DUNN TOWNSHIP'S RETROREFLECTIVITY SIGN POLICY

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FOREWORD

Signs are considered essential to communicating regulatory, warning, and guidance information. It is critical that signs are able to fulfill this role during both daytime and nighttime periods. The ability of a sign to fulfill its role during nighttime periods is provided by a unique form of reflection known as "retroreflectivity." The retroreflectivity of signs, however, degrades as the signs age in the field. A new standard requires that agencies maintain traffic signs to a minimum level of retroreflectivity. Various methods can be used within an agency's sign management processes to meet and maintain a minimum retroreflectivity requirement for traffic signs. This policy describes Dunn Townships method for maintaining traffic sign retroreflectivity that can be used to:

- Systematically identify those signs that do not meet the minimum level of retroreflectivity.
- Initiate activities that will upgrade signs that fall below the minimum required levels.
- Monitor the retroreflectivity of in-place signs.
- Create procedures that will assess the need to change practices and policies to enhance the nighttime visibility of signs.

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CHAPTER 1. INTRODUCTION

BACKGROUND

The purpose of traffic control devices and the principles for their use is for the promotion of highway safety and efficiency by providing for the orderly movement of all road users. Those devices notify road users of regulations, provide warning, and give guidance needed for safe, uniform, and efficient operation of all elements of the traffic stream.

Dunn Township has been tasked with actively managing its traffic signs and ensuring that its traffic signs are performing as they are intended. It is generally believed that maintaining the daytime performance of traffic signs (i.e., placement, clarity of message, adequate sight lines, redundancy, and color) is more easily accomplished than maintaining the nighttime performance. Nighttime performance of traffic signs can be more difficult to maintain for a variety of reasons. One of the primary differences between daytime and nighttime sign performance is a material property called retroreflection. Retroreflection is a special type of reflection that redirects incident light (i.e., from headlights) back toward the source. In the case of highway application, traffic signs are made with retroreflective sign sheeting material that redirects headlamp illumination back toward the vehicle, thereby making the sign visible at nighttime to the vehicle driver.

The nighttime visibility of traffic signs that is provided through retroreflective sign sheeting materials is difficult to assess during daytime conditions using visual inspection methods. Futhurmore, the retroreflective properties of all sign sheeting materials degrade over time, making signs progressively less visible (i.e., less bright) at night. Environmental conditions, such as UV-radiation from the sun, moisture, and pollutants cause a substantial amount of the deterioration in retroreflective performance. However, loss of retroreflectivity can also occur due to vandalism, such as paint ball shots, gunshots, and spray paint.

As signs degrade and become less retroreflective, their effectiveness in communicating regulatory, warning and guidance messages to road users at nighttime diminishes to the point that they cannot be seen or read in time for a driver to react properly. Thus, to maintain nighttime effectiveness, signs must be replaced before they reach the end of their useful retroreflective life. Research has led to the development of recommended minimum maintained levels of traffic retroreflectivity for regulatory, warning, and guide signs for currently available materials, vehicle fleet characteristics, and capabilities of the driving population.

The Federal Highway Administration (FHWA) developed minimum maintained traffic sign retroreflectivity levels in response to a Congressional directive in the Department of Transportation and Related Agencies Appropriations Act, 1993 (public law 102-388; October 6, 1992). Section 406 of this Act directed the Secretary of Transportation to revise the Manual on Uniform Traffic Control Devices (MUTCD) to include a standard for minimum levels of retroreflectivity that must be maintained for traffic signs and pavement markings, which apply to all roads open to public travel. As a result of rulemaking, Dunn will need to implement sign maintenance methods that incorporate the consideration of minimum retroreflectivity levels to provide for nighttime visibility of signs. This document provides general information on methods for maintaining minimum traffic sign retroreflectivity levels.

CHAPTER 2. RETROREFLECTIVITY MAINTENANCE METHODS

The FHWA has outlined maintenance methods that are intended to provide agencies, including Dunn Township, with a flexible means of conformance with the MUTCD requirements for minimum retroreflectivity of traffic signs and provide protection from potential tort claims.

The establishment of minimum maintained sign retroreflectivity levels in the MUTCD requires that agencies adopt one or more acceptable methods. This provision was intended to assure that agencies use methods that will be effective in maintaining nighttime visibility for their deployed traffic signs.

In order to minimize the risk to an agency of being found negligent in meeting the requirements for minimum traffic sign retroreflectivity, a sign maintenance program must be provided in order to ensure the nighttime visibility of signs.

DEFINITIONS OF MAINTENANCE METHODS

The following accepted methods are described in greater detail in this report.

* **Nighttime Visual Inspection.** The retroreflectivity of an existing sign is assessed by a trained sign inspector following a formal visual inspection procedure from a moving vehicle during nighttime conditions. Signs that are visually identified by the inspector to have retroreflectivity below the minimum levels should be replaced.
* **Measured Sign Retroreflectivity.** Sign retroreflectivity is measured using a retroreflectometer. Signs with retroreflectivity below the minimum levels should be replaced.
* **Expected Sign Life.** The installation date is labeled or recorded when a sign is installed, so that the age of any given sign is known. The age of the sign is compared to the expected sign life. The expected sign life is based on the retroreflectivity degradation in a geographic area. Signs older than the expected life should be replaced.
* **Blanket Replacement.** All signs in an area/corridor or of a given type are replaced at specified intervals. This eliminates the need to assess retroreflectivity or track the life of individual signs. The replacement interval is based on the expected sign life for the shortest-life material used in the area/corridor or on a given sign type.
* **Control Signs**. Replacement of signs in the field is based on the performance of a sample set of signs. The control signs might be a small sample located in a maintenance yard or a selection of signs in the field. The control signs are monitored to determine the end of retroreflective life for the associated signs. All signs represented by a specific set of control signs should be replaced before the retroreflectivity levels of the control signs reach the minimum retroreflectivity levels.

A sign management system could also be used as one of the evaluation methods. However, an evaluation method is a tool that supports a sign management system. A sign management system does not provide a means for evaluating nighttime sign visibility; it provides a means of managing information from one or more evaluation systems used to predict when a sign should be replaced.

The sign retroreflectivity maintenance methods described above are divided into two groups, assessment methods and management methods, as noted in the following table. Agencies have flexibility to adapt these methods for maintaining sign retroreflectivity into existing sign management processes or may upgrade their sign management process by incorporating an approved maintenance method.

Retroreflectivity Maintenance Methods

Assessment Methods	Management Methods
Nighttime Visual Inspections Retroreflectivity Measurements	Expected Sign Life Blanket Replacement Control Signs

COMBINING MAINTENANCE METHODS

Combinations of two or more methods may be viable for some agencies.

One possible combination is the use of a management method with both daytime and nighttime visual inspections. The expected life of a sign is a management method and is based on the age and degradation of the sheeting types used. This management method in combination with daytime visual inspections may allow an agency to track how many signs they have, how old they are, and where they are located. It also provides field crews with a list or summary of deployed signs that can be easily used to note for sign replacements or repairs when conducting nighttime visual inspections. Combining the expected sign life management method with both daytime and nighttime visual inspections is one example of adapting methods that meet an agency's needs.

OBJECTIVES OF SIGN RETROREFLECTIVITY MAINTENANCE METHODS

The intent of the methods is to provide a systematic means for agencies to maintain traffic sign retroreflectivity at or above the minimum levels. The FHWA has determined that agencies that use an approved method to maintain traffic sign retroreflectivity are in conformance with the minimum maintained retroreflectivity requirements established in the MUTCD.

Substantial conformance with the MUTCD Section 2A.09 is achieved by having a method in place to maintain the minimum retroreflectivity levels. Conformance does not require or

guarantee that every individual sign will meet or exceed the minimum retroreflectivity levels at every point in time.

Regardless of which maintenance method is adopted by an agency, documentation of the sign management process is important in assisting agencies to achieve conformance with the MUTCD standard to maintain minimum retroreflectivity levels of traffic signs. Written procedures ensure that agency personnel properly follow the selected method, while maintenance records provide the agency with a systematic process for sign replacements and justification for the allocation of limited resources. As long as an agency has a reasonable method in place to manage or assess its signs and establishes a reasonable schedule for sign replacement as needed, the agency will be deemed to be in conformance.

CHAPTER 3. ASSESSMENT METHODS

VISUAL NIGHTTIME INSPECTIONS

Visual inspections are perceived to be the most likely means to find nighttime visibility problems with signs. Using this approach, it is possible to assess more than just the retroreflectivity of a sign. Damage, obstructions, poor placement, and other factors that might detract from the nighttime visibility of the sign can be observed. The MUTCD currently includes language that encourages agencies to undertake periodic daytime and nighttime visual inspections. Many agencies already perform some type of periodic sign inspection, although not all inspections are performed at nighttime. This method requires a minimal investment of resources on the part of the agency, although there is a need for a record-keeping system for inspection data and the potential for higher labor costs where overtime pay is required. While visual inspections will reveal night visibility problems not discernable under any other method, they are subjective and hence more difficult to tie to a benchmark value of retroreflectivity. Agencies using visual inspections must establish procedures to provide consistency in inspections. This implies the need for training programs and certification of inspectors to assure consistency of inspections. Inspection procedures should address the type of vehicle used, type of headlamps on the inspection vehicle, headlamp aiming, and age and visual acuity of the inspector(s).

Concerns

One concern associated with nighttime visual inspections is that it is the most subjective of all the methods. Another concern is funding overtime pay to conduct the inspections during late-evening or early-morning hours. It is also important that inspectors are properly trained.

MEASURED SIGN RETROREFLECTIVITY

In general there are two ways that sign retroreflectivity can be measured in the field: with hand-held contact instruments or with non-contact instruments. Contact instruments require the measurement device to be in physical contact with the sign surface. Non-

contact instruments, which measure the retroreflectivity from a distance, include both a hand-held device and vehicle-based systems. The use of the measurement method as an exclusive process to maintain sign retroreflectivity has not historically appealed to agencies.

Concerns

The main concern with the measured sign retroreflectivity method is that retroreflectivity only accounts for one aspect of a sign's appearance. Other factors should be considered when determining whether or not a sign is adequate for continued use at a particular location. These factors include ambient light levels, presence of glare, location relative to the road, and the complexity of the visual background. A sign that is acceptable in a rural environment may not be acceptable in a complex urban environment.

Another concern with this method is the amount of time it takes to measure the retroreflectivity of a traffic sign using hand-held devices. Given the current methods and technology available to obtain a sign's retroreflectivity, the time commitment required to take retroreflectivity readings of all signs within an agency's jurisdiction may be labor intensive and cost prohibitive.

CHAPTER 4. MANAGEMENT METHODS

EXPECTED SIGN LIFE

In this method, signs are replaced before they reach the end of their expected service life. The expected service life is based on the time required for the retroreflective material to degrade to the minimum retroreflectivity levels. The expected service life of a sign can be based on sign sheeting warranties, test deck measurements, measurement of signs in the field (control signs) and measurement of signs taken out of service, or information from other agencies. The key to this method is being able to identify the age of individual signs. This is often accomplished by placing a sticker or other label on the sign that identifies the year of fabrication, installation, or planned replacement or by recording the date of installation in a sign management system. Various approaches or algorithms can be used to trigger an indication of the need to replace a sign. For example, one software system uses sign material type, color, age, and direction the sign faces in a model that predicts the level of retroreflectivity at any point in time. When the minimum levels are approached, the sign is flagged for replacement. The process must, however, be geared to flag signs that need replacement early enough to assure that the process of physical replacement can be completed before the signs drop below the minimum retroreflectivity levels.

Concerns

The main concern with this method is that there is little data on how different types of sheeting deteriorate over time in a given climate. It can be a complex process to determine how long signs of a certain sheeting type and color will last in a given region of the country. Also, there are no definitive results on the role that the orientation of the sign face

plays in the deterioration of the sign and whether or not signs facing different directions deteriorate at significantly different rates. While there have been many studies, these studies do not come to the same conclusions about the relationship between sign face orientation and deterioration rates.

One of the easiest ways to assign expected sign life to retroreflective sheeting materials is to use the manufacturer's warranty. However, these warranties obviously include a certain factor of risk on the part of the manufacturer and therefore are often conservative. They also vary depending on the region of the country. In general, however, it can be expected that retroreflectivity sheeting materials will have a warranty provided for the ASTM Type-designated materials as shown in the following table. Additional information on sign sheeting durability can be found in several research reports.

Typical Warranty Life

ASTM D4956 Type	Years of Warranty*
I and II	7
III and IV	10
VII, VIII, IX, X	12
*May be different for fluorescent materials	

BLANKET REPLACEMENT

The blanket replacement method is essentially the expected sign life method executed on a spatial or strategic basis. On the spatial basis, all the signs in a specific area or corridor get slated for replacement at the same time, when the effective service life is reached. On a strategic basis, all the signs of a specific type get slated for replacement at the same time. Depending on the size of the jurisdiction, it may be possible to plan sign replacements that consider both geographic and strategic criteria. The blanket replacement is being used by various agencies around the country such as the City of Glendale, AZ.

This method is probably the simplest of the management methods in that tracking the age of individual signs, either by physical labeling or in a database, is not necessary. It is only necessary to maintain a record of when the blanket actions were undertaken and when they need to be repeated. Usually this method is repeated after a set number of years, depending on the expected life of the signs.

Concerns

One of the issues with this method is that the replacement times can vary depending on the region of the country in which the agency is located, or even across a jurisdiction for large agencies. The replacement time also depends on the types of sheeting that are used to

make the agency's traffic signs. Therefore, an agency needs to have relevant data on the in-service life of all the sheeting materials it has in the field. Another concern is that this method potentially wastes resources by removing signs before their useful life has been reached. This is particularly true where signs have been added or replaced in an area after the last replacement cycle. When the replacement cycle comes around, these signs will be replaced regardless of their age. They can be reused if handled properly, but that would require that each sign that is replaced be inspected to determine the amount of useful sign life remaining.

CONTROL SIGNS

The control sign method is based on measurements made of a subset of signs that represent an agency's inventory. The subset of signs represents a population of signs made with the same material for which the retroreflectivity performance over time is monitored by actual measurements. As the retroreflectivity levels of the control signs approach the minimum levels, it triggers action to begin replacement of the entire associated population. The control signs can be located at one or more of the agency's maintenance yards or can be traffic signs that are deployed at various locations in the jurisdiction. The control signs are measured periodically to monitor actual degradation of retroreflectivity. This method requires only the management of the control sign information and the retroreflectivity measurements of those signs over time.

Concerns

The effectiveness of this method is dependent upon the size of the control sign sample. The larger the sample, the better the estimation of the retroreflectivity levels of the sign populations it represents. There is no specific guidance on the number or percentage of the population the sample represents. However, a minimum of three signs per type of sheeting and color should be monitored.

Another question relates to how often a set of control signs is needed. Each new sign material or deployment of a major product order would warrant a set of control signs, as there are likely to be differences in retroreflectivity performance.

Another consideration is how often control signs should be checked for their retroreflectivity levels and appearance. If the time interval between measurements is too short, then this may needlessly waste time and personnel resources. On the other hand, if the time interval is too long, signs may be left in the field that are not adequate for continued use and may pose as a possible safety risk. An annual inspection of the signs, including retroreflectivity measurements, may be appropriate.

CHAPTER 5. DUNN TOWNSHIP'S APPROVED MAINTENANCE METHOD

BLANKET REPLACEMENT

After review of the various methods proposed for sign maintenance, Dunn Township has approved the Blanket Replacement method on a geographic basis. This method is the easiest method to implement and allows for the least amount of judgmental input.

Specifications

- Currently, the two most commonly used sheeting for signs (that meet the retroreflectivity standards) are the High Intensity Prismatic (HIP) reflective sheeting and the Diamond Grade quality. It appears that the extra cost of the Diamond Grade does not significantly increase the expected life of the sign. Therefore, Dunn Township will purchase HIP grade signs.
- It is expected that each sign will have a date strike attached to mark the date placed in service.

Timeline

- It is expected that sign replacement will begin in the 2010 calendar year and that all signs in the township will be updated within 4 years.
- The township will be divided in to 4 quarters. All signs within a quadrant will be replaced in a specific year.
- The expected life of HIP signs is 10 years. Therefore, it would be expected that signs would again be replaced, on a quadrant basis, in 2020, etc.

Anderson Passe sign inventory/recommended action

- In September/October, 2009, Anderson Passe Associates were contracted to review all signs within Dunn Township and recommended either replacement or removal of existing signs or placement of new signs. Dunn Township will follow the general recommendations of Anderson Passe, but will reserve the right to make decisions regarding individual signs within the township. A copy of the Anderson Passe report can be obtained by contacting the Dunn Township Clerk.

REFERENCES

Dunn Township's Retroreflectivity Sign Policy relies heavily on Publication #FHWA-HRT-08-026 of the U.S. Department of Transportation, Federal Highway Administration and in many cases quotes that publication verbatim.