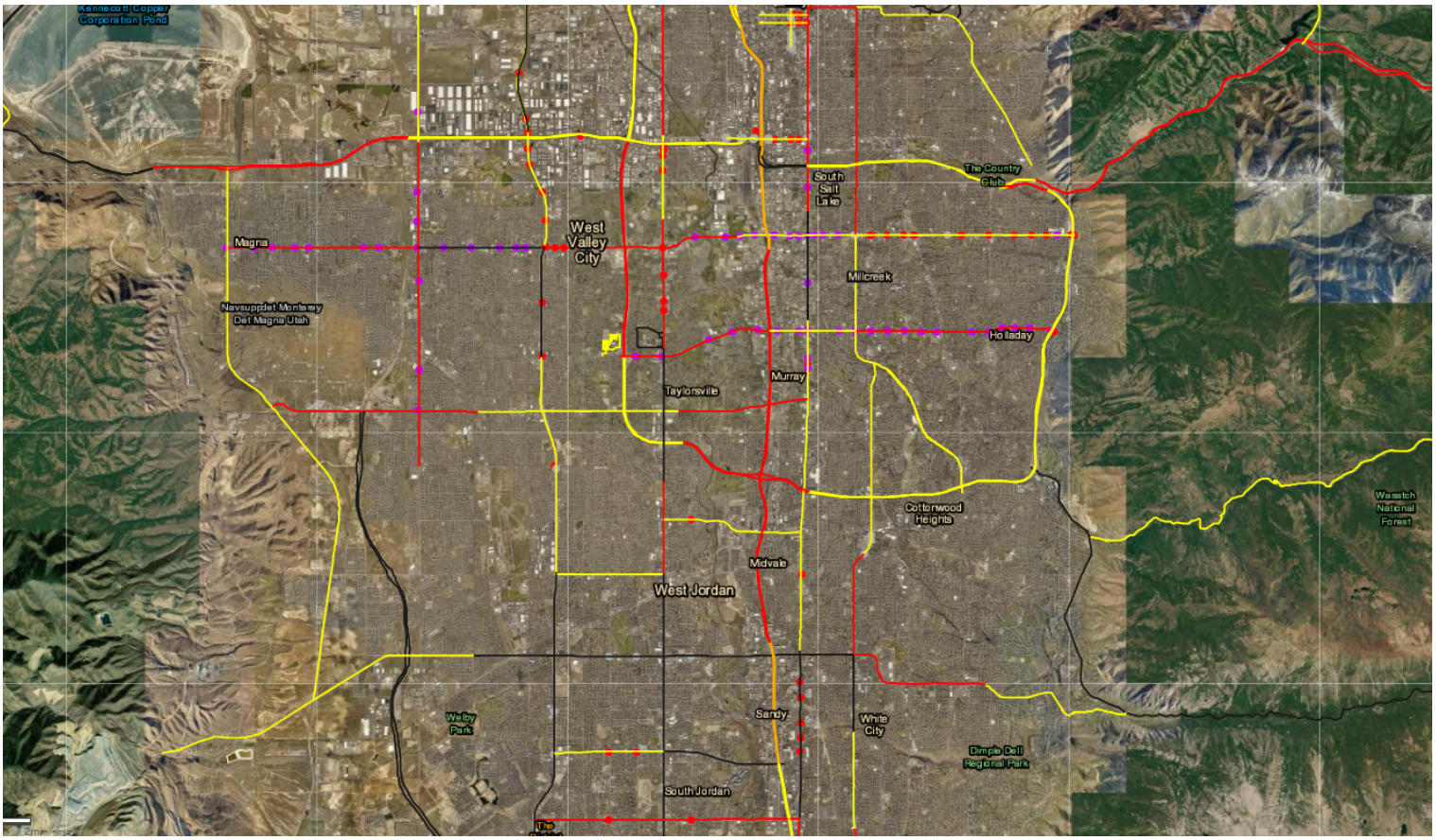

Pavement Marking Materials Selection Guideline

UDOT Keeping Utah Moving

Prepared and Published by
The Utah Department of Transportation

Revised

3/06/2025

TABLE OF CONTENTS

SECTION 1- INTRODUCTION

Pavement markings are crucial road safety features that delineate lanes to motorists.

One of the important aspects of a safe and efficient roadway is the timely and proper application of pavement markings materials. Pavement marking visibility, durability, and presence are of a critical safety priority especially during wet weather conditions and at night.

Pavement Markings are one of the highest priority assets for UDOT. The Department strives to improve key measures pertaining to pavement markings performance, visual consistency for drivers, accommodation for vehicle sensor technology, and funding efficiency.

Successful performance of pavement marking depends on many factors such as material selection, surface type, proper installation, a section is included in this guideline as a reference. More detailed information can be found at the UDOT's Pavement Marking Materials website:

https://www.udot.utah.gov/connect/public/pavement-markings/pavement-marking-materials/

SECTION 2- PURPOSE

The purpose of this document is to guide maintenance, construction, designers and others engaged in the selection of pavement marking materials and to choose optimum pavement marking materials to be installed on UDOT's highway system. UDOT recognizes that improvement of pavement markings impacts several targets of interest. Optimum marking materials are those that provide driver comfort in low light and/or wet conditions. Also they are compatible with the surface type, provide an appropriate level of service life, reduce lane departures, and are more cost effective.

SECTION 3- FACTORS AFFECTING MATERIAL SELECTION

Major factors that influence and affect pavement marking performance such as safety, environmental conditions, winter operation, traffic volume, pavement surface type, elevation, and time to next pavement treatment.

Many materials can be used for pavement markings. However, the performance and cost of the different materials vary greatly. It is also important to recognize that some materials are more appropriate for a given set of circumstances than other materials.

The useful service life of a pavement marking material often varies widely based on many factors. Materials should be selected that will meet or exceed the performance requirements at the lowest cost. To ensure consistency for the drive and maximize cost-effectiveness, material selection may be based on the Striping Selection Logic flowchart that includes roadway safety, surface type, traffic volumes, amount of snow plow events, and expected time to the next pavement treatment. The greatest factor

affecting the performance of pavement markings in Utah is abrasion from snow plowing activities or removal.
Traffic volume also influences the performance of a pavement marking. The service lives of pavement marking materials decrease when exposed to higher traffic volumes. For this reason, more durable markings are often considered for roadways with higher average annual daily traffic (AADT).

The pavement surface type can affect the bonding characteristics of marking materials. Therefore, markings can have different service lives depending on the surface on which they are placed.

SECTION 4- MATERIAL SELECTION

Material selection is an important process for maintenance and design engineers. Currently UDOT predominantly uses the following four products for pavement markings.

4.1 Waterborne Paint

Waterborne paints are the most widely used pavement marking materials used by UDOT and still remains the most inexpensive of all pavement marking materials. Waterborne paint comes in white and yellow colors and is almost exclusively used for longline applications, often in maintenance projects. Downside to waterborne paint is the short life span of the product in high traffic areas.

4.2 Wet-ReflectiveTape

Tapes are highly durable and abrasion resistant in most applications. Because of their high installation costs and slow application procedure, they are often used only in locations with the most severe traffic conditions. While tapes have a significantly higher initial cost than most other materials, the service lives are usually superior to most other materials, often making them a cost-effective choice in locations with high traffic volumes.

4.3 Epoxy

Epoxy materials are durable, sprayable materials that provide exceptional adhesion to both bituminous surfaces and concrete surfaces with good abrasion resistance. Epoxies are more expensive than standard waterborne paints and generally have exceptional durability under many different roadway conditions.

4.4 Thermoplastic (Preformed)

Thermoplastics have been a common pavement marking material mostly for pavement messages at UDOT. They are a mixture of plasticizer and resins that serves to hold all of the other ingredients together and exists as a solid at room temperature, but becomes liquid when heated.

4.5 Methyl-Methacrylate

Methyl-Methacrylate (MMA) is a two-component durable pavement marking material used for longitudinal lines, legends, and symbols on all pavement surfaces. It is cold applied so no heating is required on all surfaces.

***As UDOT tests new and approved products the guide will be updated to include them.**

SECTION 5- RECOMMENDED MARKING MATERIAL MATRIX

The current version of the *Recommended Pavement Marking Material* matrix can be used by UDOT personnel to determine the most appropriate marking materials given AADT, and pavement surface types. Ultimately the decision for material selection types and widths lie with the Regions and available budgets.
Pavement marking material selection matrix is presented in Table 1. This Matrix recommends what product to select from for a given condition. The current Pavement Marking Materials Matrix uses an asset management, safety, and engineering economic modeling approach. It is a financially based methodology that maximizes the efficient use of limited budgets. Many materials can be used for pavement markings. However, the performance and cost of the different materials vary greatly. This matrix can be used as a guide and uses the following questions to direct the selection of materials:

- Surface Type: What is the material that the marking will be placed on?
- Time to Next Treatment: How long until the next pavement project in that selection?
- AADT: What is the AADT of the Route?

Table 1: Pavement Markings Materials Matrix

RECOMMENDED PAVEMENT MARKING MATERIALS FOR PROJECTS (see Notes 1,2)

Last Edited April 22, 2025

SURFACE TYPE	TIME TO NEXT PAVEMENT TREATMENT (see Note 3)	AADT	AADT	
		0-30,000	30,000-50,000	> 50,000
Low Seal Surfaces (Microsurface, Chip Seal, Slurry Seal, etc.)	6 or more years	Waterborne Paint	Epoxy	Epoxy
	3-5 years		Epoxy	Epoxy
	Less than 3 years		Waterborne Paint (see Note 5)	Waterborne Paint (see Note 5)
Concrete (see notes 6 and 7)	6 or more years	Waterborne Paint	Grooved-in Waterborne Paint	Grooved-in Wet Reflective Tape
	3-5 years			Grooved-in Epoxy
	Less than 3 years			Waterborne Paint (see Note 5)
HMA, or SMA, or High Seal Surfaces (Bonded Wearing Course, Open Graded Surface Course, HMA overlays, etc.)	6 or more years	Waterborne Paint	Grooved-in Waterborne Paint	Grooved-in Wet Reflective Tape
	3-5 years			Grooved-in epoxy
	Less than 3 years			Waterborne Paint (see Note 5)

https://acrobat.adobe.com/id/urn:aaid:sc:US:0168c4c3-aaa7-4b0a-8170-fd5452f98f62

1. Materials recommended represent the "minimum quality material" for the given conditions. Estimated service life of marking materials are: Waterbased Acrylic = 1-2 years; Epoxy (or equivalent) = 2-4 years; Wet Reflective Tape = 4-6+ years. Engineers/managers may elect to use a "higher quality" material than recommended herein.
2. For roadways addressed through the durable marking program see associated Striping Selection Logic for Maintenance Efforts flow chart: Click here for Selection Logic
3. As determined by Region Pavement Engineer.
4. Marking widths for roadways in the durable marking program are 6/10-inch wide. Marking widths of other roadways are determined by Region Maintenance Engineer based on route specifics.
5. Conditions in green text may not meet visibility standard and are considered maintenance striping until durable striping can be reapplied.
6. Do not groove in stripings on structures without prior approval from UDOT Structures. Avoid using tape on structures when grooving is not possible.
7. Use "lead-lag" contrast for all dashed and dotted striping applied to concrete pavements (i.e. lead white, lag black striping colors, also known as "tiger tail" pattern).

SECTION 6- DURABLE MARKING PROGRAM

Durable marking program will mostly include urban interstate mainline striping. It will also include all system-to-system interchanges, all collector-distributor ramps, and all gore markings for entrance- and exit-ramps.

Figure 1 shows the routes included in the durable marking program. The program installs 6-inch wide durable markings on I-15 (MP 258-331), I-80 (MP 102-128), and I-215. Each year the Maintenance Division appropriates $6 million towards maintaining the durable markings within its program limits The installation of durable markings is carefully coordinated with the local Region personnel, upcoming projects, warranty limits, and retroreflectivity readings. The latest 10-year plan can be seen here. Occasionally funds are available to support the UDOT Regions with their durable striping needs. Central maintenance will coordinate with the local Regions to help install durable markings on roadways they select outside of the above list. The latest *Striping Selection Logic* flow diagram can be used to help understand how these extra funds are used.

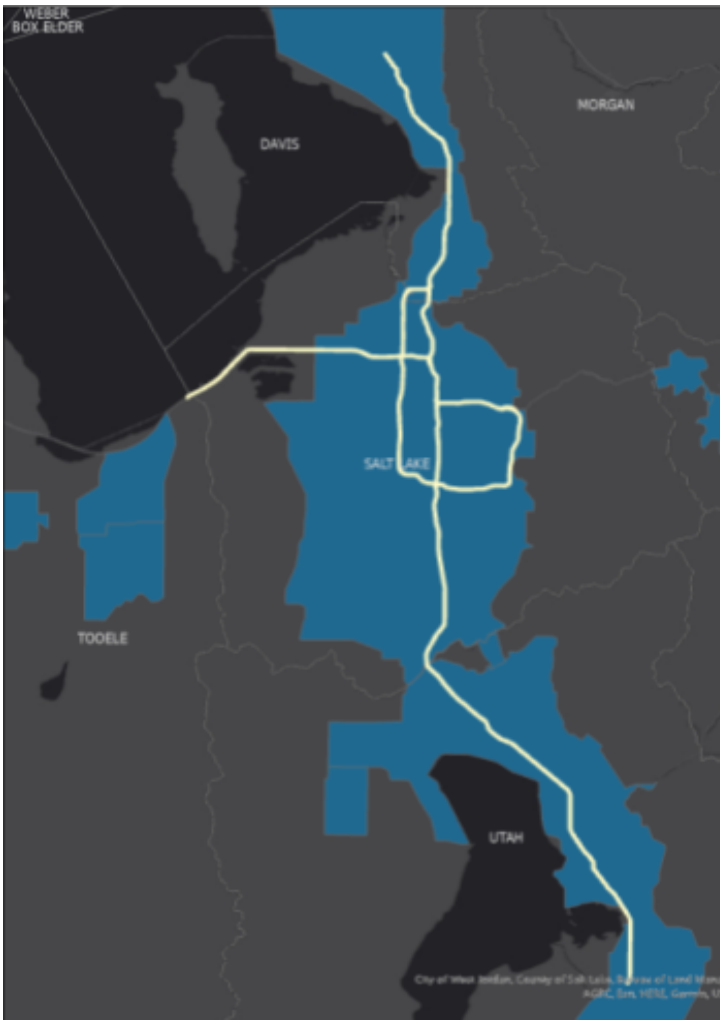

Figure 1: Durable Marking Program Limits

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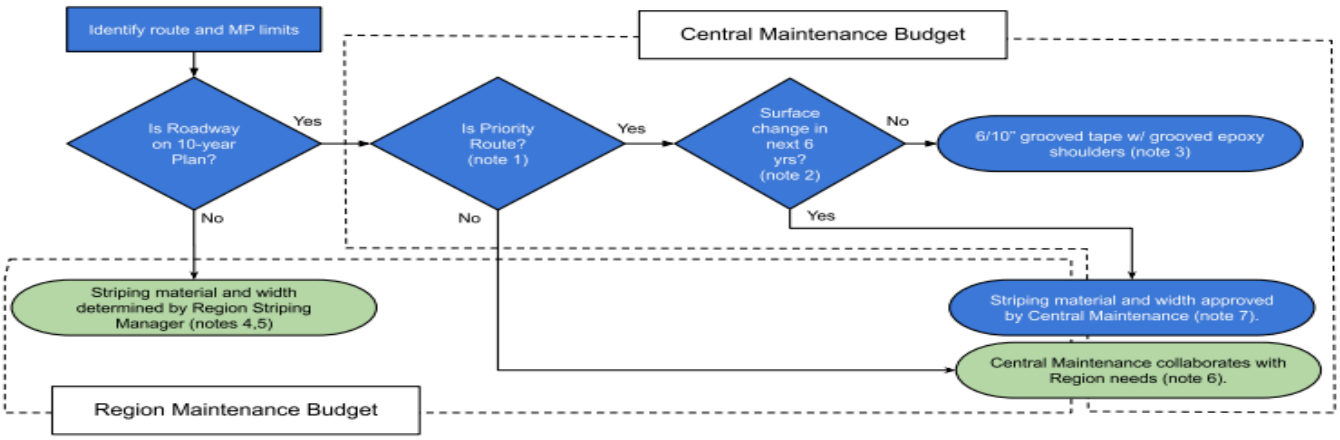
Striping Selection Logic for Maintenance Efforts



Logic Diagram Notes:

1. Priority routes include the following routes and associated interchanges (ramps and collector/distributors only; no crossroads):
   a. I-15 from MP 258 to 331 (Spanish Fork, US-6 to Layton)
   b. I-215 all
   c. I-80 from MP 102 to 128 (SR-201 to I-215 east side)
2. Determined by Region Paving Manager.
3. See attached diagram below.
4. Determination based on standard drawings and projected Region maintenance budget.
5. Tape material should be "wet-reflective", contrast should be "tiger tail" pattern.
6. Budget from Central Maintenance may help with the capital investment of installation. Region funds future maintenance.
7. Central Maintenance and Region Maintenance collaborate for funding and striping selection.

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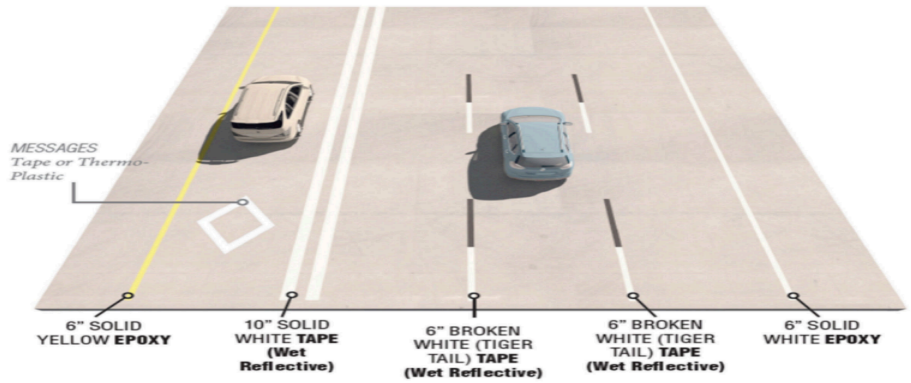


Striping Materials and Widths for Priority Routes

SECTION 7- PLOWING ZONES

Snow plows' frequency affects the performance of pavement markings. Because of this, the following map takes into account storm frequency and amount of plowing for the state. For more detailed information please refer to Statewide Plowing Zones Map: https://arcg.is/1058jK

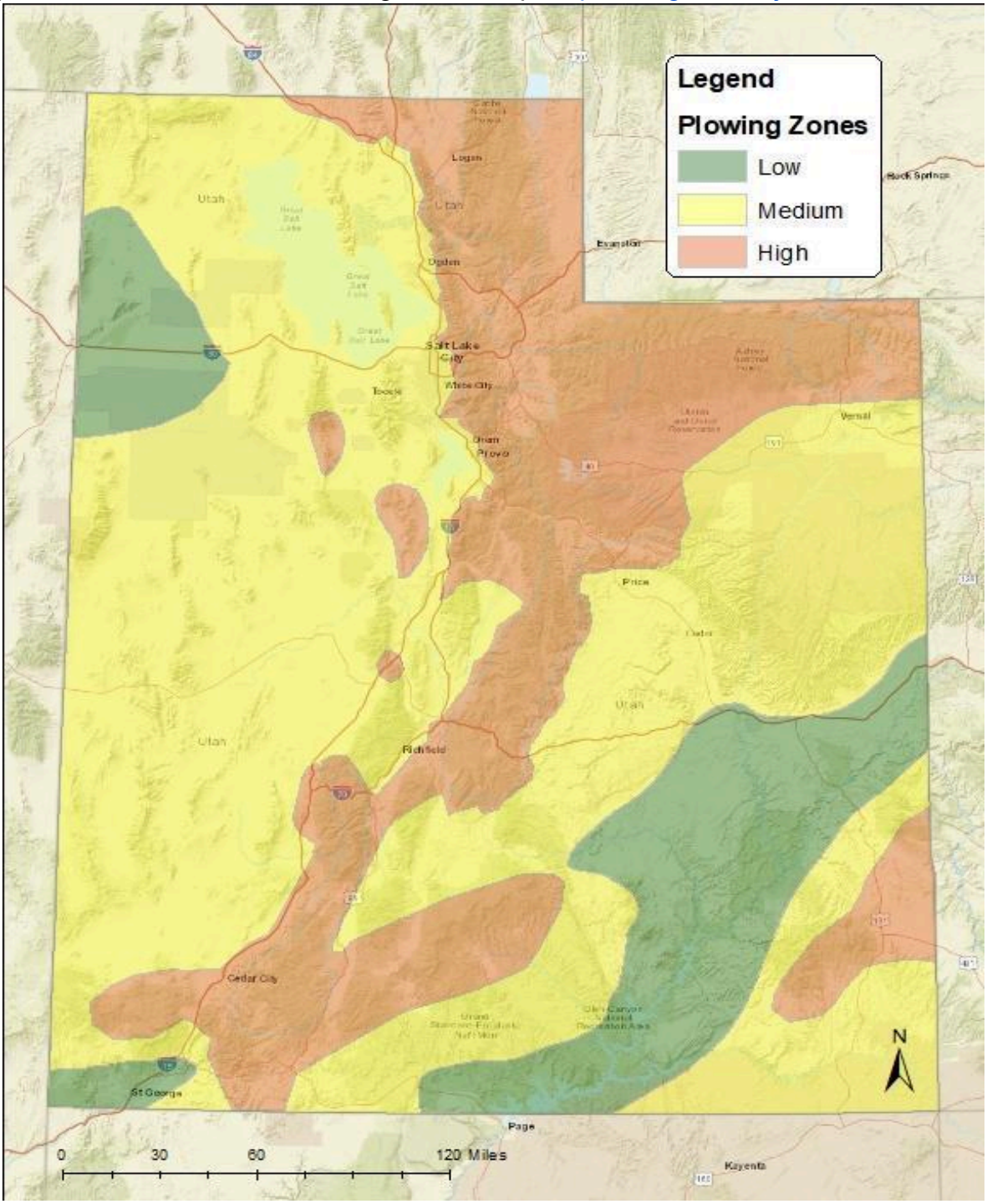


Figure 1: Pavement Markings Zones Map Based on Snow Plow Frequency

Another factor in determining pavement marking material is snowplow frequency, which affects pavement marking performance. UDOT has gathered data that includes storm frequency and the amount of plowing for areas around Utah and uses this data in its decision making processes.

- Low Plowing Zone = less than 13 days per year
- Medium Plowing Zone = 14 to 27 days per year
- High Plowing Zone = more than 27 days per year

For projects crossing zone boundaries in Figure 1, please use your professional judgment for selecting the optimum marking materials.

SECTION 8- INSTALLATION

Performance of a pavement marking depends on proper installation, and manufacturer's recommendations. Following manufacturer's recommendations is required along with making sure the surface is adequately prepared, dry and free of debris. For more detailed information on required preparation for installing pavement markings please refer to related UDOT's Specifications.

SECTION 9- RESTRIPING MATERIAL COMPATIBILITY

When considering marking materials for maintenance striping (restriping), it is important to note that not all material types are compatible with one another. Some materials will adhere to existing materials of another type, and others will adhere only to existing materials of the same type. When a marking is not compatible as the restripe material, then the existing material must be removed.

Even when marking materials are compatible, the existing material must still be bonded well to the pavement and loose material should be removed during surface preparation. Table 2 summarizes the compatibility of marking materials for restriping.

Table 2: Pavement Markings Restriping Material Compatibility

Existing Material	**Restripe Material**			
	Waterborne Paint	Tape	Epoxy	Thermoplastic
Waterborne Paint	Y	N	N	N
Tape	Y	N	N	N
Epoxy	Y	N	Y	N
Thermoplastic	Y	N	N	Y

When re-striping Waterborne Paint over Tape, make sure existing markings still adhere well to the pavement; its surface is clean, free from debris, and loose material. If there is an issue of bonding to the existing tape, then for restriping to be effective, the existing material must be removed.

For restriping a stretch of roadway the pavement marking matrix should still be followed along with the compatibility chart.

SECTION 10- PAVEMENT MESSAGES

Current pavement messages are mostly thermoplastic and some waterborne paint. Thermoplastics have been used as a common pavement message material on roadways in Utah for years and should be used in a majority of the cases. To not use thermoplastic messages please consult the Region Maintenance Paint Supervisor.
For more detailed information on pavement messages, please refer to Statewide Messages Map:
https://uplan.maps.arcgis.com/apps/mapviewer/index.html?layers=c8983e8ebefb4e8eb543382cce34e3de

SECTION 11- PAVEMENT MARKING REQUIREMENTS

UDOT adheres to the set of national standards for pavement markings set forth in the Utah Manual on Uniform Traffic Control Devices (MUTCD) along with UDOT'S latest specific drawings and specifications. The Utah MUTCD can be downloaded from the UDOT website:
https://www.udot.utah.gov/main/f?p=100:pg:0:::1:T,V:4072,

SECTION 12- PAVEMENT MARKINGS PERFORMANCE MEASURES

Pavement marking performance considers nighttime visibility, marking presence and service life of marking materials. All retroreflective performance measures include minimum retroreflectivity values. In addition, retroreflectivity measurement provides a numeric comparison of how efficiently a marking returns light to the driver's eyes, thereby reducing the subjectivity that exists when performing night-time visual evaluations. Minimum retroreflectivity values will be determined by FHWA rulemaking and referenced in the Utah MUTCD:
https://drive.google.com/file/d/1JyNnvMXo5LgvhvSltSOh5miCxD84PSdJ/view

SECTION 13- PAVEMENT MARKING REMOVAL

The removal methods should, to the fullest extent possible, cause no significant damage to the pavement surface. For detailed information, please refer to UDOT's Special Provision SECTION 02769S and the UDOT Construction Inspectors Guide.
https://www.udot.utah.gov/main/f?p=100:pg:0:::1:T,V:1572,

SECTION 14- GRINDING FOR GROOVED-IN PAVEMENT MARKINGS

Grind pavement along lines and in pavement message areas to specified depth, width, and length according to the Department's Supplemental Specification Section 02983. In general, grooving will double pavement marking life.

The decision to groove or not depends on local conditions including estimated surface life relative to estimated pavement marking life. In all cases, surface types should be sufficiently cured before they are grooved. Add additional funds to the pavement marking cost for grooving. Grooving will be done according to the Department's Supplemental Specification Section 02983.

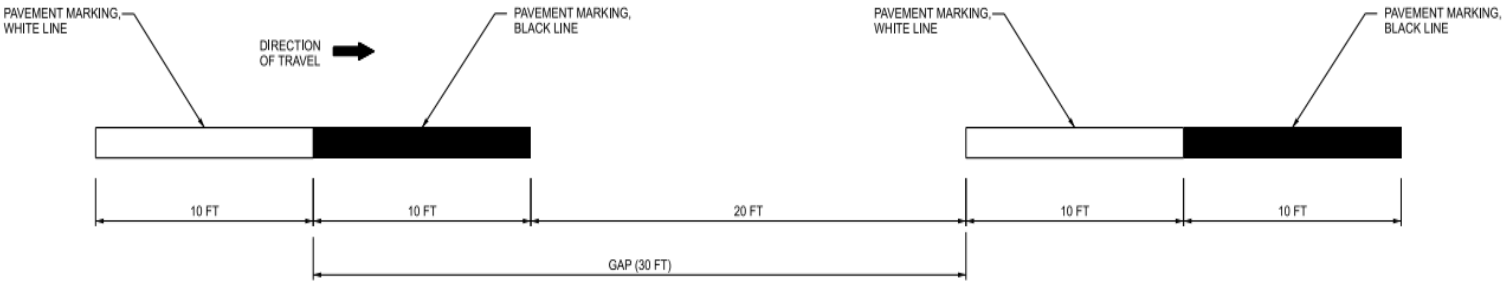
SECTION 15- TAPE, AND THERMOPLASTIC MARKING WARRANTIES

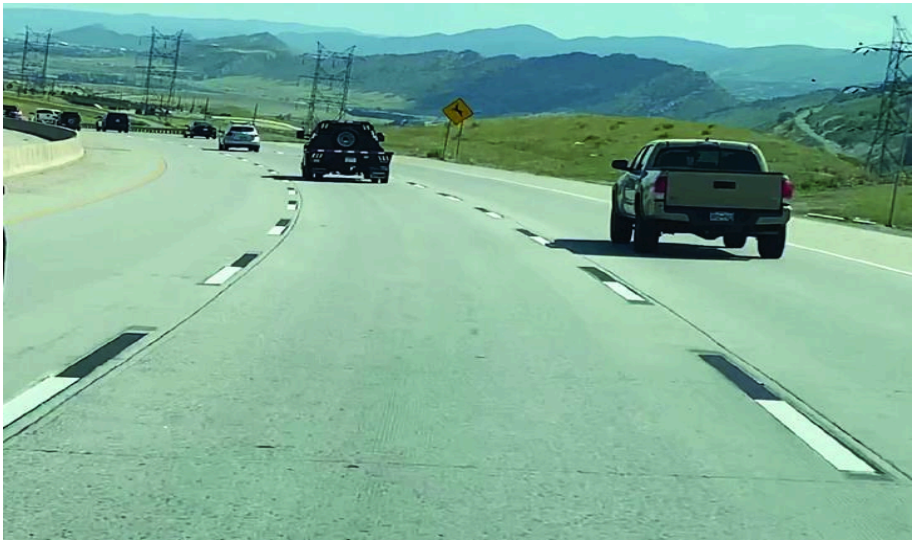
Refer to Section 02767S and 02768 of the Department's specification: Pavement Marking Manufacturer's warranty is required for Tape and Thermoplastic messages durable markings.

When pavement marking tape or thermoplastic messages are installed on a project, the contractor is required to fill out the Pavement Marking Warranty Form. Also all product manufacturers are required to submit an annual manufacturer's warranty bond. Should the tape or thermoplastic fail within the warranty period, the manufacturer or contractor is required to replace the distressed materials at no cost to the Department. For current statewide manufacturer warranties for durable products, please refer to UDOT's Vendor Warranty Bond website:https://www.udot.utah.gov/connect/business/pavement-marking-warranties/

SECTION 16- CONTRAST MARKING

Many concrete and heavily oxidized asphalt pavement surfaces are so light in color that during the day, white pavement markings appear to blend in with the pavement surface. To improve the visibility of pavement markings on light-colored pavements, markings are often applied over the top of a compatible black "tiger-tail" contrast design for white lane lines. This contrast method features 10-foot black lines installed behind the white lines for increased visibility on concrete surfaces. For more detailed information, please refer to UDOT's Standard Drawing ST 3 and Supplemental Specification SECTION 02983.





SECTION 17- GLASS BEADS

Glass beads play the most important role in pavement marking retroreflectivity. Markings without beads are virtually useless at night. The bead returns light from a headlamp back to a driver.

When markings are wet and submerged in water, the film of water that covers the marking causes light to scatter before it can enter the bead. This causes the wet markings to be nearly invisible at night.
For detailed information regarding glass beads, please refer to UDOT's Standard Specification SECTION 02765.

SECTION 18- SERVICE LIFE

Another important to the decision-making process is the life cycle of the various pavement marking materials. Pavement markings can reach the end of service life because of loss of material due to chipping and abrasion or loss of pigment/ color change resulting in reduced daytime visibility, as well as, bead loss resulting in poor nighttime retroreflectivity. Pavement markings should be inspected frequently to ensure that they are in acceptable condition. Service life shown in the table below:

Material	Relative Cost	Service Life
Waterborne Paint	$	0.5-1
Tape	$$$	4-8
Epoxy	$$	3-5
Thermoplastic	$$	3-5
MMA	$$	3-5

SECTION 19- INSPECTION

For detailed information, please refer to UDOT's Construction Inspection Guide at this link: https://www.udot.utah.gov/connect/business/construction-engineering-management/

SECTION 20- PAVEMENT MARKINGS ASSET MANAGEMENT PLAN

Improved marking performance is achieved through choosing the appropriate material and installation method for each roadway. Historically UDOT has relied heavily on the use of waterborne paint. While waterborne paint is the most economic marking material it has led to driver complaints and poor overall performance. Waterborne paint will still be used as a primary maintenance marking material. UDOT will begin to implement other materials based on roadway suitability.

SECTION 21- REFERENCE MATERIALS

UDOT's Manual on Uniform Traffic Code Devices (UMUTCD),
UDOT's Standard Specifications for Road and Bridge Construction
UDOT's Construction Inspection Guide
SECTION 01558- Temporary Pavement Markings
SECTION 02765: Pavement Marking Waterborne Paint
SECTION 02766S: Pavement Marking Epoxy
SECTION 02767S: Pavement Marking Tape
SECTION 02766: Glass Beads for Waterborne Traffic Paint
SECTION 02768: Pavement Marking Materials
SECTION 02983: Grinding for Grooved-In Pavement Markings