



Mates

Issue No. 61

March 1992

PAVEMENT MARKING MATERIALS

The perfect pavement marking material would provide year round, day-night, wet-dry visibility on all types of road surface. Unfortunately, no single material can achieve this, regardless of cost. A combination of durable striping products and raised pavement markers can meet this goal, but it will be expensive. To be effective, striping depends upon small glass beads to reflect light back to the motorist at night. This phenomenon is called retroreflectivity. If water on the pavement covers the beads, they will not reflect at night. Further, traffic wear and snowplow damage also reduce day and nighttime visibility. Addressing these problems will be expensive due to Michigan's short painting season, snow removal techniques, and high traffic volumes.

In the past, one obstacle to providing year round lane delineation has been limited funds. Traditionally, the pavement marking program has been funded with 100 percent Michigan money. The budget of \$7,000,000 for fiscal year 1991 was insufficient to provide anything other than products of limited durability. The decision was made to change the program to Federal funding, but in order to qualify, the Department's pavement marking policy needed revision. The Traffic and Safety Division recently revised this policy to specify durable products for new construction and restriping. The Federal Highway Administration approved the new policy in December 1991, thus allowing use of 100 percent Federal funding starting in 1992. This new policy established a grid of conditions (i.e., pavement type, ADT, edge or centerline, etc.) and generic products that will be used. This is an improvement over past practice where the same material was used on all lines for a project. For cost effectiveness, only the most durable products will be placed on the centerline where wear is the greatest. During the upcoming three-year transition period, funding levels will be as high as \$12,000,000 per year to cover initial installation of raised pavement markers and reflectorized tape. By fiscal year 1996 the program will require funding at \$10,800,000 to maintain. With this funding increase, the Department has more flexibility in deciding what materials to use, and a greater potential for increased quality in the pavement marking program.

High traffic volumes affect the choice of marking materials in two ways. First, only durable products will survive from one season to the next, and, second, products must dry quickly so that traffic disruption and 'tracking' of the paint are minimized. These two factors, unfortunately, work against each other since the most durable paints have unacceptably long drying times.

The fact that pavement markings must withstand the rigors of snow removal equipment also limits the products that can be applied. Only the best raised pavement markers will survive the winter in snow belt areas. Southern states can utilize less expensive versions. Low quality, less durable paint and tape are scraped off easily by our underbody snow blade pressures up to 500 psi.

The following table shows the types of material available, their cost, and their projected effective service life under moderate (20,000 ADT) traffic volumes.

Waterborne paint is the newest addition to the list of available materials. It remains in the experimental phase, with 1992 being a key evaluation period, but results to date

PRODUCT	COST/FOOT*	EFFECTIVE SERVICE LIFE
Fast Dry Paint	\$.03	3 to 6 Mos.
Regular Dry Paint	.03	up to 1 Year
Waterborne Paint	.05	1 Year
Polyester	.09	2 Years
Epoxy	.20	4 Years
Thermoplastic	.45	4 Years
Tape [regular]	1.25 - 1.50	4 Years
Tape [waffle]	1.75 - 2.00	4+ Years
Raised Pavement Markers	22.50 ea. (100-ft spacing)	3 Year lens life

*'Best cost' based on longer projects; obviously the cost is higher for shorter projects.

are encouraging. We anticipate replacing all fast and regular dry paint used on edgelines with waterborne paint by 1993. Not only is it more durable, but it is much easier to handle and store since it doesn't have any flammable solvents. It does require replacing all paint carrying lines on the trucks with stainless steel tubing to prevent clogging. The drying time of this type of paint is prolonged by high humidity, and rain can wash out the stripe if it falls too soon after application.

During 1991, maintenance crews in the Grand Rapids area converted a truck to handle waterborne paint and applied 3,000 gallons for the first trial of this product in Michigan. It was applied to both portland cement concrete and bituminous pavement surfaces with average daily traffic volumes up to 40,000. Monitoring sites were chosen to represent different traffic volumes and surface types. The night brightness of traffic markers depends upon their retroreflectivity. Periodic retroreflectivity readings using a field retroreflectometer have been taken to track performance. Initial results are encouraging and the evaluation expands in 1992, with approximately 30,000,000 ft of waterborne paint stripes to be applied in west central lower Michigan as edgeline and skipline striping.

Polyester is being used successfully in Michigan, and is the product of choice for restriping existing bituminous pavements. It is a two-part system with a 'paint' component and a curing agent which is mixed in just prior to application. Epoxy is similar to polyester in that it is also a two-component system. It works very well on concrete pavements but its drying time of up to one hour has disqualified it as a product for our use.

Thermoplastic materials have been used sparingly due to their high cost. They are supplied in dry form, melted in the application equipment, and sprayed or extruded at a temperature of over 400 F. Since polyesters cannot be used until new bituminous surfaces have aged nine months, thermoplastics will be the product of choice for new bituminous construction.

Materials and Technology Engineering and Science

MATES is a news bulletin authorized by the transportation director to disseminate technical information to MDOT personnel, and is published by the Materials & Technology Division. The cost of publishing 800 issues at \$0.05 per issue is \$40.00 and it is printed in accordance with Executive Directive 1991-6.



Preformed cold plastic tape was not approved for use under the old policy, but has been applied on a few experimental projects. It has excellent durability on both bituminous and concrete surfaces and is easy to apply. It is also the most expensive striping option. It is supplied in two forms, flat or patterned. The patterned tape uses a ceramic bead which is impregnated into the sides of a raised 'waffle' textured surface. This product is the most durable marking material available and can last at least nine years if rolled into a fresh bituminous surface. It is being considered for skipline striping on lighted concrete freeway pavements.

Since tape is now approved for use on regular projects, a Qualified Products List (QPL) needed to be established to assure product quality. In August 1991, the Materials and Technology Division established a test section on M 43 west of Lansing. A series of permanent and temporary traffic tapes were laid transversely on both bituminous and concrete surfaces. Retroreflectivity and durability have been monitored since then with a final report on temporary tapes pending. The permanent tapes will be studied until they fail. The data from this study will result in the establishment of a QPL which will control what products can be used on state projects.

The last product in the arsenal of pavement marking products is the raised pavement marker. This is the only way to provide wet night reflectivity, since the reflective lenses are elevated above any water layer on the pavements. Raised pavement markers of the premium type usable in Michigan consist of a plastic reflective lens installed in a protective metal casing, and cemented with an epoxy adhesive into slots cut in the pavement (Fig. 1). The metal casing protects the reflective lens from snowplow damage.

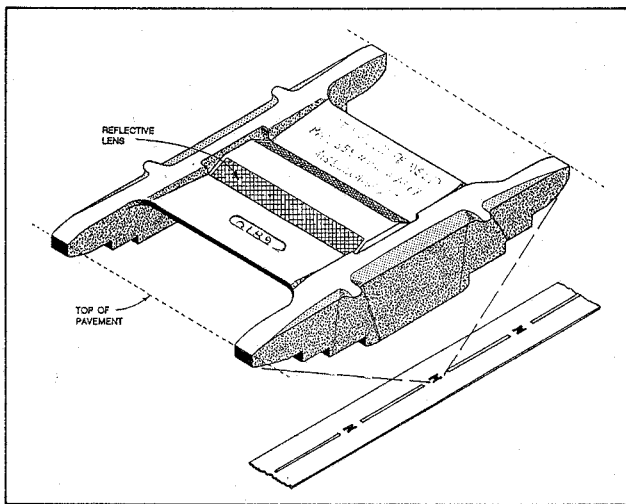


Figure 1.

Raised pavement markers were installed experimentally on a section of I 96 near Grand Ledge and some non-freeway locations to evaluate their durability. Results of this study indicate that the protective casings will last indefinitely, but the lenses should be replaced every three years, on the average. Although high in initial cost (\$22.50) they can be maintained at \$.08/ft when placed at 100-ft intervals. Since raised pavement markers provide no daytime delineation, they will be combined with conventional centerline marking materials on unlighted freeways only. The Department continues to study their use on other roadways, especially on two-lane roads.

Warranty Specifications

As noted above, it has been the Department's policy to provide potential bidders on pavement marking jobs with

a list of MDOT-approved products. It may take up to two years of laboratory research and field testing before a new material's suitability can be ascertained. Since a product will stay on our list for two years, we may be using products that are outdated. To help remedy this problem, we have developed a Warranty Specification for pavement marking products. Two projects will be selected for a 1992 trial use, one on concrete pavement (I 69 north of Lansing, east of US 127) and one on bituminous pavement (M 43 between Lansing and Grand Ledge).

This is a performance based specification. Rather than providing contractors with a choice of pre-approved products, and simply holding them responsible for the proper application of the product, the warranty specification allows them to use the product of their choice (alkyd paints excluded). The product must, however, perform as required by the Department for a period of two years. A final inspection is performed by the Project Engineer to see that the initial application is acceptable. First of all, a marking must meet the initial reflectivity standard (300 [mdc/l/sq m] for white, 200 for yellow) upon installation, and for two years thereafter, not fall below 150 and 120, respectively. Should a product fail in any way, the contractor must return and reapply the marking, bringing it back to within these standards. In order to ensure that the contractors do this, they are required to supply a performance bond of a specified percentage of the contract's amount; thus a fund is available should the contractor fail to honor the warranty. This places the burden of providing a quality product upon the contractor and his suppliers, rather than on the Department. The unique part of this warranty specification is that the warranty period covers the entire useful life (two years) of the product instead of just a portion of it.

There were some problem areas which had to be resolved during the development of the pavement marking warranty specification. First was the problem of setting the reflectivity minimums. If we set them too high, only one material would qualify. If set too low, inferior products may be tried and yield a high failure rate which would adversely affect the warranty program. Another problem concerned monitoring the product's performance; who would do it, how often would it be done, how should it be done? In going to warranty specifications, we do surrender our control over the materials and procedures to be used. Thus, we cannot exclude out-of-hand materials that we feel won't be effective. Finally, what will our warranty repair policy consist of? Our aim, of course, is that the material last for the duration of its warranty life, rather than having contractors' out on the roadway performing restorative measures. The requirements on the two experimental projects are that the contractor must replace or repair any defective material (based upon our measurements) with the same material that was originally applied. The two experimental projects will demonstrate to both the contractors and the Department, the most efficient materials and methods for meeting the specifications.

We feel that warranty specifications are part of our future. As this article addresses only the subject of pavement marking, we have not gone into detail on all of the facets of warranty specifications. A future MATES article will be devoted to this timely, and interesting concept.

As each facet of the program comes into being, we expect to achieve our goal of high quality, year round, day-night, wet-dry visibility for Michigan's pavement markings. This is one more area in which the Materials and Technology Division, and the Traffic and Safety Division, are working to enhance the safety of the motoring public.

-Dave Long

This document is disseminated as an element of MDOT's technical transfer program. It is intended primarily as a means for timely transfer of technical information to those MDOT technologists engaged in transportation design, construction, maintenance, operation, and program development. Suggestions or questions from district or central office technologists concerning MATES subjects are invited and should be directed to M&T's Technology Transfer Unit.

Technology Transfer Unit
Materials and Technology Division
Michigan DOT
P.O. Box 30049
Lansing, Michigan 48909
Telephone (517) 322-1637