APPENDIX A

Survey Questionnaire

NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM
Project 20-5, Synthesis Topic 31-07

LONG-TERM PAVEMENT MARKING PRACTICES

QUESTIONNAIRE

The survey that you have been asked to complete is part of an NCHRP synthesis on pavement marking practices. Pavement marking practices are the usual ways a transportation agency selects, specifies, applies, maintains, and removes pavement markings. The objective of the synthesis is to document current practices for long-term, permanent pavement marking applications**.**

Please return your completed questionnaire, along with any supporting documents by November 30, 2000 to:

James Migletz
Graham-Migletz Enterprises, Inc.
P.O. Box 348
Independence, MO 64050

If you have any questions Mr. Migletz may be contacted by telephone at 816-254-1788, by fax at 816-254-4654, or by e-mail at JMIGLETZ@AOL.COM.

Please provide the name of the person completing this questionnaire or someone else who may be contacted to obtain any needed follow-up information:

Name: _____

Title: _____

Agency: _____

Street Address/P.O. Box: _____

City, State, and Zip Code: _____

Telephone: _____

Fax: _____

E-Mail: _____

Thank you for your help.

Criteria for Making Decisions

1. How does your agency decide where to put pavement markings on the agency system of roads? *(Please describe below or provide the policy, warrants, or guidelines in an attachment.)*

   Comment: _____

2. How does your agency select materials (marking material, glass beads, RPMs, etc.) for long-term pavement markings for the agency system of roads? *(Please describe below or provide the policy, warrants, or guidelines in an attachment.)*

   Comment: _____

3. How does your agency decide when to remove or replace long-term pavement markings? *(e.g., removing one type of marking in preparation for applying another type of marking. Please describe below or provide the policy, warrants, or guidelines in an attachment.)*

   Comment: _____

Road Mileage and Pavement Marking Expenditure

4. What are the centerline-miles (kilometers) on the agency system of roads?

   _____ Centerline-miles (kilometers) on the agency system of roads.

5. What are the centerline-miles (kilometers) of asphaltic concrete (AC) and portland cement concrete (PCC) pavements on the agency system of roads?

   _____ Centerline-miles (kilometers) of AC pavement on the agency system of roads?

   _____ Centerline-miles (kilometers) of PCC pavement on the agency system of roads.

6. What is the total annual expenditure for obtaining, placing, and repairing pavement markings on the agency system of roads for work done by contractors and the agency?

   $_____ Total annual expenditure.

Materials

7. What is the specified width of longitudinal pavement markings? _____ *(in./cm)*

8. Do you use longitudinal markings that are wider than 4 in. (10 cm)? Yes _____ No _____
   (If yes, where and why?)

Comment: _____

Questions No. 9 through 14 pertain to the respective columns in Table A1. Please answer these questions by completing Table A1 for markings used on the agency system of roads.

9. What is the percentage of each marking material used on the agency system of roads? *(Approximate percentages are acceptable. Please note "other" material types, including those used for word and symbol markings.)*

   Comments in addition to the table: _____

10. What is the unit cost and units for obtaining and placing each of the marking materials used on the agency system of roads applied by agency forces and contractors? *(i.e., $/linear foot or metric equivalent)*

    Comments in addition to the table: _____

11. What is the specified applied thickness for each marking material? *(mils or metric equivalent)*

    Comments in addition to the table: _____

12. What are the specified bead type and application rate for each material? *(Please provide the bead type and application rate for each bead type used, e.g., Epoxy- Type 4, 12 lb/gal and Type 1, 12 lb/gal or Thermoplastic- 12 lb/100 ft^2. Or metric equivalent.)*

    Comments in addition to the table: _____

13. What percentage of each material is applied on AC and PCC pavements? *(Approximate percentages are acceptable.)*

    Comments in addition to the table: _____

14. What percentage of long-term markings is applied by agency forces and contractors? *(Approximate percentages are acceptable.)*

    Comments in addition to the table: _____

TABLE A1
MARKING MATERIALS USED ON THE AGENCY SYSTEM OF ROADS

		Question 9. Estimated Percentage of Pavement Marking Materials (%)	Question10. Unit Cost for Obtaining and Placing Markings		Question 11. Applied Material Thickness (mils)	Question 12. Bead Types and Application Rates				Question 13. Estimated Percent of Materials Applied on		Question 14. Estimated Percent of Long-Term Markings That Are	
						Application Rates				AC	PCC		
			Agency Applied ($/linear ft)	Contractor Applied ($/linear ft)		First Bead Type	(lb/gal or lb/100 ft^2)	Second Bead Type	(lb/gal or lb/100 ft^2)	Pavement (%)	Pavement (%)	Agency Applied (%)	Contractor Applied (%)
1.	Conventional paint	—											
2.	Waterborne paint	—											
3.	Epoxy	—											
4.	Methyl methacrylate	—											
5.	Profiled methyl methacrylate	—											
6.	Polyester	—											
7.	Profiled polyester	—											
8.	Profiled preformed tape	—											
9.	Flat preformed tape	—											
10.	Thermoplastic	—											
11.	Profiled thermoplastic	—											
12.	Other	—											
13.	Other	—											
	Total	100%											
14.	Conventional RRPMs	—											
15.	Snowplowable RRPMs	—											
16.	NonRRPMs	—											
17.	Other	—											
	Total	100%											
	Word and symbol Markings												
18.	Preformed	—											
19.	Striped on site	—											
20.	Other	—											
	Total	100%											
Comment:													

15. What adhesive is specified for raised pavement markers (RPMs) on AC and PCC roads?

AC Roads: _____ Bituminous _____Epoxy _____ Other
PCC Roads: _____ Bituminous _____Epoxy _____ Other

Comment: _____
_____
_____

16. Pavement and word symbol markings, also known as "horizontal signing," are used to guide (e.g., US-40), warn (e.g., STOP AHEAD), or regulate (e.g., STOP) traffic. Part III of the *Manual on Uniform Traffic Control Devices* (MUTCD) presents examples of "typical" pavement and word symbols/horizontal signing.

Are there other, "non-typical," pavement and word symbols/horizontal signing that are used by your agency?

_____ Yes (*Please describe other "non-typical" pavement and word symbols below or provide examples in an attachment.)*
_____ No

Comment: _____

Specifications

17. What types of specifications are used to provide quality pavement markings? (*Please check all that apply and provide a copy of each in an attachment.)*

_____ Prescriptive	Recipe for exactly what is wanted in the marking material.
_____ Performance-based	Payment depends on the level of retroreflectivity that is achieved with an incentive or disincentive applied to the contract payment.
_____ Warranty provisions	Work is guaranteed for a period of time and a minimum level of retroreflectivity is to be maintained during the warranty period.

_____ Other _____

Comment: _____

18. Is your agency satisfied that the specifications ensure quality pavement markings?

_____ Yes (*Please explain below*) _____ No (*Please explain below*)

Comment: _____

Applying and Removing Pavement Markings

19. How is the pavement surface prepared for application of long-term pavement markings? *(Please describe below or provide the policy, warrants, or guidelines in an attachment.)*

Comment: _____

20. How does your agency control the quality of long-term pavement markings at the time of application? *(Please describe below or provide the policy, warrants, or guidelines in an attachment.)*

Comment: _____

21. How does your agency remove long-term pavement markings? *(Please describe below or provide the policy, warrants, or guidelines in an attachment.)*

    Comment: _____
    _____
    _____

Managing the Pavement Marking System

22. Does your agency have a computerized inventory/management system for pavement markings?

    _____ Yes *(Please describe the inventory/management system or provide the description in an attachment.)*

    _____ No (*Skip to Question No. 25*.)

    Comment: _____
    _____
    _____

23. What are the documented benefits of the computerized inventory/management system? *(e.g., cost savings, extended service life, accident reduction, driver satisfaction, etc. Please describe the documented benefits or provide documentation in an attachment.)*

    Comment: _____
    _____
    _____

24. How can the computerized inventory/management system be improved?

    Comment: _____
    _____
    _____

(*Skip to Question No. 26*.)

25. Are there plans to develop or implement a computerized inventory/management system?

    _____ Yes (*Please explain what is planned.*) _____ No

    Comment: _____
    _____
    _____

Performance Evaluation

26. What evaluations does your agency do to substantiate the retroreflectivity and performance of long-term pavement markings? *(Please check all that apply.)*

    Objective evaluations using a retroreflectometer

    _____ Dry performance of pavement markings–Measurement of pavement marking retroreflectivity, day or night.

    _____ Wet performance of pavement markings–Measurement of pavement marking retroreflectivity, day or night, during conditions of rain.

_____ Luminance contrast ratio–The relative difference in retroreflectivity between a pavement marking and the adjacent pavement surface.

Subjective evaluations

_____ Dry performance of pavement markings–Subjective evaluation made at night using vehicle headlights during dry conditions *(e.g., using a 0 to 10 scale)*.

_____ Wet performance of pavement markings–Subjective evaluation made at night using vehicle headlights during conditions of rain *(e.g., using a 0 to 10 scale)*.

_____ Bead Retention–Subjective evaluation of the retroreflectivity and bead distribution during the daytime under sunny conditions *(e.g., using the sunlight-shadow technique with a pass or fail rating)*.

_____ Pocket Microscope–A microscopic evaluation of bead distribution, embedment, and damage.

_____ Pavement Marking Durability–Subjective evaluation of the material's resistance to wear and loss of adhesion to the pavement surface over time (*e.g., percentage of material remaining using a 0 to 10 scale)*.

_____ Pavement Marking Color–Subjective evaluation of the marking's color *(e.g., using a 0 to 10 scale)*.

_____ Pavement Marking Color–Subjective evaluation of yellow color using a yellow color tolerance chart of standard colors.

_____ Other _____*(Please describe below.)*

_____ Other _____*(Please describe below.)*

Comment: _____

_____

_____

27. How often does your agency evaluate the retroreflectivity and performance of long-term pavement markings? *(Please check all that apply and give the schedule of evaluations.)*

New markings

_____ At the time of or just after markings are placed. _____ How soon after?

Existing markings

_____ On a regular schedule during the life of the marking. _____ How often?

_____ Occasionally during the life of the marking. _____ How often?

_____ On special occasions *(Please explain below.)*.

_____ Other *(Please explain below.)*.

Comment: _____

_____

_____

28. Which of the following types of retroreflectometers does your agency use to evaluate pavement marking retroreflectivity and how many does your agency own?

_____ Hand Held (30 m) _____ Manufacturer/Model _____How many?

_____ Hand Held (12 or 15 m) _____ Manufacturer/Model _____How many?

_____ Mobile (30 m) _____Manufacturer/Model _____How many?
_____ Other _____Manufacturer/Model _____How many?
_____ None

Comment: _____
_____
_____

Research and Challenges

29. Has your agency conducted any research on pavement markings in the past 5 years?

_____ Yes *(Please provide information on reports and other documented results in an attachment.)*

_____ No

Comment: _____
_____
_____

30. Has your agency documented a reduction in traffic crashes/accidents or other benefits as a result of pavement markings?

_____ Yes *(Please describe the documented benefits or provide documentation in an attachment.)*
_____ No

Comment: _____
_____
_____

31. What are the most significant problems/challenges facing your agency? *(Please describe solutions your agency may be working on, or provide documentation in an attachment.)*

Comment: _____
_____
_____

Thank You!

Reminder. Please enclose any information on:

- Policies, warrants, and guidelines for making pavement marking decisions.
- Description of "non-typical" pavement and word symbols/horizontal signing.
- Pavement marking specifications.
- Description of the computerized pavement marking inventory/management system and documented benefits of the system.
- Research reports and summaries of research in progress, including documented reduction in traffic accidents/crashes.

APPENDIX B

Survey Respondents

TABLE A1 LIST OF SURVEY RESPONDENTS

Project 20-5, Synthesis Topic 31-07, Long-Term Pavement Marking Practices

Survey Respondents (Number of Respondents)

State (37)	**Canadian Province and Territory (5)**
Alabama Department of Transportation	Alberta Infrastructure
Alaska Department of Transportation and Public Facilities	Great Northwest Territories Department of Transportation
Arkansas State Highway and Transportation Department	Manitoba Highways and Government Services
California Department of Transportation	New Brunswick Department of Transportation
Colorado Department of Transportation	New Foundland Department of Works, Services and Transp.
Connecticut Department of Transportation	
Florida Department of Transportation	**County (5)**
Georgia Department of Transportation	Delaware County, Iowa, Secondary Road Department
Idaho Transportation Department	Franklin County, Ohio, Engineer
Illinois Department of Transportation	Lake County, Illinois, Division of Transportation
Indiana Department of Transportation	Pierce County, Washington
Iowa Department of Transportation	Road Commission for Oakland County, Michigan
Kansas Department of Transportation	
Louisiana Transportation Research Center	**City (4)**
Maryland State Highway Administration	City of Amarillo, Texas
Mississippi Department of Transportation	City of Des Moines, Iowa
Montana Department of Transportation	City of Kansas City, Missouri
Nebraska Department of Roads	City of Lubbock, Texas, Traffic Engineering
New Hampshire Department of Transportation	
New Jersey Department of Transportation	**Equipment/Material Manufacturer/Distributor (8)**
New Mexico State Highway and Transportation Department	Avery Dennison
New York State Department of Transportation	Crown Technology II, IIC
North Carolina Department of Transportation	Flint Trading Company, Inc.
North Dakota Department of Transportation	Kelly-Creswell Company, Inc.
Ohio Department of Transportation	Master Builders, Inc.
Oklahoma Department of Transportation	M-B Companies, Inc.
Oregon Department of Transportation	Potters Industries
Pennsylvania Department of Transportation	Swarco Industries
Rhode Island Department of Transportation	
Tennessee Department of Transportation	**Retroreflectometer Manufacturer/Distributor (2)**
Texas Department of Transportation	Flint Trading Company, Inc.
Utah Department of Transportation	Mechatronic GMBH
Virginia Department of Transportation	
Washington State Department of Transportation	
West Virginia Department of Highways	
Wisconsin Department of Transportation	
Wyoming Department of Transportation	

Type of Transportation Agency and Manufacturer Responding to Survey	Surveys Sent	Surveys Returned	% Returned
State	52	37	71
Canadian agencies	13	5	38
County	14	5	36
City	34	4	12
Equipment/material manufacturer/supplier	69	8	12
Retroreflectometer manufacturer/supplier	8	2	25
Total	190	61	32

APPENDIX C

Annual Pavement Marking Expenditure and Highway Mileage in the Year 2000

Transportation Agency	Annual Expenditure ($)[a]	Centerline Mileage (mi)[b]	Annual Expenditure Per Centerline Mile ($/mi)	Asphaltic Concrete Centerline Mileage (mi)	Portland Cement Concrete Centerline Mileage (mi)
STATE					
Alabama	10,000,000	11,500	870	11,000	500
Alaska	–	3,160	–	–	–
Arkansas	3,000,000	–	–	–	–
California	21,000,000	15,000	1,400	10,500	4,500
Colorado	2,000,000	2,000	1,000	150	1,850
Connecticut	4,000,000	3,800	1,053	3,774	26
Florida	10,606,557	12,275	864	9,207	3,068
Georgia	10,300,000	17,984	573	17,376	608
Idaho	1,995,000	4,953	403	4,640	292
Illinois	30,870,000	16,500	1,871	–	–
Indiana	7,500,000	11,300	664	10,550	750
Iowa	3,201,612	11,170	287	3,792	7,378
Kansas	13,500,000	10,000	1,350	8,000	2,000
Louisiana	7,500,000	16,681	450	–	–
Maryland	20,000,000	5,142	3,890	5,078	64
Mississippi	12,081,623	13,677	883	11,875	1,100
Montana	–	–	–	–	–
Nebraska	–	9,969	–	8,252	1,673
New Hampshire	3,000,000	4200[c]	714[c]	4200[c]	0[c]
New Jersey	6,000,000	–	–	–	–
New Mexico	11,497,563	11,637	988	11,055	582
New York	15,500,000	15,500	1,000	14,200	1,300
North Carolina	–	–	–	–	–
North Dakota	1,550,000	7,378	210	6,728	650
Ohio	14,000,000	19,794	707	19,373	421
Oklahoma	3,696,265	12,977	285	12,270	707
Oregon	14,500,000	7,483	1,938	550	6,933
Pennsylvania	19,500,000	40,100	486	35,000	5,100
Rhode Island	2,500,000	1,300	1,923	1,100	200
Tennessee	6,000,000	13,942	430	13,765	177
Texas	–	79,102	–	59,326	19,776
Utah	4,000,000	7,453	537	6,611	842
Virginia	23,900,000	38,410	622	38,000	410
Washington	9,100,000	7,061	1,289	4,133	518
West Virginia	11,500,000	16,258	707	15,821	437
Wisconsin	9,500,000	11,816	804	10,044	1,772
Wyoming	4,000,000	6,780	590	6,530	250
Average (29)[d]	**10,527,539**	**12,754**	**825**	**10,782**	**1,572**
50 State Estimate	**636,099,391[e]**	**770,638[f]**			
CANADIAN					
Alberta	2,845,557	9,636	295	9,188	0
Great Northwest Territories	132,660	2,149	62	435	0
Manitoba	1,750,000	7,499	233	7,351	147
New Brunswick	1,857,240	4,968	374	4,956	12
New Foundland	1,114,344	8,899	125	8,899	0
Average (5)[d]	**1,539,960**	**6,630**	**232**	**6,166**	**32**
13 Prov. & Territ. Estim.	**20,019,483[e]**	**86,193[g]**			

Transportation Agency	Annual Expenditure ($)[a]	Centerline Mileage (mi)[b]	Annual Expenditure Per Centerline Mile ($/mi)	Asphaltic Concrete Centerline Mileage (mi)	Portland Cement Concrete Centerline Mileage (mi)
COUNTY					
Delaware County, Iowa	50,000	909	55	140	70
Franklin County, Ohio	175,000	350	500	350	0
Lake County, Illinois	–	281	–	272	9
Pierce County, Washington	600,000	1,519	395	1,485	15
Oakland County, Michigan	1,200,000	2,607	460	700	200
Average (4)[d]	**506,250**	**1,346**	**376**	**669**	**71**
County Estimate	**664,164,896[e]**	**1,766,396[f]**			
CITY					
Amarillo, Texas	227,829	899	253	823	0
Des Moines, Iowa	220,000	830	265	580	193
Kansas City, Missouri	278,000	2,300	121	2,270	30
Lubbock, Texas	100,000	300	333	298	2
Average (4)[d]	**206,457**	**1,082**	**191**	**993**	**56**
Town, Township, & Municipal Estimate	**228,333,051[e]**	**1,195,461[f]**			
ALL AGENCIES	**1,548,616,821**	**3,818,688**	**406**		

Conversion: 1 mi = 1.61 km. Costs are in $U.S. converted at the exchange rate of $1.00 U.S. = $1.5076 Canadian (March 29, 2001).
[a]Total annual expenditure for obtaining, placing, and repairing pavement markings on the agency system of roads.
[b]Includes mileage of "other" pavement types.
[c]Lane-mi.
[d]Based on the number of agencies (*N*) that provided annual expenditure and centerline mileage.
[e]Total Estimated Annual Expenditure = Centerline Miles x $/Centerline Mile.
[f]Rural and urban state, county, and city agency mileage. (*Source*: Highway Statistics 1999 Table HM-10.)
[g]Total Estimated Centerline Mileage = (13/5) x sum of the centerline mileages.

APPENDIX D

Examples of Pavement Marking Material Selections and Placement Guidelines

PAVEMENT MARKING MATERIAL SELECTION GUIDELINES FOR NEW PAVEMENT					
TYPE	ASPHALT ROADWAY		CONCRETE ROADWAY		CONCRETE BRIDGE
FREEWAY					
SKIP	TAPE		CONTRAST TAPE		CONTRAST TAPE
EDGE	PROFILE THERMO / THERMO		PROFILE THERMO / THERMO		PROFILE THERMO / THERMO
TRANSVERSE	THERMO /TAPE		THERMO /TAPE		THERMO /TAPE
MISC	THERMO /TAPE		THERMO /TAPE		THERMO /TAPE
MULTILANE					
CENTER	PROFILE THERMO /THERMO		CONTRAST TAPE		CONTRAST TAPE
SKIP	PROFILE THERMO /THERMO		CONTRAST TAPE		CONTRAST TAPE
EDGE	THERMO / PROFILE THERMO		THERMO / PROFILE THERMO		THERMO / PROFILE THERMO
TRANSVERSE	THERMO/TAPE		THERMO/TAPE		THERMO/TAPE
MISC	THERMO/TAPE		THERMO/TAPE		THERMO/TAPE
2-LANE, ADT >2000					
CENTER	THERMO		CONTRAST TAPE		CONTRAST TAPE
SKIP	THERMO		CONTRAST TAPE		CONTRAST TAPE
EDGE	THERMO		THERMO		THERMO
TRANSVERSE	THERMO/TAPE		THERMO/TAPE		THERMO
MISC	PAINT/THERMO		PAINT/THERMO		THERMO
2-LANE, ADT <2000					
CENTER	PAINT		CONTRAST TAPE		CONTRAST TAPE
SKIP	PAINT		CONTRAST TAPE		CONTRAST TAPE
EDGE	PAINT		PAINT		PAINT
TRANSVERSE	PAINT		PAINT		PAINT
MISC	PAINT		PAINT		PAINT

Miscellaneous Markings include messages, arrows, railroad, ect.
Transverse Markings include shoulder,stop bars,crosswalks, etc.

FIGURE D1 Arkansas State Highway and Transportation Department Paving Marking Material Selection Guidelines for New Pavement. (*Source*: Arkansas DOT 1998.)

1) **Restriping by Contract:**

If the expected life of the pavement surface is two or more years, the District will generate a form 402 reflecting the type and quantities of pavement marking materials required. Funding will derive from the Pavement Marking Set-Aside Program. 402 forms will be transmitted to the Bureau of Construction and Maintenance by June 1.
Otherwise, replacement pavement marking material types for asphalt surfaces should be selected from the following table:

Pavement Surface Life Remaining	Present Pavement Marking Type	District Should Select Renewal With:
All concrete surfaces or where preformed tapes are installed and in need of replacement		Contact Traffic Engineering for choice of marking material.
2 years	Epoxy	Epoxy
2 years	Thermoplastic Spray	Thermoplastic Spray
2 years	Thermoplastic	Thermoplastic Spray
More than 2 years	Epoxy	Epoxy
More than 2 years	Thermoplastic Spray	Thermoplastic
More than 2 years	Thermoplastic	Thermoplastic

If there are any questions or concerns regarding material selection, contact the Bureau of Traffic Engineering at (785) 296-3618 for assistance.

2) **Re-striping by District Maintenance Forces:**

If the expected life of the pavement surface is less than two years and the retroreflectivity is inadequate, then the roadway will be painted by District forces throughout the remainder of the service life of the roadway surface and no further status reporting is required until the next overlay cycle.

3) **Do Nothing:**

If the expected life of the pavement surface is less than two years and if a long-life marking material is exhibiting good daytime appearance and borderline-adequate retroreflectivity, no action is necessary prior to the next overlay cycle.

Step Four - Letting of Re-striping Contracts:

Depending on the amount of work required, the Bureau of Construction and Maintenance may let individual re-striping contracts or elect to let District-wide or statewide striping contracts. The target letting date will be August, with re-striping to commence the following spring.

FIGURE D2 Kansas Department of Transportation Pavement Marking Maintenance Policy. (*Source*: Kansas DOT 2000.)

Roadway Type	Pavement Marking Type
Interstate Hwy / Freeway / Expressway: Asphalt - Urban	Lane Lines: Patterned Tape w/ RPM's Edge Lines: Durable Markings
Interstate Hwy / Freeway / Expressway: Asphalt - Rural	Lane Lines: Patterned Tape w/ RPM's Edge Lines: Paint (Durable Markings Optional)
Interstate Hwy / Freeway / Expressway: Portland Cement - All	Lane Lines: Patterned Tape w/ RPM's Edge Lines: Epoxy (Patterned Tape Optional)
NHS, multi-lane or divided highway other than Interstate / Freeway / Expressway ADT > 25,000	Lane Lines: Durable Markings w/ RPM's Center Lines: Durable Markings w/ RPM's Edge Lines: Durable Markings (Paint Optional)
NHS, multi-lane or divided highway other than Interstate / Freeway / Expressway ADT < 25,000	Lane Lines: Durable Markings w/ RPM's Center Lines: Durable Markings w/ RPM's Edge Lines: Paint (Durable Markings Optional)
2 Lane 2 Way 45 MPH or greater ADT > 15,000	Center Lines: Paint (Durable Markings Opt.) w/ RPM's Edge Lines: Paint (Durable Markings Optional)
2 Lane 2 Way 45 MPH or greater ADT < 15,000	Center Lines: Paint w/ RPM's Edge Lines: Paint
2 Lane 2 Way 40 MPH or less ADT > 15,000	Lane Lines: Paint (Durable Markings Optional) Center Lines: Paint (Durable Markings Optional)
2 Lane 2 Way 40 MPH or less ADT < 15,000	Lane Lines: Paint Center Lines: Paint
PCC Bridge Decks	Lane Lines: Patterned Tape Center Lines: Epoxy (Patterned Tape Optional) Edge Lines: Epoxy (Patterned Tape Optional)

- **Durable Markings:** Currently these include thermoplastic, patterned tape, and epoxy applications. When used in the table above, it is intended to give the option to the engineer as to which to use. The decision may be based on desired performance, or marketplace availability and prices.
- **Paint:** Wherever paint is listed as an application, the 50/50 blend of large and standard glass beads is recommended.
- When patterned tape is installed on new asphalt, it should be inlaid.
- When remarking, materials shall be installed as per manufacturers' specifications over existing markings.

FIGURE D3 Maryland State Highway Administration Recommended Pavement Markings. (*Source*: Maryland State Highway Administration 2000.)

AS 3A-2
October 29, 1999
Attachment A

TABLE OF PAVEMENT MARKING MATERIALS

Pavement Surface and Condition	Center, Lane and Channelizing Lines	Edge Lines	Auxiliary Markings
New Asphalt	thermoplastic or epoxy**** if ADT is 6,000 or more vehicles per lane; otherwise paint	thermoplastic or epoxy**** if ADT is 6,000 or more vehicles per lane; otherwise paint	thermoplastic, preformed plastic inlaid during paving, or fast dry alkyd paint
Asphalt*- good condition	polyester, thermoplastic or epoxy**** if ADT is 6,000 or more vehicles per lane	polyester, thermoplastic or epoxy**** if ADT is 6,000 or more vehicles per lane; otherwise, waterbase paint	thermoplastic; or fast dry alkyd paint
Asphalt- poor condition	fast dry waterbase paint	fast dry waterbase paint	fast dry alkyd paint
PC Concrete - new or good condition rough finish, no curing compound	epoxy****, thermoplastic** or Type A3 preformed plastic may be used if ADT is 6,000 or more vehicles per lane***	epoxy****, thermoplastic** or Type A3 preformed plastic may be used if ADT is 6,000 or more vehicles per lane.***	thermoplastic**
PC Concrete - poor condition or smooth finish, or containing curing compound	fast dry waterbase paint	fast dry waterbase paint	fast dry alkyd paint

* Polyester pavement marking material shall only be used on pavement Items 448, 446, or 404 surface courses. This material shall not be used on the following asphalt concrete surfaces due to poor bonding qualities: open graded courses, slurry seal, Item 412 Asphalt Concrete, Supplemental Specification (SS) 805 Rubberized Sand Asphalt, and SS 807 Latex Modified Emulsified Asphalt Pavement Course. Any Asphalt Concrete (Item Special) should be questioned before considering placement of polyester material on it.

** Primer is required for thermoplastic in this application.

*** Due to the high cost of Type A3 material, it should only be considered for use where extra long life is needed in certain applications, such as bridge decks where thermoplastic has not adhered well.

**** Epoxy should only be used on pavements in good condition after surface preparation by mechanical grinding has been accomplished.

Figure D4 Ohio Department of Transportation Selection of Pavement Marking Materials. (*Source*: Ohio DOT 1999.)

PAVEMENT MARKING MATERIAL SELECTION

ROADWAY		ADT > 10,000			ADT 4000-10,000			ADT 2000-4000			ADT < 2000
TYPE	CONDITION	CENTER/SKIP	EDGE	MISC	CENTER/SKIP	EDGE	MISC	CENTER/SKIP	EDGE	MISC	CENTER/SKIP, EDGE, & MISC
ASPHALT	NEW	INLAID PATTERNED PREFORMED PLASTIC	INLAID PATTERNED PREFORMED PLASTIC	PAINT	INLAID PATTERNED PREFORMED PLASTIC	PAINT	PAINT	PAINT	PAINT	PAINT	PAINT
	GOOD @	PATTERNED PREFORMED PLASTIC	PAINT	PAINT	PATTERNED PREFORMED PLASTIC	PAINT	PAINT	PAINT	PAINT	PAINT	PAINT
	FAIR/POOR @	PAINT	PAINT	PAINT	PAINT	PAINT	PAINT	PAINT	PAINT	PAINT	PAINT
CONCRETE	NEW	GROOVED PATTERNED PREFORMED PLASTIC	GROOVED PATTERNED PREFORMED PLASTIC	PAINT	GROOVED PATTERNED PREFORMED PLASTIC	PAINT	PAINT	GROOVED PATTERNED PREFORMED PLASTIC	PAINT	PAINT	PAINT
	GOOD @	GROOVED PATTERNED PREFORMED PLASTIC	PAINT	PAINT	GROOVED PATTERNED PREFORMED PLASTIC	PAINT	PAINT	PAINT	PAINT	PAINT	PAINT
	FAIR/POOR @	PAINT	PAINT	PAINT	PAINT	PAINT	PAINT	PAINT	PAINT	PAINT	PAINT

@ Use the Pavement Management System to determine condition.

FIGURE D5 North Dakota Department of Transportation Pavement Marking Material Selection Policy. (*Source*: North Dakota DOT.)

STATE OF TENNESSEE
DEPARTMENT OF TRANSPORTATION
NASHVILLE, TENNESSEE 37243-0350

INSTRUCTIONAL BULLETIN NO. 99-37

Regarding Policy For Permanent Pavement Markings

Effective for the December 10, 1999 letting, section 4-716.15 on pages 4-62 and 4-63 of the English version of the Design Guidelines (pages 4-69 and 4-70 of the Metric Roadway Design Guidelines) shall be modified as follows:

4-716.15 POLICY FOR PERMANENT PAVEMENT MARKINGS

TYPE ROADWAY	ADT	MATERIAL
Asphalt Interstate or Other Similar Freeways Expressways (See Note No. 1 Below)	75,000 or Over	Preformed Plastic Lane Lines and Edgelines and (716M10.15 - 150 mm) (716-10.15 - 6 inch)
Asphalt Interstate or Other Similar Freeways Expressways	Under 75,000	Thermoplastic Centerlines, Lane Lines and Edgelines (716M02.10 - 150 mm) (716-02.10 - 6 inch)
Asphalt Multilane Conventional Highways	All ADT's	Thermoplastic Centerlines, Lane Lines and Edgelines (716M02.01)(716-02.01)
Asphalt Two-lane	5,000 or Over	Thermoplastic Centerlines, Lane Lines and Edgelines (716M02.01)(716-02.01)
Asphalt Two-lane	Under 5,000	Paint Centerlines and Edgelines (716M05.01)(716-05.01)
Concrete All Roadways (See Note No. 2 Below)	All ADT's	Preformed Plastic Centerline, Lane Lines and Edgelines (716M10.01 or 716M10.15) (716-10.01 or 716-10.15)
Concrete Grinding	All ADT's	Preformed Plastic Centerline, Lane Lines and Edgelines (716M10.01 or 716M10.15) (716-10.01 or 716-10.15)
Intersection Project	All ADT's	Thermoplastic - Asphalt (716M02.01)(716-02.01) Preformed Plastic - Concrete (716M10.01)(716-10.01)

1. On Microsurface pavements, thermoplastic shall be used for lane lines and edgelines.

2. Includes all concrete ramps and concrete bridge decks.

FIGURE D6 Tennessee Department of Transportation Policy for Permanent Pavement Markings. (*Source*: Tennessee DOT 1999.)

Ice Chisel Snow Removal Areas					
Roadway Classification	Marking Type				
	Center Lines	Lane Lines	Edge Lines	Wide Lines	Special Markings
Interstate	N.A.	Plastic Insets	Paint	Paint	Paint
Major Arterial	Paint and RRPMs	Paint	Paint	Paint	Paint
Minor Arterial	Paint	Paint	Paint	Paint	Paint
Collector	Paint	Paint	Paint	Paint	Paint
Steel Blade Snow Removal Areas					
Roadway Classification	Marking Type				
	Center Lines	Lane Lines	Edge Lines	Wide Lines	Special Markings
Interstate-Urban	N.A.	Plastic	Paint or Plastic	Paint or Plastic	Paint or Plastic
Interstate-Rural	N.A.	Paint	Paint or Plastic	Paint or Plastic	Paint or Plastic
Major Arterial	Paint and RRPMs or Plastic	Paint	Paint or Plastic	Paint or Plastic	Paint or Plastic
Minor Arterial	Paint	Paint	Paint	Paint or Plastic	Paint or Plastic
Collector	Paint	Paint	Paint	Paint or Plastic	Paint or Plastic
Rubber Blade Snow Removal Areas					
Roadway Classification	Marking Type				
	Center Lines	Lane Lines	Edge Lines	Wide Lines	Special Markings
Interstate-Urban	N.A.	RPMs only or Plastic and RPMs	Paint or Plastic	Plastic	Plastic
Interstate-Rural	N.A.	RPMs only or Plastic and RPMs	Paint	Plastic	Plastic
Major Arterial	Paint and RPMs or Plastic and RPMs	Paint and RPMs	Paint	Plastic	Plastic
Minor Arterial	Paint and RPMs	Paint and RPMs	Paint	Plastic	Plastic
Collector	Paint and RPMs	Paint	Paint	Plastic	Plastic

Notes

1. Insets are grooves ground into the pavement and filled with material, usually methyl methacrylate.
2. Plastic refers to methyl methacrylate, thermoplastic, or preformed tape.
3. See Standard Plan H-5d for RPM substitute applications.
4. See Standard Plan H-3 and H-3a for RPM applications with paint or plastic.
5. Special Markings include arrows, symbols, letters, channelizing lines, and transverse markings.
6. RRPMs refers to RPMs installed in a groove ground into the pavement.
7. Type 2 RPMs are not required with painted or plastic center or lane line in continuously illuminated sections. See Section 830.03(2).

FIGURE D7 Washington State Department of Transportation Pavement Marking Material Selection Guide. (*Source*: Washington State DOT 2000.)

Permanent Pavement Marking Choices For Newly Paved Or Resurfaced Roads [a]

Surface Type Roadway Type	Length of Project	Edgelines	Lane or Centerlines
Asphaltic Surface 2 Lane	>3 miles (5 km)	Epoxy with Standard Beads	Epoxy with Standard Beads [b]
Asphaltic Surface 2 Lane	<3 miles (5 km)	Match Marking Material Adjacent	Match Marking Material Adjacent [b]
Asphaltic Surface Multilane	>3 miles (5 km)	Epoxy with larger beads	A-380 Tape
Asphaltic Surface Multilane	<3 miles (5 km)	Match Marking Material Adjacent	Match Marking Material Adjacent [b]
Tined Concrete	>3 miles (5 km)	Epoxy with Standard Beads	Epoxy with Standard Beads
Tined Concrete	<3 miles (5 km)	Match Marking Material Adjacent	Match Marking Material Adjacent
Untined Concrete 2 Lane	>3 miles (5 km)	Epoxy with Standard Beads	Epoxy with Standard Beads
Untined Concrete 2 Lane	<3 miles (5 km)	Match Marking Material Adjacent	Match Marking Material Adjacent
Untined Concrete Multilane	>3 miles (5 km)	Epoxy with Larger Beads	Epoxy with Larger Beads
Untined Concrete Multilane	<3 miles (5 km)	Match Marking Material Adjacent	Match Marking Material Adjacent

(a) Assumes the pavement will be free of maintenance (which would obliterate markings) for at least 3 years.

(b) Permanent tape or hot paint may be used if project requires same day marking. See section on Same Day Pavement Marking.

FIGURE D8 Wisconsin Department of Transportation Permanent Pavement Marking Choices for Newly Paved or Resurfaced Roads. (*Source*: Wisconsin DOT 1999.)