Ontario

Book 4

Ontario Traffic Manual

March 2020

Ground-mounted Sign and Support Inspection and Maintenance

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Ontario Traffic Manual

Foreword

The purpose of the Ontario Traffic Manual (OTM) is to provide information and guidance for transportation practitioners and to promote uniformity of treatment in the design, application and operation of traffic control devices and systems across Ontario. The objective is to increase safe driving behaviour, achieved by a predictable roadway environment through the consistent, appropriate application of traffic control devices. Further purposes of the OTM are to provide a set of guidelines consistent with the intent of the Highway Traffic Act and to provide a basis for road authorities to generate or update their own guidelines and standards.

The OTM is made up of a number of Books, which are being generated over a period of time, and for which a process of continuous updating is planned. Through the updating process, it is proposed that the OTM will become more comprehensive and representative by including many traffic control devices and applications specific to municipal use. Some of the Books of the OTM are new, while others incorporate updated material from the Ontario Manual of Uniform Traffic Control Devices (MUTCD) and the King's Highway Guide Signing Policy Manual (KHGSPM).

The OTM is directed to its primary users, traffic practitioners. The OTM incorporates current best practices in the Province of Ontario. The interpretations, recommendations and guidelines in the OTM are intended to provide an understanding of traffic operations and they offer a broad range of traffic situations encountered in practice. They are based on many factors which may determine the specific design and operational effectiveness of traffic control systems. However, no manual can cover all contingencies or all cases encountered in the field. Therefore, field experience and knowledge of application are essential in deciding what to do in the absence of specific direction from the Manual itself and in overriding any recommendations in this Manual.

The traffic practitioner's fundamental responsibility is to exercise engineering judgement and experience on technical matters in the best interests of the public and workers. Guidelines are provided in the OTM to assist in making those judgements, but they should not be used as a substitute for judgement.

Design, application and operational guidelines and procedures should be used with judicious care and proper consideration of the prevailing circumstances. In some designs, applications, or operational features, the traffic practitioner's judgement is to meet or exceed a guideline while in others a guideline might not be met for sound reasons, such as space availability, yet still produce a design or operation which may be judged to be safe. Every effort should be made to stay as close to the guidelines as possible in situations like these, and to document reasons for departures from them.

Custodial Office

Inquiries about amendments, suggestions or comments regarding the Ontario Traffic Manual or Book 4 (Ground-mounted Sign and Support Inspection and Maintenance) may be directed to:

Ministry of Transportation, Ontario
Provincial Traffic Office
301 St. Paul Street, 2nd Floor
St. Catharines, Ontario L2R 7R4

Tel: (905) 704-2960
E-mail: otm@ontario.ca

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Acknowledgements

Project Consultant Team

Mike Walters, Dillon Consulting Limited

Paul MacLeod, Dillon Consulting Limited

Heather Swan, Dillon Consulting Limited

Milton Harmelink, Arges Training & Consulting

Rodney Edwards, Arges Training & Consulting

Maryann Lovicsek, IBI Group

Anthony Sgro, IBI Group

Peter Jefford, Delcan Corporation Limited

Pam Pittens, Delcan Corporation Limited

Sue Hope, Delcan Corporation Limited

Bob Darrall, Delcan Corporation Limited

Suzanne Rodenkirchen (Design & Layout)

Technical Steering Committee

Mazda Hodiwala, Ministry of Transportation (MTO), Provincial Traffic Office

Tracey Difede, MTO Provincial Traffic Office

Vic Ozymtchak, MTO Provincial Maintenance Office

Martin Sneep, MTO Traffic, Central Region

Joe Roloson, MTO Maintenance, Central Region

Richard Sturge, MTO Maintenance, Central Region

Mark McMahon, MTO Operations, Northwest Region

Kwong-Yui Chu, MTO Provincial Bridge Office

Arshad Azhar, MTO Provincial Design & Contract Standards Office

Tracey Johnston, MTO Sign Shop

Lawrence M. K. Dunks, City of Ottawa

Allen Pinkerton, City of Toronto

Henry Chu, City of Toronto

Danny Antwi, City of Toronto

Ariel Guevarra, City of Mississauga

Domenic Galamini, City of Mississauga

Brian Anderson, Ontario Good Roads Association (OGRA)

Dave Jessop, Carillion (Area Maintenance Contractor, West)

James Delamere, Stinson Equipment

Ron Haslam, Maximum Signs

Table of Contents

List of Tables

List of Figures

1. Introduction

Book 4 (Ground-mounted Sign and Support Inspection and Maintenance) is part of a series of volumes that makes up the Ontario Traffic Manual (OTM). Book 4 describes practical methods and guidelines for inspecting and maintaining signs and sign support structures for ground-mounted signs. Book 4 does not address overhead signs or overhead sign support structures. Overhead sign structures, including signs mounted on traffic signal mast arms and bridge spans, are addressed in the Ministry of Transportation's (MTO) Sign Support Manual (SSM), and guidance regarding inspection and maintenance can be found in the MTO "Sign Support Inspection Guidelines". Book 4 is intended for those engaged in the actual practice of inspecting and maintaining signs and ground-mounted sign supports.

OTM Book 3 (Ground-mounted Sign Support and Installation) should be referenced for selecting and designing suitable ground-mounted support structures.

Other Books in the OTM series provide practical guidance on a full range of traffic control devices and their application. Other documents, not in the OTM series, are also useful. The TAC Geometric Design Guide 2017 along with MTO Design Supplement (issued by Design and Contract Standards Office in December 2017), the MTO Roadside Design Manual, and OTM Book 7 (Temporary Conditions) also provide guidance in the design of temporary conditions. These and other references are listed in Appendix B, References.

1.1 Purpose and Scope

OTM Book 4 (Ground-mounted Sign and Support Inspection and Maintenance) has been developed both to improve uniformity among agencies having experience and knowledge of inspecting and maintaining signs and sign supports and to provide direction and guidance on procedures for agencies having little experience in these areas. Book 4 is intended for use by the following agencies and organizations:

(1) The Provincial, Municipal, and private road authorities in Ontario and their contractors.

(2) Utilities, contractors, and others who may have approval to work on public roadways.

Sign and sign support inspection and maintenance must be carried out in a safe environment and a safe manner. OTM Book 7 (Temporary Conditions) is the Ontario standard addressing work zone traffic control and safety, and its procedures are applicable to sign inspection and maintenance. Book 7 is referenced in Book 4 where appropriate.

OTM Book 4 contains information needed to prepare and implement an inspection and maintenance program for ground-mounted signs and supports. This includes preparation of an inventory management system, sign inspection and review, identification of maintenance prioritization, and sign maintenance.

This Book provides guidance for consistency of ground-mounted sign inspection and maintenance across Ontario for municipal and provincial transportation systems.

1.2 Legal Authority – Signs

MTO, through the Highway Traffic Act (HTA), the Public Transportation and Highway Improvement Act, and various related statutes, has the legal authority and responsibility to regulate and control traffic on a highway (see definition, Appendix A), and to regulate and control motor vehicles operating in the province. MTO has contracted the maintenance of highways under a series of Maintenance Contracts, which include specifications for the maintenance of roadside features including regulatory, warning and information signing.

Municipalities, through the Municipal Act and various regional municipality acts, and as empowered to enact municipal by-laws through various provisions of the HTA and other provincial acts, have the legal authority and responsibility to regulate and control traffic on their highways. This authority and responsibility also applies to construction and maintenance activities on highways. The regulation under the Municipal Act (Ontario Regulation 239/02 as amended), specifies minimum maintenance standards for municipal roads in Ontario. Traffic signs and other devices to regulate, warn or guide traffic are to be installed only under the authority of the road agency having jurisdiction.

When they have been delegated or designated authority, work zone contractors and utility companies may be permitted to install temporary conditions signs and devices, or to use traffic control persons to protect road users, the public, workers, and equipment. This is subject to the guidelines of OTM Book 7 (Temporary Conditions), the Occupational Health and Safety Act and its regulations, and the requirements of the road authority.

Regulatory devices may need to be supported by applicable legislation, regulations, or by-laws. Effective traffic control requires both the appropriate application of traffic control devices and reasonable, effective enforcement.

Where the use of prescribed or official signs is required by the HTA or the Regulations under the HTA, such signs may be erected by the public authority having jurisdiction over the particular highway, or by its agent. However, in the cases set out more particularly in the HTA, where a municipal by-law is required, the prescribed or official sign indicated should not be erected without the authority of such a by-law.

Traffic signs, or their supports, should not bear unauthorized commercial advertising. Signs may not be placed on a public highway by private organizations without the approval of the road authority. All unauthorized signs should be removed since they divert attention from authorized signs.

Erection of temporary conditions signs by public utility companies may be authorized by obtaining specific permission in each case. Temporary conditions signs and devices required to protect workers and equipment engaged in maintenance or repair work on a public highway do not need specific permission, provided that they conform to the manual standards as to size, shape, and colour. Slight deviations are permissible if found more effective and if they are approved by the proper road authorities. Temporary conditions devices and the policies pertaining to their use and maintenance are found in OTM Book 7 (Temporary Conditions).

1.3 Metrication

All dimensions are in millimetres unless otherwise stated.

2. Maintenance Prioritization

Clean, legible, properly mounted devices in good working condition command the respect of road users and are necessary for safety. Prioritization of maintenance is necessary to allocate limited resources in a rational and economical method.

Signs may be prioritized for their eventual maintenance and/or replacement through a risk-based approach that considers: condition, sign and route importance, administrative cost, replacement options, and other contributing variables. The premise is that the most important sign in the worst condition is given the highest priority.

Maintenance prioritization requires a sign inventory that records the location of all signs, recent maintenance activities, and inspection results (which could be categorized as acceptable, marginal or unacceptable) and proposed maintenance activity. Sign inventories are discussed in more detail in Sections 5 and 8.

3. Implications of Maintenance Deficiencies

3.1 Highway Safety and Operational Implications

Inspection and maintenance of signs and sign supports is as important as the selection and installation of these signs. Improper sign maintenance can lead to drivers making erratic manoeuvres including slowing or stopping on the road, making abrupt turns, or missing intended routes or destinations. Some possible implications of maintenance deficiencies include a reduced level of safety for road users (which could lead to injury or death), and an increase in pollution due to additional drive time for missed turns.

An injury due to an collision can have a significant impact on an individual, family and community. It can cost significant dollars to the health care system, not only in the immediate care related to the injury, but follow-up care related to impairment of mobility, and can seriously impact the ability for someone to earn a living.

Initially, the capital, operating, and maintenance costs may increase as a road authority catches up to its backlog. However, in the longer term, the road authority will gain the benefits of inspection and maintenance with an opportunity for net savings and a sustainable sign infrastructure.

3.2 Liability Implications

Proper inspection and maintenance of signs (including the prudent documentation of these activities) is essential to satisfy legal and contractual requirements for signage. It can assist in providing defense against lawsuits arising from collisions which challenge the condition of a sign. Road authorities should be aware of the legal implications and associated costs of poorly maintained signage. Delaying needed inspections and maintenance jeopardizes public safety, and results in the road authority (and their insurance providers) having to cover the expenses and damages of preventable collisions.

All regulatory and warning signs must be inspected routinely to ensure the signs are adequate and functioning properly. Currently there are minor differences regarding the timing of inspection and maintenance requirements for Provincial Road Authorities and Municipal Road Authorities. Refer to the regulation under the Municipal Act (Ontario Regulation 239/02) and Provincial Performance specification 4001 to confirm current time lines for inspecting, replacing or repairing signs.

See Section 4 for the further details regarding retroreflectivity levels, sheeting types, and contrast and Table 1 for a summary of minimum maintained retroreflectivity levels (min. Ra).

4. Retroreflectivity

Traffic signage provides drivers with the information they need in order to use the road system safely and efficiently. Care is therefore required to ensure that signs are clear both during the day and night. The use of retroreflective sheeting enhances the luminosity (brightness) of a sign by reflecting the light from the vehicle's headlights directly back (retro) to the driver. Retroreflective levels, or Retroreflective coefficient of (R) indicates the proportion of the light reflected back to the driver from the sign surface, in candelas per lux per square meter.

The intent of using brighter signs is to make signs more noticeable in an effort to reduce collisions and collision-related costs. A few studies have concluded that updating critical road signs with brighter sheeting and using bigger signs can potentially reduce collisions. The use of better signs which are clearly understood and are well maintained will reduce costs associated with collisions and make for a better transportation system. Removing ineffective signs will also help in reducing confusion and in maintaining the importance of more critical signs.

Levels of retroreflectivity of signs in similar settings should be consistent and function to assist the driver in noticing the sign, its importance, and to enhance its legibility. On roads where there is constant glare from other light sources, higher retroreflectivity levels could be considered to ensure road signs are not overlooked by drivers. For example, in urban areas where there are illuminated advertising signs competing for the driver's attention, a critical warning or regulatory sign should not go unnoticed.

On lower volume rural roads with no illumination, the ambient light at night tends to be lower than in urban areas and a driver using high beams can make retroreflective road signs overly bright, illegible and possibly distracting. As the driver's eyes attempt to adjust to the sudden source of light and the immediate absence of light after passing the sign, there may be moments when the driver is temporarily blinded, in the same manner that the high beams of an occasional oncoming vehicle on a two-lane road can negatively affect the driver's vision.

4.1 Minimum Maintained Retroreflectivity Levels

A road authority should maintain retroreflectivity for critical regulatory and warning signs at or above the minimum levels summarized in Table 1. This table is based on the Transportation Asscociation of Canada (TAC) MUTCD Table A1-5 modified for use in Ontario.

In areas where higher levels of lighting are present (e.g., roads with street lighting, roads with glare from other light sources), it may not be practical to maintain sign retroreflectivity to the levels shown in Table 1. In these cases, the values shown in Table 2 should be considered best practices to follow.

Table 1 – Minimum Maintained Retroreflectivity Levels for Critical Signs

Sign Colour	Additional Criteria	Sheeting Type (ASTM D4956 11a)			
		Beaded Sheeting			Prismatic Sheeting
		I	II	III	IV, VIII, IX, XI
Black on Fluorescent Yellow/Green	None	Y*; O*			Y/G ≥ 75
Black on Yellow	None	Y*; O*	Y ≥ 75; O ≥ 75		
White on Red	See Note **	W ≥ 35; R ≥ 7			
Black and White	None	W ≥ 35			

Special Cases

- **WB-1** (Stop Ahead) – Red retroreflectivity ≥ 7
- **WB-2** (Yield Ahead) – Red retroreflectivity ≥ 7; White retroreflectivity ≥ 35
- **WB-4** (Signal Ahead) – Red retroreflectivity ≥ 7; Green retroreflectivity ≥ 7
- **WB-9** (Speed Reduction) – White retroreflectivity ≥ 50
- **WA-37** (Delineation Markers) – White/Yellow sheeting is minimum 15 cd/lx/m

Exclusions to Minimum Maintained Retroreflectivity Levels

- Temporary Conditions signs (TC Series signs)
- Guide and Information signs
- Parking, Standing, and Stopping Prohibited signs
- Acknowledgement signs
- Signs that are not intended for use by motorists

Notes:

* This sheeting type should not be used for this colour for this application. The minimum maintained retroreflectivity levels shown in this table are in units of cd/lx/m^2 measured at an observation angle of 0.2° and an entrance angle of -4.0°.

** Minimum sign contrast ratio ≥ 3:1 (white retroreflectivity ÷ red retroreflectivity)

Table 2 – Recommended Best Practices

<table>
<tr><th rowspan="3">Sign Colour</th><th rowspan="3">Additional Criteria</th><th colspan="4">Sheeting Type (ASTM D4956 11a)</th></tr>
<tr><th colspan="3">Beaded Sheeting</th><th>Prismatic Sheeting</th></tr>
<tr><th>I</th><th>II</th><th>III</th><th>IV, VIII, IX, XI</th></tr>
<tr><td colspan="6">Roads with Street Lighting</td></tr>
<tr><td>Black on Fluorescent Yellow/ Green</td><td>None</td><td colspan="3">Beaded sheeting should not be used</td><td>Y/G ≥ 90</td></tr>
<tr><td>Black on Yellow</td><td>None</td><td>Y*; O*</td><td colspan="3">Y ≥ 90; O ≥ 90</td></tr>
<tr><td>White on Red</td><td>See Note **</td><td colspan="4">W ≥ 40; R ≥ 8</td></tr>
<tr><td>Black and White</td><td>None</td><td colspan="4">W ≥ 40</td></tr>
<tr><td colspan="6">Roads with Glare (from other light sources) and No Street Lighting</td></tr>
<tr><td>Black on Fluorescent Yellow/ Green</td><td>None</td><td colspan="3">Beaded sheeting should not be used</td><td>Y/G ≥ 145</td></tr>
<tr><td>Black on Yellow</td><td>None</td><td colspan="3" rowspan="3">Beaded sheeting should not be used</td><td>Y ≥ 270; O ≥ 145</td></tr>
<tr><td>White on Red</td><td>See Note **</td><td>W ≥ 360; R ≥ 65</td></tr>
<tr><td>Black and White</td><td>None</td><td>W ≥ 360</td></tr>
<tr><td colspan="6">Special Cases</td></tr>
<tr><td colspan="6">• WB-1 (Stop Ahead) – Red retroreflectivity ≥ 7
• WB-2 (Yield Ahead) – Red retroreflectivity ≥ 7; White retroreflectivity ≥ 35
• WB-4 (Signal Ahead) – Red retroreflectivity ≥ 7; Green retroreflectivity ≥ 7
• WB-9 (Speed Reduction) – White retroreflectivity ≥ 50
• WA-37 (Delineation Markers) – White/Yellow sheeting is minimum 15 cd/lx/m</td></tr>
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• Acknowledgement signs
• Signs that are not intended for use by motorists</td></tr>
<tr><td colspan="6">Notes:
* This sheeting type should not be used for this colour for this application. The minimum maintained retroreflectivity levels shown in this table are in units of cd/lx/m^2 measured at an observation angle of 0.2° and an entrance angle of -4.0°.
** Minimum sign contrast ratio ≥ 3:1 (white retroreflectivity ÷ red retroreflectivity).</td></tr>
</table>

4.2 Factors which affect Maintained Retroreflectivity Levels

As a sign in service ages its retroreflectivity levels will decrease. There are many interconnected factors which affect the rate of decrease of a sign's retroreflectivity:

(1) Sheeting type/sign materials

(2) Environmental factors, such as:

- solar radiation
- temperature, and temperature changes
- water, dew and frost
- snow and ice

(3) Foreign materials on the sign, such as;

- spray paint, stickers, and other graffiti
- dirt and dust

(4) Physical impacts, such as:

- scrapes and deformations from misguided and large vehicles
- target practice type vandalism.

Sheeting Type/Sign Material
Section 4.3 discusses the current retroreflective traffic sign sheeting types in more detail, but essentially all sign sheetings are made up of various layers, typically an outer protective layer of clear plastic/polymer, a reflectorization layer which will include materials such as glass beads or micro-prismatic plastic mirrors fused to a base such as polyvinyl chloride to hold them in place, and an adhesive layer to be attached to the metal or wood sign board. The initial retroreflective level required for each sheeting type is well documented as well as the levels after two to three years in service. Further studies may be completed to determine the typical rate at which each sheeting type deteriorates with age, depending on exposure to controlled environmental factors.

Environmental Factors
Naturally, with time, the various plastic, adhesive and other chemicals will migrate into the atmosphere or 'off gas'. This process is accelerated with exposure to the sun and exposure to extreme temperatures, as well as humidity and temperature changes. These environmental factors increase the energy in the elemental chemistry of the sign material increasing the rate of 'off gassing' and deterioration of the sheeting materials.

Temperature changes lead to expansion and contraction of the sign and since it is made of various materials, and most will have different rates of expansion/contraction, this will lead to cracks being formed on the surface, or splitting of the layers. The presence of water in any cracks or between any of the materials will exacerbate the situation because it also has its own unique expansion and contraction rate and will evaporate, leaving more surface area for exposure to the atmosphere. Additionally, any water on the sign will expand when temperatures drop below the freezing point. At this time the other materials will contract making the cracks and layer separations even larger.

Dew and frost also have a more immediate effect on maintained retroreflectivity levels. A TAC Study completed in 2004, Traffic Sign Retroreflectivity and the Canadian Environment, concluded that the presence of dew and frost on signs significantly decreased the levels of retroreflectivity and in general, full frost coverage will decrease the levels more than dew and typically to levels less than the minimum maintained levels.

The red background of this stop sign has many cracks due to environmental factors.

Foreign Materials

Vandalism, such as spray paint, stickers and posters or any other opaque material attached to the face of a sign will have a negative effect on the sign's retroreflectivity.

The surface of a sign is typically made as smooth as possible. This is important for the proper reflection of light but also for its cleanliness, so that loose foreign materials like dirt/dust can wash off easily with rainwater. As the sign ages and the plastic and other materials deteriorate, the surface will become less smooth and the debris will interfere with the reflection of light.

Physical Impacts

Physical impacts to the sign which produce scrapes, dents, and deformations will reduce the retroreflectivity of a sign. Any type of damage that reduces the sign's flat surface area viewed by drivers, will reduce its retroreflectivity levels. Impacts may also distort the micro-prisms which are key in directing as much light as possible from a vehicle's headlamp back to the driver. The impacted area of the sign may scatter light in directions other than back at the driver.

4.3 Retroreflective Sheeting

Retroreflective sheeting comes in a number of types, as documented in OTM Book 1B, and as specified in American Society for Testing and Materials (ASTM) Specification D4956 and Canadian General Standards Board (CSGB) 62-GP-11M. Exact sheeting choice for new signs or replacement signs will depend on a number of factors, including the sign type, required use, orientation and location and nighttime visibility requirements of the specific application. A description of the various sheeting types, as classified by the current (2011) ASTM D4956-11(a) is provided below. Sheeting types will change from time to time and the most recent information should be used. This is a guideline based on information available at the time.

- **Type I (also known as Engineer Grade)**
  Basic reflective sheeting made up of very small glass beads enclosed in a translucent, pigmented substrate. It has no distinctive identifying pattern, other than, of course, it reflects. This material is one of the most durable (in its ability to withstand rough handling) of all the sign sheeting products, and is generally regarded to have a seven-year service life. Engineer Grade sheeting has reflectivity visible from about 150 m and is commonly used in street signs and municipal signs. Type I signs may be used for regulatory and warning signs but it is not recommended for critical signs, as the retroreflectivity levels may fall below the required value after only a few years.

- **Type II (also known as Super Engineer Grade)**
  Type II is similar to Type I, except it uses larger glass beads which provide about twice the level of reflectivity of Type I sheeting. This sheeting can be identified by small trademarks which are screened into the sheeting. It is generally regarded to have a seven- to ten-year service life. Super Engineer Grade is visible from about 230 m and is the minimum required sheeting for cities and municipalities in the U.S.

The following types are considered high intensity sheeting and will be visible from at least 300 m:

- **Type III**
  This sheeting can be "encapsulated lens" or prismatic sheeting. It is made of two layers: an outer translucent pigmented layer; and an inner reflective layer faced with glass beads or plastic prismatic lenses. The two layers are connected by a lattice, hence its distinctive 'honeycomb' appearance. The lattice pattern varies by manufacturer for easy identification. This is currently the minimum recommended sheeting for critical, warning, and marker signs in Ontario as indicated in OTM Book 5 and Book 6. It is generally regarded to have a ten-year service life.

- **Type IV**
  This is also multi-layer sheeting, except that the reflective layer is made of microscopic reflectors. This sheeting can be distinguished by the pattern of small "squares" superimposed upon a hexagonal lattice grid. This sheeting is about seven times as bright as Type I. It is generally regarded to have a ten-year service life.

The following types are considered to be high reflectivity micro-prismatic:

- **Type VII**
  This has been discontinued and has been reclassified as Type VIII.

- **Type VIII**
  Type VIII is a cube-corner micro prismatic sheeting type similar in design to Type IX and XI, but with distinguishing characteristics similar to Type IV. This sheeting is about six times brighter than Type I. It is generally regarded to have a ten-year service life.

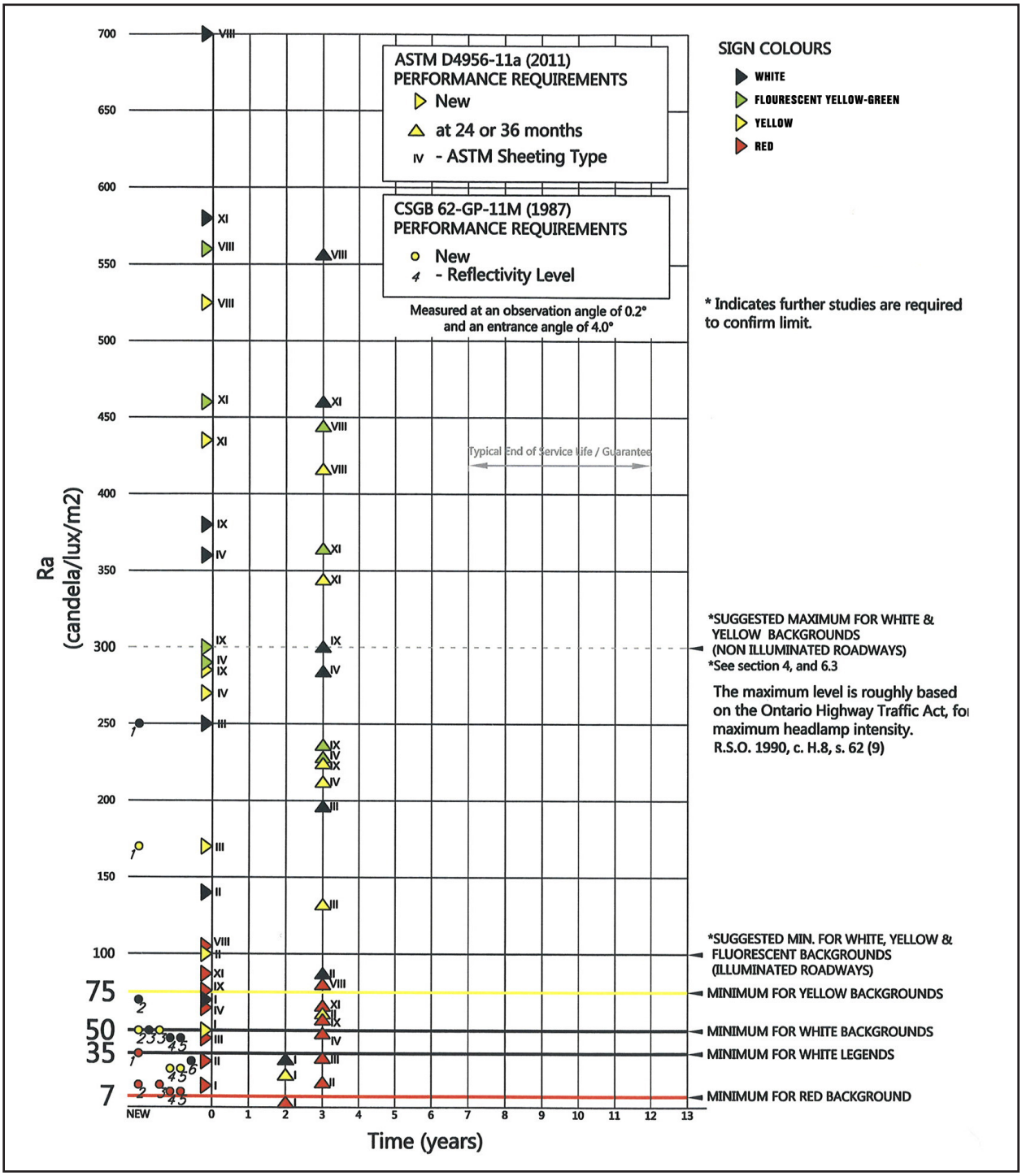
- **Type IX**
  This is also a micro prismatic sheeting distinguished from Type VIII by the "fine" grain of the micro-prisms. This sheeting is about six times brighter than Type I. It is generally regarded to have a ten-year service life. The sheeting is visible from more than 350 m and is commonly used on road construction signs and highway signs where higher speeds require legibility from longer distances.

- **Type X**
  This has been discontinued and has been reclassified as Type VIII.

- **Type XI**
  Type XI is at the highest level of reflectivity for traffic signs and is most commonly used on high-speed highways and construction projects, and in areas where high visibility is critical. It includes the colours fluorescent orange and fluorescent yellow-green, which are used most often for signs posted at school, pedestrian and bicycle crossings. It is generally regarded to have a ten-year service life.

The ASTM specifications are guidelines for manufacturers to produce a consistent product. The specification for retroreflectivity indicates the minimum required R-values of each type of sheeting material for each colour it is produced in (the R-value indicates the portion of light reflected back to the driver). It also specifies the minimum acceptable R-values after an outdoor weathering test. According to the specification, it is acceptable

Figure 1 – Performance Standards for Traffic Sign Sheeting and Minimum Maintained Retroreflectivity Levels for Critical Signs



for most of the sheeting materials used on ground-mounted signs (Type III, IV, VIII, IX, and XI) to show only a 20% reduction in R-value after three years in service. Type I sheeting has the lowest R-values and Type VIII has the highest.

Figure 1 depicts the retroreflectivity performance standards for many of the sheeting types commonly used on traffic signs in Ontario as set out in the current ASTM and CGSB Specifications. Please note that periodically new sheeting types are developed and the sheeting numbering may change. Figure1 also indicates the required minimum maintained retroreflectivity levels for critical regulatory and warning signs.

Some retroreflectivity limits have also been suggested in Figure 1. These limits require further study:

(1) A maximum maintained retroreflectivity level for yellow and white signs on non-illuminated roadways is suggested to reduce the temporary blinding effects of an overly bright sign, typically on dark rural roads as discussed in Sections 4 and 6.3.

(2) A higher minimum maintained retroreflectivity level for white, yellow and fluorescent signs for illuminated roadways, including those roads illuminated with street lighting and from other light sources at night, such as commercial property security lights or illuminated advertisement signs.

4.4 Contrast

The contrast ratio is a comparison of the retroreflectivity levels between the legend and the background. Contrast ratio (Ra legend: Ra background) should be between 4:1 and 50:1. For signs with white legends (text and symbols) on red, green, or blue backgrounds, it is particularly important that the background colour is consistent both during the day and at night, and dark enough to provide contrast with the legend for legibility. If the background colour of these signs is allowed to fade closer to white, the message will be lost as the contrast disappears (even thought the reflectivity of the background material may increase, possibly making the sign more noticeable). Please refer to OTM Book 1, Appendix B for more details regarding contrast.

The street name sign on the pole is deficient because of diminished contrast (approaching 1:1) making it harder to read.

The red from this sign has completely faded away (contrast red:white is 1:1) which could make it unclear whether parking is allowed or not.

5. Sign and Sign Support Inventory Management

As indicated in Section 2, before maintenance can be prioritized, a sign inventory may be developed. As such, each road authority or jurisdiction in Ontario may implement an inventory management system. An inventory management system can include a sign inventory (i.e., sign type, placement, condition and history), and identify procedures regarding maintenance of deficient signs.

The following outlines steps to develop a sign inventory:

Step 1 – Identify sign inventory elements
Identify the types of signs to be included in the inventory. This will be specific to the types of roads found in each jurisdiction and the associated maintenance requirements.

Step 2 – Define inventory (data storage) format
Options including static, computerized and GIS databases are discussed below.

Step 3 – Data collection
Inventory collection methods are discussed in Section 5.3. Data collection protocols may be established by a road authority.

Step 4 – Sign and support inspection and maintenance
Once the data is collected, there then needs to be a program in place to identify and track maintenance required/completed, including a maintenance prioritization process/plan. Inventory management protocols could identify how results from the inventory allow for the generation of work requests to address immediate maintenance requirements (such as repair or replacement of signs and supports, cleaning of signs and vegetation control) and identification of required completion dates.

5.1 Identify Sign Inventory Elements

Information needs to be recorded and documented in a way such that each sign can be uniquely referenced in the field and that pertinent information and details about each sign can be used in the decision-making process. To ensure the integrity of this data, it is important to record metadata as well as the physical features and attributes of the sign.

Where a sign inventory exists, its elements could be reviewed against the recommendations in this book and refined if appropriate.

Items that may be included in a traffic sign inventory include:

- sign manufacturer and installation contractor, if known;
- unique reference for each sign such as a bar-code or radio frequency identification (RFID) tags;
- metadata associated with the sign;
- method to document the history of a sign;
- detail of material specifications;
- reason for installation;
- reference to type of support and attachment;
- reference to the physical location and orientation;
- medium for documenting and updating sign condition;
- anticipated life expectancy related to date of installation and environmental conditions;
- asset value;
- maintenance thresholds;
- embedded maintenance actions;
- maintenance and inspection requirements; and
- failures and failure rectification.

5.2 Define Inventory (Data Storage) Format

The selection and development of the database structure is outlined in this book, taking into account best practices and current technologies, while keeping in mind the need for flexibility across municipalities of varying sizes.

A sign inventory can exist in a number of formats including:

- paper records;
- a database in Microsoft Access, Excel or equivalent; and/or
- GIS-based inventory system.

Regardless of format, the information collected needs to be stored appropriately so that the data is readily available, and be consistent, so that information can be directly compared for all signs within a jurisdiction. Forms that identify the expected inventory content are provided in Section 11.

There are benefits to using a digital system that can be accessed and updated in the field, however this is not mandatory.

5.2.1 Static Inventory Management Database

If a static (paper) system is used for the inventory, the parameters for collection of the data could be the same as an interactive system. The benefits of this system are lower cost and ease of creation. However, it does limit the ability for broad real-time collection and distribution of information.

An inventory will readily identify the type of sign missing; a RFID tag may help locate it if it is very near by. It could also help identify ownership if a sign is found elsewhere.

5.2.2 Computerized Inventory Management Database

The use of a database (i.e., Microsoft Access, Excel or equivalent) allows for a system that is generally more easily accessible and updateable. Most road authorities and jurisdictions will have access to a database program, which should be used if possible. This may require gathering information in the field on paper forms and then updating the database later at the office.

Another option is the use of interactive systems that allow real-time collection of data and remote access to central databases. These systems can increase automation of the data collection process and provide efficiencies in data management and retrieval.

5.2.3 GIS Systems

A GIS compatible system is one example of a technology that can be used to improve the inventory management process.

If a GIS compatible system is chosen for inventory management it is recommended that the system be compatible with the existing software and other infrastructure used (including data storage).

Typical GIS systems components include a lightweight hand-held device with remote download capability, bar code, RFID or other unique identity code generator/printer and reader, camera and GPS locator that works with a secure central database(s) for mapping and other data storage.

5.3 Establish Data Collection Protocols

Data collection requirements for inventory management fall into two distinct categories;

(1) Inventory collection, and

(2) Inventory maintenance (i.e., inspections and updating when new signs are installed).

5.3.1 Inventory Collection

Inventory collection tasks provide the initial data for the inventory management system. The initial data collection phase provides a baseline for all future inventory management.

How this task is completed will depend upon the system being used, and could include all of the information in the forms provided in Section 11.

5.3.2 Inventory Management

Inventory management means updating the inventory when new signs are added, removed or have been maintained.

How this task is completed will depend upon the system being used, but could include all of the information in the forms provided in Section 11.

5.4 Establish Inspection and Maintenance Protocols

Signage provides drivers with the information they need in order to use the road system safely and efficiently. Care is therefore required to regularly inspect and maintain signs to ensure that they continue to function as intended. Inspecting and maintaining signs ensures that the information or instruction on the sign is conveyed in a clear and legible manner.

As part of their inventory management system, each road authority or jurisdiction could identify a consistent minimum standard for sign maintenance and encourage the use of planned (scheduled/ routine and preventative) maintenance protocols. Each road authority or jurisdiction may also identify a program for consistent collection and updating of the sign inventory.

The inventory may be prepared so that it is suitable for the generation of planned and emergency maintenance programs.

Sample forms for the planning and record management of maintenance tasks are included in Section 11.

6. Sign Inspection

Sign inspections confirm the information available in an inventory and confirm maintenance requirements. The inspection items should be understood by a qualified inspector and may be addressed through an appropriate training program. This is particularly important for the evaluation of retroreflectivity which is addressed in Section 4.

In addition, inspecting signs allows a road authority or jurisdiction the opportunity to confirm whether the operation of the roadway still warrants the traffic sign. While confirming the need for a sign is generally not the responsibility of sign maintenance crews, maintenance staff may relay their findings/thoughts back to the road authority or jurisdiction for a technical review.

An important component of sign inspection is route planning. The inspections can be based on a sign by sign basis or road by road. If the inspection is completed on a road by road basis, a rating of the overall condition of the signs per road section could be established for prioritization of sign maintenance activities.

Annual inspections can be used to develop a sign replacement budget and schedule for the routine sign replacement program. However, critical regulatory and warning signs must meet minimum standards (i.e., retroreflectivity, legibility, orientation and no obstruction), and in the event of an knockdown, blow down, or not meeting the required minimum standards, an emergency sign repair/replacement must be undertaken. Each road jurisdiction should have the labour, equipment and materials available in order to address emergency maintenance without delay. Emergency maintenance is addressed in Section 8.2.

6.1 Types of Signs and Inspection Requirements

Traffic signs in Ontario fall into four major classifications as defined in OTM Book 1, Section 7:

(1) **Regulatory Signs** are signs that inform drivers of traffic laws or regulations, and are enforced by the HTA.

(2) **Warning Signs** indicate conditions that are potentially hazardous to traffic.

(3) **Temporary Conditions Signs** indicate a temporary condition that drivers need to be aware of.

(4) **Information Signs** identify routes, direct motorists and identify distances.

The frequency of roadway patrolling is key in detecting sign condition and reflectivity deficiencies. Please see Section 3 for direction with regard to inspection frequency and minimum response times for regulatory and warning signs.

Inspection programs may include preparation for inspection, inspection methods and updates to the sign inventory. The inspection program should take into account the frequency of inspections, and the nature of inspections and reporting requirements.

Given that not all sign types are of equal importance, the frequency and types of sign inspections will have to be matched to the importance of the individual sign, the role it plays at the specific location and the prevailing situation and/or event.

Each jurisdiction or road authority may prepare guidelines that identify the criteria surrounding the selection of the appropriate frequency and level of inspection for:

- the different types of sign classifications;

- identified situations (annual inspections, nighttime assessment, scheduled maintenance, periodic maintenance, summer/winter performance assessments, direction, etc.); and
- events (collisions, environmental, residual life thresholds, etc.).

The data and information collected during an inspection will vary depending upon:

- the type of sign being inspected;
- details of previous inspections; and
- maintenance options with regard to rehabilitation, repair and replacement.

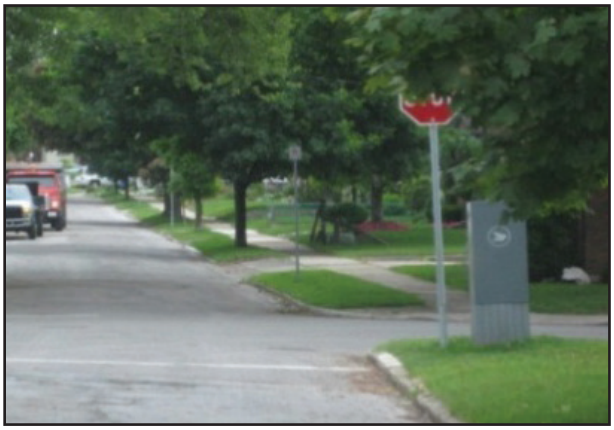
All of these factors will combine so that a structure for inspections is available, coupled with defined maintenance works.

To facilitate the development of the different structures for the inspections, current practices such as those contained in MTO Maintenance Special Provisions (MSPs), sign manufacturers literature, and other maintenance practices have been considered. The guidelines and best practices outlined in this book can be used by a road authority to prepare their program.

Updates to a sign inventory can be undertaken as part of inspections which are done as part of either planned or emergency maintenance. Sign and support inspection checklists for sign maintenance crews could include the following:

- confirming the presence of the sign and placement of the signs, including orientation, location, set back from street;
- confirming the continued need for the traffic sign (which will involve discussions with local transportation engineering staff);
- confirming the sign meets specification requirements;
- confirming the effective presentation of the sign information (e.g., is it blocked by vegetation or other obstacles) and the effectiveness of the sign in conveying the intended message;
- confirming sign attributes including type of sign, size of sign and components;
- confirming sightlines and mounting height;
- confirming condition of signs (OK or replace);
- confirming condition of sign elements (faces, posts, bases, attachments);
- assessing post condition (rusting/rotting, bent, twisted, broken, out of plumb);
- checking post connection at ground (cracked, bent, loose) – for non-breakaway;
- checking post connection below sign (cracked, bent, loose) – for breakaway;
- assessing post leg (cracked, bent, dented);

The smaller square sign in this picture attached to the pole cannot be read from any direction. It has been installed in a poor location facing the information sign.



The stop sign in this picture will be partially obscured by trees in the summer and fall.

- checking condition of sign bracing (cracked, bent, loose);
- removing debris;
- checking sign foundation (concrete cracked or spalled);
- assessing sign foundation bearing condition (poor contact, lifting);
- confirming overall condition at time of inspection/ maintenance (new or needs replacement);
- assessing the impact of environmental conditions;
- assessing relevance of the sign in the current location;
- recording and documenting sign conformance;
- recording and documenting sign and support conditions (i.e., graphics, including colour and content);
- providing updates to any local asset management policies;
- recording inspection/maintenance date.

Sample Form 1 in Section 11 provides an outline of what an inspection form could look like.

Consideration has been given to the materials being used on the sign face and how these materials may be assessed in the field for retroreflectivity, and what costs might be associated with different types of field inspection using a range of possible techniques.

6.2 Retroreflectivity Assesment Methods

The sign retroreflectivity maintenance methods described below are divided into two groups, evaluation methods and management methods. Road Authorities have flexibility to adapt these methods for maintaining sign retroreflectivity into existing sign management process or may upgrade their sign management process by incorporating an approved maintenance method.

Evaluation Method	Management Method
Nighttime Visual Inspection	Expected Sign Life
Retroreflectivity Measured	Blanket Replacement
	Control Signs

Therefore, a number of options for carrying out testing in the field have been explored. It will be up to the road authority or jurisdiction to identify which options will meet their needs and budgets.

6.3 Office Preparation

Figure 2 provides an overview of office preparation. Training of personnel, inspectors and patrol officers is covered in Section 9. Traffic control and safety issues should be reviewed prior to inspection.

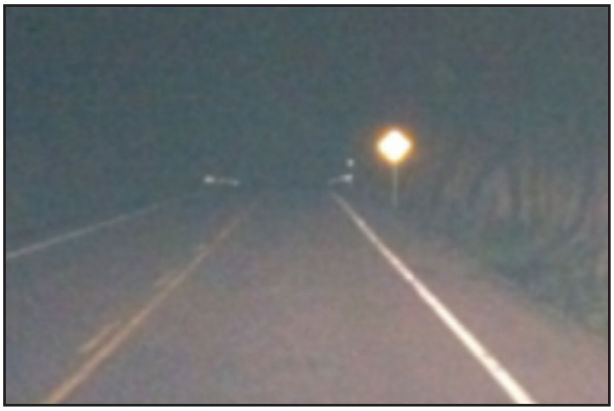
6.4 Nighttime Field Inspection

Night field inspections may be conducted to ensure signs are visible and functional at night.

A sign's level of retroreflectivity may be determined at night. Even if a road authority has a hand-held retroreflectometer for the daytime inspection, a dynamic nighttime inspection can be beneficial, as the effects of sign orientation on its retroreflective nature and the effects of sign obstructions will be more readily apparent.

Nighttime visual inspections should use the low-beam headlamps of the vehicle as the source of illumination for the signs. The interior light of the vehicle should remain off to the extent feasible. The inspection should be performed at highway speeds and from the travel lanes and not the shoulder. As the vehicle approaches the sign, the sign's overall appearance in terms of brightness and legibility is assessed.

Usually the sign is given a rating defined by the road authority. At a minimum, the rating scale should include three designations: good, fair and poor (i.e., acceptable, marginal and unacceptable). The inspector should record the information for each sign and the rating that it is given. Signs rated as poor should be scheduled for replacement. Depending on the inspection schedule, signs rated as fair can be noted as requiring attention during the daytime follow-up, the next set of scheduled inspections, or can be identified for additional assessment, such as measurement at a later date using a hand-held retroreflectometer.



This sign may be highly reflective but not legible on a non-illuminated rural road.

The nighttime field inspection vehicle and inspector(s) combination should be selected to provide a conservative estimate of sign retroreflectivity. Relatively new vehicles, with visually/optically aimable (VOA) headlamps, could be used when possible. It is important that guidelines for inspection be used consistently to decrease the subjectivity of inspections. This could include procedures to clean the headlamps and windshield before each night of inspections and to periodically check the headlamp aiming.

Figure 3 provides an overview of a nighttime field inspection.

Figure 2 – Office Preparation Flow Chart

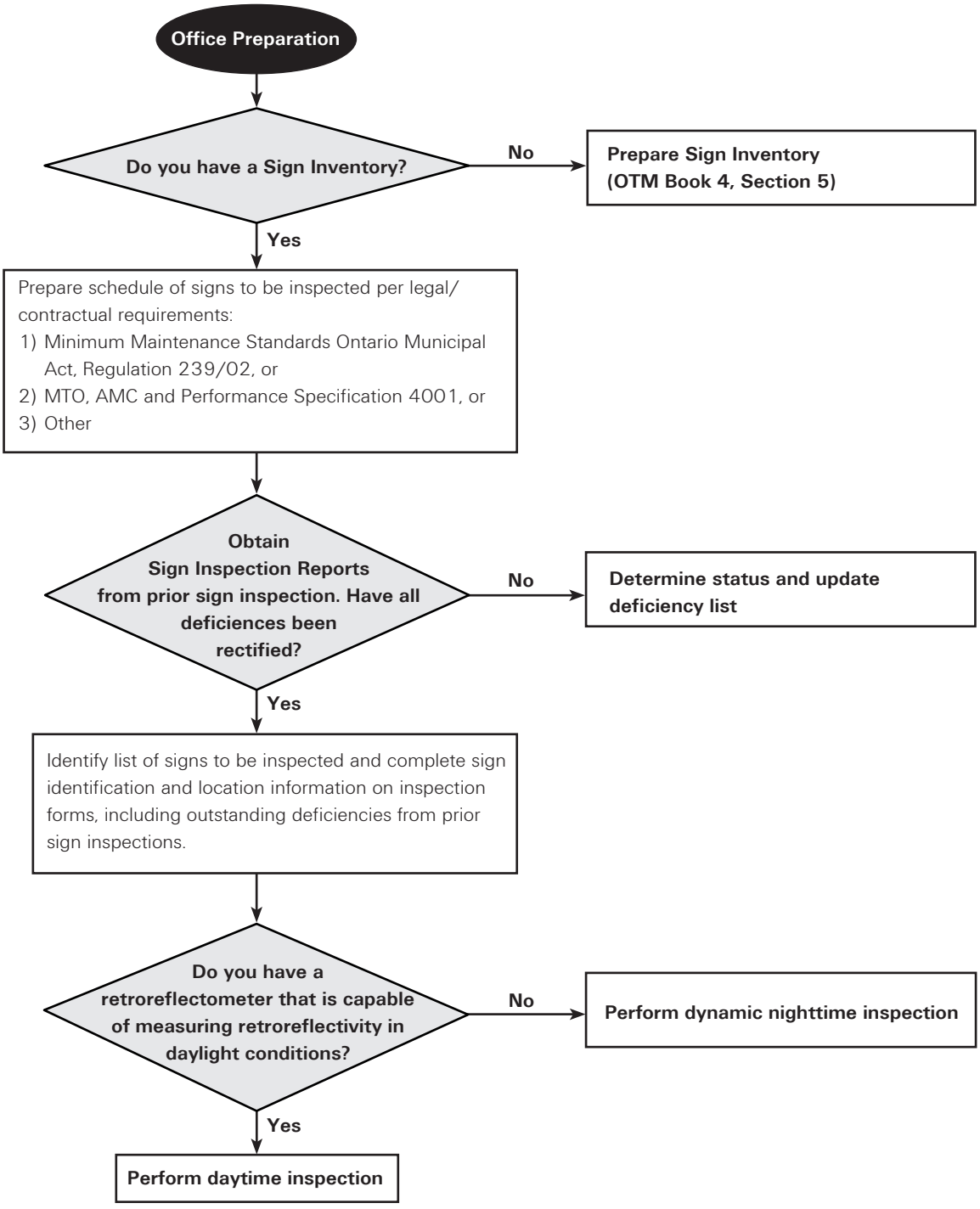
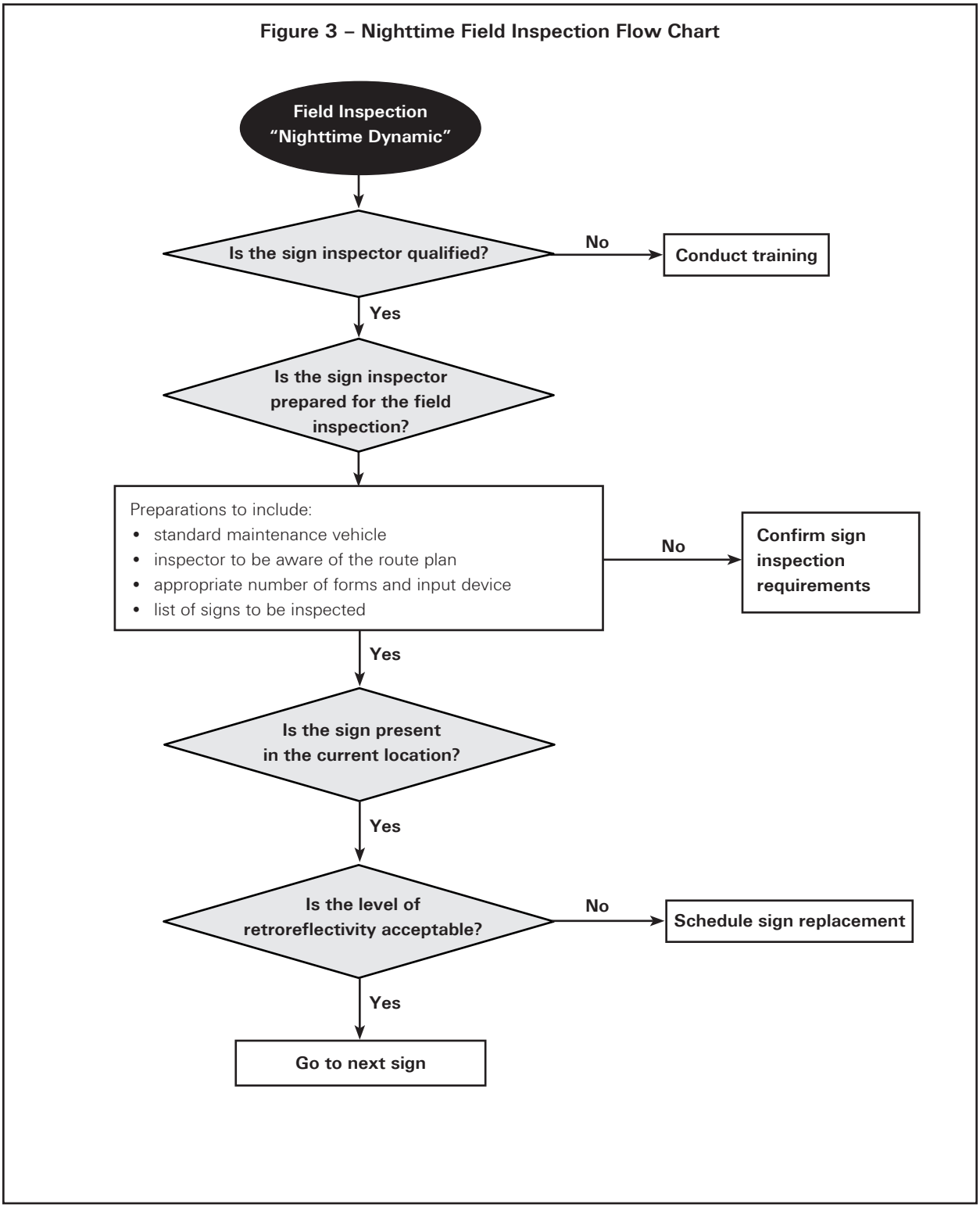


Figure 3 – Nighttime Field Inspection Flow Chart



6.5 Daytime Follow-up

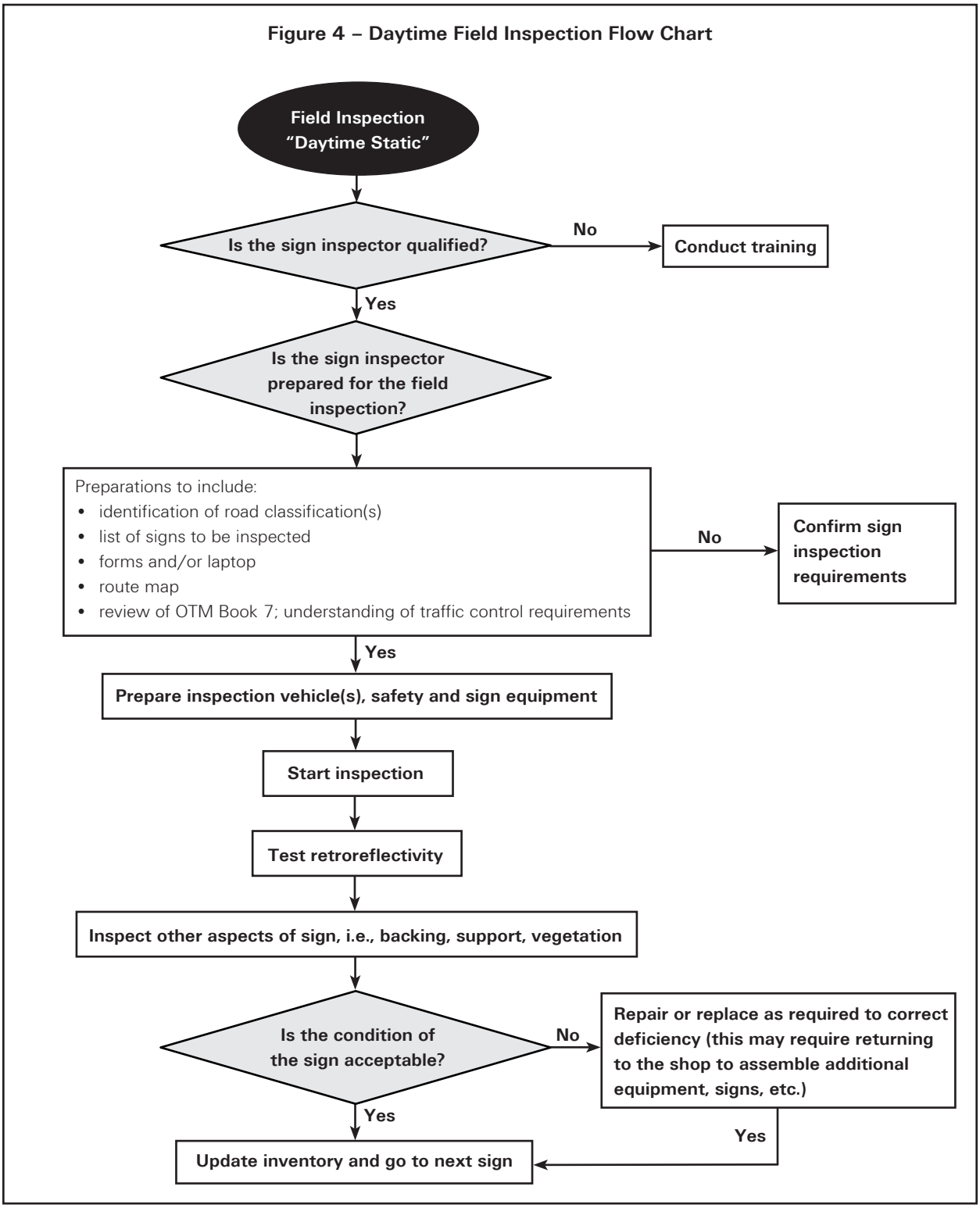
Daytime inspection and follow-up investigation allows for a much more thorough inspection, covering all data elements that were not inspected during the nighttime inspection, or for items which require further inspection. Figure 4 provides an overview of daytime field inspection.

Table 3 lists possible items to be reviewed for each sign which includes supports. This type of inspection is a static inspection and will require the inspector to have a close look at the sign, possibly from outside the patrol vehicle with a hand-held retroreflectometer.

Table 3 – Description of Data Elements

Data Elements	Description
Sign Identification	Unique number/barcode
Roadway Identification	Road name and/or number
AADT	Average annual daily traffic
Road Geometrics	Number of lanes, lane width, shoulder/boulevard width, crossfall, horizontal and vertical alignment grades, etc.
Location	GPS latitude, longitude (northing/easting), municipal address, distance from intersection and side of the road
Sign Code	OTM designation, i.e., R-1a, W-1
Installation Date/Date Code Sticker Information	When the sign post, footing, sleeve, back and face were manufactured and installed or modified, and if possible, by whom
Sign Position	Location of the sign relative to the road, including side of the road (Lt or Rt) • Direction of the sign face (signs facing south may deteriorate faster than those facing north due to greater sun exposure) • Angle, rotation, twist, tilt of roadway
Offset	Distance from edge of pavement
Sign Height	Height of the sign above road level
Sign Size	Width and height of the sign
Sign Sheeting Type and Manufacture	Grade of retroreflective material
Backing Type	Wood, aluminum, stainless steel, etc.
Nuts, Bolts and Washers	Galvanized steel, stainless steel, etc.
Post/Support Type	Type of sign support (wood, tube, steel) and number of posts
Foundation	Concrete or direct in ground

Figure 4 – Daytime Field Inspection Flow Chart



6.6 Retroreflectivity Measured

Sign retroreflectivity can be measured using a retroreflectometer, or non-contact instrument. Signs with retroreflectivity below the minimum levels should be replaced.

6.7 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 experience of sign retroreflectivity degradation in a geographic area. Signs older than the expected life should be replaced.

6.8 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.

6.9 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.

7. Additional Methods for Identifying Sign Deficiencies

In addition to the scheduled inspection and maintenance program, there are other methods for identifying sign deficiencies. Even when regular inspections are performed by a road authority, there will be situations (e.g., damage to signs and supports by collisions, weather and unforeseen occurrences) when sign deficiencies will require input from other people.

Vegetation control maintenance required.

Agency field employees and the general public may notice, on an ad-hoc basis, sign deficiencies. Typically the opportunity to easily report sign deficiencies or signs requiring attention is made available via a website listing phone numbers and e-mails.

Police officers on regular patrol typically also have the opportunity to report sign deficiencies directly to the road authority, as they will be the jurisdiction's initial contact at the scene in an emergency situation.

Planning for the receipt of this type of information (including the training of staff) is important. Employees may be trained to record applicable information when a sign deficiency is identified by a member of the public, police, etc. Forms can be provided by the road authority on their websites or at their offices to facilitate the collection of this information.

8. Sign Maintenance

Sign maintenance can fall loosely into one of two categories:

(1) **Planned Maintenance** would include the planned repair and replacement of signs and sign supports, installation of anti-theft measures and updating of older signs and supports. This could include straightening, changing, cleaning and controlling vegetation in close proximity to the signs.

It could also include preventative repairs and replacement of signs and sign supports as needed or reported on an ad-hoc basis, to prevent damage or loss. All the bolts and washers could be replaced on the "New, no heavy truck" sign in the photo opposite.

(2) **Emergency Maintenance** would include the repair/replacement of regulatory and warning signs that, if not performed quickly, would have a significant impact on liability. Emergency maintenance would typically be required as the result of an collision or knock down, vandalism or perhaps due to a blow down or other weather condition.

Preventative and scheduled maintenance programs are an important component of an inventory management system, and can generally be termed as "planned maintenance". This can allow for increased efficiency in the maintenance of signs within a jurisdiction through planning repair and maintenance for multiple signs in the same geographic area to reduce travel time. For example, sign crews can be set up and dispatched with the proper equipment to effect the sign repair/replacement, including the equipment and planning required for a traffic control plan as required by OTM Book 7. As well, the signs can be prepared in advance.

Maintenance requirements for regulatory and warning signs associated with safety and legal enforcement are of paramount importance, while those associated with information and directional signing, while carrying less significance in terms of obligations and liability, still have importance. This should be considered when jurisdictions are preparing the preventative and scheduled maintenance programs (see Section 2).

Work orders generated to address identified deficiencies may include task description for failure rectification and planned future work with the materials if appropriate and why (face materials are beyond the expiry date, vegetation has grown back and is blocking the signs).

New, no heavy truck sign. The top fastener on the "new" sign has failed. Planning is required to determine whether the sign fasteners should be replaced or if the "new" portion of the sign can be removed.

If the specific preventative inspection includes maintenance tasks, identify work completed and update the service record and database.

Existing policy documents, within the Province, on traffic sign maintenance have been reviewed and key requirements and periods for actions and responses outlined in these documents have been used to provide an array of maintenance requirements and response periods.

Based on the above, maintenance requirements and response periods have been developed for each of the four primary sign categories. Where particular deterioration mechanisms are identified, inspection details have been tailored to address them. For example, the effects of weathering will be picked up by the inspection of the sign face for cracking or peeling.

A fallen stop sign requires emergency maintenance.

Through the adoption of best practices, defect and deterioration mechanisms can be effectively identified, and appropriate mitigation measures introduced to correct and eliminate problems in the traffic signage over time.

8.1 Planned (Preventative and Scheduled) Maintenance

Planned maintenance should be undertaken to mitigate the possibility of failure. This type of maintenance is usually prioritized by statutory requirements related to the specific sign.

Planned maintenance should be undertaken to confirm that essential information provided on all Ontario traffic signs is properly placed and presented and that signs and supports are repaired and replaced as necessary. Also, preventative inspections may be used to ensure that consistent daytime and nighttime appearance for signs with retroreflective face materials is maintained.

Effective performance life will depend upon substrate selection and preparation, compliance with recommended sheeting application procedures (outlined in OTM Book 1), exposure conditions and maintenance.

Damaged, defaced or dirty signs are ineffective, therefore, it is important that signs be well-maintained. Dirt which may not be obvious on a sign face in daylight can seriously impair the appearance and legibility after dark. A sign, especially one mounted low to the roadway such as an object marker, may require frequent cleaning. It is noted that some cleaning agents may be harmful to the sign surface. Typically, natural exposure to precipitation is sufficient to effectively clean a sign.

The annual inspection will indicate if a sign is in need of cleaning. Some signs may need to be cleaned more frequently (e.g., twice a year)

depending on their location and exposure to dirt or lack of exposure to rain (i.e., under freeways). One inspection per year may be carried out at night to ensure adequate level of retroreflectivity.

Care should be taken that vegetation does not obstruct the sight line of a traffic sign. Extra snow removal efforts may also be required to ensure sight lines are maintained.

For illuminated signs, a regular schedule of lamp replacement could be maintained so that lamps will be replaced before they are normally expected to burn out.

8.2 Emergency Maintenance

On receipt of an emergency work request, response shall be immediate or as required by the minimum maintenance standards.

Event-based inspections may be undertaken when regulatory and warning signs require immediate amelioration due to damage (knock down), vandalism, weather (including fallen trees), etc.

Inventory management tasks associated with emergency maintenance may include:

- date of the incident;
- identification of the type of damage;
- date of the repair;
- record of the work that was undertaken to return the sign to normal status, including a new unique identifier and photograph of the "new" sign installation, with description of the work;
- materials used;
- warranty of new parts, if appropriate;
- revised status/life expectancy of the sign;
- revised placement information (including orientation and set back from the street if appropriate);
- new/further maintenance requirements; and
- timeline for maintenance, as appropriate.

Additionally, the road authority should have staff and equipment to provide appropriate traffic control until such time as the emergency maintenance is completed.

8.3 Replacement (New versus Overlay)

Sign replacement could be required due to retroreflectivity levels or contrast being inadequate, or if the sheeting material is deteriorating (cracking or peeling).

If a sign requires replacement due to the condition of the sign face, an overlay may be applied to the existing sign board if the face is properly cleaned and prepared as per the manufacturer's instructions. Best practice is that overlay should not be applied to an individual sign face more than once.

8.4 Failure Reporting – Maintenance Program

In all cases where failures are noted during inspection or maintenance, a record of the nature of the failure and the timeline for rectification of the failure should be recorded together, and once the maintenance is completed, the date of rectification of the problem documented. Failure to do this may result in future liability.

9. Inspection and Maintenance Crews

9.1 Staffing

Staffing of sign inspection and maintenance crews could be planned well in advance, including labour, equipment and materials as required to provide traffic control (see OTM Book 7).

It will be necessary to identify all the types of signs to be maintained, the types of maintenance tasks, and all the different types of roadways and work environments that a worker will be exposed to, to determine the personnel and equipment required for each work release.

In many cases, specialized maintenance tools, materials and supplies may also be required.

Qualified persons should be identified for undertaking inspection and maintenance of signs and supports.

9.2 Training

Training programs may need to be prepared by each road authority or jurisdiction to provide workers with adequate training to perform the sign inspection and maintenance functions under the Occupational Health and Safety Act. The program may include the relevant hazardous goods regulations to ensure that workers are aware of the special needs to ensure safe handling of materials.

Training may include familiarizing staff with the different types of equipment used in the inspection and maintenance of the various types and sizes of signs.

All staff required to perform work on a public roadway need to be trained on the requirements of OTM Book 7. Training may be tailored to the needs of those workers performing the sign inspection and maintenance functions on different classifications of roadways.

Training could also include review of the road authority Inventory Management System and forms. Training updates may be undertaken as necessary and provided on a regular basis.

9.3 Equipment

Equipment needs for sign repair and replacement can vary widely, depending upon the installation and location of the sign. While smaller sign installations might be done off the back of a pick-up, ground-mounted signs can be very large, often requiring lift equipment to erect the sign boards.

Sign support post selection can also vary widely and can require different equipment for maintenance.

Sign maintenance crews will also require a variety of materials for sign repair and replacement to repair the various sign types commonly used, including wood post, steel U-channel posts, round steel posts, perforated square tube, etc., potentially including:

- **Supplies and Sign Hardware Items**
  - anti-theft, vandal-resistant fasteners
  - oversized neoprene or nylon washers
  - several boxes of bolts, nuts and washers
  - sling and clevis
  - rivets
  - rivet gun

- **Hand Tools**
  - level
  - adjustable wrenches
  - pliers
  - weed cutter
  - brace and bits
  - hacksaw
  - crosscut saw for cutting wood posts
  - posthole auger/digger and breaker bar
  - double-handed slip hammer
  - double-faced sledge hammer
  - claw hammer
  - long handled shovel
  - heavy duty tall stepladder or extension ladder
  - rubber mallet.

9.4 Supervision

The road authority or maintenance contractor is responsible for assigning a competent supervisor to ensure that the sign maintenance crews are properly trained and equipped to undertake the work safely in accordance with:

- The Ontario Occupational Health & Safety Act;
- The Traffic Control Manual for Temporary Road Work Operations (OTM Book 7, Temporary Conditions).

The road authorities' work processes and procedures need to address work place safety and operational concerns specific to local conditions.

10. Traffic Control During Inspection and Maintenance

OTM Book 7 (Temporary Conditions) provides information related to traffic control during inspection and maintenance.

11. Sample Forms

A series of sample forms are provided and can either be used by a road authority or jurisdiction, or used as a basis for preparing their own forms.

A number of forms and reports can be useful in an Inventory Management System including:

- Inventory Form
- Inspection Form
- Sign Ownership Form

In addition, if a computerized inventory system is used, it can be configured to provide the following outputs:

- Inventory Record
- Confirmation of Requirements
- Inspection Reports
- Condition Reports
- Work Orders
- Stock Control
- Work Completion Notification
- Inventory Updates

Sample Form 1 – Ground-mounted Sign and Support Inspection Form

Inspection Category: _____

Date: _____

Inspected By: _____

Sign Identification

Road Name: _____

Barcode Number: _____ **Confirmed** ❑ **Not Correct** ❑

Sign Location GPS: _____ **Confirmed** ❑ **Not Correct** ❑

Type of Sign No: _____ **Confirmed** ❑ **Not Correct** ❑

Roadway Classification: _____ **Confirmed** ❑ **Not Correct** ❑

MTO Sign Type:

Number: _____

Class: _____

Subclass: _____

Shape Code: _____

Colour Code: _____

Comments MTO: _____

Number of posts and sizes: _____ **Confirmed** ❑ **Not Correct** ❑

Sign Message:

Side 1: _____

Side 2: _____

Sign appropriate for current use?

Yes ❑

No (describe) _____

_____

_____

Sample Form 2 – Sign Condition

		Defect			Date Rectified	Maintenance Required, Comments
		N/A	Yes	No		
Foundation	Concrete (cracked, spalled?)					
	Ground Grades (erosion impacting sign?)					
Columns (Posts) of Support	Post condition (rusting/rotting, bent/ broken?) Indicate number of posts to be maintained					
	Connection at ground for breakaway sign (cracked, bent, loose)?					
	Connection below sign, for breakaway sign (cracked, bent, loose?)					
	Leg (bent, dented, cracked?)					
Sign Board	Sign panels (properly attached to post?)					
	Condition of sign board (rusting, rotting, bent or broken?)					
	Orientation about x axis (i.e., forward, backward?)					
	Orientation about y axis (i.e., face twisted or upside down?)					
	Orientation about z axis (i.e., rotation to the roadway)					
Sign	Retroreflectivity level					
	Contrast and legibility					
	Sign panel face damaged (cracking, delaminated, pitted, vandalized, etc.)					
	Obscured by vegetation					
	Present (i.e., exists?)					
Other						
Initial Work Order		**Remedial Action Items**				
Follow Up						
General Comments						

Sample Form 3 – Sign Structure Inspection Form

Inventory No.	Hwy. No.	Direction	Patrol	Ramp
Location				
Type of Structure (Wood or Steel)				
Collision No.				
Inspection	Drainage Holes			
	Condition of Welds			
Steel Breakaway Structure				
Bases	Galv. Bolts	SS Bolts	Torqued	No. of Cols
Fuse Plates	No. of T-Connection	No. of Attach Plates	No. of Crossarms	
Sign A	Size			
		Colour:		
		Legend:		
		Condition:		
		O/Lay:		
Assembly Type 1				
Date Started:		Crew Names:		
Date Finished:				
Inspector Signature:				

Sample Form 4 – Ground-mounted Roadside Extruded Sign Support Maintenance Inspection

Date: _____

AMC No.: _____

Inspected By: _____

Signature: _____

Sign Support Identification

Name/Location: _____

Hwy #/ Direction: _____

Core/Collector/Ramp: _____

Sign Message: _____

Site No.: _____

No. of Columns (Posts): _____

No. of Horizontal Cross Arms (if Steel): _____

		Defect			Maintenance Required, Comments
		N/A	Yes	No	
Foundation	Concrete (cracked, spalled?)				
Columns (Posts) of Support	Connection at ground for breakaway sign (cracked, bent, loose)?				
	Connection below sign, for breakaway sign (cracked, bent, loose?)				
	Leg (bent, dented, cracked?)				
	Sign Panels (bent, loose?)				
	Sign Panel Clamps (broken, loose?)				
	Other				
Other					
Friction Plate Bolts Re-torqued to 67N-m					
Fuse Plate Bolts Re-torqued to 176 N-m					
Follow-up with District Office/Structural Section					
General Comments					

Sample Form 5 – Sign Inspection

Sign Description: _____ **Date of Inspection:** _____

Catalogue No.: _____ **Inspected by:** _____

Measurement: _____ **Signature:** _____

Location: _____

Sign Damage	Minor	Major	Description			
Reflectivity						
Cracking						
Delamination						
Fading						
Rusted						
Pitted						
Damaged						
Vandalized						
Post Damage	**4 x 4**	**6 x 6**	**5′ U-flange**	**8′ U-flange**	**10′ U-flange**	**1 x 1**
Twisted						
Bent						
Out of Plumb						
Broken						
Not Solid in Ground						
Hardware Damage						
Missing						
Broken						
Loose						
Bent Fasteners						
Vegetation						
Description						
Recommendations and Repair Date:						

Sample Form 6 – Township Annual Sign Maintenance and Inspection Form

Township:	County:
Date of Annual Inspection:	Year:

Sign ID	Sign Code	Sign Panel Legend	Size	GPS Lat.	GPS Long.	Action	Reason	Comments	Date

General Comments:

The Town of _____ certifies that the road signs described in this form have been inspected and maintained for inspection year _____ pursuant to the retroreflectivity requirements set forth by the current Ontario Traffic Manual.

Signature:	Date:

Sample Form 7 – Township Traffic Sign Field Inventory Report

Township:	Inspected By:	
County:	Date Inspected:	Reason for Inspection:

Sign Identification No:	Direction Sign is Facing:	Route:
Sign Code:	Sign Structure Type:	Reference Point:
Sign Legend:	Structure Condition:	Reference Pt. Distance (ft):
Sign Width (inches):	Mounting Height (feet):	GPS Latitude:
Sign Height (inches):	Offset (feet):	GPS Longitude:
Substrate:	Sign Owner:	Comments:
Sheeting Material:	Installation Date:	
Sign Condition:	Sign Manufacturer:	

Sign Maintenance History			
Date	Inspector Name	Action Required	Comments

Sample Form 8 – Generic Township Sign Inventory and Inspection Form

Date: _____

Sign ID	OTM Code	Description	Size	Visual Daytime Condition *	Sign Retro-reflectivity **	Easting	Northing	Comments
				N A P	F M A			
				N A P	F M A			
				N A P	F M A			
				N A P	F M A			
				N A P	F M A			
				N A P	F M A			
				N A P	F M A			
				N A P	F M A			
				N A P	F M A			
				N A P	F M A			
				N A P	F M A			
				N A P	F M A			
				N A P	F M A			
				N A P	F M A			
				N A P	F M A			
				N A P	F M A			

* **Visual Daytime Condition**
N = New or Near New
A = Adequate Appearance
P = Poor Conditions/Vandalized/Damaged

** **Sign Retroreflectivity**
F = Fail
M = Marginal
A = Adequate

Sample Form 9 – Sign Inventory and Inspection Collection Sheet

Route:	**Date:**	**Page _____ of _____**
Starting Point:	**Observer:**	
Travel Direction:	**Sheet No.:**	

Meter Reading	Position *	Offset	OTM Code	Orient	Size	Sheeting	Backing	Posts	Post Type	Date	Comments	Condition **
	R O L											E G F P
	R O L											E G F P
	R O L											E G F P
	R O L											E G F P
	R O L											E G F P
	R O L											E G F P
	R O L											E G F P
	R O L											E G F P
	R O L											E G F P
	R O L											E G F P
	R O L											E G F P
	R O L											E G F P
	R O L											E G F P
	R O L											E G F P
	R O L											E G F P
	R O L											E G F P
	R O L											E G F P
	R O L											E G F P

* **Position**
- **R** = Right
- **O** = Overhead
- **L** = Left

** **Condition**
- **E** = Excellent
- **G** = Good
- **F** = Fair
- **P** = Poor

Sample Form 10 – Sign Ownership

Sheet No.	Sign ID No.	Sign Code	Owner

Sheet No.	Sign ID No.	Sign Code	Owner

Sheet No.	Sign ID No.	Sign Code	Owner

Sample Form 11 – Inspection Report

Name of Road Authority: _____

MTO Sign Type No.	Commis-sioned? Yes / No	Graphic	GPS Location Lat/Long	Reflective Background	Mounting Type	Support Type	Date	Comments
								

Appendix A • Definitions and Notation

The following definitions are specific to this Book.

Contrast
Contrast refers to the differences in colour or in brightness which allow a sign message or symbol to be seen against the sign background.

$$\text{Contrast} = \frac{R_L - R_B}{R_B}$$

$$\text{Contrast Ratio} = \frac{R_L}{R_B}$$

Where: R_L is Reflectance of Legend; and
R_B is Reflectance of Background.

For light-emitting dynamic message signs, the same relationships apply, except that reflectance is replaced by emitted light intensity, for both legend and background.

Critical Signs
Refers to regulatory and warning signs which require inspection for retroreflectivity.

Highway
A public roadway for purposes of vehicular and pedestrian travel, including the entire area within the right-of-way. This includes King's Highways, regional and county roads, rural roads, municipal roads and streets.

Information Sign
Information signs are essential for directing motorists; identifying intersecting routes; identifying geographical locations and distances; and directing motorists to towns, cities, and other important destinations.

Metadata
Data that provides information about other data.

Qualified Inspector
A person with knowledge of sign and sign support maintenance practices and the ability to identify sign defects gained through training and experience relating to inspection of traffic signs and supports.

Qualified Person
A person with knowledge of sign and sign support maintenance practices and the ability to identify sign defects and perform maintenance activities gained through training and experience relating to inspection or maintenance of traffic signs and supports.

Reflectivity
A measure of the degree to which a surface reflects incident light.

Reflectorization
A method of incorporating light-reflective material on the approach face of a traffic sign so that the face will reflect light during the hours of darkness while retaining the same colours by day.

Regulatory Sign
A sign that informs highway users of traffic laws or regulations and indicates the legal requirements that would otherwise not be apparent. Examples are Stop and Speed Limit signs.

Retroreflective Material
A type of material applied in either strips or sheets which reflects illumination back to its source.

Retroreflectivity
This indicates the proportion of the light reflected back to the driver from the retroreflective surface, in candelas per lux per square metre.

Retroreflectometer
A device capable of measuring the proportion of the light reflected back to the driver from the retroreflective surface, in candelas per lux per square meter.

Roadside
The area between the outside edge of the shoulder rounding and the right-of-way limits and features within the roadway that do not form an integral part of the driving surface, such as drainage features and guiderails.

Roadway
The part of the highway that is improved, designed or ordinarily used for vehicular traffic, but does not include the shoulder, and, where a highway includes two or more separate roadways, the term "roadway" refers to any one roadway separately and not to all of the roadways collectively.

Temporary Conditions Sign
These indicate a temporary condition that drivers need to be aware of.

VOA Headlights
A headlamp system which is designed to be visually/optically aimable. This type of headlamp system is becoming more common. They are not mechanically aimable. The system is designed to reduce glare and the low beams have a vertical cutoff angle.

Warning Sign
A sign that indicates conditions on or adjacent to a highway or street that are actually or potentially hazardous to traffic operations (e.g., Curve Sign).

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Ontario

Book 4

Ontario Traffic Manual

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