria should include maximum/minimum values for night visibility to ensure that the material is effective for its intended use.

Field Application

Observation of the tape applicators revealed that the Prismo machine was inefficient and labor intensive, primarily because of problems with the backing paper. Because of the way the Prismo applicator is loaded, in addition to the problem with the backing paper, a hazardous situation was created since the employee had to work in the active traffic lane in many cases. The 3M applicator was lighter and more efficient, in part because the 3M tape does not have a backing paper.

RECOMMENDATIONS

It is recommended that cold, preformed, plastic tape not be used on concrete pavement for centerlining, because of the observed failures in durability.

It is believed that until a realistic means of handling the night visibility ratings is decided upon, a cost analysis based on the overall ratings should not be undertaken. Maximum/minimum retroreflective values for preformed tapes should be established for any future evaluations and, because of the low night visibility values evident in this study, the manufacturers should be required to demonstrate that their products have night visibility characteristics acceptable to the Department prior to further consideration of the use of preformed tapes.

ACKNOWLEDGEMENTS

Special thanks are extended to Brad Lee of the Maintenance Division for his assistance in evaluating the materials.

Appreciation is extended to the traffic personnel of the Salem, Richmond, and Staunton districts for their help in evaluating the field application of the materials.

Also, appreciation is extended to Roy Cleek and other personnel of the Ashland Residency for their cooperation in providing traffic control for the sites located on Interstate 95.

INFORMATION ON 3M AND PRISMO TAPES

3M Tape

Description:

"STAMARK" Brand Pavement Markings, Pliant Polymer Grade, Series 5730, 6330, and SMS-900 are designed for use as words and symbols, lane lines, edge lines, channelizing lines, and gore markings.

These markings are precoated with a pressure sensitive adhesive, and should be inlaid into new asphalt concrete surfaces with a pavement roller during final compaction, but may be applied mechanically to existing pavement surfaces. They may also be applied manually to existing pavement surfaces in non-snow removal areas after priming the pavement with one coat of a liquid contact cement.

Series 5730 Tapes, Series 6330 Sheeting which may be cut into words and symbols, and Series SMS-900 Precut Words and Symbols are durable, conformable and retroreflective. They consist of high quality polymeric materials, pigments, and glass beads, with a reflective layer of beads bonded to the top surface. They are available in a standard thickness of 0.06 inch (1.5 mm). The white and yellow markings will retain their color throughout their effective performance life.

A. Reflectance:

These markings have the following initial minimum reflectance values at 0.2° and 0.5° observation angles and 86.0° entrance angle as measured in accordance with the testing procedures of Federal Test Method Standard 370. The photometric quantity

measured is specific luminance (SL)*, and is expressed as millicandelas per square foot per footcandle $[(\text{mcd} \cdot \text{ft}^{-2}) \cdot \text{fc}^{-1}]$.

Product Numbers	—5730, 6330—		5731, 6331—	
Color	White		Yellow	
Observation Angle	0.2°	0.5°	0.2°	0.5°
Specific Luminance [[mcd · ft ⁻² · fc ⁻¹]	550	380	410	250

*"The quantity SL (specific luminance) relates to the way the effective retroreflective surface is focused on the retina of the human eye and to the visual effect thereby produced. It is recommended for describing the performance of highway signs and striping, or large vehicular markings which are commonly viewed as discernable surface areas." Federal Test Method Standard 370, 3.1.2, Note 6. March 1, 1977.

B. Skid Resistance:

The surface of the markings provides a minimum initial skid resistance value of 35 BPN when tested according to ASTM E303-74.

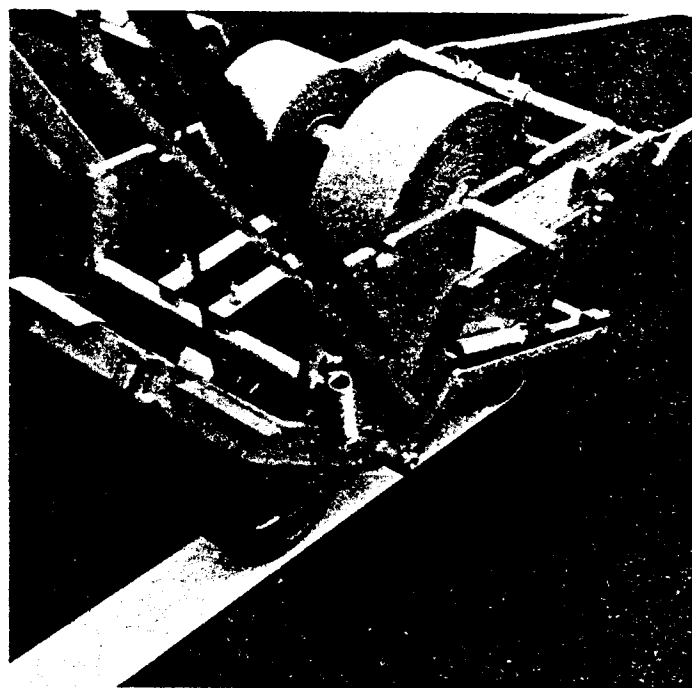
C. Patchability:

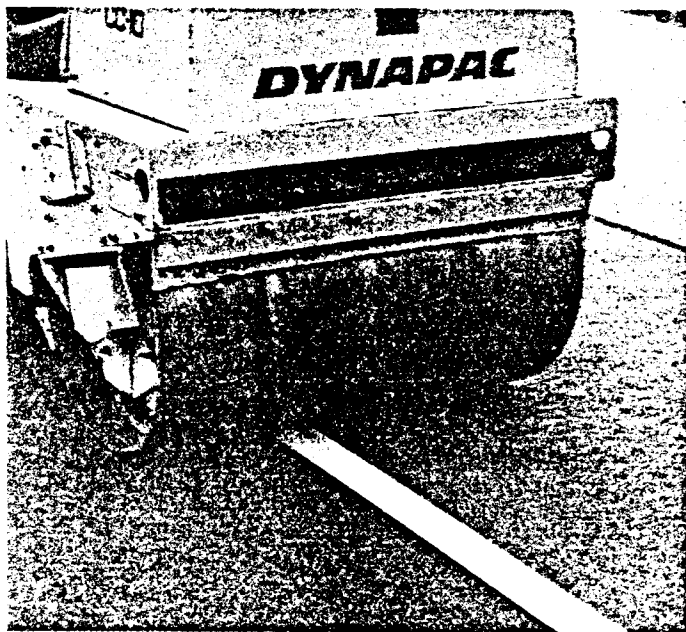
Heavy wear or snowplowing may result in some markings removal, but with minimal surface preparation and application effort a patch can be applied to replace the worn or missing area.

Application:**A. Procedure for Inlaying Markings into New Pavements:**

Series 5730 Tapes are designed to be inlaid into new asphalt concrete surfaces using a 3M tape applicator. The tape is applied while the pavement is at temperatures between 130° F. and 150° F., before final compaction of the surface has taken place. The tape is applied using the "SCOTCHLINER" Brand Manual Highway Tape Applicator or the "SCOTCHLINER" Brand Mechanical Highway Tape Applicator. More detailed instructions for mechanical application are available from your 3M Sales Representative. (Refer to Information Memo LM-GIE500, the "SCOTCHLINER" Brand Manual Highway Tape Applicator, or LM-GIE114R-1, Instructions for Transport and Use of the "SCOTCHLINER" Mechanical Highway Tape Applicator (HTA).

Words and symbols may be inlaid with the final compaction roller after manual positioning of the marking.





B. Procedure for Overlaying Markings on Existing Surfaces:

The pavement surface must be clean, dry and relatively smooth. These markings should not be applied over other markings or old paint. Either remove the old markings or apply adjacent to them.

The minimum temperatures for application are 60° F (16° C) for air and 70° F (21° C) for roadway surface, with both temperatures rising. The markings should be applied during a season when daytime temperatures are above 70° F (21° C) and nighttime low temperatures are above 40° F (4° C).

1. Non-Snow Removal Areas:

In non-snow removal areas, the markings may be applied manually to asphalt or portland cement concrete surfaces at the time of installation. Coverage is approximately 80 square

feet per gallon of contact cement. A solvent resistant paint roller such as SLT-934, with a 3/4" or greater nap is used to apply "STAMARK" Brand E-44 Contact Cement.

The markings must be firmly tamped into position with an RTC-1 Roller Tamper Cart with a minimum 200 pound load. An SLT-929 Brush Tamper may also be used. Additional tamping by driving on the pavement marking with a vehicle tire is recommended. The marked area should be opened to traffic as soon as possible.

2. Snow Removal and Non-Snow Removal Areas:

Longitudinal lines may be overlaid on existing pavements in both snow removal areas and non-snow removal areas without priming if applied with a "SCOTCHLINER" Brand Mechanical Tape Applicator. The mechanical applicator is referred to above in the procedure for inlaying pavement markings.

C. Patching:

Worn or missing pieces of markings may be replaced by adhering a butt spliced patch adjacent to areas of firmly applied firm. Sweep the surface dirt from the worn or missing area and from an area of "STAMARK" Tape on each side. Apply a coat of E-44 Contact Cement to the cleaned area and proceed as directed for new marking applications.

More detailed information concerning product characteristics and application procedures are available from your 3M Representative. Refer to Specifications for Preformed Plastic Pavement Markings, LM-SP500 and Information Memo, Instructions for Application of 5730, 6330, and SMS-900 Series Pressure Sensitive Adhesive Coated Films, Symbols, and Legends, LM-GIE 116R.

Storage:

"STAMARK" Markings should be stored in a cool, dry area indoors and used within one year after purchase. "STAMARK" Brand Contact Cement should be stored under similar conditions above 40° F (4° C) and used within six months of the purchase date.

Caution: Type E-44 Contact Cement contains flammable solvents and should be stored in compliance with local fire codes. Handling and storage precautions stated on the container must be observed. Pensky-Martens Open Cup Flash Point is below -14° F (-25.5° C).

Removal:

The marking is not designed to be removed easily. Removal can best be accomplished by a scraping and jabbing

action using a sharpened spade, ice scraper, or similar tool. Burning or grinding are not recommended removal procedures.

Performance Life:

The performance life of pavement marking materials will vary greatly depending on 1) traffic conditions, 2) snow removal practices, 3) pavement surfaces, and 4) application techniques. It is recommended that each customer thoroughly evaluate

"STAMARK" Markings under the various conditions in his specified location. While experience has shown that properly applied, these materials are highly effective traffic control devices, the 3M Company makes no generalized performance life claims.

Material Replacement Provision:

Under normal roadway conditions, some damage to pavement marking materials can be expected. Without implying product warranties, the 3M Company will provide replacement materials for

any "STAMARK" Markings determined to be inadequate traffic control devices for the period of time defined in the following table.

New Asphalt Surfaces Markings Inlaid

MUTCD Application	Material Replacement Period	
	Snow Removal Areas	Non-Snow Removal Areas
Longitudinal lines, words and symbols	Two years	Two years
Crosswalks and Stop Bars	*	Two years

New or Existing Clean and Dry Pavements Markings Overlaid

MUTCD Application	Material Replacement Period	
	Snow Removal Areas	Non-Snow Removal Areas
Lane lines and channelization lines	One year, and only when applied with a 3M mechanical applicator	One year, but only when applied with a 3M mechanical applicator, or when hand applied to pavements primed with one coat of E-44 contact cement.
Edge lines and gore markings	*	One year, but only when applied with a 3M mechanical applicator, or when hand applied to pavements primed with one coat of E-44 contact cement.
Words and symbols (except railroad crossings)	*	Two years, but only when pavement has been primed with one coat of E-44 contact cement.
Crosswalks and stop bars	*	One year, but only when pavement has been primed with one coat of E-44 contact cement.
Railroad crossings	*	*

*3M makes no material replacement provisions for these marking applications. Each customer must carefully evaluate his traffic conditions and judge for himself the suitability of markings used in these applications.

3M's liability will be limited to material replacement only for the amount of markings actually missing from the roadway and is not intended to include other performance life features not specifically stated in this Product Bulletin.

The period shall begin from the date of application to the road.

Note: Applications made after September 1 in snow removal areas do not qualify for replacement under this provision.

"STAMARK BRAND E-44 Contact Cement Product Information

Danger!

Extremely Flammable. Vapors May Cause Flash Fire. Vapor Harmful.

Keep Away From Heat, Sparks and Open Flame

N.Y.F.D. C.O.F.A. NO. 933

This adhesive is intended for use in outdoor locations. The vapors released by this adhesive will burn and must be kept away from sources of ignition. See all cautions which are stated below for

contact adhesives.

Vapors may ignite explosively. Prevent buildup of vapors — Open all windows and doors — Use only with cross-ventilation. Keep away from heat, sparks, and open flame. Do not smoke or ignite any flame (such as matches, lighters, etc.). Extinguish all flames and pilot lights, and turn off (and do not turn on again) stoves, ovens, all gas and electric appliances (space and water heaters, furnaces, etc.), electric motors and other sources of ignition during adhesive use and until all vapors are gone. Do not use electric light switches. Do not generate static sparks (such as by walking on carpet, etc.).

Use same precautions in the work area and all connected areas. Be sure that any other person in these areas understands and follows these precautions and also that a copy of these precautions is attached to any other container to which this product may be transferred. Contains petroleum distillates, acetone, MEK. Use only in well ventilated areas with enough air movement to remove vapors and prevent vapor buildup. Avoid prolonged breathing of vapor and prolonged or repeated contact with skin. Avoid eye contact. Suggested first aid: for eyes, flush immediately with plenty of water for at least 10 minutes. If swallowed, do not induce vomiting. For eye contact or swallowing, call a physician immediately. Close container after use. Keep out of reach of children.

Terms and Conditions of Sale

All statements, technical information and recommendations contained herein are based on tests we believe to be reliable, but the accuracy or completeness thereof is not guaranteed, and the following is made in lieu of all warranties, express or implied.

Seller's and manufacturer's only obligation shall be to replace such quantity of the product proved to be defective. Neither seller nor

consequential, arising out of the use of or the inability to use the product. Before using, user shall determine the suitability of the product for his intended use, and user assumes all risk and liability whatsoever in connection therewith.

Statements or recommendations not contained herein shall have no force or effect unless in an agreement signed by officers of seller

Prismo Tape

Application Instructions

Prismo PLASTIX is a durable, adhesive-backed thermoplastic marking material which can be applied onto the road surface (Overlay) or rolled into hot asphalt (Inlay). Proper application is essential to insure long, useful life. These instructions cover both PLASTIX HR and PLASTIX HT.

THE OVERLAY METHOD

For applying markings on top of existing asphalt or Portland cement concrete, follow these simple steps for a good installation:

Preparing The Pavement

Before applying PLASTIX, make sure the surface is Clean, dry and warm.

1. CLEAN the pavement. Use a stiff bristle broom or compressed air to remove all dirt or flaking paint. Remove any oil or grease. Be sure no oily film is blown on the surface if you used compressed air.
2. Be sure the pavement is DRY. Allow 24 hours after rain. Wait until the sun dries early morning dew. Moisture trapped under the material will cause PLASTIX to lift up later.
3. Check the PAVEMENT TEMPERATURE. Do Not apply PLASTIX until the pavement surface is at least 60°F (16°C). When the pavement temperature is between 60°F and 80°F (27°C), use Prismo PLASTIX Adhesive Activator. When the pavement temperature is above 80°F (27°C), Activator is not needed. (Generally, if the air temperature has been over 70°F (21°C) for an hour on a sunny day, the pavement surface will be up to 60°F.)
4. On NEW PORTLAND CEMENT CONCRETE, the curing agent must be removed before the PLASTIX is applied, and Prismo PLASTIX Adhesive Activator should be used, even though the pavement temperature is over 80°F (27°C).

Applying The Marking

1. Mark the location of the edge of the line or the bottom of the legend with a chalk line. Remove the excess chalk dust.
2. When applying lines, unroll enough PLASTIX from the carton for one line, cut to length. (Standard rolls are 150 feet long.) When applying letters or arrows, unpack one at a time. (Layout instructions are packed with each letter or arrow.)
3. Lay the PLASTIX on the pavement, with the paper backing side up, next to the chalk line. Pull off the backing paper evenly, starting at one end, from the entire piece. Discard the paper.
4. If PLASTIX Adhesive Activator is used, apply to the black adhesive only. A very thin coat (.003") is all that is needed to make the adhesive "tacky". One gallon of Activator is enough to coat 500 square feet of PLASTIX (1500 linear feet of 4" material, 1000 linear feet of 6" material.) Test with your finger. If more than a thin string of material sticks to your finger when you lift it off, you have applied too much Activator. **DO NOT USE SOLVENTS, GASOLINE OR ADHESIVE CEMENT. USE ONLY PRISMO PLASTIX ADHESIVE ACTIVATOR.**
5. Turn the PLASTIX over in place next to the chalk line. Starting at one end, press in place with your foot. Hold the PLASTIX taut as you go along, but be careful not to pull hard, as the material will stretch. Use butt joints, do not overlap.
6. Roll the PLASTIX in place. If a light hand roller is not available, run a pickup truck or automobile tire over the material slowly. One pass will be sufficient. Do Not reverse directions or turn the wheel or roller while on the PLASTIX.

Your marking is now ready for traffic.

THE INLAY METHOD

When Prismo PLASTIX is properly inlaid into a new, hot asphalt surface, it will provide a highly durable traffic marking which is flush with the pavement. Installation is not difficult. Cement or activator is not needed; just remove the paper backing and roll the PLASTIX into the smooth pavement.

When To Apply

Inlay PLASTIX into the last layer of asphalt, after the surface has been compacted, but while the asphalt is still hot. Application of the PLASTIX is the final step.

Before inlaying PLASTIX, be sure the temperature of the asphalt is *not lower* than 120°F (49°C) and *not above* 150°F (66°C). If the asphalt is too cool, it will be difficult to roll the PLASTIX flush with the surface; if the asphalt is too hot, the roller may move the PLASTIX out of line or cover the edges.

Do not apply PLASTIX when the air temperature drops below 50°F (10°C).

Applying The Material

1. Spot the cartons along the road. Do not unpack more material than you need to keep up with the rollers.
2. After the compacting or vibrator rolling, and just before the final rolling, snap chalk lines as a guide for the edge of the line, or the bottom of the arrow or legend. Avoid too much chalk dust.
3. Test the asphalt by running the roller over a few feet of chalk line. If the roller moves the chalk line out of true, make another pass with the roller.
4. Place the PLASTIX along the chalk line paper side up. Pull off the backing paper evenly, starting at one end. (The empty carton makes a good waste container.)
5. Flip the PLASTIX over into position, black side down. Starting at one end, press into place with your foot, while the other end is held in place. Use butt joints; do not overlap. Cooling water should not be sprayed over the PLASTIX before it is rolled in.
6. Run the pavement roller over the PLASTIX in one direction to press it into the asphalt. Do not reverse or turn the roller while it is on the PLASTIX.

The marking is now complete.

Storage

Under proper conditions, Prismo PLASTIX can be stored for up to twelve months. The material must be stored indoors where the temperature will not fall below freezing nor above 100°F (38°C). Roll stock cartons should be stored flat, not more than six high. When necessary to store PLASTIX on a job site, the cartons should be protected by a cover, against rain and direct sunlight.

Warranty

Prismo warrants this product to be free from defects in workmanship and materials. REPLACEMENT OF ANY DEFECTIVE MATERIAL SHALL BE PURCHASER'S EXCLUSIVE REMEDY. THIS WARRANTY IS MADE IN LIEU OF ALL WARRANTIES, EXPRESS OR IMPLIED, INCLUDING WARRANTIES OF MERCHANTABILITY AND FITNESS FOR INTENDED PURPOSE. PRISMO SHALL, UNDER NO CIRCUMSTANCES, BE LIABLE FOR CONSEQUENTIAL OR INDIRECT DAMAGES.

