Transport Canada Transports Canada

GRADE CROSSING HANDBOOK

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This document is meant to be used in conjunction with the *Grade Crossings Regulations* as well as the *Grade Crossings Standards*.

Canada

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Foreword

This document is developed to provide guidance on the engineering best practices and requirements for safety at or around grade crossings and is to be used as a complement to the requirements found in the *Grade Crossings Regulations* (GCR), and the incorporated by reference *Grade Crossings Standards* (GCS) made pursuant to the *Railway Safety Act* (RSA). Every party responsible for a road or a railway line involving a grade crossing should consult the legal requirements of these instruments.

Minimum safety standards are set out for the construction, alteration, and maintenance of grade crossings, including the inspection and testing of grade crossing warning systems. They also include minimum safety standards for road approaches and other land adjoining the land on which the railway line is situated insofar as the safety of the grade crossings may be affected.

In addition to the GCR and GCS, the RSA provides for Engineering Standards relating to the construction or alteration of railway works, and such engineering standards may embrace both physical specifications and performance standards. If a proposed railway work does not align with an Engineering Standard, an application for approval of the proposed work may be filed with the Minister of Transport for Canada under section 10 of the RSA.

Any comments or suggestions regarding Engineering Standards or other grade crossings related requirements, should be addressed to the Rail Safety Directorate.

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Part A – Preface

Background

Under subsection 2(2) of the *Railway Safety Act* (RSA), the federal government has jurisdiction, in respect to transport by railway to which Part III of the *Canada Transportation Act* applies. In general, this means that TC has jurisdiction over companies that have a certificate of fitness issued by the Canadian Transportation Agency (CTA). This jurisdiction applies to all road crossings on rail lines under federal jurisdiction.

The Government of Canada has jurisdiction over approximately 16,000 public and 9,000 private grade crossings along over 42,650 km of federally regulated rail lines in Canada. The *Grade Crossings Regulations* (GCR) and the *Grade Crossings Standards* (GCS) serve to improve safety at these federally regulated grade crossings.

At the federal level, grade crossings are governed by various instruments under the RSA. Prior to the introduction of the GCR, these were also governed by the following two regulations (now repealed):

- Railway-Highway Crossing at Grade Regulations (E4)
- Highway Crossings Protective Devices Regulations (E6)

Other federal guidelines and voluntary standards to uphold safety at federally regulated grade crossings include (also included in the GCS):

- Engineering Standards for "Walk Light" Grade Crossing Warning Systems (TC E-39)
- Engineering Standards for Grade Crossing Warning Systems Used at Restricted Grade Crossings (TC E-52)
- Transport Canada Standard for LED Signal Modules at Highway Railway Grade Crossings
- Standards Respecting Railway Clearances (TC-E-05)
- Draft RTD 10 – Road / Railway Grade Crossings – Technical Standards and inspection, Testing and Maintenance Requirements

In August 2010, the Transportation Safety Board (TSB) indicated on its Watch list of safety issues that the "risk of passenger trains colliding with vehicles remains too high in busy rail corridors." It recommended that the Government of Canada develop a

comprehensive solution for mitigating risk at grade crossings that includes new grade crossing safety regulations.

Between 2006 and 2010, collisions involving railway equipment, at public and private crossings, resulted in an average of 27 serious injuries and 25 fatalities annually. On average, there was one fatality for every nine collisions at grade crossings, and one serious injury for every seven collisions. In addition, trains derailed in one out of every 40 crossing collisions, often resulting in significant property damage and transportation system delays.

Thousands of road authorities, as well as railway companies, are responsible for the safety of grade crossings, making maintaining grade crossing safety a complex, multi-jurisdictional challenge. Public grade crossing safety involves over 1,500 different municipal, provincial, territorial, and federal authorities, and First Nation communities. The safety of private crossings involves thousands of private authorities and many different types of roads, including residential, agricultural, industrial, and commercial roads and recreational paths and trails.

The knowledge and collaboration of each party; the road or private authority and the railway company, play a pivotal role in ensuring adequate safety at grade crossings. Road authorities and railway companies must collaborate in sharing safety information, track and roadway layout, traffic volume, train speed, train volume, warning systems, and available sightlines, to enable each party to meet the required safety standards.

Several possible changes can affect safety at a grade crossing, including:

- road and rail traffic volumes
- land use; and
- railway and road design speeds

However, the roles and responsibilities of railway companies and road authorities with respect to monitoring conditions at new and existing grade crossings may not always be clear; section 3 of the GCR provides more clarity.

Previous RSA reviews acknowledged that grade crossings fall under multiple jurisdictions, and that this complexity in the roles and responsibilities could lead to safety deficiencies. RSA reviews also identified blocked grade crossings as a serious safety concern.

In addition to the above, the requirements and definitions under the RSA are broad and provide the scope of its authorities. Other instruments also provide clarity on the design and maintenance of grade crossings or consistency with other governing authorities with respect to:

- the Canadian Rail Operating Rules
- provincial highway traffic acts and other applicable standards
- the operating characteristics of vehicles and trains; and
- driver training and education programs

Although legislation and regulations exist governing grade crossing safety, other unregulated matters are covered by guidelines and best engineering practices. In the early 2000s, Transport Canada and stakeholders drafted standards (RTD-10) that set out best engineering practices for safety oversight at grade crossings, which road authorities and railway companies generally adhered to on a voluntary basis.

Objectives

The primary objective of the Grade Crossings Regulations (GCR) is to increase safety at Canada's federally regulated grade crossings: to reduce the incidence of death, injury and property damage and reduce environmental impacts. To achieve this, the RSA and GCR will require that railway companies, road authorities and private authorities oversee and manage the safety of their grade crossings in accordance with sound engineering principles, and in a manner like the way the safety of other road and railway infrastructures is managed. Implementation of the GCR is expected to:

- reduce the creation of new safety deficiencies at grade crossings; and
- ensure that all new and existing grade crossings consistently meet required safety standards.

Description

Under the authority of the RSA, the GCR is expected to reduce the frequency and severity of accidents at federally regulated grade crossings. This will save lives and prevent injuries and derailments and will further Transport Canada's objective to serve the public's interest through the promotion of a safe and secure transportation system in Canada. In particular, the GCR will improve safety by providing comprehensive safety standards:

- establishing enforceable safety standards for grade crossings
- clarifying the roles and responsibilities of railway companies and road authorities; and
- ensuring the sharing of key safety information between railway companies and road authorities

The GCR also covers the relevant requirements of the repealed *Railway-Highway Crossing at Grade Regulations* and the *Highway Crossings Protective Devices Regulations*, thereby eliminating the remaining gaps identified in previous RSA reviews.

The following are key aspects of the GCR:

Grade Crossings Standards (GCS) — The GCS is incorporated by reference in the GCR. The GCS are clear, enforceable standards for meeting the safety goals of the RSA, thus improving consistency and safety at grade crossings. Railway companies and road authorities are required to comply with all of the GCS when constructing new grade crossings. In the event of a change at a grade crossing, railway companies and road authorities are required to comply with the GCS safety standards applicable to that change. Standards for existing public and private grade crossings are also set out in the GCR and the GCS. In the case of existing crossings, the GCR are designed to prioritize the timing at which a grade crossing must come into compliance with various requirements, which may or may not cause the grade crossing to be upgraded. The timing of these requirements is dependent on the physical and operational characteristics of a grade crossing. The requirements can come into effect as of November 28th, 2022 or November 28th, 2024 depending on the specific physical and operational characteristics of the grade crossing.

Roles and responsibilities — The GCR provide detailed clarification of the roles and responsibilities of railway companies, road authorities and private authorities regarding:

- the sharing of information and timelines.
- the design, construction, and maintenance of crossing surfaces.
- sightlines within a railway right-of-way; on the land on which the road is situated; and on the land, including private property, adjoining the railway right-of-way and in the vicinity of a grade crossing.
- Railway Crossing signs, Stop signs, Emergency Notification signs, Number of Tracks signs and traffic control devices; and
- the installation, inspection, testing and maintenance of grade crossing warning systems (GRC section 3).

Sharing of information — Railway companies and road authorities are required to share information with each other regarding existing public grade crossings within two (2) years of the coming into force of the GCR (e.g., by November 28th, 2016) to provide each party with sufficient time to assess the safety of their infrastructure and plan accordingly. The GCR specifies the critical information to be shared between both parties to ensure safety at their grade crossing (e.g., information on the interconnection

between traffic signals and warning systems). In addition, railway companies and road authorities are required to share information when a new grade crossing is constructed or when an alteration or operational change is made at an existing grade crossing. Railway companies are required to keep the most recent information provided to, and received from, road authorities. This sharing of information is intended to culture of collaboration among railway companies and road authorities responsible for safety at a given grade crossing (GCR sections 4 to 18).

Sightlines — Under the GCR, road authorities, private authorities and railway companies will be required to maintain sightlines at grade crossings. The GCR set out standards for sightlines and their maintenance. Sightlines will be preserved by prohibiting the construction of buildings or structures, or the placement of objects, that would obstruct them. Individuals will also be required to remove any trees or brush obstructing sightlines. Railway companies will be prohibited from leaving unattended any railway equipment that obstructs sightlines. For existing grade crossings, most requirements concerning sightlines must be met by November 28th, 2022 or November 28th, 2024; for grade crossings that are subject to the GCR, newly constructed grade crossings or grade crossings that undergo alterations or operational changes must meet the applicable sightline requirements. (GCR sections 19 to 28).

Inspection and testing — The GCR establishes that the design plan for a warning system must be kept at the grade crossing. Furthermore, warning systems, and traffic control devices that are interconnected with warning systems, must be inspected and tested in accordance with the GCS. Railway companies are required to keep a record of inspections and testing, as well as a record of any warning system malfunction or failure, for a minimum of two years (GCR sections 93, 95, 96, 109 and 110).

Prohibition of obstruction of public crossings — Under the GCR, where a city, town, municipality, or other organized district passes a resolution that the obstruction of a public grade crossing creates a safety concern, the railway company and road authority will be required to collaborate to resolve the safety concern (GCR section 98).

Furthermore, railway companies are required to use all necessary measures to clear a public grade crossing immediately when an emergency vehicle requires passage; and road authorities are required to ensure that vehicles do not stop on the crossing surface of a public grade crossing where there is evidence that queued traffic regularly stops on that crossing surface (e.g. traffic lights cause congestion which leads to vehicles stopping on the crossing surface once a week) (GCR sections 97 to 100).

Temporary protection measures — The GCR establish safety requirements for periods when the road authority or railway company is undertaking an activity at a railway line or grade crossing that compromises the safety of railway operations. If a warning system, or a traffic control device that is interconnected with a warning system,

malfunctions or fails, the railway company or the road authority must immediately put in place the protection measures necessary to address any threat to the safety of railway operations. As well, all information concerning such occurrences and any measures taken must be shared with the other authority (GCR sections 102, 103 and 110).

Train whistling (audible warning) — The GCR prescribe the requirements for areas where train whistling may be prohibited under section 23.1 of the RSA. The GCR provide for the safety attributes of grade crossings in such areas. For instance, for whistling cessation to occur, a grade crossing may require a warning system to be installed (GCR sections 104 to 107).

Repeals — The GCR repeal the Railway-Highway Crossing at Grade Regulations and the Highway Crossings Protective Devices Regulations. The GCR and the GCS together encompass the relevant requirements of both regulations (GCR sections 111 and 112).

Article 1 Definitions

Standards, procedures, guidelines, and recommended practices of other organizations are incorporated by reference into the requirements set out in this document. If differences exist, the GCR and GCS shall prevail.

The following definitions apply in this handbook.

Activation Failure – means the failure of an automatic warning system to indicate the approach of a train at least 20 seconds prior to the train's arrival at the crossing surface or the presence of a train occupying the crossing unless the crossing is provided with an alternative means of actively warning crossing users of approaching trains. (This type of failure results in motorists assuming that it is safe to proceed across the railroad tracks, when in fact it is not safe to do so.) (Échec d'activation)

Adjoining – means directly beside or surrounding (referred to in section 3(1) (a)(v) of the GCR). (Contigu)

Advance Pre-emption – means that notification of an approaching train is forwarded to the highway traffic signal controller prior to activation of the grade crossing warning system. (Pré-déclenchement prioritaire)

Advisory Speed Tab sign – means the sign referred to in Article 8.2.1 of the GCS, that is, a road sign indicating that a change in travelling speed is required for safety, given the design of the grade crossing. (Panneau « vitesse recommandée »)

Average Annual Daily Railway Movements – means the number of movements of engines, or engines coupled with railway equipment, across a grade crossing in a year,

divided by the number of days in that year. (Moyenne annuelle de mouvements ferroviaires quotidiens)

Adequate Lock – means an ANSI Grade 1 certified high-security lock, or equivalent. The lock should be protected by a padlock cover, fastened, and be operated only by key, or specialized knowledge. (GCR 92) (Serrure adéquate)

Assistive Devices[1] – includes all specialized aids, devices or services that enable persons with disabilities to carry out their everyday activities, such as making it easier for them to get around (wheelchair, hand or arm support), or helping them to hear, see or speak (hearing aid, Braille reading materials, keyboard device for communicating). (Appareils fonctionnels)

Average Annual Daily Traffic – means the number of motor vehicles that cross a grade crossing in a year, divided by the number of days in that year. (Débit journalier moyen annuel)

Back Light – means a light unit within a warning system, found facing approaching traffic on the farthest side of the rail, focused to the point marking 15 m (50ft) measured from the closest flasher mast, gate, or cantilever. (Feu arrière)

Bike Lane – refers to a lane intended for the exclusive use of bicycles, immediately adjacent to a roadway used by motorized vehicles. (Voie cyclable)

Bike Path – is a bicycle facility, physically separated from travelled way. (Piste cyclable)

Braking Distance – means the distance it takes to stop the design vehicle once the brakes have been applied. (Distance de freinage)

Blocked Crossing – means that a train, by either switching or standing, is preventing drivers and pedestrians from passing at a public grade crossing for more than five (5) minutes. This includes the operation of the warning system gates. A train or engine may stand on any part of a public grade crossing for an extended period, but only if no vehicle or pedestrian requires passage. (Passage à niveau obstrué)

Boulevard – The strip of land paralleling the roadway between the curb and the sidewalk, often planted with trees, grass, and/or shrubbery. (Banquette)

Clear Days – means the days between two given days, excluding those days. For example, between Sunday and the following Sunday, there are six clear days. (Jour franc)

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[1] Statistics Canada, Participation and Activity Limitation Survey: Disability Supports in Canada, (2001)

Collision – means an impact, other than an impact in normal operating circumstances, between rolling stock; rolling stock and a person; or rolling stock and an object or animal, if the rolling stock is damaged or derailed. (Collision)

Company – means a railway company or local railway company (see RSA). (Compagnie)

Component – An individual part or combination of parts that, when interconnected, perform a design function(s). (Composante)

Crossing Identification Number – means the unique number assigned to each grade crossing, established by Transport Canada. (Numéro d'identification de passage à niveau)

Cross-product – means the product of the average annual daily railway movements and the average annual daily number of motor vehicles that cross a grade crossing. (Produit vectoriel)

Crossing Surface – means the part of a road that lies between the ends of a railway tie and that has the width shown in Figure 5-1 of the GCS. (Surface de croisement)

Crossing User – means vehicle, driver, pedestrian, cyclist, and person using assistive devices. (Usager du passage à niveau)

Crossing Work – means a road crossing or utility crossing. (Ouvrage de franchissement)

Cyclist[2] – means a person who operates a muscular powered or motor assisted bicycle, tricycle, or unicycle. (Cycliste)

Design Plan – means a plan, sketch, or preliminary drawing outlining the following details (Plan de conception)

- the configuration of the components of the warning system.
- the layout of the circuitry and signal equipment.
- the parameters for the operation of the components of the warning system.
- the type of light, including the lens deflection angles, if applicable, and the alignment coordinates of the light units; and
- the details of any interconnection with a traffic control device.

[2] Ontario Traffic Manual, Cycling Facilities, Book 18, December 2013

Design Vehicle – means the most restrictive vehicle that routinely traverses a grade crossing may be one of the vehicles shown in figures 1.2.4.1 to 1.2.4.11 of the *Geometric Design Guide for Canadian Roads*, published by the Transportation Association of Canada in September 1999. (Véhicule design)

Emergency Notification Sign – means the sign referred to in Article 8.5 of the GCS. It is used by employees of railway or road authorities, as well as the public, to report incidents, malfunctions, or threats to the safety of railway operations. (Panneau « Avis d'urgence »)

Engineering Standards – means engineering standards established pursuant to section 7 of the RSA. (Normes techniques)

> **Note:** All engineering work relating to railway works must be approved by a professional engineer. (RSA 11(2))

Existing Grade Crossing – means a grade crossing for which actual construction started before the day on which the GCR came into force (e.g., before November 28th, 2014). (Passage à niveau existant)

Expressway – means a high-speed, divided highway for through traffic, with partially or fully controlled access. (Route express)

Fail-safe – means a railway signaling design principle, the objective of which is to eliminate the hazardous effects of a failure of a component or system. (À sûreté intégrée)

Failure to Warn – See activation failure. (Impossibilité d'avertir)

Freeway – means an express highway, more particularly one with controlled access. Freeways inherently preclude grade crossings, as they cannot be crossed, except by overpasses and underpasses. (Autoroute)

Front Light – means a light unit within a warning system, found facing approaching traffic on the near side of the rail, focused to a point not less than the stopping sight distance (SSD) and, where possible, measured from in advance of the closest flasher mast, gate, or cantilever. (Feu avant)

Grade Crossing – means a road crossing at grade, or two or more road crossings at grade where the lines of railway are not separated by more than 30 m. This encompasses road approaches from the SSD. (Passage à niveau)

Grade Crossings Standards – means the Grade Crossings Standards (GCS) published by the Department of Transport, on January 1, 2019. (Normes sur les passages à niveau (NPN))

Grandfathered – means exempt from a new law or regulation. (Droits acquis)

Ground – means a conducting connection, whether intentional or accidental, by which an electrical circuit or equipment is connected to the earth, or to some conducting body of relatively large extent that serves in place of the earth. (Mise à la terre, mise à la masse)

Interconnection – means the electrical connection between the railroad active warning system and the highway traffic signal controller assembly for the purpose of pre-emption of any kind. (Interconnexion)

Intermediate Front Light – means an additional set of light units added to a warning system to provide visibility from an entrance way or road intersection including sidewalks, paths, or trails. (Feu avant intermédiaire)

Isolation – means the physical and electrical arrangement of the parts of a facility, system, or equipment to prevent uncontrolled electrical contact within or between the parts. (Isolement)

Line Work – means a line of railway, including any structure supporting or protecting that line of railway or providing for drainage thereof; a system of switches, signals, or other like devices that facilitates railway operations; or any other structure built across, besides, under or over a line of railway, that facilitates railway operations, but does not include a crossing work. (Ligne de chemin de fer)

Maximum Railway Operating Speed – in respect of a grade crossing, means the maximum zone speed for railway equipment—considering speed restrictions due to gradients, permanent or temporary slow orders, passenger stations or track configuration—operating on a line of railway while approaching a grade crossing. (Vitesse maximale pratiquée sur la ligne de chemin de fer)

Maximum Road Operating Speed – in respect of a grade crossing, means the maximum vehicle speed at the safe stopping sight distance and within the grade crossing approaches. (Vitesse maximale pratiquée sur la route)

Minister – means the Minister of Transport for Canada. (Ministre)

Multi-Use Pathway – refers to a pathway that is separated from the travelled way for intended use of pedestrian, cyclist, and similar user type. A multi-use pathway may be shared or may be separated. (Chemin à usages multiples)

New Grade Crossing – means a grade crossing for which actual construction was started on or after the day on which the Regulations came into force (e.g., after November 28th, 2014). (Nouveau passage à niveau)

Number of Tracks Sign – means the sign referred to in Article 8.1.2 of the GCS and, for the purposes of sections 58 and 73 of the GCR, the sign referred to in Article 4 of Part B of the Grade Crossings Standards. (Panneau « Nombre de voies ferrées »)

Obstruction of a Public Crossing – with respect to section 97 of the GCR, means leaving railway equipment on a crossing surface or otherwise obstructing the flow of road traffic for more than five minutes—including by activating a warning system or a warning system with gates—when vehicular or pedestrian traffic is waiting to cross. (Obstruction d'un passage à niveau public)

Padlock Cover – See adequate lock (Couvre-cadenas)

Pedestrians – include people walking, running, or standing; manual/motorized wheelchair or scooter users; people using canes or walkers; people pushing strollers or carts; dismounted cyclists; and users of various other low speed forms of human locomotion (e.g., skateboards). (Piétons)

Pedestrian Refuge Area – is a small section of pavement or sidewalk where a pedestrian can stop before crossing. (Zone de refuge piéton*)*

Persons with Mobility Disability[3] – means any persons that has difficulty walking on a flat surface for 15 minutes (Personnes à mobilité réduite)

Pre-emption – means the transfer of the normal operation of traffic signals to a special control mode. (Commande prioritaire)

Prepare to Stop at Railway Crossing sign – means the sign referred to in Article 18.1 of the GCS. (Panneau « Préparez-vous à arrêter à un passage à niveau »)

Private Authority – means a person, other than a road authority, who has a right with respect to a private grade crossing. (Autorité privée)

Private Grade Crossing – means a grade crossing that is not a public grade crossing, where railway tracks intersect with a road that is typically owned and used by private authorities, such as farmers, commercial businesses, or private individuals. (Passage à niveau privé)

Proponent – in respect with a railway work, means the person who proposes, or has proposed, the construction or alteration of the railway work, whether voluntarily or because of a requirement under the RSA. (Promoteur)

Public Grade crossing – means a grade crossing where railway tracks intersect with a road that is owned or maintained by a public authority, such as a province, municipality, or band council, and used by the general public. (Passage à niveau public)

Railway Crossing Ahead Sign – means the sign referred to in Article 8.2.1 of the GCS. (Panneau « Signal avancé d'un passage à niveau »)

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[3] Statistics Canada 2012 Canadian Survey on Disability

Railway Crossing Sign – means the sign and post referred to in Article 8.1.1 of the GCS and the sign referred to in Article 4 of Part B of those Standards. (Panneau « Passage à niveau »)

Railway Design Speed – means the railway equipment speed that corresponds to the current design of the grade crossing. (Vitesse de référence sur la voie ferrée)

Railway Work – means a line work or any part thereof; a crossing work or any part thereof; or any combination of the foregoing. (Installations ferroviaires)

Road Approach – means the part of a road, other than the crossing surface, that lies between the point that marks the start of the stopping sight distance (SSD) and the point that marks the front of a design vehicle when it is past the clearance point as shown in Figure 10-1 of the GCS. (Abord routier)

Road Crossing – means that part of a road that passes across, over or under a line of railway, and includes any structure supporting or protecting that part of that road. (Franchissement routier)

Road Crossing Design Speed – means the motor vehicle speed that corresponds to the current design of the grade crossing. (Vitesse de référence au franchissement routier)

Safe Railway Operations – in respect of the RSA, includes actions and situations that do not constitute a threat to or that enhance the safety of railway operations, railway equipment, and persons and property transported by or crossing railways, and of persons, goods, and property in the vicinity of a railway. (Ferroviaire sécuritaire)

Separate Grade Crossing – for the purposes of the GCR, means two adjacent and separate roads that are used by motor vehicles and that cross one or more lines of railway. (Passage à niveau distinct)

Shoulder – refers to the portion of roadway that is continuous with the travelled way intended for emergency stopping, and or lateral support of the roadway structure. It may also be configured to be accessible for cyclist and may vary in width from one jurisdiction to another. (Accotement)

Sightlines – means the sightlines referred to in sections 20 and 21 of the GCR, as applicable. Sightlines are measured from a point 1.05 m above the road surface to a point 1.2 m above the top of the lowest rail. They include the line of sight from the stopping sight distance to a set of front light units, or a Railway Crossing sign, at a grade crossing with or without an automatic warning system with or without gates. (Lignes de visibilité)

Sidewalk[4] – refers to a travelled way intended for pedestrian use, following an alignment generally parallel to that of adjacent roadway. (Trottoir)

Simultaneous Pre-emption – means that notification of an approaching train is forwarded to the highway traffic signal controller unit or assembly and railroad active warning devices at the same time. (Déclenchement avancé simultané)

Smooth and Continuous – in respect of the surface of a road approach, crossing surface, travelled way and shoulders, means to be free of defects (potholes, rutting, heaving, rough surfaces, cracks) and the horizontal and vertical alignment between or within the crossing surface/road approaches shall transition evenly without causing road users to stop abruptly, reduce their speed or deviate from the roadway. (Lisse et continu).

Stand-alone Sidewalk, Path, or Trail – means a separate grade crossing located outside of an adjacent grade crossing warning systems island circuit. (Trottoir, piste ou sentier Indépendant)

Stand on any part of a crossing for a longer period than five minutes – means to stop, assume a stationary position, or cease to move. A train or engine may stand on any part of a public grade crossing for an extended period, provided no vehicle or pedestrian requires passage. (Bloquer toute partie du passage à niveau pour plus de cinq (5) minutes)

Stop Ahead Sign – means the sign referred to in Article 8.3.1 of the GCS. (Panneau « Signal avancé d'arrêt »)

Stop Sign – means the sign referred to in Article 8.4.1 of the GCS. (Panneau « Stop »)

Stopping Sight Distance (SSD) – means the distance calculated in accordance with Article 7.2 of the GCS. (Distance de visibilité d'arrêt (SDD))

Storage Distance – means, on a road that crosses a grade crossing, the shortest distance between the rail nearest the road approach of the grade crossing and the edge of the nearest intersecting road, measured along the centre line of the road, as represented by D in Figure 11-1 of the *Grade Crossings Standards*. (Distance de stockage)

Switching – means moving equipment from one track to another track, or to different positions on the same track. This includes the moving of equipment in the make-up and break-up of trains; the moving of equipment on industrial switching tracks or interchange

[4] *Transportation Association of Canada* (TAC), 2017, Geometric Design Guide for Canadian Roads

tracks; and the general movement of equipment within terminals or at junctions. The doubling over of trains, in the make-up and break-up of trains, is also considered to be switching. (Manœuvre)

Tactile Walking Surface Indicator (TWSI) – refers to a warning treatment along the road approach that alerts the pedestrian to the presence of a grade crossing through a tactile surface and/or contrasting color. (Indicateur tactile de surface de marche)

Traffic Control Device(s) – (Dispositif de contrôle de la circulation):

- a Stop sign.
- a Stop Ahead sign.
- a Railway Crossing Ahead sign.
- an Advisory Speed Tab sign.
- a Prepare to Stop at Railway Crossing sign, including the interconnection with the warning system means; or
- a traffic signal, including the interconnection with the warning system.

Travelled Way – means that part of a road intended for vehicular, excluding shoulders. (Chaussée)

Vehicle – includes an automobile, a motorcycle, a motor assisted bicycle and any other vehicle propelled or driven otherwise than by muscular power but does not include a streetcar or other motor vehicle running only upon rails, a power-assisted bicycle, a motorized snow vehicle, a traction engine, a farm tractor, a self-propelled implement of husbandry or a road-building machine. (véhicule)

Vicinity – means the area adjoining, surrounding and nearby (referred to in 3(1)(b)(iv) of the GCR). (À proximité)

Vulnerable Road User (VRU)[5] – means pedestrians, individuals on a bicycle or motor assisted bicycle, individuals in a wheelchair, or other devices driven by muscular or any other kind of power that is designed for and used by a person whose mobility is limited by one or more conditions or functional impairments. (Usager de la route vulnérable)

Warning System – means an automated system, other than an interconnected traffic signal, that indicates the approach or presence of railway equipment at a grade crossing

[5] From Bill 158, Protecting Vulnerable Road Users Act, 2017 *https://www.ola.org/en/legislative-business/bills/parliament-41/session-2/bill-158*

and that is composed of any combination of light units, bells, gates, operating mechanisms and circuits. (Système d'avertissement)

Within – means throughout the entire area between two points. (Dans les limites)

Article 2 GCR Amendments

The *Grade Crossings Regulations* (GCR) use a phased-in approach providing flexibility to stakeholders. In November 2021, changes were made to the regulations' compliance deadlines. The compliance timelines have been modified in a manner that prioritizes grade crossings by levels of risk:

a) November 28th, 2022 for high-priority grade crossings, and

b) November 28th, 2024 for all other grade crossings

Note: Existing private grade crossings can have a limited use warning system installed, as long as the crossing access conditions are met.

2.1 High Priority Grade Crossings

A **high-priority grade crossing** is a public grade crossing that's used on average by ten (10) or more trains per day, and with a railway design speed of 97 km/h (60 mph) or more. High priority crossings must meet the regulations by November 28th, 2022.

If a crossing's characteristics change and is deemed to be high priority after November 28th, 2022, it will need to meet the regulations immediately.

ⓘ For information on train volumes or speeds, refer to the grade crossings map, or contact the railway company.

2.2 Other Grade Crossings

All other grade crossings must meet the regulations by November 28th, 2024.

2.3 Grade Crossing Upgrades

There are 4 types of conditions where a new or existing grade crossing will not be required to meet some of the regulatory requirements.

The following types of crossings do not have to meet the requirements in sections 19 to 96 of the regulations:

a) Public grade crossings that are used by no more than 3 trains, the railway design speed is 17 km/h (10 mph) or less, no more than one track crosses the grade crossing, the storage distance (the shortest distance between closest rail to the crossing's road approach and edge of the nearest intersecting road, measured along the centre line of the road) is 30 meters or more, whistling is required or

allowed when railway equipment approaches the grade crossing, and the cross-product (average annual daily railway movements multiplies the average annual daily traffic) is less than 2,000.

b) Private grade crossings where the railway design speed is 17 km/h (10 mph) or less, no more than two tracks cross the grade crossing, and the cross-product (average annual daily railway movements multiplies the average annual daily traffic) is less than 100.

c) Private grade crossings where the railway design speed is 41 km/h (25 mph) or less for freight trains and 49 km/h (30 mph) or less for passenger trains, no more than one track crosses the grade crossing, the storage distance (the shortest distance between closest rail to the crossing's road approach and edge of the nearest intersecting road, measured along the centre line of the road) is 30 meters or more, the cross-product (average annual daily railway movements multiplies the average annual daily traffic) is less than 100, and there's no sidewalk.

d) Public or private grade crossing where trains have stopped using the railway line.

Learn how these amendments could affect you here.

Article 3 Citations

62-GP-11M refers to the Canadian General Standards Board (CGSB) standard 62-GP-11M, *Marking Material, Retroreflective Elements, Adhesive Backing*, and dated May 1978, as amended in July 1987 (Amendment No. 1). Withdrawn June 2016.

AREMA Communications and Signals Manual means the 2014 edition of the *Communications and Signals Manual of Recommended Practice*, published by the Communications and Signals Group of the American Railway Engineering and Maintenance-of-Way Association (AREMA), in effect since December 31, 2013.

ASTM D4956 is the 11th edition of the *Standard Specification for Retroreflective Sheeting for Traffic Control*, published by the American Society for Testing and Materials (ASTM), dated March 30, 2011.

Grade Crossings Standards means the *Grade Crossings Standards* published by the Department of Transport on January 1, 2019.

Manual of Uniform Traffic Control Devices for Canada means the 6th edition of the *Manual of Uniform Traffic Control Devices for Canada* (MUTCDC), prepared by the Traffic Operations and Management Standing Committee, published by the Transportation Association of Canada (TAC), in June 2021.

CROR stands for the *Canadian Rail Operating Rules*, approved by the Minister of Transport under the authority of the *Railway Safety Act*, as amended from time to time.

Geometric Design Guide means the *Geometric Design Guide for Canadian Roads,* published by the Transportation Association of Canada (TAC), in September 1999.

Guide for the Design of Roadway Lighting means the *Guide for the Design of Roadway Lighting*, Volume 2 – *Design*, Chapter 13: At-Grade Railway Crossing, published by the Transportation Association of Canada (TAC), as amended from time to time.

ITE Pre-emption Practices means *Pre-emption of Traffic Signals Near Railroad Crossings*, a recommended practice of the Institute of Transportation Engineers (ITE), published in 2006, as amended from time to time.

NCHRP Report 350: Recommended Procedures for the Safety Performance Evaluation of Highway Features are the procedures recommended by the National Cooperative Highway Research Program (NCHRP), published by the Transportation Research Board (TRB), a division of the (U.S.) National Research Council.

Grade Crossings Regulations means SOR/2014-275 the regulations pursuant subsection 7(1) section 7.1 subsections 18(1) and 18(2) paragraph 23.1(1)(a), subsection 24(1) and sections 37 and 47 of the *Railway Safety Act* Registration 2014-11-28.

Article 4 Units of Measurement

Although the metric system was first legalized in Canada by Prime Minister John A Macdonald in 1871, the British imperial system of units (based on yards, pounds, gallons, etc.) continued to predominate. In the 1960s, with technology rapidly advancing and expanding worldwide trade, the need for an international measurement system became increasingly apparent. In addition, the size of measurements such as the gallon differed between the United States and Canada, despite both countries using the imperial system. Beginning with the 1969 White Paper, Canada gradually transitioned from the imperial to the metric system of measurement.

Imperial measures continue to be used by the railway industry today. Standards respecting train speed and distances along railway rights-of-way and are in imperial units.

Table 4-1 Conversion of Length from Metric to Imperial

Metric			Imperial	
1 millimeter [mm]		→	0.0393701 inch [in.]	0.00328084 foot [ft.]
1 centimeter [cm]	10 mm	→	0.393701 inch [in.]	0.0328084 foot [ft.]
1 meter [m]	100 cm	→	3.2808399 foot [ft.]	0.000621371 mile [mi]
1 kilometer [km]	1000 m	→	3280.84 foot [ft.]	0.621371 mile [mi]

Table 4-2 Conversion of Length from Imperial to Metric

Imperial			Metric	
1 inch [in.]	0.083333 ft.	→	25.4 millimeter [mm]	2.54 centimeter [cm]
1 foot [ft.]	12 in.	→	304.8 millimeter [mm]	30.48 centimeter [cm]
1 foot [ft.]	0.000189394 mi.	→	0.3048 meter [m]	0.0003048 kilometer [km]
1 mile [mi.]	5280 ft.	→	1609.34 meter [m]	1.60934 kilometer [km]

Table 4-3 Conversion of Speed from Metric to Imperial

Metric			Imperial	
1 kilometer per hour [km/h]	0.277778 m/s	→	0.621371 mile per hour [mph]	0.911344 foot per second [ft./s]
1 meter per second [m/s]	3.6 km/h	→	2.23694 mile per hour [mph]	3.28084 foot per second [ft./s]

Table 4-4 Conversion of Speed from Imperial to Metric

Imperial			Metric	
1 mile per hour [mph]	1.46667 ft./s	→	0.44704 meter per second [m/s]	1.60934 kilometer per hour [km/h]
1 foot per second [ft./s]	0.681818 mph	→	0.3048 meter per second [m/s]	1.09728 kilometer per hour [km/h]

Table 4-5 Distance Travelled in Feet per Second

Seconds		**10**	**15**	**20**	**25**	**30**	**35**	**40**	**45**	**50**	**55**	**60**
Miles per Hour	**Feet per Second**	**Distance Travelled in Feet**										
1	1.47	14.67	22.00	29.33	36.67	44.00	51.33	58.67	66.00	73.33	80.67	88.00
2	2.93	29.33	44.00	58.67	73.33	88.00	102.67	117.33	132.00	146.67	161.33	176.00
3	4.40	44.00	66.00	88.00	110.00	132.00	154.00	176.00	198.00	220.00	242.00	264.00
4	5.87	58.67	88.00	117.33	146.67	176.00	205.33	234.67	264.00	293.33	322.67	352.00
5	7.33	73.33	110.00	146.67	183.33	220.00	256.67	293.33	330.00	366.67	403.33	440.00
10	14.67	146.67	220.00	293.33	366.67	440.00	513.33	586.67	660.00	733.34	806.67	880.00
15	22.00	220.00	330.00	440.00	550.00	660.00	770.00	880.00	990.00	1,100.00	1,210.00	1,320.00
20	29.33	293.33	440.00	586.67	733.34	880.00	1,026.67	1,173.34	1,320.00	1,466.67	1,613.34	1,760.00
25	36.67	366.67	550.00	733.34	916.67	1,100.00	1,283.34	1,466.67	1,650.00	1,833.34	2,016.67	2,200.01
30	44.00	440.00	660.00	880.00	1,100.00	1,320.00	1,540.00	1,760.00	1,980.00	2,200.01	2,420.01	2,640.01
35	51.33	513.33	770.00	1,026.67	1,283.34	1,540.00	1,796.67	2,053.34	2,310.01	2,566.67	2,823.34	3,080.01
40	58.67	586.67	880.00	1,173.34	1,466.67	1,760.00	2,053.34	2,346.67	2,640.01	2,933.34	3,226.67	3,520.01
45	66.00	660.00	990.00	1,320.00	1,650.00	1,980.00	2,310.01	2,640.01	2,970.01	3,300.01	3,630.01	3,960.01
50	73.33	733.34	1,100.00	1,466.67	1,833.34	2,200.01	2,566.67	2,933.34	3,300.01	3,666.68	4,033.34	4,400.01
55	80.67	806.67	1,210.00	1,613.34	2,016.67	2,420.01	2,823.34	3,226.67	3,630.01	4,033.34	4,436.68	4,840.01
60	88.00	880.00	1,320.00	1,760.00	2,200.01	2,640.01	3,080.01	3,520.01	3,960.01	4,400.01	4,840.01	5,280.01
65	95.33	953.34	1,430.00	1,906.67	2,383.34	2,860.01	3,336.67	3,813.34	4,290.01	4,766.68	5,243.35	5,720.01
70	102.67	1,026.67	1,540.00	2,053.34	2,566.67	3,080.01	3,593.34	4,106.68	4,620.01	5,133.35	5,646.68	6,160.01
75	110.00	1,100.00	1,650.00	2,200.01	2,750.01	3,300.01	3,850.01	4,400.01	4,950.01	5,500.01	6,050.01	6,600.02

Seconds		**10**	**15**	**20**	**25**	**30**	**35**	**40**	**45**	**50**	**55**	**60**
Miles per Hour	**Feet per Second**	**Distance Travelled in Feet**										
80	117.33	1,173.34	1,760.00	2,346.67	2,933.34	3,520.01	4,106.68	4,693.34	5,280.01	5,866.68	6,453.35	7,040.02
85	124.67	1,246.67	1,870.00	2,493.34	3,116.67	3,740.01	4,363.34	4,986.68	5,610.01	6,233.35	6,856.68	7,480.02
90	132.00	1,320.00	1,980.00	2,640.01	3,300.01	3,960.01	4,620.01	5,280.01	5,940.01	6,600.02	7,260.02	7,920.02
95	139.33	1,393.34	2,090.00	2,786.67	3,483.34	4,180.01	4,876.68	5,573.35	6,270.01	6,966.68	7,663.35	8,360.02
100	146.67	1,466.67	2,200.01	2,933.34	3,666.68	4,400.01	5,133.35	5,866.68	6,600.02	7,333.35	8,066.69	8,800.02
105	154.00	1,540.00	2,310.01	3,080.01	3,850.01	4,620.01	5,390.01	6,160.01	6,930.02	7,700.02	8,470.02	9,240.02
110	161.33	1,613.34	2,420.01	3,226.67	4,033.34	4,840.01	5,646.68	6,453.35	7,260.02	8,066.69	8,873.35	9,680.02
115	168.67	1,686.67	2,530.01	3,373.34	4,216.68	5,060.01	5,903.35	6,746.68	7,590.02	8,433.35	9,276.69	10,120.02
120	176.00	1,760.00	2,640.01	3,520.01	4,400.01	5,280.01	6,160.01	7,040.02	7,920.02	8,800.02	9,680.02	10,560.02

Part B – Design Standards

Public and private grade crossings can be viewed as simply a special type of roadway intersection, as three of the fundamental elements of a roadway intersection are present: the intersection itself; vehicles; and motorists/pedestrians. As with road intersections, motorists and pedestrians must yield the right of way to opposing traffic as appropriate. Unlike a regular roadway intersection, however, the opposing traffic—in this case the train—can only rarely yield the right of way to motorists/pedestrians. Motorists and pedestrians can alter direction and speed relatively quickly. Train operators, on the other hand, are restricted to travelling on a fixed path, and changing speed takes a much longer time. For this reason, motorists and pedestrians bear most of the responsibility for avoiding collisions with trains at grade crossings.

Section 26.2 of the *Railway Safety Act* (RSA) states that "the users of a road shall give way to railway equipment at a road crossing if adequate warning of its approach is given." Adequate warning is therefore crucial at grade crossings. As well as a grade crossing's warning system, its design, its sightlines, its road approaches, and its crossing surface all contribute to providing adequate warning. Safety at grade crossings is therefore a shared responsibility. As such, sharing information about the site-specific parameters of a grade crossing is essential. The requirements of the *Grade Crossings Regulations* (GCR) cannot be properly met if each parameter is addressed separately, without regard to how a change in one could affect another. The following articles provide guidance as to the requirements for the proper design of all components of a grade crossing.

Section 11 of the RSA states that all work relating to railway works, including design, construction, evaluation, maintenance, and alteration, must be done in accordance with sound engineering principles, and that all engineering work relating to railway works must be approved by a professional engineer. More information regarding the application of section 11 of the RSA can be found on Transport Canada's website at: Guideline - Engineering Work Relating To Railway Works (Section 11 - Railway Safety Act) (canada.ca)

Article 5 Crossing Surface

5.1 Crossings Surface (New grade crossings)

Applicable to all new grade crossings constructed on or after November 28, 2014, and to existing crossings to which changes were made. (See Article 2 for more information on amendments to the GCR timelines)

Crossing surface of a grade crossing, and a crossing surface of a sidewalk, path or trail must be as shown in Figure 5-1 and in accordance with Table 5-1, and must be smooth and continuous.

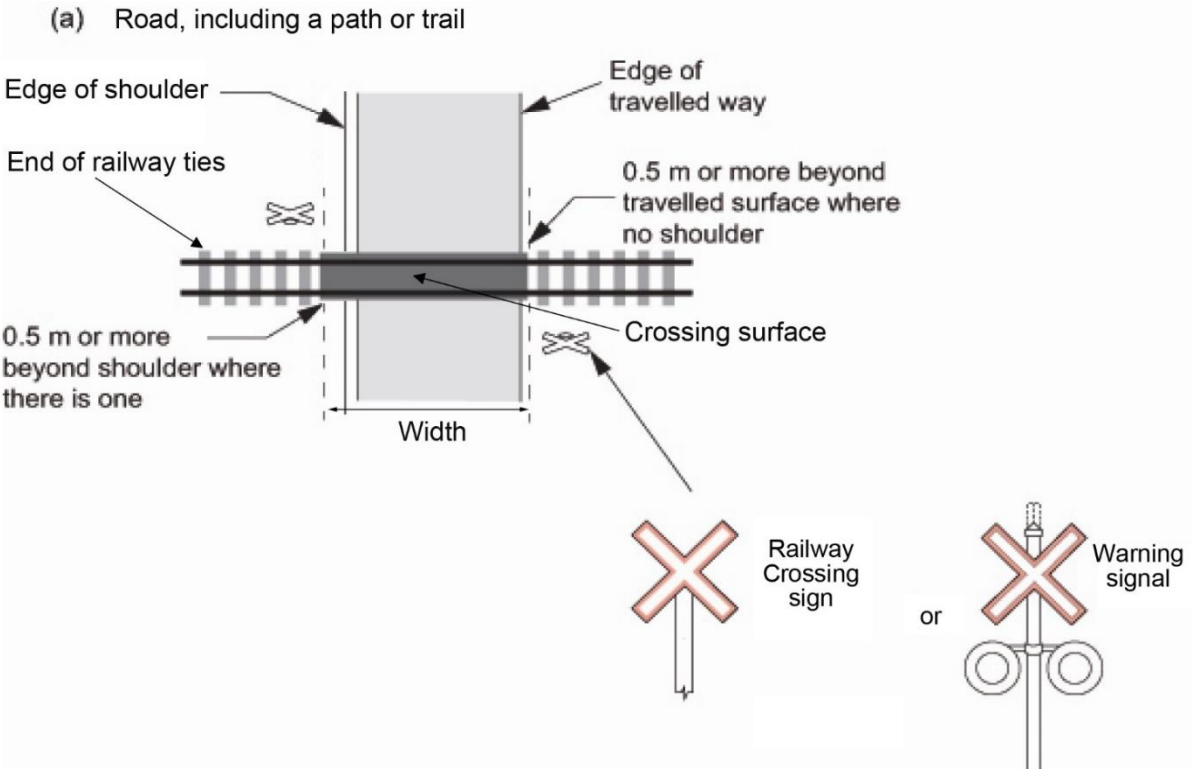
5.1.1 A smooth and continuous surface helps to ensure the safe and comfortable crossing by cyclists and pedestrians, including pedestrians with visual or mobility impairments. A smooth and level surface reduces the risk of tripping and falling for pedestrians, cyclists and users of wheelchairs or other mobility assistive devices.

5.1.2 As with the flangeway gap, the vertical difference between the rail and adjacent surfaces must be minimized. Vertical differences can be as critical as horizontal gaps because they can cause the swivel casters of wheelchairs or other assistive devices to turn sideways and drop into the gap.

The presence of vulnerable road users (VRU) at grade crossings in particular persons using assistive devices is a significant factor for assessing risk at a grade crossing. Special consideration should be given to accessibility needs for persons with mobility impairments.

Reference Appendix M of this Handbook to find further guidance on VRU treatments.

5.1.3 Grade crossing surface systems, including any Flangeway material components, gauge or field side of rail, should be electrically non-conductive so as not to interfere with train control or crossing signals operation.[6]



[6] AREMA, *Manual for Railway Engineering*, 2017, Volume 1, Part 5, Section 8.5.1: Crossing Surface Materials

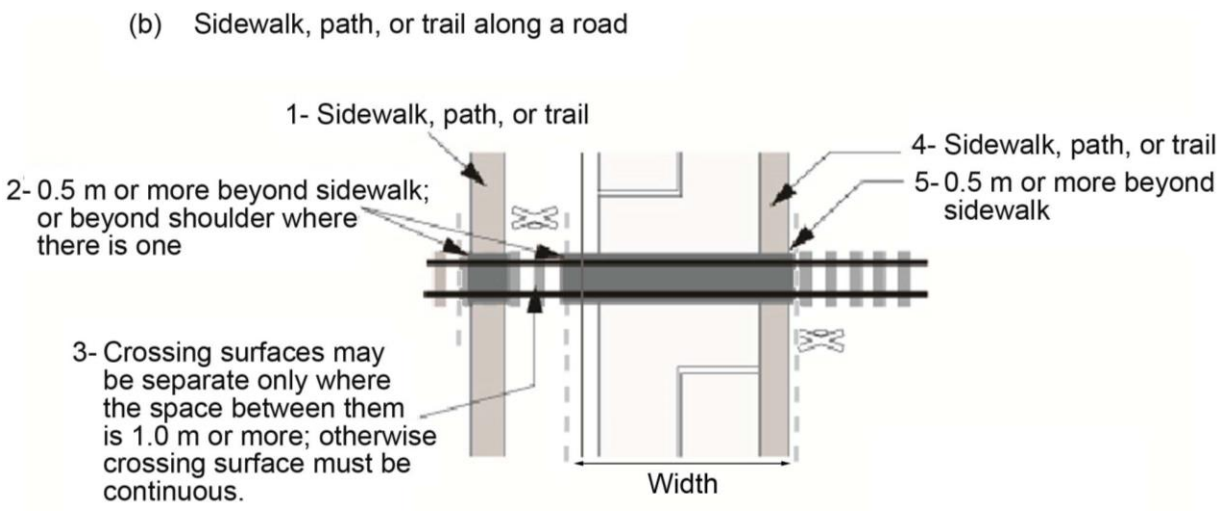


Figure 5-1 Grade Crossing Surface Dimensions

Table 5-1 Grade Crossing Surface – Crossing Section

a) Flangeway		
Width	Minimum	65 mm
	Maximum for	
	Public sidewalks, paths or trails designated by the road authority for use by persons using assistive devices (only the portion of the crossing surface used by persons with assistive devices)	75 mm
	All other grade crossings	120 mm
Depth:	Minimum	50 mm
	Maximum for:	
	Public sidewalks, paths and trails designated by the road authority for use by persons using assistive devices (only the portion of the crossing surface used by persons with assistive devices)	75 mm
	All other grade crossings	No limit

<table>
<tr><td colspan="3">b) Field side gap
A space is permitted on the outer side of the rail at rural locations, except for public sidewalks, paths or trails designated by the road authority for use by persons using assistive devices.</td></tr>
<tr><td colspan="2">Maximum width</td><td>120 mm</td></tr>
<tr><td colspan="2">Maximum depth</td><td>No limit</td></tr>
<tr><td colspan="3">c) Elevation of the top of the rail with respect to the crossing surface
The top of the crossing surface must be installed as close as possible to the top of the rail within the wear limits below.</td></tr>
<tr><td colspan="3">Wear limits</td></tr>
<tr><td colspan="3">Public sidewalk, path or trail designated by the road authority for use by persons using assistive devices
(only the portion of the crossing surface used by persons with assistive devices)</td></tr>
<tr><td rowspan="2"></td><td>Maximum distance of the top of the rail above crossing surface</td><td>13 mm</td></tr>
<tr><td>Maximum distance of the top of the rail below crossing surface</td><td>7 mm</td></tr>
<tr><td colspan="2">All other public grade crossings: Maximum distance of the top of the rail above or below the crossing surface</td><td>25 mm</td></tr>
<tr><td colspan="2">Private grade crossings: Maximum distance of the top of the rail above or below the crossing surface</td><td>50 mm</td></tr>
</table>

5.2 Crossing Surface (Existing grade crossings)

This section is applicable to existing grade crossings built before November 28, 2014. (See Article 2 for more information on amendments to the GCR timelines)

The crossing surface must be of a width that is equal to the width of the travelled way and shoulders of the road, plus 0.5 m on each side, measured at right angles to the centerline of the road, as shown in Figure 5-2 as applicable.

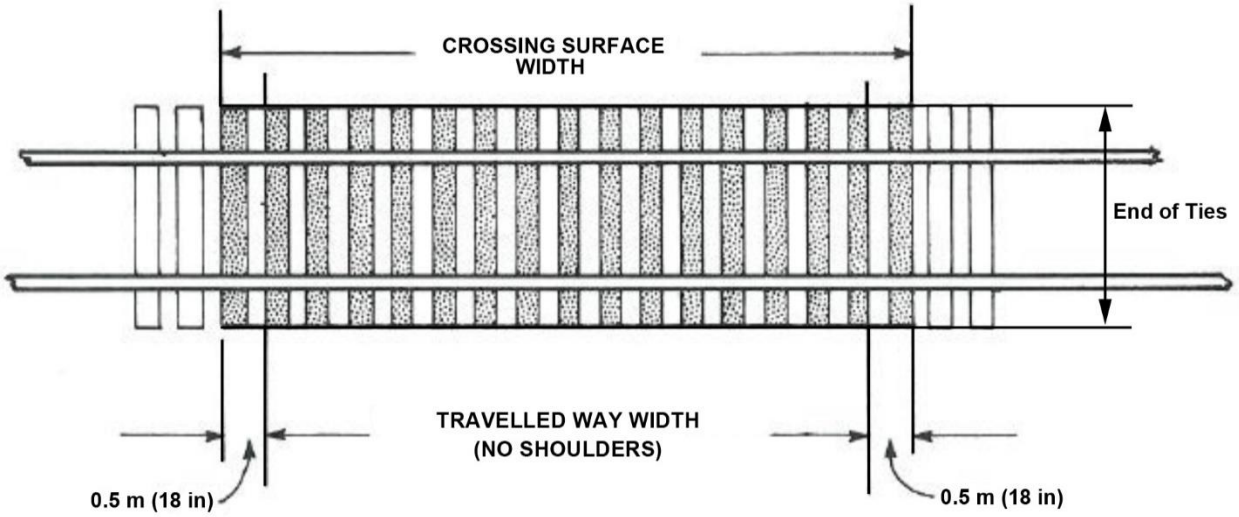
5.2.1 A smooth and continuous surface helps to ensure the safe and comfortable crossing by cyclists and pedestrians, including pedestrians with visual or mobility

impairments. A smooth and continuous surface reduces the risk of tripping and falling, for pedestrians, cyclists and users of wheelchairs or other mobility assistive devices.

5.2.2 A flangeway must be provided between the gauge side of the rail and the road surface and must be between 65 mm and 120 mm wide, and between 50 mm and 75 mm deep.

5.2.3 As with the flangeway gap, the vertical difference between the rail and adjacent surfaces must be minimized. Vertical differences can be as critical as horizontal gaps because they can cause the swivel casters of wheelchairs or other assistive devices to turn sideways and drop into the gap.

a)



b)

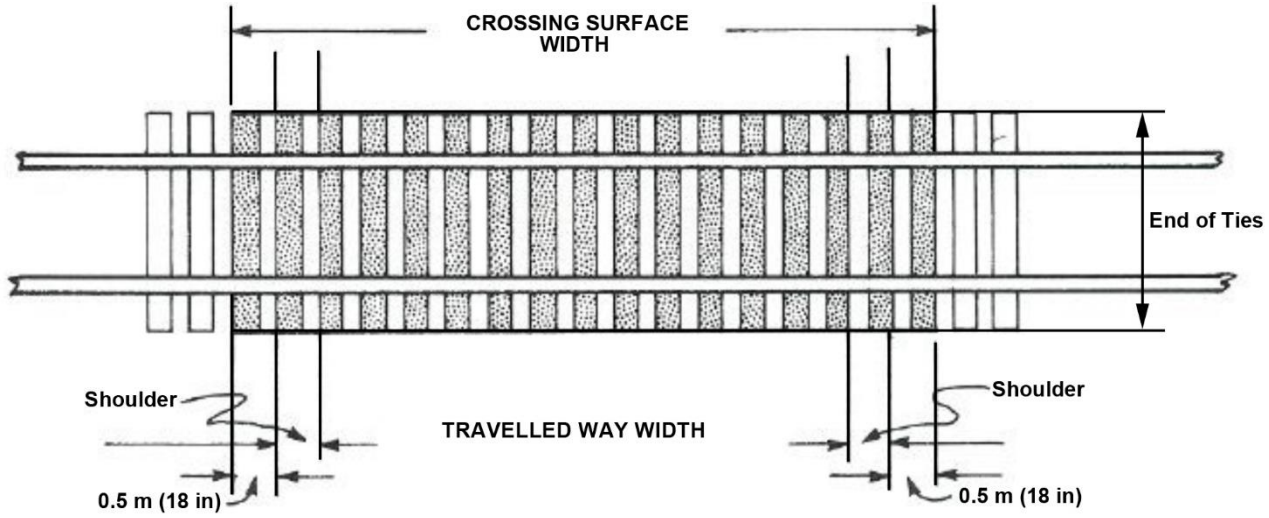


Figure 5-2 Crossing Surface

Article 6 Road Geometry

6.1 Grade Crossings and Road Approaches

Applicable to all new grade crossings and to changes made at existing grade crossings to the location, gradient or crossing angle to improve the overall safety of the grade crossing (GCR 32 and 88) (see Article 2 for more information on amendments to the GCR timelines)

6.1.1 The horizontal and vertical alignment of the road approach and the crossing surface must be smooth and continuous.

6.1.2 The allowable difference between the road approach gradient and railway cross-slope, or the railway gradient and the road approach cross-slope, must be in accordance with Table 6-1.

6.1.3 The maximum gradients for road approaches must not exceed the following:

a) ratio of 1:50 (2 per cent) within 8 m of the nearest rail and 1:20 (5 per cent) for 10 m beyond, at public grade crossings for vehicular use.

b) ratio of 1:50 (2 per cent) within 8 m of the nearest rail and 1:10 (10 per cent) for 10 m beyond, at private grade crossings for vehicular use.

c) ratio of 1:50 (2 per cent) within 5 m of the nearest rail at a sidewalk, path, or trail; and

d) ratio of 1:100 (1 per cent) within 5 m of the nearest rail at a sidewalk, path or trail designated by the road authority for use by persons using assistive devices.

6.1.4 The width of the travelled way and shoulders of the crossing surface must not be less than the width of the travelled way and shoulders on the road approaches. This is to avoid creating an hour-glass effect.

6.1.5 A grade crossing angle, measured from the tangent of the centreline of the road approach at the crossing surface to the tangent of the centreline of the line of railway, shall, where the railway design speed is more than 25 km/h (15 mph), be:

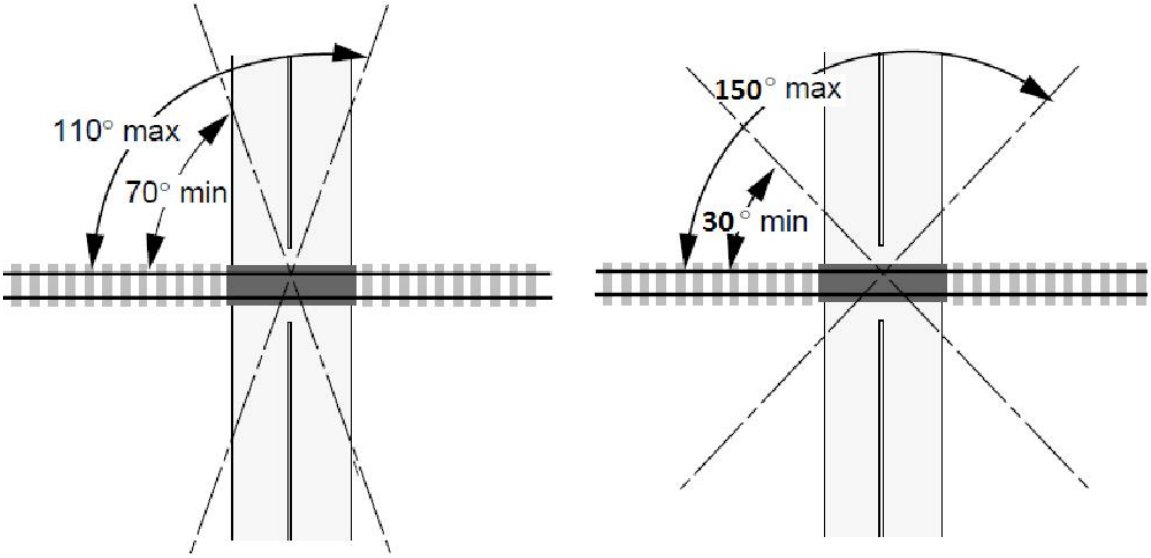
a) not less than 70 and not greater than 110 degrees for grade crossings without a warning system (Figure 6-1 (a)) or

b) not less than 30 and not greater than 150 degrees for grade crossings with a warning system (**Error! Reference source not found.** (b))

6.1.6 When a grade crossing is not a 90-degree intersection of track and road, the problems caused by vertical differences between railway and crossing surface are exacerbated. Vertical differences in skewed-angle grade crossings also increase the likelihood of cyclists losing control of their bicycles. Vertical differences should therefore be minimized at skewed-angle grade crossings.

The presence of vulnerable road users (VRU) at grade crossings in particular persons using assistive devices is a significant factor for assessing risk at a grade crossing. Special consideration should be given to accessibility needs for persons with mobility impairments.

Reference Appendix M of this Handbook to find further guidance on VRU treatments.



a) Grade Crossing without a Warning System.

b) Grade Crossing with a Warning System.

Figure 6-1 Maximum Crossing Angle: Grade Crossing

Table 6-1 Difference in Gradient

Classification	Difference in Gradient (%)
R L U	2
R C U	1
R C D	1
R A U	0
R A D	0
R F D	-
U L U	3
U C U	2
U C D	2
U A U	0

*Legend						
Urban (U)	Rural (R)	Local (L)	Collector (C)	Arterial(A)	Expressway (E)	Freeway(F)
Divided (D)			Undivided (U)			

Source: *Geometric Design Guide for Canadian Roads*, Transportation Association of Canada, September 1999

6.2 Existing Grade Crossing Road Geometry

Grade crossings that existed prior to November 28, 2014, are grandfathered from some of the road geometry requirements set out in the GCR. However, existing grade crossings are required to satisfy Article 6.1 of the GCS by November 28, 2022, or November 28, 2024, depending on the specific physical and operational characteristics of the grade crossing. (See Article 2 for more information on amendments to the GCR timelines) Despite the phased-in approach to comply with the road geometry requirements, if at any time a grade crossings sees a change to its location, gradient or crossing angle, the grade crossing must comply with subsection 88(1) of the GCR. GCR 88(1) stipulates that the location, gradient and crossing angle are not required to comply

fully with articles 6 or 11 of the GCS, but the changes to these elements of the grade crossings are required to be done in a manner that will improve the overall safety of the grade crossing.

Article 7 Sightlines

Under the GCR, road authorities, private authorities and railway companies are required to maintain sightlines at grade crossings by November 28, 2022 or November 28th, 2024 (GCR 23) depending on the specific physical and operational characteristics of the grade crossing. (See Article 2 for more information on amendments to the GCR timelines). The GCR set out standards for sightlines and their maintenance. Sightlines will be preserved by prohibiting the construction of buildings or structures, or the placement of objects, that obstruct them. Individuals will also be required to remove any trees or brush obstructing sightlines. Railway companies will be prohibited from leaving unattended any railway equipment that obstructs sightlines. For newly constructed grade crossings, or those that undergo alterations or operational changes, these requirements must be met immediately. Sections 24 to 28 of the GCR are in force as of day one, e.g., November 28, 2014 (GCR 19 to 28).

Note: Sightlines are not required at a grade crossing which is equipped with an automatic warning system with gates. (GCR 22)

Note to Municipalities: Since November 28, 2014, section 24 of the GCR requires that special attention be paid to land adjoining the land on which a line of railway is situated. Before a permit to build a permanent structure within the sightlines of a grade crossing is granted, the applicant should be advised that the GCR require the area within the sightline triangle shown of the GCS and this document remain clear at all times. At grade crossings equipped with an automatic warning system (with or without gates), while the sightline triangle is reduced, there remains requirements to see the warning system's front light units, as well as the Railway Crossing sign, from the stopping sight distance (SSD) (GCR 68 and 82).

Note: Under the GCR, sightlines are not required to be met until November 28, 2022 or November 28, 2024, depending on the specific physical and operational characteristics of the grade crossing, unless a new grade crossing is built or a change is made to any of the following elements at the grade crossing, in which case sightlines would be required at the time of the change (GCR 28). (See Article 2 for more information on amendments to the GCR timelines).

The list of alterations or operational changes that will trigger a requirement for sightlines, are as follows:

- a line of railway is added within the sightlines.

- the class of track, as per column 1 (Table 7-1), changes as a result of a change in the maximum allowable operating speed as set out in column 2 or 3 of that table, as applicable.
- the design vehicle changes; or
- the specification in column B of GCS table 10-2 corresponding to the road approach changes because of an increase in the road crossing design speed, as per the characteristics set out in table 10-3 or table 10-4 of these Standards, as applicable.

Note to Railways: Temporary slow orders do not exempt a company from sightline requirements. Sightlines must be calculated based on railway design speed, which can differ from one direction to the other (GCR 20 and 21).

7.1 General

7.1.1 Sightlines are to be measured from a point 1.05 m above the road surface to a point 1.2 m above top of lowest rail.

The 5 m mentioned in Figure 7-1 is to allow for different lengths of motor vehicle front ends.

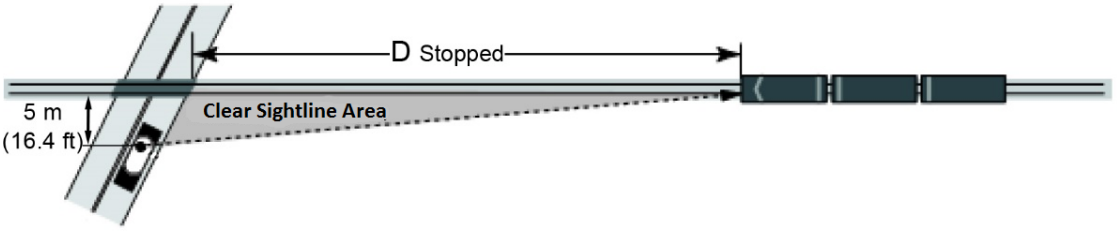
7.1.2 For the purpose of sections 28(b) of the GCR, refer to the Class of Track Figure 7-1 below.

Table 7-1 Class of Track

Column 1	Column 2	Column 3
Class of Track	**Maximum Operating Speed for Freight**	**Maximum Operating Speed for Passenger**
Class 1	17 km/h (10 mph)	25 km/h (15 mph)
Class 2	41 km/h (25 mph)	49 km/h (30 mph)
Class 3	65 km/h (40 mph)	97 km/h (60 mph)
Class 4	97 km/h (60 mph)	129 km/h (80 mph)
Class 5	129 km/h (80 mph)	153 km/h (95 mph)

Source : https://tc.canada.ca/en/rail-transportation/rules/2021-2022/rules-respecting-track-safety/part-ii-track-safety-rules

a) Sightlines for users stopped at a grade crossing (applicable to all quadrants)



b) Sightlines for users approaching a grade crossing (applicable to all quadrants)

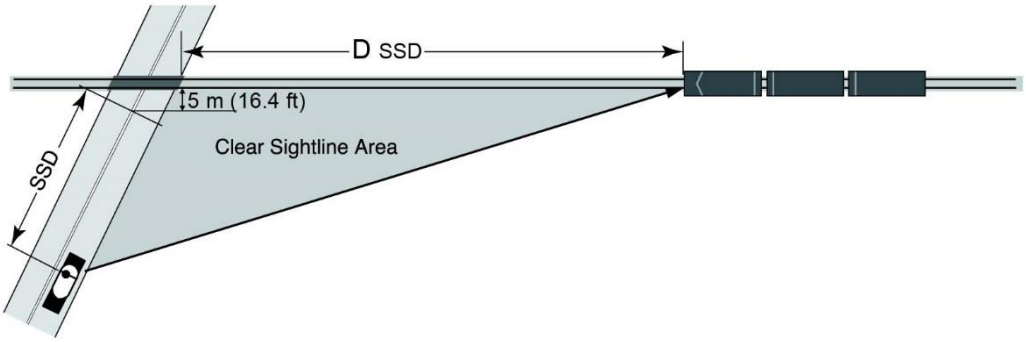


Figure 7-1 Minimum Sightlines - Grade Crossings

7.2 Determination of Sightlines

In Figure 7-1,

a) SSD is the stopping sight distance and is calculated using the following formula:

$$SSD = 0.278 \times 2.5 \times V + d$$

where:

d = braking distance (m) as per the Geometric Design Guide for Canadian Roads
V = road crossing design speed (km/h)

b) D_{SSD} is the minimum distance along the line of railway from which a crossing user must see approaching railway equipment from the SSD and does not apply if the grade crossing is equipped with a Stop sign or warning system.

D_{SSD} is equal to the distance required for the design vehicle at its road crossing design speed to go from the SSD to completely past the clearance point on the other side of the grade crossing.

$$D_{SSD}(m) = 0.278 V_T \times T_{SSD}$$

$$D_{SSD}(ft.) = 1.47 V_T \times T_{SSD}$$

where:

V_T = railway design speed in km/h or mph

$$TSSD\ (seconds)\ = \frac{SSD\ +\ cd\ +\ L}{0.278V}$$

V = road crossing design speed (km/h)
cd = grade crossing clearance distance (m)
L = length of the grade crossing design vehicle (m)

c) $D_{Stopped}$ is the minimum distance along the line of railway from which a crossing user must be able to see approaching railway equipment from the stopped position at a grade crossing.

d) $D_{Stopped}$ is equal to the greater of the distances that railway equipment at the railway design speed will travel during

   i) the departure time for the grade crossing design vehicle calculated in accordance with Article 10.3.2, or
   ii) the departure time for pedestrians, cyclists, and persons using assistive devices calculated in accordance with Article 10.3.3.

$D_{stopped}$ must be calculated using the following formula:

$$D_{stopped}(m) = 0.278V_T \times T_{stopped}$$

$$D_{stopped}(ft.) = 1.47V_T \times T_{stopped}$$

where:

V_T = railway design speed in km/h or mph
$T_{stopped}$ = the departure times, calculated in accordance with Article 10.3

A guide for determining minimum sightlines at grade crossings can be found on Transport Canada's website at Determining Minimum Sightlines at Grade Crossings Guide.

Obstructions to sightlines include but are not limited to:

a) trees
b) crops
c) snowbanks
d) brush
e) buildings installed as of November 28th, 2014
f) parked unattended equipment/vehicles
g) any object that prevents a road user from knowing whether it is safe to proceed

h) stored material

Where a grade crossing has inadequate sightlines and no warning system, and it is not physically or economically feasible to correct the deficiency, below are examples of what can be done to improve the grade crossing's safety:

a) improve the roadway geometry.

b) install appropriate warning signs (including active types and gates),

c) reduce the posted roadway/railway design speed in advance of the crossing:

   i) advisory signing as a minimum.

   ii) regulatory posted limit if it can be effectively enforced.

d) close the crossing.

e) reconfigure/relocate the crossing.

f) Grade-separate the crossing (after considering review of location).

Article 8 Signs

Note: Should a stakeholder decide to install any of the non-mandatory signs referred to in the GCR or GCS, such signs must nonetheless be installed in accordance with those documents (GCR 48 and 73).

8.1 Railway Crossing Sign and Number of Tracks Sign

See Article 2 for more information on amendments to the GCR timelines.

Note: For private grade crossings, this applies only when signs are installed.

8.1.1 Railway Crossing Sign

A sign providing warning of a grade crossing (Railway Crossing sign) must be as shown in Figure 8-1 a) (GCR 38, 48, 58 and 73) and must:

a) have a retroreflective coating that covers the entire front surface of the sign.

b) have a 50-mm border on the front of each blade, with transparent red ink silk-screen processed over sheeting material.

8.1.2 Number of Track Sign

A sign indicating the number of tracks at a grade crossing (Number of Tracks sign) must be as shown in Figure 8-1 b) (GCR 38, 48, 58 and 73) and must:

a) have a retroreflective coating that covers the entire front surface of the sign.

b) have a digit and symbol that is transparent red inked silk-screened processed.

c) be installed on the supporting post of each Railway Crossing sign as shown in Figure 8-1 c).

d) for grade crossings that existed prior to November 28th, 2014, be either red or black, unless a sign is replaced after November 28th, 2014, in which case it must comply with standard 8.1.2(b) (GCR 58, 73 and 86; GCS 4.1).

Note: Railway Crossing and Number of Track signs are not mandatory at private grade crossings. However, if such signs are installed at a private grade crossing, they must comply with standards 8.1.1 and 8.1.2 (GCR 48 and 73).

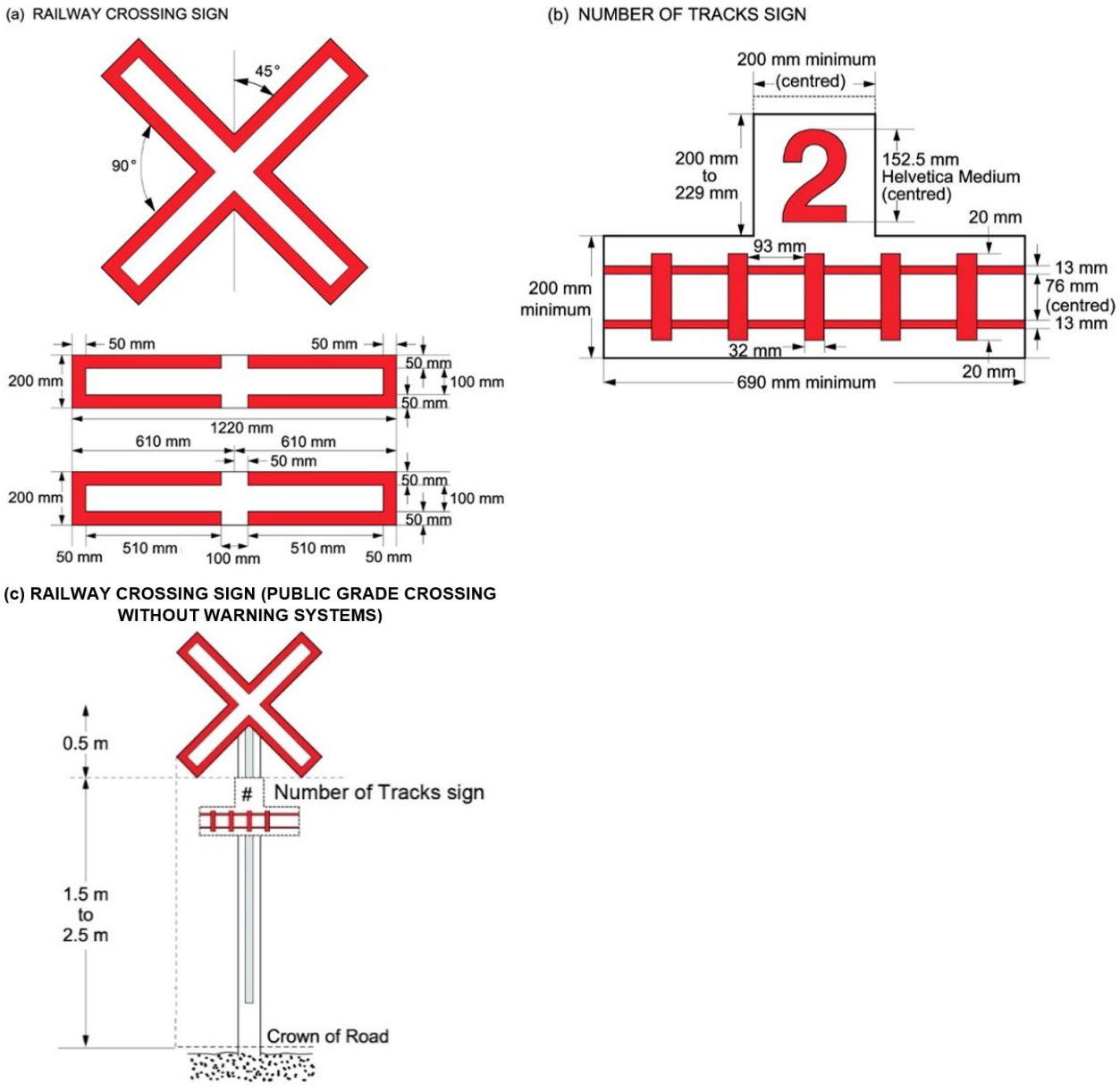


Figure 8-1 Railway Crossing and Number of Tracks Signs

Source: *Grade Crossings Standards*, January 1, 2019

8.1.3 Additional Requirements for Grade Crossings Without Warning Systems

Existing grade crossings and grade crossings installed or modified as of November 28th, 2022, or November 28th, 2024 require (see Article 2 for more information on amendments to the GCR timelines):

8.1.3.1 A 100-mm retroreflective strip must be applied on the back of each blade of the Railway Crossing sign, for the full length of each blade.

8.1.3.2 A 50-mm strip of silver white sheeting must be applied on the front and back of the supporting post, extending from no higher than 300 mm above the crown of the adjacent road surface to 70 mm above the centre of the Railway Crossing sign, and must be as shown in Figure 8-2.

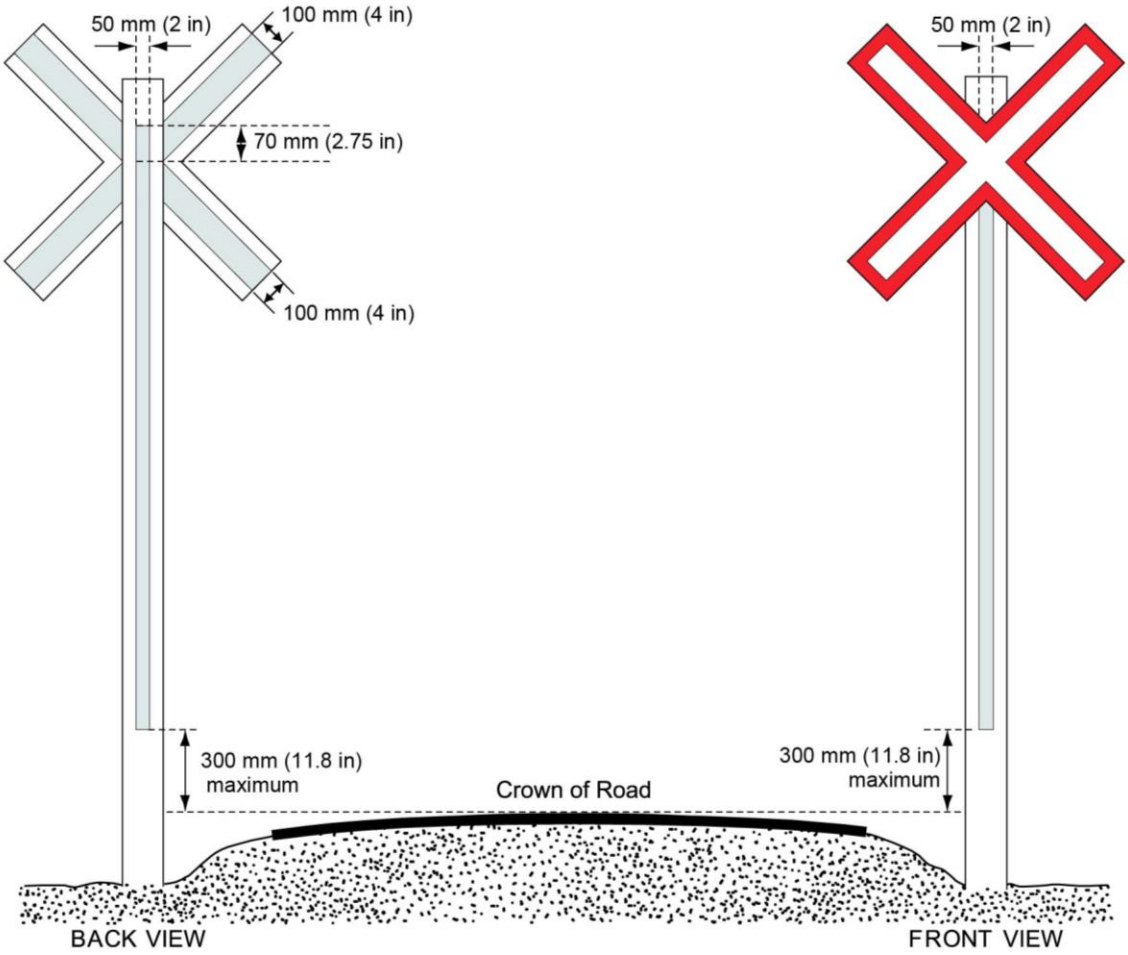


Figure 8-2 Retroreflective Stripes on the Back of the Railway Crossing Sign and, on the Sign, Supporting Post (Public Grade Crossings without a grade crossing warning system)

Source: *Grade Crossings Standards*, January 1, 2019

8.1.3.3 The Railway Crossing sign must be located:

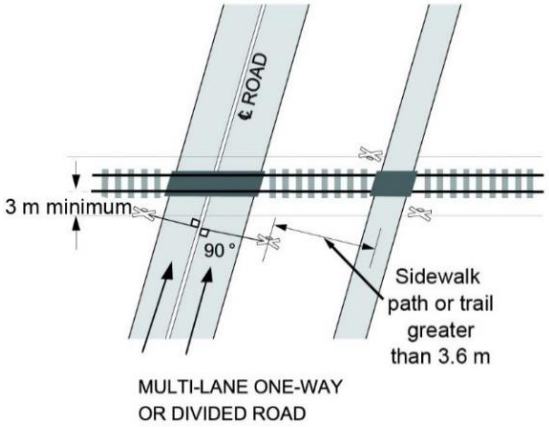
a) between 0.3 m and 2.0 m from the face of the curb or the outer edge of the road shoulder or, where there is no curb or shoulder, 2.0 m to 4.5 m from the edge of the travelled way: and

b) not closer than 3 m measured to the nearest rail, as shown in Figure 8-3.

8.1.3.4 At public grade crossings and where provided at a private grade crossing, a sidewalk, path, or trail with a centerline that is at a distance of more than 3.6 m (12 ft.) from a Railway Crossing sign supporting post beside a road approach for vehicle traffic must have a separate Railway Crossing sign, as shown in Figure 8-3 (GCR 38, 58 and 73; GCS 4.1.1(f)).

New grade crossings and grade crossings modified on or after November 28th, 2014 (see Article 2 for more information on amendments to the GCR timelines).

a)



b)

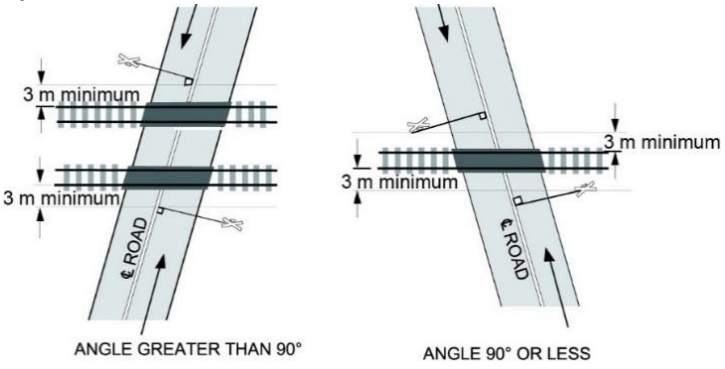


Figure 8-3 Location of Railway Crossing Signs (public grade crossings without warning systems)

Source: *Grade Crossings Standards*, January 1, 2019

8.1.4 Supporting Post Design Criteria

8.1.4.1 For new Railway Crossing sign supporting posts and when changes are made to an existing post supporting of a Railway Crossing or Number of Track sign, the supporting post must:

a) unless the Railway Crossing sign is installed on the mast of a warning system, be of such construction that an 820-kg vehicle striking it at a speed of 32 km/h or greater will not have a change in velocity greater than 4.57 m/s. (GCR 38, 48 and 86; GCS 8.1).

The intent of Article 8.1.7(a) is to ensure that the support post will break safely when struck by a vehicle from any direction, to prevent potential injuries that such an impact with an unyielding structure could cause. Breakaway sign supports are designed and constructed to break or yield when struck by a vehicle. This type of supporting post is made by drilling through the horizontal axis of the post at locations determined by its size. Structurally the post must be able to hold the weight of the sign.

Table 8-1 provides a guide for determining the size of wooden post to use and the size of breakaway holes to drill at the base of the post 75 mm and 435 mm above finished grade, as shown in Figure 8-4.

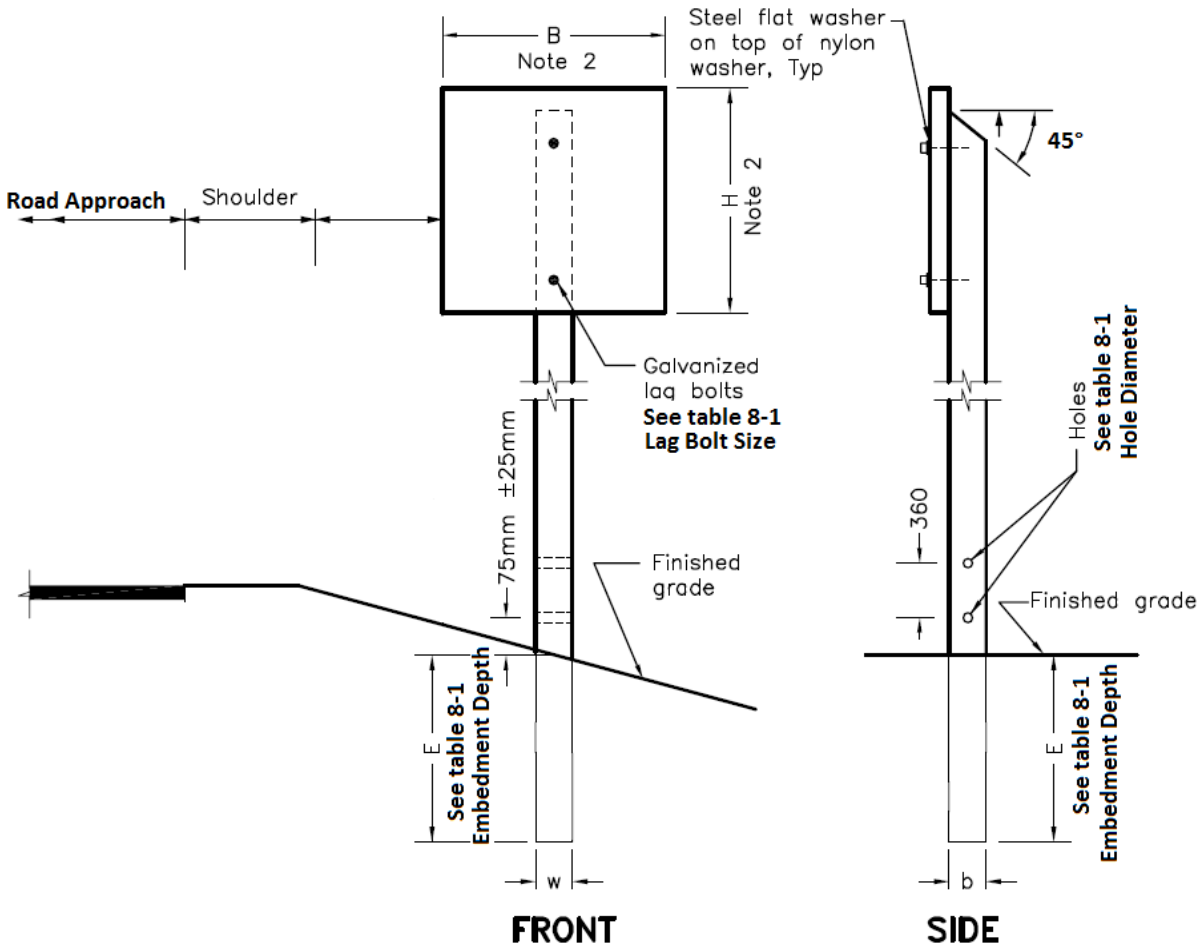


Figure 8-4 Wooden Sign Post Breakaway Hole and Embedded Depth

8.1.5 Wood Preservative

Wood preservative should be in accordance with CAN/CSA-O80, Series-08, Use Category UC 4.1.

All wooden posts should be stamped for wood preservative treatment using a certification mark authorized by the Canadian Wood Preservers Bureau (CWPB). The wood preservative stamp should be visible after installation and located at least 1.8 m from the bottom of the post.

Cut ends and field-drilled holes should receive two applications of 2% copper naphthenate wood preservative. Field-applied wood preservative that encounters any metal components should be removed immediately.

Table 8-1 Wood Sign Support Post Requirements

Sign Support Requirements							
Empadment Depth	**Dressed Post Size and Hole Diameter**			**Note 2**			**Galvanized Lag Bolt Size**
				Max. Sign Dimensions		**Max. Sign Area**	
E	**w**	**b**	**Hole Dia.**	**B cm**	**H cm**	**A M2**	**Inch**
920	89	89	N/A	120	90	0,41	3/8 X 3
1000	89	140	38	120	120	0,90	3/8 X 3
1000	140	140	51	120	180	1,08	3/8 X 4
1200	140	184	76	120	180	1,80	3/8 X 4

Source: Ontario Provincial Standard Drawing 985.110

8.1.6 Metal U-Flange Posts

Metal U-Flange posts should only be used for Railway Crossing signs on low-speed roadways with barrier-type curbs and posted speeds of under 70 km/h.

U-Flange posts can be made of cold-formed or hot-formed steel. However, all metal posts must be hot dip galvanized after fabrication, in accordance with ASTM A123. Whether cold- or hot-formed steel is used, the tolerance for thickness should not be greater than ±0.38 mm and should be in conformance with Figures Figure 8-5 and Figure 8-6.

Specifications on how to treat damaged or cut areas of hot-dip galvanized coatings on any galvanized components, are provided under ASTM A780.

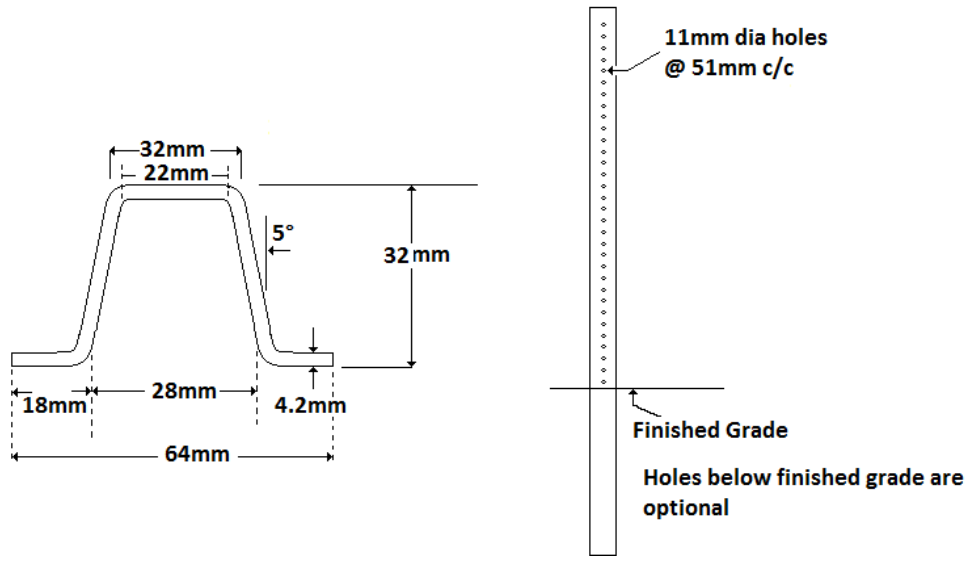


Figure 8-5 Cold Formed Steel Post Detail

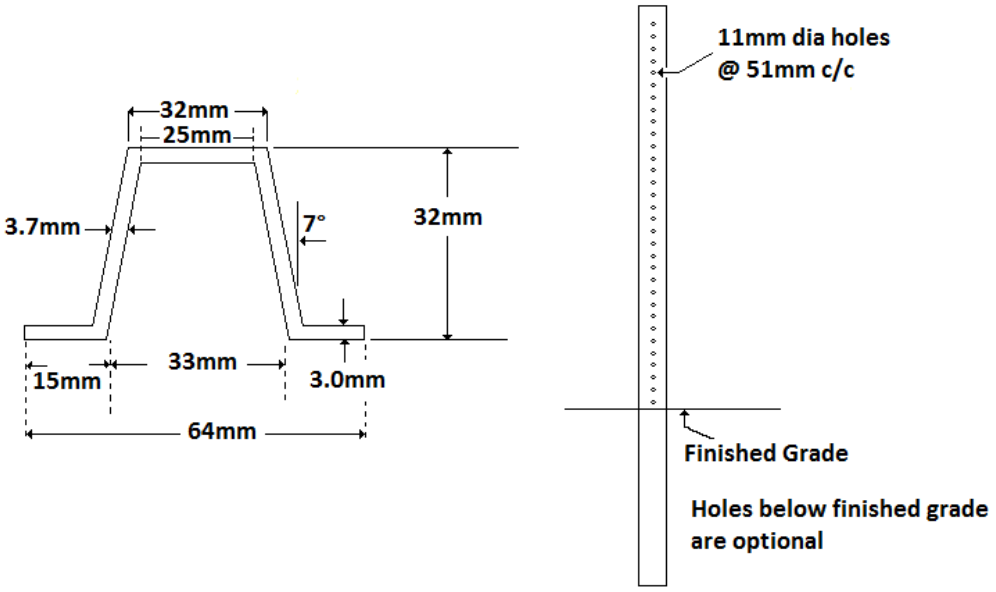


Figure 8-6 Hot Formed Steel Post Detail

8.1.7 Sign Hardware

All sign hardware should be hot dip galvanized in accordance with ASTM A153.

Posts should be plumbed within a tolerance of ±20 mm. The sign should be levelled on a multiple-post system within a tolerance of ±10 mm.

8.1.8 Retroreflective Material

The following applies to all new grade crossings, to existing crossings when a warranted change is made and, as of November 28th, 2022 or November 28th, 2024 for existing

grade crossings (see Article 2 for more information on amendments to the GCR timelines).

8.1.8.1 Retroreflective material referred to in 8.1.1 to 8.1.4 must meet the specifications for Type IV material, white sheeting, as specified in sections 4.2.4 and 6.1.4 of ASTM D4956 when tested in accordance with the test methods for type IV material specified in sections 7 and 9 of that Standard (GCR 38, 48 and 62; GCS 8.1.9).

8.1.8.2 The retroreflection coefficient of the retroreflective material referred to in 8.1.8 is to be maintained above 50 per cent of the value specified for Type IV material specified in article 6.1.4 of ASTM D4956 GCR 38, 48 and 62: GCS 8.1.9).

8.2 Railway Crossing Ahead Sign and Advisory Speed Tab Sign

8.2.1 A sign providing advanced warning of a grade crossing (Railway Crossing Ahead sign) and a sign specifying a recommended speed (Advisory Speed Tab sign) must be as shown in articles A3.4.2 and A3.2.5 in the Manual of Uniform Traffic Control Devices for Canada and must meet the applicable standards set out in Article A1.6 of that Manual.

A Railway Crossing Ahead sign with an Advisory Speed Tab sign must be installed if:

a) the installed Railway Crossing sign is not clearly visible within the SSD; or

b) a motor vehicle on the road approach needs to reduce its speed to conform to the road crossing design speed (GCR 42, 50, 66 and 80; GCS 8.2).

8.3 Stop Ahead Sign

Note: A Stop Ahead sign must be installed if a Stop sign is installed and it is not clearly visible within the stopping sight distance (GCR 41, 49, 65 and 79).

8.3.1 A Stop Ahead sign must be as shown in article A3.6.1 of the Manual of Uniform Traffic Control Devices for Canada and must meet the applicable standards set out in article A1.6 of that Manual.

8.4 Stop Sign

Stop signs, as traffic control devices, cause travel delays and can increase fuel consumption, vehicle emissions and collision frequency. They should therefore not be used indiscriminately. Stop signs are not intended as speed control devices, and their use should be limited to the control of right-of-way conflicts.

Stop signs should be used only where traffic engineering studies indicate that their use is warranted. These studies should consider such aspects as traffic speeds, traffic volumes, sightlines, and collision history. Stop signs are warranted at grade crossings without a warning system if the road crossing design speed is under 15 km/h.

8.4.1 A Stop sign must be as shown in article A2.2.1 of the Manual of Uniform Traffic Control Devices for Canada and must meet the applicable standards set out in Article A1.6 of that Manual. Where required by law, the word “Arrêt” will replace the word “Stop,” or may be added to the Stop sign.

8.4.2 When a Stop sign is installed on the same post as a Railway Crossing sign, it must be installed as shown in Figure 8-7 and maintained by the Railway (GCR 3(1)(a)(ii)).

8.4.3 Stop signs on their own post must not block the visibility of the Railway Crossings sign, and where there is a Railway Crossing sign, the Stop sign should be installed in advance of the Railway Crossing sign.

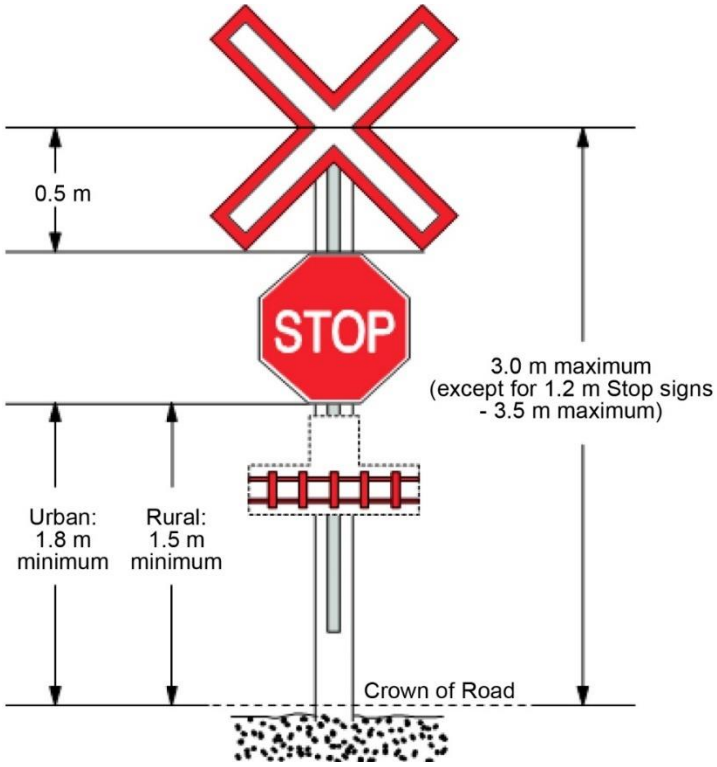


Figure 8-7 Stop Signs

8.5 Emergency Notification Sign (ENS)

As of November 28th, 2022, or November 28th, 2024, depending on the specific physical and operational characteristics of the grade crossing, railway companies will be required to install Emergency Notification signs (ENSs) at all public grade crossings. However, it is considered a best practice to install ENSs at all grade crossings, including private grade crossings. (See Article 2 for more information on amendments to the GCR timelines)

These signs provide all crossing users with the information needed to report/notify railway companies about emergencies or malfunctioning warning systems or any traffic control devices at grade crossings.

8.5.1 As of November 28th, 2022, or November 28th, 2024 an ENS that provides the railway company's emergency telephone number and the required information to positively identify the location of the grade crossing must be installed at all public grade crossings ((GCR sections 39, 63, 53(2) and 53(3)). (See Article 2 for more information on amendments to the GCR timelines).

a) Parallel to the road, or

b) On each side to the grade crossing, facing traffic approaching the grade crossing.

Best engineering practice is to install the ENS oriented to face the same direction as the other traffic control signs. (Perpendicular to the centre line of the road approach)

8.5.2 The ENS must be clearly legible.

8.5.2.1 The ENS should include the following information/characteristics at a minimum:

a) The railway company's emergency telephone number established to receive reports about emergencies or malfunctions of the warning system and the traffic control devices within the crossing approaches.

b) The Crossing ID should preferably include a Mile Point and Subdivision name (Sub).

The wording should include the following at a minimum:

The word EMERGENCY (e.g., "REPORT EMERGENCY 1-800-555-5555")

8.5.3 In order to be conspicuous, each ENS should:

a) Measure 30.5 cm (12 inches) wide by 22.86 cm (9 inches) high at a minimum.

Note: Proportional increases above the minimum sign dimensions to optimize the visibility of the ENS and/or to accommodate a bilingual message is permissible.

b) Be retroreflective; making it conspicuous to all crossing users by day and night.

c) Provide a minimum legible text (i.e., letters and numerals) with a character height not less than 2.54 cm (1 inch) for the sign information/message required above.

d) Have white text on a blue background with a white border; and

e) Be a traffic control type sign manufactured using the specifications for retroreflective sheeting material for traffic control signs as required by *Grade*

Crossings Standards (GCS) Article 8.1.8. Decals should not be used unless they are constructed with materials meeting Article 8.1.8 of the GCS and are mounted on a ridged sign backer plate mounted in a manner to be read horizontally.

8.5.4 If the ENS is installed on the same mast/post as all the other railway signs, the ENSs should be placed, immediately below the Railway Crossing Sign, or where applicable, below the Number of Tracks Sign or Stop Sign, along the right side of each road/sidewalk/path or trail approach to the crossing.

For multi-lane road approaches, additional ENS should be considered.

If not installed on the same mast/post as all the other railway signs, the ENS should be located between 0.3 m and 2.0 m from the face of the curb or the outer edge of the road shoulder or, where there is no curb or shoulder, 2.0 m to 4.5 m from the edge of the travelled way while ensuring the sign does not obstruct other traffic control devices or warning system components.

While the ENS is permitted to be installed parallel to the road, to be conspicuous for all crossing users, the best engineering practice is to install the ENS orientated to face the same direction, as the other signs on the warning device mast/post (perpendicular to the centerline of the road approach). This orientation will provide visibility for all crossing users in a wide variety of situations. Minor variations may be justified in certain situations to optimize the visibility of the signs.

8.5.5 Many jurisdictions in Canada may require that signs, such as these, provide its information in both official languages. While the language (English or French) is not specified in the GCR, or GCS, the use of bilingual signs may be required depending on the applicable jurisdiction.

For convenience, French, English and Bilingual (French/English), examples of ENSs are shown in Figure 8-8 below.

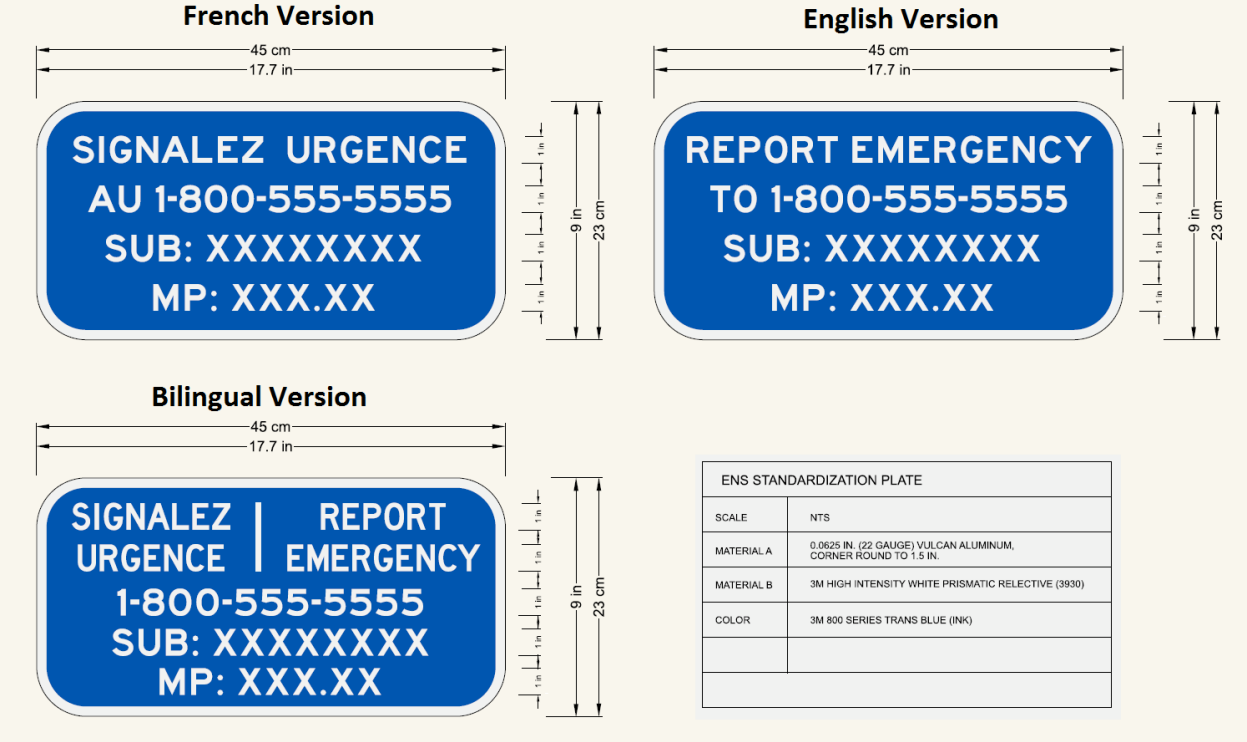


Figure 8-8 Examples of Emergency Notification Signs

8.6 Low Ground Clearance Sign

The Low Ground Clearance at Railway Crossing sign indicates a roadway vertical alignment at a grade crossing that may cause the underside of a vehicle (especially long wheel-based vehicles) to encounter the road surface and/or the rails when crossing the railway.

> **Note:** Installation instructions are provided in the *Manual of Uniform Traffic Control Devices for Canada. Attention should be made to avoid obstructing* the retroreflective material referred of other signs or warning system installations.

The Low Ground Clearance at Railway Crossing sign is illustrated in Figure 8-9.

WA-52

750 mm x 750 mm

Figure 8-9 Low Ground Clearance at Railway Crossin Sign (WA-52)

8.7 Second Train Event Warning Sign

The Second Train Event Warning sign and “ATTENTION 2 TRAINS” warning tab are used to alert pedestrians and drivers of the potential presence of a second train at a grade crossing.

a) These signs should be used when two or more tracks allow for the movement of trains on both tracks at the same time and where the approach of a second train may immediately follow the departure of the first, such as near a train station or at a track junction and/or multiple track alignment (two tracks or more).

b) The Second Train Event Warning sign is a diamond-shaped warning sign measuring a minimum of 450 mm by 450 mm; the “ATTENTION 2 TRAINS” warning sign is a rectangular tab measuring a minimum of 450 mm by 200 mm that emphasizes the warning.

c) Both of these signs should be mounted as close as possible to the minimum height, e.g., two meters from the surface of the ground to the bottom of the sign, as specified at Article A6.10.3 of the *Manual of Uniform Traffic Control Devices for Canada*. If they are mounted higher than the minimum height, pedestrians may not see or may not notice the signs.

d) These warning signs should be placed such that the nearest edge is not less than 0.3 m and not more than 1.0 m from the curb face. The signs should be placed a maximum of 5.0 m from the nearest rail (the closer to the crossing, the

better, but the minimum railway clearance setbacks from the nearest rail must be respected).

e) The Second Train Event Warning sign should be installed and maintained by the road authority and coordinated with the railway company to ensure the signs are placed and maintained in a consistent manner and are highly visible to pedestrians. Signs to be installed are required to have all buried facilities identified and their location indicated prior to installation on any public, railway, or private land. This will prevent damage and unnecessary repairs.

Note: The Second Train Event Warning sign should be installed in a manner not to obstruct the retroreflective material referred to in sections 38 and 62 of the GCR, nor obstruct sightlines or the visibility of the Railway Crossing sign and or light units.

The Second Train Event Warning sign and “ATTENTION 2 TRAINS” tab and their typical installation are illustrated in Figures Figure 8-10 and Figure 8-11.

WC-27

450 mm x 450 mm

WC-27S

450 mm X 200 mm

Figure 8-10 Second Train Event Warning Sign and "ATTENTION 2 TRAINS" Warning Tab

Source: Manual of Uniform Traffic Control Devices for Canada, Article A6.10.3.

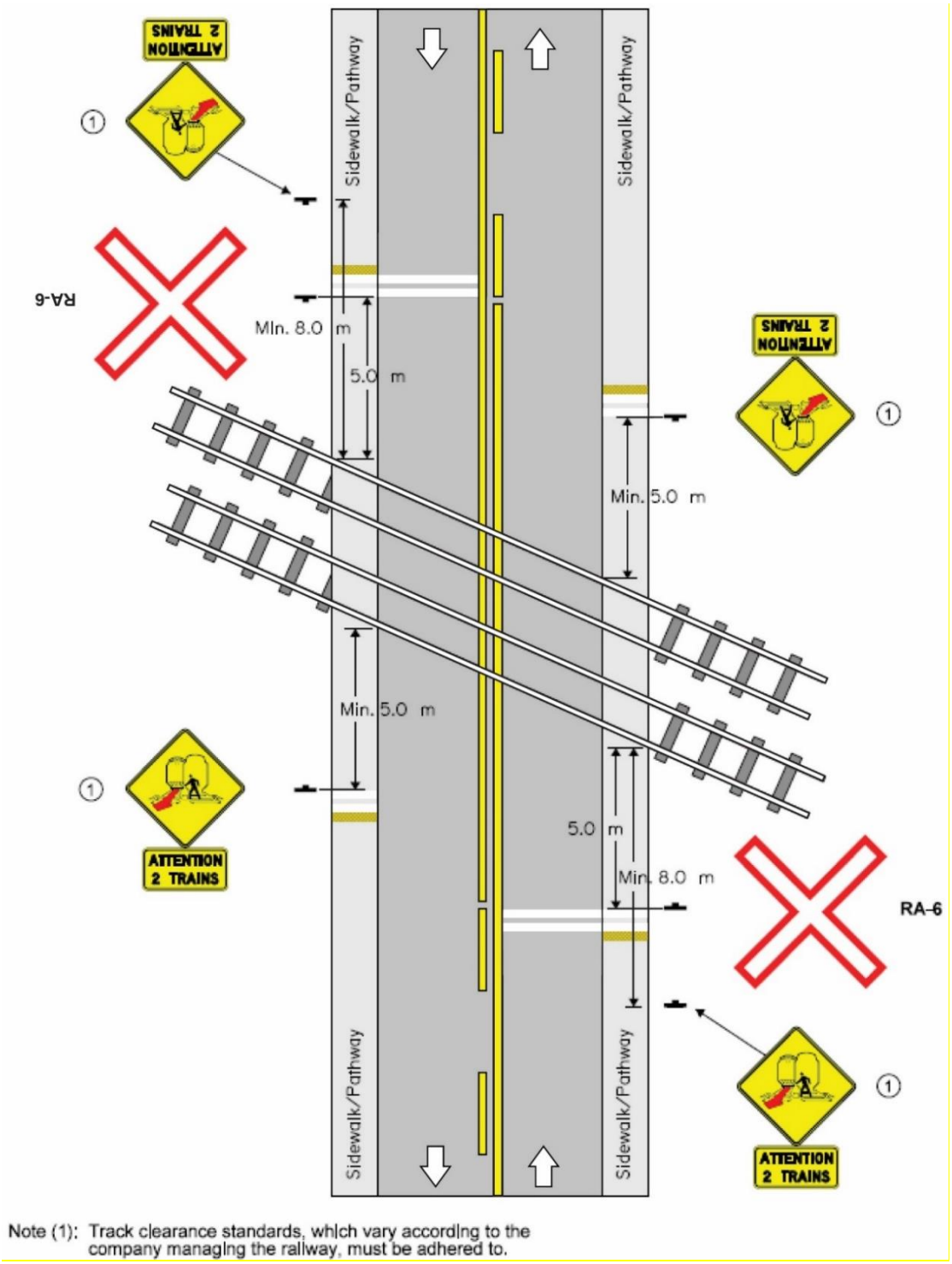


Figure 8-11 Second Train Event Warning Sign Installation

8.8 Pavement Markings

Pavement markings are used to supplement the regulatory and warning messages presented by crossing signs and signals. Pavement markings have limitations in that they may be hidden by snow, may not be clearly visible when wet, and may not be very durable when subjected to heavy traffic.

Pavement markings in advance of grade crossings should consist of an X, as shown in Figures Figure 8-12 and Figure 8-13. These pavement markings should be placed on each approach lane on all paved approaches to grade crossings where crossing signals or automatic gates are located, and at all other crossings where the prevailing speed of roadway traffic is 40 km/h or greater.

Pavement markings should conform to Part C of the Manual of Uniform Traffic Control Devices for Canada.

For grade crossings without a warning system, stop bars should be installed 5 m from the nearest rail, perpendicularly to the paved road approach. Where the Railway Crossing sign or signal mast is installed more than 3 m in advance of the nearest rail, the stop bars should be located a minimum of 2 m in advance of the centre of the Railway Crossing sign or signal mast on the paved road approaches, as shown in Figures Figure 8-12 and Figure 8-13.

The presence of vulnerable road users (VRU) at grade crossings in particular persons using assistive devices is a significant factor for assessing risk at a grade crossing. Special consideration should be given to accessibility needs for persons with mobility impairments.

Reference Appendix M of this Handbook to find further guidance on VRU treatments.

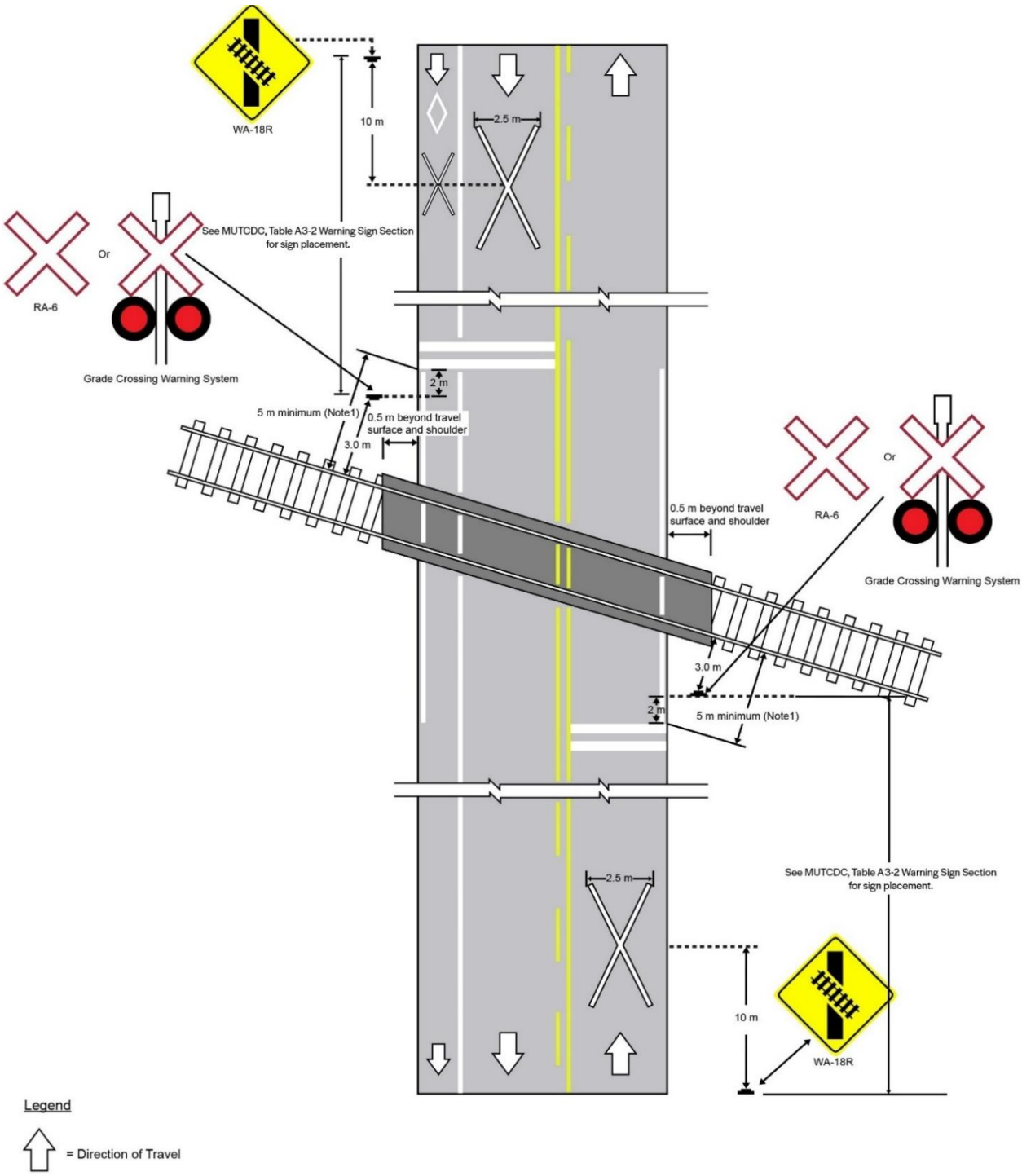


Figure 8-12 Pavement Markings (left hand angle)

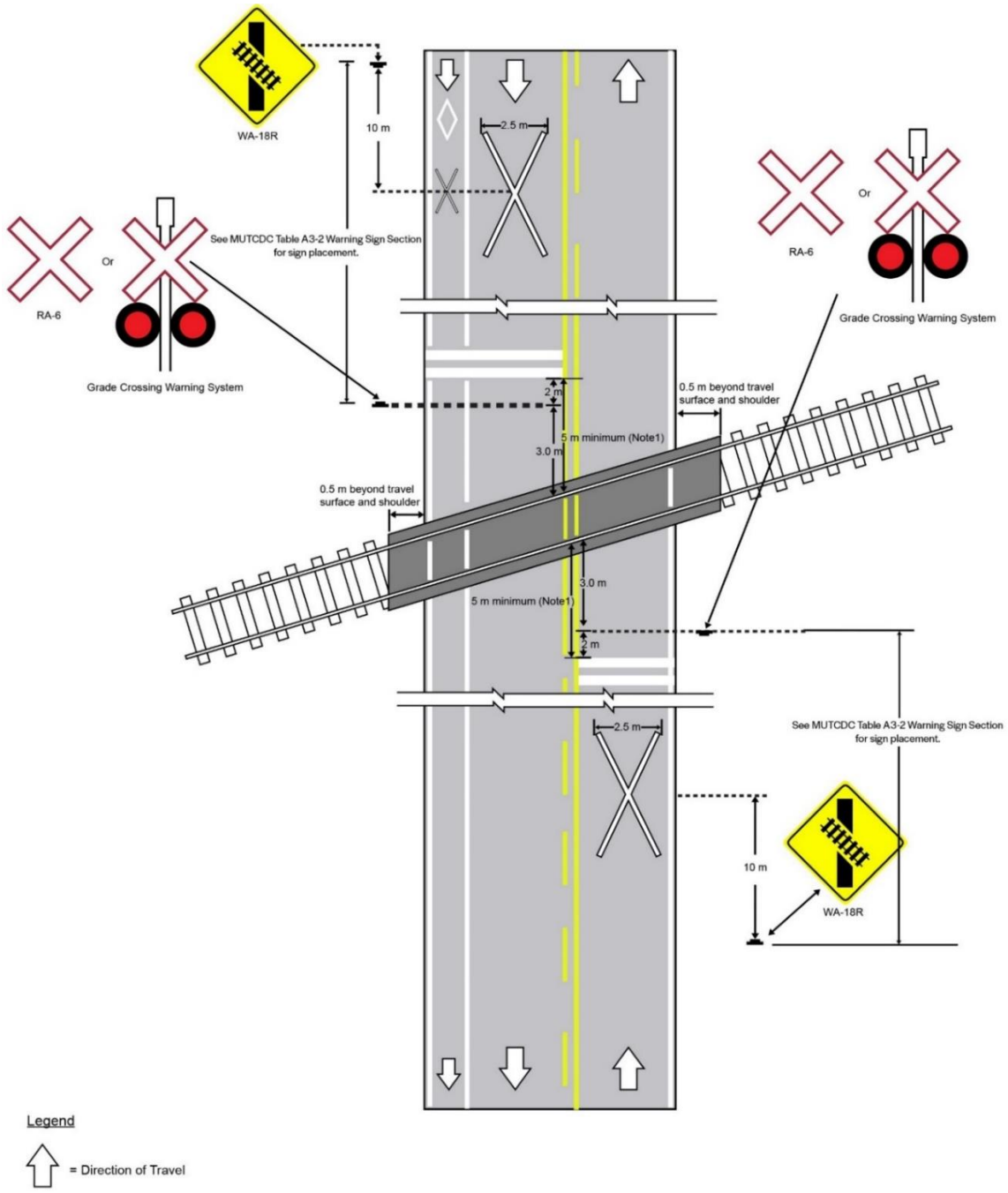


Figure 8-13 Pavement Markings (right-hand angle)

8.9 Rumble Strips

In addition to stop bars and other pavement markings on the road approaches, rumble strips may be installed as an added safety measure, to make drivers aware of their surroundings. For this, an engineering study may be required.

Note: Rumble strips are not to be used to replace any component of a warning system, only as an added feature.

Article 9 Warning System Specifications

The following articles set out the minimum specifications which may require a warning system to be installed, with or without gates, for public and private grade crossings.

This section applies to all new grade crossings (See Article 2 for more information on amendments to the GCR timelines).

The GCR do not require that existing grade crossings be upgraded to meet these standards. However, whenever new information regarding an existing grade crossing is provided/received that could change its requirements, it is considered a best engineering practice for both the railway and the applicable authority to review the criteria below, and any other elements that may impact safety, on a frequent basis (as described in Article 31 of this Handbook), and upgrade as needed to improve the overall safety at the location.

9.1 Criteria for requiring a warning system without gates (public grade crossings):

a) The forecast cross-product is 2,000 or more; or

b) there is no sidewalk, path or trail and the railway design speed is greater than 129 km/h (80 mph); or

c) there is a sidewalk, path or trail and the railway design speed is greater than 81 km/h (50 mph); or

d) the railway design speed is greater than 25 km/h (15 mph) but less than the railway design speed referred to in (b) or (c), as applicable, and

   i) there are two or more lines of railway where railway equipment may pass each other, or
   ii) the distance as shown in Figure 9-1 between a Stop sign at an intersection and the nearest rail in the crossing surface is less than 30 m, or
   iii) in the case of an intersection with a traffic signal, the distance between the stop line of the intersection and the nearest rail in the crossing surface, as shown in Figure 9-1, is less than 60 m or, where there is no stop line, the distance between the travelled way and the nearest rail in the crossing surface is less than 60 m.

9.2 Criteria for requiring a warning system with gates (public grade crossings):

9.2.1 A warning system is required under Article 9.1, and

a) the forecast cross-product is 50,000 or more; or

b) there are two or more lines of railway where railway equipment may pass each other; or

c) the railway design speed is greater than 81 km/h (50 mph); or

d) the distance as shown in Figure 9-1 between a Stop sign at an intersection and the nearest rail in the crossing surface is less than 30 m: or

e) in the case of an intersection with a traffic signal, the distance between the stop line of the intersection and the nearest rail in the crossing surface, as shown in Figure 9-1, is less than 60 m or, where there is no stop line, the distance between the travelled way and the nearest rail in the crossing surface is less than 60 m.

9.3 Criteria for requiring a warning system without gates (private grade crossings):

9.3.1 the forecast cross-product is 2,000 or more; or

9.3.2 the railway design speed is greater than 25 km/h (15 mph), and

a) the forecast cross-product is 100 or more and there are two or more lines of railway where railway equipment may pass each other; or

b) the forecast cross-product is 100 or more and grade crossing does not include a sidewalk, path or trail and the railway design speed is greater than 129 km/h (80 mph); or

c) the grade crossing includes a sidewalk, path or trail and the railway design speed is greater than 81 km/h (50 mph).

9.4 Criteria for requiring a warning system with gates (private grade crossings):

9.4.1 A warning system is required under Article 9.3, and

a) the forecast cross-product is 50,000 or more; or

b) there are two or more lines of railway where railway equipment may pass each other; or

c) the railway design speed is greater than 81 km/h (50 mph).

9.5 Criteria for requiring a warning system without gates (grade crossings that are a sidewalk, path, or trail):

a) The sidewalk, path or trail is outside the island circuit of an adjacent warning system, and

b) the railway design speed is greater than 81 km/h (50 mph).

9.6 Criteria for requiring a warning system with gates (grade crossings that are a sidewalk, path, or trail):

a) The sidewalk, path or trail is outside the island circuit of an adjacent warning system, and

b) the railway design speed is greater than 25 km/h (15 mph), and

c) there are two or more lines of railway.

9.7 Criteria for requiring a warning system to be interconnected with traffic signals (all types of grade crossings) (GCR 46, 56 and 100(2)):

a) The travelled way of an intersection controlled by traffic signals is within 30 m of the nearest rail of the grade crossing: or

b) there are repeat instances of road traffic queuing over the grade crossing; or

c) road traffic backed up from a nearby downstream grade crossing could interfere with signalized road traffic intersections; or

d) operational conditions exist that warrant the interconnection of a warning system with traffic signals.

Note: See Part E of this document for more information pertaining to interconnected devices.

9.8 The criteria for a grade crossing requiring a warning system to be interconnected with a Prepare to Stop at Railway Crossing sign are as follows (GCR 43, 51, 67 and 81):

a) The road approach is an expressway considering the characteristics set out for expressways in Table 10-4 of the GCS; or

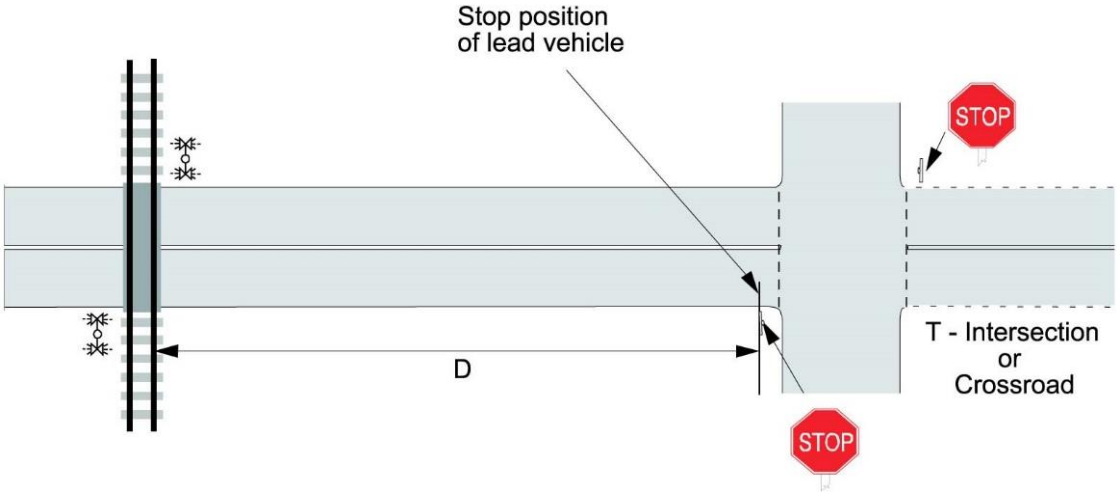
b) at least one set of front light units of the warning system is not clearly visible within the SSD of at least one of the lanes of the road approach; or

c) the weather conditions at the grade crossing repeatedly obscure the visibility of the warning system; or

d) operational conditions exist that warrant the interconnection of a warning system with a Prepare to Stop at Railway Crossing sign.

Note: See Part E of this document for more information pertaining to interconnected devices.

a) Intersection with Stop sign



b) Intersection with Traffic Signal

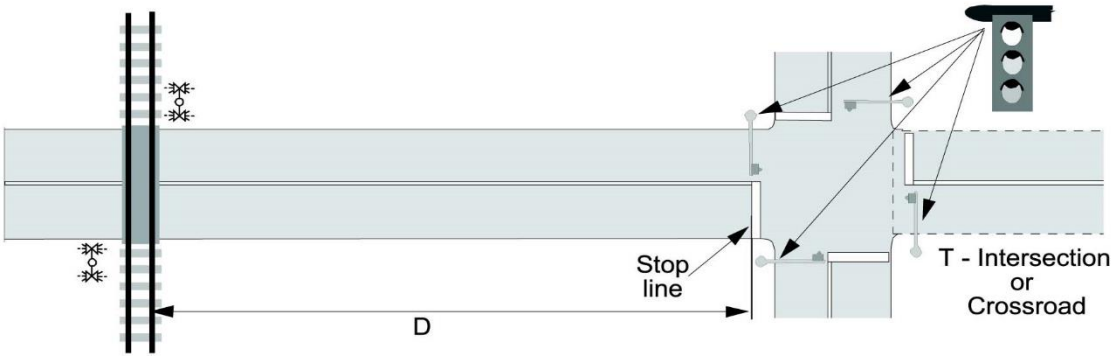


Figure 9-1 Proximity of Warning Systems to an Intersection with Stop Sign or Traffic Signal

Source: *Grade Crossings Standards*, January 1, 2019

Part C – Design Calculations

Article 10 Design Considerations

10.0.1 Design Vehicle

The design of a grade crossing and its approaches depends greatly on the design vehicle's length and its braking and acceleration characteristics. Together with the gradient of the road approach and the length of the grade crossing clearance distance, the design vehicle characteristics are vital for determining the stopping sight distance (SSD), the sightlines along the railway right-of-way and in advance of the warning system, and the advance warning time and gate descent time requirements for the grade crossing's warning system. A grade crossing design vehicle must be established for all crossings for vehicular use. This has been mandatory for all existing grade crossings since the GCR came into force (GCR 57 and 72).

The design of a grade crossing for pedestrians, cyclists and persons using assistive devices, including its approaches, depends on the abilities of the users of the crossing and the types of devices they use. Consideration should therefore be given to the slowest users.

10.0.2 Vehicle Classification

The Transportation Association of Canada (TAC) Geometric Design Guide, cited at the beginning of this Handbook, sets out the various classes of design vehicles and their characteristics.

Table 10-5 below, lists these various design vehicles and their respective descriptions and lengths. The Geometric Design Guide provides further details on these vehicles, as well as listing four categories of special design vehicles whose dimensions and characteristics are not specified. The most common of these are listed in Table 10-6 of this document, there are still other special design vehicles, not described in the Geometric Design Guide, that routinely operate over certain private and public grade crossings, such as those used in the agricultural, industrial, and natural resources sectors. The most common of these special vehicles are described in Table 10-7. As with the vehicles of Table 10-6, the dimensions of these vehicles are not specified, so each vehicle needs to be measured, as their length can vary significantly.

10.0.3 Selecting a Grade Crossing Design Vehicle

It is not practical to design every public grade crossing for all road vehicles. In selecting the grade crossing's design vehicle, consideration should be given to the most restrictive design vehicles expected to routinely use the grade crossing. For public grade crossings, this responsibility falls to the road authority; for private grade crossings, this responsibility falls to the railway company. For public grade crossings, a traffic study may be useful in selecting the design vehicle, whereas for private crossings, the landowner or appropriate authority should be contacted to guide this selection.

Table 10-7 may be used as a guide for selecting a grade crossing's design vehicle. However, direct observation or a traffic study is the preferred and more accurate way of determining the proper design vehicle for a given location.

10.0.4 Changing Design Vehicle

If the road authority determines that there is a need to change the design vehicle, for example because of a change in the way the road is being used, written notice must be provided to the railway company, no later than 60 days before the date on which the change begins, outlining the details of the change and including the information referred to in subsection 12(1) of the GCR relating to the change (GCR 91).

A Temporary Design Vehicle Notice should also be provided to the railway company for any oversized vehicle permits that may be issued (dimensional loads).

Upon receipt of a dimensional load permit application, efforts should be made to communicate to the affected railway company, information on the route to be used. This information will allow for adequate measures to be put in place to protect the temporary design vehicle. Section 102 of the GCR must be applied (see Article 22 of this Handbook).

If the design vehicle changes, the period during which the warning system must operate before railway equipment reaches the crossing surface must meet 16.1 (GCR 91).

Should the railway decide to change the design vehicle at a private grade crossing, notice should be provided to the private authority no later than 60 days before the change takes place, to give them the opportunity to accept or refute the change.

10.0.5 Stopping Sight Distance

The perception-reaction time refers to the interval of time between the occurrence, or appearance, of a signal (usually a visual stimulus) and the driver's physical reaction to it. A complex, unexpected situation requiring several possible courses of action results in a considerably longer reaction time than a simple, anticipated situation. The longer the reaction time, the shorter the time available to attend to other information, thus compounding the chance of error. Perception-reaction time is generally considered to consist of four elements:

a) detection

b) identification

c) decision

d) response

Stopping sight distance (SSD) is one of several types of sight distance used in road design. It is the minimum distance a vehicle driver needs to be able to see to have room to stop before colliding with something within the road approach, such as railway tracks, pedestrians, traffic control devices, a stopped vehicle or road debris. Insufficient SSD can adversely affect the safety of railway operations.

SSD is the total distance travelled during perception-reaction time and therefore the braking distance for a selected design vehicle. Braking distance is the distance it takes to stop the vehicle once the brakes have been applied.

Braking distance ("d" shown in the formula below) depends on the type and condition of the vehicle, the gradient of the road, the available traction, and numerous other factors. Direct measurement is often the most accurate way of determining braking distance.

The following tables and formulae are taken from the Geometric Design Guide and are applicable to the general grade crossing design vehicles listed in Table 10-5. The SSD for the special vehicles listed in Table 10-6 or for any other vehicle, are to be calculated in accordance with the principles set out in the Geometric Design Guide or as mentioned earlier, through direct measurement.

$$d = \frac{V^2}{2gf} = \frac{V^2}{2(9.81)f} \times \left(\frac{1000^2}{3600^2}\right) = \frac{V^2}{254f}$$

[Geometric Design Guide Formula 1.2.5.2]

where:

d = braking distance (m)

V = maximum road operating speed (km/h)

f = coefficient of friction between tires and the roadway [Table 10-8]

g = 9.81 m/s^2

then:

$$SSD = (0.278 \times 2.5 \times V) + d$$

[Geometric Design Guide Formula 1.2.5.2]

where:

SSD = stopping sight distance (m)

Table 10-9 provides the minimum SSD on level grade and wet pavement for the general design vehicles listed in Table 10-5. These values are used to design road approaches and to determine SSDs for existing grade crossings, sightlines, and the placement and alignment of signs and grade crossing warning signals.

The SSDs in Table 10-9 may need to be increased or decreased for a variety of reasons, including grade, vehicle braking capability and road surface condition.

10.0.6 Variation for Trucks

Because they are seated higher, drivers of trucks can generally see farther than drivers of cars. In some instances, however, the driver's height is a disadvantage. For example, a downgrade vertical curve where visibility is cut off by an overpass can dramatically reduce visibility. Also, a truck's braking characteristics vary according to the load being carried (in the case of a bus, the number of passengers). Effective braking distance must be considered when determining SSD.

10.0.7 The Effect of Grade on Braking Distance

Braking distance increases on downgrades and decreases on upgrades. When the roadway is on a grade, whether positive or negative, the braking distance can be calculated using the following formula (keeping in mind that, as mentioned earlier, direct measure is often the most reliable means of obtaining this value):

$$d = \frac{V^2}{254(f \pm G)}$$

[Geometric Design Guide Formula 1.2.5.3]

where:

G = the percent grade divided by 100 (up is positive, down is negative, as observed from SSD); if unknown, G can be obtained using the following formula:

G = rise/run

V = maximum road operating speed (km/h)

f = coefficient of friction between tires and the roadway [Table 10-8].

10.0.8 Acceleration Curves for General Design Vehicles

The assumed acceleration curves for general design vehicles and long-load logging trucks, starting from a stopped position on level and smooth roads, can be found in the Geometric Design Guide and are reproduced in Table 10-2. These can be used to assist in the determination of the time required for general design vehicles and long-load logging trucks to cross the grade crossing clearance distance.

The acceleration curve for single-unit trucks may be used for standard single-unit buses (B-12) and intercity buses (I-BUS), and the acceleration curve for tractor-trailers and long combination vehicles may be used for articulated buses (A-BUS).

10.0.9 Grade Crossing Conditions

The acceleration curves provided in Figure 10-2 are for crossings with smooth and continuous road surfaces and are provided for guidance only. A greater number of tracks, super elevated tracks, surface roughness, unevenness created by the crossing angle, and restrictions on shifting gears while crossing tracks all increase acceleration time. Such factors must be considered when calculating acceleration time, plus time accordingly added to the acceleration curves provided in Figure 10-2, as applicable.

10.0.10 Effect of Road Gradient on Acceleration

The effect of road gradient should be factored into the design vehicle's acceleration time by multiplying its acceleration time on level ground by the acceleration ratio for that vehicle on that gradient. Acceleration ratios for general and special design vehicles on continuous grades of -4%, -2%, 0%, 2% and 4% are provided in the Geometric Design

Guide and reproduced in Table 10-1 and can be used to determine the time it takes such vehicles to cross the grade crossing clearance distance.

The road approach gradient (in percentage) is the average of the gradients measured within the stopping sight distance (SSD). The road approach gradient is always measured in the same direction: approaching the grade crossing from the start of the SSD. A positive (+) value represents an ascending grade, and a negative (-) value represents a descending grade. The gradient must be determined for each road approach. This is done by the road authority.

Once the average road approach gradient has been determined, the ratio in Table 10-1 is applied only to the travel time through the portion of the road at that gradient and using the maximum gradient in any area of transition for the direction of travel.

10.1 Grade Crossing Clearance Distance (cd)

10.1.1 The grade crossing clearance distance (cd) is the distance between the departure point (normally 5 meters or more from the nearest rail; but this can vary, depending on the layout of the Railway Crossing signs or warning signal masts) to a point (called the clearance point) 2.4 meters beyond the farthest rail, as shown in Figure 10-1. Crossing characteristics that increase clearance distance include:

- a crossing angle greater or less than 90°.
- multiple tracks.
- greater-than-standard spacing between multiple tracks; and
- the presence of a Railway Crossing sign, signal, stop sign, or pavement stop line.

10.1.2 The clearance point is the point 2.4 meters beyond the outside edge of the rail farthest from the departure point, measured perpendicularly to the rail. The departure points for drivers, pedestrians, cyclists, and persons using assistive devices is 5 meters before the nearest rail or 2 meters before a Stop sign, Railway Crossing sign, warning signal or gate arm.

Normally, where the crossing angle is 90°, a Railway Crossing sign, warning signals, or gate arm is located 3 meters from the nearest rail, measured perpendicularly to the rail, and the stopped position of the front of a vehicle is 2 meters beyond that, therefore 5 meters from the nearest rail. This departure point is used to calculate the clearance distance, although it can vary, depending upon the layout of the Railway Crossing signs or warning signal masts,

Where the crossing angle is greater or less than 90°, the distance along the road between such devices and the nearest rail will be greater than 3 meters, and the stopped position of the front of a vehicle will therefore be greater than 5 meters for the

calculation of clearance distance. See Figure 10-1 for an illustration of clearance distance.

10.2 Vehicle Travel Distance(s)

10.2.1 The vehicle travel distance is calculated using the following formula:

$$s = cd + L$$

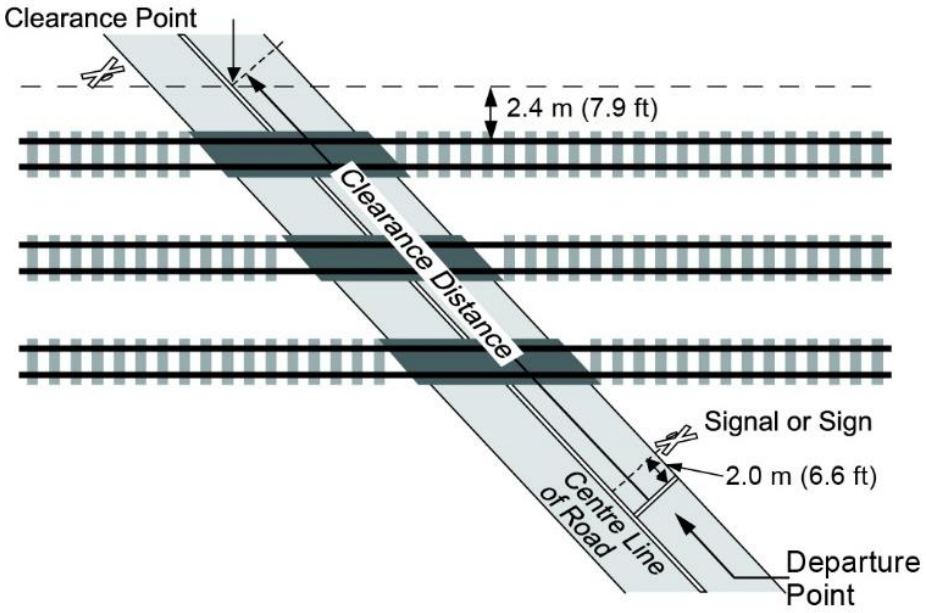
where:

s = distance the road vehicle must travel to pass through the grade crossing clearance distance (m)

cd = grade crossing clearance distance [Figure 10-1]

L = length of the grade crossing design vehicle [Table 10-5]

a) For Grade Crossings with a Warning System or Railway Crossing sign



b) For Grade Crossings without a Warning System or Railway Crossing sign

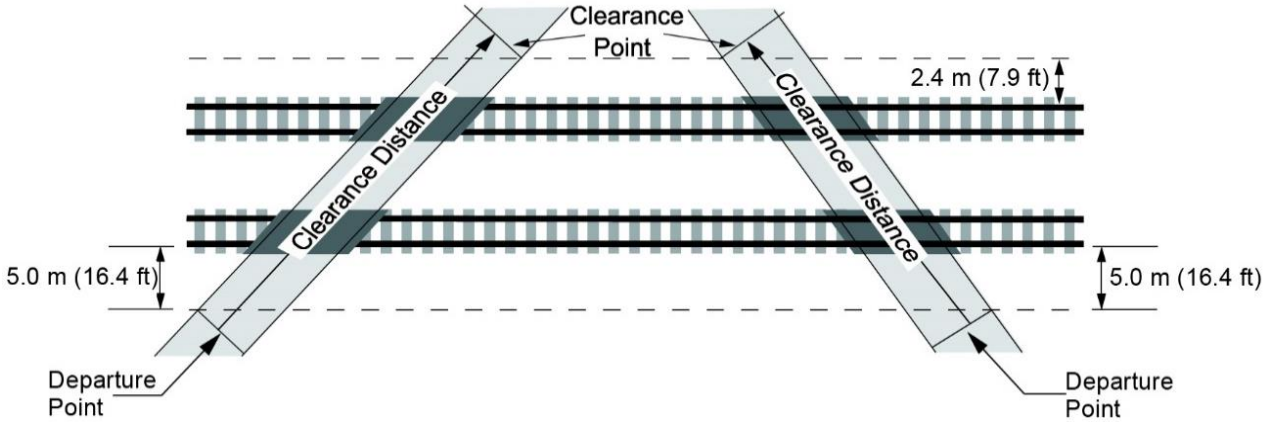


Figure 10-1 Clearance Distance for Grade Crossings

Source: *Grade Crossings Standards*, January 1, 2019

10.3 Departure Time – General

Departure time (TD) is the greater of either the time required for the design vehicle to pass completely through the clearance distance from a stopped position or the time required for pedestrians, cyclists or persons using assistive devices to pass completely through the clearance distance (TP). Departure time is essential for determining how far along the railway right-of-way sightlines need to be cleared to provide road users with enough time to decide whether it is safe to traverse the grade crossing.

A vehicle's acceleration from a stopped position and the time it takes to pass over the grade crossing depend on a number of factors:

- The road surface, including the crossing surface, must be in good condition. Clearance of snow and treatment of ice is required for proper vehicle traction on the road surface.
- The rates of acceleration of design vehicles vary greatly according to their mass/power ratios.
- Certain factors at grade crossings may increase the time required for vehicles to travel the grade crossing clearance distance. These factors may include:
    i) condition of the road surface.
    ii) super elevated track.
    iii) an intersection on the far side of the grade crossing where vehicles are required to stop, which will slow vehicle acceleration over the crossing.
    iv) restrictions on gear shifting while passing over the grade crossing.
    v) non-standard placement of stop line pavement markings.

vi) the road gradient from where the vehicle is stopped and throughout the crossing clearance distance will affect vehicle acceleration, and therefore departure time.

10.3.1 Ratio of Acceleration Times on Grades of Design Vehicles

Table 10-1, below, expresses the effect of road gradient on the design vehicle's acceleration time as a ratio. Departure time on a given road gradient is obtained by multiplying the design vehicle's acceleration time on level ground (t), which is the clearance distance + the length of the design vehicle, by the ratio of acceleration time (G) for that vehicle on that gradient.

Table 10-1 Ratio of Acceleration Times on Grades

Grade Crossing Design Vehicle	**Road Grade (%)**				
	-4	-2	0	+2	+4
Passenger car	0.7	0.9	1.0	1.1	1.3
Single-unit truck or	0.8	0.9	1.0	1.1	1.3
Tractor-semitrailer	0.8	0.9	1.0	1.2	1.7

Source: *Geometric Design Guide for Canadian Roads*, Transportation Association of Canada, September 1999.

10.3.2 Departure Time – Design Vehicle (T_D)

The design vehicle departure time depends on the clearance distance, the length of the design vehicle, and the vehicle's acceleration.

The departure time is the total time, in seconds, the design vehicle must travel to pass completely through the clearance distance (cd) and is calculated using the following formula:

$$T_D = J + T$$

[Equation 10.3a from the GCS]

where:

J = perception-reaction time, in seconds (e.g., the time it takes the crossing user to look in both directions, shift gears, if necessary, and prepare to start); a minimum of 2 seconds; and

T = the time, in seconds, that it takes the grade crossing design vehicle to travel through the vehicle travel distance (s), considering the road gradient at the grade crossing.

Note: T may be obtained by measuring the time it takes for the selected design vehicle to travel the grade crossing clearance distance either at the actual grade crossing or by using the following formula:

$$T = (t \times G)$$

[Equation 10.3b of the GCS]

where:

t = the time, in seconds, that it takes the design vehicle to accelerate through the vehicle travel distance (S) on level ground, as per Figure 10-2, Assumed Acceleration Curves; and

G = the ratio of acceleration times based on the gradients from Table 10-1, Ratios of Acceleration Times on Grade.

The road gradients indicated in Table 10-1 are the maximum road gradients over the distance the design vehicle must travel, measured from the rear of the design vehicle when at the stopped position to the clearance point (e.g., point at which the rear of the vehicle is said to be clear of the crossing surface by 2.4 m). This value can be different for each road approach to the grade crossing. The road approach gradient is always measured from the stopped position towards the crossing. A positive (+) value represents an ascending slope, and a negative (-) value represents a descending slope. To calculate the design vehicle departure time, the road approach gradient should be determined for both approaches. The value used for G should be the higher of the two.

Note: For one-way roads, use the actual maximum road gradient (+ or -) within the vehicle travel distance, where; S = L + cd to calculate the departure time from the stopped position.

Values for *t* and G should be calculated by a qualified person.

Note: When an oversized load or a longer design vehicle applies for an oversized load permit to traverse certain roads comprising of a grade crossing, or when a railway wide load is scheduled to travel over the grade crossing, the road authority or railway company, as applicable, must notify the other party of the date and time on which the move is scheduled to take place so that the proper temporary protection measures can be put in place. (GCR 102).

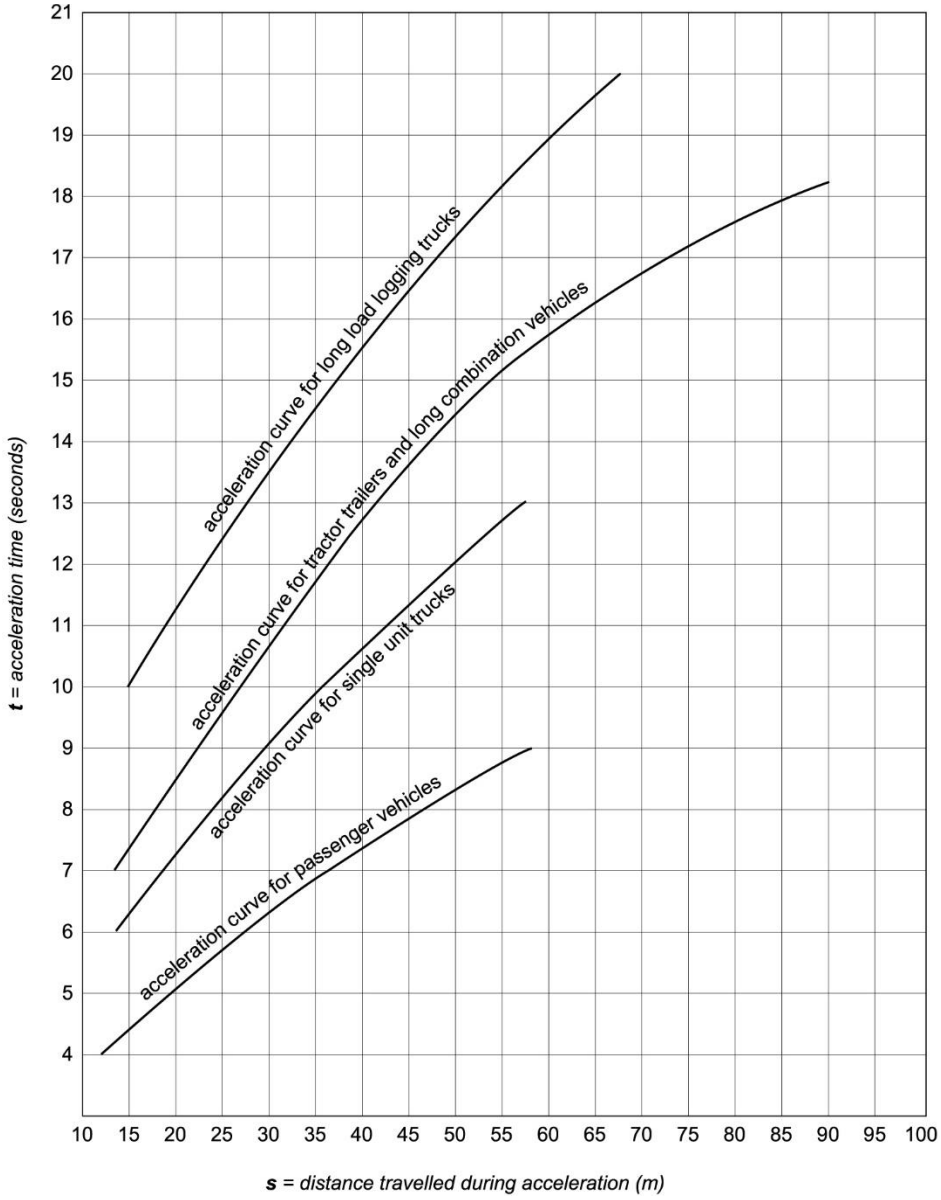


Figure 10-2 Assumed Acceleration Curves for Grade Crossings with Smooth Approaches and Continuous Road Surfaces – General Design Vehicles (Geometric Design Guide)

Source: *Geometric Design Guide for Canadian Roads*, Transportation Association of Canada, September 1999.

10.3.3 Departure Time – Pedestrians, Cyclists and Persons Using Assistive Devices (T_P)

The amount of time, in seconds, that it takes pedestrians, cyclists and persons using assistive devices to pass completely through the clearance distance (c_d) is calculated using the formula below.

Note: Because warning system gates on sidewalks, paths or trails must extend across the full width of the sidewalk path or trail, the clearance distance for such crossings equipped with gates should be measured from the point, marking 2 meters in advance of the nearest gate to the gate arm on the far side (clearance side) of the grade crossing. This is to prevent pedestrians from being trapped on the crossing surface by the horizontal gates (GCS 12.1(f)(i)).

$$T_p = \frac{\mathrm{cd}}{V_p}$$

[Equation 10.3c of the GCS]

where:

cd= the clearance distance, in meters (Article 10.1); and

V_p = the average travel speed, in meters per second (m/s), for pedestrians, cyclists, and persons using assistive devices (to a **maximum value** of **1.22 m/s**).

Note: While the *Grade Crossings Standards* (GCS) allow up to a **maximum value** of **1.22 m/s** for the variable V_p, practitioners may wish to consult additional guidance material such as the 6th Edition of the TAC MUTCDC which provides recommendations/guidance on pedestrian walking speeds ranging from 0.8 m/s to 1.0 m/s. The *TAC Geometric Design Guide for Canadian Roads* (June 2017 Edition) also provides further guidance on design speeds for cyclists and for walking speeds for persons using assistive devices.

Practitioners should use consistent practice in their own jurisdictions and apply engineering judgment to determine whether the above walking speeds are to be used to calculate the crossing time at the intersection or are to be applied specifically to the calculation of the pedestrian clearance interval only.

10.4 Gate Arm Clearance Time

10.4.1 Gate Arm Clearance Time for a Roadway

Gate arm clearance time (GACT) is the time required for the design vehicle to travel the entire gate arm clearance distance (cd_{Gstop}) from either the stopped position or the SSD, whichever is greater. The gate arm clearance point is the point at which the rear end of the vehicle is said to \be clear of the gate arm, as shown in Figure 10-3 below.

Warning: GACT should only be adjusted when site-specific design parameters (design vehicle, road speed, etc.) at the grade crossing change or are deemed inadequate. These site-specific design parameters are established by the road authority, who shares a responsibility for ensuring that GACT is adequate for the characteristics of the grade crossing. GACT must therefore never be adjusted by the railway company without first communicating the change to the road authority.

The time required for vehicles to stop or accelerate on a descending or ascending grade must be considered. Refer to the Geometric Design Guide and Article 10.0.5 to calculate the effect of gradient on stopping sight distance or acceleration, and to calculate the gate delay requirement for special vehicles.

Note: Where a warning system equipped with four-quadrant gates is interconnected with traffic signals at a grade crossing, advance pre-emption should be considered, as additional operating time is required for the GACT. In most cases, GACT and maximum pre-emption time are concurrent with queue clearance time. It is critical to ensure that an appropriate amount of time is provided for right-of-way transfer, queue clearance, separation, and gate arm clearance. See Part E for more information on device interconnection.

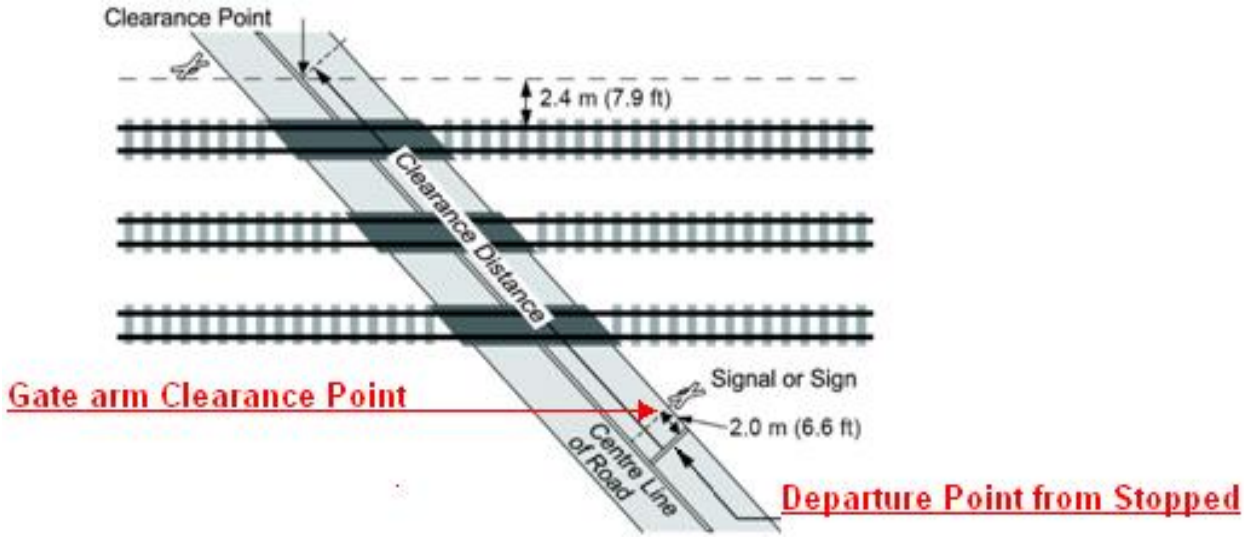


Figure 10-3 Gate Arm Clearance Point

Gate Arm Clearance Time from the SSD position

Gate arm clearance time from the SSD is the greater of $T_{G\ SSD}$ or $T_{G\ stop}$ and represents the time, in seconds, that it takes the design vehicle to travel from either the stopping sight distance (SSD) or the stopped position to the point past the gate arm, whichever is greater.

Gate arm clearance time from the SSD position ($T_{G\ SSD}$) is calculated as follows:

$$T_{G\ SSD} = \frac{c_a G(SSD)}{0.27 \times V_{road}}$$

[Equation 10.3c of the GCS]

where:

V_{road} = the road crossing design speed over the crossing, in kilometers per hour (km/h); and,

$$cd_{G\,SSD} = SSD + 2m + L$$

where:

SSD is the stopping sight distance, in meters, and is calculated using the following formula:

$$SSD = 0.278 \times 2.5 \times V + d$$

where:

d = braking distance (m) (found in Article 10.0.5)

V = initial speed (km/h)

L = the total length, in meters, of the design vehicle

Gate Arm Clearance Time from the stopped position

This means the time it takes the grade crossing design vehicle to accelerate and travel across the full gate clearance distance from the stopped position. A driver decides to proceed only after perceiving that the warning lights are not flashing, at which point he/she normally begins to move without delay. There should be sufficient time for the vehicle to cross the gate arm clearance distance before the gate arm descends.

Gate arm clearance time for stopped vehicles should be calculated concurrently with the design vehicle departure time for that crossing, as per Article 10.3.

Gate Arm Clearance Time from the Stop position (TG stop) is calculated as follows:

$$T_{G\,stop} = J + (Tcd_{G\,stop} \times G)$$

where:

J = 2 seconds, which is the perception-reaction time needed for a crossing user to look in both directions, shift gears, if necessary, and prepare to start; and

G = the ratio of acceleration time as per Table 10-1, Ratios of Acceleration Times on Grade, or as measured directly; and

$Tcd_{G\ stop}$ = the time, in seconds, required for the design vehicle to accelerate through the gate arm clearance distance ($cd_{G\ stop}$) on level ground as per Figure 10-2, Assumed Acceleration Curves (Note; (cdG stop) is used in place of (s) and (*t*cdG stop) is used in place of (*t*) from Figure 10-2); and

$$cd_{G\,stop} = 2m + L$$

where:

L = the total length, in meters, of the design vehicle.

10.4.2 Gate Arm Clearance Time for stand-alone sidewalks, paths, or trails

This means the time, in seconds, that it takes pedestrians, cyclists and persons using assistive devices to travel across the full clearance distance (cd) on a sidewalk path or trail (SPT), as shown in Figure 10-4

Note: The gate arm clearance time for stand-alone sidewalks, paths or trails should be measured from 2 meters in advance of the nearest gate to the gate on the far side (clearance side) of the grade crossing. Because GCS 12.1(f)(i) specifies that warning system gates on sidewalks, paths or trails must extend across the full width of the sidewalk path or trail, gate arm clearance time must be properly calculated to prevent pedestrians from being trapped on the crossing surface by the gate.

Gate Arm Clearance Time for stand-alone Sidewalks, Paths, or Trails (TG stop) is calculated as follows:

$$T_{G\ stop} = \frac{SPT_{cd}}{V_p}$$

where:

SPTcd = the clearance distance, in meters, measured from 2 meters in advance of the nearest gate to the farthest gate: and

Vp = the average travel speed, in meters per second (m/s), of pedestrians, cyclists, and persons using assistive devices (to a maximum value of 1.22 m/s).

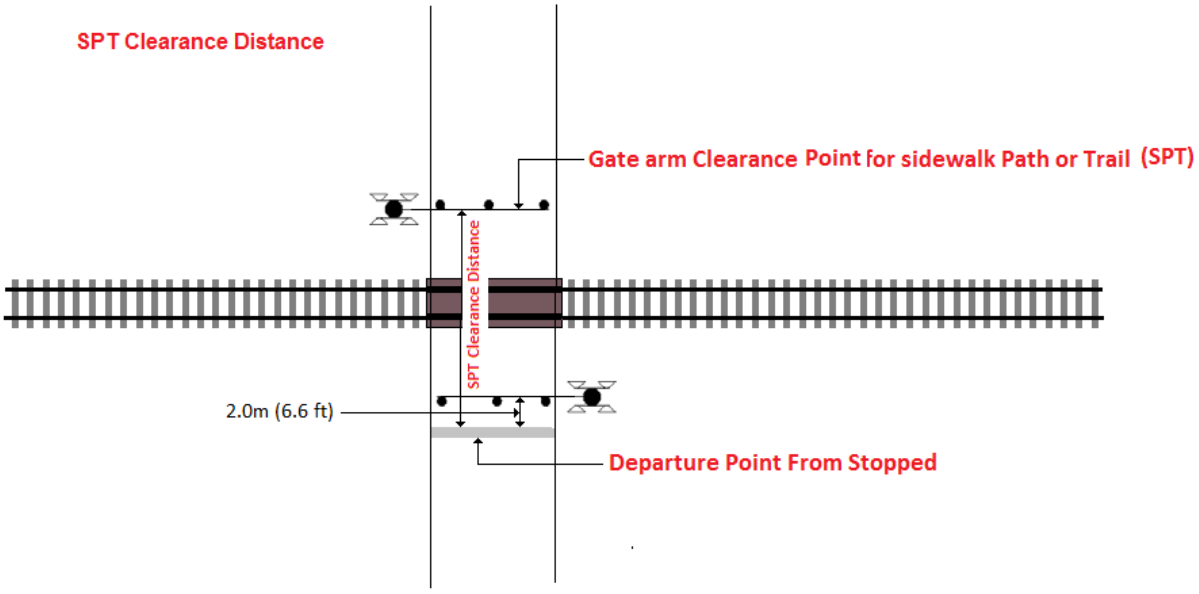


Figure 10-4 Gate arm Clearance Time for Stand Alone Sidewalk Paths or Trails

10.5 Effect of Design Vehicle

For maximum accuracy, it is recommended that the departure time for a given design vehicle be measured directly. Figure 10-2 and Table 10-1 above, should be used to determine departure time at a given grade crossing only when a single design vehicle is used at that crossing.

Table 10-2 Road Design Specifications for Road Approach

Specifications		
Column A	Column B	Column C
Rural	Local	Divided
	Collector	
Urban		Not Divided
	Arterial	

Table 10-3 Characteristics of Rural Roads

	Rural Locals	**Rural Collectors**	**Rural Arterials**	**Rural Freeways**
Service function	Traffic movement secondary consideration	Traffic and land access of equal importance	Traffic movement primary consideration	Optimum mobility
Land service	Land access primary consideration	Traffic movement and land access of equal importance	Land access secondary consideration	No access
Traffic volume vehicles per day (typically)	<1000 AADT	<5000 AADT	<1 2000 AADT	>8000AADT

	Rural Locals	Rural Collectors	Rural Arterials	Rural Freeways
Flow characteristics	Interrupted flow	Interrupted flow	Uninterrupted flow except at	free flow (grade separated) major intersections
Design speed (km/h)	50 – 110	60 - 110	80 – 130	100 – 300
Average running speed (km/h) (free flow conditions)	50 – 90	50 – 90	60 – 100	70 -110
Vehicle type	Predominantly passenger cars, light to medium trucks and occasional heavy trucks	All types, up to 30% trucks in the 3 t to 5 t range	All types, up to 20% trucks	All types, up to 20% heavy trucks
Normal connections	Locals collectors	Locals collectors arterials	Collectors arterials freeways	Arterials freeways

Source: *Geometric Design Guide for Canadian Roads*, published by the Transportation Association of Canada, September 1999

Note: The terms **urban** and **rural** are to be interpreted in the same manner as in the *Geometric Design Guide*. They refer to the predominant characteristics of the road (referred to in Table 10-3 and Table 10-4).

Table 10-4 Characteristics of Urban Roads

	Public Lanes		**Locals**		**Collectors**		**Arterials**		**Expressways**	**Freeways**
	Residential	**Commercial**	**Residential**	**Indust / Comm.**	**Residential**	**Indust/ Comm**	**Minor**	**Major**		
Traffic service function	Traffic movement not a consideration		Traffic movement secondary consideration		Traffic movement and land access of equal importance		Traffic movement major consideration	Traffic movement primary consideration	Traffic movement primary consideration	Optimum mobility
Land service/ access	Land access only function		Land access primary function		Traffic movement and access of equal importance		Some access control	Rigid access control	No access	no access
Traffic volume (veh/day) (typical)	<500	<1000	<1000	<3000	<8000	1000-12 000	5000 – 20 000	10 000 – 30 000	>10000	<20 000
Flow characteristics	Interrupted flow		Interrupted flow		Interrupted flow		Uninterrupted flow except at signals and crosswalks		Uninterrupted flow except at signals	Free flow (grade separation)
Design speed (km/h)	30-40		30 – 50		50 - 80		40-60	50-90	80 – 110	80- 120
Average Running speeds (km/h) (off-peak)	20 - 30		20 - 40		30 - 70		40 - 60	50 -90	60 - 90	70 – 110

	Public Lanes		Locals		Collectors		Arterials		Expressways	Freeways
	Residential	**Commercial**	**Residential**	**Indust / Comm.**	**Residential**	**Indust/ Comm**	**Minor**	**Major**		
Vehicle type	Passenger and service vehicles	All types	Passenger and service vehicles	All types	Passenger and service vehicles	All types	All types	All types up to 20% trucks	All types up to 20% trucks	All types up to 20% trucks
Desirable connections	Public lanes, locals		Public lanes, locals, collectors		Locals, collectors, arterials		Collectors, arterials, expressways, freeway		Arterials, expressway, freeways	Arterials, expressways, freeways
Transit service	Public lanes, locals		Public lanes, locals, collectors		Locals, collectors, arterials		Express and local busses permitted		Express buses only	Express buses only
Accommodation of cyclists	No restriction or special facilities		No restriction or special facilities		No restriction or special facilities		Lanes widening or separate facilities desirable		prohibited	prohibited
Accommodation of pedestrians	Pedestrian permitted, no special facilities		Sidewalks normally on one or both sides	Sidewalks provided where required	Sidewalks provided both sides	Sidewalks provided where required	Sidewalks may be provided, separation for traffic lanes preferred		Pedestrian Prohibited	Pedestrian Prohibited
Parking (typically)	Some restrictions		No restrictions or restrictions one side only		Few restrictions other than peak hour		Peak hour restriction	Prohibited or peak hour restriction	prohibited	prohibited

	Public Lanes		Locals		Collectors		Arterials		Expressways	Freeways
	Residential	Commercial	Residential	Indust / Comm.	Residential	Indust/ Comm	Minor	Major		
Min. Intersection spacing1 (m)	As needed		60		60		200	400	800	1600 (between interchanges)
Right-of-way width (m) (typically)	6 - 10		15 - 22		20 - 24		20[2] - 45[3]		>45[3]	>60[3]

Source: *Geometric Design Guide for Canadian Roads*, Transportation Association of Canada, September 1999.

Table 10-5 General Vehicles Classes

General Vehicle Descriptions	Length (m)	Design Vehicle
1. Passenger Cars, Vans, and Pickups (P)	5.6	Passenger Car
2. Light Single-unit Trucks (LSU)	6.4	Truck
3. Medium Single-unit Truck (MSU)	10.0	Truck
4. Heavy Single-unit Truck (HSU)	11.5	Truck
5. WB-19 Tractor-Semitrailers (WB-19)	20.7	Truck
6. WB-20 Tractor-Semitrailers (WB-20)	22.7	Truck
7. A-Train Double (ATD)	24.5	Truck
8. B-Train Double (BTD)	25.0	Truck
9. Standard Single-Unit Buses (B-12)	12.2	Bus
10. Articulated Buses (A-BUS)	18.3	Bus
11. Inter-city Buses (I-BUS)	14.0	Bus

Source: *Geometric Design Guide for Canadian Roads*, Transportation Association of Canada, September 1999.

Table 10-6 Special Vehicles - Design Vehicle Description, Length and Width

Design Vehicle Description	Length (m)	Width (m)
Agriculture machinery	To be determined in the detailed safety assessment.	To be assessed for the area. To be determined in the detailed safety assessment.
Special trucks such as long-load logging trucks and long combination vehicles (LCVs)	To be determined in the detailed safety assessment. May be up to 38 m in length in Canada	Standard road width
Recreational vehicles (RVs) and towed recreational trailers	To be determined in the detailed safety assessment.	Standard road width
Industrial equipment, including quarrying, sand and gravel, mining.	To be determined in the detailed safety assessment.	To be determined in the detailed safety assessment and assessed for the area.

Source: *Geometric Design Guide for Canadian Roads*, Transportation Association of Canada, September 1999.

Table 10-7 Grade Crossing Design Vehicle Selection

Road Use	Description	Design Vehicle(s)
Local roads serving seasonal residences	summer and winter areas	single-unit trucks
Tourist area	self-propelled or towed recreational vehicles	single-unit trucks, special vehicles – recreation
Agricultural area, e.g., farm to farm	private road grade crossing serving agricultural use or local public roads within the area	single-unit trucks, buses, truck tractors with semitrailers, combination vehicles with B train doubles, or special vehicles such as farm tractors with trailers, towed cultivating or harvesting equipment, or large self-propelled cultivating and harvesting machinery
Access roads to residential property	where the traffic stream is almost exclusively residential use	passenger car, light van, and pickup
	where the users have large trucks or special vehicles	single-unit trucks, truck tractors with semitrailers, or special vehicles – recreational
Industrial	private roads	single-unit trucks, truck tractors with semi-trailers, A or B train doubles, or special vehicles – machinery or long combination vehicle
	public grade crossings within an industrial area	combination vehicles
	resource road	single-unit trucks, tractor trailers, combination vehicles, special vehicles – off road mining, long load logging trucks
Local residential road	regular use by commercial delivery vehicles, moving vans, road maintenance vehicles and garbage trucks	single-unit trucks, buses
Residential collector	regular use by commercial delivery vehicles, moving vans, road maintenance vehicles, garbage trucks, or buses	single-unit trucks, buses

Road Use	Description	Design Vehicle(s)
Urban and rural arterial roads		combination vehicles, buses
Designated truck route		combination vehicles
Designated special or vehicle route, e.g.oversized or dimensional loads		special vehicles – long-load logging trucks or long combination vehicles

Source: *Draft RTD 10*, October 24, 2002.

Table 10-8 Coefficient of Friction for Wet Pavements

Maximum Road Operating Speed (km/h)	Coefficient of Friction (f)
0 – 30	0.40
31 – 40	0.38
41 – 50	0.35
51 – 62	0.33
63 – 69	0.31
70 – 76	0.30
77 – 84	0.30
85 – 90	0.29
91 – 97	0.28
98 – 120	0.28

Source: *Geometric* Design *Guide for Canadian Roads*, Transportation Association of Canada, September 1999.

Table 10-9 Stopping Sight Distances (Level Grade, on Wet Pavement)

Road Crossing Design Speed (V) (km/hr)	Stopping Sight Distance (SSD) (m)																				
	Road Approach Gradient																				
	-10%	-9%	-8%	-7%	-6%	-5%	-4%	-3%	-2%	-1%	0%	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%
10	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
20	21	21	21	21	21	21	20	20	20	20	20	20	20	20	20	20	19	19	19	19	19
30	33	33	32	32	32	31	31	31	30	30	30	30	30	29	29	29	29	29	29	28	28
40	51	50	49	49	48	48	47	46	46	45	45	45	44	44	43	43	43	42	42	42	42
50	76	75	73	72	71	70	69	68	67	66	65	64	63	63	62	61	61	60	60	59	59
60	104	101	99	97	95	93	91	89	88	86	85	84	83	81	80	79	78	77	77	76	75
70	140	135	132	128	125	122	119	117	114	112	110	108	106	105	103	101	100	99	97	96	95
80	182	176	171	166	161	157	153	149	146	143	140	137	135	132	130	128	126	124	122	121	119
90	223	216	209	202	197	191	186	182	178	174	170	167	163	160	157	155	152	150	148	145	143
100	281	271	262	253	245	238	232	226	220	215	210	205	201	197	194	190	187	184	181	178	175
110	345	331	318	307	296	287	278	270	263	256	250	244	239	234	229	224	220	216	212	209	205

Source: Transport Canada Guideline for Determining Minimum sightlines at Grade Crossings: A Guide for Road Authorities and Railway Companies (Table 2)

Notes:

1. This table may be used as a guide reference for all design vehicle classes in Table 1-8 of the *Geometric Design Guide for Canadian Roads*, TAC: 2017.
2. Table 10-9 was generated using the formulas contained in Article 7.2 of the *Grade Crossing Standards*.

Article 11 Location of Grade Crossings

The purpose of this requirement is to help ensure clear storage space for vehicular road users at all grade crossings. When clear storage space cannot be provided, there is a risk of vehicles queuing over the railway tracks, putting them at significant risk of collision with a train.

If a minimum of 30 meters of clear storage space cannot be provided at a vehicular grade crossing, the installation of a warning system and interconnecting that system with the traffic signals (if present) should be considered. See Part E of this Handbook for interconnection requirements.

Grade crossings that existed before the GCR came into force, are grandfathered; that is, they are not required to meet the standards set out below (GCS article 11) until warranted changes are made. However, it is recommended that these locations be reviewed as per Article 13 of the GCS, and they may nonetheless be required to have additional light units installed for intersecting roads or entrance ways.

If the location, gradient or crossing angle of a grade crossing changes, articles 6 and 11 of the GCS must be applied in a manner that improves the overall safety of the grade crossing (GCR 88).

This requirement also applies to grade crossings constructed after the coming to force of the GCR. (See Article 2 for more information on amendments to the GCR timelines)

> **Note:** this requirement does not apply to a public grade crossing that is a standalone sidewalk, path or trails, or access is for the exclusive use of pedestrians and non-motor vehicles.
>
> Standalone sidewalk, path or trail is as defined in Article 1 of this Handbook.

11.1 Proximity to an intersection

A public grade crossing at which the railway design speed is greater than 25 km/h (15 mph) must be constructed so that no part of the travelled way of an intersecting road or entrance way (other than a railway service road), is closer than 30 meters to the nearest rail of the grade crossing (defined as “D” in Figure 11-1, below).

A person may construct a new road intersection or an access road on a road approach to a public grade crossing if:

- The railway design speed is 25 km/h (15 mph) or less; or
- The location of the grade crossing meets the standards set out in article 11 of the GCS. (GCR 101)

Grade crossings that are separated by more than 30 meters between lines of railway shall be considered separate grade crossings (GCR definition of “grade crossing”).

For the purposes of the GCR, two adjacent and separate roads that are used by motor vehicles and that cross one or more lines of railway are considered to be separate grade crossings.

In cases where the road approach is curved, the D measurement must be taken from along the centerline of the roadway. (Defined as “D” in Figure 11-2, below).

11.2 Grade Crossings Within or In Close Proximity to Circular Intersections

At circular intersections, such as roundabouts and traffic circles, that include or are within close proximity to a grade crossing, a queue of vehicular traffic could cause highway vehicles to stop on the grade crossing.

Where circular intersections include or are within 60 meters (200 feet) of a grade crossing, an engineering study should be conducted to determine if queuing could impact grade crossing safety. If such is the case, provisions should be made to clear highway traffic from the grade crossing prior to the arrival of rail traffic (GCR 100).

Among the actions that can be taken to keep the grade crossing clear of traffic or to clear traffic from the grade crossing prior to the arrival of rail traffic are the following:

- Elimination of the circular intersection.
- Revision of the geometric design.
- Installation of grade crossing regulatory and warning devices.
- Installation of highway traffic signals.
- Installation of traffic metering devices.
- Installation of “Prepare to stop at Railway Crossing” signs.
- A combination of these or other actions.

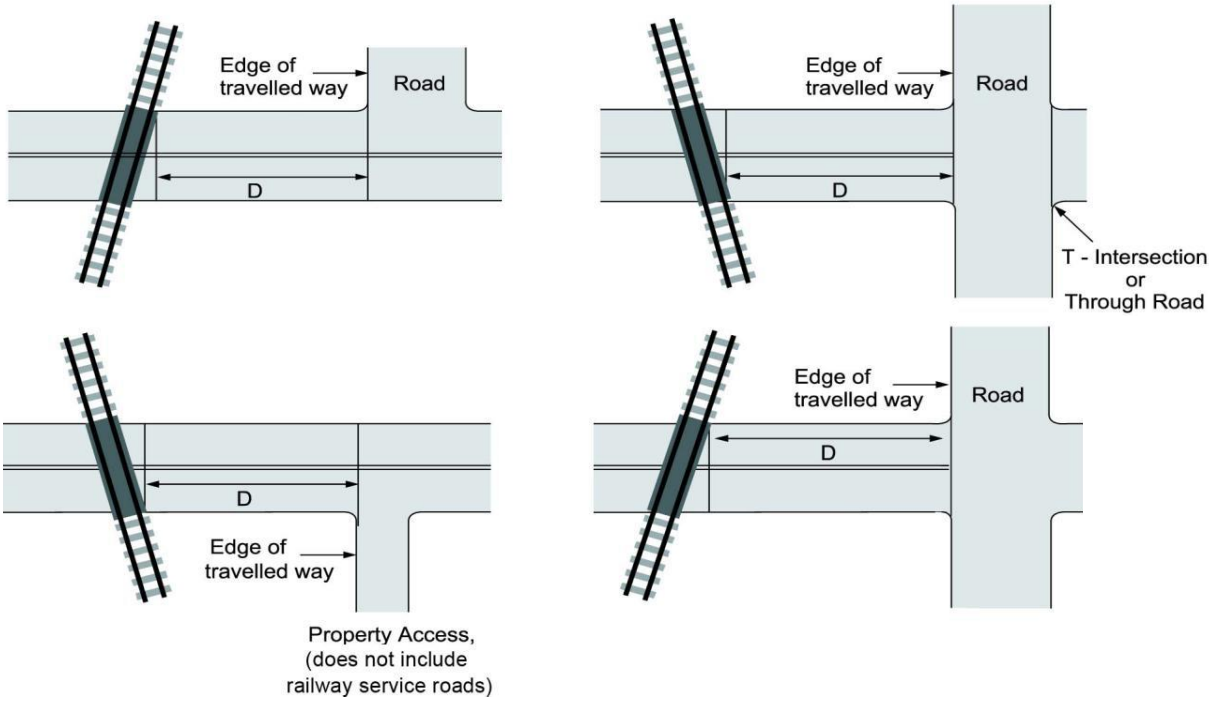


Figure 11-1 Restrictions on the Proximity of Intersections and Entranceways to Grade Crossings

Source: *Grade Crossings Standards*, January 1, 2019

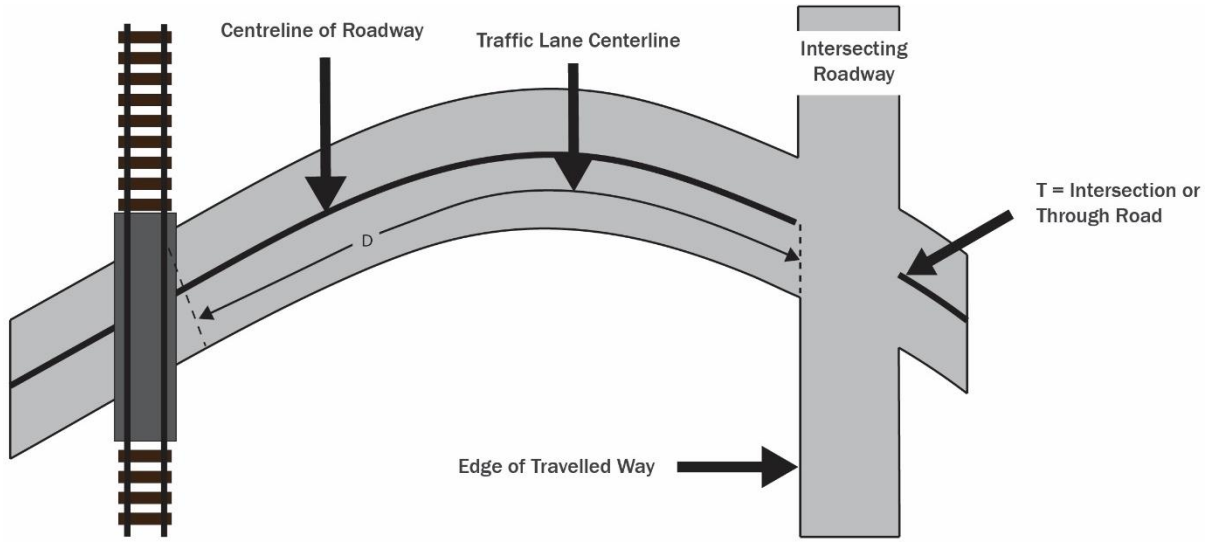


Figure 11-2 Intersection with a Curved Roadway

Part D – Warning System Design

Article 12 Warning System Operation

12.0.1 Except as otherwise specified in articles 12 to 16 and Appendix B of these Standards, or in the *Grade Crossing Regulations*, warning systems must be in accordance with the requirements and recommended practices of Part 3 of the AREMA Communications and Signals Manual.

12.0.2 For the purposes of these Standards, the following interpretations and adjustments apply with respect to the AREMA's Communications and Signals Manual of Recommended Practice:

- Any guidelines, recommendations, and similar, are to be considered mandatory.
- Any references to "should" are to be read as "must".
- The term "highway-rail grade crossing warning system" is to be read as "warning system".
- The term "railroad" and the phrase "operators of the passenger or commuter rail system" are to be read as "railway company".
- The term "lights" is to be read as "light units," unless it refers to gate light units.
- The term "train" is to be read as "railway equipment".
- The term "roadway" and "roadway approach" are to be read as "road approach".

The following are to be disregarded:

- All references to the "MUTCD".
- All "Purpose" Articles; paragraph 2 of Article 3.1.16 G.1(b)(ii); and Article 3.2.35 K.5 of the AREMA.
- All references to and requirements related to the "Diagnostic Team".
- All references to and requirements related to the "highway agency" or "highway agency or authority with jurisdiction".
- All references to and requirements related to the "agency" or "public agency".
- All references to and requirements related to "manufacturers," except where the requirement is to do something in accordance with the manufacturer's instructions.

- All references to “unless otherwise specified” or “other considerations,” all references to approvals or orders, and any other reference to exercising discretion.
- All purchase order requirements.
- All requirements to create or keep records.
- All requirements for a diagnostic review, an engineering study, a study of train operations, a risk analysis, a safety analysis, and all requirements to provide special instructions, operating rules, orders, or operational procedures.

12.1 Signal Assemblies

Note: All grade crossings installed or modified as of November 28th, 2014, are required to meet these specifications before they can be placed into service. (See Article 2 for more information on amendments to the GCR timelines).

Signal assemblies, gate assemblies and cantilever assemblies at grade crossings that existed before November 28th, 2014, should be as shown in Figure 12-1, Figure 12-2, and Figure 12-3 respectively, and should meet the specifications below. (See Article 2 for more information on amendments to the GCR timelines)

Note: All measurements shown in Figure 12-1, including the light unit spacing with respect to the center of the mast and the light units; the distance of the Railway Crossing sign and Number of Track sign from the top and bottom of the light unit backgrounds; the clearance line; the foundation height; and the height of the light unit above the crown of the road also apply to Figure 12-2, Figure 12-3, Figure 12-4, Figure 12-5.

a) The minimum clearance distance from the face of a curb to the clearance line must be 625 mm (2 ft).

b) Where there is no curb, the minimum clearance distance must be 1.875 m (6 ft) from the edge of the travelled way to the clearance line and a minimum of 625 mm (2 ft) from the outer edge of the road approach shoulder to the clearance line if there is a shoulder.

This clearance distance is provided to allow road users the space required to recover without colliding with any objects in the event of a loss of control, trip or fall, in addition, the horizontal clearance is provided to ensure the required space is available for maintenance equipment (sweeping and snow removal) to prevent potential damages to warning system components.

For additional guidance on minimum clearance distances, refer to Figure 12-6, Figure 12-7, Figure 12-8, Figure 12-9 outlining four typical cases as *per Geometric Design Guide for Canadian Roads (TAC)*.

Note: The minimum clearance distances specified in articles 12.1 (a) and (b) must also be maintained for stand-alone sidewalks, paths, or trails. Also, where sidewalk, paths or trails are installed at a grade crossing with vehicular traffic, a minimum clearance distance applies from the field side edge of a sidewalk, path or trail to the clearance line not less than 625 mm (2 ft) as referenced in Figure 12-4 and Figure 12-5.

c) The top of the warning signal foundation must be a maximum of 100 mm (4 in) above the surrounding ground. The slope of the surrounding ground away from the foundation toward the travelled way must not exceed a ratio of 4:1 (AREMA 3.1.35 note:3).

d) The gate arm reflective materials shall have

   i) stripes of 406 mm (16 in) and must be affixed with white and red alternately and be aligned vertically.

Note: Article 12.1(d)(i) applies only to grade crossings constructed as of November 28th, 2014, and to grade crossing that existed before November 28th, 2014, when any of their components are changed (GCR 68(1), 82(1), 87(1) and 87(2)). (See Article 2 for more information on amendments to the GCR timelines)

   ii) Retroreflective material must meet the specifications for Type XI, white sheeting, in sections 4 and 6 of ASTM D4956 (cited in Part A), when tested in accordance with the Test Methods for Type XI specified in sections 7 and 9 of that Standard; and

   iii) The retroreflection coefficient of the retroreflective material referred to in (ii) is to be maintained above 50 per cent of the value specified for Type XI, white sheeting, in sections 4 and 6 of ASTM D4956 (cited in Part A).

Note: Sub-articles (ii) and (iii) apply to all grade crossings as of the coming into force of the GCR (GCR 58; GCS 4.1.3(2)) (see Article 2 for more information on amendments to the GCR timelines)

e) For grade crossings used by vehicles, gate arms must extend to no more than 1 m (3 ft) from the longitudinal axis (edge of farthest lane or travelled way) of the road approach. Where gates are installed on each side of the same road approach, gate ends must extend to within 1 m (3 ft) of each other.

f) Where gates are installed at sidewalks, paths, or trails,

i) each gate arm must extend across the full width of the sidewalk, path, or trail; and
ii) in the case of a sidewalk, path or trail that is less than 3.5 m (11.5 ft) wide, two lights are required on each gate arm located so that the lights are over the two points dividing the sidewalk, path, or trail into thirds. The two gate arm lights must flash alternately.
iii) Where gates are dedicated strictly for sidewalks, paths or trails, the gate height from the crown of the road should be maintained as close as possible to the lower end of the gate height tolerances shown in Figure 12-2 but shall not be installed less than 1.1m (3.5 ft)

g) The height of the cantilever assembly clearance must be between 5.2 m (17 ft) and 6.0 m (20 ft) above the crown of the road, as shown in Figure 12-3 (AREMA 3.2.5 C 8).

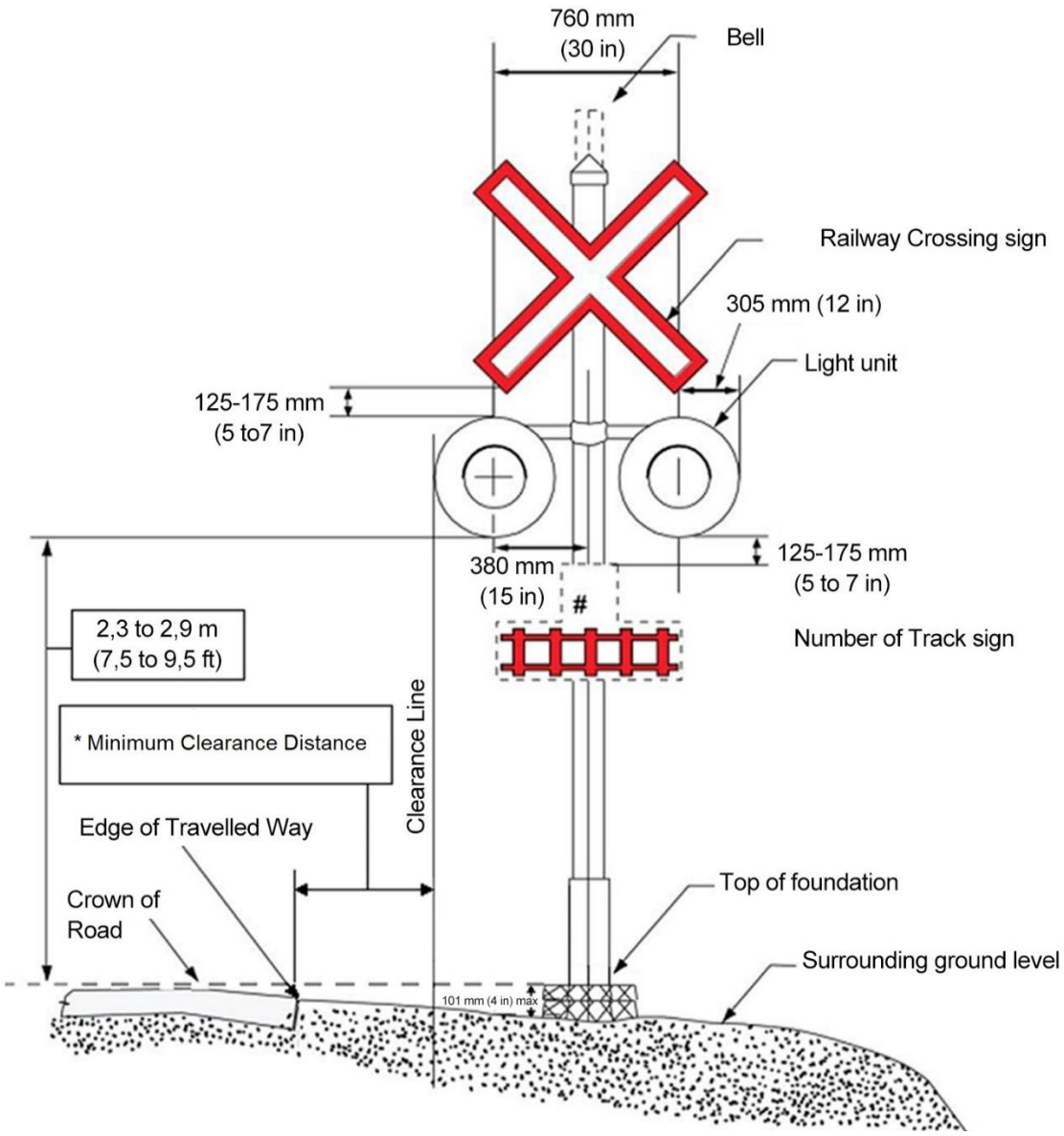


Figure 12-1 Warning Signal Assemblies

*For minimum clearance distances please refer to article 12.1(a) and (b).

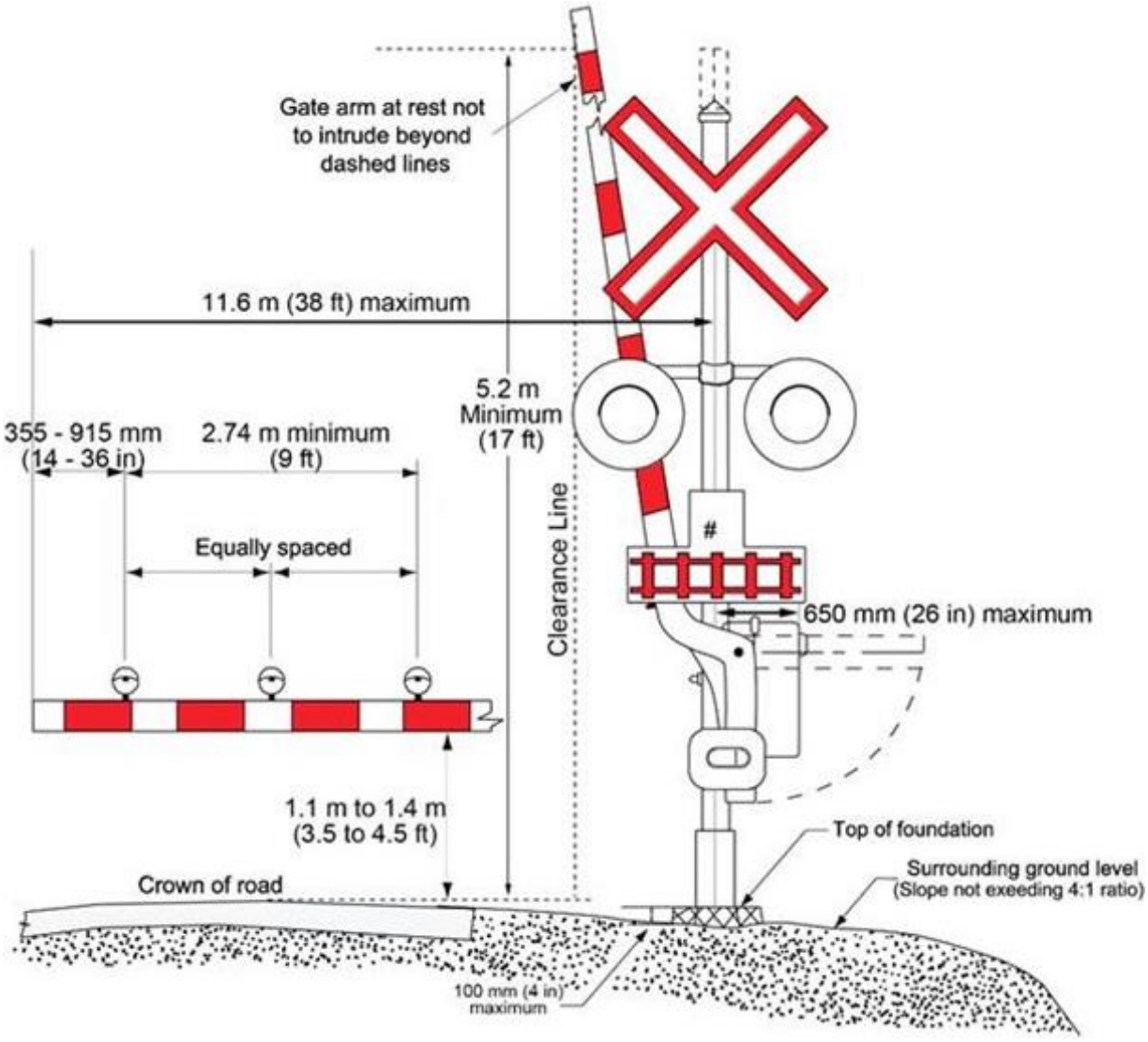


Figure 12-2 Gates

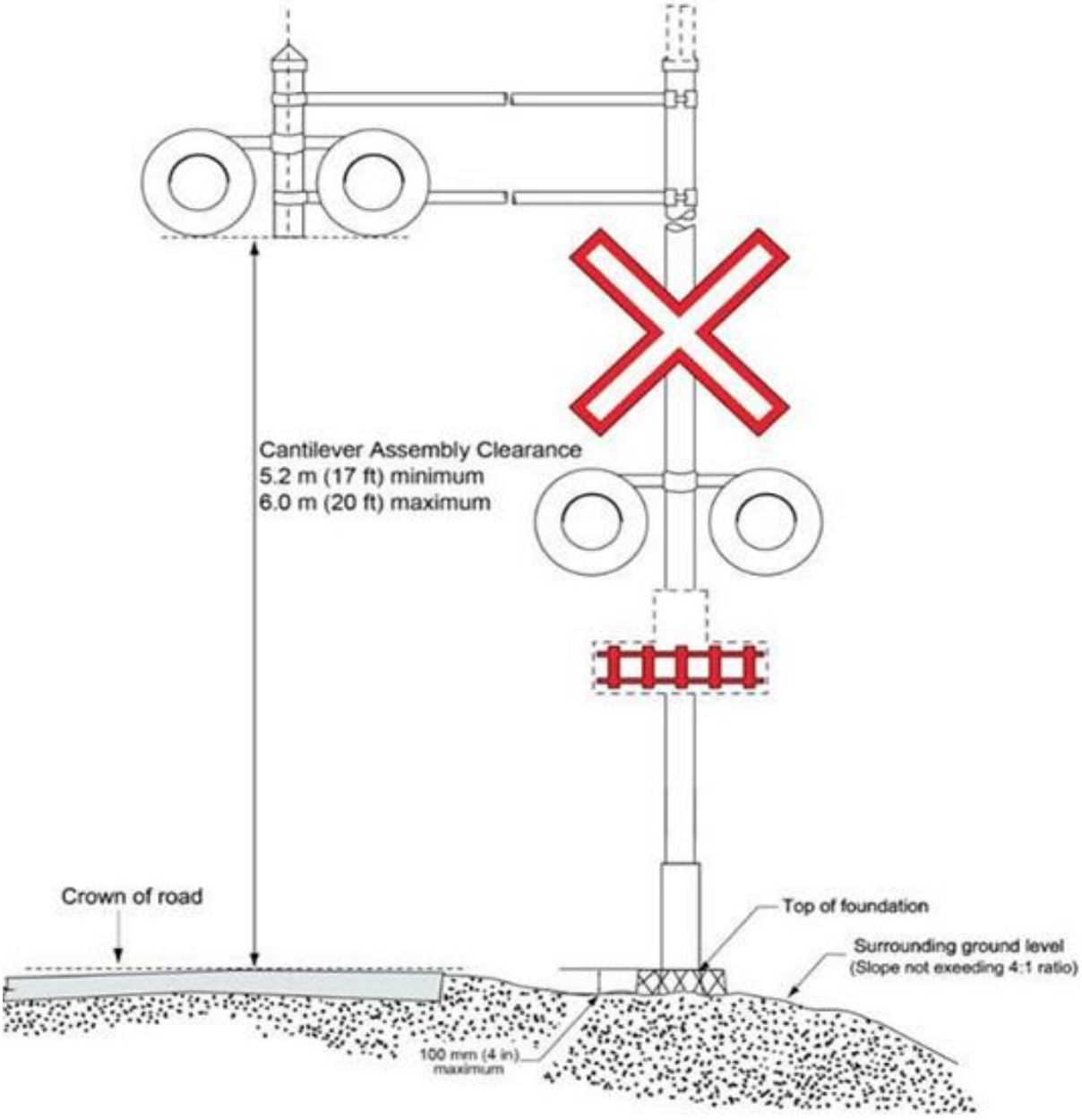


Figure 12-3 Cantilever

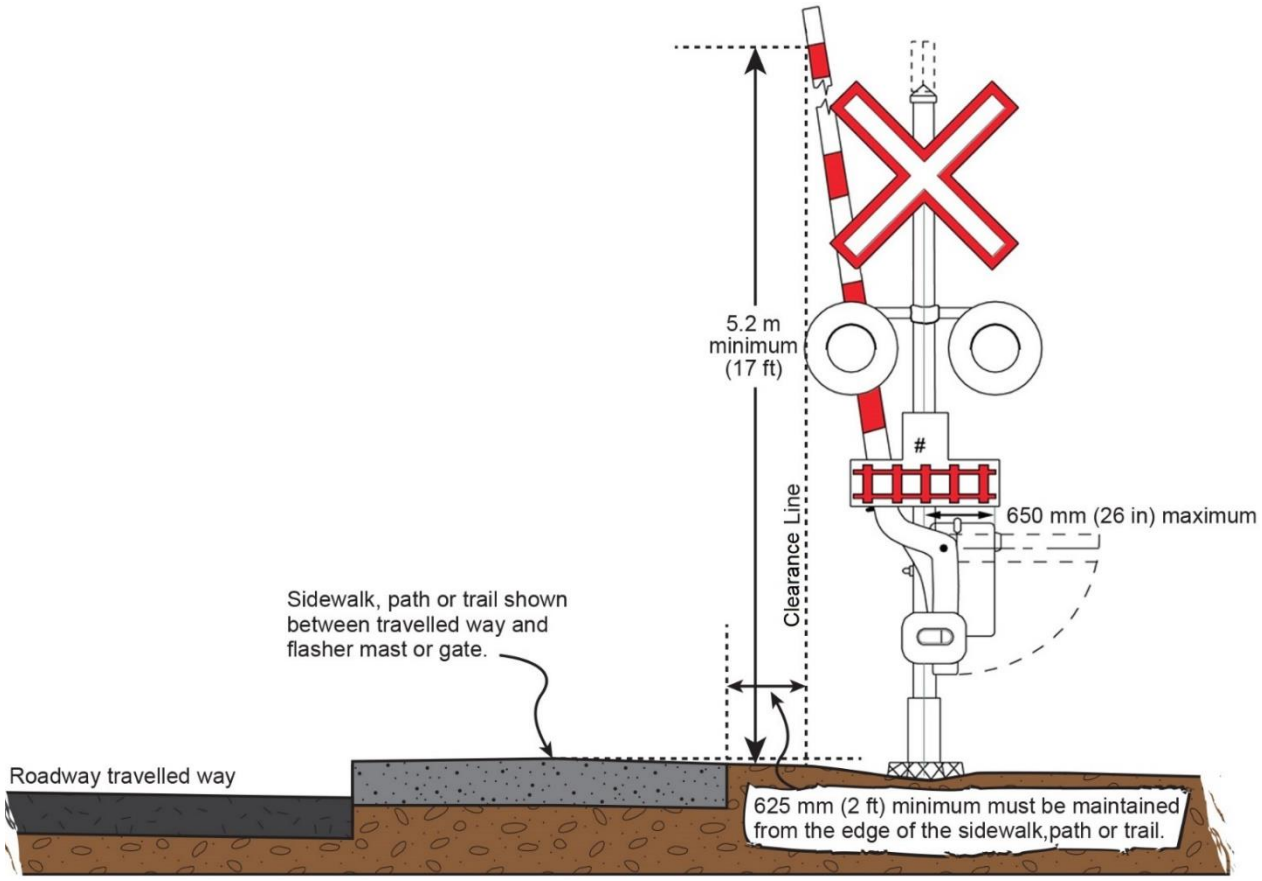


Figure 12-4 Gates with Front Sidewalk

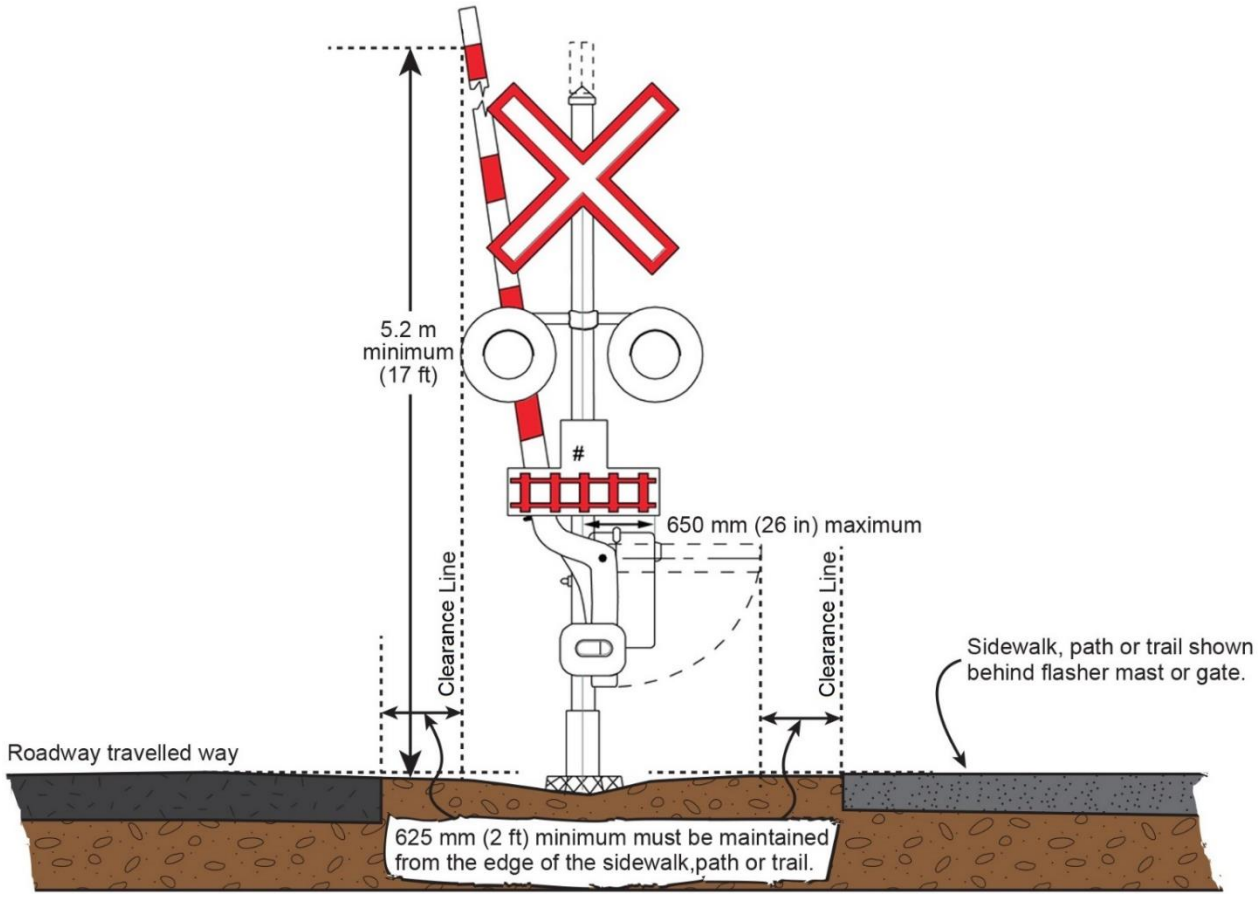


Figure 12-5 Gates with Rear Sidewalk

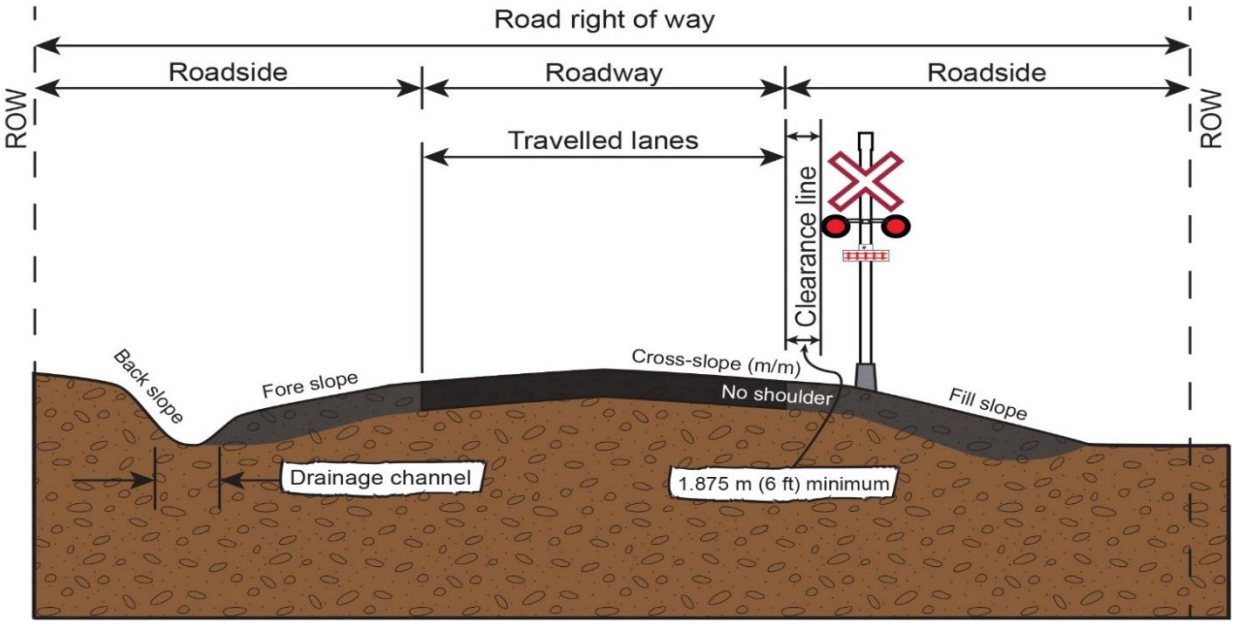


Figure 12-6 Minimum Clearance Distance with No Shoulders and No Curb or Gutter

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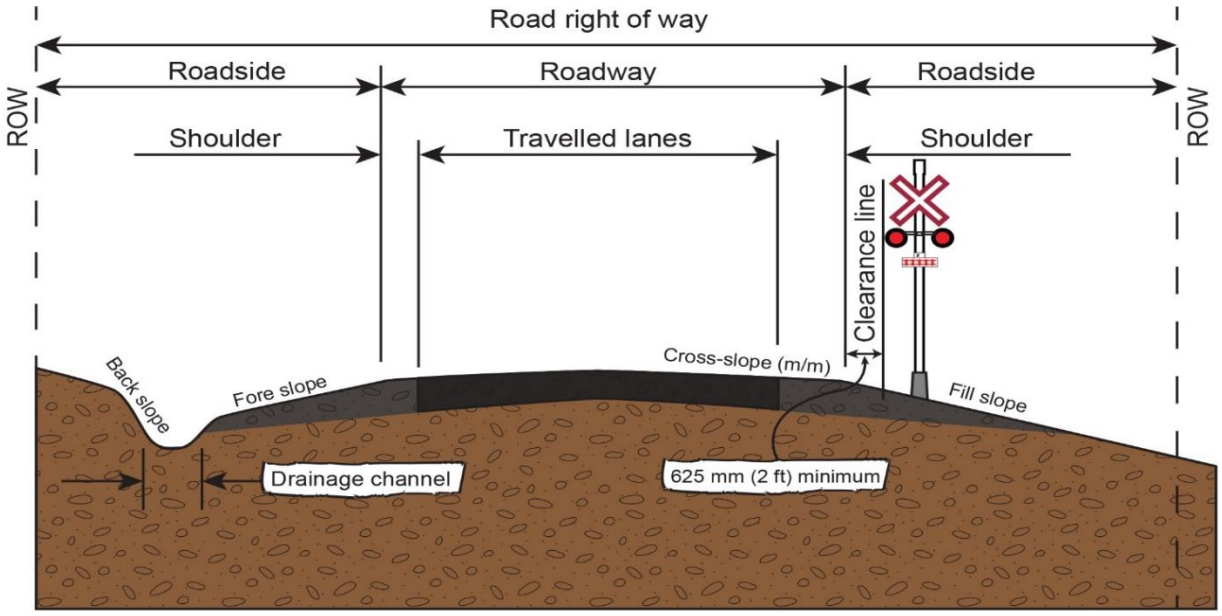

Figure 12-7 Minimum Clearance Distance with Shoulders and No Curb or Gutter

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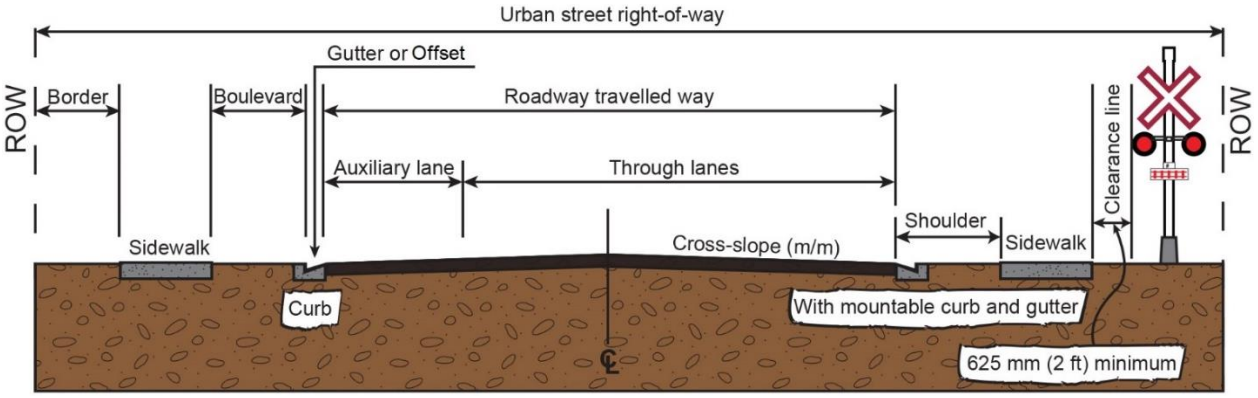

Figure 12-8 Minimum Clearance Distance with Shoulder, Curb, and Mountable Gutter with a Separate Sidewalk, Path, or Trail

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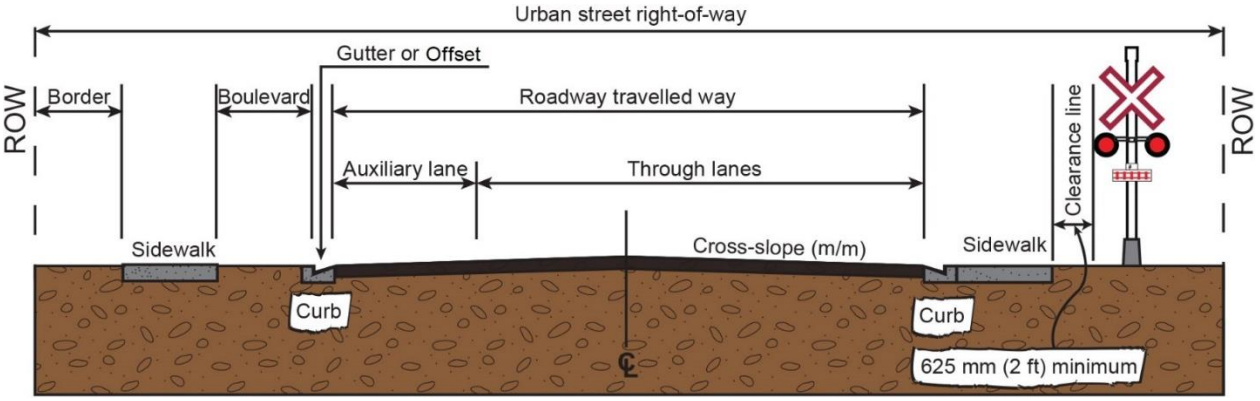


Figure 12-9 Sidewalk, Path, or Trail

Image is not to scale.

12.2 Recorders

In addition, grade crossing warning systems installed on or after November 28th, 2014, and those installed prior to this date to which warranted changes are made must have monitoring devices that gather and retain the date and time of the following information for a minimum of 30 days (see Article 2 for more information on amendments to the GCR timelines):

a) Activation and deactivation of interconnected devices.

b) Gates have returned to or have left the vertical position (Gate Up position)

c) Gates have descended to a point [angle of] 10 degrees from the horizontal (Gate Down position).

d) Activation of the warning system test switch.

e) Activation and deactivation of all track circuits used in the control of the warning system, including electronic track circuits.

f) Activation of the warning system.

g) Activation and deactivation of all devices used to control the warning systems at adjacent crossings; and

h) Activation and deactivation of all devices used to activate the warning system from a location other than the crossing.

The date and time recorded should be the local time and should be verified at least monthly.

12.3 Control Circuits

All control circuits that affect the safe operation of a warning system must operate in a manner that activates the warning system if there is a failure of a safety-critical component of that system.

12.4 Electromagnetic, Electronic, or Electrical Apparatus

The electromagnetic, electronic, or electrical apparatus of a warning system must be operated and maintained in accordance with the limits within which the system is designed to operate.

12.5 Track Circuits

In the early years of railways, to prevent two trains from using the same section of track at the same time, timetables and train orders were developed. Later, block signal systems were developed to indicate to the locomotive engineer whether a train was ahead in the next "block" of track. These signals were set manually until the development of the track circuit, which sensed the presence of a train in the block and set the signals automatically. The track circuit was designed to be fail-safe, so that if the battery or any wire connections were to fail, or if a rail was broken, a stop signal would be displayed. Blocks of track were separated by insulated joints.

The DC track circuit, shown in Figure 12-10, was the first means used for automatic train detection. It is a relatively simple circuit and is still used in many crossings warning systems and signaling systems today. The maximum length of these circuits is more than adequate to provide the necessary warning time for crossing warning systems, even with today's train speeds.

The rails are used as conductors of energy supplied by a battery. This energy flows through the limiting resistor to one rail, then through another limiting resistor to the coil of the DC relay, and back over the other rail to the battery, thereby completing a simple series circuit. The relay is energized if the continuity of the rails is intact, and no train is present on the circuit between the battery and the relay. The circuits are limited by insulated joints—devices placed between two joining rail sections to electrically isolate the two sections.

Should an insulated joint fail, the circuit's resistance increases, causing the relay to drop and failsafe. Adjacent track circuits should be designed in such a way that on each side of the insulated joints, the battery polarity is staggered, thus providing another form of fail-safe protection if the integrity of the insulated joints is compromised.

Therefore, railway track circuits must:

a) detect non-insulated railway equipment axles in any part of the track circuit.

b) detect a 0.06-ohm shunt when the shunt is connected across the track rails on any part of the circuit.

c) within a turnout, or switch, provide a set of fouling wires that consist of at least two discrete conductors, and must ensure the proper operation of the track circuit when the circuit is shunted. The use of a single duplex wire with a single plug is not permitted.

d) in the case of a non-insulated rail joint within the limits of a track circuit, be bonded by means other than joint bars, and the bonds must ensure electrical conductivity; and

e) in the case of an insulated rail joint used to separate track circuits, prevent current from flowing between rails separated by the insulation, and be spaced as shown in Figure 12-11, below.

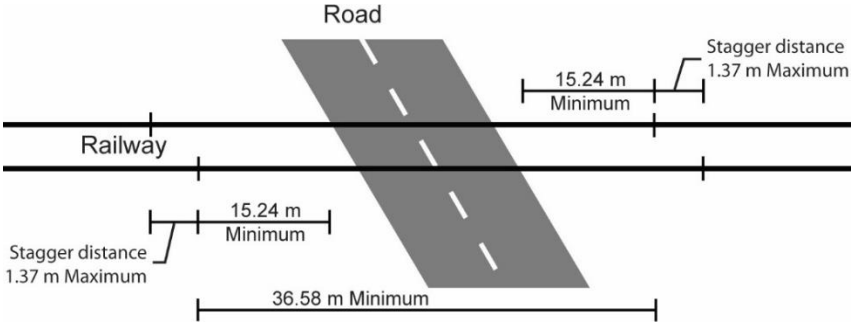
Tests must be made upon the installation of, and when changes or adjustments are made to, the control system or track circuit to ensure that the system is operating as intended (AREMA 3.3.20 B 3; GCR 94(2)).

When biased relays or two-element, two-position AC relays are used, the polarities of adjacent track circuits should be staggered for feed/relay, relay/relay configuration. In other types of track circuits, the polarities of adjacent circuits may be staggered, as required by the individual railway (AREMA 8.6.1 B 13).

The length of any track circuit (approach or island) should be greater than the maximum inner wheelbase of any railway equipment that may occupy the track circuit, or a minimum of 36.58 m (120 ft), unless other provisions for protection are made. (AREMA 3.1.30, 8.6.1 B 14). See Figure 12-11.

Figure 12-10 DC Track Circuit

a) Island Track Circuit Defined by Insulated Joints



b) Electronic Island Circuit

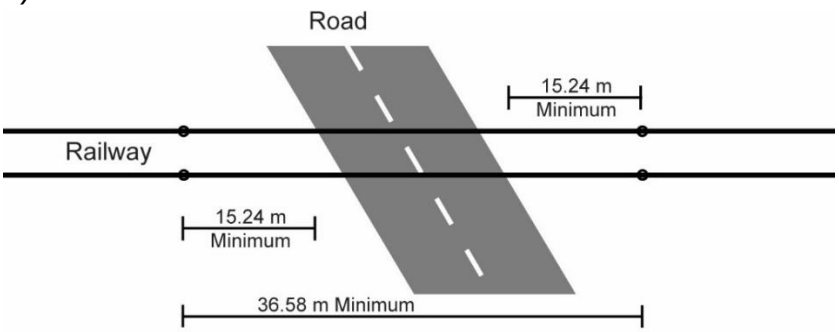


Figure 12-11 Recommended Insulated Joint Location for Grade Crossing Island Circuit

Bonding and Rail Connectors

Bonding is an essential part of the track circuit. Without continuous conductivity in the rails, the track circuit would be unstable and impossible to adjust properly. It is important to bond all angle bars within the track circuit, as well as to install all track connections at the insulated joints, as indicated in Figure 12-12 and Figure 12-13, to maximize continuity and broken rail protection.

To maintain the integrity of the track connectors, they should be installed on the side of the rail on which the bonding hole was drilled and should not be pounded in excessively. (Bonds that have been pounded in up to the shoulder as indicated in Figure 12-12 should be replaced.)

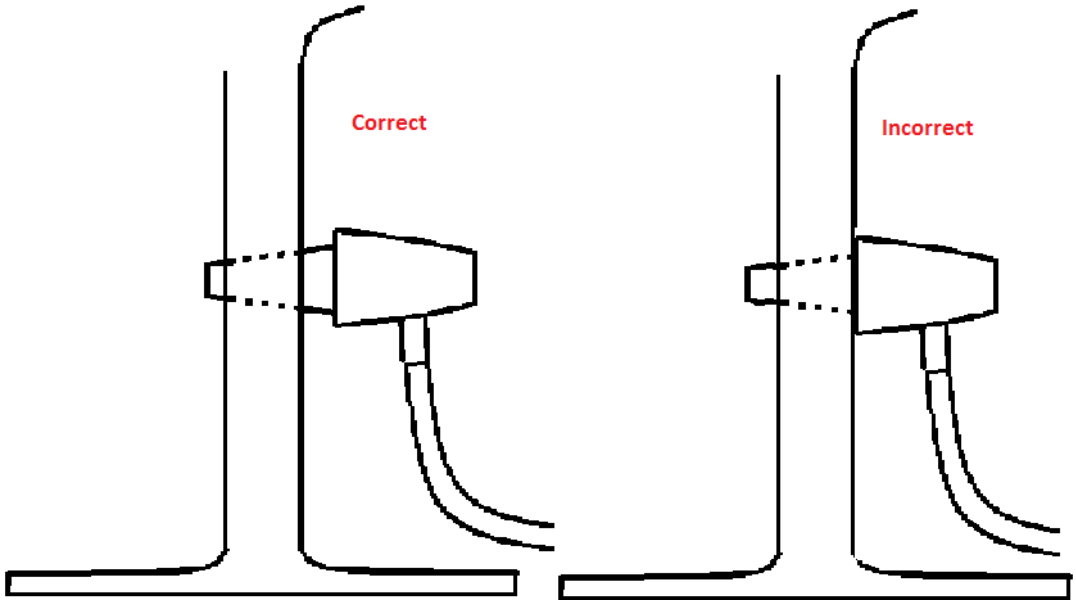


Figure 12-12 Proper Track Connector Installation

Bonding holes should be drilled at the neutral axis of the rail, approximately midway between the base fillet and head of the rail fillet. Therefore, the location of the bonding hole should be at a minimum distance of four times the minimum track bolt hole size, measured from the centre line of the last hole in the angle bar or insulated joint, as shown below. Drilled bonding holes should also be 3/8 inch in diameter.

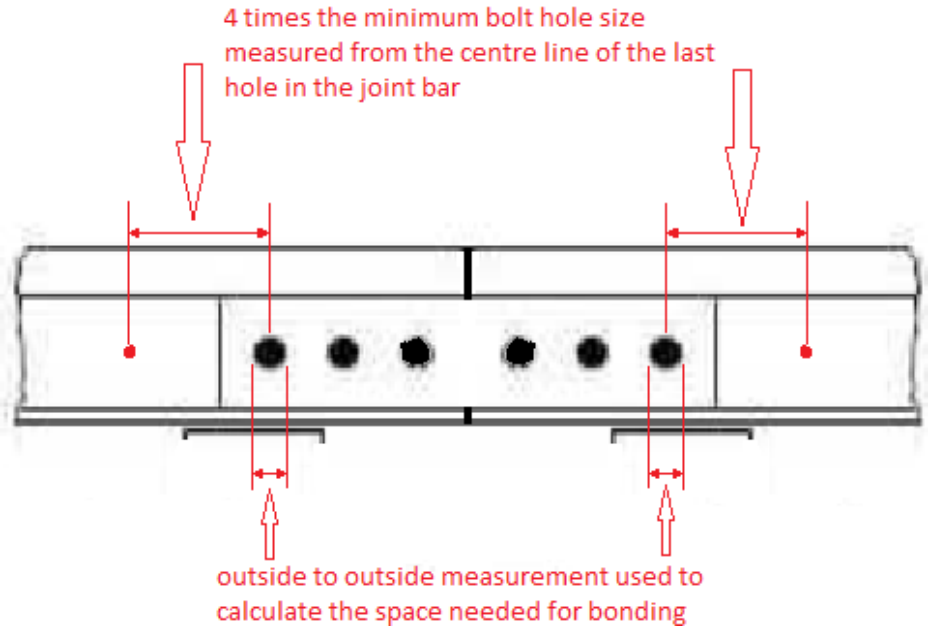


Figure 12-13 Proper Bonding Techniques

12.6 Battery Back-up

A battery is a device consisting of two or more electromechanical cells that convert stored chemical energy into electrical energy. Each cell has terminals, or electrodes: a positive electrode, or cathode, and a negative electrode, or anode. The terminal marked positive has greater electrical potential energy than the terminal marked negative. The terminal marked positive is the source of electrons that, when connected to an external circuit, will flow and deliver energy to an external device. Connecting the battery to an external circuit causes the ions to move within the cell, causing chemical reactions at each of the terminals. These reactions produce electrical energy that is supplied to the external circuit. It is the movement of the ions in the battery that allows current to flow out of the battery to perform work. Although the term battery technically means a device with multiple cells, individual cells are also popularly called batteries. Railways use several different makes and models of batteries, provided by many different manufacturers.

Secondary batteries can be discharged and recharged multiple times, as the original charge of the electrodes is restored by reverse current.

The requirement to provide warning system battery back-up for 8 hours of continuous activation and 24 hours of normal railway operations, applies to grade crossings installed after November 28th, 2014 (GCR 44), and when changes are made to grade crossings installed after that date (GCR 87).

Items that could be considered when determining the required battery back-up Amp hour (AH) rating are as follows:

- Number of railway equipment moves that activate the warning system
- Length of all railway equipment moves
- Speed of railway equipment which activates the warning system.
- Minimum designed warning time.
- Duration for which the warning system will operate for each railway equipment move.
- Current draw of the activated warning system components; and
- Current draw of all control equipment in its normal state.

12.6.1 Types of railway batteries in the field

The batteries used by railways include the following.

Secondary – Rechargeable (can be reused repeatedly (storage))

Some examples are:

- Lead-acid (all types)
- Nickel-iron (wet)
- Nickel-cadmium (all types)
- Nickel metal hydride (all types)
- Silver-oxide (dry)
- Lithium-ion
- Lithium-polymer

Primary – Non-rechargeable (can be used one time only)

Some examples are:

- Carbon
- Alkaline (all types)
- Lithium
- Zinc (all types)
- Mercury

Batteries not used within a reasonable length of time should be given a charge periodically, and if the specific gravity of the battery's electrolyte drops below 1.180, the battery should be recharged as per the manufacturer's instructions.

Electrolyte lost due to spillage should be replaced with the proper amount of electrolyte of the same specific gravity as that of the battery's other cells. Electrolyte should not be added under any other circumstances. As a temporary, emergency measure only, if the electrolyte level is below the top of the plates, add water to prevent the plates from becoming dry.

Freshly mixed electrolyte should not be placed the in cells until it has cooled.

12.7 Power-Off Light

A Power Off light is a steady-lit, white LED or incandescent lamp located on the external housing of the signal bungalow or on a post which indicates to train crew and employees that the crossing is operating under normal conditions. When the Power Off light is extinguished or flashing, the railway authority is responsible for reporting and attending to the situation.

Article 13 Number and Location of Light Units

Note: This is a requirement for new grade crossings equipped with a warning system. Existing grade crossings have until November 28th, 2022, or November 28th, 2024, depending on the specific physical and operational characteristics of the grade crossing, to comply with this requirement, unless they undergo a change before then (GCR 44, 53, 68, 82 and 87) (See Article 2 for more information on amendments to the GCR timelines).

13.0 Incandescent Lights

Where incandescent lights are installed, the light unit voltage must be maintained between 90 and 110 per cent of the rated voltage under standby power conditions.

13.1 Light Unit Visibility for Crossing Users

Light units must be installed as part of a warning system in such a location as to ensure that the crossing user in each land of a road approach, or accessing a road approach,

a) is within the effective distribution range of luminous intensity of a set of light units within the distances specified for the front light units within the SSD; and

b) can see at least one set of front light units clearly.

13.2 Light Unit Visibility for Crossing Users in a Stopped Position

Except when the visibility of units is obstructed by railway equipment, light units must be provided in a warning system in such a location as to ensure that a crossing user in the stopped position at the grade crossing,

a) is within the effective distribution pattern of luminous intensity of a set of back lights (e.g., those lights on the far side of the tracks, for approaching traffic); and

b) so that at least one set of back lights is clearly visible to crossing users in each lane.

13.3 Cantilevered Light Units

13.3.1 Except on a one-way road, or a roadway with a center median, where a second warning signal is installed on the left side of the lane, a cantilevered light unit must be provided in a warning system if:

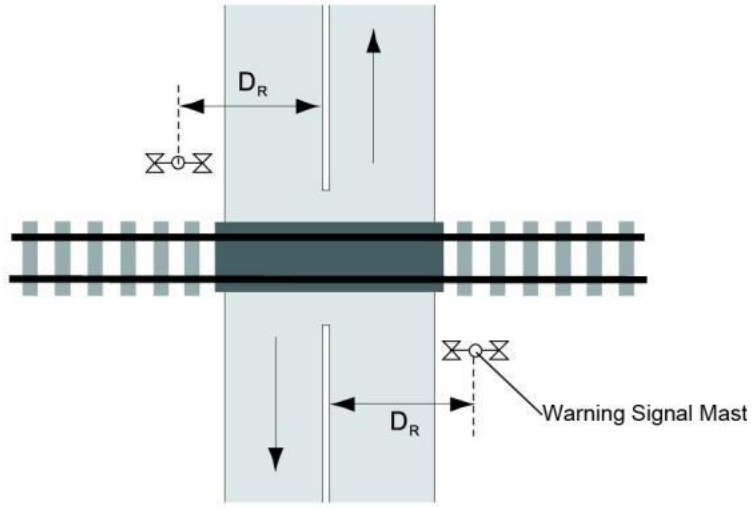
- the distance between the center of a warning signal mast and the edge of the lane of the road that is the farthest from the mast, measured perpendicular to the road, exceeds
  7.7 m for DR, or 8.7 m for DL, as shown in Figure 13-1: or

- the front light units of the warning signal (e.g., those on the same side of the track as approaching traffic) are not clearly visible within the distance for the set of light units as specified in Article 14.4.

13.3.2 Cantilevered light units must be installed for a warning system on a road that meets the specifications for an expressway as specified in Table 10-4.

Note: Cantilevered light units are most appropriate for vehicular traffic; however, there may be a need for them along wide sidewalks, paths, or trails.

a) Two-Way Road



b) One-Way or Divided Road

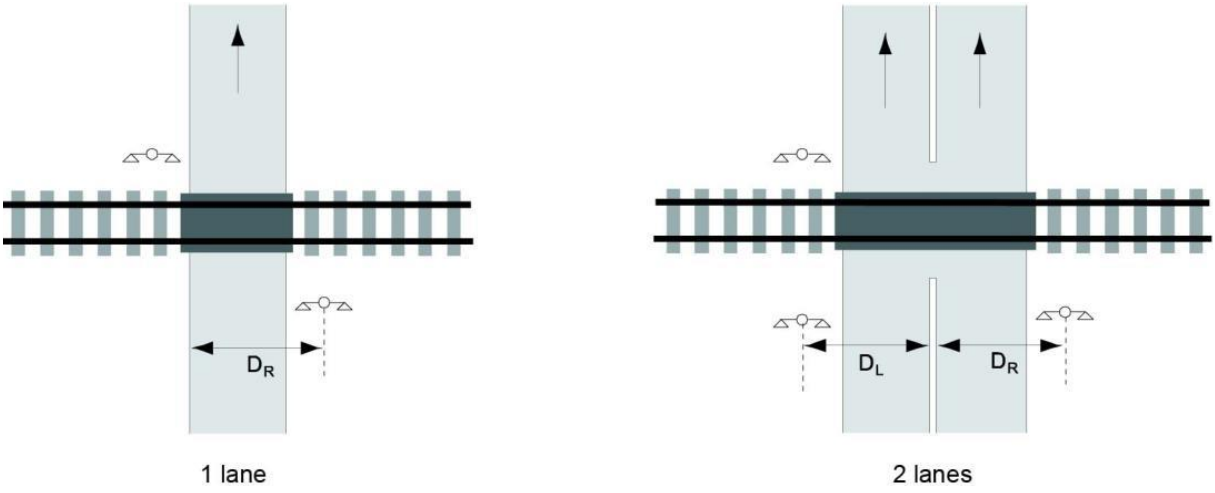


Figure 13-1 Warning Signal Offsets Requiring Cantilevered Light Units

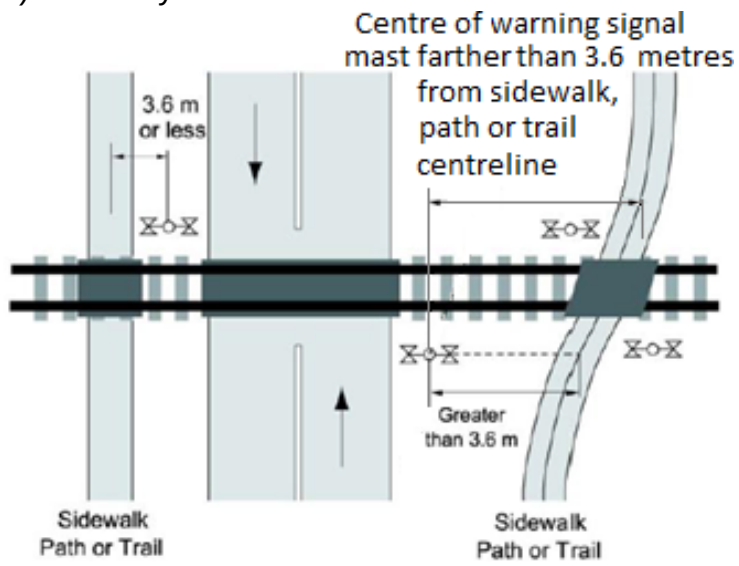
13.4 Light Units for a Sidewalk, Path, or Trail

13.4.1 A sidewalk, path, or trail with a centreline more than 3.6 m (12 ft) from the centre of a warning system signal mast must have separate light units for each direction of travel, as shown in Figure 13-2 a).

Note: This distance is measured from the center of the warning system signal mast located on the same side as the sidewalk path or trail.

13.4.2 Lights must be installed for persons travelling in the direction opposite to vehicle traffic where there is a sidewalk, path or trail along a one-way road as shown in Figure 13-2 b).

a) Two-Way Road



b) One-Way Road

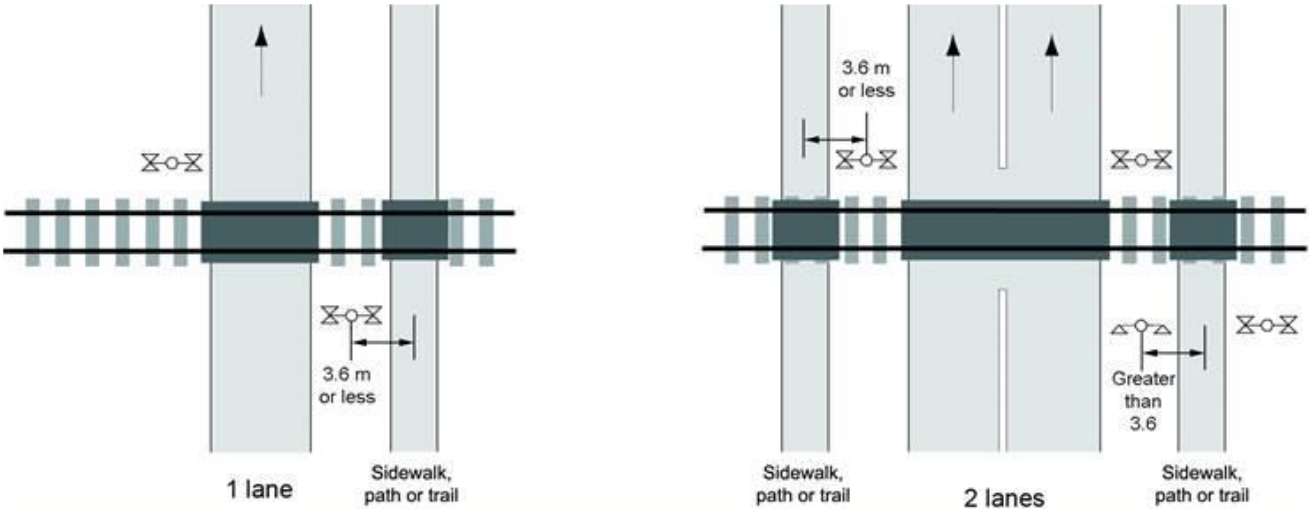


Figure 13-2 Sidewalks, Paths, and Trails

13.5 Vertical and Horizontal Cones of Vision

The effectiveness of a grade crossing warning system depends on the capability of the warning system lights to attract the attention of a driver looking ahead along the road approach.

Cone of vision describes the driver's lateral vision. A driver has excellent lateral vision at up to 5 degrees on each side of the centre line of the eye position (a cone of 10 degrees) and adequate lateral vision at up to 20 degrees on each side. Figure 13-3 illustrates the horizontal cone of vision for drivers approaching and stopped at a grade crossing.

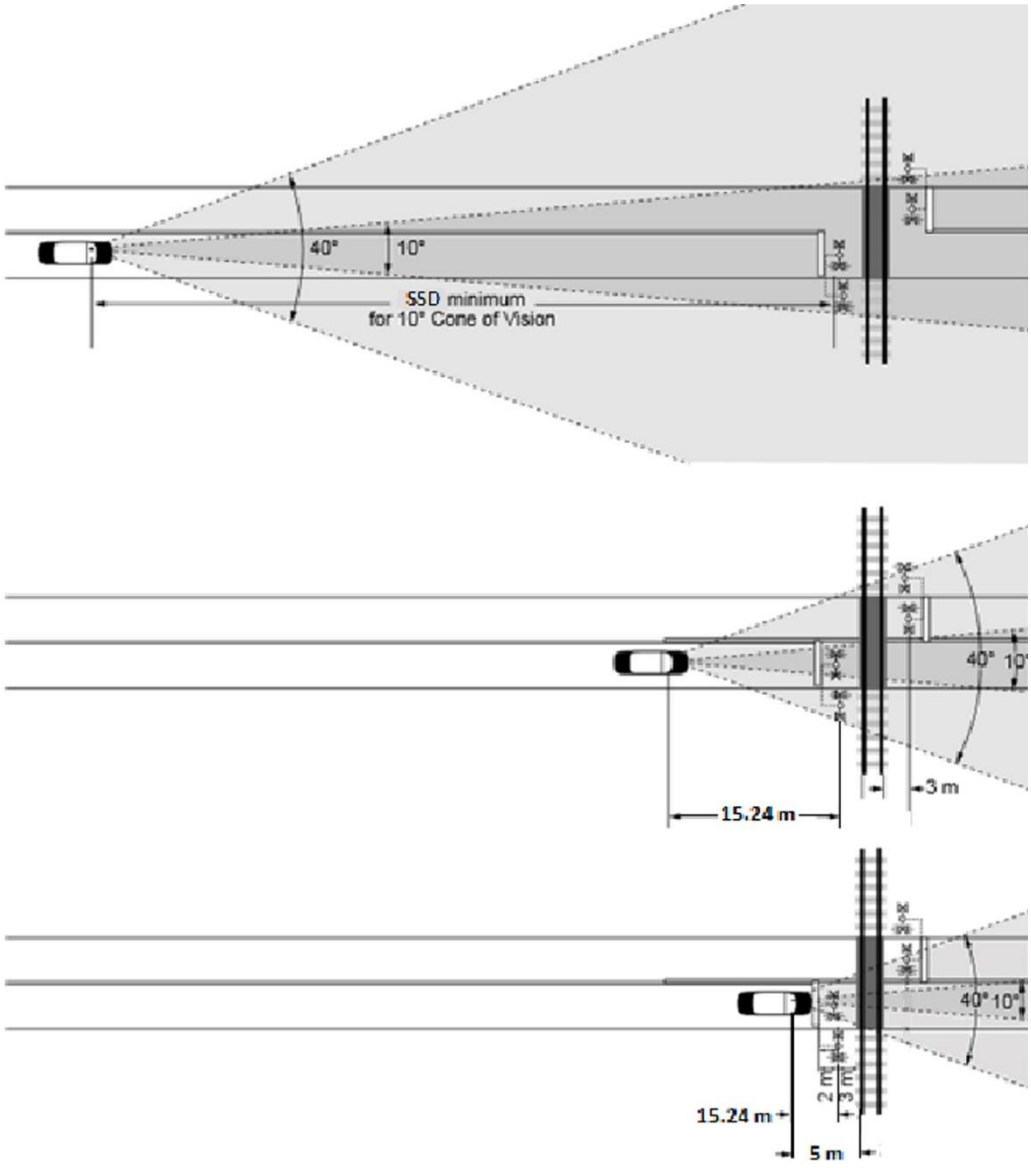


Figure 13-3 Horizontal Cone of Vision

The driver's vertical vision is limited by the top of the windshield, resulting in a need for overhead light units at a minimum height of 5.2 m, placed at least 15 m in advance of the stopped position for vehicles. Figure 13-4 illustrates the vertical limits.

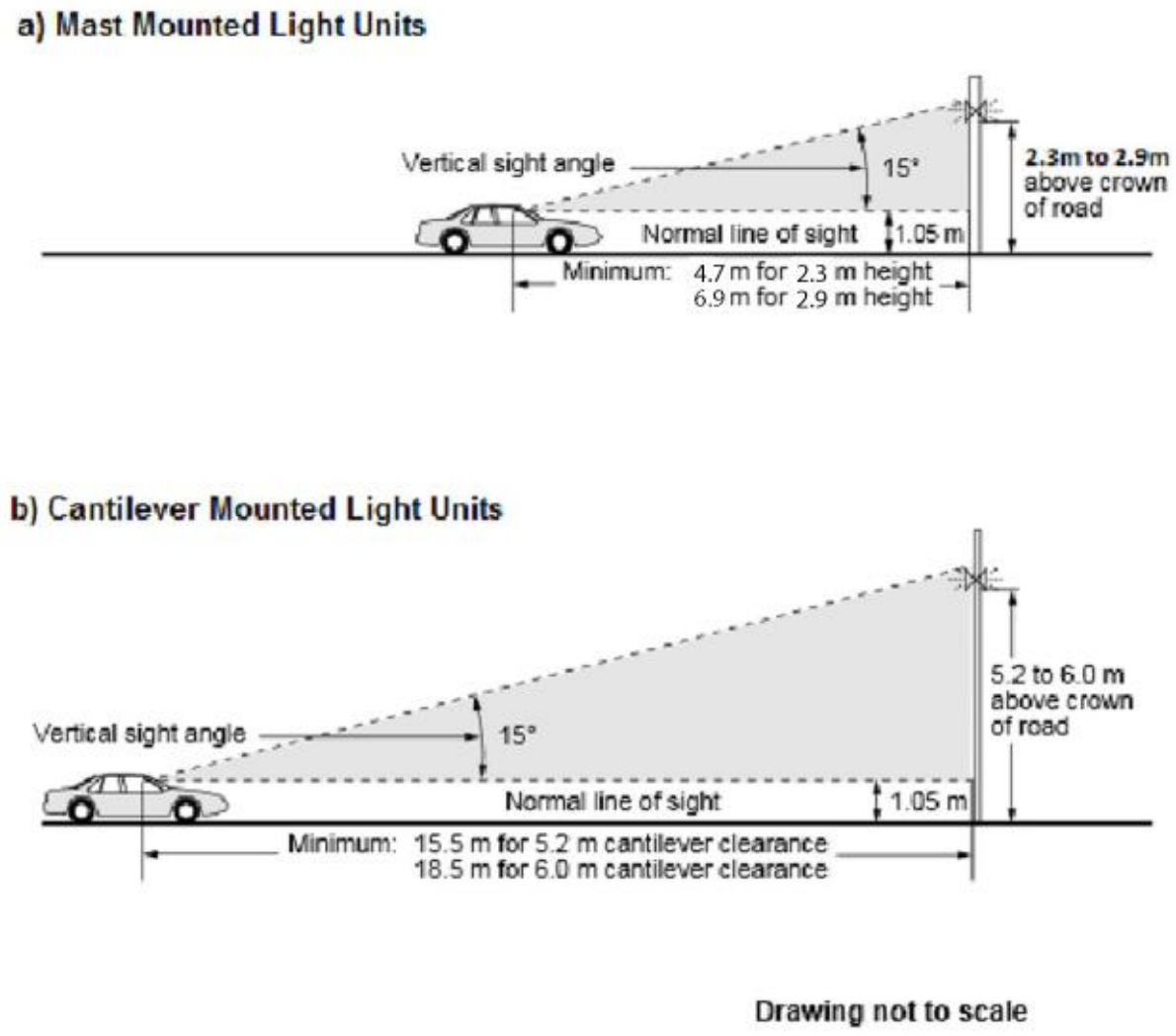


Figure 13-4 Vertical Vison Limits

Note: The vertical cone of vision is limited to 15° by the top of the windshield.

The number and positioning of light units may be affected by the horizontal and vertical curvature of the road approach, the proximity of intersecting roads and entranceways, and the width of the road at the crossing. See Figure 13-5 for a representation of light units positioned for visibility for all approaching vehicles.

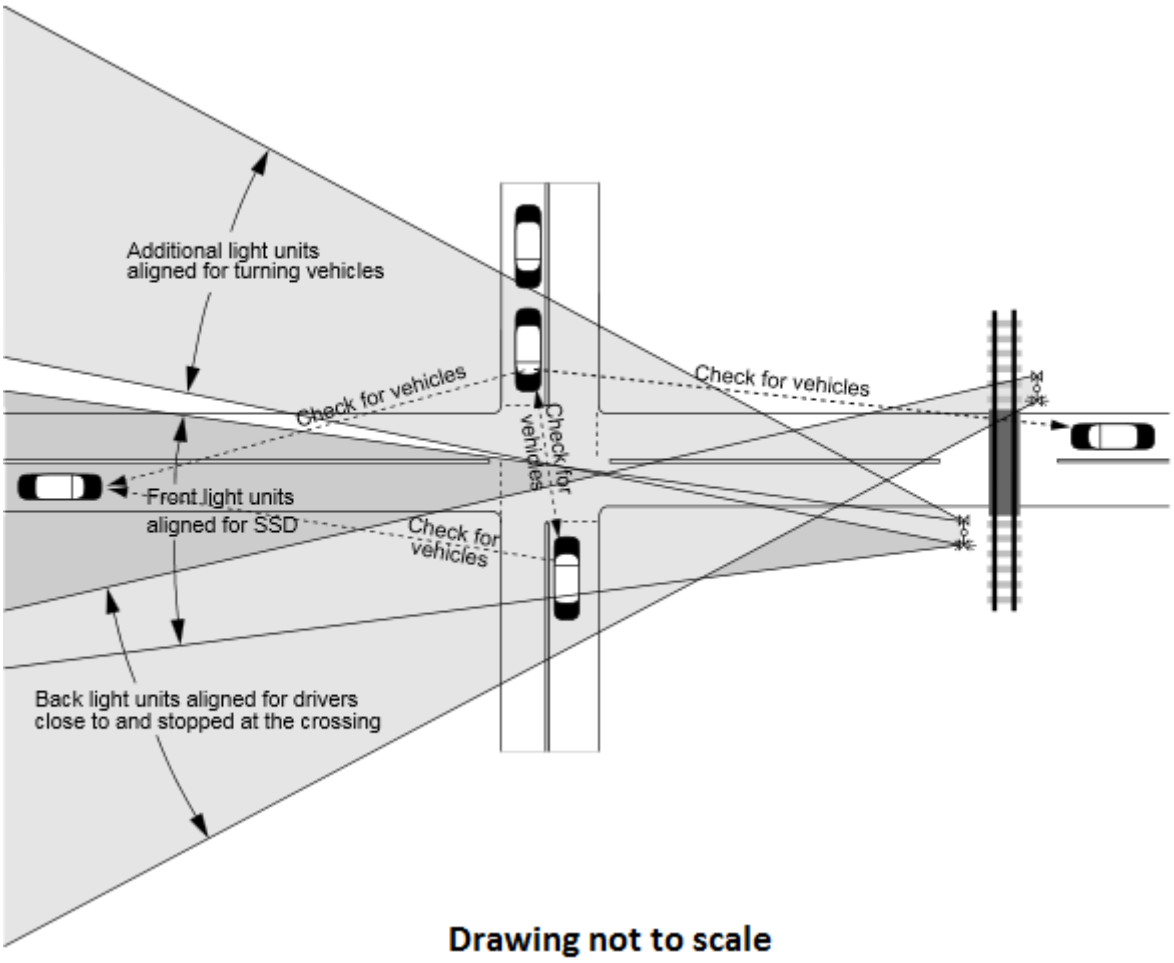


Figure 13-5 Typical Light Unit Arrangement for an Adjacent Intersection

Article 14 Light Units – Alignment

For grade crossing warning systems to be effective, the light units must be visible to road users in a manner that allows them to stop safely before a train arrives. in terms of grade crossings, therefore, visibility is defined as the distance in advance of the stop line or vehicle stop position to a point known as the stopping sight distance (SSD) over which a set of front light units must be continuously visible from and within SSD.

Sets of primary front light units on the warning signal, intermediate lights, and on a cantilever structure, where provided, must be aligned as described below.

14.1 General – Light Units

The following applies to new grade crossings, and to existing crossings to which a change is made to any component (GCR 68(1), 82(1), 87(1) and 87(2)). (See Article 2 for more information on amendments to the GCR timelines)

14.1.1 Light units must be of a 200-mm or 300-mm light emitting diode (LED) signal module type and as specified in Appendix A to this document.

14.1.2 Sets of light units of warning systems must flash alternately and uniformly at a rate of 45 to 65 flashes per minute.

14.2 Alignment Height – Front and Back Lights for Vehicles

Articles 14.2 to 14.6 apply to new grade crossings immediately, and to existing grade crossings by November 28th, 2022, or November 28th, 2024, depending on the specific physical and operational characteristics of the grade crossing, and if a change is made to any component (GCR 68(2), 82(2), 87(1) and 87(2)). (See Article 2 for more information on amendments to the GCR timelines):

14.2.1 Light units must be aligned so that their axis passes through a point 1.6 m above the road surface at the SSD.

> **Note:** If this is not possible, a Prepare to Stop at Railway Crossing sign must be installed. See Article 18 or information (GCR 67 and 81(1)).

14.3 Alignment Distance – Front Light Units for Vehicles

14.3.1 Front light units must be aligned through the center of the approaching traffic lane for which they are intended, as follows:

a) at a minimum, to the stopping sight distance; or

b) to the point at which the light units are first visible, if this point is less than the distance specified in (a).

14.4 Alignment – Intermediate Front Light Units for Vehicles

14.4.1 Additional sets of light units must be aligned to cover any intermediate areas of the road approaches between the coverage provided by the front light units, aligned as required in Article 14.3, and the back light units, aligned as required in Article 14.5.

14.4.2 Additional sets of light units provided for a crossing user must be aligned through the point that is 1.6 m above the surface of the road at the point at which the crossing user enters the road approach.

14.5 Alignment – Back Light Units for Vehicles

14.5.1 Back light units, intended for road users approaching the grade crossing from a lane on the opposite side of the line of railway from the warning signal on which they are installed, must be aligned through the center of that lane, 15 m in advance of the warning signal for that side of the line of railway.

14.6 Alignment – Light Units Installed Exclusively for Sidewalks, Paths, or Trails

14.6.1 Light units installed exclusively for sidewalks, paths or trails must be aligned so as to be visible through a point 1.6 m above the center of the sidewalk, path or trail and 30 m (100 ft) in advance of the nearest rail on both sides of the line of railway or at the point at which the set of lights units first become visible, if less than 30 m (100 ft).

Article 15 Bells and Gates

15.1 Bells

The following applies to new grade crossings, and to existing crossings at which a change is made to any component [GCR 44, 53, 68(1), 82(1), 87(1) and 87(2)].

A crossing warning bell is an audible warning device used to supplement other active devices, such as light units and gates. A bell is an effective means to warn pedestrians, cyclists or person using assistive devices.

When used, the bell is usually mounted on top of one of the signal support masts.

There are several different types of bells installed at Railway Crossings across the country, each with its own requirements regarding decibel levels. For example, an electronic or electromechanical loud-tone bell must not be louder than 105 dB(A) and not quieter than 85 dB(A). However, an electronic or electromechanical soft-tone bell must operate at not more than 85 dB(A) and not less than 75 dB(A). See Articles 3.2.60 and 3.2.61 of the AREMA Communications and Signals Manual for the recommended design criteria for bells.

15.1.1 A bell is required as part of all warning systems except the limited-use warning systems referred to in Appendix B and the limited-use warning systems with walk lights referred to in Appendix C.

15.1.2 Where there is only one sidewalk, path or trail along a road approach, the bell must be located on the signal mast adjacent to the sidewalk, path, or trail.

15.1.3 A bell is required on a signal mast adjacent to a sidewalk, path or trail if separated from any other signal mast with a bell by more than 30 m (100 ft).

15.1.4 All bells must continue to operate for the same duration as the light units.

15.2 Gates

Warning system gates are designed to restrict access to a grade crossing temporarily during the passage of railway equipment or in the event of a failure. They typically consist of a moveable automatic gate arm, a locking assembly and a housing containing the electromechanical components that lower and raise the arm. The arm and locking

assembly are bolted to a concrete or steel foundation, which holds the lowered or raised gate arm in place during normal operation.

15.2.1 The gate arm should be installed perpendicular to the longitudinal axis of the road approach.

15.2.2 The descent of the gate arm must take 10 to 15 seconds and its ascent must take 6 to 12 seconds (AREMA 3.2.15 U 2, 3.2.15 U 1a and 3.3.30 D 5).

15.2.3 The gate arm must begin its descent once the gate arm clearance time has elapsed, calculated in accordance with article 10.4 of the GCS and this document (AREMA 3.3.30 D 3).

15.2.4 For a grade crossing where railway equipment enters the grade crossing at over 25 km/h (15 mph), the gate arm must be in the horizontal position at least 5 seconds before the arrival at the crossing surface of railway equipment (AREMA 3.3.30 D 4).

15.2.4.1 For a grade crossing where the railway equipment enters the grade crossing at a speed of 25 km/h (15 mph) or less, the gate arm must be in the horizontal position when the railway equipment arrives at the crossing surface.

15.2.5 The gate arms must operate uniformly, smoothly, and without rebound, and must be held securely when in the raised position (AREMA 3.2.15 U 5).

15.2.6 If a gate arm strikes or fouls any object during its ascent or descent, it must readily stop and, on removal of the obstruction, assume the position corresponding with the control apparatus (AREMA 3.2.15 U 7).

15.2.7 Where gates are located in the median, additional width may be required to provide minimum clearance for the high-wind gate arm support bracket (AREMA 3.1.35(4)).

15.2.8 Means should be provided to rotate the gate mechanism 90 degrees, or easily disconnect the gate arm from gate arm support, for servicing (AREMA 3.2.15 G 7).

15.2.9 Means should be provided to prevent damage to the mechanism from varying load conditions due to weather when the gate is descending or by the counterbalancing device driving it to the clear position in the event of a broken gate arm (AREMA 3.2.15 U 4).

Article 16 Circuitry

Warning systems' circuitry design must adhere to section 11 of the RSA, which stipulates that all work relating to railway works must be done in accordance with sound

engineering principles and that all related engineering work must be approved by a professional engineer (RSA 11(1) and 11(2)).

16.1 Warning Time

Section 26.2 of the RSA states that "The users of a road shall give way to railway equipment at a road crossing if adequate warning of its approach is given." In cases where sightlines are not provided, and traffic volumes are high, with multiple tracks traversing the location, the greater the need for reliable warning devices. Failure to provide adequate warning of approaching railway equipment can create a hazardous situation in which the risk of a vehicle-train collision increases.

16.1.1 The time during which the warning system must operate before the arrival of railway equipment at the crossing surface must be the greatest of

a) 20 seconds, unless the grade crossing clearance distance (Figure 10-1) is greater than 11 m (35 ft), in which case the duration must be increased by one second for each additional 3 m (10 ft) or fraction thereof (GCS 16.1.1(a); AREMA 3.3.10 B 2(a)).

b) the departure time for the design vehicle (GCS 10.3.2).

c) the departure time for pedestrians, cyclists, and persons using assistive devices (GCS 10.3.3).

d) the gate arm clearance time plus the time to complete the gate arm descent, plus 5 seconds.

e) the minimum warning time required for traffic signal interconnection, as specified in GCS 19.1; or

f) the time for the design vehicle to travel from the stopping sight distance and pass completely through the clearance distance.

16.2 Consistency of Warning Times

16.2.1 Operating control circuits must provide consistent warning times for railway equipment regularly operating over the grade crossing.

Note: This is a requirement for new grade crossings with a warning system and for existing grade crossings when a warranted change is made.

16.2.2 Where the maximum railway operating speed has been reduced, the approach warning times for railway equipment regularly operating over the grade crossing must not be more than 13 seconds longer than the warning time for the railway design speed.

Note: Article 16.2.2 is a requirement for new grade crossings with a warning system and, as of November 28th, 2022, or November 28th, 2024 for existing grade

crossings, where the maximum railway operating speed has been reduced (See Article 2 for more information on amendments to the GCR timelines)

16.2.3 Where a grade crossing has more than one line of railway, consideration should be given to operation of the warning system or traffic control devices when a second train approaches following the passage of the first train.

Considerations may include the use of an "extended hold" to ensure that the crossing gates remain down until the second train has arrived at the crossing surface, active second train event signs can also be installed in addition to the "extended hold", as well as the use of traffic signal controller logic, which can assure that a second track clearance can be provided in the event the gates have been raised prior to the arrival of a second train where interconnected traffic signals are installed.

16.3 Cut-Outs

Note: This is a requirement for new grade crossings with a warning system and grade crossings at which a warranted change is made and, as of November 28th, 2022, or November 28th, 2024 for all grade crossings (See Article 2 for more information on amendments to the GCR timelines)

16.3.1 Where railway equipment regularly stops, or railway equipment is left standing, within the activating limits of a warning system, the warning system must be equipped with a control feature to minimize the operation of the warning system.

16.3.2 A switch, when equipped with a switch circuit controller connected to the point and interconnected with the warning system circuitry, must cut out only when the switch point is within 12.7 mm (half an inch) of the full-reverse position.

16.4 Directional Stick Circuits

Note: This is a requirement for new grade crossings with a warning system and for existing crossings at which a change is made to the directional stick circuitry and, by November 28th, 2022, or November 28th, 2024 for all grade crossings (See Article 2 for more information on amendments to the GCR timelines)

16.4.1 Where a warning system is equipped with directional stick circuits, each circuit

a) must include a stick release timer to activate the warning system after a pre-set interval of time in the event of the failure of an approach circuit; or

b) when centralized traffic control (CTC) or automatic block signals (ABS) are used, should cause a train control signal system to restrict railway equipment speed to 25 km/h (15 mph) or less, and include a stick release timer.

When CTC or ABS are used, the stick release timer should be programed to 75 per cent of the amount of time it takes for railway equipment travelling at maximum railway operating speed to reach the grade crossing from one direction or the other, whichever is the lesser, measured from the closest control location, interlocking, spur or electric switch lock.

16.5 Identification

16.5.1 Each wire in all housings, including switch circuit controllers and terminal or junction boxes, must be identified at each terminal, and the identification must not interfere with moving parts of the warning system. Material used for identification purposes must be made of insulating material. This requirement does not apply to light units or wiring that is an internal part of solid-state equipment. (GCR 16.5.1)

> **Note:** This applies to all grade crossings (new and existing), as it is a maintenance requirement since November 28th, 2014 (GCR 93(2); GCS 16.5 and AREMA 3.3.1 D 2) (See Article 2 for more information on amendments to the GCR timelines).

Article 17 Warning Systems and Traffic Signals Installed at Grade Crossings in lieu of a Warning System – Inspection and Testing

A warning system or traffic control device that is interconnected with a warning system must be maintained, inspected, and tested in accordance with Article 17 of the GCS. Railway companies will also be required to keep records of inspections and testing, as well as a record of warning system malfunctions or failures, for a minimum of two years. (See Article 21 for more details on record-keeping.)

Except as otherwise specified in articles 12 to 16 of the GCS or sections 95 and 96 of the GCR, new and existing warning systems must be inspected and tested in accordance with the requirements and recommended practices of Part 3 of the AREMA Communications and Signals Manual at the frequency specified in tables 17-1, 17-2 and 20-1 of the GCS (GCR 3(2)).

Maintenance, inspection and testing of warning systems must be done in accordance with Articles 3.3.1 and 3.1.15 of the AREMA Communications and Signals Manual.

Inspection and testing of traffic signals installed at a grade crossing in lieu of a warning system must be done in accordance with the road authority's procedures.

Table 17-1 Required Frequencies of Inspections and Tests for Warning Systems and Traffic Signals Installed at a Grade Crossing in Lieu of a Warning System

Designated Frequency	Definition	Maximum interval between each inspection or test
Weekly	Once every week (Sunday to Saturday)	10 clear days
Monthly	Once every calendar month	40 clear days
Quarterly	Once every 3 months (January to March, April to June, July to September, and October to December)	100 clear days
Twice annually	Once every 6 months (January to June and July to December)	200 clear days
Annually	Once every calendar year	13 months
Every 2 years	Once every 2 calendar years	26 months
Every 4 years	Once every 4 calendar years	52 months
Every 10 years	Once every 10 calendar years	130 months

Table 17-2 Required Frequencies of Inspections and Tests for Warning Systems and Traffic Signals installed at a Grade Crossing in Lieu of a Warning System

Item	Elements: Inspection and testing requirements	Frequency for warning systems and traffic signals installed at a grade crossing in lieu of a warning system	Frequency for limited - use warning systems	Frequency for limited - use warning systems with walk light
1	Warning Systems: for operation of lights, bell, gates, and power-off light	Weekly or no more than 7 days before the operation of railway equipment	N/A	N/A
2	Light units: for misalignment, physical damage, and conspicuity	Monthly	Quarterly	Quarterly
3	Standby power: for operating bank voltage	Monthly	Quarterly	Quarterly
4	Light units, and gates: for damage, cleanliness, and visibility	Monthly	Quarterly	N/A
5	Bell: for operation	Monthly	N/A	N/A
6	Gate arm: for operation	Monthly	N/A	N/A
7	Surge protection: for condition	Monthly	Quarterly	Quarterly
8	Circuits: for grounds	Monthly	Quarterly	Quarterly
9	Battery: for isolation faults	Monthly	Quarterly	Quarterly
10	Batteries: for voltage, current, electrolyte level, and plate deterioration where plates are visible	Monthly	Quarterly	Quarterly

Item	Elements: Inspection and testing requirements	Frequency for warning systems and traffic signals installed at a grade crossing in lieu of a warning system	Frequency for limited - use warning systems	Frequency for limited - use warning systems with walk light
11	Interconnection components: for energization of circuits as intended	Monthly	N/A	N/A
12	Switch circuit controller: for adjustment	Quarterly	Quarterly	Quarterly
13	Batteries: for degree of exhaustion, voltage and current	Quarterly	Quarterly	Quarterly
14	Fouling circuits: for continuity	Quarterly	Quarterly	Quarterly
15	Direct current relays: for condition	Semi-annually	Semi-annually	Semi-annually
16	Bond wires, track connections, insulated joints, and other insulated track appliances: for condition	Semi-annually	Semi-annually	Semi-annually
17	Cut-out circuits (any circuit that overrides the operation of a warning system): for operation	Semi-annually	Semi-annually	Semi-annually
18	Gate mechanism and circuit controller: visual inspection of condition	Semi-annually	N/A	N/A
19	Control circuits operation of traffic signals installed at a	Semi-annually	N/A	N/A

Item	Elements: Inspection and testing requirements	Frequency for warning systems and traffic signals installed at a grade crossing in lieu of a warning system	Frequency for limited - use warning systems	Frequency for limited - use warning systems with walk light
	grade crossing in lieu of a warning system			
20	Light units: for proper alignment, focus, and visibility	Annually	Annually	Annually
21	Light Unit: for voltage	Annually	Annually	Annually
22	Track circuits: for proper functioning	Annually	Annually	Annually
23	Flash controller: for flash rate	Annually	Annually	Annually
24	Battery: load test	Annually	Annually	Annually
25	Warning time: for required time	Annually	Annually	Annually
26	Electronic railway equipment detection devices, including processor-based systems: for programming and function ability	Annually	Annually	Annually
27	Timing relays and timing devices: for required time	Annually	Annually	Annually
28	Cable and wire entrances: for condition	Annually	Annually	Annually
29	Switch circuit controller centering device: for condition	Annually	Annually	Annually

Item	Elements: Inspection and testing requirements	Frequency for warning systems and traffic signals installed at a grade crossing in lieu of a warning system	Frequency for limited - use warning systems	Frequency for limited - use warning systems with walk light
30	Interconnection operation between of warning systems and traffic control devices	Annually	N/A	N/A
31	Pole line and attachments: for condition	Every 2 years	Every 2 years	Every 2 years
32	DC polar, AC vane, and mechanical timer relays: for electrical values and operating characteristics	Every 2 years	Every 2 years	Every 2 years
33	Gate mechanism: for electrical values, mechanical clearances, and torque	Every 4 years	Every 4 years	Every 4 years
34	Relays that affect the proper functioning of a warning system (except for DC polar, AC vane and mechanical timer): for electrical values and operation	Every 4 years	Every 4 years	Every 4 years
35	Ground: for resistance value	Every 10 years	Every 10 years	Every 10 years
36	Wire and cable insulation: for resistance	Every 10 years	N/A	N/A

Note: See Appendix J and Appendix L for details pertaining to each test requirement outlined in this table.

Part E – Interconnected Devices

The road authority or authority with jurisdiction (private or public) and the railway company or companies, as applicable, jointly determine the need and select the devices to be interconnected at a given grade crossing. This includes the need for pre-emption, the type of pre-emption, the time interval for any advance pre-emption, the exit gate clearance time, and the exit gate operating mode (AREMA 3.1.15). As a part of any pre-emption needs study, a thorough evaluation of all site-specific parameters, should be conducted, as described in Article 31 of this Handbook. This includes traffic signal operating sequences and timing, the use of pre-signals or queue-cutter signals, railroad warning devices, warning times and the impact of train operations on warning times.

If vehicle queue builds up inside the clear storage area of a highway intersection that is located at or near a grade crossing (with or without active warning devices) and that is not controlled by traffic signals, the road authority or authority with jurisdiction should consider installing a highway traffic signal and/or railroad active warning devices. See the *Manual of Uniform Traffic Control Devices for Canada*, 6th edition (MUTCDC) Part B: Traffic Control Signals, for specific information. Interconnection and pre-emption of the traffic signal controller should be provided if it falls within the requirements of the MUTCDC.

When a traffic control signal or other traffic control device is interconnected to a grade crossing warning system, a label must be installed in the traffic signal controller cabinet and the railway warning system housing informing maintenance personnel of the interconnection. The label must provide contact information for both the public agency responsible for the traffic signals and the railroad maintenance facility.

Article 18 Prepare to Stop at Railway Crossing Sign (MUTCDC WB-6)

18.0 Where and When

A Prepare to Stop at Railway Crossing sign must be installed at new grade crossings with a warning system if:

a) the road approach is an expressway, as defined in table 10-4 of the *Grade Crossing Standards* (GCS) (GCR 43 and 51).

b) at least one set of front light units on the warning system is not clearly visible from the SSD of at least one of the lanes of the road approach; or

c) weather conditions at the grade crossing repeatedly obscure the visibility of the warning system.

Note: Existing grade crossings must meet Articles 18.0 (a) to (c) by November 28th, 2022, or November 28th, 2024. (GCR 67 and 81). (See Article 2 for more information on amendments to the GCR timelines)

The Prepare to Stop at Railway Crossing Sign must meet the standards set out in the following articles.

18.1 General Requirements

The Prepare to Stop at Railway Crossing sign must be as shown in A3.6.6 of the *Manual of Uniform Traffic Control Devices for Canada* and meet the applicable specifications in article A1.6 of that Manual, and must operate:

a) before the warning system light units are activated; and

b) while the warning system light units are in operation.

18.1.1 The Prepare to Stop at Railway Crossing sign (WB-6) should be installed at the point that marks the SSD as determined in Article 7.2 and shown in Figure 18-1 a). Where site-specific conditions warrant, the Prepare to Stop at Railway Crossing may be installed closer than SSD but must maintain visibility from the SSD as shown in Figure 18-1 b).

18.2 Advance Activation of sign

The advance activation time must be the greater of the time it takes a vehicle travelling at the road crossing design speed to pass a deactivated Prepare to Stop at Railway Crossing sign and to:

a) clear the grade crossing before the arrival of railway equipment at the crossing surface, where there is a warning system without gates (TSSD, formula found below); or

b) clear the grade crossing before the gate arms start to descend (TGSSD, formula found below), where there is a warning system with gates.

Formulas:

$$T_{SSD}(\text{seconds}) = \frac{SSD + cd + L}{0.278V}$$

where:

SSD is calculated in accordance with Article 7.2

cd is calculated in accordance with Article 10.2.1

L is the length of the selected design vehicle.

$$T_{G\ SSD}(\text{seconds}) = \frac{cd_{G\ SSD}}{0.27\ x\ V_{road}}$$

where:

TGSSD is calculated in accordance with Article 10.4.1

18.3 Battery Backup

Where a Prepare to Stop at Railway Crossing sign is installed, four hours of continuous battery back-up power must be provided for its operation.

Note: This is a requirement for all Prepare to Stop at Railway Crossing signs installed after November 28th, 2014. This requirement does not apply to Prepare to Stop at Railway Crossings signs installed before November 28th, 2014; however, it is considered an engineering best practice. (See Article 2 for more information on amendments to the GCR timelines)

Plans and Documents

Plans and forms for Prepare to Stop at Railway Crossing signs, traffic signals that are interconnected with grade crossing warning systems and traffic signals installed in lieu of grade crossing warning systems must include, at a minimum:

a) a location plan.

b) a circuit and electrical plan.

c) a description of the design timing sequencing and operational characteristics; and

d) all other information necessary to carry out inspection, testing and maintenance in accordance with the GCS.

Alterations made to system components must be indicated on the plans. Such changes must be dated and initialed by the person making the change. When a change is made, an updated copy of the plans must be placed in the equipment housing as soon as possible (GCR 93(3)).

a)

b)

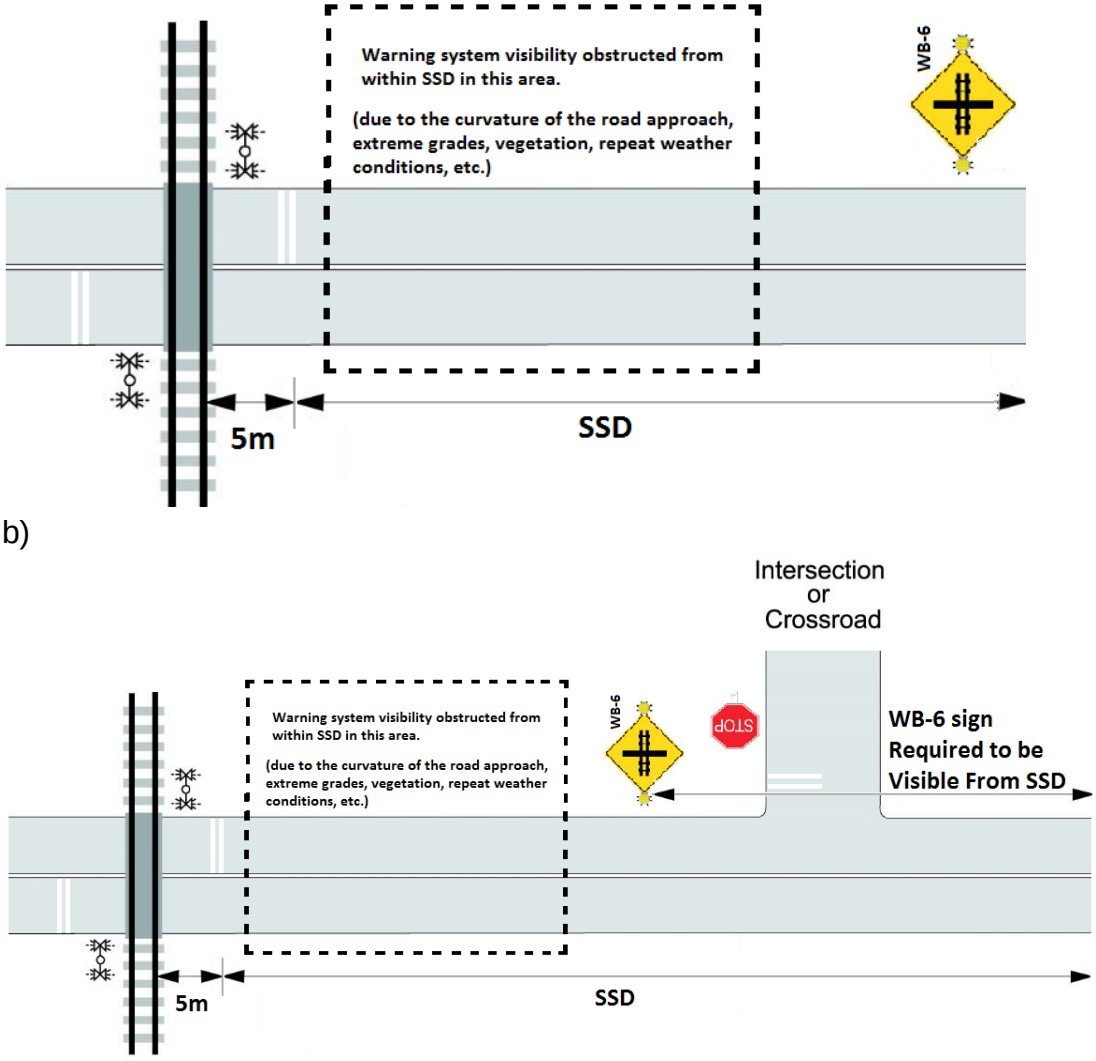


Figure 18-1 Prepare to Stop at Railway Crossing Sign

Article 19 Interconnection of Traffic Signals with Warning Systems

19.1 Where and When

Interconnection is to be provided at grade crossings where the railway design speed is 25 km/h (15 mph) or greater and where there is less than 30 m between the nearest rail of the crossing and the travelled way of an intersection with traffic signals.

Note: If interconnection is provided at a grade crossing even though it is not required under the GCR it should nonetheless meet the requirements for interconnection as per articles 19.2 to 19.4 of the GCS.

Also, if a traffic signal is installed at a grade crossing that meets the specifications set out in Article 19.1 of those Standards, the warning system must be interconnected with the traffic signal, and the interconnection must meet the standards set out below.

19.2 General requirements

Except where otherwise specified in the GCS or the GCR, the interconnection of a warning system with traffic signals at a grade crossing that meets the specifications of 19.1 must be designed and operated in accordance with Part 3.1.10 of the AREMA Communications and Signals Manual.

19.3 Minimum Timing Required

The interconnection of traffic signals with a warning system must

a) provide sufficient time for vehicles to clear the grade crossing before the arrival of railway equipment at the crossing surface; and

b) prevent movement of road traffic from the intersection towards the grade crossing.

19.4 Battery Backup

Where traffic signals are interconnected with a warning system, four (4) hours' worth of continuous battery back-up must be provided for the traffic signals.

Article 20 Interconnected Devices – Inspection and Testing Frequencies

20.0 Testing and maintenance

See Article 2 for more information on amendments to the GCR timelines.

Except where otherwise specified in this Part, inspection, testing, and maintenance of the pre-emption of traffic signals by a grade crossing warning system must be in accordance with ITE Pre-emption Practices and the AREMA Communications and Signals Manual.

The Prepare to Stop at Railway Crossing sign and traffic signal pre-emption must be maintained, inspected, and tested in accordance with design plans and forms to ensure that they operate as intended (GCR 93(2), 95 and 96).

> **Note:** All tests and maintenance conducted on the following devices should be conducted jointly by the railway and the responsible road authority. For more information, see Appendix L Guideline for Inspecting and Testing Pre-emption of Interconnected Traffic Control Signals and Grade Crossing Warning Systems.

20.0.1 The frequency requirements for inspections and tests for a Prepare to Stop at Railway Crossing sign, traffic signal pre-emption and traffic signals installed at a grade crossing in lieu of a warning system are specified in Table 17-2 for railways and Table 20-1 for road authorities. Local circumstances may require inspection and testing more frequently than the maximum intervals specified herein.

20.0.2 The inspection and testing of the elements set out in column 2 of table 20-1 the GCS must be conducted at the frequency—as defined in table 17-1 of those Standards—set out in column 3 of Table 20-1[GCR 96(2)].

20.0.3 Information regarding the operating parameters of a traffic control device must be available on site for the road authority who inspects it [GCR 96(3)].

Table 20-1 Required Frequencies of Inspections and Tests for Prepare to Stop at Railway Crossing Signs or an Interconnected Traffic Signal

Item	Elements and inspection and testing requirements	Frequency
1	Prepare to Stop at Railway Crossing signs and traffic signal pre-emption	Immediately following installation, repair, adjustment, or maintenance
2	Prepare to Stop at Railway Crossing sign: for visibility of light units	Annually
3	Traffic signals installed at a grade crossing in lieu of a warning system: for cleanliness, visibility of signal heads and physical damage	Annually
4	Traffic signal interconnection: for activation and operation with warning systems	Annually
5	Prepare to Stop at Railway Crossing sign: for activation and operation	Annually

Note: The road authority is responsible for the integrity of the cable between the warning system and the interconnected devices. Cable insulation resistance maintenance, inspection and testing should be completed at a frequency of no less than every 10 years as defined in Table 17-1of the GCS or this document.

See Appendix K and Appendix L for details pertaining to each test requirement set out in Table 20-1.

Part F – General

Article 21 General Requirements

The *Grade Crossings Regulations* (GCR) apply to all public and private grade crossings, except for private grade crossings at which the road is opened or maintained by a railway company that is the sole private authority at the crossing. However, it is considered an engineering best practice to apply the GCR at all grade crossings, not only at those legally governed by those Regulations.

Equipment housings

Signal enclosures should be kept clean and should not be used for storing material, tools, or supplies, unless special provisions are made. They should not be opened in severe or stormy weather unless necessary (e.g., an emergency maintenance call) or means are provided to protect their contents.

Any modification, alteration or addition of a warning system component must be indicated on the design plans. Such changes must be dated and initialed by the person making the change. When a change is made, a revised design plan reflecting the modification or installation must be prepared to replace the former, annotated plan at the site (GCR 93(3)).

Doors covers and fastenings should be kept in good condition with suitable gaskets in place.

All instrument housings of a warning system must be kept locked with an approved device when unattended (GCR 92).

Signal Equipment Service Bulletin

Railway equipment service bulletins, traffic signal/interconnected components with a warning system bulletins and all software revisions should be reported to Transport Canada so that any equipment and/or software issues can be reported nationally.

Average Annual Daily Railway Movements

Average annual daily railway movements must be provided to the road authority, if that value is three (3) or greater, and it increases by 50% or more relative to the previous value provided to the road authority. (GCR 8)

Average Annual Daily Traffic

When a road authority has recalculated the Average Annual Daily Traffic (AADT) of a grade crossing, the updated value should be communicated to the railway company if that value has increased by 20% or more relative to the previous value provided to the railway.

Various tools exist to help in calculating the AADT. For locations that are expected to see seasonal variations in the road traffic, the AADT should take these variations into account. Also, the AADT should be re-calculated every five years, or whenever significant project development is planned or carried out in the area.

21.1 Railway Records

Warning system records of inspection, testing, maintenance, malfunctions, and failures, including such that have not been confirmed, must by law be retained for a minimum of two years. The information to be included in these records is detailed below [GCR 109(3) and 110(2)].

> **Note:** The GCR requires that a design plan of the warning system's configuration be kept at the grade crossing at all times. (GCR 93).

21.1.1 Inspection, Testing and Maintenance Records

To be considered complete, inspection, testing and maintenance records must contain the following information:

a) The identity of the person who conducts the inspection testing or maintenance.

b) The date on which the inspection, testing or maintenance was conducted.

c) The precise location of the warning system that was inspected, tested, or maintained.

d) The reason for the inspection, testing or maintenance.

e) A description of the inspection, testing or maintenance that was conducted.

f) An indication of any malfunction of failure of components of the warnings system; and

g) An indication of any deviation from the GCS and action taken to remedy it.

The record must be completed on the day on which the railway company inspects, tests, or maintains the warning system and must not be changed once it has been created (GCR 109(1) and 109(2)).

The record must be kept for a minimum of two years after the day on which it is created.

Note: If the GCS specify an interval of two or more years between each inspection, test or maintenance activity, a record of the two most recent inspections, tests or maintenance activities must be kept (GCR 109 (3)).

21.1.2 Records of Malfunction, Failure, or Suspected Malfunction or Failure

To be considered complete, records of malfunction, failure, or suspected malfunction or failure must contain the following information:

a) The nature of the malfunction, failure, or condition.

b) The precise location(s) of the grade crossing(s) in question.

c) The date and time at which the railway company was advised or became aware of the malfunction, failure, or condition.

d) All measures taken by the railway company to address any threat to the safety of railway operations.

e) The date and time at which a representative of the railway company arrived at the grade crossing to

   i) take the measures referred to at (d), above, and
   ii) remedy the malfunction, failure, or condition.

f) All measures taken by the railway company to restore the grade crossing to use or to remedy the malfunction or failure or condition or, if no measures are taken, the reason for this decision; and

g) The date and time at which the grade crossing was restored to use, or the malfunction, failure or condition was remedied.

21.1.3 Electronic Record Storage Requirements

For the purposes of compliance with this article, records may be kept in an electronic system, provided that:

a) the system is designed so that the integrity of each electronic record is maintained through the application of security measures, including means to uniquely identify the person who authored that record. No two persons must have the same electronic identity.

b) the electronic storage of each record is initiated by the person who performed the maintenance, testing or inspection by the end of the day following the day on which the maintenance, testing or inspection was performed.

c) the system ensures that no electronic record can be modified in any way or replaced after the record has been transmitted and stored in the system.

d) any correction or amendment to an electronic record is electronically stored and retained separately from the electronic record it corrects or amends. Such correction must be used only to correct a data entry error in the original electronic record. The electronic system must uniquely identify the person who made the correction.

e) the system provides for records maintenance without corruption or loss of data.

f) all electronic records are kept for two years after the day on which they are created. However, if the GCS specify an interval of two or more years between each inspection, test or maintenance activity, the records of the two most recent inspections, tests or maintenance activities must be kept available to the persons who performed the maintenance, tests, or inspections and to those performing the subsequent maintenance, tests, or inspections.

Article 22 Temporary Protection Measures

The GCR requires that temporary protection measure be put in place during planned activities at a grade crossing, as well as when a grade crossing warning system is reported as malfunctioning. The specific provisions of those Regulations are provided below.

> **Note:** putting temporary protection measures in place does not eliminate the requirement to ensure compliance to the *Grade Crossings Regulations* and by reference the Grade *Crossings Standards*.

Planned Activities

GCR 102(1) When a railway company or a road authority undertakes, at a public grade crossing, an activity that could constitute a threat to, or that interferes with, the safety of railway operations, the railway company and the road authority must put in place the necessary protection measures to address the threat or the interference.

GCR 102(2) Within a reasonable period of time before the activity begins, whichever of the two—the railway company or the road authority—undertakes the activity must provide the other with sufficient details about the activity to determine the necessary protection measures to be put in place.

Malfunction, failure, or condition

GCR 103 When a railway company or a road authority is advised or becomes aware that a warning system, or a traffic control device that is interconnected with a warning system, has malfunctioned, or failed, or that a condition exists that may cause a malfunction or failure, the railway company or the road authority has a duty to report.

a) notify the other of the malfunction, failure, or condition, even if the existence of the malfunction, failure or condition is not confirmed.

b) immediately put in place the necessary protection measures to address any threat to, or interference with, the safety of railway operations.

c) immediately after putting in place the protection measures, notify the other of those measures; and

d) within a reasonable period, take the necessary measures to restore the use of the grade crossing or remedy the malfunction, failure, or condition.

GCR 102 is designed to provide protection during planned activities at public grade crossings, and it applies to both the railway and the road authority.

GCR 103 is designed to provide protection in the event of malfunctions or failures even if they are not confirmed, and it likewise applies to both stakeholders.

22.1 Application of GCR 102 and 103

Below are three examples of the application of GCR 102.

Example 1

Railway XYZ is scheduling to complete a crossing rehabilitation project the mile 123 Ottawa Sub Main St. crossing. The project is scheduled to start on July 4, 2015 at 09:00.

This project could interfere with, and has the potential to become a threat to, the safety of railway operations.

Temporary protection measures must be established and put in place for compliance with GCR 102(1).

Before XYZ Rail begins the project (or within a reasonable period, as stated in GCR 102(2)), it must communicate the project activities to the applicable road authority to give the latter the opportunity to determine the protection measures needed for both parties to protect safety while the project is carried out.

Once the necessary protection measures have been established by both stakeholders, they are put in place and the project begins with both parties in compliance with GCR 102.

Example 2

Railway XYZ plans to replace all incandescent light units with new LED lights at the mile 123 Ottawa Sub Main St. crossing.

The work will leave the warning system without visible light units to warn the public of approaching trains while the changes are being made. This could constitute a threat to, or interfere with, the safety of railway operations.

Temporary protection measures must be established and put in place for compliance with GCR 102 (1).

Before XYZ Rail begins the project (or within a reasonable period, as stated in GCR 102(2)), it must communicate the project activities to the applicable road authority to give the latter the opportunity to determine the protection measures needed for both parties to protect safety while the project is carried out.

Once the necessary protection measures have been established by both stakeholders, they are put in place and the project begins, with both parties in compliance with GCR 102.

Example 3

The road authority is planning to carry out brushing and ditching along the road approaches at mile 123 Ottawa Sub of XYZ Rail.

The machinery that will be used to perform the work will obstruct the visibility of the light units from the road approaches, which may prevent crossing users from seeing approaching trains. This could constitute a threat to, or interfere with, the safety of railway operations.

Temporary protection measures must be established and put in place for compliance with GCR 102 (1).

Before the road authority begins the project (or within a reasonable period, as stated in GCR 102(2)), it must communicate the project activities to XYZ Rail to give the latter the opportunity to determine the protection measures needed for both parties to protect safety while the work is carried out.

Once the necessary protection measures have been established by both stakeholders, they are put in place and the project begins, with both parties in compliance with GCR 102.

Scheduled railway testing and the application of GCR 102

When testing routinely interferes with and has the potential to become a threat to the safety of railway operations and is conducted according to the same process/procedure

every time, temporary protection measures must be established and put in place for compliance with GCR 102(1).

In this case, the necessary temporary protection measures required by each party while the activity takes place can be determined one time only, well in advance of the first scheduled test. (In most cases, these measures will be put in place by the railway, since it is responsible for the testing; but in some cases, the road authority may require additional measures to be applied, such as when device interconnection is tested, or when a warning system being tested is interrupting the normal flow of traffic or the normal operation of adjacent warning systems.) Once the necessary protection measures have been agreed upon by both parties (and the testing process/procedure has been provided, ideally in writing, to the other party), there is no need to contact the other party again, unless a change is made to the testing procedure, or the road authority has requested to be contacted each time the activity takes place.

22.2 Application of GCR 103

Example 1

The local road authority receives a call from a citizen claiming that XYZ Rail's warning system at mile 123 Ottawa Sub is not working correctly.

To follow GCR 103, the road authority contacts XYZ Rail to notify it of the reported malfunction, even though that malfunction has not yet been confirmed.

The road authority also decides that the police should be dispatched to the location immediately, and an alternative route created. These temporary protection measures are immediately communicated to XYZ Rail. XYZ Rail in turn informs the road authority of the measures it has put in place (General Bulletin Order[7] issued, railway police dispatched, repair/inspection crew dispatched, etc.) and verifies that the threat or interference to the safety of railway operations is properly addressed.

XYZ Rail personnel verifies that the warning system is operating properly or makes any necessary repairs. Once proper operation is confirmed, XYZ Rail contacts the road authority, at which point both parties begin the process of having the temporary protection measures removed and returning to normal operations.

Article 23 Exemptions / Notice of Railway Works

Exemption provisions exist under the *Railway Safety Act* (RSA). For information on exemption authorities under the RSA, please visit Transport Canada's website to read the Guideline on Applying for Exemption or Filing of a Notice of Exemption.

[7] Canadian Rail Operating Rules pertaining to a General Bulletin Order

23.1 Notice of Railway Works

The *Notice of Railway Works Regulations* provide requirements on what types of railway works that would require a Notice to be given and to whom. This serves to ensure that all persons, which might be directly affected, are given the opportunity to object to the proposed works, if the person considers that the proposed railway work would prejudice their safety or the safety of their property.

More information pertaining to the *Notice of Railway Works Regulations* can be found at the following website.

In addition to providing a Notice to affected parties, a copy of a Notice must also be sent to the Director of the regional Transport Canada Railway Safety Directorate office having jurisdiction over the railway line at the location of the proposed railway works. For regional contact information please refer to Appendix F.

23.2 Undertaking of Proposed Railway Works

A proposed railway work is one in respect of which a Notice has been given under RSA 8(1) and, includes a period specified in that Notice for the filing of any safety-related objections.

More information can be found in Transport Canada's Guideline *on Requesting Approval to Undertake Certain Railway Works* at the following website.

23.3 Departure from any Engineering Standard

Section 10 of the RSA provides a means for stakeholders to present a request to the Minister, when a project departs from Transport Canada Engineering Standards. For a list of TC Engineering Standards, please consult Transport Canada's website.

Under subsection 10(1) of the RSA, where a proponent wishes to propose a railway work that departs from an Engineering Standard in effect under section 7 of the RSA, the proponent must first request the approval of the Minister and, if approval is obtained, must undertake the work in accordance with the terms and conditions of that approval.

For more information pertaining to *Submitting Proposed Engineering Standards or Revisions to Engineering Standards* can be found on Transport Canada's website.

23.4 Engineering Works

Section 11 of the RSA requires that all work relating to railway works— including, but not limited to, design, construction, evaluation, maintenance, and alteration—must be done in accordance with sound engineering principles, and that all engineering work relating to the railway works must be approved by a professional engineer.

More information on the application of section 11 can be found in the *Guideline - Engineering Work Relating to Railway Works* on Transport Canada's website.

Article 24 Sharing of Information

For existing public grade crossings, railway companies and road authorities are required to share prescribed information with each other within two years of the coming into force of the GCR (by November 28th, 2016). This is to give each party time to assess the safety of its infrastructure and plan accordingly. The GCR set out the specific information that must be shared between both authorities to ensure the highest level of safety at their grade crossing. In addition, railway companies and road authorities are required to share information when a new grade crossing is constructed and when a grade crossing undergoes an alteration or operational change. Railway companies will also be required to keep records of the most recent information shared between parties.

Information sharing is intended to foster a collaborative environment between railway companies and road authorities, which are jointly responsible for the overall safety at grade crossings.

> **Note:** It is important that the road authority and the railway collaborate when sharing the information mentioned in sections 4 to 18 of the GCR, to ensure that none of the crossing's characteristics creates a potential risk to safe railway operations.

Example 1

The railway has provided all the information required under sections 4 to 11 of the GCR to the relevant road authority, and the road authority has in turn provided all the information required under sections 12 to 18 to the railway. However, the commitment to safety does not end there. This information must be reviewed to verify that the warning systems in place are adequate for the users of the grade crossing. A review of the information provided by the road authority and railway should be conducted to determine whether the grade crossing in question needs safety improvements. Article 9 of the GCS should be reviewed to verify that the minimum safety standards are in place at the crossing.

> **Note:** See Article 31 of this Handbook for information on grade crossing safety assessments.
>
> Sections 4 to 18 of the GCR set out in detail what information must be shared, and when. The following articles are adapted from those sections of the GCR and provide further explanation.

24.1 Railway requirements

In the case of a change referred to in subsection 28(a) or 28(b) or section 87 of the GCR a railway company must provide a road authority, in writing, no later than 60 days before the day on which the change comes into effect, with the details of the change and the information referred to in subsection 4(1) of the GCR relating to the change (GCR 5).

Example 1

The railway has decided to change the warning system light units from incandescent to LED. The railway is required to share the details of the change with the road authority. However, it need not provide all the information specified in subsection 4(1) only that specified in paragraph 4(1)(e) relating to the change.

Example 2

XYZ rail wants to increase its design speed to allow it to operate on a higher class of track. Sixty days before the change is to take effect, the railway must notify the relevant road authority of the proposed change. This gives the road authority sufficient time to assess the potential impact of the change on road users and put in place, as needed, any measures necessary to mitigate the risk associated with the change. (A change in railway design speed could impact the interconnection times required at a grade crossing; it is important that the road authority be made aware of this.)

a) A railway company must notify a road authority in writing of an increase in the railway design speed at a public grade crossing, not later than 60 days before the day on which the increase takes effect and must specify in the notice the precise location of the grade crossing and the new railway design speed (GCR 6).

b) Despite sections 5 and 6 of the GCR, a railway company may make a change referred to in those sections, at any time, if the road authority has advised it that the requirements of the GCR with which the road authority must comply, with respect to the railway company's changes, are met (GCR 7).

c) A railway company must provide a road authority with the average annual daily railway movements when that value is three or more, and the value increases by 50% or more relative to the previous value provided to the road authority (GCR 8).

d) If a railway company stops requiring the use of a whistle at a grade crossing, it must notify the road authority of that change in writing no later than 30 days after the day on which the change is made (GCR 9).

e) If a line of railway at a public grade crossing is transferred from one railway company to another, the railway company to which the line of railway is

transferred must, within seven days after the day on which the transfer takes effect, provide the road authority with the name, address, telephone number and email address of a contact person (GCR 10).

Note: See Appendix H for a sample sharing of information form designed as a job aid to assist railway companies with the information sharing process.

24.2 Road Authority requirements

In the case of a change referred to in GCR subsection 28(c) or 28(d), or any of the sections from 88 to 91, inclusive, a road authority must provide a railway company, in writing, no later than 60 days before the day, on which the change comes into effect, with the details of the change and the information referred to in subsection 12(1) of the GCR relating to that change (GCR 13).

Example 1

The road crossing design speed increases, resulting in a road classification change or a change in the design vehicle for the crossing.

a) A road authority must notify the railway company in writing of an increase in the road crossing design speed at a public grade crossing not later than 60 days before the day on which the increase takes effect and must include in the notice the information referred to in paragraphs 12(1)(a), (d), (h) and (i) of the GCR (GCR 14).

b) A road authority must provide the railway company with the information referred to in paragraphs 12(1)(a), (l) and (m) of the GCR not later than 60 days before the day on which an interconnected traffic signal referred to in Article 19 of the GCS, or a Prepare to Stop at Railway Crossing sign, is installed or is changed (GCR 15).

c) If a road, at a public grade crossing, is transferred from one road authority to another, the road authority to which the road is transferred must, within seven days after the day on which the transfer takes effect, provide the railway company with the name, address, telephone number and email address of a contact person (GCR 17).

d) The information referred to in sections 4 to 6, 8, 9 and 12 to 15 of the GCR must include the date on which it is sent, the name and address of the railway company / road authority, and the name, telephone number and email address of the person who provides the information (GCR 11 and 18).

Note: See Appendix G for a sample sharing of information form designed as a job aid to assist road authorities with the information sharing process.

Article 25 Out of Service Railway Lines and Warning Systems

a) On lines where railway operations have ceased temporarily, the line or portion of it, can be considered out-of-service or not-active. If a railway company places a line, or part of a line, out-of-service, it may nonetheless still be required to continue inspecting and testing grade crossing warning systems on the out-of-service portion of that line. Unless the line has been discontinued through the CTA discontinuance process, the line is considered active for the purpose of the RSA, and Transport Canada will continue to monitor its compliance with the rules and regulations pursuant to the RSA. (See Article 2 for more information on amendments to the GCR timelines.)

b) To minimize road user confusion, grade crossing light units or railway signs (i.e., Railway Crossing sign) should be bagged/covered, and gates, where used, should be held in the vertical position.

c) A sign indicating that railway lines and warning systems are out-of-service should be put in place to notify road users that the track has been placed out-of-service and that trains are no longer expected over this grade crossing. The sign should include an emergency contact number, the precise location of the grade crossing affected, and the railway company name.

d) The railway company should inform the affected municipalities and road authorities, in advance of the line is placed out-of-service.

Before an out-of-service railway line can be returned to service, the following conditions must be met:

a) Before the railway company operates equipment on any portion of an out-of-service railway line, full inspections must be performed of all grade crossing warning systems and all tests required under sections 93(2), 95 and 96 of the GCR and as per tables 17-1, 17-2, and 20-1 of the GCS must be completed before the company begins operation over the grade crossings on that portion of line. Once tests are completed, and company has confirmed the grade crossings are compliant to the GCR, any covered signs or light units can be uncovered, within seven days prior to resumption of operation.

   Note: Any component, relay, or other electromagnetic device that fails to meet the requirements of the GCR must be removed from service and must not be restored to service until its operating characteristics are within its operating limits. Repaired or replaced components must be inspected in accordance with GCR 94(2).

b) The railway company must issue a bulletin with the following instructions:[8]

"Due to the possibility of rusty rail conditions, railway equipment must approach all public/private crossings that are equipped with automatic warning devices within the portion of track that is out-of-service, in a "Prepare to stop" manner, and must not obstruct the crossing surface until the warning system without gates are seen to be operating for at least 20 seconds or until a crew member has provided manual protection of the grade crossing or until the gates (when provided) of a warning system have been in the horizontal position for at least 5 seconds."

c) The railway company must modify the rail traffic control system on the affected subdivisions to prevent issuance of a clearance until the rail traffic controller has received notice from engineering services that the line has been inspected and is safe for the operation of railway equipment. This involves testing all of crossing signals on the section of line for which a clearance is to be issued. On other than main tracks, an operating bulletin must be issued to prevent operation until notice has been received from engineering services that the line has been inspected and is safe for the operation of railway equipment. The railway must provide assurance that these provisions will prevent railway equipment movement on the line before signal testing has been performed.

d) Upon the return to service of the of the formerly out-of-service railway line, the railway company resumes all maintenance, inspections and tests specified in Tables 17-1, 17-2 and 20-1 of the GCS and sections 93(2), 95 and 96 of the GCR.

e) The railway informs affected municipalities and road authorities in advance of any reinstatement of maintenance, inspections, or testing.

Article 26 Maze Barriers and Guide Fencing

Maze barriers and guide fencing are designed to channel pedestrian movements to a designated crossing area and limit the number of potential pedestrian-rail conflict points. Fences are used to create a "maze" that slows pedestrians as they approach the crossing.

Proper channelization ensures that pedestrians will use a crossing as intended. Channelization treatments should be installed in such a way that pedestrians (or cyclists) are not able to easily circumvent them.

[8] *Canadian Rail Operating Rules:* Rule 103: Public Crossings at Grade

Figure 26-1 shows an example of pedestrian barriers installed in a maze, or zigzag, style pattern on sidewalks. The configuration of the paths forces pedestrians to slow down and face the direction of approaching railway equipment along the railway right-of-way. Maze barriers and guide fencing should be used only at pedestrian crossings, sidewalk paths or trails with adequate sight distance.

GCR 106(3) If a warning system without a gate is indicated as being required in Table D-1 of the *Grade Crossings Standards*, guide fencing must be installed to deter persons from crossing the line of railway other than at the grade crossing.

GCR 106(4) If a warning system is not indicated as being required in column 5 of Table D-1 of the *Grade Crossings Standards*, guide fencing must be installed, as well as a barrier that is intended to slow a person's approach to the grade crossing and to encourage a person to look both ways before crossing the grade crossing.

Guard rails, when required or requested by the road authority, should be installed by the road authority per the latter's specifications (AREMA 3.1.35(6)).

Guard rail, bollards, fences, and other obstructions must not interfere with a warning system's operation and maintenance area or obstruct sightlines or the visibility of light units (AREMA 3.1.35(7)).

The presence of vulnerable road users (VRU) at grade crossings in particular persons using assistive devices is a significant factor for assessing risk at a grade crossing. Special consideration should be given to accessibility needs for persons with mobility impairments.

Reference Appendix M of this Handbook to find further guidance on VRU treatments.

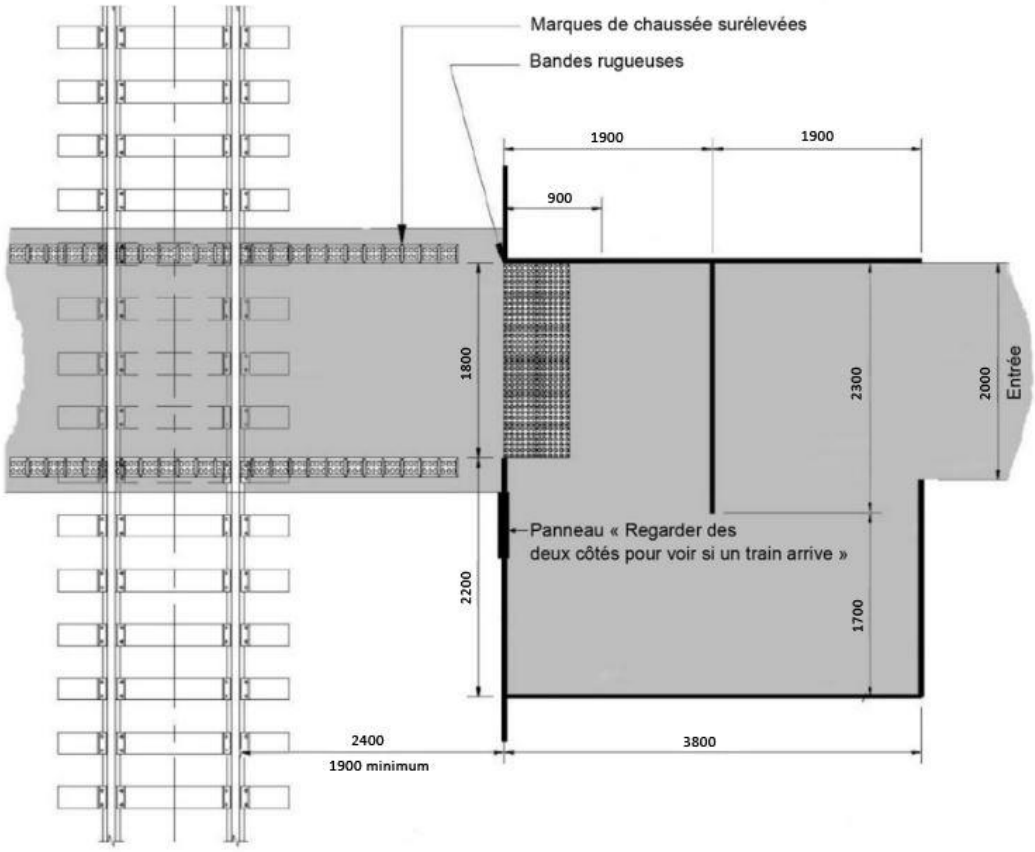


Figure 26-1 Typical Pedestrian Maze Barrier for Public Grade Crossing

Figure 26-2 Example image of Pedestrian Maze Barrier for Public Grade Crossing

Source: U.S. Department of Transportation, Federal Railroad Administration

Article 27 Blocked Crossings

27.1 Public Crossings

A public grade crossing is said to be blocked when railway equipment, either by standing on the crossing surface or by activating a warning system with gates while switching, prevents road users from using the crossing. If there are no road users waiting to cross, the crossing is not considered blocked.

Blocking a public grade crossing should be always avoided. Not only is a blocked crossing a nuisance to road users; it can also create a safety concern if, for example, it prevents emergency responders from reaching their destination. The GCR have provisions to prevent this, including stipulating a maximum time limit during which public grade crossings can be blocked while road users are waiting to cross and a process for resolving grade crossing obstruction issues. They are:

GCR 97(1) It is prohibited for railway equipment to be left standing in a manner that causes the activation of the warning system at a public grade crossing other than for the purpose of crossing that grade crossing.

GCR 97(2) It is prohibited for railway equipment to be left standing on a crossing surface, or for switching operations to be conducted, in a manner that obstructs a public grade crossing—including by the activation of the gate of a warning system—for more than five minutes when vehicular or pedestrian traffic is waiting to cross it.

GCR 98 (1) If railway equipment is operated in a manner that regularly causes the obstruction of a public grade crossing, including by the activation of a warning system, and the municipality[9] with the grade crossing is located declares in a resolution that the obstruction of a public grade crossing creates a safety concern, the railway company and road authority must collaborate to resolve the safety concern.

GCR 99 Despite sections 97 and 98, if an emergency vehicle requires passage across a grade crossing, a company must take all necessary measures to immediately clear the grade crossing.

GCR 100(1) A road authority must take measures to ensure that motor vehicles do not stop on the crossing surface of a public grade crossing, if there is evidence that queued traffic regularly stops on that crossing surface.[10]

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[9] This can be a city, town, or other organized district.

[10] For example, if traffic lights cause congestion that results in vehicles stopping on the crossing surface once a week.

27.1.1 Blocked Public Grade Crossing

The first step in addressing a blocked public grade crossing is to determine whether it poses, or is likely to pose, a safety concern.

There is a safety concern if railway equipment blocks a public grade crossing on a regular basis and may consequently cause physical harm, property loss and/or an environmental impact, regardless of the length of time that it blocks the crossing. As stated earlier, for example, blocking a public grade crossing that is on the primary access route of an emergency vehicle would be a valid safety concern that could require immediate action.

Once it has been established that a blocked public grade crossing poses a safety concern, the municipality must be notified. Once the municipality has been notified, safety concerns are assessed on a case-by-case basis by the road authority/municipality and the railway company. Together they must attempt to resolve any safety concerns by following the procedure set out in section 98 of the GCR, which can be summarized as follows:

a) The municipality passes a resolution stating that the blocked crossing is creating a safety concern.

b) The municipality, provincial government, or band council (road authority) writes to the Minister of Transport and the railway company to inform them of the resolution.

c) The railway company and the road authority work together to resolve the safety concern within 90 days.

If the railway and municipality/road authority cannot reach an agreement within the 90-day period on how to resolve the safety concern related to the blocked public grade crossing, the road authority must notify the Minister of Transport.

The Minister of Transport may take further action to resolve any safety issues.

27.2 Private Crossings

Blocked grade crossings can cause the same concerns at private grade crossings. However, the current Regulations have no provisions for private crossings in this respect. Sections 97(1) and 97(2) of the GCR, apply only to public grade crossings.

27.2.1 How to Resolve a Blocked Private Grade Crossing

The first step in addressing a blocked private grade crossing is to determine whether it poses, or is likely to pose, a safety concern.

There is a safety concern if railway equipment blocks a private grade crossing on a regular basis and may, consequently, cause physical harm, property loss and/or an environmental impact, regardless of the length of time that it blocks the passage.

Here again, blocking a private grade crossing that is on the primary access route of an emergency vehicle could constitute a valid safety concern that could require immediate action. If you witness railway equipment blocking a private grade crossing, contact your Transport Canada regional office (contact information provided in Appendix F) and provide the following information:

- location of the crossing (city and intersection/road)
- date and time
- name of the railway company
- what the train was doing and for how long

The Minister of Transport may take further action, and involve the railway and private authorities, to resolve the matter. Additionally, disputes concerning a private crossing agreement filed with the Canadian Transportation Agency (CTA) or the suitability of a private grade crossing being maintained by the railway company may be raised with the CTA for ruling.

27.3 What to do in the event of an emergency at a blocked grade crossing

Call the railway company's emergency telephone number immediately if you:

a) become aware of an emergency at a Railway Crossing; or

b) see an emergency vehicle, such as an ambulance, stopped at a blocked crossing and needing to pass immediately.

At a public grade crossing, you can find the railway company's emergency telephone number and the crossing's location information on the Railway Crossing signs, on a nearby equipment housing compartment known as the signal bungalow, or on the flasher masts facing approaching traffic.

Make sure to give the railway company the location of the blocked crossing and a description of the emergency so it can take immediate action to clear the crossing and prevent railway movement on all tracks affected. Next, you should contact your municipality.

At a private grade crossing, there may or may not be an emergency notification sign. If an emergency contact number is not provided, call 911 or, where 911 is not available, your local police or fire service.

Article 28 Whistling Cessation

Train whistling is the sounding of a whistle or horn when a train approaches a public grade crossing. Train whistling is essential in keeping drivers, cyclists, and pedestrians safe when using public grade crossings. The *Canadian Rail Operating Rules* (CROR) requires trains to sound their whistle when they approach a public grade crossing.

Whistling cessation is the act of putting an end to train whistling when a train approaches a public grade crossing. Train whistling can be bothersome to people living close to public grade crossings. As a result, some municipalities may wish to end train whistling to provide those residents with some relief from the noise.

The RSA allows municipalities to implement whistling cessation at public grade crossings if certain safety requirements are met. These are detailed in sections 104 to 107 of the GCR and Appendix D of the GCS. The requirements vary according to railway design speed, vehicle and pedestrian use, the number of railway tracks and the history of trespassing and other incidents at the grade crossing, among other considerations, and may include flashing lights, bells, or gates.

The GCR prescribe the area inside of which train whistling may be prohibited under section 23.1 of the RSA. The GCR also prescribe the safety devices required inside of this area. For example, to be granted whistling cessation, a grade crossing may be required to have a warning system, and that warning system must meet the GCS Articles 12 to 16 (GCR 104 to 107).

28.1 The Process

The process for municipalities to stop train whistling at a public grade crossing is detailed in the Procedure for Eliminating Train Whistling at Public Grade Crossings in Appendix D to this document.

In summary, the municipality must.

- consult with the railway company to assess whether whistling cessation at the grade crossing would still allow the safety requirements of the GCR and the GCS to be satisfied.
- notify the public and other interested parties of the municipality's intent to stop the whistling; and
- pass a council resolution to have the whistling stopped.

After a resolution for whistling cessation is passed, both the municipality and the railway company are responsible for maintaining and monitoring the conditions supporting the whistling cessation. Recurring occurrences of trespassing and vehicle-train collisions, among other events, could result in a re-evaluation of the conditions that allowed

whistling cessation. In some instances, the railway company and municipality may decide to reinstate whistling.

> **Note:** Transport Canada can at any time order a railway company to reinstate whistling at a public crossing after a resolution is passed if the railway company or the municipality fails to maintain the conditions supporting the cessation of train whistling.

Part G

Article 29 Grade Separation

The GCR states that new at-grade crossings must not be constructed where the railway design speed would be more than 177km/h (110mph); or the road approach of the proposed grade crossing would be a freeway, considering the characteristics set out for rural roads of the *Grade Crossing Standards* or the characteristics set out for urban roads in table 10-4 of those Standards, as applicable.

For guidance to assist railway companies and road authorities on when to consider grade separation, please consult Transport Canada's Grade Separation Assessment Guidelines.

Article 30 Left Blank Intentionally

Article 31 Grade Crossing Safety Assessment

A detailed safety assessment (DSA), formally referred to as Detailed Field Safety Assessment, is a systematic process used to evaluate the safety of a road/railway grade crossing. It is a proactive strategy to:

- Reduce the risk of a crash at the grade crossing,
- Minimize the frequency and severity of crashes by ensuring that all measures to eliminate or mitigate to a minimum identified safety problem are fully considered, evaluated, and documented,
- Consider the safety of all grade crossing users, including trains, pedestrians, and motorized and non-motorized vehicles; and
- Help assess compliance with the safety technical standards referred to in the *Railway Safety Act* (RSA), *Grade Crossings Regulations* (GCR) and included in the *Grade Crossings Standards* (GCS).

While it is not a regulatory requirement to conduct DSAs at grade crossings, it is recommended, as a best engineering practice, to develop a crossing safety program that incorporates a DSA program.

DSAs are intended to be a relatively inexpensive complement to existing programs for improving safety at grade crossings. They should not be used to replace other strategies, such as identifying high-crash locations or conducting regular grade crossing maintenance inspections.

The purpose of the DSA is to:

- Review the crossing and its environment.
- Identify and characterize problems; and
- Recommend various measures to improve safety in the short, medium, and long terms.

The DSA consists of a review of the site characteristics, the existing traffic control system and the roadway and railway operational characteristics. An assessment of existing and potential hazards is based on this review. If safety deficiencies are identified, countermeasures can be recommended. Appendix I to this document includes a consistent and comprehensive guideline for conducting safety assessments at grade crossings.

> **Note:** The field sheets (or "prompt lists") included in the *Canadian Grade Crossing Detailed Safety Assessment Guide* cannot, and should not, replace experience and due diligence by members of the assessment team. Rather, the lists are provided to remind those in the field of the range of issues that should be considered in the review. Those involved in the assessment should have a thorough working knowledge of the key documents that set out design guidelines and standards for grade crossings, including:
>
> - The Grade Crossings Standards
> - The Grade Crossings Regulations
> - Guideline for Inspecting and Testing Pre-emption of Interconnected Traffic control Signals and Railway Crossing Warning Systems
> - Geometric Design Guide for Canadian Roads
> - The Manual of Uniform Traffic Control Devices for Canada

31.1 Recommended Frequency for Conducting Detailed Safety Assessments

a) Within seven years of the coming into force of the GCR (e.g., by November 28th, 2021) and at least every five years after that date, railways and road authorities should jointly conduct a DSA of their public grade crossings.

b) Within seven years of the GCR's coming into force and at least every five years after that date, it is considered good practice for a railway company to conduct a DSA of private grade crossings on its network.

Authorities for a given crossing are responsible for jointly establishing the schedule for the DSAs referred to in articles 31.1(a) and 31.1(b), above.

Notwithstanding subsection 31.1(a), the relevant authorities may agree at the time of a DSA to extend the deadline for the next DSA to more than five years, but not more than 10 years, if they have reason to believe that the safety conditions at, or in the vicinity of, the grade crossing will remain stable. If, however, a responsible authority identifies a developing condition or situation that could affect safety at, or in the vicinity of, the grade crossing, such as rapid development in the area, it must notify the other relevant authorities and request that the next DSA be conducted sooner. Likewise, a DSA may need to be conducted sooner than later if conditions change that could impact safety at the crossing, such as the following:

a) Diversion of traffic from or to the crossing.

b) Volumes and types of vehicle traffic in the area.

c) Volumes of pedestrian traffic, including persons using assistive devices.

d) Operating characteristics of the grade crossing design vehicle.

e) Road design speed on each road approach; including the observed speed.

f) Vertical clearance requirements for any special vehicles using the grade crossing where cantilever structures are used Updated dates to reflect new GCR amendments.

g) Road traffic patterns, including an assessment of the potential for

    i) Conflicts between the indications given by road and railway signs and signals, such as between crossing signals and nearby traffic signals; parking signs directing vehicles to park in a manner that would obstruct the view of crossing signs or signals, or an approaching train; or maximum speed limit signs on the road approaches to a crossing where a stop is required.
    ii) Queuing of vehicles within 2.4 meters of the nearest rail, for example, from road intersections, bus stops, or on congested roadways; and
    iii) Queuing of vehicles from the grade crossing onto roads intersecting the grade crossing approach road.

h) Road geometry within the minimum safe stopping sight distances (SSDs) of the grade crossing.

i) Physical surroundings, both within and outside of the road and railway rights-of-way, that may distract driver attention from the grade crossing, such as intersections on the road approaches, merging traffic lanes, vehicle parking, bus stops, highway, or commercial information signs or messages.

j) Volumes and types of railway traffic in the area.

k) Railway operations and railway traffic patterns within the area of the required sightlines and the control circuits of the grade crossing warning system.

l) Maximum railway operating speed on each approach.

m) Sightlines, including grade crossing warning system, and signs Updated dates to reflect new GCR amendments.

n) Potential for two or more trains to be operating on, or in the vicinity of, the grade crossing at the same time.

o) Whether the area including the grade crossing meets the requirements for train whistling cessation or might be affected by proposed or granted whistling cessation at a different location.

p) Safety of train crews required to manually protect train movements over the crossing, including an assessment of the requirements of the Canadian Rail Operating Rules (CROR) and any specific instructions from the railway company regarding to the crossing.

q) Accident history at the grade crossing; and

r) Evidence of repeat incidents of unauthorized access to the line of railway.

Note: If the DSA reveals conditions that could eventually affect safety at the grade crossing, the next DSA should be scheduled sooner than what is stipulated in 31.1 (a) and (b).

See Appendix I for a copy of the Canadian Road/Railway Grade Crossing Detailed Safety Assessment Guide.

Part H - Appendices

Appendix A Light Emitting Diode (Led) Signal Modules

1. Definitions

Candela (cd) – SI unit of luminous intensity. The candela is the luminous intensity, in each direction, of a source that emits monochromatic radiation of frequency 540 nm and that has a radiant intensity in that direction of 1/683 W per steradian (1 cd = 1 lm/sr).

Lumen (Lm) – SI unit of luminous flux. Luminous flux emitted in unit solid angle [steradian (sr)] by a uniform point source having a luminous intensity of 1 candela (1 lm = 1 cd x 1 sr).

Luminance Lv (in a given direction, at a given point on a real or imaginary surface) – quantity defined by the formula:

$$L_v = \frac{d\Phi_v}{dA \cdot d\Omega \cdot \cos\theta}$$

where:

$d\Phi_v$ is the luminous flux transmitted by an elementary beam passing through the given point and propagating in the solid angle $d\Omega$ containing the given direction; dA is the area of a section of that beam containing the given point; θ is the angle between the normal to that section and the direction of the beam (footlambert, cd/m^2).

Luminous Efficacy or Radiation (K) – the luminous flux Φv divided by the corresponding radiant flux Φe (K = Φv/Φe).

Luminous Intensity (Iv) (of a source in a given direction) – the luminous flux $d\Phi_v$ leaving the source and propagating in the element of solid angle dΩ containing the given direction, divided by the element of solid angle ($I_v = d\Phi_v / d\Omega$ candela).

Luminous Flux (Φv) – quantity derived from radiant flux Φ_e by evaluating the radiation according to its action upon the CIE standard photometric observer (lumen).

Rated Voltage – the nominal or design operating voltage of the LED signal module; the voltage at which rated watts, candelas, and life are determined.

Rated Watts – the average initial power (watts) consumed when the lamp is operated at rated voltage.

2. Photometric Requirements

2.1 Luminous Intensity

When LED signal modules are in use at a warning system, they must meet the minimum luminous intensity values shown in Appendix Table A-1.

Appendix Table A-1Minimum Luminous Intensity (Candela) over Temperature and Lifetime

	0˚	**5˚Left (L)/Right (R)**	**10˚L/R**	**15˚L/R**	**20˚L/R**	**25˚L/R**	**30˚L/R**
0˚	400	375	250	150	75	40	15

	0˚	5˚Left (L)/Right (R)	10˚L/R	15˚L/R	20˚L/R	25˚L/R	30˚L/R
5˚Down (D)	350	325	250	150	75	40	15
10˚D	130	125	110	85	60	35	15
15˚D	45	40	35	30	25	20	15
20˚D	15	15	15	15	15	15	10

2.2 Chromaticity

A signal module must produce a uniform red-light output as specified in Article 4.2 of the *Vehicle Traffic Control Signal Heads – Light Emitting Diode Circular Supplement,* published by the *Institute of Transportation Engineers*, dated June 2005.

2.3 Uniformity

The ratio of the greatest and least luminance on the signal module must not be more than 5:1, when measured over average areas of 500 mm^2.

2.4 Rise/Fall Time

The maximum rise time from zero intensity to full intensity, and the maximum fall time from full intensity to zero intensity, must be 75 milliseconds.

3. Physical And Mechanical Requirements

3.1 LED Signal Module Design

3.1.1 The LED signal module must be designed to fit the grade crossing light unit housings, described in Part 3.2.35 of the AREMA Communications and Signals Manual (cited in Part A), without requiring modification of the mechanical, structural, or electrical components.

3.1.2 The LED signal module must be either 200 mm or 300 mm in size.

3.1.3 The LED signal module must have either a clear or a red lens.

3.1.4 Any gasket or similar sealing provisions must be made of a material as specified in Part 15.2.10 of the AREMA Communications and Signals Manual (cited in Part A).

3.2 Environmental Requirements

3.2.1 The LED signal module must operate over an ambient temperature range of -40°C (-40°F) to 70°C (158°F) in accordance with sections 1 to 3 of the "Method 1010.8

Temperature Cycling", dated June 18, 2004, of MIL-STD-883H, Test Method Standard, Microcircuits, published by the United States Department of Defense, dated February 26, 2010 and must satisfy the failure criteria set-out in Article 3.3 of that standard, and any reference to end-point measurements and examinations are to be read as those provided by the supplier.

3.2.2 The LED signal module must be protected against dust and moisture intrusion in a Type 4 enclosure in a manner that meets the requirement of Article 8.6.2 of the *Canadian Standards Association standard CAN/CSA-C22.2 No. 94.2-07* entitled Enclosures for Electrical Equipment, Environmental Considerations, as amended from time to time, when tested in accordance with Article 8.6.1 of that Standard.

3.2.3 The LED signal module must meet mechanical vibration and shock requirements as specified in Part 11.5.1 of the AREMA Communications and Signals Manual (cited in Part A).

3.2.4 The LED signal module lens must be UV stabilized.

3.3 Identification

3.3.1 The LED signal module must have a label containing the following information:

a) the LED colour.

b) the beam deflection classification.

c) the operating voltage.

d) the current consumption at operating voltage.

e) the module's serial number; and

f) the date of manufacture.

3.3.2 If the module or its components require orientation, they must be prominently and permanently marked with an indexing arrow.

4. Electrical Requirements

4.1 Transient Voltage Protection

LED signal module circuitry must include voltage surge protection as specified in Part 11.3.3 of *AREMA Communications and Signals Manual* (cited in Part A).

4.2 LED Drive Circuitry

LED signal module circuitry must operate as specified in Part 3.2.35 of the *AREMA Communications and* Signals *Manual* (cited in Part A).

4.3 Dielectric and Electromagnetic Interference

LED signal module circuitry must conform to dielectric and electromagnetic interference requirements for Class B equipment in Part 11.5.1 of *AREMA Communications and Signals Manual* (cited in Part A).

Appendix B Limited Use Warning Systems and Signs

If the grade crossing provides access to fewer than three private dwellings and does not provide access to a business, a limited-use warning system and signs that meet the standards set out in Appendix B of the *Grade Crossings Standards* (GCS) may be installed at the grade crossing instead of the warning system referred to in the *Grade* Crossings *Regulations* (GCR).

1. Operating Requirements

1.1 Battery backup for a minimum of 24 hours of normal railway operations must be provided.

1.2 Power monitor lights must be provided.

2. Warning System Requirements

2.1 Limited Use Warning System must meet the specifications of Articles 12 to 16 of the GCS except:

a) it does not require a gate.

b) the height of the light unit may be different than that stated in the AREMA's Communications and Signals Manual or the GCS as to improve conspicuity.

c) the signal mast may be located closer to the road approach than that stated in the AREMA's Communications and Signals Manual or the GCS to improve conspicuity.

d) A bell is not required; and

e) Front and back lights must be provided on each warning signal assembly.

3. Signage Requirements

3.1 An Emergency Notification sign must be installed at each location.

3.2 A sign indicating that the road is private must be posted near the entrance to the private road.

Appendix C Limited Use Warning System with Walk Light

If they meet the standards set out in Appendix C of the *Grade Crossing Standards* (GCS), reproduced below, signs and a limited-use warning system with a walk light may be installed at a grade crossing instead of the warning system referred to in the *Grade Crossings Regulations* (GCR), if:

a) access to the road is controlled by a locked barrier; or

b) the grade crossing is for the exclusive use of the private authority and is not used by the public.

1. Operating Requirements

1.1 Battery backup of a minimum of 8 hours must be provided.

1.2 Power monitor lights must be provided.

2. Signal Requirements

2.1 A Limited Use Warning System with Walk Light must meet the specifications below:

a) must be installed on each side of the grade crossing and face a crossing user approaching the grade crossing.

b) must include a signal head that displays a signal indicating to a crossing user that it is safe to proceed when railway equipment is not approaching. This signal head must be extinguished when railway equipment is approaching.

c) The signal head must be as specified in sections 2 to 5, excluding the last paragraph of section 4.1.1, of the ITE "*Pedestrian Traffic Control Signal Indications - Part 2: Light Emitting Diode (LED) Pedestrian Traffic Signal Modules*" prepared by the *Joint Industry* and *Traffic Engineering Council Committee*, published by *the Institute of Transportation Engineers*, dated March 19, 2004, except for the following aspects:

   i) 12VDC pedestrian module is to be used instead of a 120VAC input voltage.
   ii) the operating voltage range must be 9 – 15VDC, and the light must shut off at 7.3VDC or less; and
   iii) References to "LED Pedestrian Signal Module" or "Module" are to be read as "Walk Light".

d) The walk light indicating that it is safe to proceed must be extinguished a minimum of 20 seconds plus the clearance time before the arrival of railway equipment at the crossing surface.

e) The clearance time must be based on design vehicle and must be calculated in accordance with Article 10 of the GCS.

3. Signage and Post Requirements

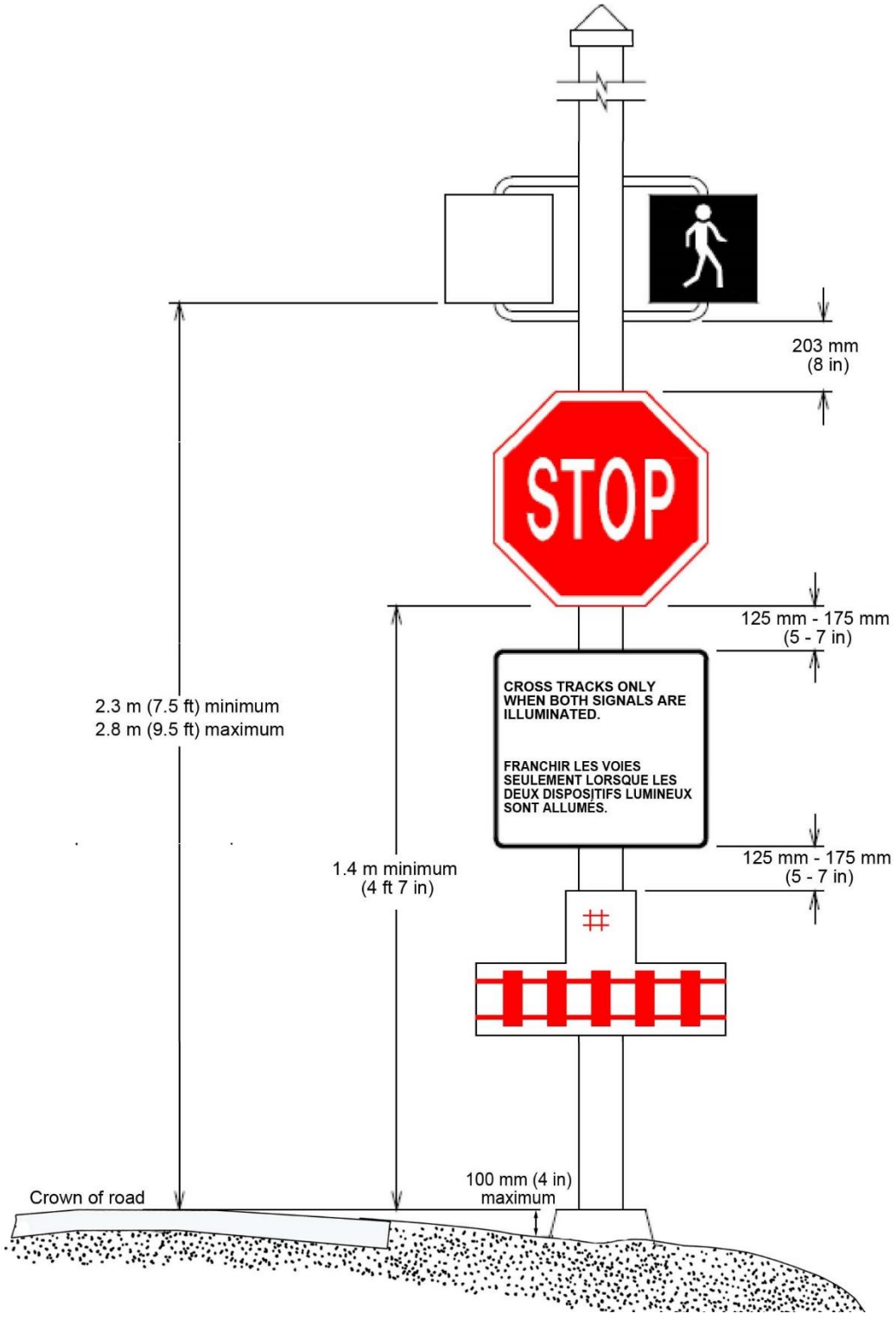
3.1 Signage indicating how to use a Limited Use Warning Systems with Walk Light must be as shown in Appendix Figure C-2 and must:

a) be mounted on the mast under the walk light signal head as indicated in Appendix Figure C-1; and

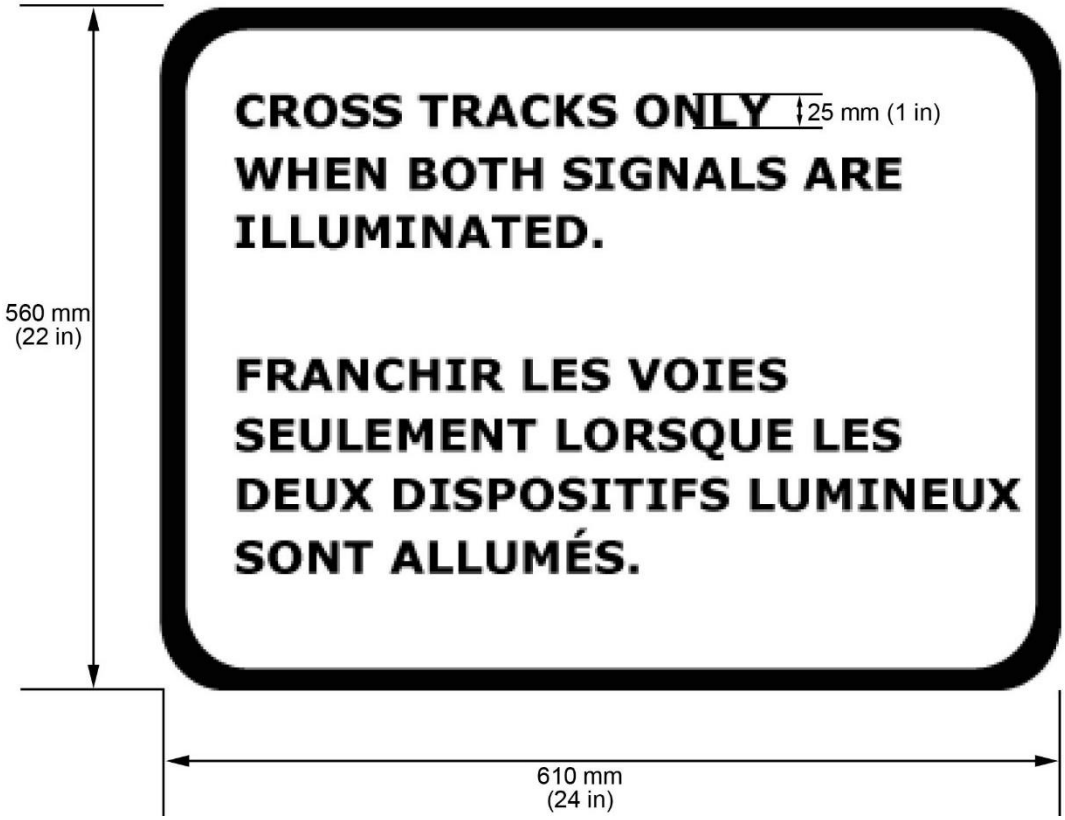
b) have a silver background that is reflective with silk screened black or vinyl lettering. Where required by law, the word “Arrêt” may replace the word “Stop” or may be added to the Stop Sign.

3.2 A Stop sign must be as shown in Article A2.2.1 of the *Manual of Uniform Traffic Control Devices for Canada* and must meet the applicable specifications A1.6 of that Manual. Where required by law, the word “Arrêt” will replace the word “Stop” or may be added to the Stop sign. The Stop sign must be mounted on the mast as shown in Appendix Figure C-1.

3.3 An Emergency Notification sign must be located at each Limited Use Warning System with Walk Light Assembly.



Appendix Figure C-1Limited Use Warning System with Walk Light Assembly



Appendix Figure C-2 Instruction Sign

Appendix D Whistling Cessation

Train whistling is an important way to keep drivers, cyclists, and pedestrians safe. The Canadian Rail Operating Rules require all trains to whistle whenever they approach a public grade crossing.

In some cases, train whistles bother people who live nearby. Municipalities may wish to stop the whistling to provide residents with relief from the noise. Please visit Transport Canada's website for more information.

Appendix E Guideline for Determining Minimum Sightlines at Grade Crossings

To view the complete guide to determining minimum sightlines at grade crossings for road authorities and railway companies please visit the following website.

Appendix F Rail Safety Regional Contacts

Headquarters

Director, Safety Policy & Regulatory Affairs
Enterprise Building, Minto Place, 427 Laurier Avenue West, 14th Floor
Ottawa ON K1A 0N5
Phone: 613-990-8690, Fax: 613-990-7767

Rail Safety Regional Office's

Atlantic Region

Regional Director
95 Foundry Street, PO Box 42
Moncton, NB, E1C 8K6
Tel.: 506 851-7040, Fax: 506 851-7042

Ontario Region

Regional Director
4900 Yonge Street, 3rd Floor
North York, ON, M2N 6A5
Tel.: 416 973-9820, Fax: 416 973-9907

Prairie and Northern Region

Regional Director
McDonald Building, 344 Edmonton Street, 3rd Floor
Winnipeg, MB, R3B 2L4
Tel.: 1-888-463-0521, Fax: 204 983-8992

Pacific Region

Regional Director
2010-7445 132nd Street
Surrey, BC, V3W 1J8
Tel.: 604 666-0011, Fax: 604 666-7747

Quebec Region

Regional Director
700 Leigh-Capreol Place
Dorval, QC, H4Y 1G7
Tel.: 514 633-3400, Fax: 514 633-3569

Appendix G Sharing Of Information Form Road Authority

In accordance with Transport Canada's *Grade Crossings Regulations*

This form may be used by the Road Authority when sharing information with a Railway for the purpose of complying with sections 12 to 18 of the *Grade Crossings Regulations* (GCR). The Road Authority Sharing of Information Form Job Aid can be referenced to complete the forms.

Cover Form

<table>
<tr><td colspan="2">SECTION 1 – General</td></tr>
<tr><td>1. Road Authority:</td><td>2. Date of Submission (yyyy/mm/dd):</td></tr>
<tr><td colspan="2">3. Road Authority Contact Information</td></tr>
<tr><td colspan="2">Title (optional):</td></tr>
<tr><td>Name:</td><td>Mailing Address:</td></tr>
<tr><td></td><td rowspan="5"></td></tr>
<tr><td>E-mail Address:</td></tr>
<tr><td></td></tr>
<tr><td>Telephone Number:</td></tr>
<tr><td></td></tr>
<tr><td colspan="2">Additional Road Authority Contact Information (in case of emergency)</td></tr>
<tr><td colspan="2">Title (optional):</td></tr>
<tr><td>Name:</td><td>Mailing Address:</td></tr>
</table>

E-mail Address:	
Telephone Number:	
4. Railway Company:	

Crossing Form	Crossing No. _____of_____
SECTION 2 – Grade Crossing Location (At least two [2] of the four [4] fields must be completed to identify the grade crossing location)	
5. Railway Subdivision & Mileage	1
6. Latitude & Longitude	2
7. Roadway Name	3
8. City or Town Name	4
SECTION 3 – Reason(s) for Sharing Information with the Railway (Select all that apply and provide details below)	

9. Information must be shared for existing public grade crossings no later than two years of the GCR coming into force. (e.g., by November 28th, 2016) Ref. (GCR *12*. (3))	❑
10. Receipt of a notice from a railway company, under section 3 of the *Notice of Railway Works Regulations*. Ref. (GCR *12*. (2))	❑
11. A change in the design vehicle and the sightlines at the grade crossing, which must meet the requirements in section 20 of the GCR Ref. (GCR 13 ➔ GCR 28. (c))	❑
12. An increase in the design speed of the road crossing, which will result in a change to the road approach's classification as set out in column B of the Table 10-2 of the *Grade Crossings Standards* (GCS). Ref. (GCR 13 ➔ GCR 28. (d))	❑
13. The location, gradient or crossing angle of a grade crossing has changed, and Articles 6 and 11 of the GCS must be applied in a manner that improves the overall safety of the grade crossing. Ref. (GCR 13 ➔ GCR 88. (1))	❑
14. An increase of the absolute gradient of a road approach to an existing grade crossing which meets the standards set out in Article 6.3 of the GCS. Ref. (GCR *13* ➔ GCR 88. (2))	❑
15. The number or width of traffic lanes of a road approach increases, or a shoulder is added, or a shoulder's width is increased. The grade crossing must meet the standards set out in Articles 5.1 and 6.4 of the GCS. Ref. (GCR *13* ➔ GCR 89)	❑

16. A traffic signal is installed at a grade crossing that corresponds to the specifications set out in Article 19.1 of the GCS, the warning system must be interconnected with the traffic signal, and the interconnection must meet the standards set out in Articles 19.2 to 19.4 of the GCS. Ref. (GCR *13* ➔ GCR 90)	❑
17. A change in the design vehicle, which has resulted in a change to the period of time that the warning system must operate, before railway equipment reaches the crossing surface and therefore must meet the standards set out in Article 16.1 of the GCS. Ref. (GCR *13* ➔ GCR 91)	❑
Details with respect to the change(s) selected:	
SECTION 4 – Notification of Other Changes (Select all that apply and provide details below)	
18. An increase in the road crossing design speed at a public grade crossing. (If this change is selected, the following fields in this form must be completed: SECTION 2, SECTION 5 [26] and SECTION 6 [30 & 32].) Ref. (GCR 14)	❑
19. An interconnected traffic signal referred to in Article 19 of the GCS, or a Prepare to Stop at Railway Crossing sign, is installed or is changed at a public grade crossing. (If this change is selected, the following fields in this form must be completed: SECTION 2, SECTION 6 [33] and SECTION 7 [34].) Ref. (GCR 15)	❑

20. If a road at a public grade crossing is transferred from one road authority to another, the information below must be provided. ❑ Ref. (GCR 17)	
Contact information (name and Title):	
Road Authority Name:	
Address:	
Telephone Number:	
E-mail Address:	
E-mail Address:	
Date of Transfer:	
Details with respect to the change(s) selected:	

SECTION 5 – Railway Crossing Details

21. Total Number of Traffic Lanes	22. Annual Average Daily Traffic (AADT)	23. Existing Roadway Width (m)	24. Grade Crossing Angle (°)

25. Road Approach Information		
Column A	Column B	Column C

<table>
<tr><td colspan="2" rowspan="2">❑ Rural</td><td colspan="2">❑ Local</td><td colspan="2" rowspan="2">❑ Divided</td></tr>
<tr><td colspan="2">❑ Collector</td></tr>
<tr><td colspan="2" rowspan="3">❑ Urban</td><td colspan="2">❑ Arterial</td><td colspan="2" rowspan="3">❑ Not Divided</td></tr>
<tr><td colspan="2">❑ Expressway</td></tr>
<tr><td colspan="2">❑ Freeway</td></tr>
<tr><td colspan="2">26. Average Approach Gradient</td><td colspan="2">27. Existing Shoulder Width</td><td colspan="2">28. Path or Sidewalk</td></tr>
<tr><td>Approach 1</td><td>Approach 2</td><td>Approach 1</td><td>Approach 2</td><td>❑ Yes</td><td rowspan="5">❑ No</td></tr>
<tr><td colspan="2">Orientation / Direction</td><td colspan="2">Orientation / Direction</td><td rowspan="4">❑ Designated for persons using assistive devices</td></tr>
<tr><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="2">Gradient (%)</td><td colspan="2">Shoulder Width (m)</td></tr>
<tr><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="6">SECTION 6 – Crossing User Details</td></tr>
<tr><td>29. Design Vehicle</td><td>30. Road Crossing Design Speed (km/h)</td><td>31. Departure Time (sec)</td><td>32. Stopping Sight Distance (SSD)</td><td colspan="2">33. Advanced Activation time (sec)</td></tr>
<tr><td></td><td></td><td></td><td></td><td colspan="2"></td></tr>
<tr><td colspan="6">SECTION 7 – Interconnected Devices</td></tr>
</table>

34. Interconnection Time	❑ Yes Time (sec): _____	❑ No Interconnection at Crossing

Job Aid – Road Authority Sharing Of Information Form

This Job Aid is to be used as a reference document when completing the **Road Authority Sharing of Information Form**.

Road Authorities are required to share safety-related information with the Railways for all federally regulated crossings in their jurisdiction by November 28th, 2016.

Additionally, it is the Road Authority's responsibility to provide notification of changes and share specific information related to these changes with the Railways in accordance with the requirements of the *Grade Crossings Regulations*.

The sharing of information will foster collaboration between the Road Authorities and Railway companies responsible for the safety at grade crossings. The **ROAD AUTHORITY SHARING OF INFORMATION FORM** may be used by the Road Authority to share information or to provide notification of changes concerning construction and operations.

Once completed, the form should be sent to the appropriate Railway Company within the required timeframe indicated in the *Grade Crossings Regulations*. A courtesy copy may be sent to Transport Canada Rail Safety for their records.

Mailing Address:

Transport Canada
Rail Safety Directorate
Mailstop: ASR
427 Laurier Street West,
Ottawa, Ontario, K1A 0N5

Email: RailSafety@tc.gc.ca

Fax: 613-990-7767

COVER FORM
To be completed and used as a general cover page to which all Crossing Forms associated with the same Railway can be attached.

SECTION 1 – General

General information to be completed by the Road Authority. All fields must be completed.

1. Road Authority: Full name of the Road Authority responsible for the maintenance and/or construction within the road approaches of the grade crossing.

2. Date of Submission: Date on which the form is sent. All information provided must be updated to reflect the actual conditions of the crossing on the date of submission.

3. Road Authority Contact Information:

Name: Full name of the individual responsible for completing the form.

E-mail Address: E-mail address for the individual responsible for completing the form.

Telephone: Telephone number for the individual responsible for completing the form.

Mailing Address: Road Authority mailing address for the individual responsible for completing the form.

Note: The GCR requires that contact information be provided for the purposes of information sharing (Section 12), planning maintenance (Section 102) and emergency notification (Section 103). While only one contact is required, Road Authorities may wish to provide one contact for information sharing and planning and a separate contact for emergency notifications in the additional field provided.

4. Railway Company: Name of appropriate Railway Company being notified.

SECTION 2 – Grade Crossing Location

At least two [2] of the four [4] fields must be completed to identify the grade crossing location.

5. Railway Subdivision & Mileage: Full name of railway subdivision and railway mileage point rounded to two [2] decimal places used to identify the location of the crossing within the Railway's network.

Example: Mile 102.91 Parry Sound Subdivision

6. Latitude & Longitude: Latitude and longitude coordinates identifying the centre point of the crossing. The centre point can be defined as the intersection between the centerline axis of the railway tracks and the centerline axis of the roadway.

7. Roadway Name: Full name representing the most updated and commonly known road name. Typically, the road name printed on the corresponding street sign. If a concession reference exists, this can also be provided.

Example: Murphy Road also-known-as (a.k.a.) County Road 21

8. City or Town Name: Full name representing the City or Town in which the crossing is situated. Should the crossing not be situated in a City or Town, the common name of the Township, Village, or Hamlet can be entered.

SECTION 3 – Reason(s) for Sharing Information with the Railway

This section must be completed to identify the reason(s) the corresponding information in SECTIONS 5, 6 & 7 of the Crossing Forms is being shared with the Railway. Check all that apply and include all relevant details in the fields provided.

Note: If any of the changes from ([10] to [17]) are selected, notification in writing of the change(s) must be provided to the Railway no later than 60 days before the day on which the change begins.

SECTION 4 – Notification of Other Changes

This section must be completed to identify any changes that concern a public grade crossing which must be shared with the Railway in accordance with the requirements of sections 14 to 18 of the GCR. Include all relevant details of the change(s) in the fields provided.

18. **Increase in the road crossing design speed:** When there is an increase in the road crossing design speed at a public grade crossing, the precise location of the grade crossing, the new road crossing design speed, the stopping sight distance, and the average approach gradient must be indicated in the form. Fields which must be completed when there is an increase in the road crossing design speed include SECTION 2, SECTION 5 [26] and SECTION 6 [30 & 32] in the Crossing Forms.

Notice of this change, along with the required information must be given to the Railway in writing not later than 60 days before the day on which the increase takes effect.

19**. Installation (or change) of Interconnected Traffic Signals or Prepare to Stop at Railway Crossing sign:** When an interconnected traffic signal referred to in Article 19 of the GCS, or a prepare to stop at Railway Crossing sign is installed or changed, the precise location of the grade crossing must be indicated in the form as well as the activation time and the interconnection time. Fields which must be completed for these changes include SECTION 2, SECTION 6 [33] and SECTION 7 [34] in the Crossing Forms.

Notice of this change, along with the required information must be given to the Railway in writing not later than 60 days before the day on which the increase takes effect.

20. **Transfer of a road at a public grade crossing:** When a road at a public grade crossing is transferred from one Road Authority to another, the Road Authority **to which the road**

is transferred must, within seven [7] days after the day on which the transfer takes effect, provide the Road Authority name, address, telephone number and email address of a contact person to the Railway.

SECTION 5 – Railway Crossing Details

Information specific to the crossing to be completed by the Road Authority.

21. Total Number of Traffic Lanes: The total number of existing lanes traversing the crossing (e.g., total number of lanes in both directions at the crossing).

22. Annual Average Daily Traffic (AADT): The total number of motor vehicles that cross a grade crossing in a year divided by the number of days in that year.

23. Existing Roadway Width: Existing roadway width, in meters, of travelled lane measured from the outside lane edges. See Appendix A, Figure 1(K).

24. Grade Crossing Angle: Angle, in degrees, measured starting from the centerline axis of the Railway tracks to the centerline axis of the roadway. See Appendix A, Figure 2.

25. Roadway Approach Information: To complete this field, refer to the specifications set out in **columns** A, B and C of table 10-2 (Road Design Specifications) of the GCS to which the road approach corresponds, considering the characteristics set out for rural roads in table 10-3 of the GCS, or the characteristics set out for urban roads in table 10-4 of the GCS. http://www.tc.gc.ca/eng/railsafety/grade-crossings-standards-318.htm

26. Average Approach Gradient: Average slope (in percentage) of each corresponding road approach. The 'road approach' means the part of the road, other than the crossing surface, that lies between the point that marks the start of the stopping sight distance and the point that marks the front of the design vehicle when it is past the Clearance Point. The Clearance Point is shown in Appendix A Figure 3. The approach gradient for a road approach is always measured in the same direction **approaching** the crossing from the start of the stopping sight distance. A positive (+) slope represents an ascending slope, and a negative (-) slope represents a descending slope.

Approach 1 – Indicate the appropriate orientation / direction of traffic approach (e.g., Northbound (NB) or other) and the corresponding road approach gradient in the field provided.

Approach 2 – Indicate the appropriate orientation / direction of traffic approach (e.g., Westbound (WB) or other) and the corresponding road approach gradient in the field provided.

27. Existing Shoulder Width: Average existing shoulder width, in meters, measured from the outside lane edge to the outside edge of shoulder. If no shoulder exists, the field can be left blank.

See Appendix A, Figure 1(L).

Approach 1 – Indicate the appropriate orientation / direction of traffic approach (e.g., Northbound (NB) or other) and the corresponding shoulder width in the fields provided.

Approach 2 – Indicate the appropriate orientation / direction of traffic approach (e.g., Westbound (WB) or other) and the corresponding shoulder width in the fields provided.

28. Path or Sidewalk: Select whether a path and/or sidewalk exists, and whether it is designated for persons using assistive devices.

SECTION 6 – Crossing User Details

Information specific to the crossing to be completed by the Road Authority.

29. Design Vehicle: Establish what design vehicle is used for the road crossing. The design vehicle must correspond to one of the vehicles shown in Figures 1.2.4.1 to 1.2.4.11 of *the Geometric Design Guide for Canadian Roads*, published by the Transportation Association of Canada (September 1999), and the amendment dated January 2002.

30. Road Crossing Design Speed:

(a) in the case of a new grade crossing, the motor vehicles speed used in the design of the grade crossing; or

(b) in the case of an existing grade crossing, the motor vehicles speed that corresponds to the current design of the grade crossing.

31. Departure Time: Departure time of the Design Vehicle, based on the accepted Design Vehicle, in seconds, as calculated by Article 10.3 of the GCS. Please note that the gradient (one per approach) used in the calculation of the Departure Time is the average gradient over the Vehicle Travel Distance. The Vehicle Travel Distance is the distance from the rear of the design vehicle at the stopped position to the point that marks the front of the design vehicle when it is past the Clearance Point.

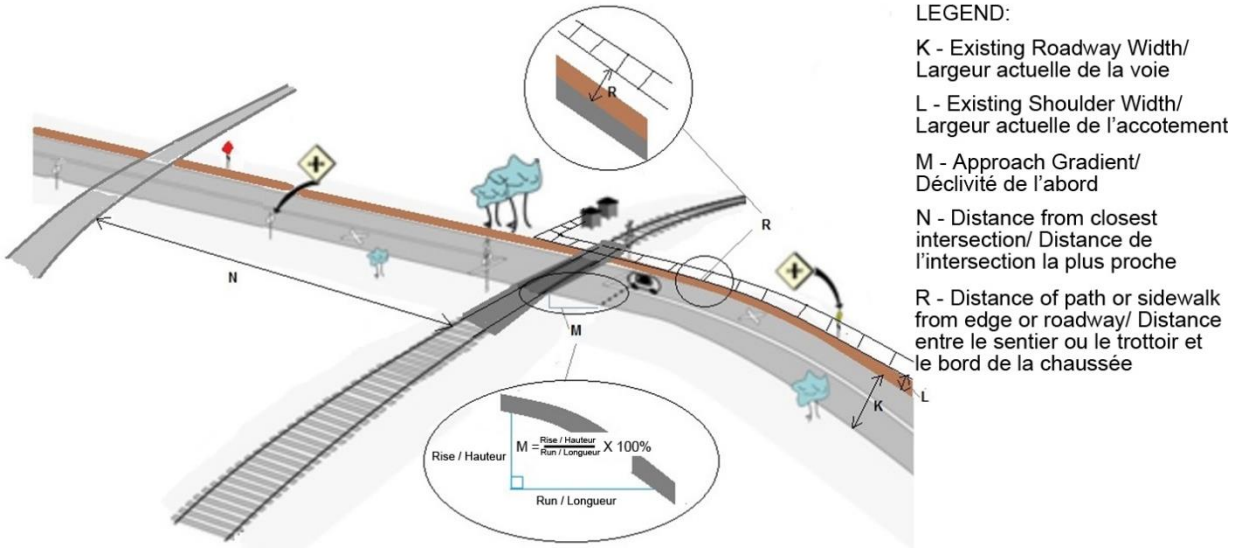
32. Stopping Sight Distance (SSD): The distance calculated in accordance with Article 7.2 of the GCS.

33. Advanced Activation Time: The time calculated for a Prepare to Stop at Railway Crossing, in accordance with Article 18.2 of the GCS.

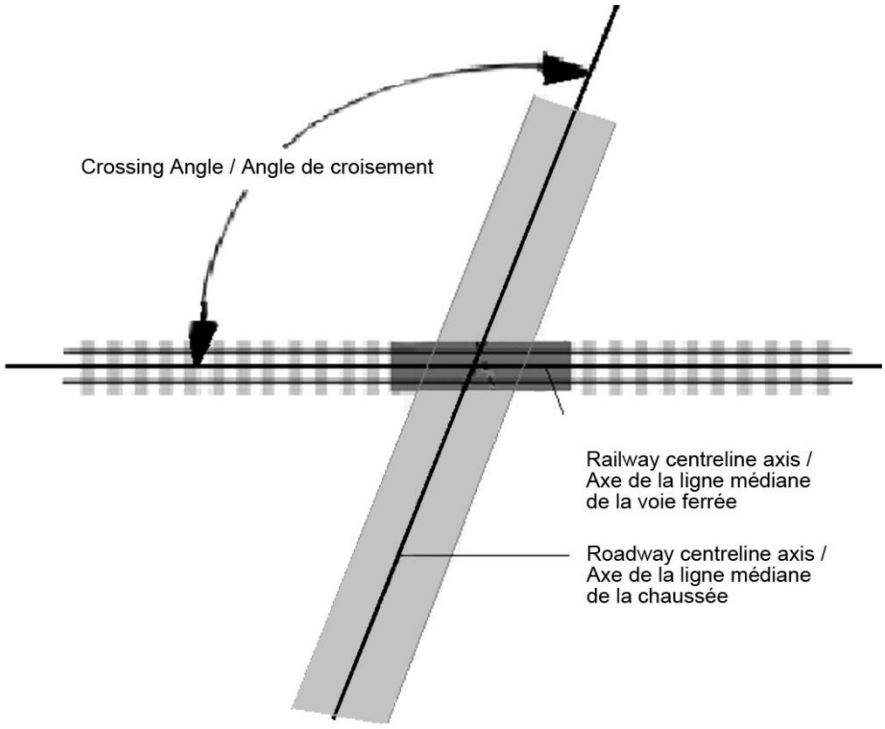
SECTION 7 – Interconnected Devices

Information specific to the crossing to be completed by the Road Authority.

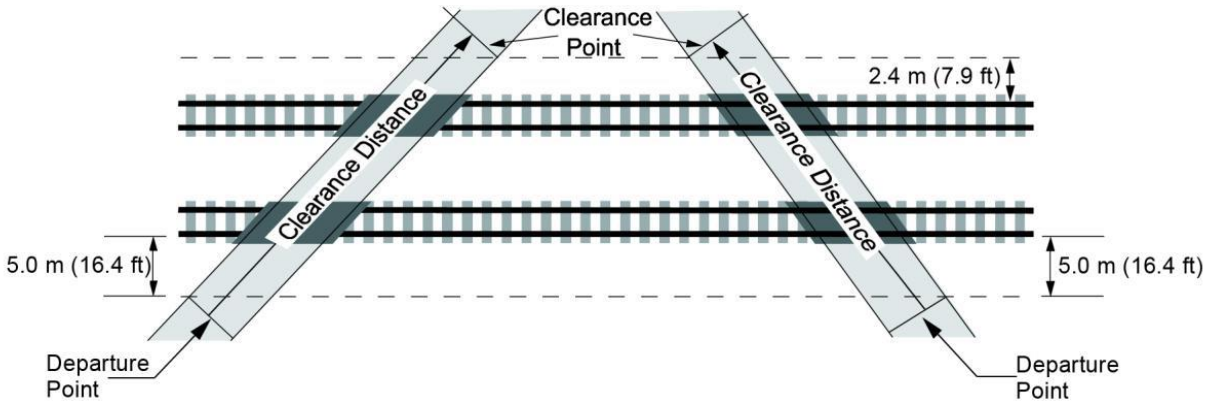
34. Interconnection Time: Select whether a warning system interconnected with nearby traffic signals exists at the crossing location. If 'yes', the 'interconnection time' must be provided, meaning the time for vehicles to clear the grade crossing before the arrival of railway equipment at the crossing surface in seconds.



Appendix Figure G-1 Grade Crossing Details (Form Appendix A Figure 1)



Appendix Figure G-2 Grade Crossing Angle (Form Appendix A Figure 2)



Appendix Figure G-3 Grade Crossing Clearance Point (Form Appendix A Figure 3)

Appendix H Sharing of Information Form Railway

In accordance with Transport Canada's *Grade Crossings Regulations*

This form may be used by the Railway when sharing information with a Road Authority for the purpose of complying with sections 4 to 11 of the *Grade Crossings Regulations (*GCR*).* The Railway Sharing of Information Form Job Aid can be referenced to complete the forms.

Cover Form

SECTION 1 – General	
A. Railway Company:	B. Date of Submission (yyyy/mm/dd):
C. Railway Company Contact Information	
Name:	Mailing Address:
E-mail Address:	
Telephone Number:	

Additional Railway Company Contact Information (in case of emergency)	
Name:	Mailing Address:
E-mail Address:	
Telephone Number:	
D. Road Authority:	
Crossing Form	Crossing No. _____of_____
SECTION 2 - Grade Crossing Location (At least two [2] of the four [4] fields must be completed to identify the grade crossing location)	
E. Railway Subdivision & Mileage	1
F. Latitude & Longitude	2
G. Roadway Name	3
H. City or Town Name	4
SECTION 3 – Reason(s) for sharing information with the Road Authority	

(Select all that apply and provide details below. **Proceed to SECTION 6 if none of the following apply**)	
I. Information must be shared for existing public grade crossings no later than two years of the GCR coming into force. Ref. (GCR *4*. (3))	❑
J. Receipt of a notice under section 3 of the Notice of Railway Works Regulations. Ref. (GCR *4*. (2))	❑
K. A line of railway is added within the sightlines of the grade crossing and the sightlines must meet the requirements in section 20 of the GCR. Ref. (GCR *5* ➔ GCR 28. (a))	❑
L. There is a change in the class of track referred to in column 1 of the table in Article 7.1.2 of the *Grade Crossings Standards* (GCS) when considering the maximum allowable operating speeds set out in column 2 or 3 of that table. Sightlines at the grade crossing must meet the requirements in section 20 of the GCR. Ref. (GCR *5* ➔ GCR 28. (b))	❑
M. A new warning system is installed at a grade crossing and must meet the applicable standards set out in Articles 12 to 16 of the GCS. Ref. (GCR *5* ➔ GCR 87. (1))	❑
N. A component of a warning system is modified or installed and must meet the applicable standards set out in Articles 12 and 16 of the GCS. Ref. (GCR *5* ➔ GCR 87. (2))	❑
O. A new installation of a warning system, or the modification or installation of a component of a warning system which results from an increase in the railway design speed. The warning system or	❑

component must meet the applicable standards set out in Articles 12 and 16 of the GCS before the increase in the railway design speed takes effect. Ref. (GCR *5* ➔ GCR 87. (3))				
Details with respect to the change(s) selected:				
SECTION 4 – Railway Crossing Details				
P. Number of Tracks				
Q. Average Annual Daily Railway Movements				
R. Railway Design Speed	Freight trains (mph):		Passenger trains (mph):	
SECTION 5 – Railway Crossing Warning System				
S. Crossing Warning System (Select all that apply)				
❑ None ❑ Crossbuck ❑ Flashing lights ❑ Bell ❑ Gates ❑ Cantilever ❑ Warning system(s) for path or sidewalk ❑ Other(s) _____				
T. Stop Sign Present				
❑ Yes, on Railway Crossing sign		❑ No		
U. Anti-Whistling Present				
❑ Yes (Optional field)	❑ Special Provision(s)		❑ No	

_____	

SECTION 6 – Notification of Other Changes (Select all that apply and provide details below)	
V. Increase in the railway design speed at a public grade crossing. Ref. (GCR 6)	❑
New railway design speed (mph):	
Date the new speed takes effect (yyyy/mm/dd):	
W. Increase in the average annual daily railway movements by 50% or more and if the value is three [3] or more. Ref. (GCR 8)	❑
New average annual daily railway movements:	
X. Whistling is no longer required at a grade crossing. Ref. (GCR 9)	❑
Date of change (yyyy/mm/dd):	
Y. Transfer of a line of railway to another company. Ref. (GCR 10)	❑
Railway Company Name:	

*/ Address:	
Telephone Number:	
E-mail Address:	
Name of Contact Person:	
Date of Transfer:	
Details with respect to the change(s) selected:	

Job Aid - Railway Sharing of Information Form

This Job Aid is to be used as a reference document when completing the **Railway Sharing Of Information Form.**

Railways are required to share safety-related information with the Road Authorities for all federally regulated crossings in their jurisdiction by November 28th, 2016.

Additionally, it is the Railway's responsibility to provide notification of changes and share specific information related to these changes with the Road Authorities in accordance with the requirements of the *Grade Crossings Regulations*.

The sharing of information will foster collaboration between the Railway Companies and Road Authorities responsible for the safety at grade crossings. The RAILWAY SHARING OF INFORMATION FORM may be used by the Railway to share information or to provide notification of changes concerning construction and operations.

Once completed, the form should be sent to the appropriate Road Authority within the required timeframe indicated in the *Grade Crossings Regulations*. A courtesy copy may be sent to Transport Canada Rail Safety for their records.

Mailing Address:

Transport Canada
Rail Safety Directorate
Mailstop: ASR

427 Laurier Street West,
Ottawa, Ontario, K1A 0N5

Email: RailSafety@tc.gc.ca

Fax: 613-990-7767

NOTE: As per section 108 of the GCR, a Railway must keep the most recent information provided to a Road Authority under sections 4 to 11 of the GCR **and** the most recent information received from a Road Authority under sections 12 to 18.

COVER FORM

To be completed and used as a general cover page to which all Crossing Forms associated with the same Road Authority can be attached.

SECTION 1 – General

General information to be completed by the Railway. All fields must be completed.

A. Railway Company: Full name of the Railway responsible for the maintenance and/or construction at the crossing.

B. Date of Submission: Date on which the form is sent. All information provided must be updated to reflect the actual conditions of the crossing on the date of submission.

C. Railway Company Contact Information:

a) Name: Full name of the individual responsible for completing the form.

b) E-mail Address: E-mail address for the individual responsible for completing the form.

c) Telephone: Telephone number for the individual responsible for completing the form.

d) Mailing Address: Railway Company mailing address for the individual responsible for completing the form.

Note: The GCR requires that contact information be provided for the purposes of information sharing (Section 4), planning maintenance (Section 102) and emergency notification (Section 103). While only one contact is required, Railways may wish to provide one contact for information sharing and planning and a separate contact for emergency notifications in the additional field provided.

D. Road Authority: Name of appropriate Road Authority being notified.

SECTION 2 – Grade Crossing Location

At least two [2] of the four [4] fields must be completed to identify the grade crossing location.

E. Railway Subdivision & Mileage: Full name of railway subdivision and railway mileage point rounded to two [2] decimal places used to identify the location of the crossing within the Railway's network.

Example: Mile 102.91 Parry Sound Subdivision

F. Latitude & Longitude: Latitude and longitude coordinates identifying the centre point of the crossing. The centre point can be defined as the intersection between the centerline axis of the railway tracks and the centerline axis of the roadway.

G. Roadway Name: Full name representing the most updated and commonly known road name. Typically, the road name printed on the corresponding street sign. If a concession reference exists, this can also be provided.

Example: Murphy Road also-known-as (a.k.a.) County Road 21

H. City or Town Name: Full name representing the City or Town in which the crossing is situated. Should the crossing not be situated in a City or Town, the common name of the Township, Village, or Hamlet can be entered.

SECTION 3 – Reason(s) for Sharing Information with the Road Authority

This section must be completed to identify the reason(s) the corresponding information in SECTIONS 4 & 5 of the Crossing Forms is being shared with the Road Authority. Check all that apply and include relevant details in the fields provided.

Proceed to SECTION 6 (Notification of Other Changes) if none of the reasons in SECTION 3 apply.

Note: If any of the changes from ([J] to [O]) are selected, notification in writing of the change(s) must be provided to the Road Authority no later than 60 days before the day on which the change begins.

SECTION 4 – Railway Crossing Details

Information specific to the crossing to be completed by the Railway.

P. Number of Tracks: Total number of existing tracks going through the crossing.

Q. Average Annual Daily Railway Movements: The total number of movements of engines, or engines coupled with railway equipment, across a grade crossing in a year, divided by the number of days in that year.

R. Railway Design Speed: Defined as

(a) in the case of a new grade crossing, the railway equipment speed used in the design of the grade crossing; or

(b) in the case of an existing grade crossing, the railway equipment speed that corresponds to the current design of the grade crossing.

SECTION 5 – Railway Crossing Warning System

Information specific to the Railway Crossing Warning System(s) to be completed by the Railway.

S. Crossing Warning System: Check all boxes that apply regarding the existing crossing warning system present at the grade crossing. The 'Other' box **may** be selected to further describe other or additional crossing protection aspects relative to the Railway, such as additional flashing lights for nearby driveways, locked gates at spur lines, pre-emption, pedestrian gates, etc.

T. Stop Sign Present: Establish whether a Stop Sign is installed on the same post as the Railway Crossing sign.

U. Anti-Whistling Present: Establish whether anti-whistling exists at the crossing. 'Special Provision(s)' can be specified to further describe any restrictions or details of the anti-whistling such as time period constraints.

SECTION 6 – Notification of Other Changes

This section must be completed to identify any changes that concern a public grade crossing which must be shared with the Road Authority in accordance with the requirements of sections 6 to 11 of the GCR. Include all relevant details of the change(s) in the fields provided.

V. **Increase in the railway design speed:** When there is an increase in the railway design speed at a public grade crossing, the precise location of the grade crossing and the new railway design speed must be indicated in the form. Notification of an increase in the railway design speed must be given to the Road Authority in writing not later than 60 days before the day on which the increase takes effect.

W. **Increase to average annual daily movements:** When the average annual daily railway movements increase by 50% or more relative to the previous value, and if the

value is three [3] or more, notification of this change must be provided to the Road Authority.

X. **Whistling is no longer required at a grade crossing:** If the use of a whistle is no longer required at a grade crossing, notification of this change must be given to the Road Authority in writing not later than 30 days after the day on which the change is made.

Y. **Transfer of a line of railway to another company:** If a line of railway at a public grade crossing is transferred from one railway company to another, the railway company **to which the line of railway is transferred** must, within seven [7] days after the day on which the transfer takes effect, provide the Road Authority with the name, address, telephone number and email address of a contact person.

Appendix I Canadian Grade Crossing Detailed Safety Assessment Field Guide

Under Development

Appendix J Testing Requirements (Railway)

Maintenance, tests, and repair work that may interfere with safe operation of trains must not be started until train movements have been fully protected. Temporary repairs or adjustments, when required, must be made in such a manner that safety of train operation will not be impaired. When a repair, adjustment, change, or replacement is made, tests must be carried out immediately to verify that the apparatus functions as intended. Proper instruments/equipment must be used to test the apparatus, and the use of such instruments or equipment must not create unsafe conditions.

In the event severe weather or other environmental conditions may have affected the operation of the warning system or its components, the warning system and its components must be inspected within a reasonable period to verify that they are working properly. (GCR 94(3)).

To verify that the warning system functions as intended, tests are to be conducted at the intervals specified in Part D of this document and tables 17-1, 17-2, and 20-1 of the *Grade Crossings Standards* (GCS), reproduced herein. Each test prescribed must be conducted at least once within the prescribed frequency, as defined in columns 2 and 3 of Table 17-1.

To facilitate troubleshooting and maintenance, each wire in all housings, including switch circuit controllers and terminal or junction boxes, must be tagged at each terminal, and its identification must not interfere with moving parts of the warning system. Identification tags/labels must be made of Insulating materials. This

requirement does not apply to light units or wiring that is an integral part of solid-state equipment.

Because of the potential for an inspection and/or test to create a condition that could compromise the safety of railway operations, it is recommended that temporary protection measures be put in place before beginning any of the inspections/tests enumerated below. Should an inspection or test pose an actual threat to the safety of railway operations, protection measures must be applied.

> **Note:** This is a regulatory requirement for all new grade crossings with a warning system, as well as to existing grade crossings, and when a change is made to components of their warning system (GCR 44, 55, 87(2)). (See Article 2 for more information on amendments to the GCR timelines)

Any issues noted during any of these inspection items must be reported to the Rail Traffic Controller immediately, in accordance with CROR 103.1 (h).

The results of the inspections and tests specified herein, and all other inspections and tests that may be required, must be recorded as per section 109 of the GCR.

Appendix K Testing Requirements (Road Authority)

> **Note:** The items listed below are within Table 20-1 of the *Grade Crossing Standards* (GCS).

Item 1 - Prepare to Stop at Railway Crossing sign: for visibility of light units

Frequency:

Annually.

Purpose

To verify that the electrical Prepare to Stop at Railway Crossing sign is installed in accordance with the Manual of Uniform Traffic Control Devices for Canada and that the signs light units are visible to road users approaching the grade crossing.

Process

Because of the potential for this inspection to trigger a condition that could compromise the safety of railway operations, it is recommended that temporary protection measures be put in place before beginning the tests.

Verify that the Prepare to Stop at Railway Crossing sign is installed in accordance with Article A1.6 of the Manual of Uniform Traffic Control Devices for Canada.

Verify that the Prepare to Stop at Railway Crossing sign and its light units can be seen by road users approaching the stopping sight distance (SSD) point at the road design speed.

Item 2 - Traffic signals installed at a grade crossing in lieu of a warning system: for cleanliness, visibility of signal heads, and physical damage

Frequency:

Annually.

Purpose

To ensure that traffic signals installed at a grade crossing in lieu of a warning system are clean, visible, and free of physical damage.

Process

Because of the potential for this inspection to trigger a condition that could compromise the safety of railway operations, it is recommended that temporary protection measures be put in place before beginning the inspection.

Verify that all traffic signals installed at the grade crossing in lieu of a warning system are clean and free of dust, grease, and dirt.

Verify that they are visible to the road users within the SSD when illuminated and that they are aligned as per to the coordinates designed for each traffic signal.

Verify that they are free of defects, damage, and faded or rusty parts.

Item 3 - Traffic signal interconnection activation and operation with warning systems

Frequency:

Annually.

Note: This inspection should be conducted jointly with the railway authority.

Purpose

To ensure that the control circuits operate as designed and provide adequate warning be means of activating the traffic signals when railway equipment is detected.

Process

Because of the potential for this inspection to trigger a condition that could compromise the safety of railway operations, it is recommended that temporary protection measures be put in place before beginning the inspection.

Information on the parameters for operating the traffic control device must be on site and available to the road authority for inspection, testing and maintenance purposes (GCR 96(3)).

Verify that the recorded pre-emption times or synchronization (for the crossing) is in accordance with the design plans. Perform a test, ideally together with the railway, to confirm that the interconnection functions as designed (traffic controller test switch, actual train move, etc.). All phases of the interconnection should be tested as per the worst-case scenario.

When the Railway Crossing warning system is activated, the interconnected traffic signals must prevent road traffic from travelling over the Railway Crossing before railway equipment arrives at the crossing surface. The traffic signals must not give road users any indication to proceed towards the interconnected grade crossing once the automatic warning system has been activated.

Take into consideration all possible traffic movement, from all directions, and verify that the traffic lights give road users no indication to travel over the grade crossing before the arrival of a train at the crossing surface once the warning system has been activated.

If the site is equipped for such, verify that a minimum of four hours of battery backup up is provided.

Item 4 - Prepare to Stop at Railway Crossing sign activation and operation

Frequency:

Annually.

Note: This inspection should be conducted jointly with the railway authority.

Purpose

To ensure that the control circuits operate as designed and provide adequate warning by activating the Prepare to Stop at Railway Crossing sign when railway equipment is detected.

Process

Because of the potential for this inspection to trigger a condition that could compromise the safety of railway operations, it is recommended that temporary protection measures be put in place before beginning the inspection.

Where Prepare to Stop at Railway Crossing signs are installed and interconnected with a grade crossing warning system, verify that the advance activation time is the greater of the time it takes a vehicle travelling at the road crossing design speed to pass a deactivated Prepare to Stop at Railway Crossing sign and to:

1. clear the grade crossing before the arrival of railway equipment at the crossing surface, where there is a warning system without gates; or
2. clear the grade crossing before the gate arms start to descend, where there is a warning system with gates.

Perform a test to confirm that the interconnection functions as designed by simulating an operation (traffic controller test switch, actual train movement, etc.).

During the simulations, verify that the light units of the Prepare to Stop at Railway Crossing sign are illuminated and flashing in unison when activated.

If the site is equipped for such, verify that a minimum of four hours of battery backup up is provided.

Appendix L Guideline for Inspecting and Testing Pre-Emption of Interconnected Traffic Control Signals and Grade Crossing Warning Systems

Introduction

This guide was developed in consultation with Canadian stakeholders including members of the railway industry, Transport Canada, municipalities, road authorities, related professional associations, and federal and provincial government agencies concerned with public safety at grade crossings.

In the past, actions were taken that adversely impacted public safety with interconnected traffic signals and grade crossing warning systems. As a result, the ITE and AREMA got together and jointly addressed the problems encountered. There is now a new FHWA produced MUTCD chapter 8 that now addresses design. AREMA standards have now been modified to reflect these requirements.

This guideline is intended for railway and road authority employees or contractors assigned to the inspection, maintenance, repair, and the testing of grade crossings warning systems and traffic control signals that are interconnected for the purpose of

pre-emption of traffic control signals, or the activation of Prepare to Stop at Railway Crossing sign(s) (WB-6) beacon lights.

The procedures and forms recommended in this guide are provided solely as a guide and should not be quoted or considered as legal authority.

This guide is not intended to replace existing safety procedures or forms in use by the railway or road authority that may be more stringent; and should not considered to be a design document.

Use of this guide is intended to promote a regular joint railway/road authority inspection or test program for interconnected traffic control locations as well as improve communication between the responsible authorities.

Transport Canada welcomes further comments and input into future revisions of this guidance document as part of the ongoing improvement process with this publication.

Guidance

When interconnected, the grade crossing warning system and the traffic control signals operate in a very precise fashion and should be regarded as one system for purpose of "railway activated" pre-emption. For this reason, the sample checklists, site information and joint inspection record form are available in Appendix L-1 of this document. The form may be personalized for your record keeping and should be kept available at each interconnected system location for use as needed.

Railway and Road Authority Sample Checklist

The Sample Checklists found in Articles 1 and 2 below of these appendices provide a systematic method of verifying interconnected systems stated design features. This is for the use of railway and road authority employees and contractors assigned to inspect, maintain, or test grade crossing warning systems interconnected with roadway traffic control signals. Additional checks may be deemed necessary by your responsible engineering managers to ensure proper functioning of interconnected systems.

> **Note:** Any changes to railway or road traffic conditions discovered during the performance of these checks or other regularly scheduled inspections must be reported to the other party. The relevance of these observed changes may trigger an engineering safety evaluation of the site. Examples of this are changes to railway operation or speed; changes to design vehicle, road crossing design speed, increase in average annual daily traffic; spotting vehicles queuing onto crossing surface area; and vehicles having difficulty stopping safely when a train approaches and activates the warning system.

Site Information and Joint Inspection Record Form

The sample site information and joint inspection record form found in Appendix L-1 provides a location for recording site-specific information including contact persons, crossing and intersection coordinates, railway control circuit features, and design timing parameters. No maintenance employee is authorized to make changes to the system settings without completion of an engineering joint safety site study. The bottom section of the form allows documentation of joint inspection due date and should be completed by the employees assigned to conduct the joint inspection and tests.

Warning Labels

The use of weather resistant, self-adhesive, florescent labels to help identify these unique interconnected systems are to be installed in the traffic control cabinet and the railroad warning system enclosure (bungalows or cases). This information could be critical during a system failure or when a manual override of the traffic control system by local enforcement agencies or rail and road supervisory and maintenance personnel is needed. The labels affixed at each signal control housing, should be clearly visible.

In cases where the Railway Crossing operation test feature also pre-empts the traffic signal, another label affixed near this test feature is required. This will remind or inform the railway employee performing the test they will cause activation of the pre-emption action at the traffic signals when testing.

Railway Safety Act and You

The *Railway Safety Act* (RSA) has requirements with respect to all engineering work relating to railway works.

- Subsection 11(1) and 11(2) of the RSA states:

  "All work relating to railway works — including, but not limited to, design, construction, evaluation, maintenance and alteration — must be done in accordance with sound engineering principles."

  And

  "All engineering work relating to railway works must be approved by a professional engineer"

Employees responsible for the maintenance of these systems should not make any changes or modifications without prior authorization by a professional engineer. Any changes on one system may have serious consequence on the other, and the impact on both systems must be carefully assessed.

- Subsection 41 (1) of the RSA, states:

  Every person who contravenes a provision of this Act is guilty of an offence and liable:

a) on conviction on indictment,

   i) in the case of a corporation, to a fine not exceeding one million dollars, and
   ii) in the case of an individual, to a fine not exceeding fifty thousand dollars or to imprisonment for a term not exceeding one year, or to both.

b) on summary conviction,

   i) in the case of a corporation, to a fine not exceeding five hundred thousand dollars, and
   ii) in the case of an individual, to a fine not exceeding twenty-five thousand dollars or to imprisonment for a term not exceeding six months, or to both.

If you would like more information regarding the application of Section 11 of the RSA, please contact Transport Canada Rail Safety at the contact info provided in Appendix F of the Grade Crossing Handbook.

Article 1 - Railway "Inspection and Tests Sample Checklist"

a) Regular Inspection and Test

   1. Ensure the design parameters are recorded on the "Site Information and Joint Inspection Record Form" (see Appendix L-1).
   2. Activate grade crossing warning system.
   3. Confirm that the pre-emption signal activates the traffic signals.
   4. If applicable, confirm advance pre-emption or activation of traffic signal (flashing signal, turn restrictions etc.).
   5. Ensure all warning labels are clearly visible and legible.
   6. If due, arrange the upcoming Joint Railway/Road Authority Scheduled Inspection and Test; and
   7. Report any railway, road traffic or physical surroundings condition changes (additions resulting in line of site obstructions etc.).

b) Joint (Railway/Road Authority) Inspection and Test

   1. Verify Timing Design Parameters listed on the "Site Information and Joint Inspection Record Form" (see Appendix L-1).
   2. Confirm interconnection circuit wires are free of grounds or foreign currents and the system fails in the safe mode.
   3. Identify if special features are included and that they function as designed (e.g.: supervisory circuit, power failure monitoring circuit).
   4. Activate grade crossing warning system and confirm pre-emption activation of traffic signals during all phases of the traffic controller unit operation.

5. Repeat previous step for multiple track locations including any advance pre-emption circuits; and
6. Record joint inspection and test date as well as the next scheduled date on the Site Information and Joint Inspection Record Form

Article 2 - Road Authority “Inspection and Tests Sample Checklist”

a) Regular Inspection and Test

1. Ensure the timing design parameters are recorded on the “Site Information and Joint Inspection Record Form”.
2. Simulate the pre-emption signal input from grade crossing warning system while confirming the railway interconnect is connected to the highest priority control unit input.
3. Confirm pre-emption activation of traffic signals including any associated pre-signals or active signs etc. and that the clear-out phase on the control unit cannot reset or resume its normal operation until the gates have returned to the vertical position or the Railway Crossing warning system is no longer operating.
4. Confirm the standby battery power “if applicable”, operates as designed.
5. Ensure all warning labels are clearly visible and legible.
6. If required, arrange upcoming Joint Railway/Road Authority Scheduled Inspection and test; and report any roadway, rail traffic, or physical surroundings condition changes that may affect the road user’s line of site visibility.

b) Joint (Railway/Road Authority) Inspection and Test

1. Confirm Timing Design Parameters on the “Site Information and Joint Inspection Record Form” are correct and are operating as designed in the field.
2. Confirm interconnection circuit wires are free of grounds or foreign currents and the system fails in the safe mode.
3. Confirm the pre-emption signal from the railway is connected to highest priority pre- emption input.
4. Identify if special features are included and function as designed (e.g.: interconnect supervisory circuit, power failure monitoring circuit).
5. Activate grade crossing warning system (railway action) and confirm pre-emption activation of traffic signals responds during all phases of the traffic controller unit operation.
6. Confirm pre-emption restarts after a CU time-out sequence (second or stopped and restarted train scenario) note: when using gates this time out sequence should not be possible unless gate arms have been activated

up resetting the CU, “this is sometimes referred to as traffic signal controller re-service”.

7. Ensure pedestrian clear-out time matches the design timing.
8. When applicable, ensure the active “Prepare-to-Stop-at-Railway-Crossing Sign (WB-6)” delayed beacon turn-off time; and
9. Record joint inspection and test date as well as the next scheduled date on both the railway and road authority Site Information and Joint Inspection Record Forms.

Definitions

Note: Common definitions are used in this guide and are adopted by the ITE. In the US the Federal Highway Administration (FHWA) produces their own definitions through the *Manual of Uniform Traffic Control Devices for Canada* (MUTCDC).

Advance Pre-emption / Advance Pre-emption Time (APT)

Notification of an approaching train is forwarded to the highway traffic signal controller by railroad equipment for a period prior to activating the railroad active warning system. This period is the difference in the Maximum Pre-emption Time required for highway traffic signal operation and the Minimum Warning Time needed for railroad operation. (Note: common definitions have been adopted by AREMA and the ITE and are used in the US FHWA version of the MUTCD)

Advance Activation Time of the Prepare to Stop at Railway Crossing Sign (WB-6)

The time specified by the road authority to provide advance notification of an approaching train before the activation of the grade crossing warning system. “See advance pre-emption time.” (TC)

Approach Timing (prescribed warning time)

Prescribed Warning Time (Minimum Warning Time) – For through train movements, Prescribed Warning Time (Minimum Warning Time) is the least amount of time a warning system shall operate prior to the arrival of a train at a grade crossing.

Beacon

This is a signal face (light) with one or more sections that operates in the flashing mode. (ITE)

Clear Storage Distance (CSD)

The distance available for vehicle storage measured between 2.4 meters from the rail nearest the intersection to the intersection stop line or the normal stopping point of the roadway.

Control Unit (CU)

A part of a traffic signal controller assembly that is devoted to the selection and timing of signal phases. (ITE) Note: These come in several versions with different characteristics regarding identifying the railway priority input(s). (ITE)

Delayed Turnoff of Prepare to Stop at Railway Crossing Sign (WB-6)

This is a delay in the turn off the advance warning sign beacons and is intended to reduce the speed of approaching vehicles thus allowing the crossing area to safely clear out of previously stored traffic after the passage of a train. (TAC)

Grade Crossing

A road crossing at grade, or two or more road crossings at grade where the lines of railway are not separated by more than 30 m.

Interconnected Signals

These are traffic signals that are connected by some means for the purpose of establishing a definite timing relationship. (ITE)

Interconnection

This is the electrical connection between the grade crossing warning system and the traffic signal controller for the purpose of pre-emption. This may be a “Vital Serial” wire or wireless connection utilizing isolated vital serial data circuit(s) or a hard wire interconnection circuit. Vital serial connections are designed using fail-safe design principals. (ITE)

Institute of Transportation Engineers (ITE)

This organization prints the US MUCTD and has a joint committee with AREMA to ensure there are common definitions used when these systems are interconnected. This guide incorporates the ITE definitions.

Manual of Uniform Traffic Control Devices for Canada (MUTCD-C)

Manual of Uniform Traffic Control Devices for Canada and is managed by the Transportation Association of Canada. You can find more information at their website.

Manual of Uniform Traffic Control Devices US (MUTCD)

The MUTCD for the USA is a product of the (FHWA) and covers all aspects of traffic design including crossing protection interconnection in section 8. The manual may be ordered from their website or may be downloaded via the FRA website.

Minimum Warning Time (through train movements)

The least amount of time a grade crossing warning system shall operate prior to the arrival of railway equipment at the grade crossing. (ITE)

Motion Sensing

Directional Logic System with additional capability to differentiate between moving trains (Greater than 2 mph) and stopped trains (Less Than 2 mph); and ability to provide direction of motion.

Pre-emption

The transfer of normal operation of road traffic control signals to a special control mode. (ITE)

> **Note:** The need for pre-emption, type of pre-emption and time interval for any advance pre-emption shall be determined by the road authority having jurisdictional authority.

Pre-Signal

This is a supplementary traffic signal that is part of the traffic control signal system and is controlled by the road intersection CU. It is normally placed in a position that controls road traffic approaching the grade crossing warning system and the intersection. (ITE)

Prepare to Stop at Railway Crossing Sign (WB-6)

The active Prepare to Stop at Railway Crossing Sign Indicates to drivers in advance of a Railway Crossing warning system that there is a high probability of having to stop for the grade crossing warning system ahead. The primary function is to reduce dilemma zone incidents. (MUTCD-C)

Queue Clearance Time (QCT)

The time required for the design vehicle of maximum length stopped just inside the clearance distance to start up and move through and clear the entire clearance distance.

Railway Safety Act (RSA)

This is an Act of the Parliament of Canada, which applies in respect of transport by federal railways to all persons, railway companies and railways within the legislative authority of Parliament. You can find a copy of the RSA here.

Right-of-way Transfer Time (RWTT)

The maximum amount of time needed for the worst-case condition, prior to display of the track clearance green interval. This includes any railway or highway traffic signal control equipment time to react to a pre-emption call, and any traffic control signal green, pedestrian walk and clearance, yellow change, and red clearance intervals for conflicting traffic.

Separation time

The maximum amount of time needed for the worst-case condition, prior to display of the track clearance green interval. This includes any railway or highway traffic signal control equipment time to react to a pre-emption call, and any traffic control signal green, pedestrian walk and clearance, yellow change, and red clearance intervals for conflicting traffic.

Simultaneous Pre-emption

Notification of an approaching train is forwarded to the highway traffic signal controller unit or assembly and railroad active warning devices at the same time. (ITE)Test and inspections:

This means to inspect certain components, and to subject them to specified electrical and/or mechanical tests to verify their proper operation, timing, and are required to be completed within the minimum frequencies prescribed in table 17-1, table 17-2 and table 20-1 of the *Grade Crossings Standards* as required by section 95 and 96 of the *Grade Crossings Regulations*

Traffic Signal Controller Re-service

This is when the pre-emption signal is re-established after an immediate prior activation as in a second train or a stop and restart scenario. (ITE)

Transport Canada (TC)

Transport Canada is the federal government department responsible for most of the transportation policies, programs and goals set by the government of Canada.

Vital Serial

Vital serial communication connections are designed using fail-safe design principals. A break or unacceptable change in the data stream acts the same as a broken or shorted wire in a conventional wire based interconnected fail-safe designed system. (ITE)

Warning System

An automated system, other than and interconnected traffic signal, that Indicates the approach or presence of railway equipment at a grade crossing and that is composed of any combination of light units, bells, gates, operating mechanisms, and circuits.

WB-6

This is the TAC (MUTCD-C for Canada) identifier used for active Prepare to Stop at Railway Crossing Signs. The old name used for this was Active Advance Warning Sign and this reference may still be used in some areas of North America. (TAC)

Appendix L-1

Site Information and Joint Inspection Record Form

For

Interconnected Grade Crossing Warning Systems with Traffic Control Signals

ATTENTION:

DO NOT MODIFY the pre-emption design without written joint approval from the railway and the road authority engineers responsible for safety at this location.

Date of joint inspection_____ Date of Road Authority inspection_____

Railway Co. _____ Subdivision _____

Contact person _____ Subdivision mileage _____

Phone no _____-_____-_____ Email address _____@_____

Railway emergency call number _____-_____-_____

Transport Canada Crossing Inventory No. _____

Road Authority _____ Road intersections _____& _____

Contact person _____ Email address _____@_____

City _____ Phone No _____-_____-_____

Province _____ R. A. Identifier _____

Road Authority (R.A.) emergency call number _____-_____-_____

Grade Crossing Warning System Type and Timing Control Circuit Settings:

Constant warning approach timing: ____ Fixed distance approach timing: ____ Motion sensing: ____

Does test switch feature deactivate pre-emption of traffic signals: Yes _____ No _____.

Does test switch feature activate pre-emption of traffic signals: Yes _____ No _____.

Grade crossing warning system warning time _____ seconds.

Advance Pre-emption Time (APT) if required by the Road Authority is _____ seconds in order to provide the total required Pre-emption time of _____seconds to the traffic signal controller.

Traffic Signal Pre-emption Activation Timing Settings and Control Circuit Type:

Controller unit type (specify):

_____

Total Traffic controller pre-emption activation warning time required prior to train arriving at crossing is _____seconds. Note: This time is greater than the crossing activation time above if the railway is requested to provide advance pre-emption (railway term) due to their normal approach time being insufficient for road authority timing purposes. Delayed WB-6 beacon turn off time as specified by the Road Authority is ____ seconds. See Guide definitions for time setting explanations and sample timeline.

Interconnection circuit: Level: ____volts, Type (check): AC ___, DC ___ or Vital Serial ____

Next Joint Inspection Due: _____/____/_____ (sign below when inspection completed)

MM / DD / YYYY/ TT: TT | Railway Contact Name | Road Authority Contact Name

_____/____/_____/___:____
|_____|_____

(Print names)
_____|_____
___

Appendix L-2

Recommended warning labels (Florescent orange or yellow background with black letters).

WARNING

THIS LOCATION IS
INTERCONNECTED WITH THE
GRADE CROSSING WARNING SYSTEM

_____

Place this label at Traffic Signal Controller Housing location

_____

WARNING

THIS LOCATION IS

INTERCONNECTED

WITH THE TRAFFIC CONTROL

SIGNALS

Place this label at the Railway Crossing Warning System Housing

---

WARNING

Keep the crossing warning test or flagging operation time short.

Activation of the Grade Crossing Warning System

Will affect the interconnected Traffic Control Signals.

Extended operation may require flagging of road traffic.

Place this label at the railway test location when applicable

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Appendix M Supplemental Engineering Design Guidance for Vulnerable Road Users at Grade Crossings

Terminology

Terms used in this guidance material are defined within Article 1 of this Grade Crossings Handbook.

Introduction

The *Grade Crossings Regulations* (GCR) and associated *Grade Crossings Standards* (GCS) came into effect on November 28th, 2014. The GCR aims to improve safety at grade crossings by setting comprehensive and enforceable safety standards for both new and existing grade crossings in Canada. The GCR clearly defines the roles and responsibilities of railway companies, road authorities and private authorities and requires that railway companies and road authorities share key safety-related information with each other. Subsection 12(1) of the GCR indicates that road authorities are required to determine if the grade crossing includes a sidewalk, path, or trail, and if

so, whether the sidewalk, path or trail has been designated for use by persons using assistive devices.

In May 2018, Transport Canada (TC) committed to the development of supplemental engineering guidance to improve safety of grade crossings designed for Vulnerable Road Users (VRU) including persons using assistive devices. This commitment was made in response to a recommendation from the Transportation Safety Board of Canada (TSB) following the fatal collision involving a person using a wheelchair at a grade crossing in Moncton, New Brunswick on July 27, 2016. The full TSB investigation report can be found here.

In 2018, TC conducted a literature review and analyzed publicly available information on VRU treatment options available at grade crossings. The term VRU is defined within the transportation industry as pedestrians, cyclists or persons using assistive devices. VRUs are at greater risk of injury when involved in a collision due to the lack of protection they have from traffic. In Canada, since 2016, there have been two reported fatal collisions at grade crossings involving persons using assistive devices.

This document provides guidance on the relevant regulatory requirements and best practices regarding assessing the level of activities of Vulnerable Road Users (VRUs) at grade crossings, strategies in risk reduction, and improving crossing safety for VRUs.

Vulnerable Road User (VRU) Level of Activity Assessment

Grade crossings present various challenges to VRUs. For those that use a wheelchair, scooter or other mobility device, the mobility constraint at a grade crossing might be associated with apprehension and hesitant behaviour, especially at unfamiliar grade crossings. Flangeway gaps can present significant trip and entrapment risks, particularly for those using devices such as wheelchairs, wheeled walkers, strollers and walking canes11. For wheelchair users, especially those in manual wheelchairs, the primary concern is getting a caster wheel stuck in one of the gaps over the crossing (i.e., a flangeway gap or any wider gaps between the surface and panels).

Existing sidewalks, paths, or trails leading to a grade crossing must meet the *GCR*, and the *GCS*. Other supplemental guiding principles are also provided in this *Grade Crossings Handbook*, the *Manual of Uniform Traffic Control Devices for Canada,* and *Geometric Design Guide for Canadian Roads*.

11 Australasian Centre for Rail Innovation – LC15 Identification of Solutions to Rail Flange Gap Issues at Pedestrian Level Crossings

Appendix Table M-1Level of VRU Crossing Activity Assessment

Parameter	Assessment
Crossing Volume*	Number of assistive device users, pedestrians, and cyclists (low, moderate, high) Number of assistive device users, pedestrians, and cyclists of neighbouring roadway if crossing count is not available
Pedestrian/Cyclist Facilities	Presence of pedestrian facilities: sidewalks or pathways/bicycle facilities/multiuse pathways Evidence of crossings activities (e.g., dirt path leading to tracks)
Neighbouring land use	Road classification: urban or rural Presence of schools, parks/playgrounds, shopping centers, plazas, recreational centers, libraries, arenas, etc. Adjacent land use (e.g., major attractions on one or both sides of the grade crossing that would encourage users to cross at that location)

Appendix Table M-1 provides a list of parameters to consider when assessing the level of activity at a grade crossing. These will serve to assess the needs of all potential users and to consider them in the design and maintenance of grade crossings. This assessment is typically collected by the responsible road authority for the grade crossing.

Assistive Device Users, Pedestrians and Cyclists Crossing Volume Activity Levels

Low: No presence of sidewalks, paths, or trails. No known use by vulnerable road users. Adjacent land use is rural/vacant, agricultural, or industrial with no sidewalks or pathways.

Moderate: Moderate use of crossing by vulnerable road users. Urban area and neighbouring land use is residential/commercial.

High: High crossing volumes. Significant attractions near the crossing (e.g., retirement residences, stadiums, schools, shopping malls). Clear evidence of vulnerable road users using the crossing on a regular basis.[12]

Crossing Volume

Direct observation is the ideal means to assess how a crossing is used and by whom. Typically, this would be a standard eight-hour count that includes the peak periods in the morning, at mid-day, and in the afternoon (like vehicle counts). However, there may be considerable activity during other time periods due to the grade crossing's proximity to areas such as entertainment and recreation centres. As such, volume counts may be required outside of the standard eight-hour count period.

Crossing volume data should be classified by type, namely pedestrians, cyclists and persons using an assistive device. It may also be useful to further break down collected information by the age group of individuals, such as children, adults, and elderly.

Pedestrian/Cyclist Facilities

If grade crossing usage count is not available, the presence of existing facilities (e.g., sidewalk, bicycle lane, multi-use pathway) leading to the grade crossing will provide an indication of the likelihood of the presence of VRUs.

Neighbouring Land Use

Urban areas are expected to have a higher number of assistive device users, pedestrians, and cyclists than in rural areas. Attention should be given to major attractions or other public facilities, such as schools and shopping malls, where crossing activity can be expected to be high. Consideration should also be given to nighttime attractions located in the vicinity of the crossing, such as night clubs, theatres, restaurants, etc.

Design Options and Considerations

There are several engineering designs options that improve grade crossing safety. For example, signage and warning systems at grade crossings provide users with a variety of visual and audible cues to assist them with crossing safely. Engineering designs should also consider disabled persons who may have added challenges crossing safely depending on the physical characteristics of the crossing, such as the structure, gradient, and track exposure[13]. The following engineering design options are applicable

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[12] AECOM, Transport Canada, 2009, Pedestrian Safety at Highway-Railway Grade Crossings

[13] Rail Safety and Standards Board Ltd. Improving safety and accessibility at level crossing for disabled pedestrian, Emma Delmonte, Simon Tong, UK, 2011

to typical grade crossings (provides a quick reference of typical design considerations for grade crossings to reduce site specific risks). Other measures can be considered, such as providing a grade separated crossing or offer alternative access (i.e., different location) to cross the tracks safely. For exceptional cases, consider having an evaluation conducted by practitioners.

Warning Signs

Warning signs caution users of hazards (e.g., skewed crossing, second train/track) or direct users to take a particular action (e.g., look both ways, do not cross here). Signs must not restrict the mobility of persons using assistive devices and must not restrict sightlines or the visibility of the warning systems at the grade crossing. Signs may lead to a moderate increase in comprehension levels.

For additional guidance refer to figures in Article 8 of this Grade Crossings Handbook.

Pavement Markings

Pavement markings define sidewalks and pathways leading to and across the crossing surface and indicate the desired location to stop while waiting for the approaching train. These markings may lead to a moderate increase in comprehension levels.

For additional guidance refer to figures in Article 8.8 of this Grade Crossings Handbook.

Surface Treatments

Surface treatments are visually contrasting materials, such as tactile walking surface indicators and flangeway gap fillers. They are expected to have a moderately positive impact on accessibility, particularly among those with a visual impairment and persons using assistive devices. Pedestrians with a visual impairment may find it difficult to identify that they are approaching a crossing because many of the cues are visual. Tactile surfaces in advance of the crossing provide visually impaired pedestrians with a reliable, recognisable indication that they are approaching a hazard.

Furthermore, flangeway gap fillers are designed to reduce the risk of small wheels or objects getting stuck in the flangeway gap and provide a smooth and continuous crossing surface. However, at the time of publication, the Canadian freight rail sector has limited experience with flangeway gap fillers; therefore, additional research may be warranted.

Barriers

Barriers, such as fencing and “Z” barriers or maze barriers, are designed to guide the crossing users to cross at a desired location. However, unless carefully designed, fencing and “Z” barriers may have a negative impact on accessibility. Persons using assistive devices and those with visual impairments may find them difficult to navigate.

Barriers should be designed with consideration to the turning radii of assistive devices. Barriers may lead to a moderate increase in comprehension levels, as well as encourage the crossing users to look in the direction in which trains may be approaching.

For additional guidance refer to Article 26 of this Grade Crossings Handbook.

Refuge Area

The refuge area is provided to crossing users to wait while a train passes in advance of the stop line or tactile walking surface indicator. Incorporate standards and best practices in the design of the refuge area and ensure it is accessible and clearly identified for all grade crossing users, including assistive device users, pedestrians, and cyclists.

Active Systems with an auditory or visual warning system

Active systems with an auditory or visual warning system activate when a train approaches or occupies the crossing. This includes second train event warning systems. In an active warning system with gates, a gate is closed or lowered when a train is approaching or occupying the crossing. These systems would have a positive impact on safety, as well as accessibility because they provide assistance to those with auditory or visual impairments.

Grade Crossing Illumination

Grade crossing illumination benefit all users by providing increased visibility of the area and surrounding environment along the crossing approach and its surface in low-light or nighttime conditions.

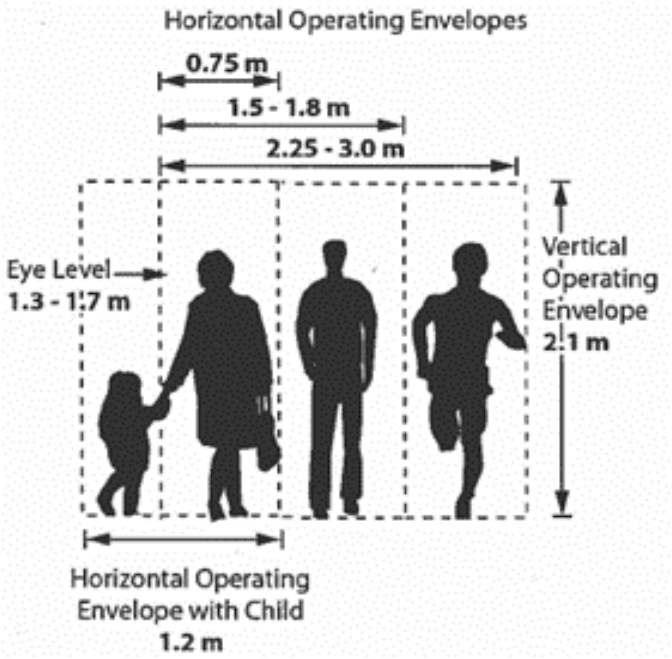
Appendix Table M-2Crossing User Typical Design Considerations

Pedestrian Category	Design Considerations Expected to Reduce Site Risk
A. Elderly B. Persons Using Assistive Device C. Persons with Visual Impairment D. Children and Youth	Automatic gates covering sidewalks/gate skirts [A, B, C, D] Active system (auditory/visual) [A, B, C, D] Signs to draw attention to the crossing as per MUTCDC and GCS and Grade Crossings Handbook (specifications in terms of location, height, visibility, ability to clearly convey the message etc.) [A, B, D] Barriers and guide fencing [A, B, C, D] Adequate illumination of the crossing and approaches [A, B, D] Signs advising train speed [A, B, D] Pavement marking as per MUTCDC (Defining and/or painting the approaches and across the tracks with edge lines) [A, B, D] Flangeway fillers [A, B, C] Tactile walking surface indicator [A, C] Visually contrasting pavement marking [A, B, C, D]

Other Reference Material

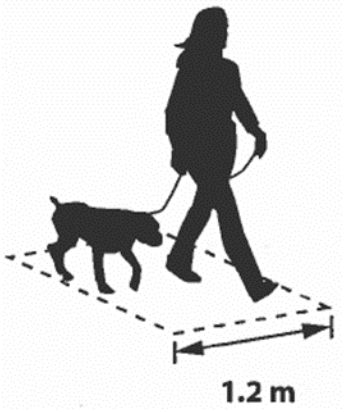
As with all aspects of geometric design, engineering judgement is necessary when assessing the range of design options presented in this guideline. The best engineering practice is to design grade crossings in an integrated approach by considering the needs of all VRUs. In other words, in urban areas or where the presence of persons using assistive devices, pedestrians and/or cyclists may be high, transportation practitioners should ensure that the design of the grade crossing considers engineering standards and best practices and guidelines. It is recommended to consider direct observation for existing grade crossings in urban areas with sidewalks, paths, or trails. For new grade crossings, assumptions can be made based on plans for future developments (e.g., urban densification estimates are an indication of more sidewalks).

The following figures provide additional guidance on the dimension/operating envelope of pedestrians, which should be integrated in the design of facilities for all pedestrians. Design specifications, operating space, and dimensions are outlined in Section 6.2 of the Geometric Design Guide for Canadian Roads.



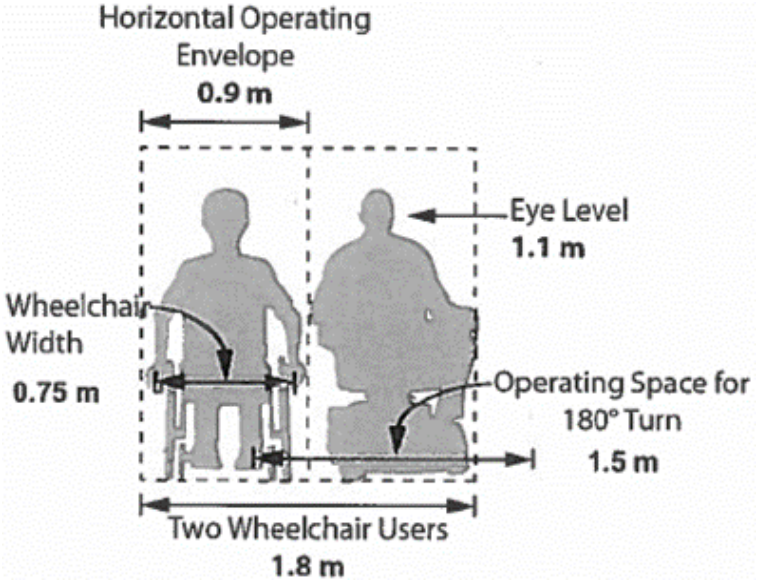
Appendix Figure M-1 Typical Pedestrian Dimensions

Source: Transportation Association of Canada (TAC), 2017, Geometric Design Guide for Canadian Roads



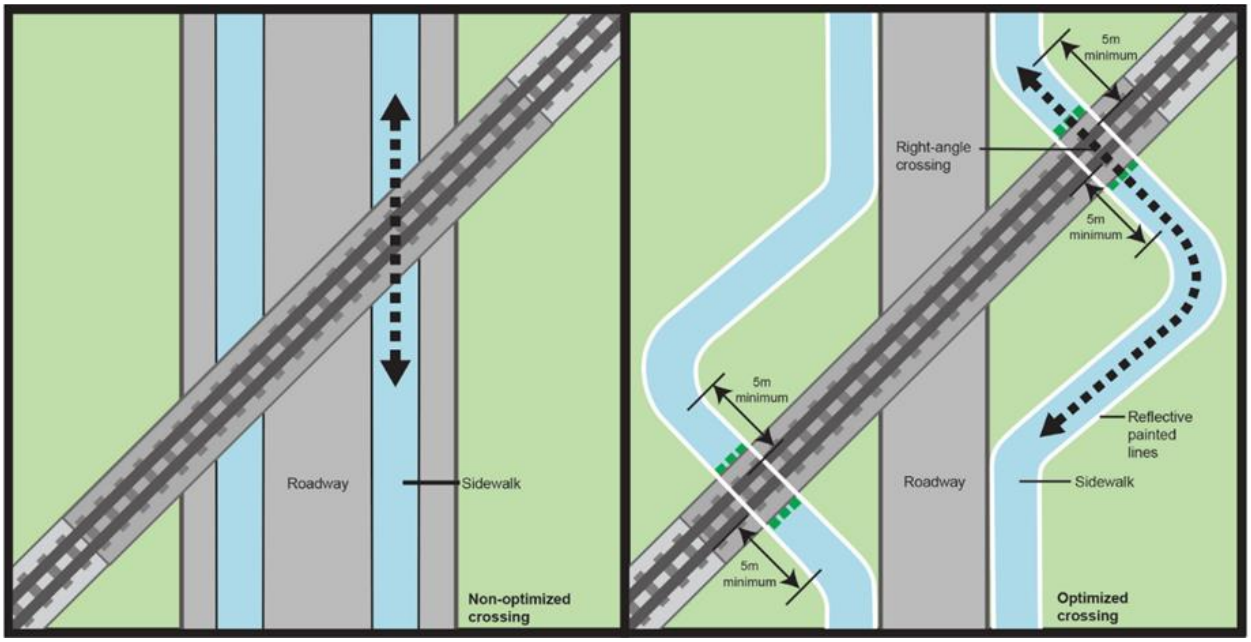
Appendix Figure M-2 Horizontal Operating Envelope for a person with a Service Animal

Source: Transportation Association of Canada (TAC), 2017, Geometric Design Guide for Canadian Roads, Chapter 6-Pedestrian Integrated Design



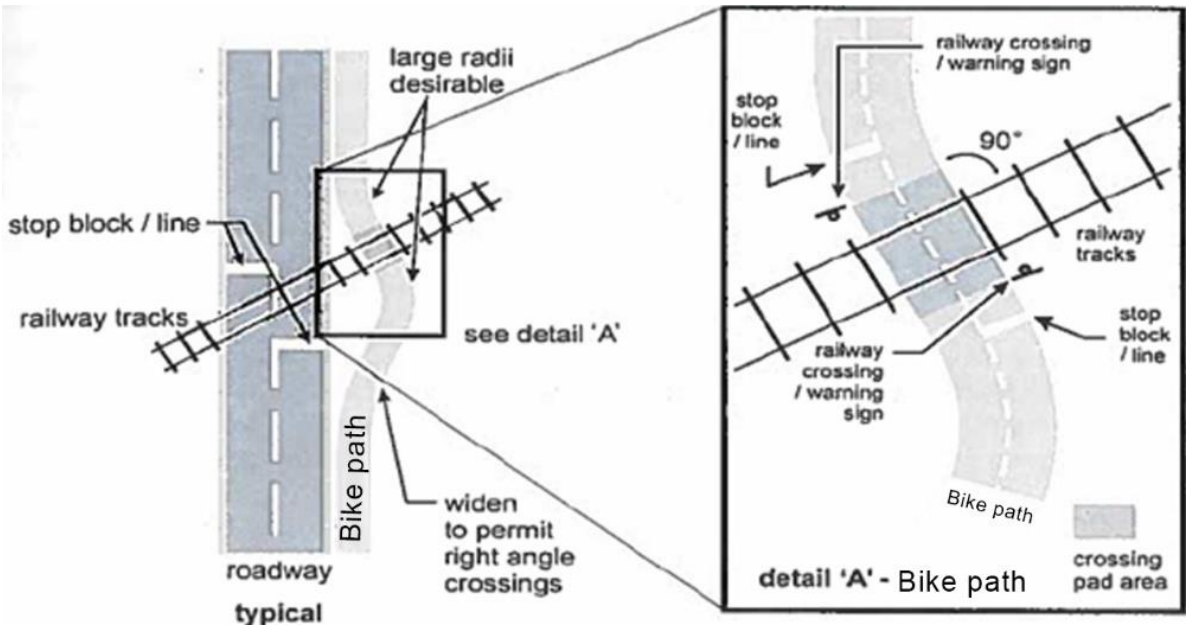
Appendix Figure M-3 Wheelchair User Dimensions

Source: Transportation Association of Canada (TAC), 2017, Geometric Design Guide for Canadian Roads, Chapter 6-Pedestrian Integrated Design



Appendix Figure M-4 Sidewalk design to optimize the railway crossing angle so that pedestrians can cross at a 90-degrees angle

Source: Transportation Safety Board (TSB) Report R16M0026, July 2016, Railway Investigation Report Figure14: Sidewalk design to optimize the railway crossing angle so that pedestrians can cross at a 90-Degree Angle



Appendix Figure M-5 Bike Path Crossing Railway/Streetcar Tracks

Source: Transportation Association of Canada (TAC), 2017, Geometric Design Guide for Canadian Roads, Chapter 5-Bicycle Integrated Design Figure 5.6.19 pg.67

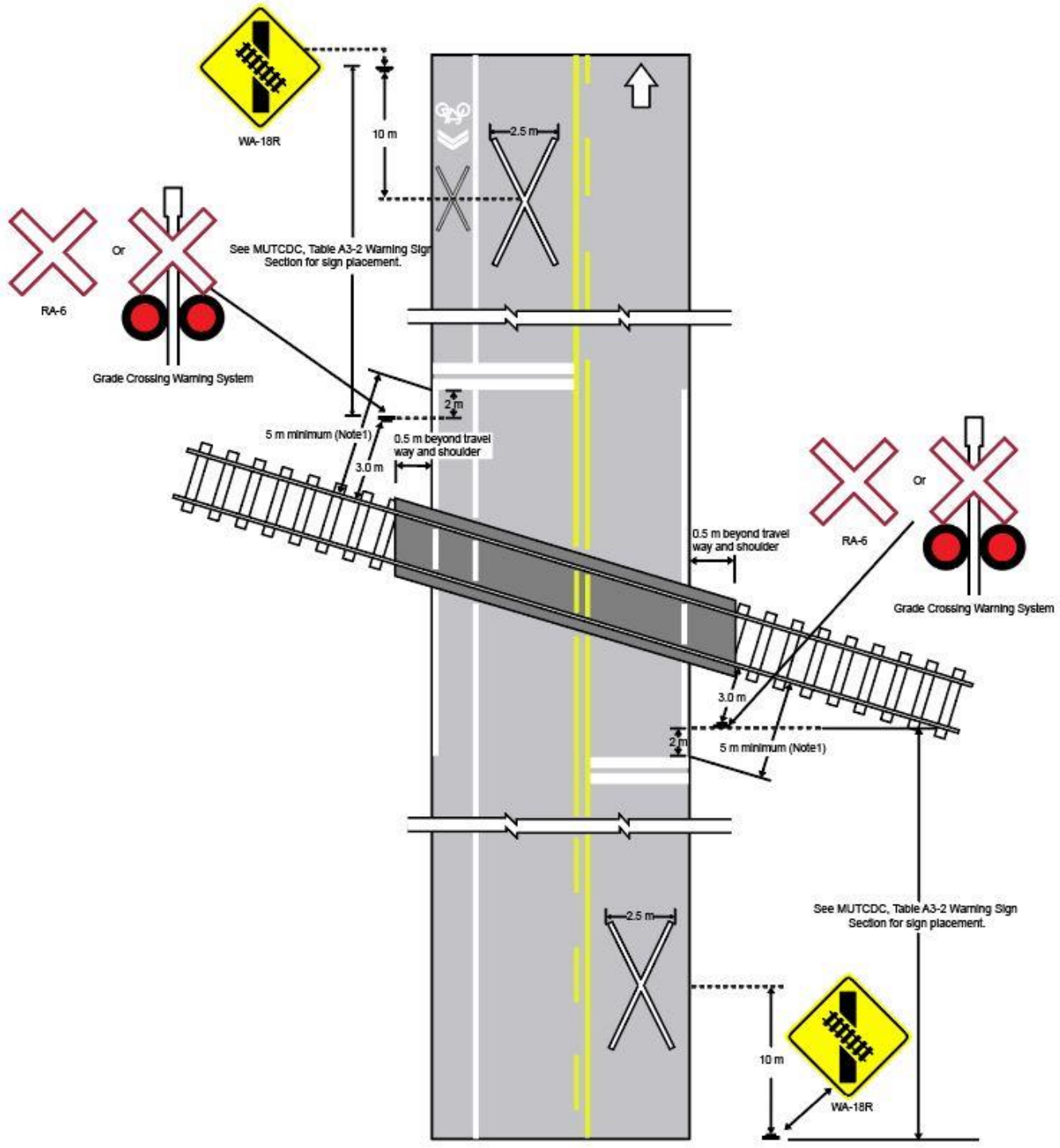
For figures specific to the required width of the crossing surface, refer to Figure 5-1 and Article 5 of this Grade Crossings Handbook.

The following figures provide examples of typical engineering design options for grade crossings with roads and bicycle lanes, grade crossings with standalone sidewalks, paths or trails, and grade crossings with a sidewalk, path or trail adjacent to the grade crossing.

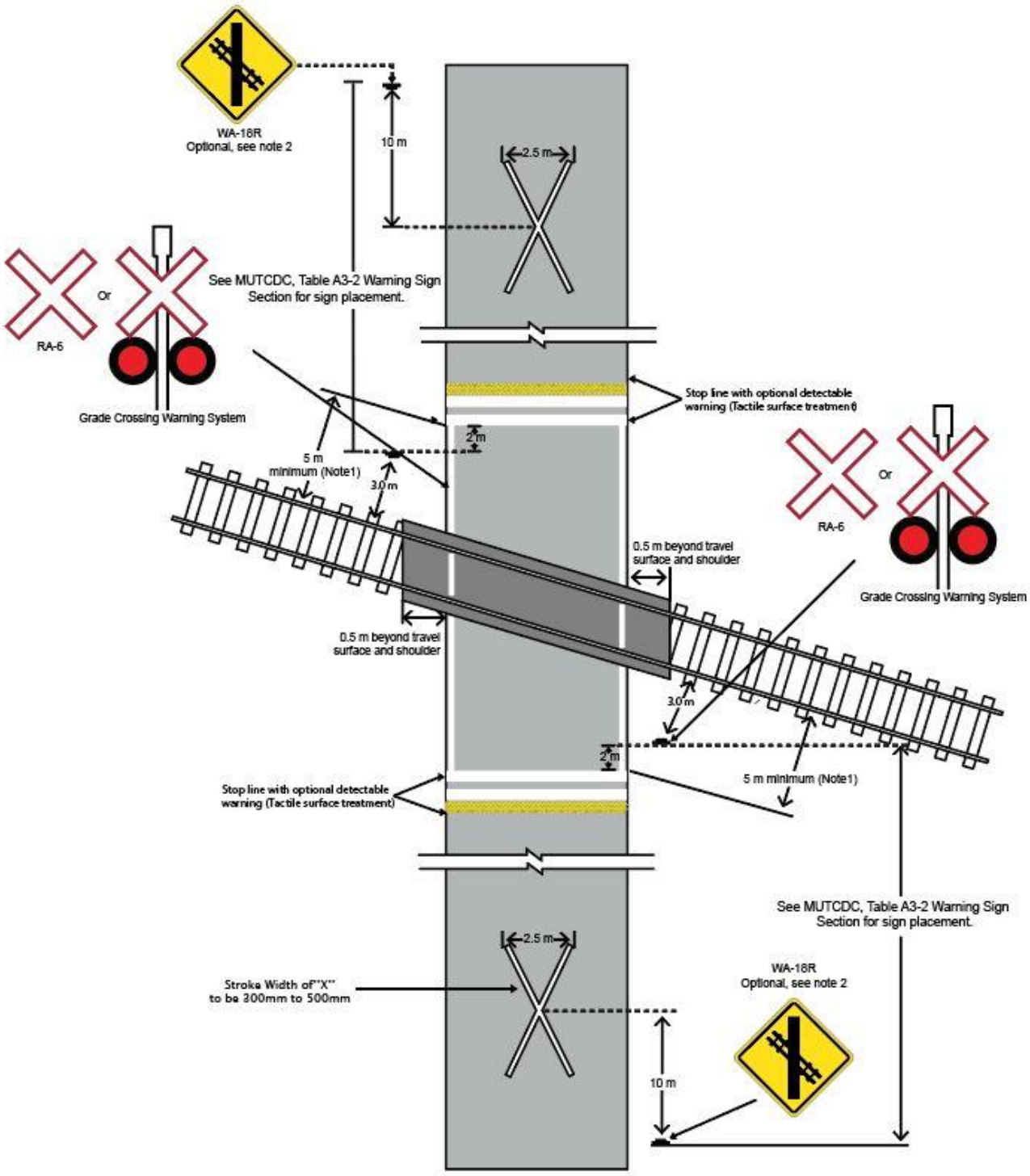
> **Note:** As provided for under Article 8.2 of this Grade Crossings Handbook, in cases where grade crossing signage cannot be seen from SSD, a "RAILWAY CROSSING AHEAD" sign must be used when the grade crossing is equipped with a Standard Railway Crossing Sign. Furthermore, as provided under Article 18 of this Grade Crossings Handbook, when the grade crossing is equipped with a warning system and the grade crossing warning system cannot be seen from SSD, a "PREPARE TO STOP AT RAILWAY CROSSING" sign must be installed.

For skewed angle grade crossings, it would be recommended to design the sidewalk, pathway, or trail perpendicular within a minimum distance of 5m from the nearest rail to the stop position to provide persons with assistive devices an opportunity to cross at a 90-degree angle.

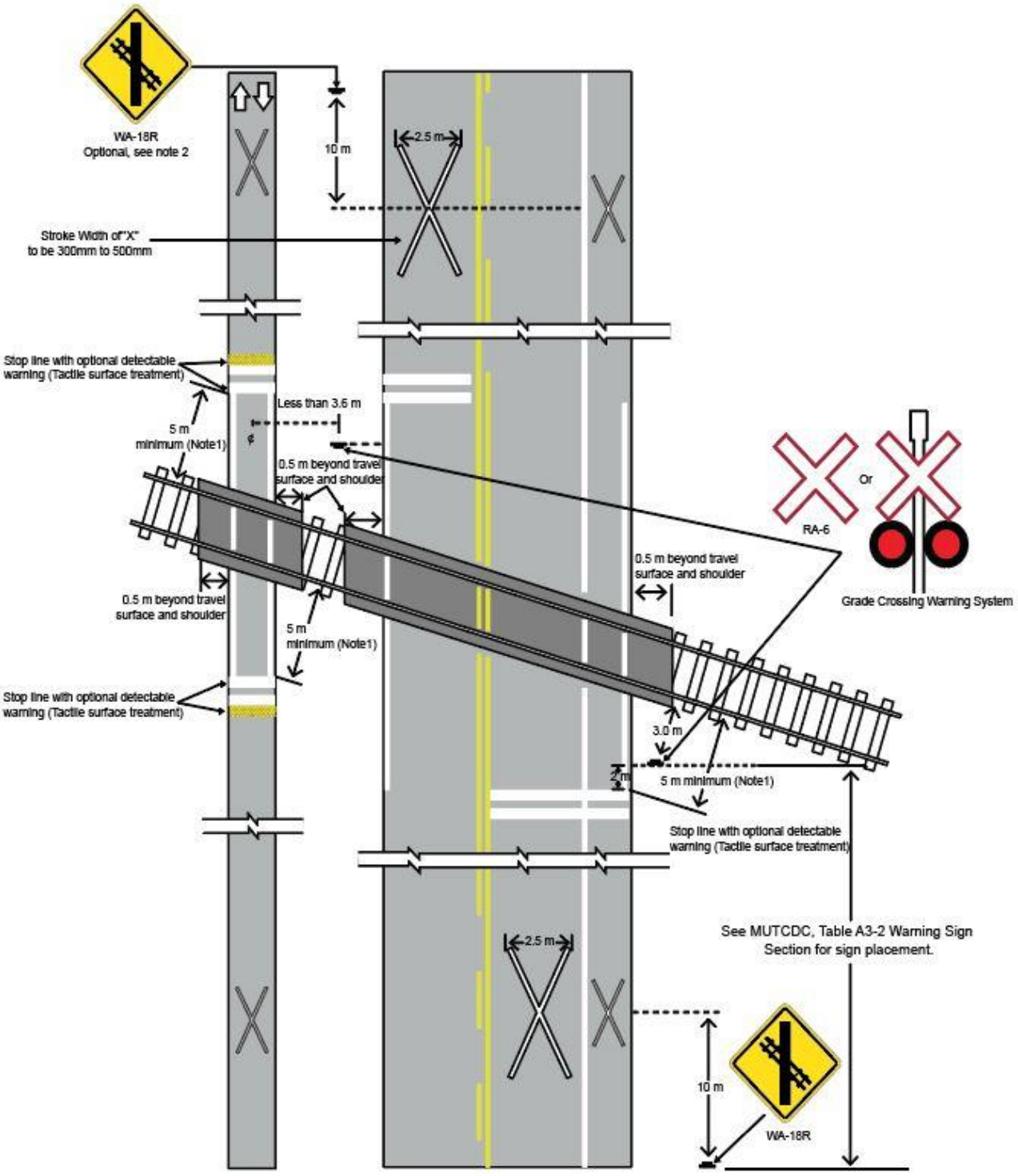
Also, as provided for in article 13.4.1 of this Grade Crossings Handbook, a sidewalk, path, or trail with a centerline more than 3.6 m (12ft.) from the centre of a nearby warning signal mast must have separate light units for each direction of travel.



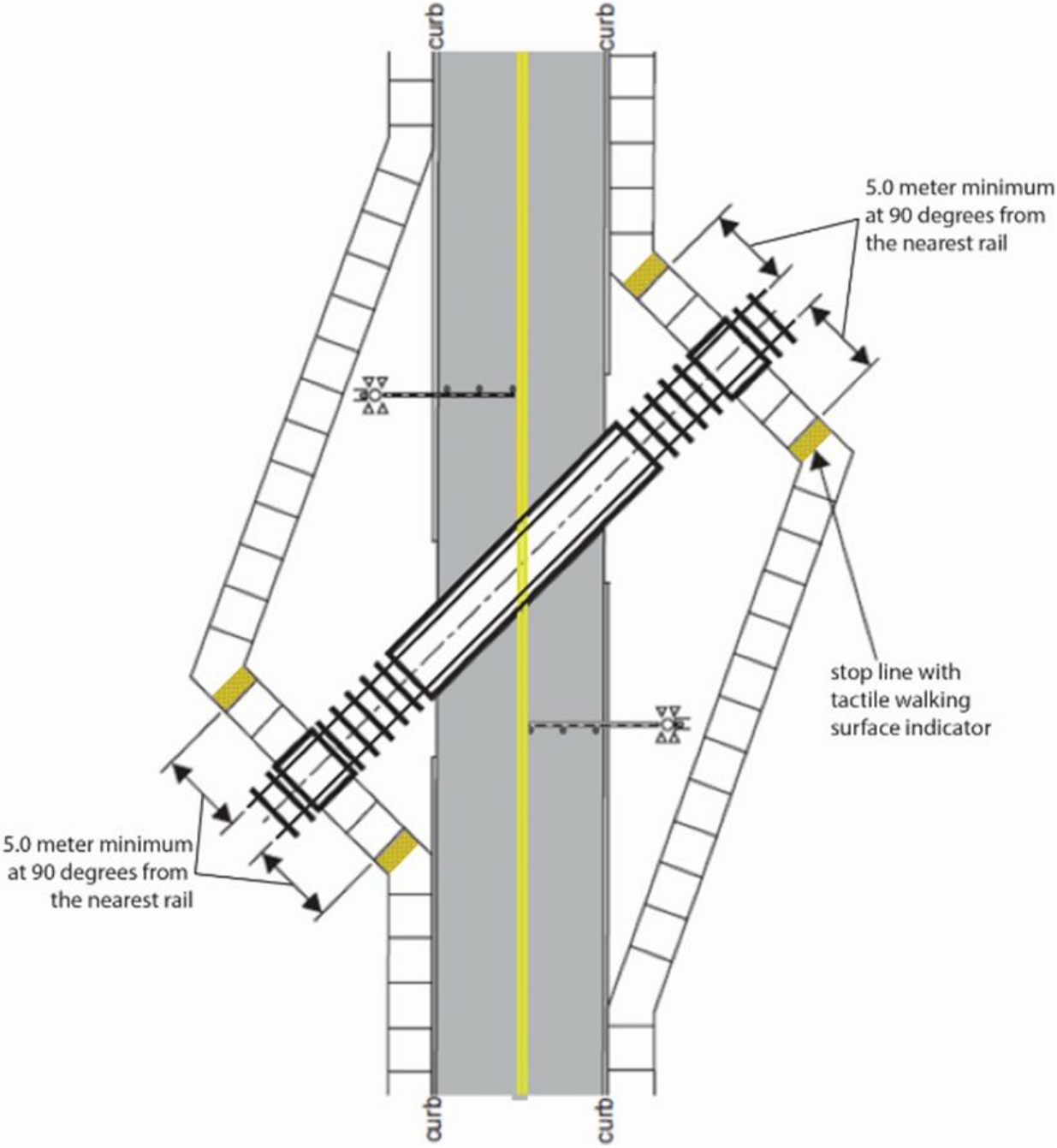
Appendix Figure M-6 Example of Typical Grade Crossing with Vehicular Road and Bike Lane



Appendix Figure M-7 Example of Typical Grade Crossing with Stand Alone Sidewalk, Path, or Trail

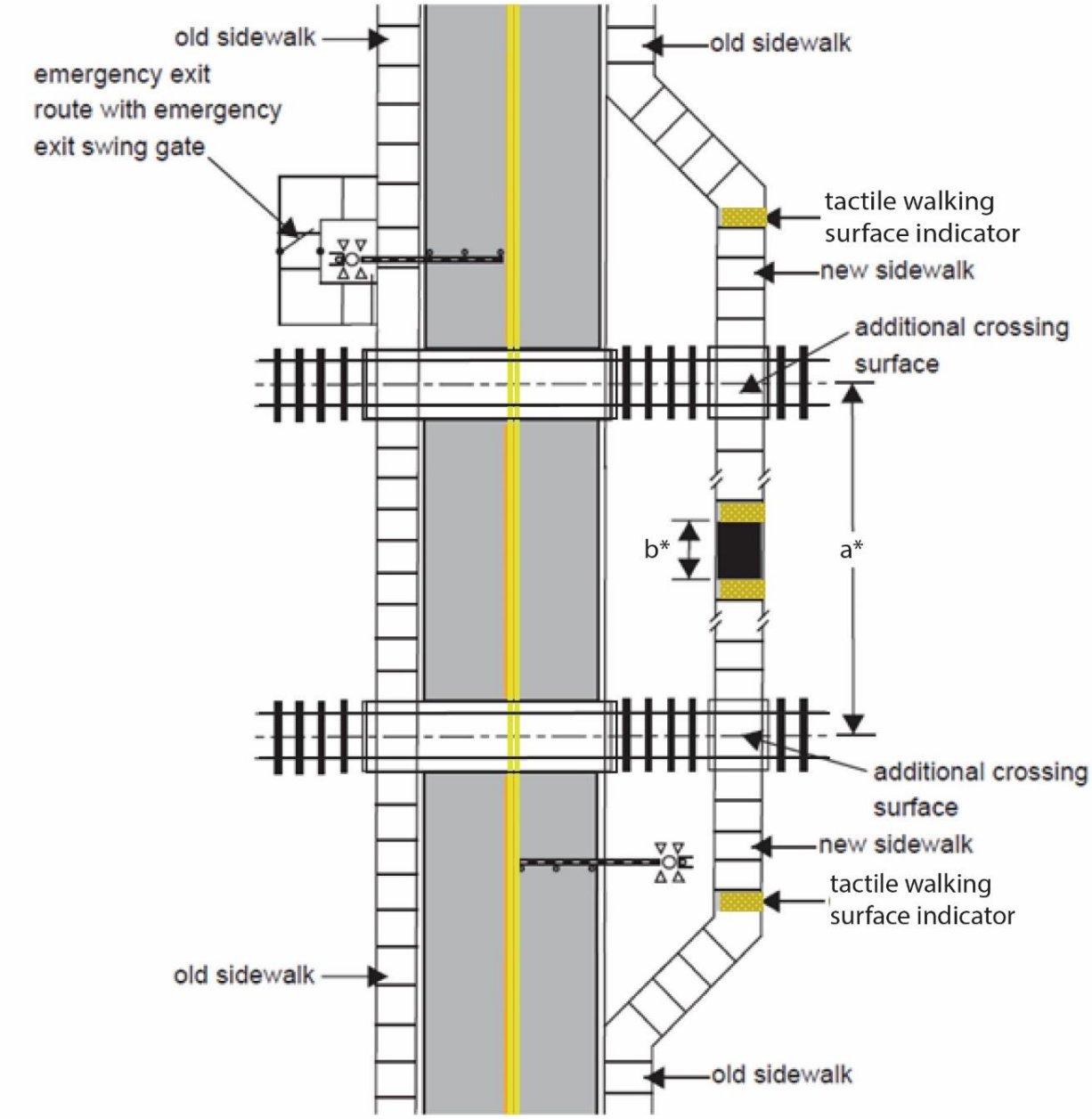


Appendix Figure M-8 Example of Typical Grade Crossing of a Road including a Sidewalk, Path, or Trail



Appendix Figure M-9 Example of Sidewalk Placements Outside of a Grade Crossing Gate (Skewed Angle Crossing)

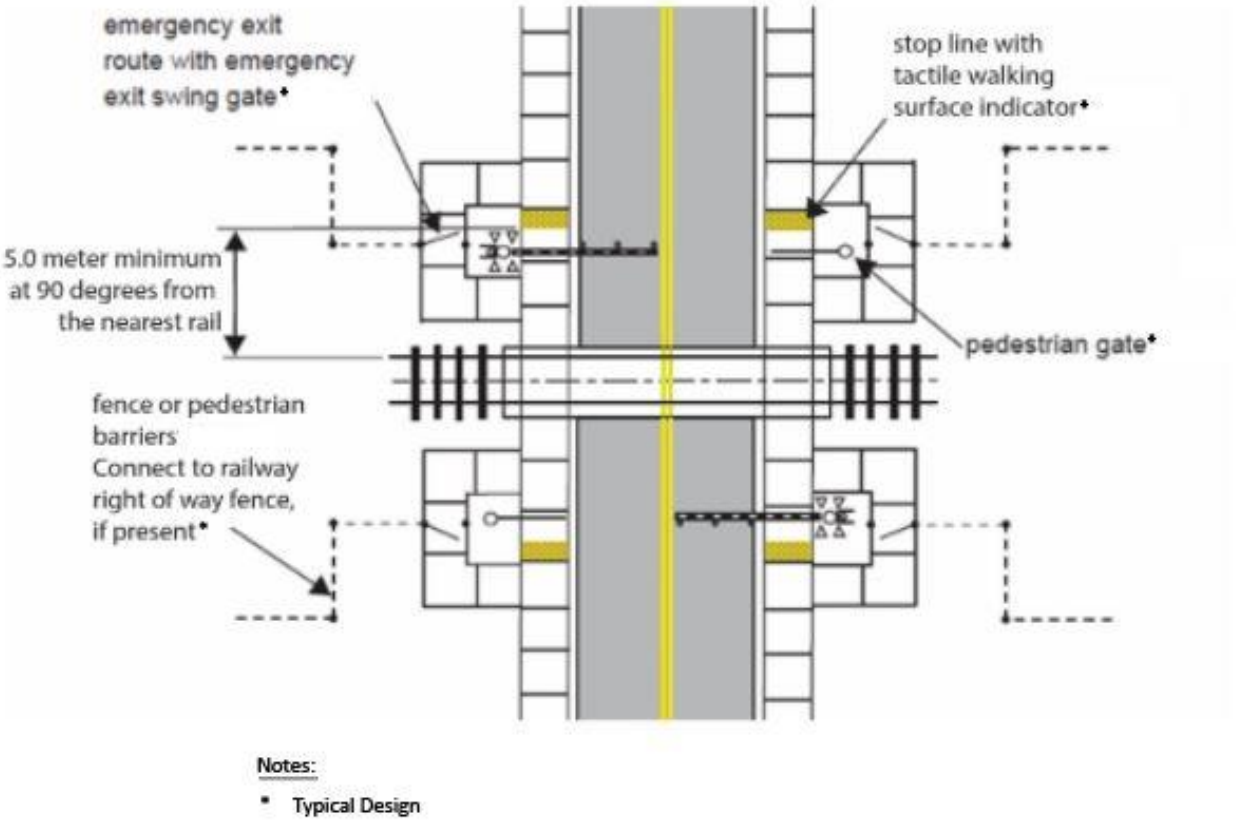
Source: Figure adapted from MUTCD 2009 Edition



NOTES:
a= track center. If 11.58 m of greater, optional additional detectable warnings with optional refuge area may be used.
b = Refuge Area between tracks, 1.22 m minimum

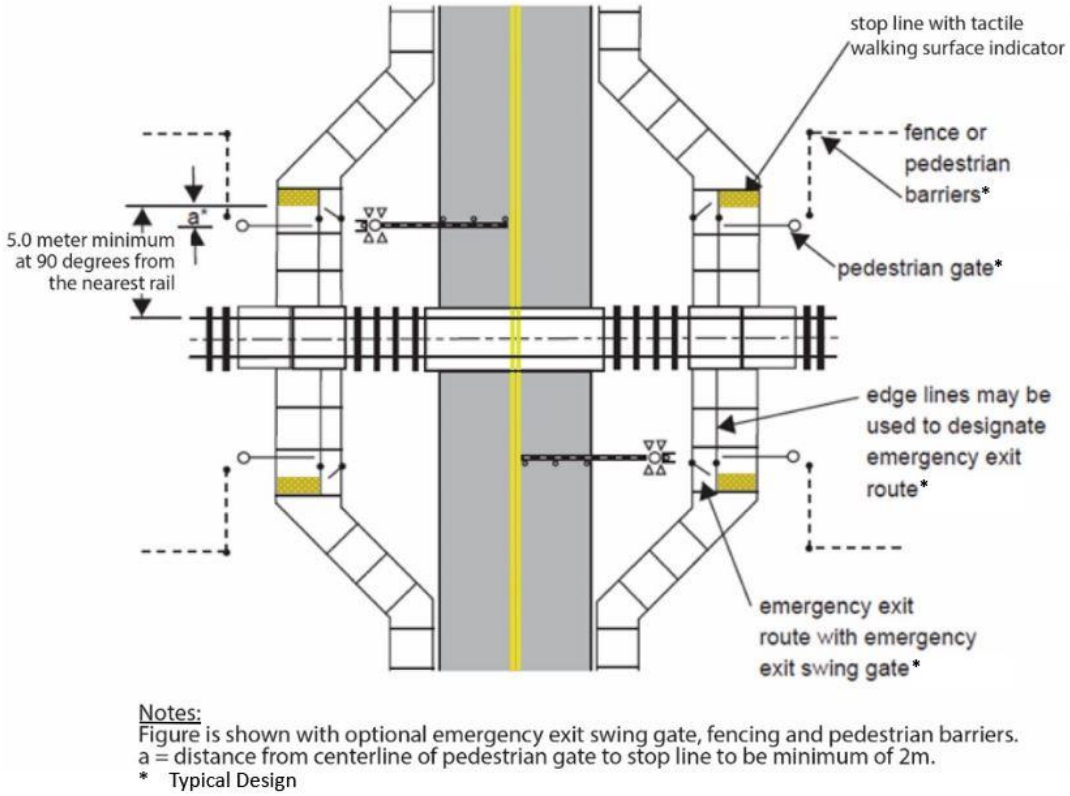
Appendix Figure M-10 Example of a Refuge Area and the use of markings on a Sidewalk Grade Crossing

Source: Figure adapted from MUTCD 2009 Edition.



Appendix Figure M-11 Example of Placement of Pedestrian Gates at a Grade Crossing

Source: Figure adapted from MUTCD 2009 Edition.



Appendix Figure M-12 Example of Placement of Pedestrian Gates at a Sidewalk Grade Crossing

Source: Figure adapted from MUTCD 2009 Edition.

Other Examples of Grade Crossing Design Options

The following figures stem from the United States. While these grade crossing design options may be applicable in the Canadian context, designers must ensure the grade crossing design satisfies the provisions of the *Grade Crossings Regulations,* and the *Grade Crossings Standards.* Other best practices should also be followed i.e., this *Grade Crossings Handbook*, the *Manual of Uniform Traffic Control Devices for Canada* (MUTCDC) and the *Geometric Design Guide for Canadian Road*.

Appendix Figure M-13 Example of Tactile Walking Surface Indicator Treatments

Source: U.S. Department of Transportation, Federal Railroad Administration

Appendix Figure M-14 Example of Gate Skirt Treatment/Emergency Exit

Source: U.S. Department of Transportation, Federal Railroad Administration