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GRADE CROSSINGS - 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*.

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FORWARD

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*, and therefore, the incorporated by reference Grade Crossings Standards made pursuant to the *Railway Safety Act*. 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. It also included 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.

If a proposed railway work does not conform to standards, an application for approval of the proposed work may be filed with the Minister of Transport for Canada under section 10 of the *Railway Safety Act*.

If a railway company or a person wishes to be exempt from the application of a requirement with respect to non-railway operations or works affecting the safety of a grade crossing, an application for an exemption may be filed with the Minister of Transport for Canada under subsection 24(1.1) of the *Railway Safety Act*.

If a person wishes to be relieved of a requirement for inspection, testing, or maintenance, an application for an exemption may be filed with the Minister of Transport for Canada under subsection 22(2) of the *Railway Safety Act*.

Any comments or suggestions regarding these standards or 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 of transport by railways 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 authority to regulate the engineering standards of road crossings is provided under section 7 of the RSA. The authority to regulate the operation and maintenance of crossing works is provided under subsection 18(2) of the RSA. Under subsection 24(1) of the RSA, this authority is not limited to the crossing itself, but also extends to vehicles, pedestrians, road approaches, nearby intersections and adjoining lands, including grade, signage and sightlines. Under subsection 31(1), this jurisdiction further covers the manner in which persons and companies operate vehicles over a grade crossing.

The jurisdiction of the federal government is intended to extend only to those aspects directly related to the safety of grade crossings. The design, construction and maintenance of roads fall under provincial jurisdiction.

The Government of Canada has jurisdiction over approximately 14,000 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) will improve safety at these federally regulated grade crossings.

At the federal level, grade crossings are governed by the RSA and the *Railway Safety Management System Regulations*. 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 Watchlist 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. Although the risk of a grade crossing collision has decreased over the past 25 years, the number of fatalities at grade crossings has increased since 2009.

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 approximately 3,000 different municipal, provincial, territorial and federal authorities, as well as Aboriginal bands. 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.

A number of 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.

Multiple RSA reviews acknowledged that the fact that grade crossings fall under multiple jurisdictions is at the root of their 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 thus do not ensure consistency in 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 there had been a long history of grade crossing safety legislation and regulation, significant gaps remained. Existing guidelines and rules had a limited scope in terms of the safety measures, operations and best engineering practices required in specific circumstances at grade crossings. Over 10 years ago, Transport Canada and stakeholders drafted standards (RTD-10) that set out best engineering practices for safety oversight at grade crossings. However, road authorities and railway companies generally adhered to these standards on a voluntary basis.

OBJECTIVES

The primary objective of the 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 similar to 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 are 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 numerous RSA reviews.

The following are the key aspects of the GCR.

- **Grade Crossings Standards (GCS)** — The GCS are 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 railway companies or road authorities have seven (7) years (e.g. by November 28, 2021) to comply with certain additional requirements, such as signs or warning systems. The seven-year period will allow for a phased-in implementation of the standards applicable to existing crossings, such as for crossing surfaces, signage and sightlines, and warning systems.
- **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 28, 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 within seven (7) years of the coming into force of the GCR; for newly constructed grade crossings or grade crossings 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 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 will be 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. In the event that 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, in order to be granted whistling cessation, a crossing may require a warning system (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 of these regulations (GCR sections 111 and 112).

ARTICLE 1 – INTERPRETATION

Particular 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.) Such failures should be reported to the Director General, Rail Safety (ASR), Transport Canada, within 15 days of their occurrence and must be reported to the Transportation Safety Board as soon as possible by the quickest means available, as per section 5(1)(c) and 5(3) of the *Transportation Safety Board Regulations*. (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. (Prédéclenchement 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)
- **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 a point not less than 15 m (50 ft.) measured from in advance of the closest flasher mast, gate or cantilever. (Feu arrière)
- **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 of time, but only if no vehicle or pedestrian requires passage. (Passage à niveau obstrué)
 - If the crossing is not visible, making it impossible to determine whether a vehicle or pedestrian requires passage, the crossing should be considered as blocked, and therefore restricting the passage of a vehicle or pedestrian.

- **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)
- **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** means one of the parts of something (such as a system or mixture); an important piece of something, including safety-critical changes. (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)
- **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.
- **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 type)
- **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 general 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 28, 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, in July 2014. (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, beside, 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—taking into account 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. (Ministre)
- **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 28, 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)
- **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 where railway tracks intersect with a road that is owned and used by private parties, 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. (Proposant)
- **Public Grade crossing** means a grade crossing where railway tracks intersect with a road that is owned 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 »)
- **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. (Exploitation ferroviaire sécuritaire)

- **Safety-critical Change** means any change that will negatively impact the safety of railway operations, such as to warning time, gate arm clearance time or gate descent. (Changement critique à la sécurité)
- **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.
- **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)
- **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, travelled way and shoulders, means free of defects (pot holes, rutting, heaving, rough surfaces, cracks) and signs of wear. (Lisse et continu)
- **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 of time, 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.
- **Stopping Sight Distance (SSD)** means the distance calculated in accordance with article 7.2 of the GCS. (Distance de visibilité d'arrêt (SDD))
- **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 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)
- **Traffic Control Device** Means (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; or
 - a traffic signal, including the interconnection with the warning system.
- **Travelled Way** means that part of a road intended for vehicular or pedestrian use, excluding shoulders. (Chaussée)

- **Vicinity** means the area adjoining, surrounding and nearby (referred to in 3(1)(b)(iv) of the GCR). (À proximité)
- **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 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)
- 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 tables 10-3 and 10-4).

ARTICLE 1.1 – AREMA INTERPRETATIONS

(American Railway Engineering and Maintenance-of-way Association)

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.

ARTICLE 2 – 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);

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 in July 2014;

Manual of Uniform Traffic Control Devices for Canada means the 4th 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 September 1998;

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 of the (U.S.) National Research Council;

Grade Crossings Regulations means 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*.

ARTICLE 3 – 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 3-1 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 3-2 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 3-3 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 3-4 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 3-5 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
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

ARTICLE 4 – LEFT BLANK INTENTIONALLY

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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—must 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 Railway 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.

Vigilance must be exercised when designing a new grade crossing and when making any alteration to an existing grade crossing. Every change in a parameter can affect another. This is why it is essential to gather all necessary information, from all sources, before designing, or altering the design of a grade crossing; and this requires the collaboration of all parties concerned.

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. The following is a non-exhaustive list of parties to which this applies:

- railway companies
- utility companies
- road authorities
- professional engineers
- consulting engineering companies
- contractors
- owners of land adjacent to a grade crossing that interferes with a railway work
- governments, agencies and other public authorities
- rail safety regulators who must interpret provisions of the RSA consistently
- provincial and territorial engineering regulators

When designing a grade crossing (with or without a warning system), the following parameters must be taken into account:

- stopping sight distance (SSD)
- road approach gradient

- clearance distance
- departure time for vehicles
- departure time for pedestrians, cyclists and persons using assistive devices
- gate arm clearance time from SSD (if applicable)
- gate arm clearance time from a stopped position (if applicable)
- Dstopped (minimum distance required to see along the railway right of way from the stopped position)

ARTICLE 5 – CROSSING SURFACE

5.1 Crossings Surface (New)

Applicable to all new grade crossings constructed on or after November 28, 2014, and to existing crossings to which changes were made

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.

Figure 5-1 Grade Crossing Surface Dimensions

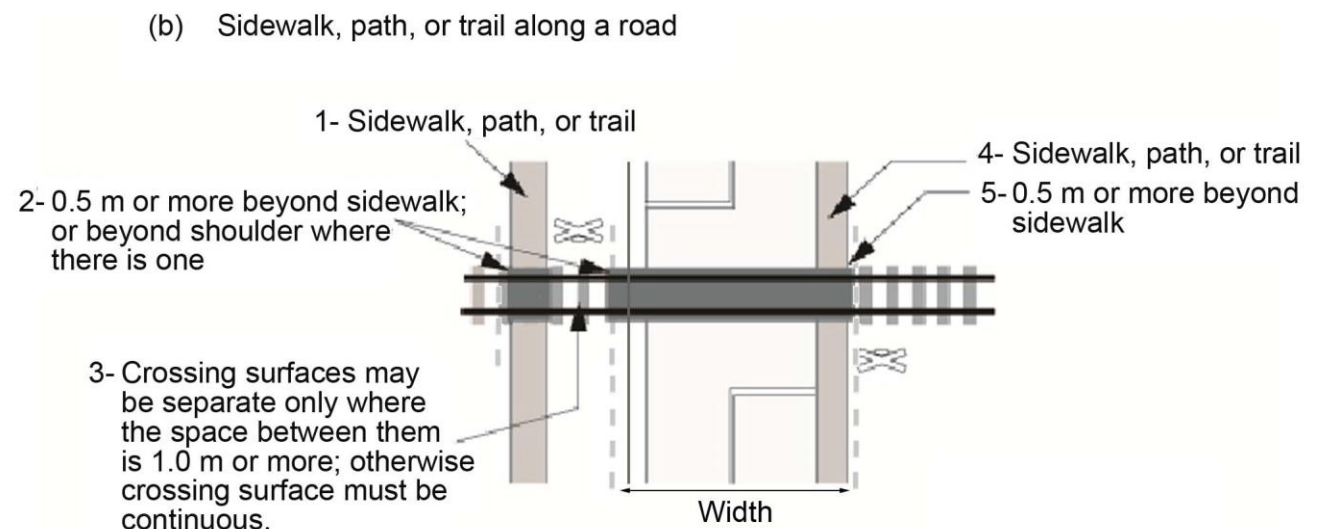
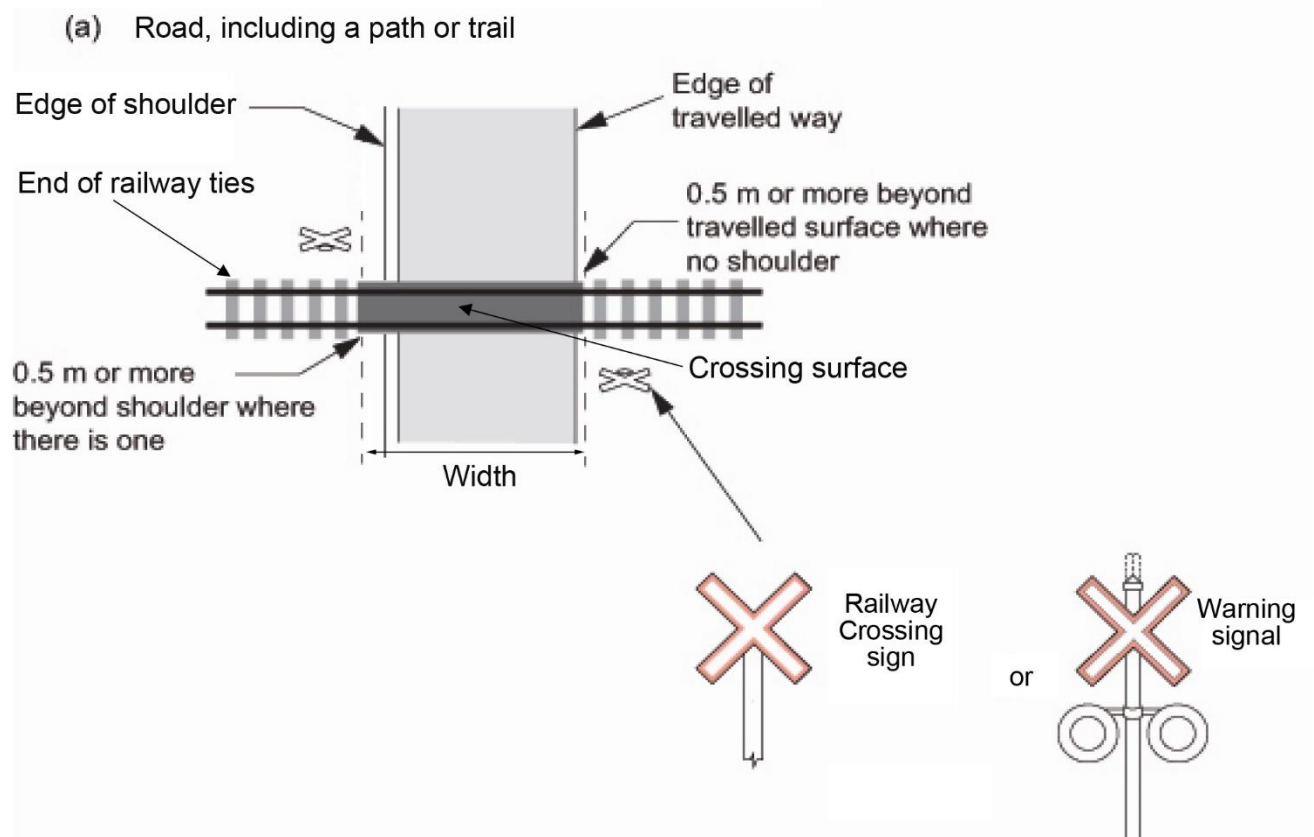


Table 5-1 Crossing Grade Crossing Surface – Cross Section

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
(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.		
	Maximum width	120 mm
	Maximum depth	No limit
(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.		
Wear limits		
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)		

	Maximum distance of the top of the rail above crossing surface	13 mm
	Maximum distance of the top of the rail below crossing surface	7 mm
All other public grade crossings: Maximum distance of the top of the rail above or below the crossing surface		25 mm
Private grade crossings: Maximum distance of the top of the rail above or below the crossing surface		50 mm

Applicable to existing grade crossings built before November 28, 2014

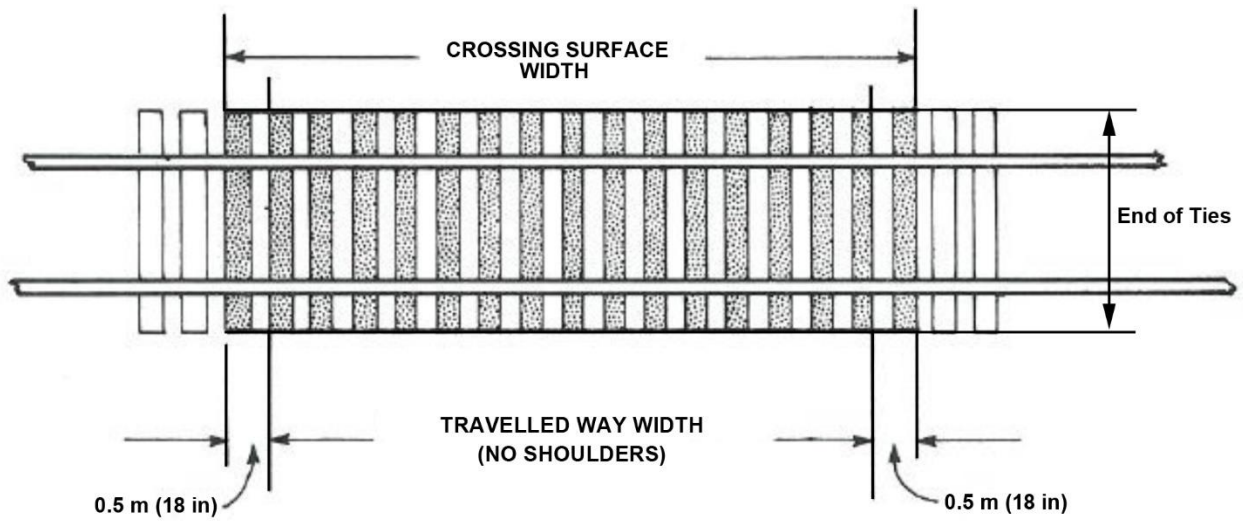
5.2 Crossing Surface (Existing)

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 (a) or (b), as applicable.

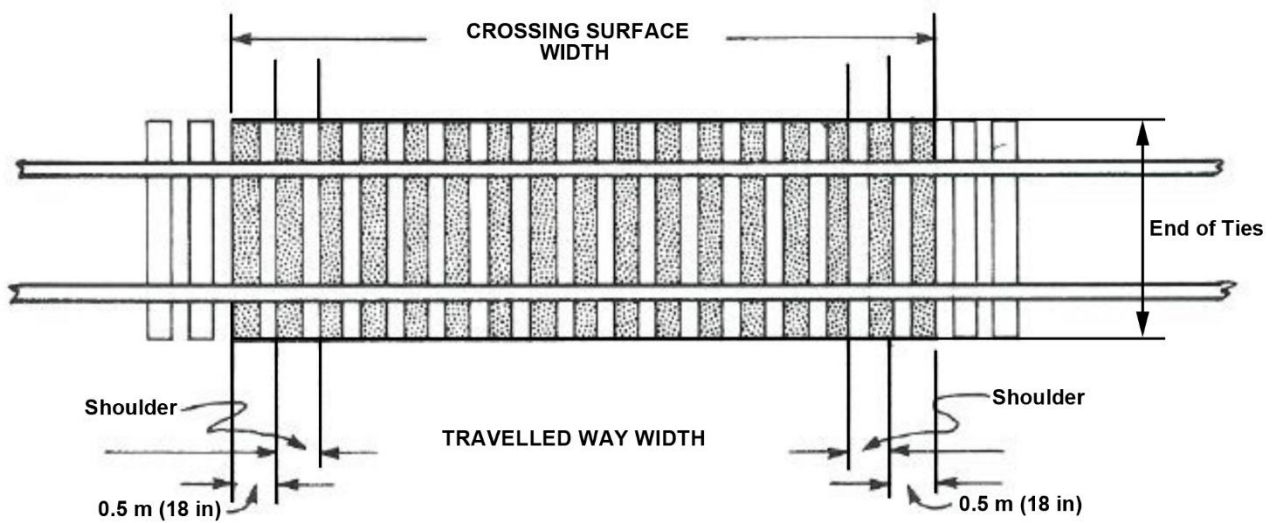
- 5.2.1 A smooth and continuous surface helps to ensure the safe and comfortable crossing by cyclists and pedestrians, including pedestrians with visual or mobility impairments. A smooth and continuous surface reduces the risk of tripping and falling, for pedestrians, cyclists and users of wheelchairs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

Figure 5-2 Crossing Surface

a)



b)



ARTICLE 6 – ROAD GEOMETRY

(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)

- 6.1 The horizontal and vertical alignment of the road approach and the crossing surface must be smooth and continuous.
- 6.2 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, Difference in Gradient.
- 6.3 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.
- 6.4 The width of the travelled way and shoulders at the crossing surface must not be less than the width of the travelled way and shoulders on the road approaches.
- 6.5 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 (Figure 6-1(b)).
- 6.6 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 must therefore be minimized at skewed-angle grade crossings.

Figure 6-1: Maximum Crossing Angle: Grade Crossing

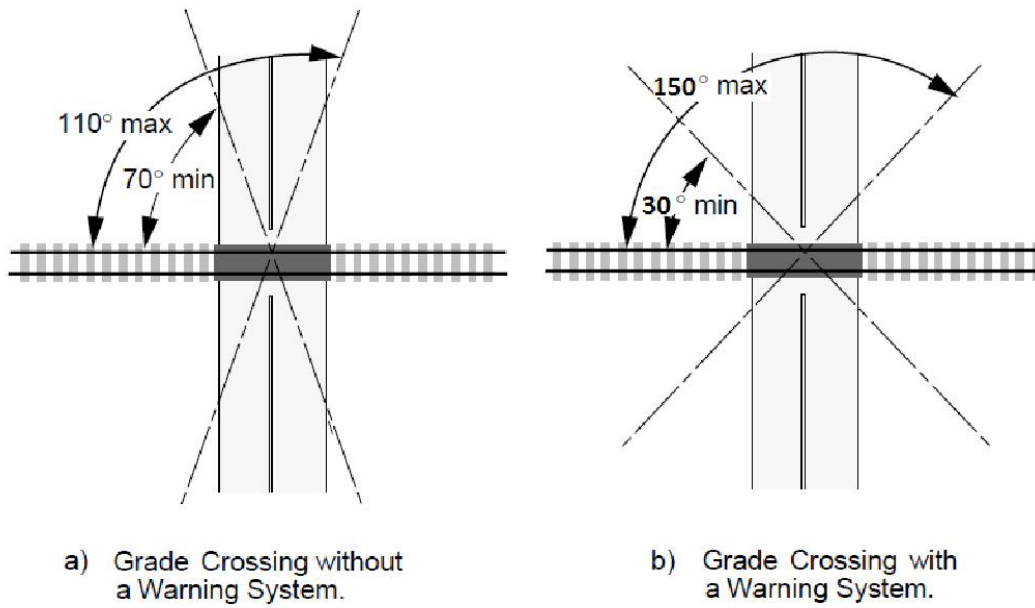


Table 6-1 Difference in Gradient

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

6.7 Existing Grade Crossing Road Geometry

The geometry of grade crossings installed prior to November 28, 2014, is grandfathered from the road geometry requirements set out in the GCR, in Article 6 of the Grade Crossings Standards (GCS) and this document. However, any changes made to the geometry of these existing grade crossings must comply with subsection 88(1) of the GCR, and therefore the location, gradient and crossing angle must comply with articles 6 or 11 of the GCS and this document, as applicable, so as to improve overall safety at the crossing.

ARTICLE 7 – SIGHTLINES

Under the GCR, road authorities, private authorities and railway companies will be required to maintain sightlines at grade crossings by November 28, 2021 (GCR 23). 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 existing grade crossings, most requirements concerning sightlines must be met within seven (7) years of the coming into force of the GCR, e.g. by November 28, 2021. For newly constructed grade crossings 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 to Municipalities: Since November 28, 2014, section 24 of the GCR requires that special attention be paid to land in the vicinity of a line of railway. Before a permit to build a permanent structure within the sightlines of a grade crossing is granted, the applicant must be advised that the GCR require the area within the sightline triangle shown in figures 7-1(a) and (b) of the GCS and this document remain clear at all times. At grade crossings equipped with an automatic warning system (with or without gates), sightlines include the area required to see front light units, as well as the Railway Crossing sign, from the stopping sight distance (SSD).

Note: The standards with respect to sightlines are not required to be met until November 28, 2021, unless a change is made to any of the following elements at an existing grade crossing, in which case these standards must be met at the time of the change (GCR 28).

Here are some examples of alterations or operational changes:

- a line of railway is added within the sightlines;
- the class of track, as per column 1 of the table under Article 7.1.2 of the GCS (reproduced below), 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 as a result of an increase in the road crossing design speed, as per the characteristics set out in Table 10-3 or Table 10-4 of those Standards, as applicable. (Tables 10-2, 10-3 and 10-4 are attached further below for reference.)

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

As of November 28, 2021, sightlines at grade crossings that existed before the GCR came into force and that meet the following criteria must be as shown in Figure 7-1(a) of the GCS:

- are equipped with a warning system without a gate;
- are in the railway right-of-way; and
- are on the land on which the road is situated.

The following are not to be taken into account when verifying sightlines:

- any attended railway equipment;
- any permanent visual obstructions that were already in existence when the GCR came into force; and
- any areas beyond the visual limits of a curve.

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 table below.

Table 7.1.2 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)

<http://www.tc.gc.ca/eng/railsafety/rules-tce54-832.htm>

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.

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

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

where:

V_T = railway design speed in km/h or mph

$T_{SSD} = [(SSD + cd + L)/0.278V]$ (s)

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.

$D_{Stopped}$ 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:

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

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

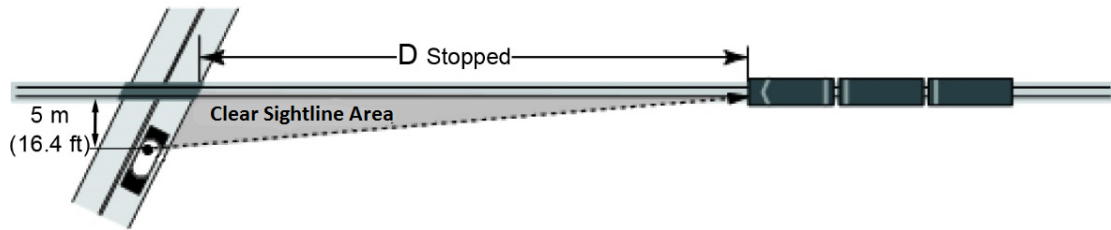
where:

V_T = railway design speed in km/h or mph

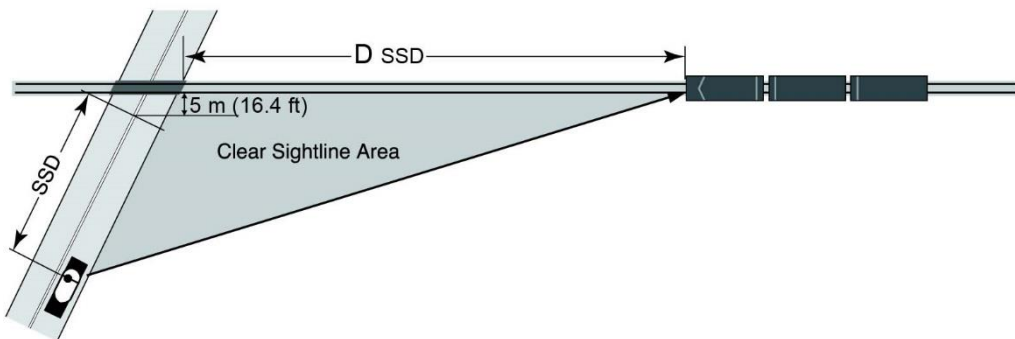
$T_{Stopped}$ = the departure times, calculated in accordance with Article 10.3

Figure 7-1 Minimum Sightlines – Grade Crossings

- 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)



A guide for determining minimum sightlines at grade crossings can be found in Appendix E or on Transport Canada's website at:

https://www.tc.gc.ca/media/documents/railsafety/Guide_sightlines_at_Grade_Crossings-EN-WEB-V3.pdf

Obstructions to sightlines include but are not limited to:

- a) trees
- b) crops
- c) snow banks
- d) brush
- e) buildings installed as of November 28, 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).

The placement of signs must not interfere with the visibility of other railway crossing traffic control devices or warning systems.

8.1 Railway Crossing Sign and Number of Tracks Sign

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

- 8.1.1 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 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 8-3(c);
 - d) for grade crossings that existed prior to November 28, 2014, be either red or black, unless a sign is replaced after November 28, 2014, in which case it must comply with standard 8.1.2(b) (GCR 58, 73 and 86; GCS 4.1).
- 8.1.3 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).

Additional Requirements for Grade Crossings Without Warning Systems

Existing grade crossings and grade crossings installed or modified as of November 28, 2021:

- 8.1.3 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;
- 8.1.4 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.

- 8.1.5 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 figures 8-3(a) and 8-3(b).
- 8.1.6 At public grade crossings and where provided at a private grade crossing, a sidewalk, path or trail with a centreline 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(a) (GCR 38, 58 and 73; GCS 4.1.1(f)).

New grade crossings and grade crossings modified on or after November 28, 2014:

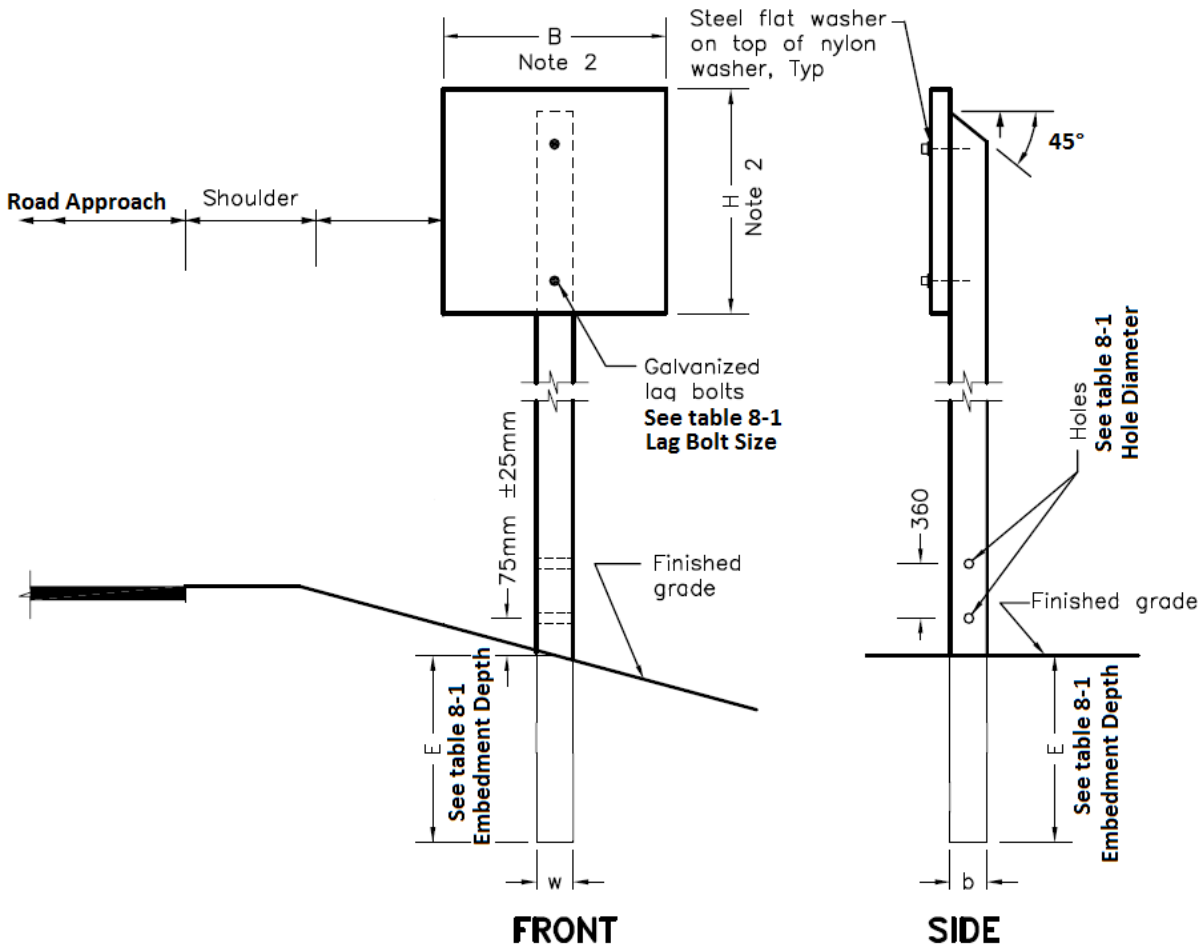
Supporting post design

- 8.1.7 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 a 820-kg vehicle striking it 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 would. 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 8.1-2.

Figure 8.1-2 Wooden Sign Post Breakaway Hole and Embedded Depth



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 comes in contact with 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 DIAMATER			NOTE 2		GALVANIZED LAG BOLT SIZE	
				MAX. SIGN DIMENTIONS	MAX. SIGN AREA		
E	w	b	HOLE DIA.	B cm	H cm	A M ²	INCH
920	89	89	S.O.	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

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 8.1-1(a) and 8.1-1(b).

Damaged or cut areas of hot-dip galvanized coatings on any galvanized components must be repaired in accordance with ASTM A780.

Figure 8.1-1 a) Cold Formed Steel post Detail

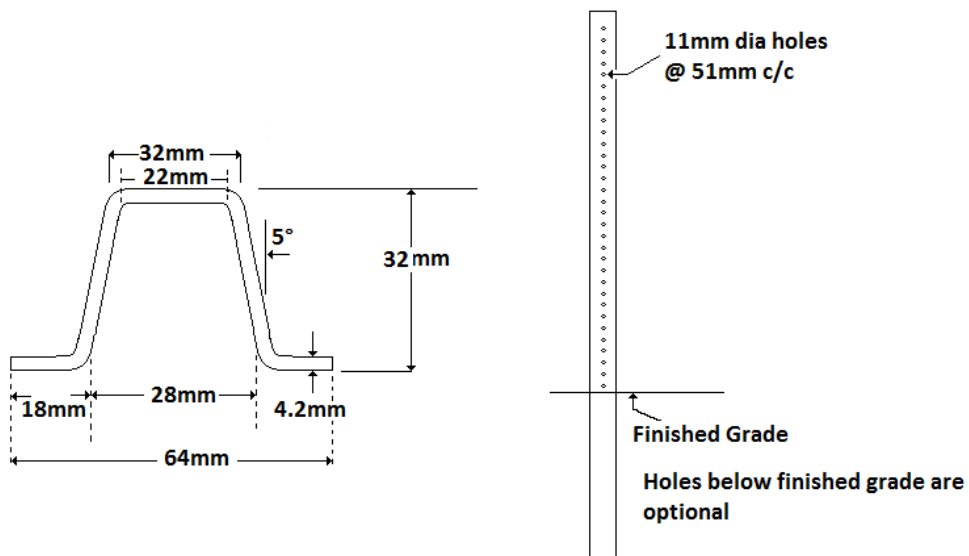
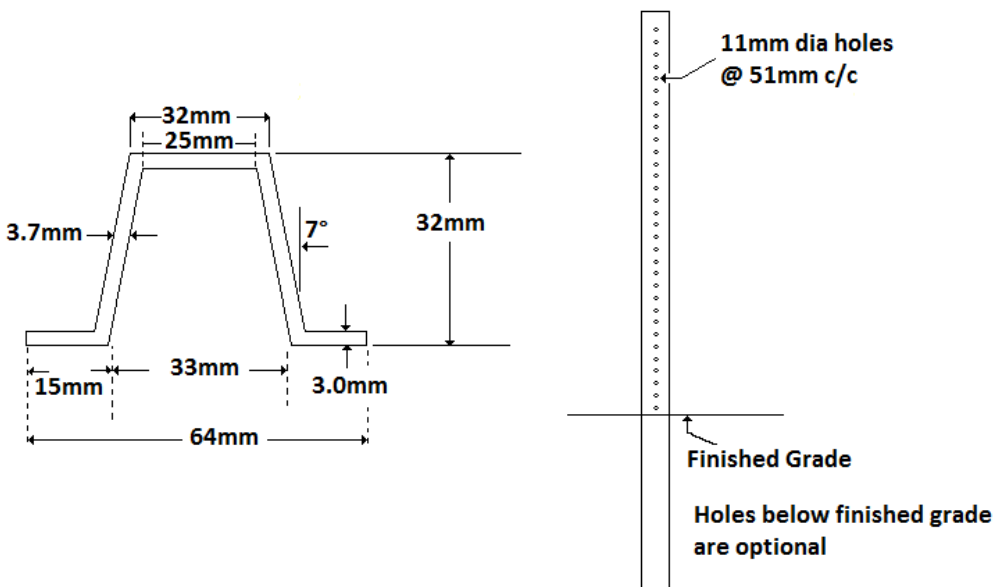


Figure 8.1-1 b) Hot Formed Steel post Detail



Sign Hardware

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

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

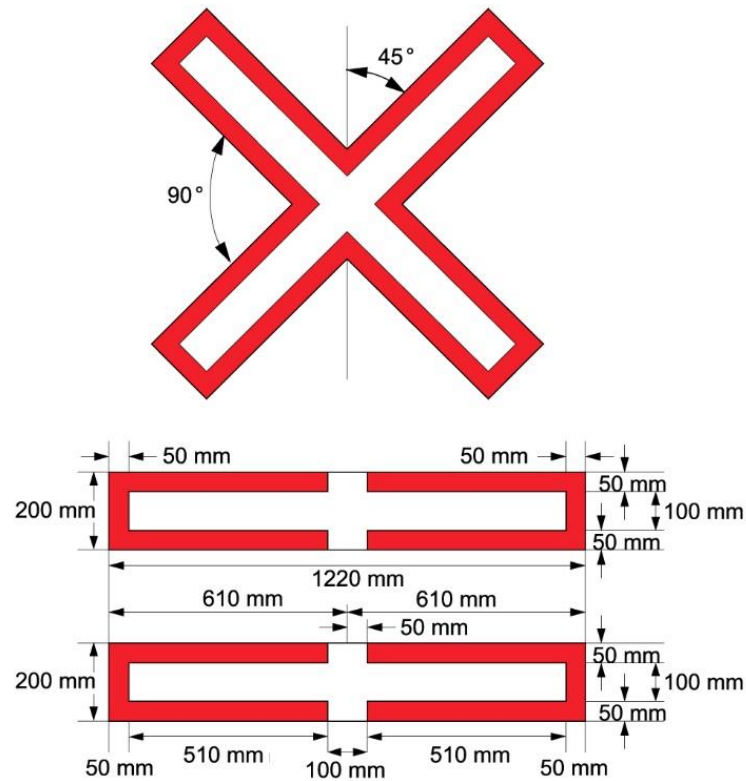
Retroreflective Material

The following applies to all new grade crossings, to existing crossings when a warranted change is made and, as of November 28, 2021, to all existing crossings.

- 8.1.8 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).
- 8.1.9 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).

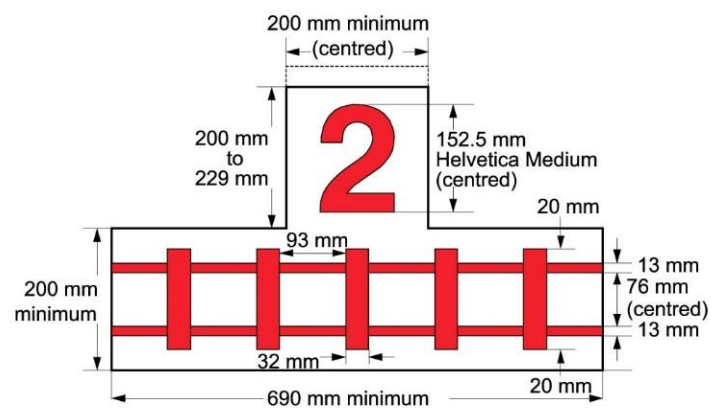
Figure 8-1 Railway Crossing Sign and Number of Tracks Sign

(a) RAILWAY CROSSING SIGN



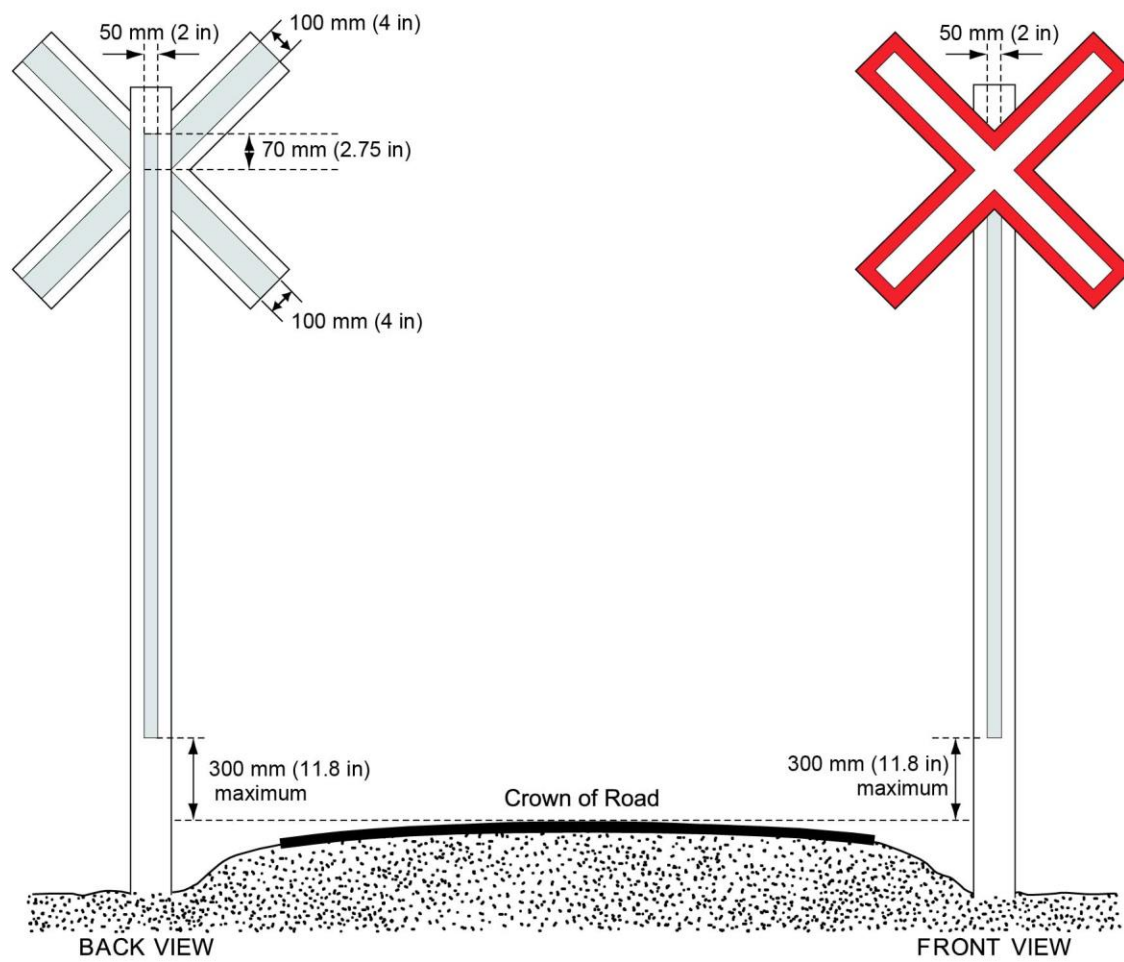
Source: Grade Crossings Standards, July 2014

(b) NUMBER OF TRACKS SIGN



Source: Grade Crossings Standards, July 2014

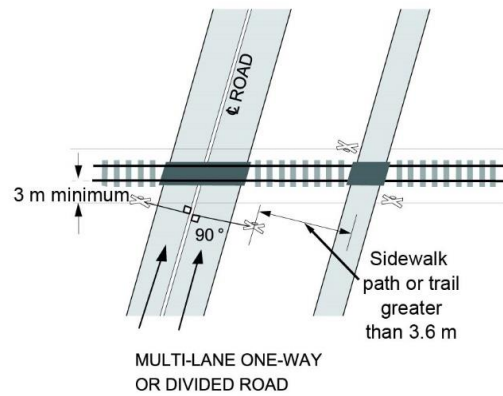
Figure 8-2 Retroreflective Stripes on the Back of the Railway Crossing Sign and on the Sign Supporting Post (public grade crossings without a grade crossing warning system)



Source: Grade Crossings Standards, July 2014

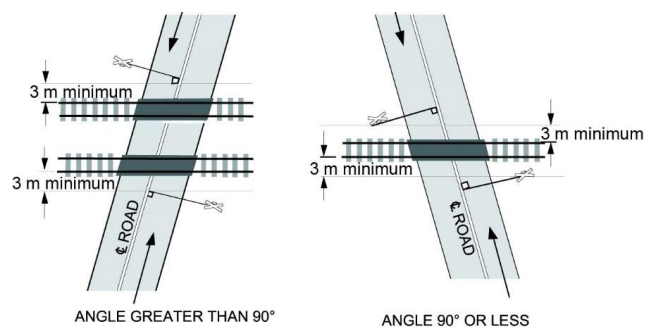
Figure 8-3 Location of Railway Crossing Signs and Number of Tracks Signs (public grade crossings without warning systems)

a)



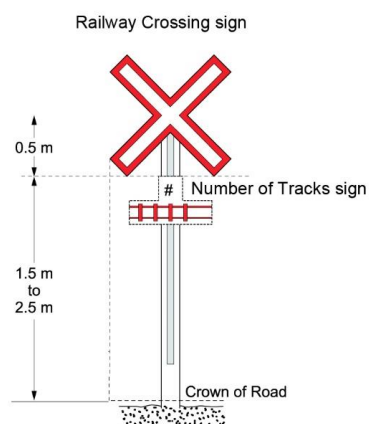
Source: Grade Crossings Standards, July 2014

b)



Source: Grade Crossings Standards, July 2014

c)



Source: Grade Crossings Standards, July 2014

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 Railway Crossing sign is not clearly visible within the SSD; or
- b) a motor vehicle on the road approach needs to reduce its speed in order to conform to the road crossing design speed (GCR 42, 50, 66 and 80; GCS 8.2).

8.3 Stop Ahead Sign

A Stop Ahead sign must be installed if the Stop sign is not clearly visible within the SSD (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.

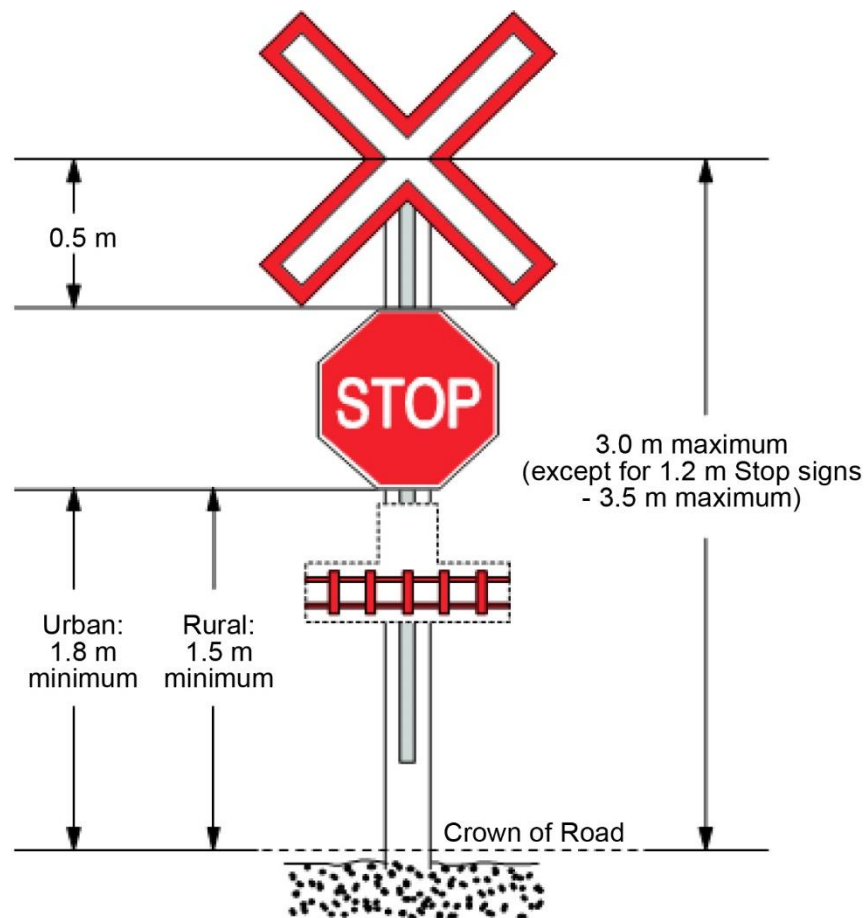
Stop signs should be used only where traffic engineering studies indicate that their use is warranted. These studies should consider such aspects as traffic speeds, traffic volumes, sightlines, and collision history. Stop signs are warranted at grade crossings without a warning system if the road crossing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

A Stop sign must not be used on the approach to an intersection equipped with traffic control signals. Portable or temporary Stop signs may be used at such intersections only in emergency or temporary situations, or when the traffic signals are not working.

Stop signs should only be installed by the authority identified in the *Highway Traffic Act* for the province or territory in which the sign is to be erected. (Generally this is the road authority or municipality, but if authority is unclear, the Minister may provide solution.)

- 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 8-4 and maintained by the Railway (GCR 3(1)(a)(ii)).
- 8.4.2.1 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.
- 8.4.3 Stop signs must not be installed at grade crossings equipped with a warning system.

Figure 8-4 Stop Signs



8.5 Emergency Notification Sign

As of November 28, 2021 (e.g. seven years after the coming into force of the GCR), railway companies, will be required to install an Emergency Notification sign at all public grade crossings. However, it is considered a best engineering practice to install Emergency Notification signs at all grade crossings, including private grade crossings, to provide road users with the information needed to report emergencies. These signs should be clearly visible to all road users.

8.5.1 As of November 28, 2021, an Emergency Notification sign that provides the railway company's emergency telephone number and information on the location of the grade crossing must be installed (GCR 39, 63, 53(2) and 53(3)):

- a) parallel to the road; on both approaches; or
- b) on each side of the grade crossing, facing traffic approaching the grade crossing.

8.5.2 The Emergency Notification sign must be clearly legible and in both official languages where warranted (see Figure 8-5).

The sign should include a Crossing ID, whether it be a mile point or a Transport Canada identification number (TCID). If the TCID is indicated, the railway company

providing the emergency contact number should provide a means for linking the TCID to the precise subdivision and mile point or road name.

Note: The Emergency Notification sign must not obstruct the retroreflective material referred to in sections 38 and 62 of the GCR, nor obstruct sightlines or the view of the Railway Crossing sign and/or light units. The sign should also be retroreflective.

Figure 8-5 Example of Emergency Notification Sign



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 come into contact with the road surface and/or the rails when crossing the railway.

Note: The Low Ground Clearance at Railway Crossing sign must be installed as per the *Manual of Uniform Traffic Control Devices for Canada*. It must not obstruct the retroreflective material referred to in sections 38 and 62 of the GCR, and must not obstruct sightlines or the visibility of the Railway Crossing sign and/or warning system.

The Low Ground Clearance at Railway Crossing sign is illustrated in Figure 8-6.

Figure 8-6 Low Ground Clearance at Railway Crossing Sign (WA-52)



WA-52
750 mm x 750 mm

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 metres 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 must not 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 Figure 8-7 and 8-8.

Figure 8-7 Second Train Event Warning Sign and “ATTENTION 2 TRAINS” Warning Tab



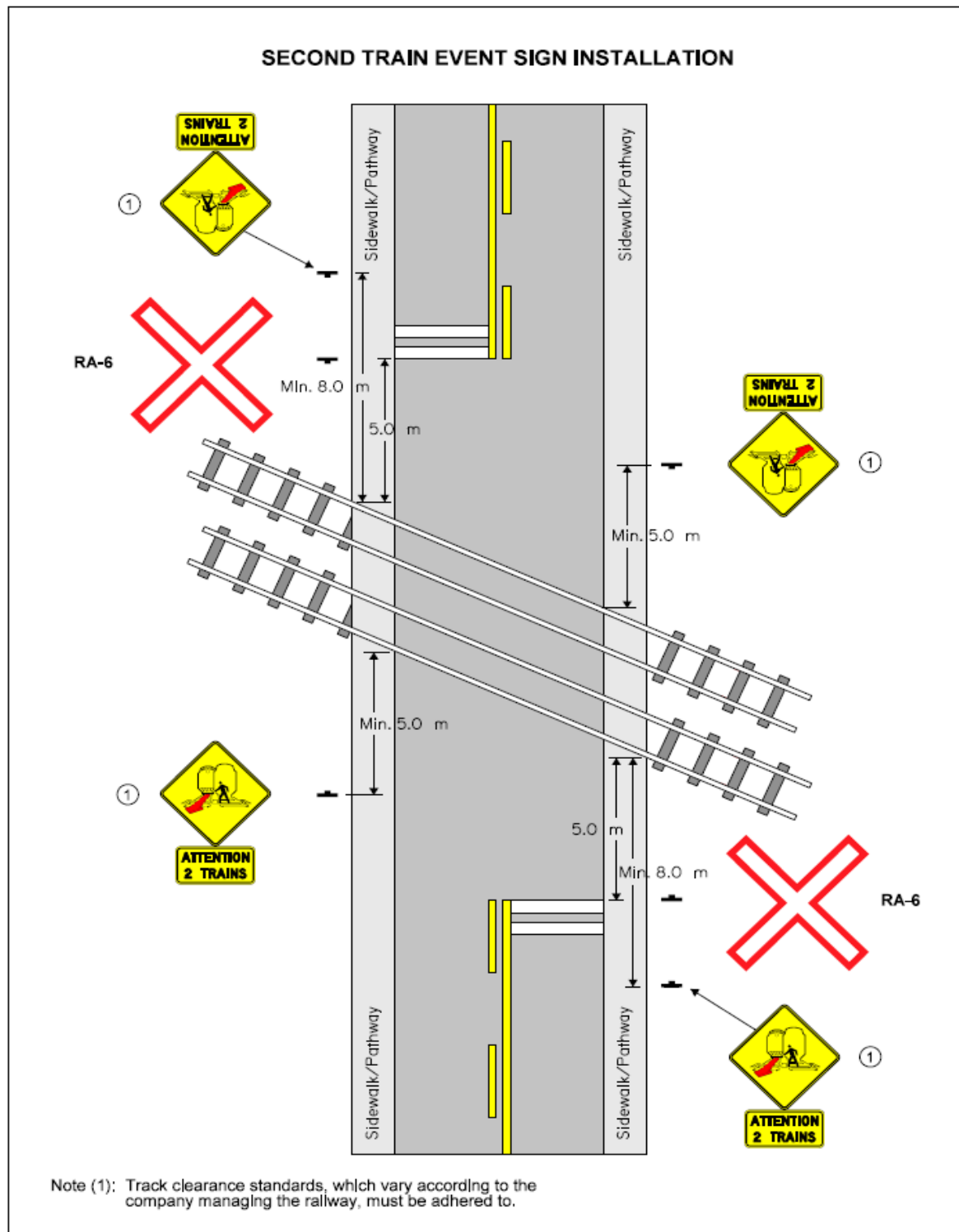
WC-27
450 mm x 450 mm



WC-27S
450 mm X 200 mm

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

Figure 8-8 Second Train Event Warning Sign Installation



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

8.8 Pavement Markings

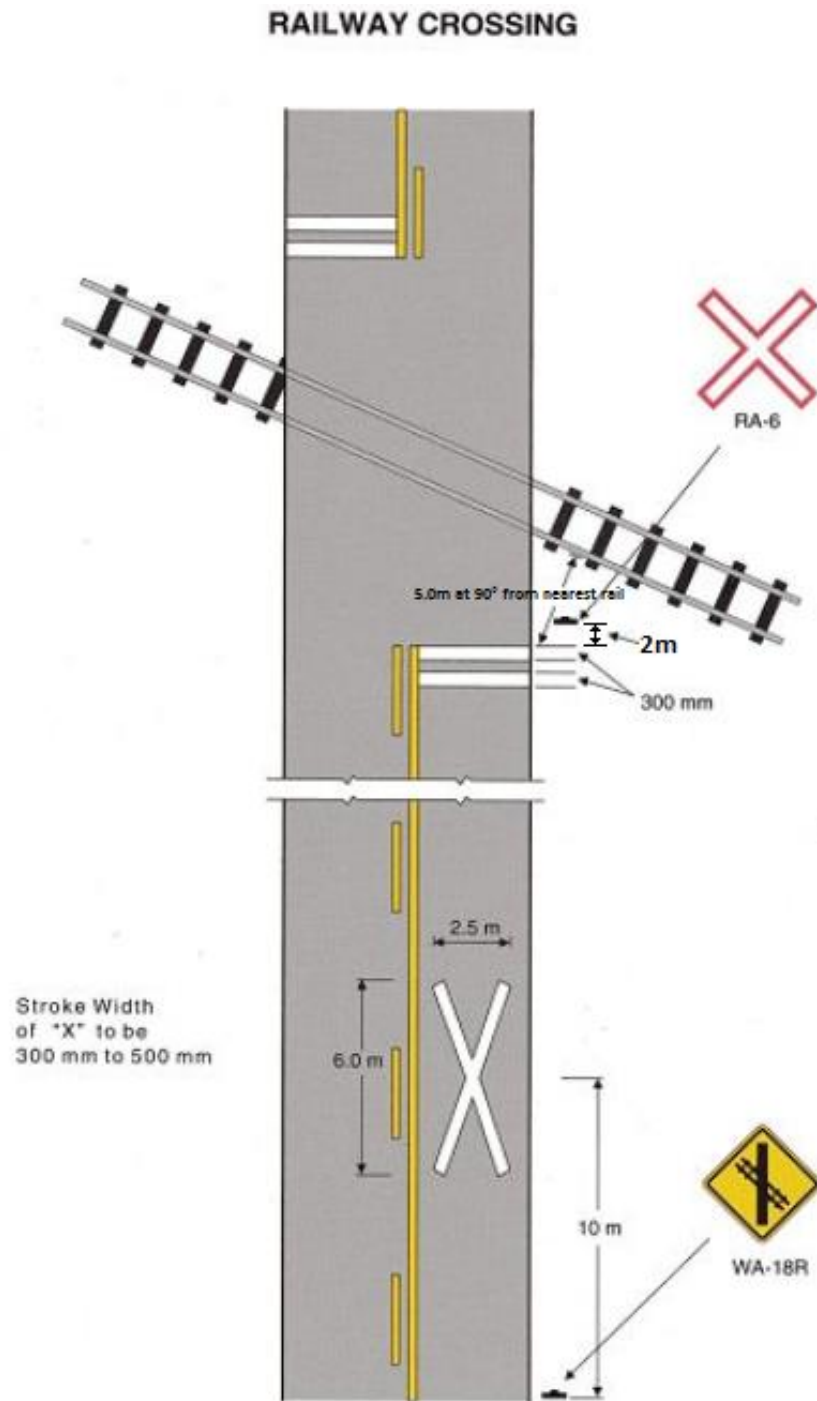
Pavement markings are used to supplement the regulatory and warning messages presented by crossing signs and signals. Pavement markings have limitations in that they may be hidden by snow, may not be clearly visible when wet, and may not be very durable when subjected to heavy traffic.

Pavement markings in advance of grade crossings should consist of an X, as shown in figures 8-10(a) and (b). 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*.

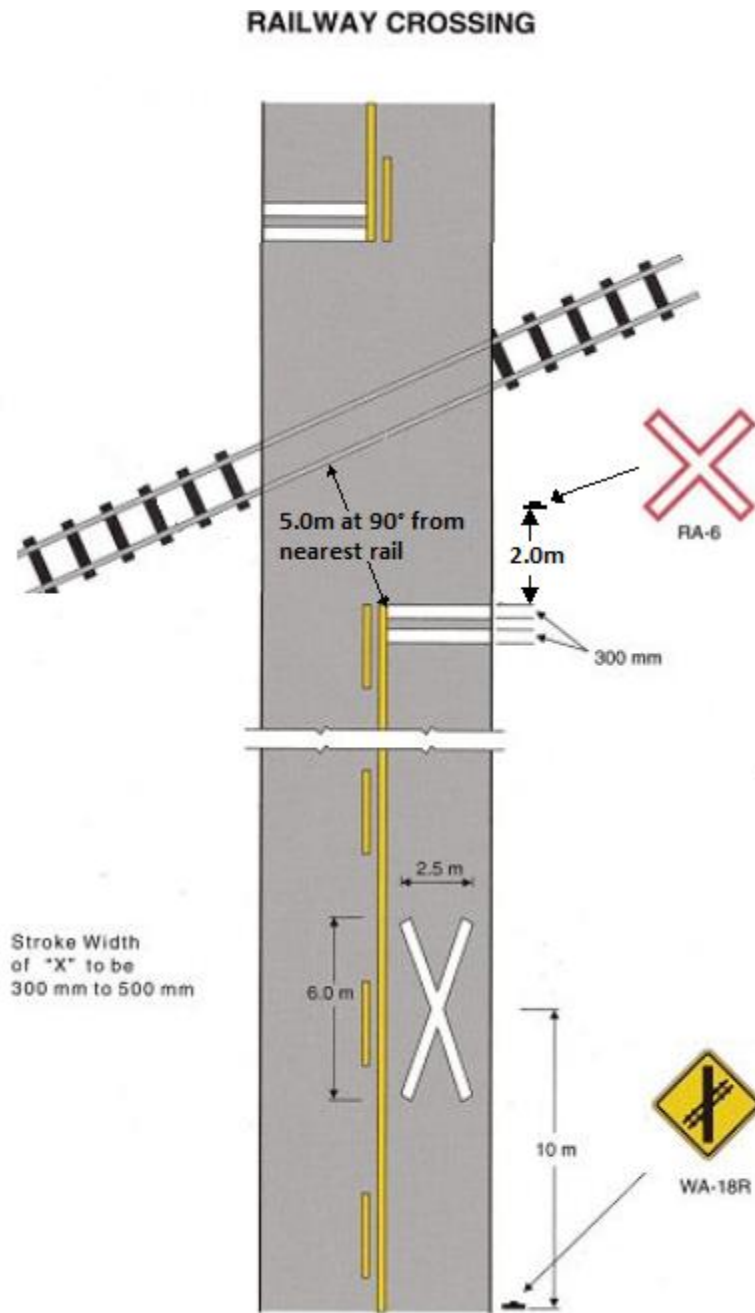
For grade crossings without a warning system, stop bars should be installed 5 m from the nearest rail, perpendicularly to the paved road approach. Where the Railway Crossing sign or signal mast is installed more than 3 m in advance of the nearest rail, the stop bars should be located a minimum of 2 m in advance of the centre of the Railway Crossing sign or signal mast on the paved road approaches, as shown in Figure 8-10(a).

Figure 8-10 (a) Pavement Markings



Source: *Manual of Uniform Traffic Control Devices for Canada.*

Figure 8-10(b) Pavement Markings (right-hand angle)



Source: *Manual of Uniform Traffic Control Devices for Canada.*

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 SYSTEMS SPECIFICATIONS

In Canada, there are over 19,794 federally regulated grade crossings, over 4.5% which are crossed by roadways of more than two lanes of traffic and over 19% of which are crossed by more than one railway track. Governments (federal, provincial and municipal) and industry must work together to ensure that Canada's rail transportation network remains one of the safest and most reliable in the world.

The following articles set out the minimum standards for warning systems, both with and without gates, for public and private grade crossings. This section is relevant only to new grade crossings and existing crossings at which warranted changes are made to certain parameters.

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(a) 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(b), 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(a) 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(b), 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 includes 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 (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.

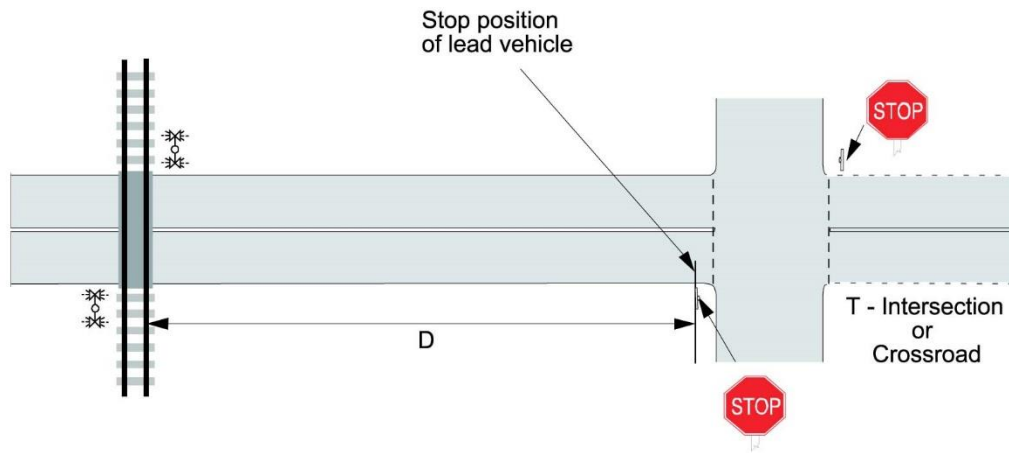
9.8 The criteria for a grade crossing requiring a warning system to be interconnected with a Prepare to Stop at Railway Crossing sign are as follows :(GCR 43, 51, 67 and 81)

- a) The road approach is an expressway taking into account 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.

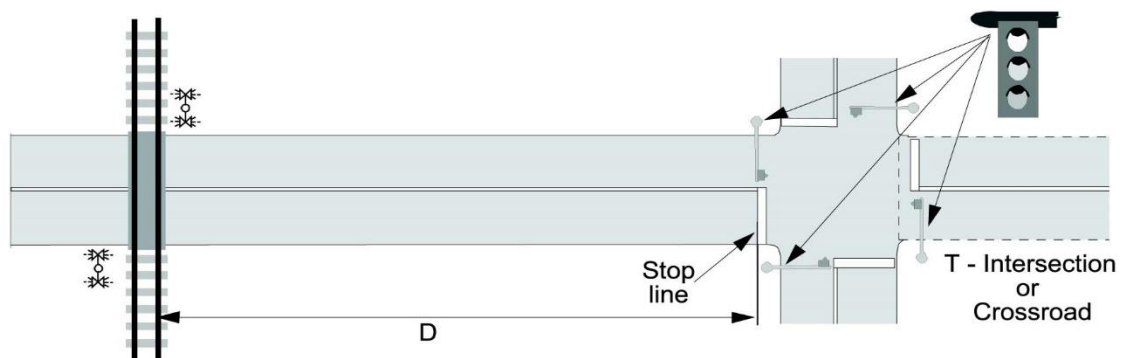
Figure 9-1 Intersection with Stop sign or Traffic Signal

a) Intersection with Stop sign



Source: Grade Crossings Standards, July 2014

b) Intersection with Traffic Signal



Source: Grade Crossings Standards, July 2014

PART C – DESIGN CALCULATIONS

ARTICLE 10 – DESIGN CONSIDERATIONS

Unless otherwise specified in this Standard or in the ITE Pre-emption Practices, the following components of grade crossing warning systems must conform to the requirements and recommended practices of the AREMA Communications and Signals Manual in effect at the time of their installation and with the Grade Crossings Standards (GCS):

- warning signal assemblies;
- light units;
- bells;
- gates;
- operating mechanisms and control circuits; and
- design and operation.

In the event of a discrepancy between the AREMA Communications and Signals Manual and the *Grade Crossings Regulations* (GCR) and GCS, the GCR and GCS shall prevail.

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, in particular, 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. For public grade crossings, a traffic study may be useful in selecting the design vehicle, whereas for private crossings, the land owner 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, no later than 60 days before the day 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 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 the route to be used to the railway affected, in order 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 of time during which the warning system must operate before railway equipment reaches the crossing surface must meet GCS 15.2.3 and 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

It takes time to process information! The expression 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:

- detection
- identification
- decision

- 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 in order 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.

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

[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/s²

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.

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.

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: $G = \text{rise/run}$, V = maximum road operating speed (km/h), f = coefficient of friction between tires and the roadway [Table 10-8].

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 Figure 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).

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 taken into account when calculating acceleration time, and time accordingly added to the acceleration curves provided in Figure 10-2, as applicable.

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

Note: For four-quadrant gate systems, the minimum track clearance distance is the length along a highway at one or more railroad tracks, measured from the departure point (either the road approach stop line or 2 metres in advance of the warning device whichever is greater) to the clearance point (e.g. the point at which the rear of a vehicle is clear of the exit gate arm) (AREMA 3.1.10 D 8).

10.1.1 The grade crossing clearance distance (cd) is the distance between the departure point (normally 5 metres 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 metres 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 metres beyond the outside edge of the rail farthest from the departure point, measured perpendicularly to the rail. The departure point for drivers, pedestrians, cyclists and persons using assistive devices is 5 metres before the nearest rail or 2 metres before a Stop sign, Railway Crossing sign, warning signal or gate arm.

Note: This does not apply to sidewalks, paths or trails equipped with gates (see article 10.2.2).

Normally, where the crossing angle is 90°, a Railway Crossing sign, warning signals, or gate arm is located 3 metres from the nearest rail, measured perpendicularly to the rail, and the stopped position of the front of a vehicle is 2 metres beyond that, therefore 5 metres 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 metres, and the stopped position of the front of a vehicle will therefore be greater than 5 metres for the calculation of clearance distance. See Figure 10-1 for an illustration of clearance distance.

Note: It is recommended to stay as far away from live tracks as possible at all times.

10.2 Clearance Distance(s) for Vehicles

10.2.1 The clearance distance shown in Figure 10-1 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]

10.2.2 Clearance Distance (s) for Sidewalks, Paths or Trail (SPTCD) Equipped With Gates

10.2.3 The total distance a pedestrian must travel to pass completely through the clearance distance in Figure 10-5 is calculated using the following formula:

$$s = \text{SPTCD} + L$$

where:

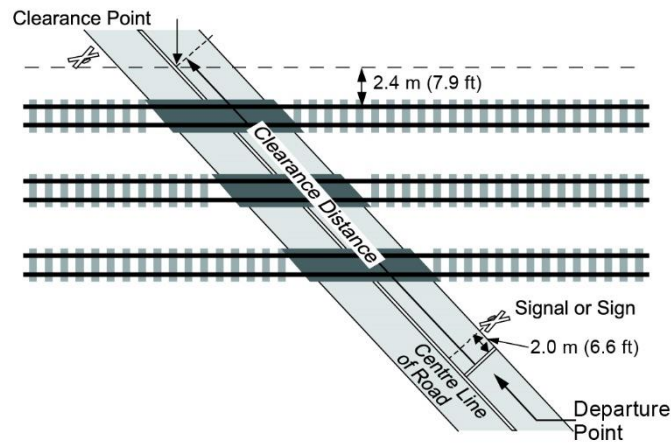
s = distance the road user must travel to pass through the grade crossing clearance distance (m)

SPTCD = grade crossing clearance distance [Figure 10-5]

L = length of the vehicle used to traverse (e.g. bicycle, assistive device)
(requires direct measurement)

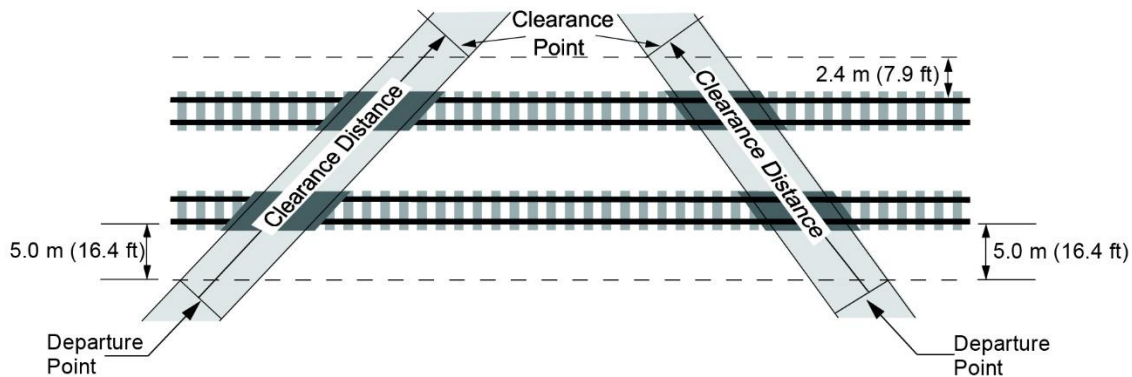
Figure 10-1 Clearance Distance for Grade Crossings

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



Source: Grade Crossings Standards, July 2014

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



Source: Grade Crossings Standards, July 2014

10.3 Departure Time – General

Departure time is the greater of either the time required for the design vehicle to pass completely through the clearance distance from a stopped position (T_D) or the time required for pedestrians, cyclists or persons using assistive devices to pass completely through the clearance distance (T_P). Departure time is essential for determining how far along the railway right-of-way sightlines need to be cleared in order 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 must be considered and 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 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 Ratios 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 bus	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), taking into account 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.

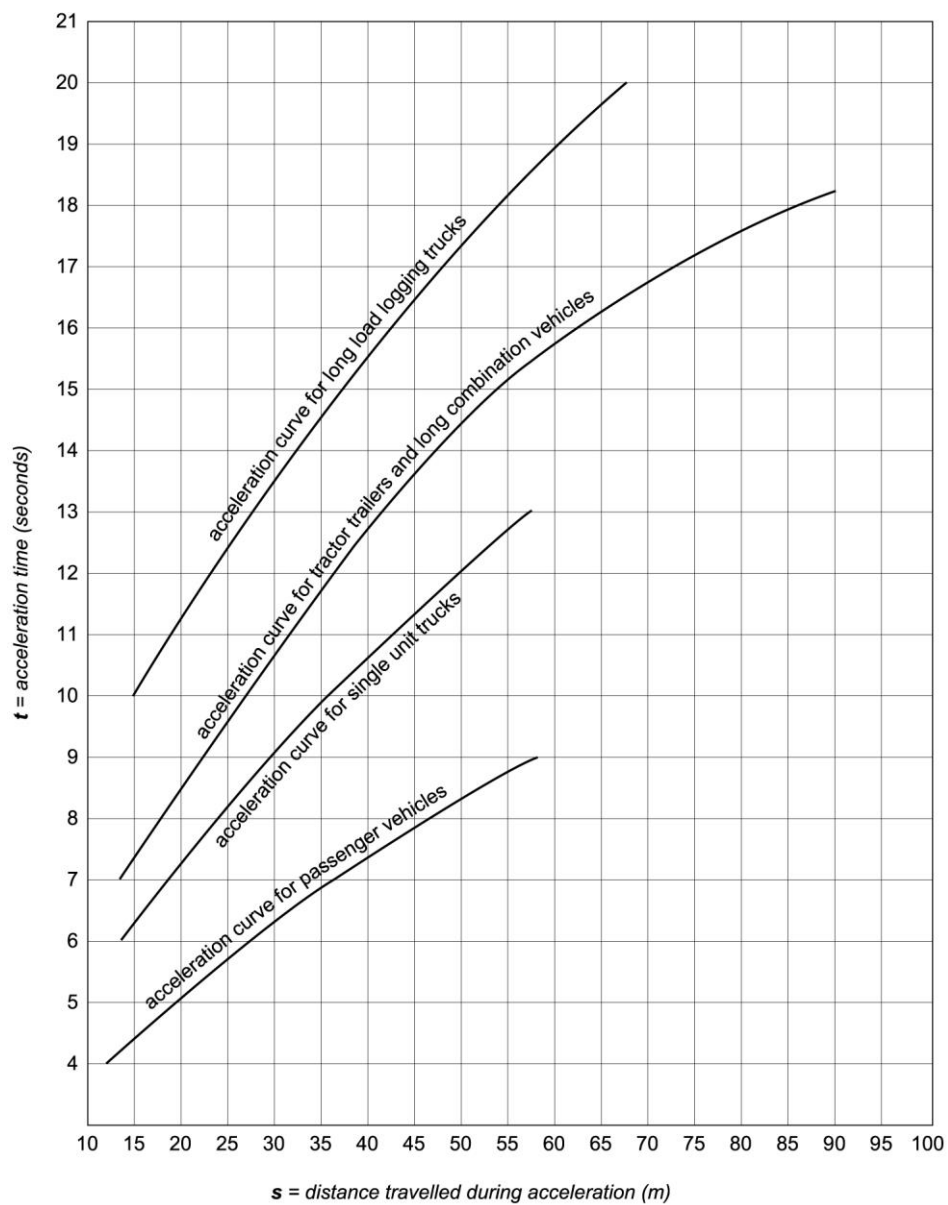
The road gradients indicated in Table 10-1 are the maximum road gradients over the distance the design vehicle must travel, measured from the rear of the design vehicle when at the stopped position to the clearance point (e.g. point at which the rear of the vehicle is said to be clear of the crossing 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. For the purpose of calculating 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 oversize 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 (cd) 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 metres 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)).

$$T_p = cd/V_p$$

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).

Figure 10-3, below, may be used as a quick reference to determine the departure time for pedestrians, cyclists and persons using assistive devices on dry, flat surfaces.

Figure 10-3 Departure Time – Pedestrians, Cyclists, and Persons Using Assistive Devices

Clearance Distance (m)	Departure Time (s)
9	7.4
14	12
18	15
22	18
26	22
30	25

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

10.4 Gate Arm Clearance Time

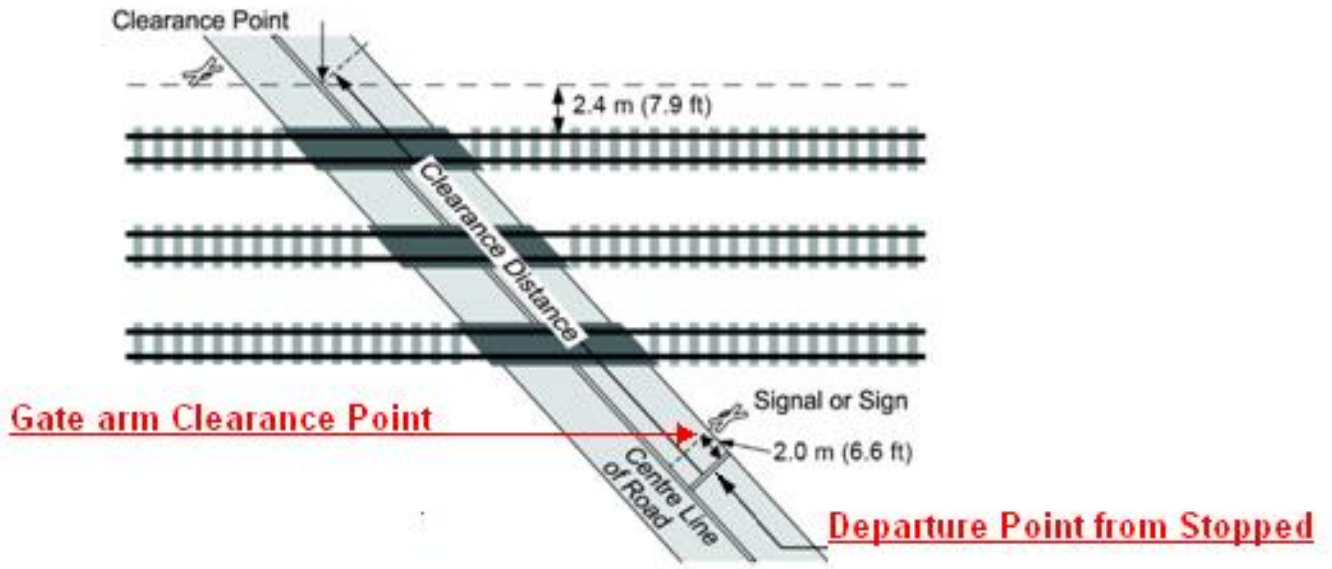
10.4.1 Gate arm clearance time (GACT) is the time required for the design vehicle to travel the entire gate arm clearance distance (cd_{Gstop}) from either the stopped position or the SSD, whichever is greater. The gate arm clearance point is the point at which the rear end of the vehicle is said to be clear of the gate arm, as shown in figure 10-4 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 parameters are established by the road authority, who is also responsible for ensuring that GACT is calculated according to these parameters. 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 the majority of 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 D, Article 15.3, for more information on four-quadrant gates and Part E for more information on device interconnection.

Figure 10-4 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:

$$T_{G\ ssd} = \frac{cd_{G\ ssd}}{(0.27 \times V_{road})}$$

Equation 10.3c of the GCS

where:

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

where:

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

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 metres, 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 ($T_{G \text{ stop}}$) is calculated as follows:

$$T_{G \text{ stop}} = J + (t \times G)$$

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

t = the time, in seconds, required for the design vehicle to accelerate through the gate arm clearance distance ($cd_{G \text{ stop}}$) on level ground as per Figure 10-2, Assumed Acceleration Curves; and

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

where:

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

Gate Arm Clearance Time for 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 10-5.

Note: The gate arm clearance time for sidewalks, paths or trails should be measured from 2 metres 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.

10.4.2 Gate Arm Clearance Time for Sidewalks, Paths or Trails ($T_{G \text{ stop}}$) is calculated as follows:

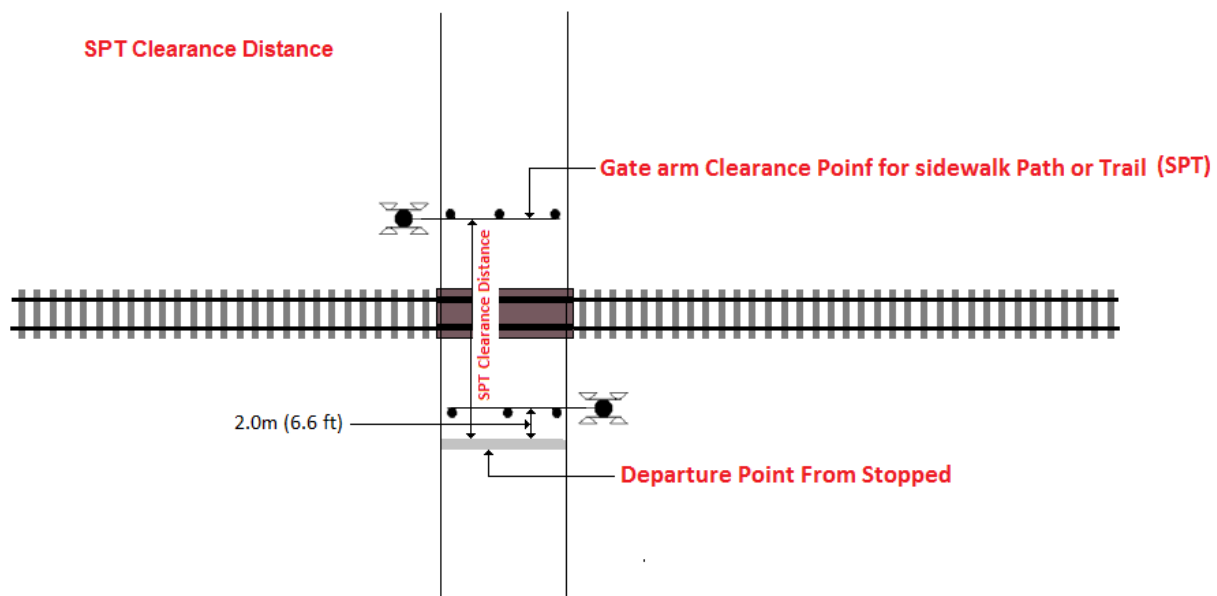
$$T_{G \text{ stop}} = \frac{SPT_{cd}}{V_p}$$

where:

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

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

Figure 10-5 Gate arm Clearance time for sidewalk paths or trails



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	Arterial	Not Divided

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
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

Table 10-4 Characteristics of Urban Roads

	Public Lanes		Locals		Collectors		Arterials		Express ways	Freeway s
	Reside ntial	Comme rcial	Residential	Indust./Comm.	Reside ntial	Indust./C omm	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
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
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 Class
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. Intercity 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
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	307	209	205

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

ARTICLE 11 – LOCATION OF GRADE CROSSINGS

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

In the event that a minimum of 30 metres of clear storage space cannot be provided at a 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, they may nonetheless be required to install additional light units 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.

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 metres 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 metres 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.

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.

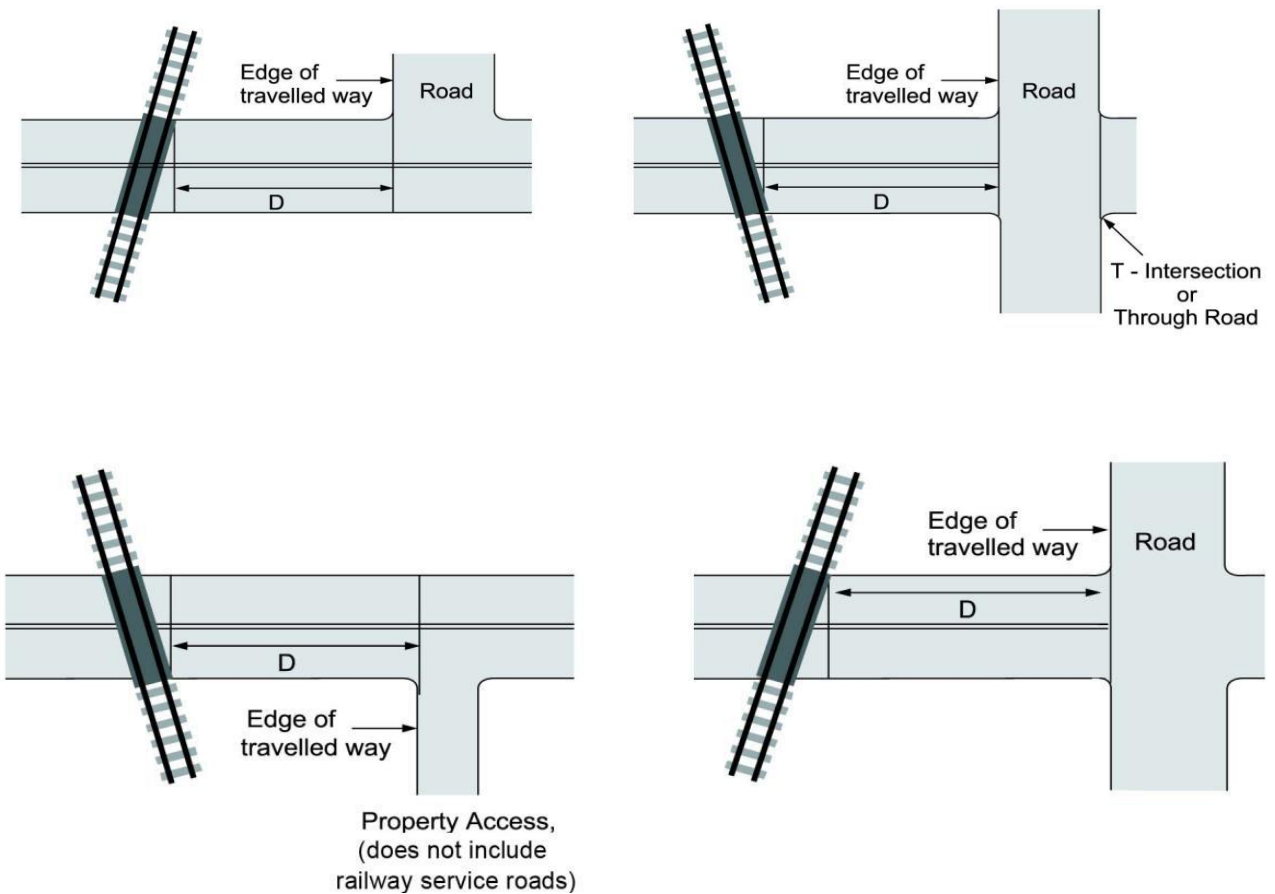
Where circular intersections include or are within 60 metres (200 feet) of a grade crossing, an engineering study should be conducted to determine if queuing could impact grade crossing safety. If such is the case, provisions should be made to clear highway traffic from the grade crossing prior to the 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, July 2014

PART D – WARNING SYSTEM DESIGN – GENERAL

ARTICLE 12 – WARNING SYSTEM OPERATION

Warning systems for existing and new grade crossings

12.1 Signal Assemblies

Note: All grade crossings installed or modified as of November 28, 2014, are required to meet these specifications before they can be placed into service.

Signal assemblies, gate assemblies and cantilever assemblies at grade crossings that existed before November 28, 2014, should be as shown in figures 12-1, 12-2 and 12-3, respectively, and should meet the specifications below.

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 figures 12-2 and 12-3.

- 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;

Note: The minimum clearance distances specified in articles 12.1 (a) and (b) must also be maintained for sidewalks, paths or trails, which are either stand-alone or adjacent to a vehicular roadway.

- 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 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 28, 2014, and to grade crossing that existed before November 28, 2014, when any of their components are changed (GCR 68(1), 82(1), 87(1) and 87(2)).

- 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)).

- 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.
- 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).

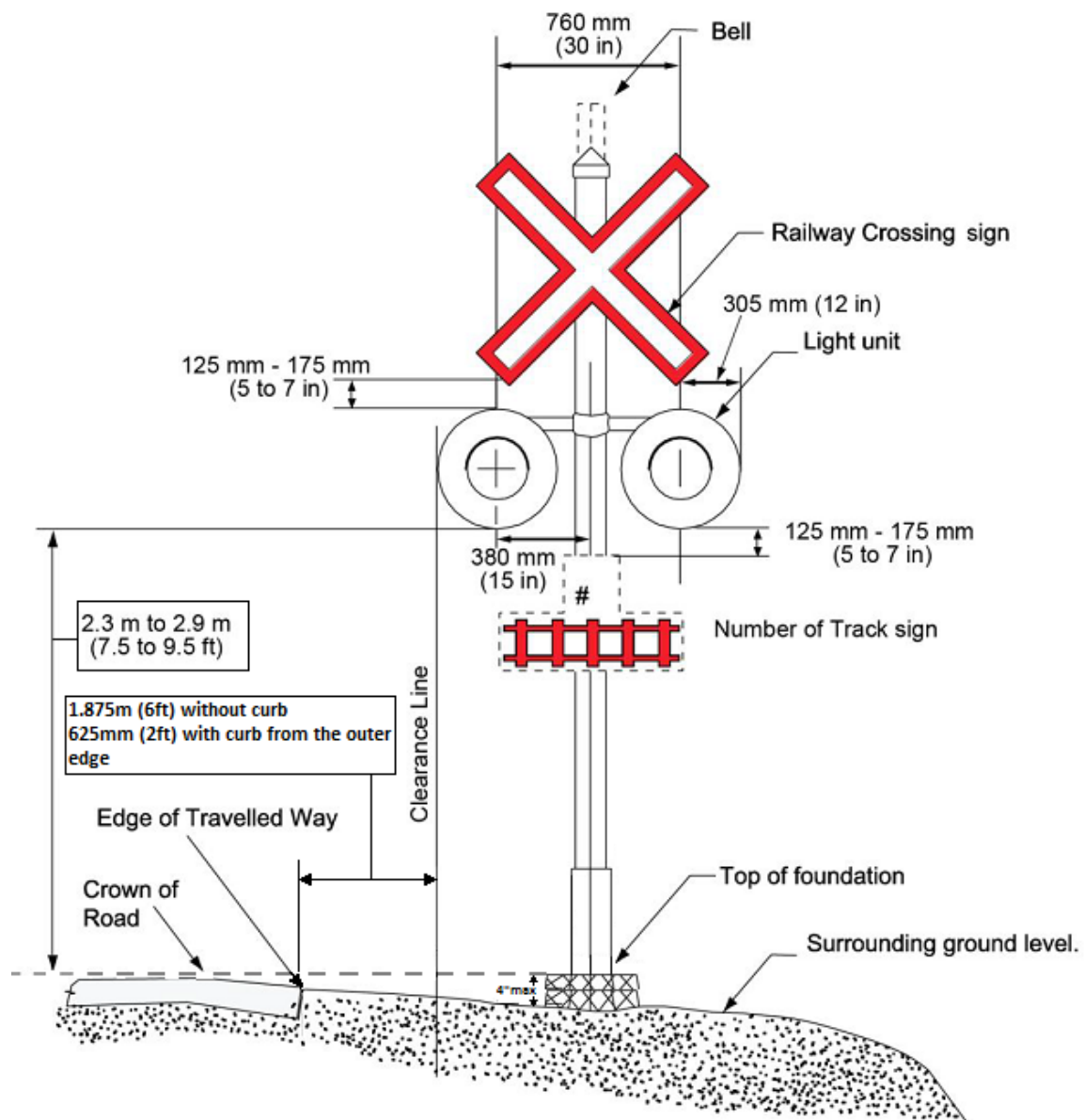
12.2 Recorders

In addition, grade crossing warning systems installed on or after November 28, 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:

- i. Activation and deactivation of interconnected devices;
- ii. Gates have returned to or have left the vertical position (Gate Up position);
- iii. Gates have descended to a point [angle of] 10 degrees from the horizontal (Gate Down position);
- iv. Activation of the warning system test switch;
- v. Activation and deactivation of all track circuits used in the control of the warning system, including electronic track circuits;
- vi. Activation of the warning system;
- vii. Activation and deactivation of all devices used to control the warning systems at adjacent crossings; and
- viii. Activation and deactivation of all devices used to activate the warning system from a location other than the crossing.

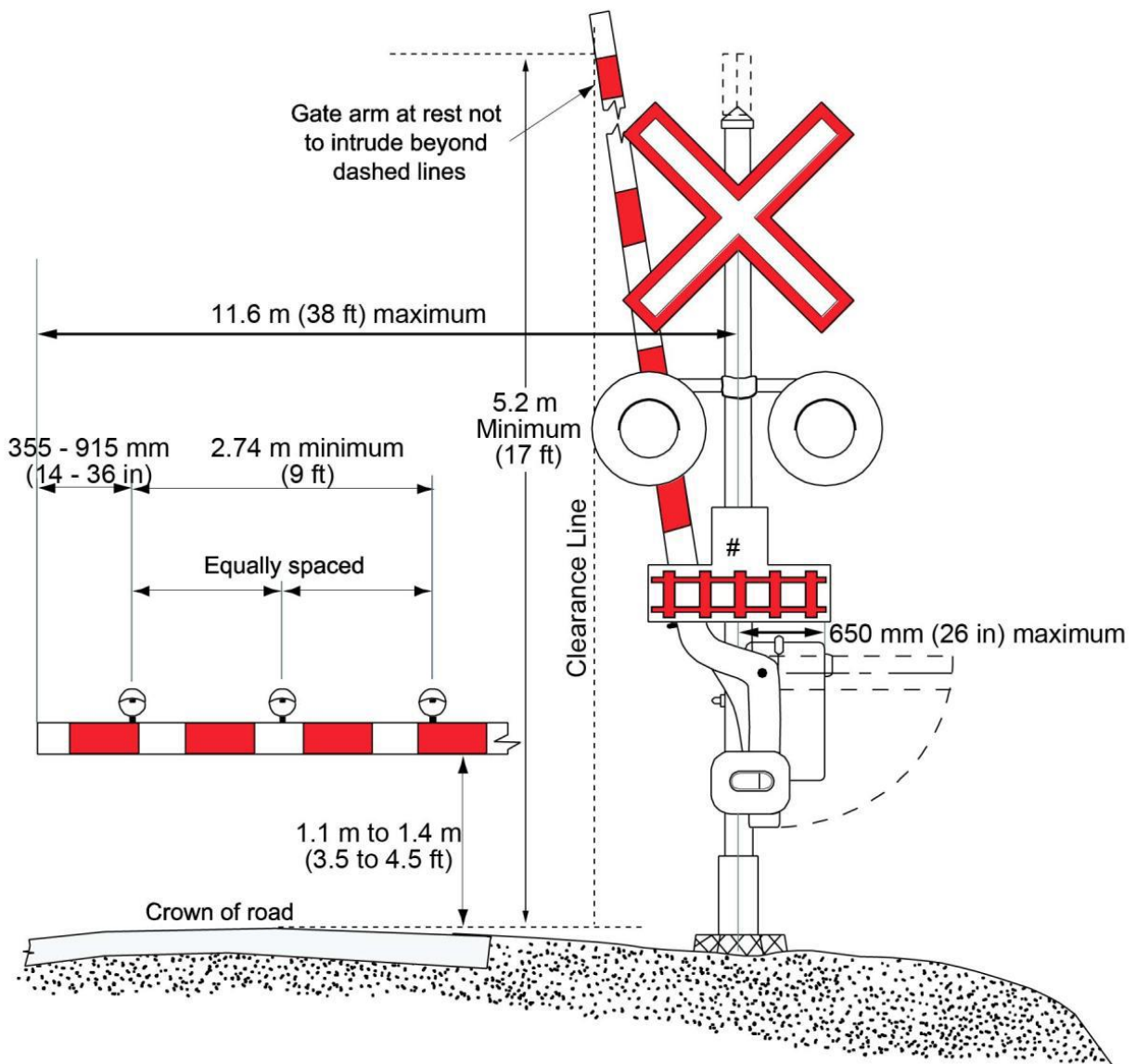
The date and time recorded should be the local time and should be verified at least monthly.

Figure 12-1 Warning Signal Assemblies



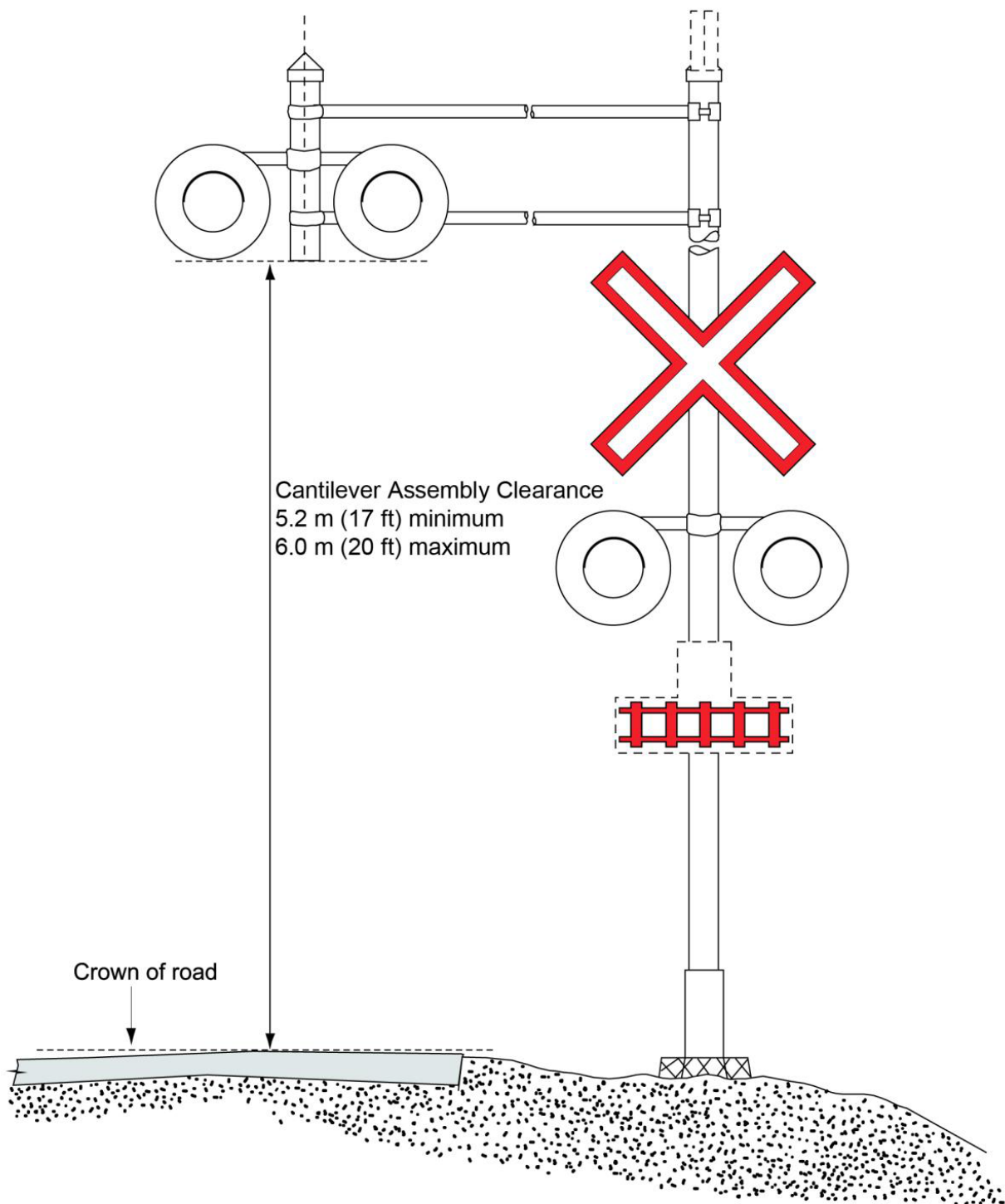
Source: Grade Crossings Standards, July 2014

Figure 12-2 Gates



Source: Grade Crossings Standards, July 2014

Figure 12-3 Cantilevers



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 railroads, 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 clear signal would be displayed. Blocks of track were separated by insulated joints.

The DC track circuit, shown in Figure 12-4, was the first means used for automatic train detection. It is a relatively simple circuit and is still used in many crossing 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 as long as 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 in the event that 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 12-5, 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).

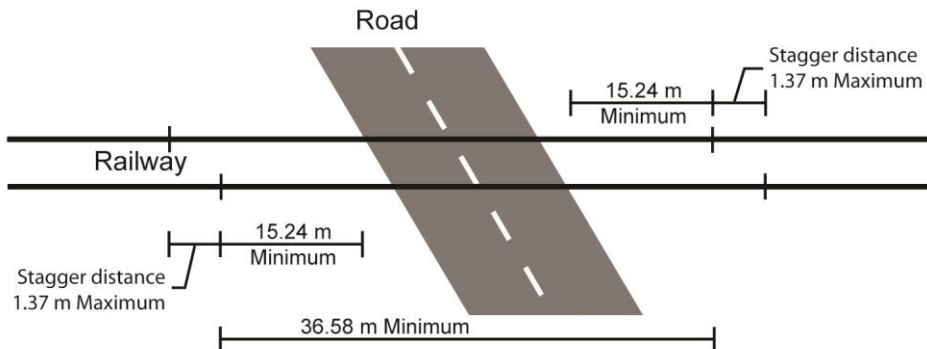
The length of any track circuit (approach or island) should be greater than the maximum inner wheelbase of any railway equipment that may occupy the track circuit, or a minimum of 36.58 m (120 ft), unless other provisions for protection are made. (AREMA 3.1.30, 8.6.1 B 14). See Figure 12-5.

Figure 12-4 DC Track Circuit

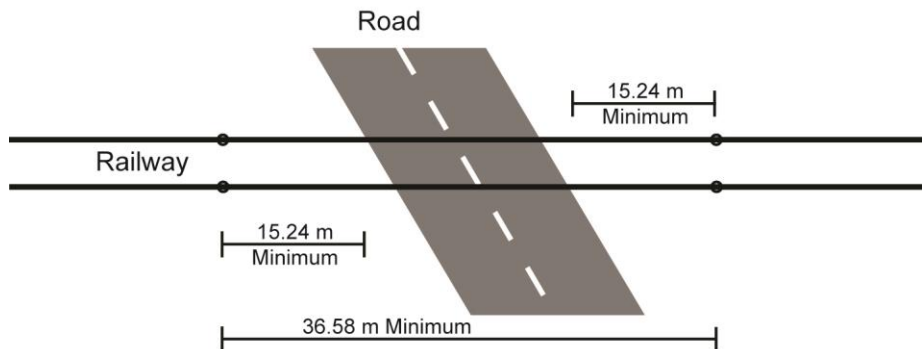


Figure 12-5 Recommended Insulated Joint Location for Grade Crossing Island Circuit

a) Island Track Circuit Defined by Insulated Joints



b) Electronic 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 12-7, 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 12-6 should be replaced.)

Figure 12-6 Proper Track Connector Installation

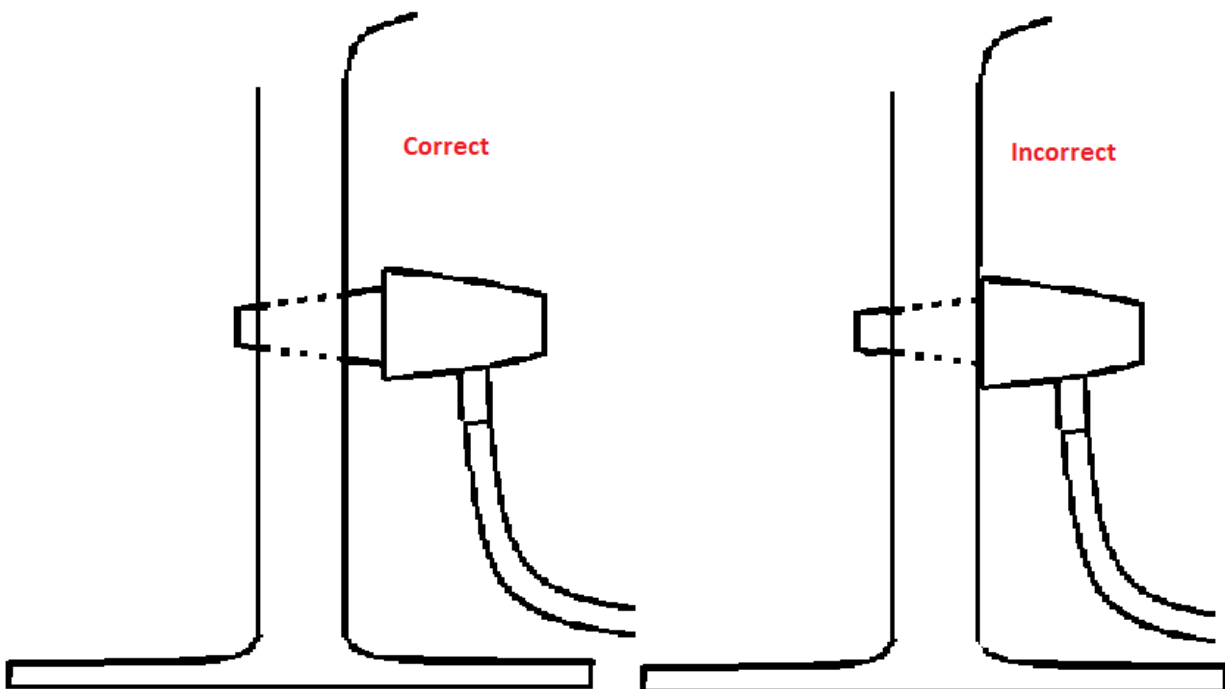
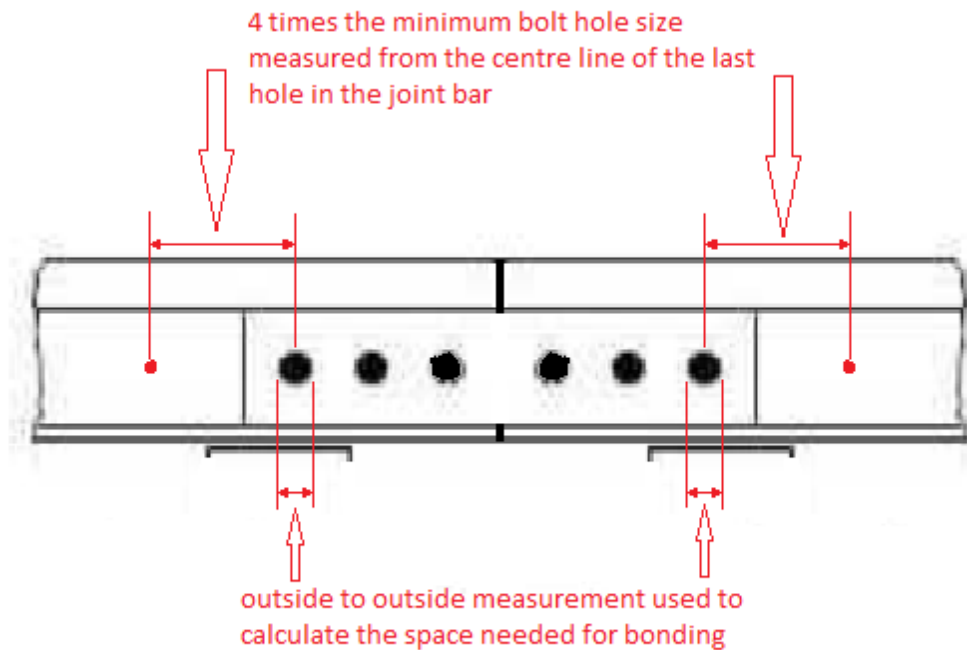


Figure 12-7 Proper Bonding Techniques

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



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 or 24 hours of normal railway operations, whichever is greater, applies to grade crossings installed after November 28, 2014 (GCR 44), and when changes are made to grade crossings installed after that date (GCR 87).

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 crossing must be reported as defective, as per CROR 103.1(h).

In addition to a reliable battery backup, warning systems should be equipped with a Power Off light clearly visible from 100 ft from both railway approaches and from the crossing surface during normal sunlight conditions.

ARTICLE 13 – NUMBER AND LOCATION OF LIGHT UNITS

For new and existing grade crossings

Note: This is a requirement for new grade crossings equipped with a warning system. Existing grade crossings have seven years from November 28, 2014, to comply with this requirement, unless they undergo a warranted change before November 28, 2021 (GCR 44, 53, 68, 82 and 87).

- 13.0 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 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) is able to see at least one set of front light units clearly.
- 13.2 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 centre 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:
 - a) the distance between the centre 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
 - b) 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 10-2.

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

13.4 Light Units for a Sidewalk, Path or Trail

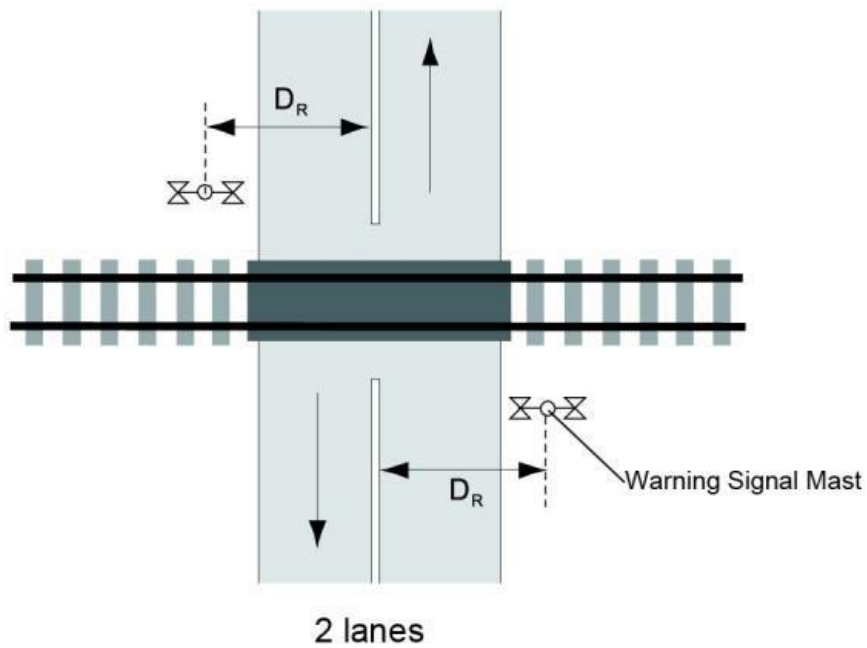
- 13.4.1 A sidewalk, path or trail with a centreline more than 3.6 m (12 ft) from the centre of a warning system signal mast must have separate light units for each direction of travel, as shown in Figure 13-2(a).

Note: This distance is measured from the centre 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).

Figure 13-1 Warning Signal Offsets Requiring Cantilevered Light Units

a) Two-Way Road



b) One-Way or Divided Road

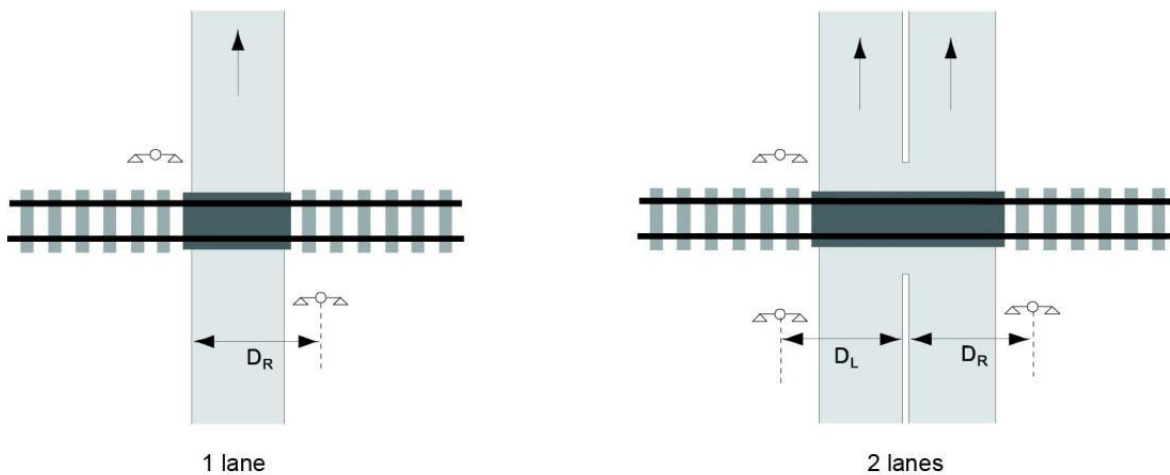
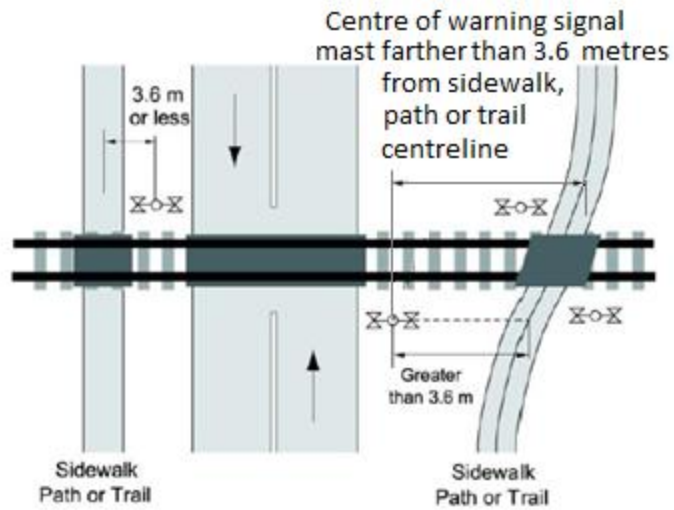
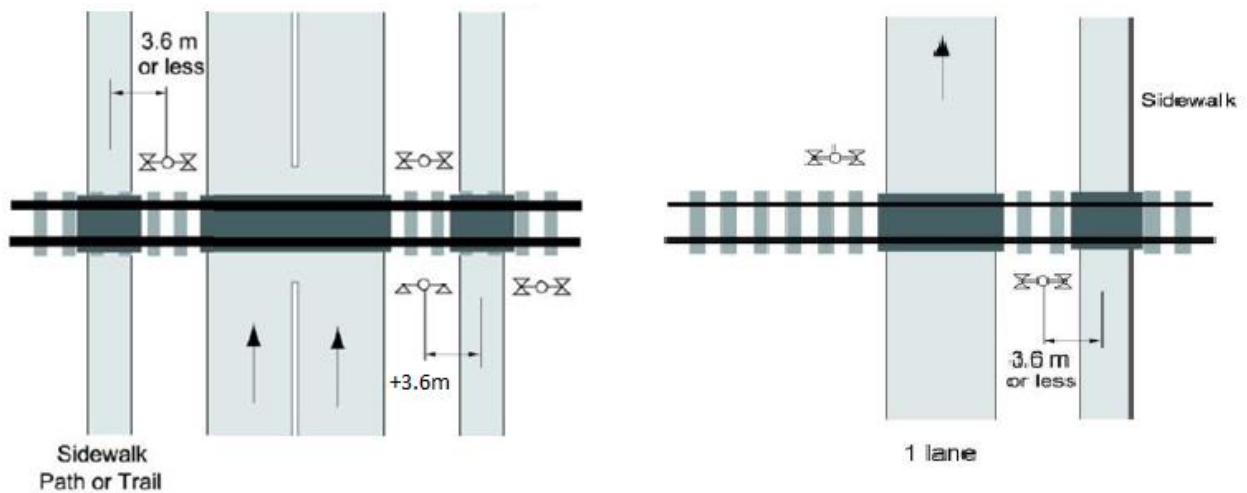


Figure 13-2 Sidewalks, Paths and Trails

a) Two-Way Road



b) One-Way Road



13.5 Vertical and Horizontal Cones of Vision

The effectiveness of a grade crossing warning system depends on the capability of the warning 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 center 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.

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.

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

Figure 13-3 Horizontal Cone of Vision

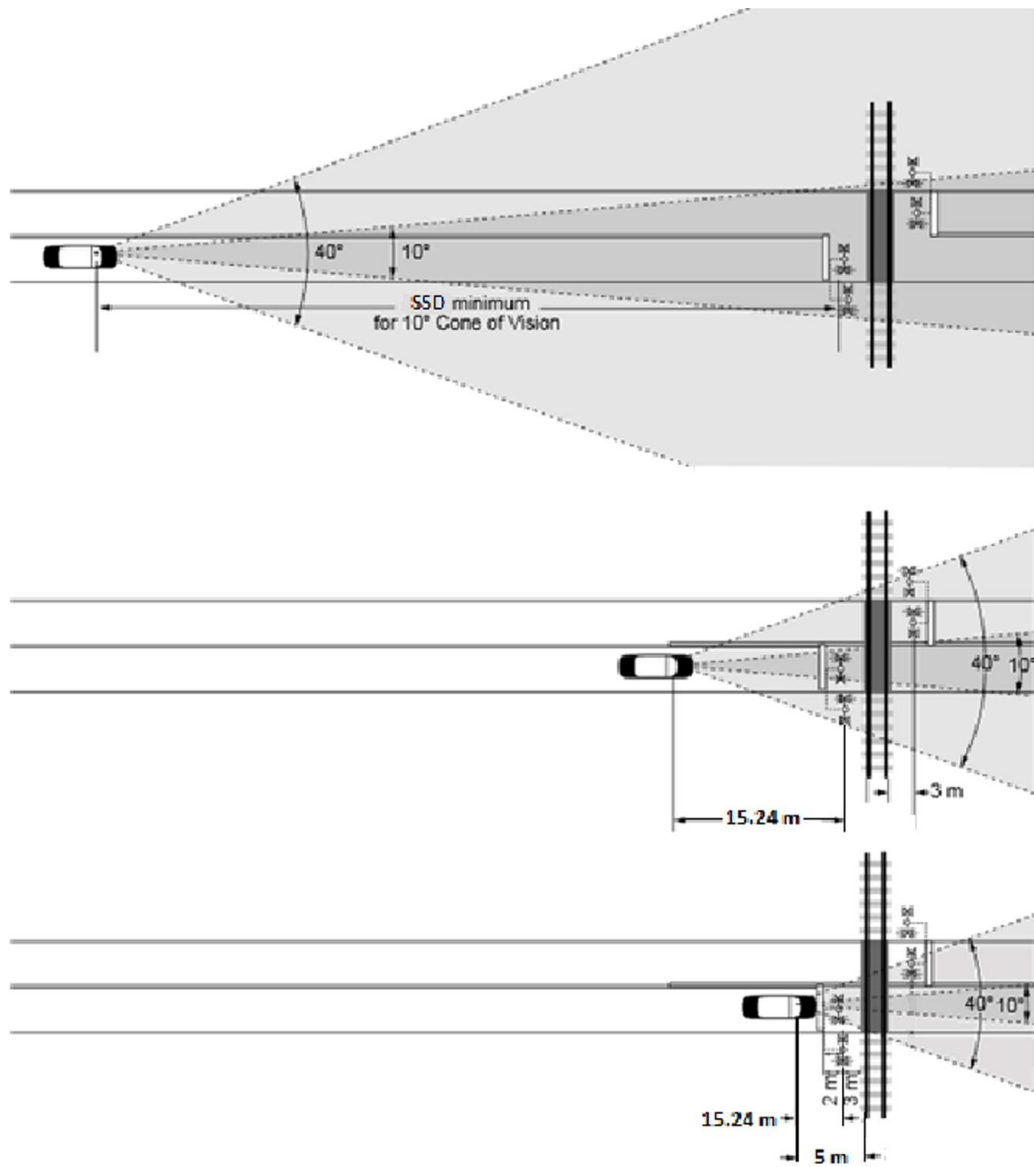
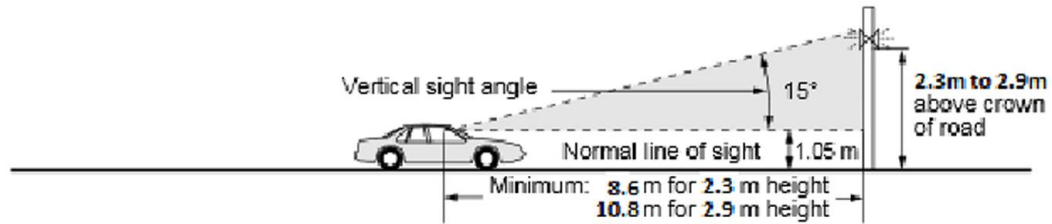
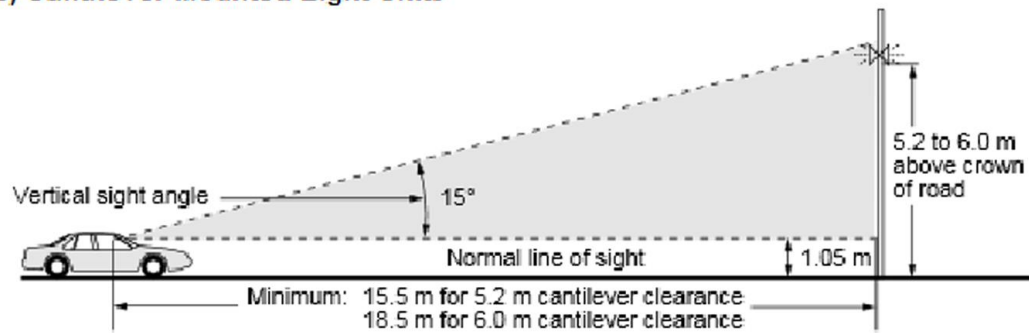


Figure 13-4 Vertical Vision Limits

a) Mast Mounted Light Units



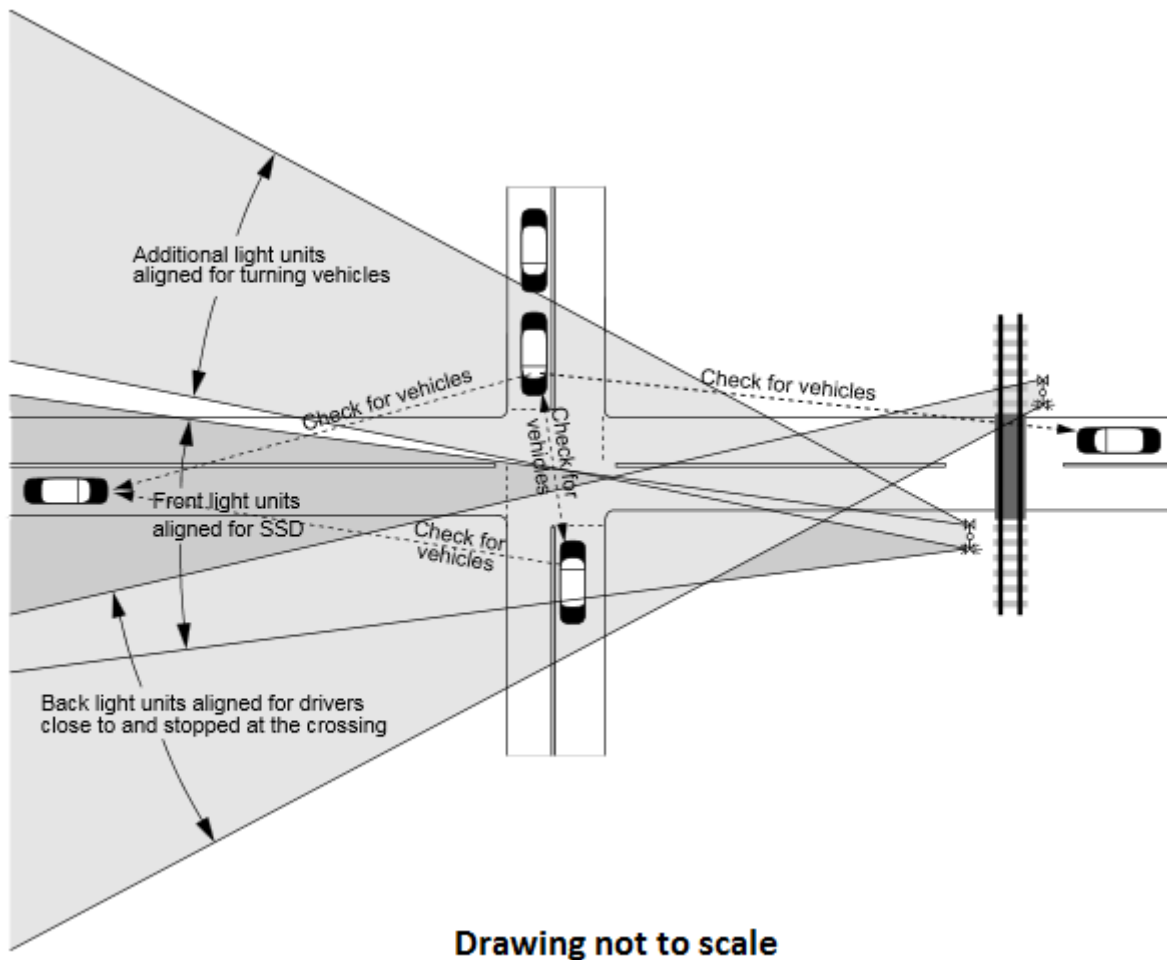
b) Cantilever Mounted Light Units



Drawing not to scale

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

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



ARTICLE 14 – LIGHT UNITS – ALIGNMENT

In order 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 at various approach speeds.

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)).

- 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 28, 2021, or as soon as a warranted change is made to any of their components (GCR 68(2), 82(2), 87(1) and 87(2)).

- 14.2.1 Light units must be aligned so that their axes pass 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 for 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 centre 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 so as 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 centre 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 centre 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.
- 15.1.5 Bell voltages must be maintained within 75% to 125% of their normal operating voltage, measured in accordance with the AREMA Communications and Signals Manual (AREMA 3.3.30 E 1).
- 15.1.6 Bells should operate at between 100 and 325 strokes per minute (AREMA 3.3.30 E 2).

15.2 Gates

Warning system gates are designed to close a grade crossing road approach 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).

15.3 Four-Quadrant Gates

Being developed

ARTICLE 16 – CIRCUITRY

Warning systems' circuitry and design must be in accordance with 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." The poorer the sightlines and the higher the traffic volume, including the presence of multiple tracks traversing the location, the greater the need for reliable warning devices. Warning time is crucial: failure to provide adequate warning of approaching railway equipment can create a hazardous situation in which the risk of a vehicle-train collision is extremely high.

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 7.3.2);
- c) the departure time for pedestrians, cyclists, and persons using assistive devices (GCS 7.3.3);
- 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 28, 2021, for existing grade crossings, at which speeds have been reduced.

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 28, 2021, for all grade crossings.

- 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 28, 2021, for all grade crossings.

- 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 integral 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 28, 2014 (GCR 93(2); GCS 16.5 and AREMA 3.3.1 D 2).

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.

Appendix J of this document was created to better define weekly testing requirements among other testing items.

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

COLUMN 1	COLUMN 2	COLUMN 3
DESIGNATED FREQUENCY	DEFINITION	MAXIMUM INTERVAL BETWEEN EACH INSPECTION OR TEST
Weekly	Once every week (Sunday to Saturday)	Not more than 10 clear days between weekly inspections or tests
Monthly	Once every calendar month	Not more than 40 clear days between monthly inspections or tests
Quarterly	Once every 3 months (January to March, April to June, July to September, and October to December)	Not more than 100 clear days between quarterly inspections or tests
Twice annually	Once every 6 months (January to June and July to December)	Not more than 200 clear days between twice-annual inspections or tests
Annually	Once every calendar year	Not more than 13 months between annual inspections or tests
Every 2 years	Once every 2 calendar years	Not more than 26 months between 2-year inspections or tests
Every 4 years	Once every 4 calendar years	Not more than 52 months between 4-year inspections or tests
Every 10 years	Once every 10 calendar years	Not more than 130 months between 10-year inspections or tests

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
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 grade crossing in lieu of a warning system	Semi-annually	N/A	N/A
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
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 appendices J and 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 queues build 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 2009 Manual of Uniform Traffic Control Devices for Canada (MUTCD), section 4C.10, for specific information. Interconnection and pre-emption of the traffic signal controller should be provided if it falls within the requirements of the MUTCD. Refer to the 2009 MUTCD, section 8C.09 for additional information.

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 railroad 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

18.01 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 18.01 (a) to (c) by November 28, 2021 (GCR 67 and 81).

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.

18.2 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; or
- b) clear the grade crossing before the gate arms start to descend, where there is a warning system with gates.

18.3 Battery Backup

Where a Prepare to Stop at Railway Crossing sign is installed, four hours' worth 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 28, 2014. This requirement does not apply to Prepare to Stop at Railway Crossings signs installed before November 28, 2014; however, it is considered an engineering best practice.

Plans and Forms

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 in order 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 94(2)).

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

Testing and maintenance

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.

- 20.1 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.
- 20.2 The inspection and testing of the elements set out in column 2 of Table 20-1 of 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)).
- 20.3 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

COLUMN 1	COLUMN 2	COLUMN 3
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 17-1 of the GCS or this document.

See appendices K and 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, with the exception of 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 absolutely 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 adequate 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 3 or greater, and it increases by 50% or more relative to the previous value provided to the road authority.

Average Annual Daily Traffic

Average annual daily traffic (AADT) should be communicated to the railway if the grade crossing is not equipped with an automatic warning system with gates and if the AADT is 2,000 or greater or when that value increases by 20% or more relative to the previous value provided to the railway

AADT should be calculated throughout an entire year in order to take into account seasonal changes. AADT should be re-calculated no later than five years after it is originally calculated, or whenever significant 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 (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 or 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
 - ii. take the measures referred to at (d), above, and
 - iii. 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.

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, as the case may be, must

- 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 of time, 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 a 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 of time, 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 in order 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 of time, 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 in order 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 of time, 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 in order 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

Below is an example of the application of GCR 103:

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 be in compliance with 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 Order¹ 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.

¹ <https://www.tc.gc.ca/eng/railsafety/rules-tco167-170.htm>

ARTICLE 23 – EXEMPTIONS / NOTICE OF RAILWAY WORKS AND RESUMPTION OF USE

23.1 Exemptions

On occasion, if a stakeholder wishes to file for an exemption to the rules or regulations made pursuant to the *Railway Safety Act* (RSA), it must apply to Transport Canada. Generally speaking, if the latter deems the request be in the interest of public safety and not likely to threaten safe railway operations, the exemption is granted. The process for applying for an exemption is outlined below.

Subsection 22.1(1) of the RSA makes provisions for specified persons, specified companies, specified railway equipment or a specified railway work to file a notice of exemption for the purpose of upcoming testing related to rail transportation, or for an immediate exemption of short duration, from any provision of the standards formulated under RSA section 7, regulations made under RSA subsection 18(1), (2.1) or 24(1), or rules in force under RSA section 19 or 20. The Minister may deny such an exemption if he/she is of the opinion that the exemption would not be in the public interest or would be likely to threaten safety.

RSA 22.1(2) A notice under subsection (1) shall be filed with the Minister and

- a) in the case of a railway company, each relevant association or organization that is likely to be affected by the exemption; or
- b) in the case of a local railway company, any railway company on whose railway the local railway company operates railway equipment and that is likely to be affected by the exemption.

RSA 22.1(3) Each of the relevant associations or organizations or the railway company to which notice must be given, as the case may be, may object to an exemption on grounds of safety by filing its objection with the Minister and the company within fourteen days after the notice referred to in subsection (1) is filed.

RSA 22.1(4) The Minister may

- a) within twenty-one days after the filing of an objection under subsection (3), confirm the objection if the Minister decides that the exemption threatens safety;
- b) within twenty-one days after the filing of an objection under subsection (3) or within thirty-five days after receiving a notice under subsection (1), impose terms and conditions on the exemption that the Minister considers appropriate, if the Minister is of the opinion that the exemption without terms and conditions is not in the public interest or is likely to threaten safety; or
- c) within thirty-five days after receiving the notice under subsection (1), deny the exemption if the Minister is of the opinion that the exemption is not in the public interest or is likely to threaten safety.

RSA 22.1(5) An exemption is effective if

- a) the company receives a response from the Minister and each of those associations and organizations or the railway company, as the case may be, indicating that they do not object to the exemption;
- b) no objections are confirmed by the Minister under paragraph (4)(a);

- c) the Minister, instead of making or confirming an objection, imposes terms and conditions under paragraph (4)(b) and the company complies with the terms and conditions; or
- d) the Minister does not deny the exemption under paragraph (4)(c).

Also, as per section 24(1.1) of the RSA, The Minister may, on any terms and conditions that the Minister considers necessary, exempt any railway company or other person from the application of any regulation made under subsection 24(1) if, in the opinion of the Minister, the exemption is in the public interest and is not likely to threaten safety. This determination should be made by means of a safety assessment.

23.2 Treatment of Out-of-Service Railway Lines and Warning Systems

An out-of-service railway line is one on which railway operations have ceased temporarily. If a railway decides to place a line, or part of a line, of railway out of service, it is nonetheless required by law to continue inspecting and testing track conditions and all grade crossings 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, and Transport Canada will continue to monitor its compliance with the rules and regulations pursuant to the RSA.

Should a railway or road authority, not perform the required warning system tests, or request an exemption to these requirements, all tracks over the affected grade crossings should be considered “out-of-service”: the railway must suspend all operations during the timeframe of the exemption, and the grade crossing warning system is also temporarily taken “out-of-service” for the duration of the exemption. The rail traffic control system, on affected subdivisions, must be modified to prevent the issuance of a clearance until the rail traffic controller (RTC) has received notice from engineering services that the line has been inspected and is safe for the operation of trains.

The grade crossing light units must be bagged/covered to prevent road user confusion, and gates, where used, must be held in the vertical position.

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. The sign should include an emergency contact number, the precise location of the grade crossing affected, and the railway company name.

The railway must inform the affected municipalities and road authorities, in advance of the cessation, of the maintenance, inspection or testing to be carried out.

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 crossing warning signals and all maintenance inspections and/or 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 successfully completed before the railway begins operation over the grade crossings on that portion of line. Tests must be performed, and covered light units must be uncovered, within seven days prior to such 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) A bulletin in the following format must be issued: 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 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 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.
- f) More information pertaining to exemptions can be found on Transport Canada's website at the following address: <http://www.tc.gc.ca/media/documents/railsafety/guideline-applying-exemption.pdf>.

23.3 Departure from any Applicable Engineering Standard

Technology today changes rapidly, making it virtually impossible for technical standards and regulations to keep up with the state of the art. This is why a departure from existing standards or regulations is sometimes requested. Section 10 of the RSA provides a means for stakeholders to present a request for departure from applicable engineering standards to the Minister.

The following section is intended to provide direction on how to propose a departure from an applicable engineering standard.

Under subsection 10(1) of the RSA, where a proponent wishes to propose a railway work that entails a departure 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 of that approval.

When the proponent files such a request with the Minister, the Proponent should provide all of the information and documentation necessary to substantiate its request and enable the Minister to determine whether the proposed railway work is consistent with safe railway operations.

Note: Failure to provide all of the necessary information and documentation may result in the request being refused or its processing delayed.

Information that is required to be provided to the Minister, where paragraph 10(1)(a) of the RSA applies:

- A copy of the request itself, including reference to the particular provision of the RSA under which the request is being made;
- A copy of the plan of work for the proposed undertaking, including drawings, specifications and other particulars as are prescribed; and

- A statement setting out the manner in which the work departs from the applicable engineering standards and the reasons for such departure; or

Information that is required to be provided to the Minister, where paragraph 10(1)(b) of the RSA applies:

- A copy of the request itself, including reference to the particular provision of the RSA under which the request is being made;
- A copy of the plan of work for the proposed undertaking, including drawings, specifications and other particulars as are prescribed; and
- A copy of the proponent's response to the outstanding objections.

In both cases:

As applicable, the proponent should provide confirmation that a professional engineer is taking responsibility for any part of the engineering work related to an exemption for a railway work.

Note: 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.

Please forward all requests to depart from any applicable engineering standard, with the necessary information and documentation to:

Email: RailSafety@tc.gc.ca
 Phone: 613-998-2985
 Toll-free: 1-844-897-RAIL (1-844-897-7245)
 Fax: 613-990-7767

Mailing Address: Transport Canada
 Rail Safety Branch
 Mailstop: ASR
 427 Laurier Street West
 Ottawa, Ontario
 K1A 0N5

23.4 Notice of Railway Works

The intent of the *Notice of Railway Works Regulations* is to provide clear direction as to the information to be provided by proponents regarding a proposed work and the persons to whom such information is to be provided. This is to ensure that all persons affected are given the opportunity to object to the proposal, should they feel the work may prejudice their own safety or the safety of their property.

23.4.1 Sections 8 and 9 of the RSA state the following:

8(1) If a proposed railway work is of a prescribed kind, the proponent shall not undertake the work unless it has first given notice of the work in accordance with the Regulations. However, it may undertake the work if all persons to whom the notice was given file with the proponent a response indicating that they do not object to the work.

8(2) A person to whom a notice is given under subsection (1) may file with the proponent an objection to the proposed railway work if the person considers that the proposed railway work would prejudice their safety or the safety of their property. The objection must include reasons and be filed before the expiry of the period specified in the notice for the filing of objections, and a copy of it must be filed without delay with the Minister.

8(3) A person who has filed an objection under subsection (2) and subsequently wishes to withdraw that objection shall so notify the proponent and the Minister, and the objection shall be deemed to be withdrawn on receipt by the Minister of the notice. R.S., 1985, c. 32 (4th Supp.), s. 8; 1999, c. 9, ss. 5, 37(E)

9(1) Where the Minister is satisfied that an objection filed under subsection 8(2) is frivolous or vexatious, the Minister may send a notice to that effect to the person who filed the objection, and the objection shall thereupon be disregarded for all purposes of this Act.

9(2) The Minister shall send a copy of a notice under subsection (1) to the proponent.

Note: Articles 23.4.2, 23.4.3 and 23.4.4 are drawn from sections 3, 4 and 5, respectively, of the *Notice of Railway Works Regulations*.²

23.4.2 Prescribed Kinds of Works

For the purposes of subsection 8(1) of the *Railway Safety Act*, the following are prescribed as railway works of a kind for which notice must be given:

- a) the construction or alteration of a line of railway involving the acquisition of land in addition to land on which an existing line of railway is situated;
- b) the construction or alteration in a municipality of railway bridges and culverts having an overall span greater than six meters and railway tunnels;
- c) the construction or alteration of structures located above or below a line of railway by a party other than a railway company, but excluding a mine or an oil or gas well;
- d) the construction or alteration of road crossings for public use, including the installation or alteration of road crossing warning systems, but excluding the installation or alteration of road crossing signs; and

² [Notice of Railway Works Regulations](#) (SOR/91-103), s. 3, 4.

- e) the construction or alteration of any line works that may affect drainage on land adjoining the land on which a line of railway is situated.

23.4.3 Time and Content of Notice

The notice referred to in section 8(1) of the RSA and section 3 of the *Notice of Railway Works Regulations* must

- a) be given at least 60 days before the proposed date of commencement of the proposed railway works;
- b) set out the period, not less than 60 days, during which objections, pursuant to subsection 8(2) of the Railway Safety Act, may be filed; and
- c) contain the following information, namely,
 - (i) a drawing showing the location of the proposed works,
 - (ii) a description of the proposed works with general plans, including elevations of proposed structures,
 - (iii) a description of any impact that the proposed works may have on the safety of persons and property, and
 - (iv) the proposed date of commencement and the projected time for completion of the proposed works.

23.4.4 Persons to Whom Notice Is To Be Given

- (1) A notice referred to in section 8(1) of the RSA and section 3 of the *Notice of Railway Works Regulations* must be given
 - a) in the case of a railway company proposing to construct or alter line works, to the municipality, or municipalities, in which the line works will be or are located and to any owner of land immediately abutting land on which the line works are situated;
 - b) in the case of any party proposing to construct a road crossing, excluding the installation of a road crossing warning system, to the following, namely,
 - (i) the railway company whose line is to be crossed,
 - (ii) the municipality in which the crossing works are to be located,
 - (iii) the authority having responsibility for the road in question, and
 - (iv) any owner of land immediately abutting land on which the crossing works are situated; and
 - c) in the case of any party proposing to alter a road crossing or to install or alter a road crossing warning system, to the following, namely,
 - (i) the railway company whose line is crossed,
 - (ii) the municipality in which the crossing works are located, and
 - (iii) the authority having responsibility for the road in question.
- (2) A copy of a notice referred to in subsection (1) must be sent forthwith to the Director of the regional Railway Safety Directorate office having jurisdiction over the railway at the location

of the proposed works. A carbon copy of the notice should be sent to Rail Safety Headquarters, at the address below.

Email: RailSafety@tc.gc.ca
Phone: 613-998-2985
Toll-free: 1 844 897-RAIL (1 844 897-7245)
Fax: 613-990-7767

Mailing Address:
Transport Canada
Rail Safety Branch
Mailstop: ASR
427 Laurier Street West,
Ottawa, Ontario
K1A 0N5

Note: Article 23.4.5 is adapted from section 10 of the RSA.

23.4.5 Undertaking of Proposed Railway Works

Where a proposed railway work is one in respect of which notice has been given under RSA 8(1) and, at the expiration of the period specified in that notice for the filing of objections, there is an outstanding objection, the proponent must not undertake that work otherwise than in accordance with the terms of the Minister's approval given under this section pursuant to a written request, filed with the Minister, for such approval.

A request to the Minister for approval of a proposed railway work under RSA 10(1) may be filed before the end of the period specified in the notice given under RSA 8(1) if all persons to whom the notice was given have filed a response with the proponent.

A proposed railway work described in RSA 10(1)(b) may be undertaken without the Minister's approval if the outstanding objection is withdrawn.

A request to the Minister for approval of a proposed railway work pursuant to RSA 10(1) must be accompanied:

- (a) in all cases, by a plan of the work to which the request relates, which plan must include such drawings, specifications and other particulars as are prescribed;
- (b) where RSA (1)(a) applies, by a statement setting out the manner in which the work departs from the applicable engineering standards and the reasons for such departure; and
- (c) where RSA (1)(b) applies, by the response of the proponent to the outstanding objections.

On receipt of a request for approval of a proposed railway work under this section, the Minister shall, having regard to the material referred to in RSA 10(2) and any other factors that the Minister deems relevant, consider whether the proposed railway work is consistent with safe railway operations and shall, before the expiration of the assessment period,

- (a) if satisfied that the work is consistent with safe railway operations, notify the proponent and any objecting party that the Minister approves the work, either absolutely or on such terms as are specified in the notice; or
- (b) if not satisfied that the work is consistent with safe railway operations, by notice
 - i. inform the proponent and any objecting party that the Minister refuses to approve the work and of the reasons why the Minister is not so satisfied, or

- ii. direct the proponent to file with the Minister and any objecting party, within the period specified in the notice, such further particulars relating to the work as are specified in the notice.

Where a railway work has been undertaken without the required approval of the Minister having first been given, the Minister may nevertheless approve the work in accordance with RSA section 10.

The Minister may, in deciding whether to approve a proposed railway work, engage any person or organization having expertise in matters of safe railway operations to furnish advice to the Minister in relation to the matter.

Where the proponent is directed to file further particulars pursuant to RSA 10(3)(b)(ii) and

- a) fails to file the further particulars within the period referred to in that subparagraph, the proponent shall be deemed to have withdrawn its request to the Minister for approval of the work; or
- b) files the further particulars within the period referred to in that subparagraph, the RSA shall thereupon have effect as if the request that the Minister approve the work had been filed only at the time when the further particulars were filed.

The Minister's approval of a proposed railway work under RSA section 10 does not authorize the commencement of that work after the expiration of

- a) the period specified in the approval; or
- b) if the approval does not specify a period, one year after the approval is given.

In this section, "assessment period," in relation to a request that the Minister approve a proposed railway work, means

- a) the period of sixty days commencing on the day on which the request is filed; or
- b) if, before the expiration of the period referred to in RSA 10(8)(a), the Minister determines that, by reason of the complexity of the work to which the request relates, the number of requests filed or any other reason, it is not feasible to consider the request before the expiration of that period, and so notifies the proponent and any objecting party, such period in excess of that period of sixty days as the Minister specifies in the notices.

Where, pursuant to section 40 of the RSA, the Minister directs a person to conduct an inquiry respecting a proposed railway work, the period commencing on the day when the Minister so directs and ending on the day when the person reports back to the Minister pursuant to section RSA section 40 shall be disregarded in computing the assessment period.

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 28, 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, in order to ensure that none of the crossing's characteristics creates a potential risk to safe railway operations.

Example: The railway has provided all of 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 of 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 of 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 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).

- 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).
- 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).
- 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).
- 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 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).
- 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).
- 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).
- 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 – GRADE SEPARATION

Being developed

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 must be installed in such a way that pedestrians (or cyclists) are not able to easily circumvent them.

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.

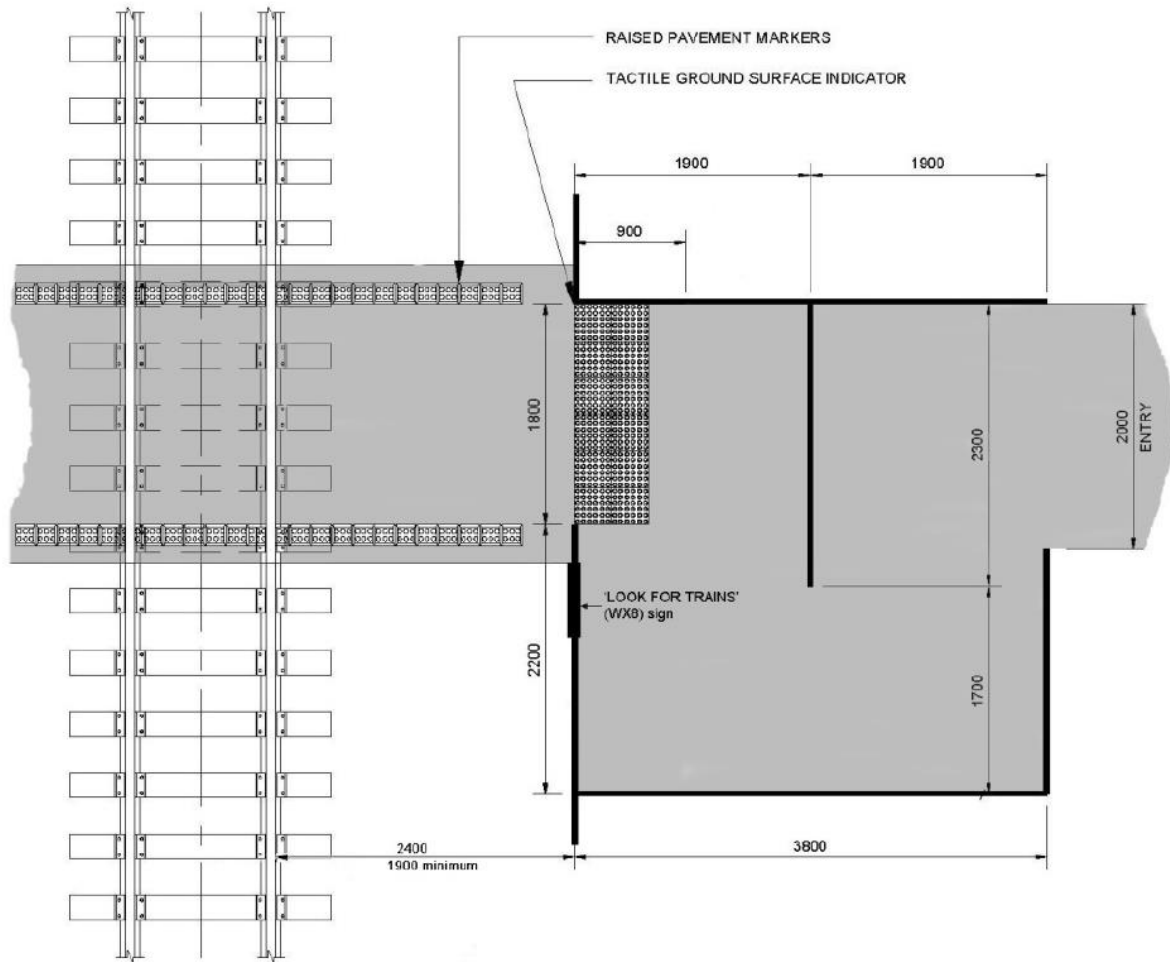
GCR 106(4) If a warning system is not indicated as being required in column 43 and 5 of Table D-1 of the Grade Crossings Standards, guide fencing must be installed, as well as a barrier that is intended to slow a person’s approach to the grade crossing and to encourage a person to look both ways before 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)).

³ Note that the current GCR 106(4) specifies only column 5. This error will be corrected in the eventually amended GCR

Figure 26-1 Typical Pedestrian Maze Barrier for Public Grade Crossing



ARTICLE 27 – BLOCKED CROSSINGS

Public crossings

A public grade crossings 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 crossings should be avoided at all times. 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 municipality⁴ where 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.⁵

27.1 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 as a consequence 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.

⁴ This can be a city, town, or other organized district.

⁵ For example, if traffic lights cause congestion that results in vehicles stopping on the crossing surface once a week.

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:

1. The municipality passes a resolution stating that the blocked crossing is creating a safety concern;
2. 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;
3. The railway company and the road authority work together to resolve the safety concern within 90 days.

In the event that 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.

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 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, as a consequence, 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 situation at a blocked grade crossing

Call the railway company's emergency telephone number immediately if you

- a) become aware of an emergency situation 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 situation 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 as long as 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, in order 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 the 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.

28.2 Replacement of Guideline Number 1

Since the new *Grade Crossings Regulations* were introduced, the *Procedure & Conditions for Eliminating Whistling at Public Crossings (Guideline No. 1)* has been replaced by the *Procedure for Train Whistling at Public Grade Crossings*.

This new procedure reflects the requirements of the *Railway Safety Act, the Grade Crossings Regulations* and the *Grade Crossings Standards*, and is provided in Appendix D of this Handbook or online at: <http://www.tc.gc.ca/eng/railsafety/railsafety-976.html>.

PART G

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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 problems 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 must be considered in the review. Those involved in the assessment must 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

31.1(a) Within seven years of the coming into force of the GCR (e.g. by November 28, 2021) and at least every five years after that date, railways and road authorities should jointly conduct a DSA of their public grade crossings.

31.1(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;
- 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;
- 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.

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

APPENDIX A - LIGHT EMITTING DIODE (LED) SIGNAL MODULES

Standards for LED Signal Modules in Warning Systems

1 DEFINITIONS

Candela (cd) – SI unit of luminous intensity. The candela is the luminous intensity, in a given 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 L_v (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/m²).

Luminous Efficacy of Radiation (K) – the luminous flux Φ_v divided by the corresponding radiant flux Φ_e ($K = \Phi_v / \Phi_e$).

Luminous Intensity (I_v) (of a source in a given direction) – the luminous flux $d\Phi_v$ leaving the source and propagating in the element of solid angle $d\Omega$ containing the given direction, divided by the element of solid angle ($I_v = d\Phi_v / d\Omega$ candela).

Luminous Flux (Φ_v) – 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 Table A-1.

Table A-1 – Minimum 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
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 mm².

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 ms.

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 Defence, 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 if:
 - 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

As long as 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 section 53(1) or 53(2) of 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.

Operating Requirements

- 1.1 Battery backup of a minimum of 8 hours must be provided.
- 1.2 Power monitor lights must be provided.

Signal Requirements

- 1.3 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.

Signage and Post Requirements

- 1.4 Signage indicating how to use a Limited Use Warning Systems with Walk Light must be as shown in Figure C-2 and must:
 - a) be mounted on the mast under the walk light signal head as indicated in 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.
- 1.5 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 Figure C-1.
- 1.6 An Emergency Notification sign must be located at each Limited Use Warning System with Walk Light Assembly.



Figure C-2 – Instruction Sign

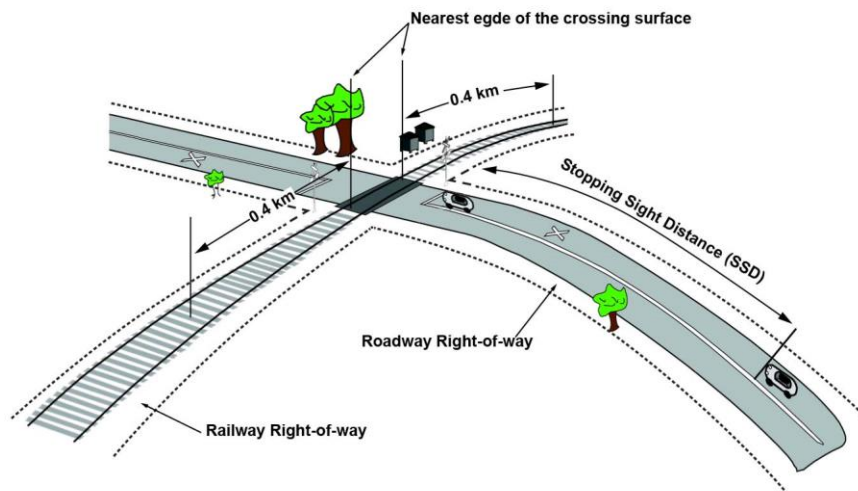


APPENDIX D – WHISTLING CESSATION

Table D-1 Requirements for Warning Systems at Public Grade Crossings within an Area without Whistling

	Column A		Column B	
Railway Design Speed	Grade Crossings for Vehicle Use		Grade Crossings For Sidewalks, Paths, or Trails with the centreline no closer than 3.6 m (12 ft) to a warning signal for vehicles	
	No. of Tracks		No. of Tracks	
	1	2 or more	1	2 or more
Column 1	Column 2	Column 3	Column 4	Column 5
1 – 25 km/h (15 mph)	FLB	FLB	No warning system requirement	No warning system requirements
25 – 81 km/h (16 – 50 mph)	FLB	FLB & G	FLB	FLB & G
Over 81 km/h (50 mph)	FLB & G	FLB & G	FLB & G	FLB & G
<p>Legend :</p> <p>FLB is a warning system consisting of flashing lights and a bell.</p> <p>FLB & G is a warning system consisting of flashing lights, a bell and gates</p>				

Figure D-1 Prescribed area for whistling cessation as per Article 23.1 of the RSA



Train Whistling at Public Grade Crossings

Train whistling is an important way to keep drivers, cyclists and pedestrians safe. The Canadian Rail Operating Rules (CROR 14) require all trains to whistle whenever they approach a public grade crossing.

In some cases, these whistles can be bothersome to people living nearby and municipalities may wish to end the whistling to provide local residents with relief from the noise.

If you are a resident wanting to stop train whistles in your neighborhood, contact your municipality. If the municipality agrees to proceed with your request, it must follow the whistling cessation procedure detailed below. In brief, the municipality must consult with the railway company to assess the feasibility of the request; notify the public and other interested parties of their intent; and ultimately pass a council resolution to stop the whistling. The procedure promotes the collaboration between municipalities and railway companies in ensuring grade crossings remain safe.

Procedure for Eliminating Whistling At Public Grade Crossings

This procedure is consistent with the requirements of section 23.1 of the *Railway Safety Act*, section 104 of the new *Grade Crossings Regulations* which came into effect on November 28, 2014, and Appendix D of the Grade Crossings Standards. It supersedes the previous Procedure & Conditions for Eliminating Whistling at Public Crossings (Guideline No. 1).

Step 1

Interest for whistling cessation is expressed.

An interest for whistling cessation exists when a municipality receives a request from a citizen or a community group to stop train whistling at a specific area (one crossing or multiple crossings) along a railway corridor.

Step 2

Municipality consults with railway company.

The municipality consults with the railway company that operates the relevant line of railway to assess the feasibility of the whistling cessation request.

Step 3

Municipality issues notifications and public notice.

The municipality notifies all relevant associations or organizations (<http://www.tc.gc.ca/eng/railsafety/legislation-380.htm>) and issues a public notice of its intention to pass a resolution declaring that it agrees that whistles should not be used at a specific area (crossing or multiple crossings) along a railway corridor.

Step 4

Municipality and railway assess the crossing(s) against the prescribed requirements in the *Grade Crossings Regulations* and *Grade Crossings Standards*.

The municipality and the railway company assess whether or not the area (crossing or multiple crossings) meets the whistling cessation requirements specified in section 104 of the *Grade Crossings Regulations* and Appendix D of the *Grade Crossings Standards*. This may be done by engaging a professional engineer to determine if the area complies with the conditions in the regulations.

Step 5

Municipality and railway agree that the crossing(s) meets the prescribed requirements of the *Grade Crossings Regulations* and *Standards*.

If the municipality and the railway company do not mutually agree that the crossing(s) meets the prescribed requirements, they should try to resolve the conflict.

Step 5A (optional)

Municipality and railway request a final decision from Transport Canada.

If disagreement between the municipality and the railway persists, the supporting documentation should be provided to Transport Canada (railsafety@tc.gc.ca) for further assessment. Transport Canada's decision on the issue is final.

Step 6

Municipality passes a resolution declaring that it agrees that whistles should not be used in that area, thereby prohibiting train whistling.

Once it is deemed that the provisions of the *Grade Crossings Regulations* and *Standards* are satisfied, the municipality must declare, by resolution, that it agrees that train whistles should not be used at the prescribed crossing(s). A copy of the resolution should be sent to the railway company and all relevant associations or organizations, including the headquarters of Transport Canada's Rail Safety Directorate (railsafety@tc.gc.ca).

Step 7

Railway company notifies Transport Canada and informs the municipality within 30 days that it has arranged to have whistling ceased at the crossing(s).

Upon receipt of the resolution, the railway company issues its special instructions, as per CROR 14(l)(iv), eliminating the application of CROR 14(l)(i), while providing for CROR 14(f). The railway company notifies the headquarters of Transport Canada's Rail Safety Directorate (railsafety@tc.gc.ca) of the effective date of whistling cessation at the crossing(s), and provide a copy of its special instructions.

The railway company notifies the municipality and/or the road authorities in writing of the whistling cessation not later than 30 days after the day whistling is ceased.

Step 8

Municipality and railway share the responsibility for monitoring and maintaining the conditions that support the cessation of train whistling at the crossing(s).

A Transport Canada Railway Safety Inspector may order the reinstatement of whistling at the crossing(s) should the responsible authorities fail to maintain the area in a manner that meets the prescribed requirements of the *Grade Crossings Regulations* and section 23.1 of the Railway Safety Act.

For More Information

Canada has one of the safest rail transportation systems in the world as a result of shared efforts between many partners including Transport Canada, provincial governments, railways and municipalities. To learn more about the many ways in which Transport Canada and its partners are improving railway safety, please visit the Rail Safety section of Transport Canada's web site at <http://www.tc.gc.ca/eng/railsafety/menu.htm>.

APPENDIX E - DETERMINING MINIMUM SIGHTLINES AT GRADE CROSSINGS

Being developed

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

Transport Canada Rail Safety Regional Office's

Atlantic Region

Regional Director
Heritage Place, 95 Foundry Street, Suite 418
Moncton, NB, E1C 5H7
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
344 Edmonton Street, 4th Floor, P.O. Box 8550,
Winnipeg, MB, R3C 0P6
Tel.: 204-983-4214, Fax: 204 983-8992

Pacific Region

Regional Director
225 - 625 Agnes Street
New Westminster, BC, V3M 5Y4
Tel.: 604 666-0011, Fax: 604 666-7747

Quebec Region

Regional Director
800 René-Lévesque Blvd. West, 6th Floor, Suite 638 Montreal, QC, H3B 1X9
Tel.: 514 283-5722, Fax: 514 283-8234

APPENDIX G - SHARING OF INFORMATION FORM ROAD AUTHORITY

ROAD AUTHORITY SHARING OF INFORMATION FORM

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

SECTION 1 – General	
1. Road Authority:	2. Date of Submission (yyyy/mm/dd):
3. Road Authority Contact Information	
Title (optional):	
Name:	Mailing Address:
E-mail Address:	
Telephone Number:	
Additional Road Authority Contact Information (in case of emergency)	
Title (optional):	
Name:	Mailing Address:

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 28, 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))	<input type="checkbox"/>
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))	<input type="checkbox"/>
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)	<input type="checkbox"/>
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)	<input type="checkbox"/>
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)	<input type="checkbox"/>
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)	<input type="checkbox"/>
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.	<input type="checkbox"/>

(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

<input type="checkbox"/> Rural		<input type="checkbox"/> Local		<input type="checkbox"/> Divided	
		<input type="checkbox"/> Collector			
<input type="checkbox"/> Urban		<input type="checkbox"/> Arterial		<input type="checkbox"/> Not Divided	
		<input type="checkbox"/> Expressway			
		<input type="checkbox"/> Freeway			
26. Average Approach Gradient		27. Existing Shoulder Width		28. Path or Sidewalk	
Approach 1	Approach 2	Approach 1	Approach 2	<input type="checkbox"/> Yes	<input type="checkbox"/> No
Orientation / Direction		Orientation / Direction		<input type="checkbox"/> Designated for persons using assistive devices	
Gradient (%)		Shoulder Width (m)			
SECTION 6 – Crossing User Details					
29. Design Vehicle	30. Road Crossing Design Speed (km/h)	31. Departure Time (sec)	32. Stopping Sight Distance (SSD)	33. Advanced Activation time (sec)	
SECTION 7 – Interconnected Devices					
34. Interconnection Time	<input type="checkbox"/> Yes Time (sec): _____		<input type="checkbox"/> 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 metres, 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, taking into account 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 or not 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 or not 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.

ANNEX A

FIGURE A1 Grade Crossing Details

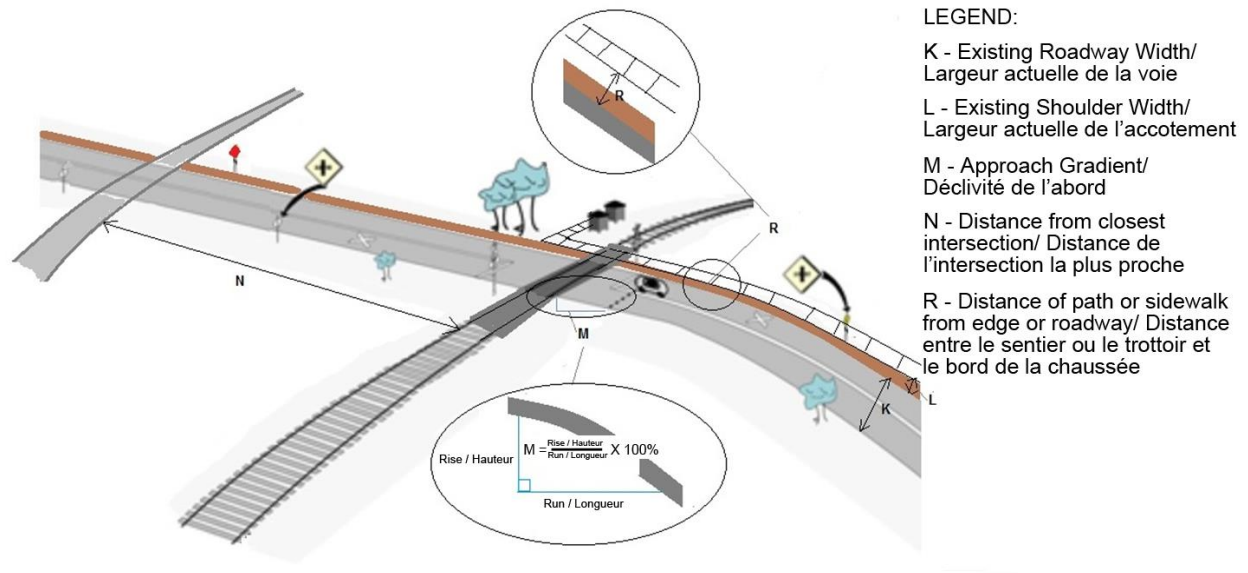


FIGURE A2 Grade Crossing Angle

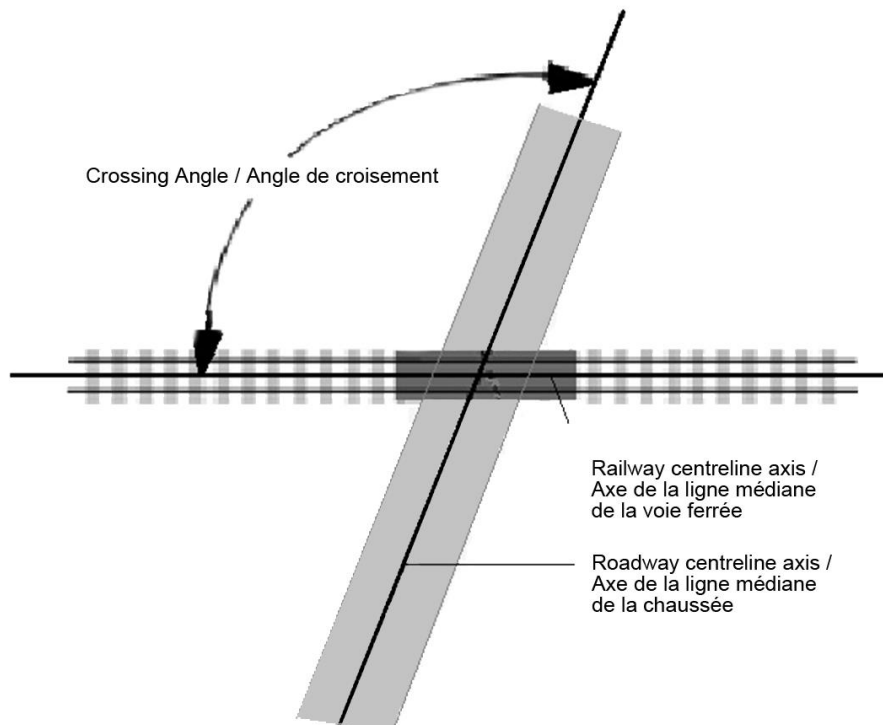
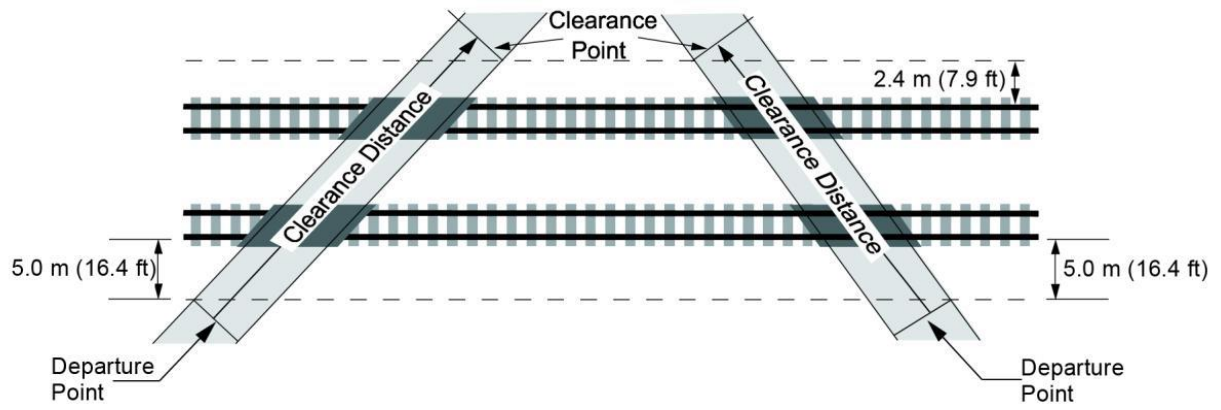


FIGURE A3 Grade Crossing Clearance Point



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. <input type="checkbox"/> Ref. (GCR 4.(3))	
J. Receipt of a notice under section 3 of the Notice of Railway Works Regulations. <input type="checkbox"/> 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. <input type="checkbox"/> 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 taking into account 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. <input type="checkbox"/>	

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. <input type="checkbox"/>				
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. <input type="checkbox"/>				
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. <input type="checkbox"/>				
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)				
<div style="display: flex; flex-wrap: wrap;"> <div style="width: 33%;"><input type="checkbox"/> None</div> <div style="width: 33%;"><input type="checkbox"/> Crossbuck</div> <div style="width: 33%;"><input type="checkbox"/> Flashing lights</div> <div style="width: 33%;"><input type="checkbox"/> Bell</div> <div style="width: 33%;"><input type="checkbox"/> Gates</div> <div style="width: 33%;"><input type="checkbox"/> Cantilever</div> <div style="width: 33%;"><input type="checkbox"/> Warning system(s) for path or sidewalk</div> <div style="width: 33%;"><input type="checkbox"/> Other(s) _____</div> </div>				
T. Stop Sign Present				

<input type="checkbox"/> Yes, on Railway Crossing sign		<input type="checkbox"/> No	
U. Anti-Whistling Present			
<input type="checkbox"/> Yes		<input type="checkbox"/> Special Provision(s) (Optional field) _____	
		<input type="checkbox"/> 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. <input type="checkbox"/> 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. <input type="checkbox"/> Ref. (GCR 8)			
New average annual daily railway movements:			
X. Whistling is no longer required at a grade crossing. <input type="checkbox"/> Ref. (GCR 9)			
Date of change (yyyy/mm/dd):			
Y. Transfer of a line of railway to another company. <input type="checkbox"/> 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:

- 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: 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

Being developed

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 of time 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 identified 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/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, when a change is made to components of their warning system (GCR 44, 55, 87(2)).

Any issues noted during any of these inspection items must be reported to the Rail Traffic Controller immediately, in accordance with CROR 103 (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.

The term “as instructed” refers to individual railroad instructions.

Weekly tests

Column 1, item 1 of Table 17-2 of the GCS stipulates that weekly tests must be conducted at grade crossings with a warning system. The frequency for such inspections is as follows:

Once every calendar week (Sunday to Saturday) at intervals not exceeding 10 clear days **OR** seven (7) days prior to the operation of railway equipment.

Railways may elect one or the other, depending on the situation that applies.

For example:

Option one

For a main track with regular daily train traffic, the warning system must be inspected/tested once every calendar week, or within an interval not exceeding 10 clear days between inspections.

Option two

For a track with lower train volumes (e.g. 1 train every 10 days), these inspections/tests can be conducted within seven (7) days before the passing of the next train.

It is important to note that all inspection/testing requirements stipulated in the *Grade Crossings Regulations* (GCR) and the GCS are in effect as of November 28, 2014, and that all exemptions from inspection/testing requirements that may have been issued before the GCR came into force are no longer valid. The inspection frequency stipulated above applies only to warning systems; all other tests listed in tables 17-2 and 20-1 of the GCS and this Handbook have their own frequency requirements.

Note: The items listed below are those of Table 17-2 of the GCS.

Item 1 Warning Systems: for operation of lights, bell, gates, and power off light.

Frequency: Weekly, or no more than 7 days before the operation of railway equipment.

Purpose

To ensure that the power off indication and test switch functions as intended and the warning system operates as intended.

Process

If inspections or tests interfere with the safe operation of trains, ensure that protection is applied. Use the test switch to activate the warning systems components only when the grade crossing is clear of road users.

Observe the warning system's operation. If there are gates, observe that they descend uniformly and within design specifications.

Perform a circle check of the grade crossing warning system: verify the visibility of the Power Off light, as well as that of the light units from all approaching lanes of road traffic; inspect the light unit side lens; check the sound of the bell; and inspect the overall condition of the warning system. Be on the lookout for damaged components, ice buildup, snow obstructions, etc.

Return the test switch to normal. If the warning system is equipped with gates, verify that the gates restore to normal within 6 to 12 seconds, with no rebound, and are securely held in place when in the raised position.

Return the test switch box to the locked position, and before leaving the site, verify that the Power Off light is still on.

A record of the inspection and any deviations from the GCS must be kept for a minimum of two (2) years (GCR 109).

Item 2 Light Units: for misalignment physical damage and conspicuity

Frequency: Monthly for warning systems and traffic signals installed at a grade crossing in lieu of a warning system; quarterly for limited-use warning systems with or without a walk light.

Purpose

To ensure that the light units are intact, clearly visible, clean, and operating as intended.

Process

Light units and their mounting brackets (housings, elbows, arms, etc.) including gate lights must be inspected monthly for physical damage (cracks, faded or peeled paint, missing parts, etc.) Light unit interiors must be kept free of dust and moisture. Roundels and reflectors must be clean and in good condition and free of bird nests, infestations and dirt/grime buildup.

The GCR require that at least one set of front light units be clearly visible from the SSD and that at least one set of back lights be clearly visible to crossing users in each lane (GCR 44, 53, 68 and 82). The alignment coordinates must be indicated on the design plan (GCR 93).

The visibility of the front and back light units must therefore be verified according to the specifications in the design plan, and adjust accordingly. Verify, too, that all light units are flashing at the correct rate and in the correct sequence, including gate lights.

Limited-use warning systems, with or without a walk light, should be inspected as above: verify the visibility of the warning system, check for broken or damaged parts, and verify that all indications of approaching trains are clearly visible to crossing users.

A record of the inspection and any deviations from the GCS must be kept for a minimum of two (2) years (GCR 109).

Item 3 Standby power: for operating bank voltage

Frequency: Monthly for warning systems and traffic signals installed at a grade crossing in lieu of a warning system; quarterly for limited-use warning systems with or without a walk light.

Purpose

The backup battery (used in the event of a failure of the primary power source) should be of sufficient ampere-hour capacity to provide the system involved with at least eight (8) hours of continuous operation or 24 hours of normal operation, whichever is greater, in the event of a power outage. The standby battery must meet design requirements and conform to the design plan (GCR 93). The purpose is also to verify that operating banks are free from signs of deterioration and are holding the required charge.

Operating battery: Storage battery used at a grade crossing to operate gate motors, bells and lamps.

Process

Obtain a reading of the operating temperature of the battery bank, or block, as well as the AC power voltage to the charger of the battery to be tested. Obtain a reading of the DC battery charge voltage with the AC power on. With this reading, calculate the individual cell charge voltage using the following formula:

$$DC_{bcv} / N = \text{cell charge voltage}$$

where:

$$DC_{bcv} = \text{DC battery charge voltage}$$

N = number of cells in the bank being tested

If the battery is charged by means of a constant current rectifier, note the battery charge current. Ensure that the charging rate is sufficient to carry the normal load. After noting the current and/or if the cell is charged using a constant voltage charger, disconnect the AC power. Allow the battery to discharge with a normal current draw (warning system not operating) for the duration specified by the manufacturer or as instructed.

Verify that the charge and discharge voltages, as adjusted for temperature, are appropriate for the application and conform to the manufacturer's specifications. As needed, replace cells as instructed.

A record of the inspection and any deviations from the GCS must be kept for a minimum of two (2) years (GCR 109).

Item 4 Light Units and gates: for damage, cleanliness and visibility

Frequency: Monthly for warning systems and traffic signals installed at a grade crossing in lieu of a warning system; quarterly for limited-use warning systems with or without a walk light.

Purpose

To ensure that the light units and gates are intact, clean and clearly visible.

Process

Light units and their mounting brackets (housings, elbows, arms, etc.) must be inspected for physical damage (cracks, faded or peeled paint, missing parts, etc.). Light unit exteriors and interiors must be kept free of dust and moisture. Roundels and reflectors should be clean and in good condition and free of bird nests, infestations or dirt/grime buildup.

The GCR require that at least one set of front light units be clearly visible from the SSD, and that at least one set of back lights be clearly visible to crossing users in each lane (GCR 44, 53, 68 and 82). The alignment coordinates must be indicated on the design plan (GCR 93).

The visibility of the front and back light units must therefore be verified according to the specifications in the design plan, and adjusted accordingly. Verify that all light units are flashing at the correct rate and in the correct sequence, including gate lights.

The retroreflective material on warning system gates must be as specified for Type IV white sheeting in sections 4.2.4 and 6.1.4 of ASTM D4956 when tested as per the test methods for Type XI set out in sections 7 and 9 of that Standard, and must be maintained at above 50 per cent of the value specified for Type IV white sheeting in sections 4 and 6 of that Standard.

If gates are used, the stripes on the gates must be alternately spaced 406-mm (16-inch) strips, alternatingly red and white. For grade crossings installed on or after November 28, 2014, these must be aligned vertically; for warning systems installed before this date, this is not a requirement but is nonetheless considered a best practice. All contacts on gate mechanism circuit controllers should be inspected to verify cleanliness in order to prevent the potential for malfunctioning. The wind bracket should be aligned in such a way that it does not obstruct the

gate arm. Shear bolts should be inspected and installed as per the manufacturer's specifications, or as instructed.

All supporting structures must be properly sealed to prevent the ingress of water and ventilated to prevent internal condensation (AREMA 3.2.5 C 18).

A record of the inspection and any deviations from the GCS must be kept for a minimum of two (2) years (GCR 109).

Item 5 Bell: For operation

Frequency: Monthly. (Not applicable to limited-use warning systems.)

Purpose

To ensure that the bell operates within its design characteristics and in accordance with the design plan, and that it produces the required volume as per parts 3.2.60 and 3.2.61 of the *AREMA Communications and Signals Manual*.

Process

In Canada, bells at new grade crossings must operate for the same duration as the light units (GCR 44 and 45; GCS 15.1.4). If a change is made to a bell's control circuits, the bell and circuits must be upgraded to meet these standards (GCR 87(2)).

The bell's nominal operating voltage should be 10 volts DC. The voltage at bell terminals should be maintained between 75% and 125% of their normal operating voltage.

Note: In the event of a discrepancy between the above specifications and those of the manufacturer, the manufacturer's specifications should be complied with.

The bell should operate at between 100 and 325 strokes per minute (AREMA 3.3.30 E 2).

Ensure all bells operate as intended, and provide adequate audible warning to road users.

A record of the inspection and any deviations from the GCS must be kept for a minimum of two (2) years (GCR 109).

Item 6 Gate arm: for operation

Frequency: Monthly. (Not applicable to limited-use warning systems.)

Purpose

To verify that gates operate smoothly, uniformly and without rebound and are securely held in position when raised.

Process

After making sure the grade crossing is clear of road users, use the test switch or equivalent method to activate the warning system.

Observe the gates' operation. Observe and record the hold (delay) and descent times, verifying that the gates complete their movement uniformly and within design plan specifications. Gates must start the downward motion no sooner than the designed gate arm clearance time after the warning system activates (AREMA 3.1.15 E 3) and must conform to the design plan (GCR 93).

Perform a circle check of the grade crossing warning system. Verify the visibility of the gates and gate lights, and observe their overall condition along with that of the wind brackets and gate shear bolts, looking out for any damaged components, ice buildup, snow obstructions, etc. Verify that the gate lights are flashing according to design specifications and in unison with the light units (AREMA 3.1.15 E 2) and ensure that they are properly spaced. Verify that the height of the gate from the crown of the road, path or trail is between 1.1 and 1.4 metres (3.5 to 4.5 feet) (GCS Figure 12-2; AREMA 3.1.35, Figure 3135-1).

Gates should be oriented perpendicular to the roadway's longitudinal axis unless site-specific conditions dictate a different orientation (AREMA 3.1.1 D viii).

Gate arms, when in the raised position, must meet all clearance requirements for overhead utilities and roadways (AREMA 3.1.1 D x).

Gate arms should be held in place with shear bolts (breakaway bolts) as per the manufacturer's specifications (AREMA 14.6.20 B).

For warning systems installed on or after November 28, 2014, verify that the gates are installed in accordance with sections 44 and 53 of the GCR.

Return the test switch or equivalent method to the normal position: verify that the gates return to the vertical (raised) position within 6 to 12 seconds, with no rebound, and are securely held when in that position.

Lock the test switch box when complete.

A record of the inspection and any deviations from the GCS must be kept for a minimum of two (2) years (GCR 109).

Item 7 Surge protection: for condition

Frequency: Monthly for warning systems and traffic signals installed at a grade crossing in lieu of a warning system; quarterly for limited-use warning systems with or without a walk light.

Purpose

To ensure that adequate surge protection is provided for circuits and equipment.

Process

Warning systems should be equipped with adequate devices for withstanding voltage surges in sensor leads, input leads, output leads and power supply leads, and must be as described in Part 11.2.1 of the AREMA *Communications and Signals Manual (Recommended General Practices for Electrical Surge Protection for Signal Systems)*, or as required by the manufacturer.

Surge protection is protection for electrical and conductive equipment and for personnel against transient high voltages, such as those introduced during lightning storms or other abnormal conditions. Primary surge protectors are often known as "lightning arresters" or simply "arresters."

Equalizer (lightning protection) is a device for equalizing voltage between two or more wires in the event of an abnormally high difference in voltage between them.

Use approved instruments to test ground and surge protective devices. Follow the manufacturer's instructions for using the instruments.

Fuses, if used on output or input, should be CSA- or UL-listed and should be of the time-delay or dual-element time-delay type to reduce false operation due to lightning surges. The nominal fuse circuit breaker rating should be not less than 125% of the maximum equipment load.

CAUTION: Extreme care must be exercised at all times when connecting or disconnecting a ground wire at any part of an earth grounding system. Lightning-induced surges, apparatus connected to the AC supply, and discharge or leakage through the surge protectors can all cause the voltage of the disconnected part of the grounding system to reach dangerous levels, putting workers at risk.

Inspect ground connections and wires from the warning system enclosure to ground electrodes for damage and loose or missing components.

Surge protectors should be visually inspected periodically, as instructed, and replaced if they appear blackened or damaged on more than 75% of their surface (AREMA 11.4.2 H 3).

Verify that all surge protection is installed as per the design plan (GCR 93(2)) and that surge protection devices are installed with discharge electrodes (teeth) pointed upward when the arresters are mounted horizontally.

A record of the inspection and any deviations from the GCS must be kept for a minimum of two (2) years (GCR 109).

Item 8 Circuits: for grounds

Frequency: Monthly for warning systems and traffic signals installed at a grade crossing in lieu of a warning system; quarterly for limited-use warning systems with or without a walk light.

Purpose

To ensure that there are no grounds, or combination of grounds, that can allow enough current flow that could affect the release of any relay or electromagnetic device.

Process:

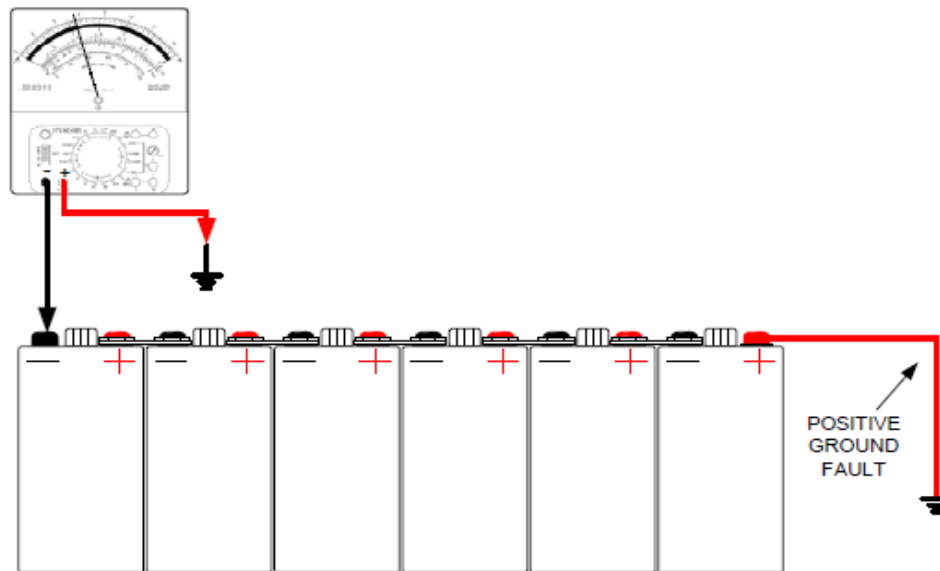
A distance known as **surface leakage distance**, equal to no less than 6.35 mm (¼ inch), should be provided between any exposed conductive part of the apparatus carrying current and any other conductive part thereof. This is to prevent grounds on non-vital equipment from creating a potential unsafe failure of the vital circuitry (AREMA 16.3.2).

A valid circuit ground test depends heavily on a good connection between the meter and ground. Before beginning, verify that all connections between prime ground terminals and ground rods are secure and in good condition.

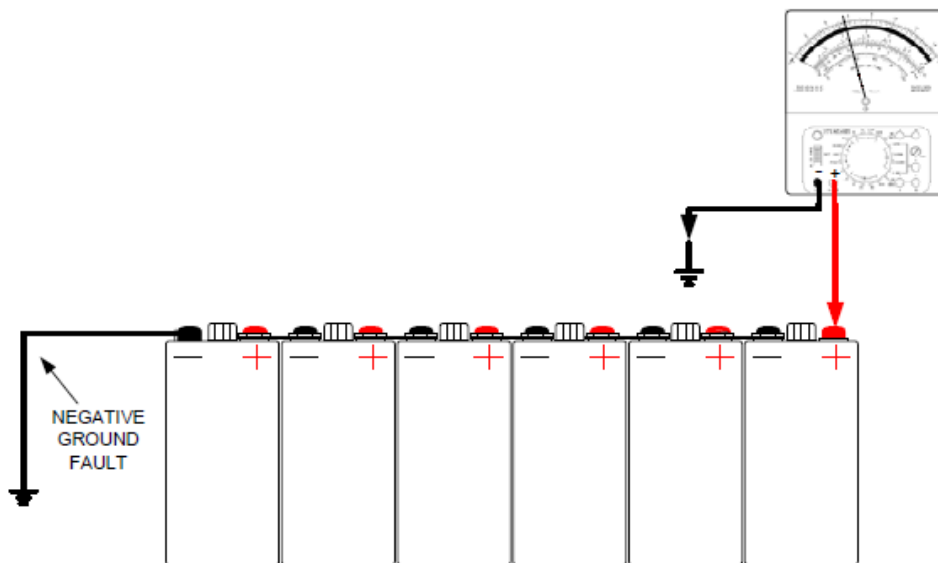
Track batteries need not be tested for grounds, since they are connected directly to the rails, which are in permanent contact with the ground. However, to verify the site's earth ground connections, verify that there is voltage between the track battery and the ground terminals before beginning this inspection.

A positive ground, which is the most hazardous type of ground fault, is said to exist if voltage readings are detected between the negative battery post and ground (see example below).

Item 8 Figure 1



A **negative ground** is said to exist if voltage readings are detected between the positive battery post and ground (see example below).



Example of a ground test of a warning system with gates:

Using an analog multimeter in the DC voltage position (or other approved railway meter) with the AC power on, place the negative lead of the meter on the ground terminal of the housing and the positive lead on the positive post of the battery bank, and operate the warning system until gates are fully horizontal. Restore the warning system to normal. Once the warning system has returned to normal, complete the test for the opposite battery bank polarity to ground in the same manner. Once complete, turn off the AC, and complete the test again as with the AC on.

All circuits that could affect the operation of the crossing warning system or the safety of railway operations must be kept free of any ground or combination of grounds that would allow a flow of current equal to or in excess of 75% of the release value of any relay or electromagnetic device in the circuit. This does **not** apply to circuits connected directly to track rails; the common return wires of single wire, single-break, control circuits using a grounded common; and alternating current power distribution circuits—all of which are grounded in the interest of safety. Should a ground of the nature mentioned above be found, the warning system must be removed from service as instructed until the ground is removed or repaired.

Any ground reading below the above value should be corrected of as soon as possible and should be kept track of, until it is corrected. False, or “phantom,” ground readings should be monitored by the railway as well, since they may indicate a potential ground issue.

Item 9 Battery: for isolation faults

Frequency: Monthly for warning systems and traffic signals installed at a grade crossing in lieu of a warning system; quarterly for limited-use warning systems with or without a walk light.

Purpose

To ensure that there are no battery isolation faults that would allow enough current flow to affect the release of any relay or electromagnetic device.

Process

Where more than one battery source exists at a grade crossing, they must be kept isolated from one another. A distance known as **surface leakage distance**, equal to no less than 6.35 mm (¼ inch) should be provided between any exposed conductive part of the apparatus carrying current and any other conductive part thereof. This is to prevent grounds on non-vital equipment from creating a potential unsafe failure of vital circuitry.

Some communication systems (specifically radio-based communications) require the DC power system to be earth grounded. There is also potential for failure when wire insulation breaks down on a non-vital circuit, allowing that circuit to become grounded. In the first case, the ground is known; in the second case, it is unknown. In both cases, a second failure on a vital circuit wire could bypass some of the safety-critical equipment inputs and outputs if sufficient surface leakage distance is not provided to ensure battery source isolation (AREMA 16.3.2).

Using an analog multi-meter (or other approved railway meter) in the DC voltage position, Place the positive voltmeter lead on the (+) terminal of energy source #1 and the negative voltmeter lead on the (-) terminal of energy source #2. Note the voltage, if any; it should be nil. Clip the negative voltmeter lead on the (-) terminal of energy source #1 and the positive voltmeter lead on the (+) terminal of energy source #2. Note the voltage, if any; it should be nil. Repeat the test between energy source #1 and all remaining energy sources, then between energy source #2 and all remaining energy sources, etc., until all combinations have been tested.

A record of the inspection and any deviations from the GCS must be kept for a minimum of two (2) years (GCR 109).

Item 10 Batteries: for voltage, current, electrolyte level, and plate deterioration where plates are visible

Frequency: Monthly for warning systems and traffic signals installed at a grade crossing in lieu of a warning system; quarterly for limited-use warning systems with or without a walk light.

Purpose

The batteries used for standby purposes should be of sufficient ampere-hour capacity to provide the system involved with at least eight (8) hours of continuous operation or 24 hours of normal railway operations whichever is greater in the event of a power outage. The standby battery must meet design requirements and conform to the design plan (GCR 93). The purpose is also to verify that operating banks including storage batteries are free from signs of deterioration, and are holding the required charge.

Track circuits fed by primary batteries are prone to rapid exhaustion, especially if railway equipment is left sitting on the approach. This inspection is also to verify the proper operation of primary batteries powering track circuits at grade crossings with warning systems.

Process

Obtain a reading of the operating temperature of the battery bank, or block, as well as the AC power voltage to the charger of the battery to be tested. Obtain a reading of the DC battery charge voltage with the AC power on. With this reading, calculate the individual cell charge voltage using the following formula:

$$DC_{bcv} / N = \text{cell charge voltage}$$

where:

DC_{bcv} = DC battery charge voltage

N = number of cells in the bank being tested

If the battery is charged by means of a constant current rectifier, note the battery charge current. Verify that the charging rate is sufficient to carry the normal load. Once this is done and/or if the cell is charged using a constant voltage charger, disconnect the AC power. Allow the battery to discharge with a normal current draw (warning system not operating) for the duration specified by the manufacturer or as instructed.

Verify that the charge and discharge voltages, as adjusted for temperature, are appropriate for the application, and conform to manufacturer specifications. As needed, replace cells as instructed.

Verify that the operating currents of all battery banks in the warning system bungalow are in accordance with the design plan and previous inspection records.

The name of the manufacturer, the date of manufacture, and the cell type and capacity must be written legibly and permanently on each cell (AREMA 9.1.3 M-1).

Wires connected to battery terminals should be tagged with the battery name and terminal polarity as designated by the design plan.

Verify that proper polarity is observed for the desired battery configuration and that all batteries connected in series are of the same ampere-hour capacity as indicated on the design plan (GCR 93(2)).

Batteries should be arranged so as to allow access for cleaning, the addition of water, and visual inspection (AREMA 9.5.1 B-6 and 9.5.6 E-3).

For cells that allow the addition of water, the water should be maintained at minimum to the level as indicated on the cell container, but no less than 12.70 mm (½ inch) above the plates. Water used in battery cells should be distilled, de-ionized, or from a source tested and approved for the battery type (AREMA 9.5.6 G-7).

Water should be kept only in approved storage containers (AREMA 9.5.1. B-12).

Connectors, cell posts, jumper lugs and their contacting surfaces should be kept clean and corrosion-free. Cell posts and connecting bolts should be tight and should be coated with NO-OX-ID, or an equivalent grease, as per the manufacturer's specifications (AREMA 9.5.1 B 7 and 9.5.6 G-10).

Battery cases should be clean, dry, and free of cracks or leaks.

Vent caps should be intact and kept clear of obstructions that could prevent the escape of battery gasses.

Battery housing vents should be provided and should be wide enough to let battery gas escape and fresh air enter. Check that vent filters are clean. If fans are provided, make sure they are operational.

Check the manufacturer's recommendations for more detailed instructions.

Additional monthly primary battery test

Track circuits fed by primary batteries are prone to rapid battery exhaustion. For this reason, an additional monthly test is required for crossing instrument housings whose track circuits are powered by primary batteries.

Process

Measure the track voltage at the relay end track wire terminals in the warning device instrument housing. Compare the voltage reading to previously recorded values and verify that it is acceptable. As needed, replace cells as instructed.

A record of the inspection and any deviations from the GCS must be kept for a minimum of two (2) years (GCR 109).

Item 11 Interconnection components: for energization of circuits as intended

Frequency: Monthly. (Not applicable to limited-use warning systems.)

Purpose

To ensure that interconnected components function as intended and that activating the warning system controls the traffic signals as required.

Process

Activate the warning system's control device, which activates the highway traffic signals and/or active advance warning signs. Verify that these traffic signals and/or signs operate as intended.

If the road authority has maintenance responsibility for the traffic signals and signs, it may be necessary to have their representative on site to assist with testing, maintenance and repairs.

A record of the inspection and any deviations from the GCS must be kept for a minimum of two (2) years (GCR 109).

Item 12 Switch circuit controller: for adjustment

Frequency: Quarterly.

Purpose

To ensure that the switch circuit controller is properly adjusted.

When a switch is equipped with a switch circuit controller connected to the point and interconnected with the crossing warning system circuitry, it should be maintained such that the warning system can be cut out only when the switch point is within 12.70 mm (½ inch) of the full reverse position.

Process

1. Place a shunt on the approach circuit.
2. Verify that the warning system is active.
3. Move the switch point to the full reverse position.
4. Verify that the reverse contacts provide continuity and that the crossing de-activates.
5. Where CTC or ABS control is available, verify that the crossing cut-out circuit does not override the block-down indication.
6. Insert a ½"-inch gauge in the reverse point and verify that the crossing activates. Make adjustments as needed.
7. Throw the switch to the normal position, verifying that the cut-out circuit does not interfere with the activation of the warning system from ½ an inch from reverse to the full normal position.
8. Remove the shunt.

A record of the inspection and any deviations from the GCS must be kept for a minimum of two (2) years (GCR 109).

Item 13 Batteries: for degree of exhaustion voltage and current

Frequency: Quarterly.

Purpose

To ensure that primary batteries have enough voltage to continue to safely supply the circuits they are designed to supply.

Process

Primary batteries must be inspected carefully upon installation, and frequently thereafter by maintenance personnel, to assess their degree of exhaustion, and must undergo such voltage and current tests as necessary to ensure that they will not exhaust completely while in service.

Voltage

Measure the voltage of the primary battery cell with the load disconnected, and then with the load connected. Ensure the normal voltage of the cell with load disconnected meets the manufacturer's specifications.

Primary track battery service limits are left to the discretion of the responsible railway. Where track battery service limits are extended to obtain maximum life, warning system safety must be the prime consideration.

A record of the inspection and any deviations from the GCS must be kept for a minimum of two (2) years (GCR 109)

Item 14 Fouling circuits: for continuity

Frequency: Quarterly.

Purpose

To ensure that bonds and fouling wires are installed and maintained in a manner that will ensure the detection of railway equipment within the fouling section of a turnout.

Process

All non-insulated rail joints in the turnout must be bonded. Other bonds in the frog and switch point area must be installed as shown in the diagrams below.

1. Inspect all bond wires within the confines of the turnout and ensure that they are secure and in acceptable condition (AREMA 8.1.20).
2. Verify that all new track connections are installed as per the *AREMA Communications and Signals Manual*.
3. Inspect all fouling wires within the limits of the turnout and verify that they are installed to AREMA standards and are secure and in good condition.
4. Place a 0.06-Ω shunt at each location identified in the following images, and ensure that the corresponding relay is de-energized.

All rail joints within the turnout must be bonded. Other bonds within the frog and switch point area must be installed as shown in the following diagrams.

A record of the inspection and any deviations from the GCS must be kept for a minimum of two (2) years (GCR 109).

Figure 1 Crossover Shunt Fouling

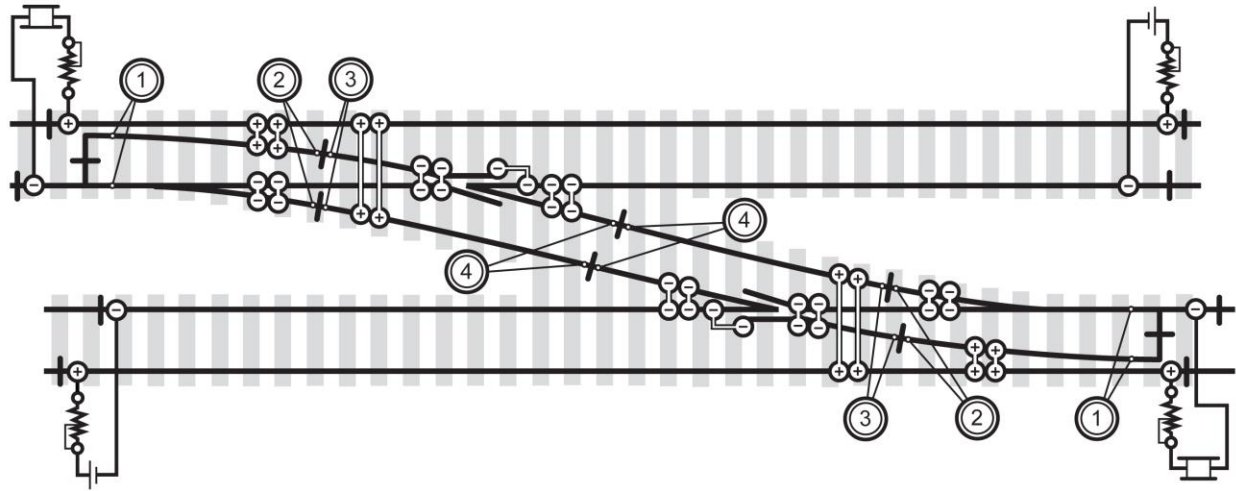


Figure 2 Turnout Shunt Fouling

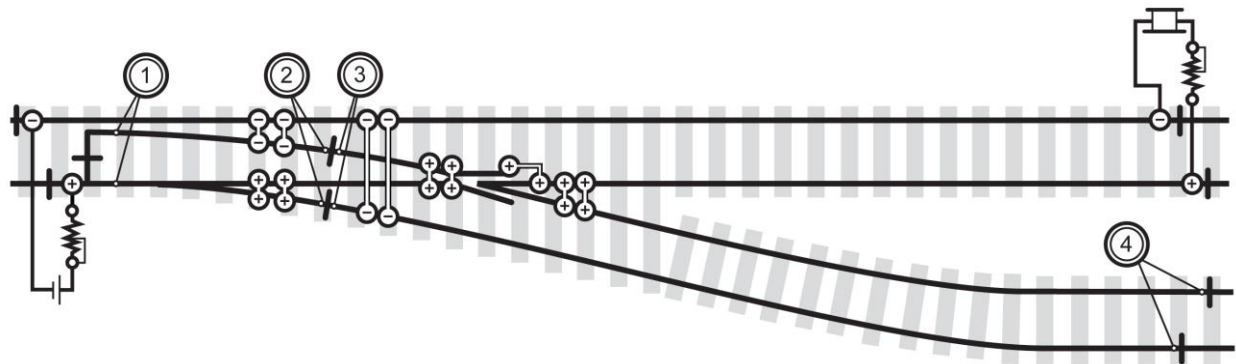


Figure 3 Turnout Series Fouling, 2 Relay

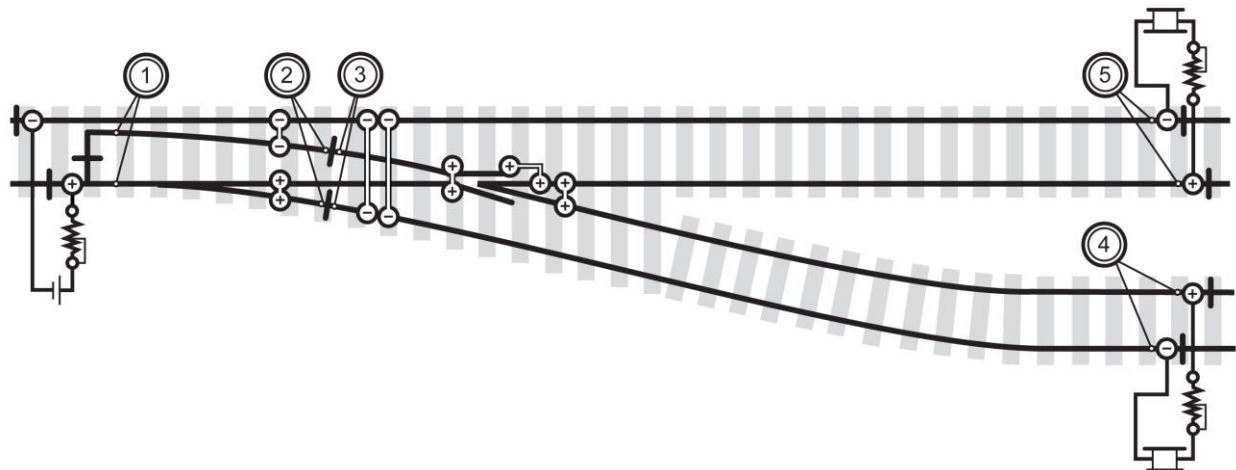
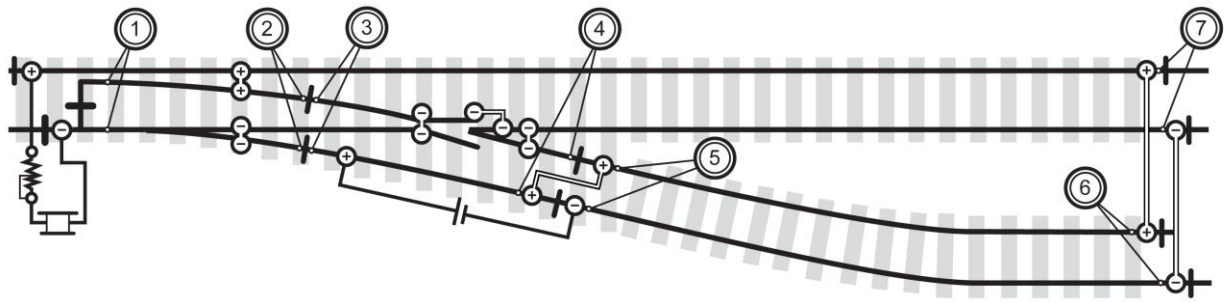


Figure 4 Turnout Series Fouling, 1 Relay



Item 15 Direct Current Relays: for condition

Frequency: Twice annually.

Purpose

To verify visually that the DC relays, including relays within gate mechanisms, are functioning properly and are in suitable condition to remain in service. Any equipment that is not in suitable condition must be promptly replaced.

Relays being inspected need not be removed from their mounting plates or chairs unless further investigation is required.

Process

Verify that

1. Plug-in relays are properly seated in the plug board and locked;
2. Shelf type relays are secured to the bungalow or housing mounting board by means of a cable tie (e.g. Ty-Rap®). Some tension should be applied when securing these relays to the mounting board so they sit securely in the spring mounting yet are prevented from tipping over as a result of vibration or impact;
3. Seals are in good condition;
4. All screws, terminal posts, nuts, and lock washers, if used, are tight and properly installed;
5. Plating in the relay is not deteriorating and that internal components have a clean appearance and are free of moisture, rust, foreign matter (bugs, mouse feces, etc.) and corrosion;
6. The relay specification sticker is in place, and the specifications match those of the design plan;
7. Moving parts are not rubbing or coming in contact with stationary parts within the relay. Clearance of 3.175 mm (1/8 inch) should be provided between stationary parts and moving parts (AREMA 6.4.1 B 9);
8. Relay contacts are in good condition, with no sign of arcing, burnt or pitted contacts, or internal corrosion;
9. Finger contacts meet fixed contact surfaces squarely and at the same time;
10. The metal support of the non-fusible contact element does not come within 0.59 mm (1/16 inch) of the contact surface;
11. Front and polar contact openings are at least 0.050 inches wide;
12. There are front, back and polar contact openings in all possible energized and de-energized states;
13. The back contact opening is at least 0.020 inch wide when the front contact is just closing (AREMA 6.4.1 D 6);
14. Relay gaskets are in good condition. A relay with a missing or damaged gasket may need to be shopped.

Relays that do not meet field requirements must be removed from service as soon as practicable and their defects recorded, as per paragraph 109(1)(f) of the GCR.

A record of the inspection and any deviations from the GCS must be kept for a minimum of two (2) years (GCR 109).

Item 16 Bond wires, track connections, insulated joints and other insulated track appliances: for condition

Frequency: Twice annually.

Purpose

To ensure that the bond wires, track connections, insulated joints and other insulated track appliances of the automatic warning system are installed in a safe and reliable manner and are in good condition.

Process

Insulated joints and hardware

Verify that

1. The end post or insulation is secure and not bridged by a lip, head flow or slivers of steel;
2. Spikes are not driven against, or installed facing, the joint bars (spikes must be reversed at insulated joints);
3. Rail fasteners or other hardware do not short or bridge the insulated joint or other insulated hardware;
4. Insulation and bolts are not missing, worn, cracked, or broken;
5. Non-insulated tie plates do not encroach within 50.8 mm (2 inches) of the end post;
6. Ties under the insulated joints are in good condition;
7. Glued joints do not show signs of longitudinal rail movement of more than 9.5 mm (3/8 inch) within the insulated bar area;
8. If poly-insulated joints are used, the insulation is not worn to the point of allowing the bare metal of the bar to make contact with the rail or spike;
9. Insulation is not saturated with grease or oil to the point where it may become conductive.

Bond wires

Verify that

1. Rail joints at grade crossings or platforms, where planking or paving is maintained or where the bonding is not accessible, are double-bonded.
2. Switch point heel joints are bonded;
3. Fouling wires used in turnouts and crossovers consist of at least two discrete stranded conductors no smaller than 8 AWG. DC resistance must not exceed 0.006 Ω ;

4. All steel deck bridges with guardrails are bonded as per Item 16 Figure 1 below;
5. Track connector holes are 3/8 inch in diameter;
6. Track bond or lead is installed on the side on which the hole was drilled;
7. Bonds provide the best possible contact through the web of the rail;
8. Exothermically welded (also known as “cadwelded”) and pin-brazed rail head bonds are installed as low as possible, leaving sufficient space for the removal of joint bars, as shown in Figure 2, below;
9. Exothermically welded and pin-brazed rail head bonds are installed within 127 mm (5 inches) of the end of the rail (for single or double bonding);
10. Exothermically welded and pin-brazed rail head bonds are installed in a manner that if the rail ends open by 25.4 mm (1 inch) or more, the bond will fail;
11. Exothermically welded and pin-brazed rail web bonds are installed at or near the neutral axis of the web of rail, as shown in Figure 3, below.

Figure 1

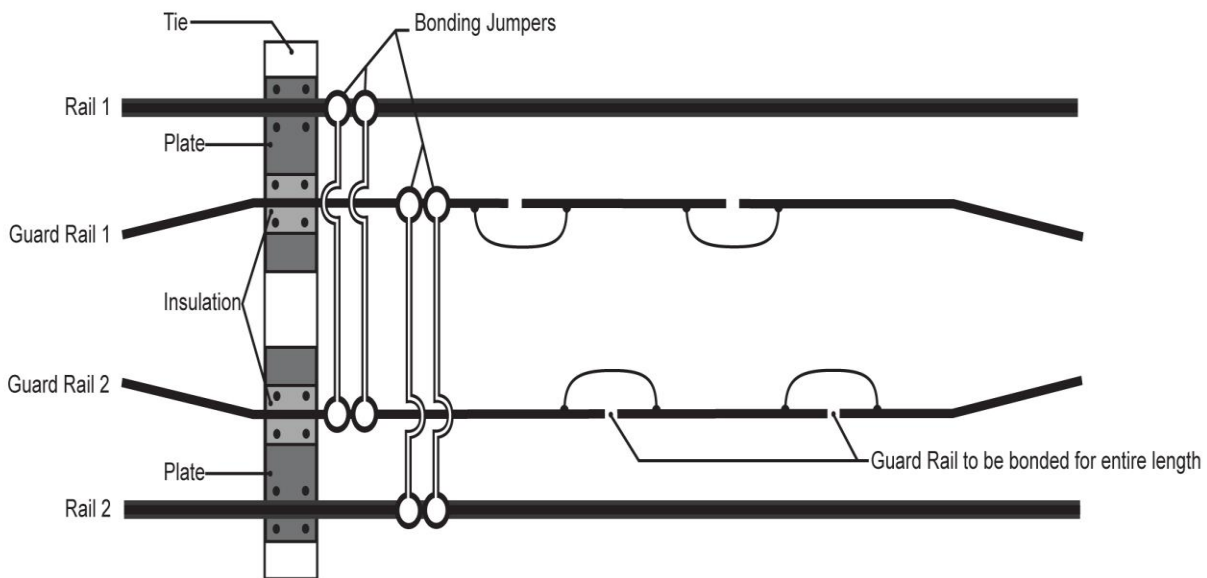


Figure 2

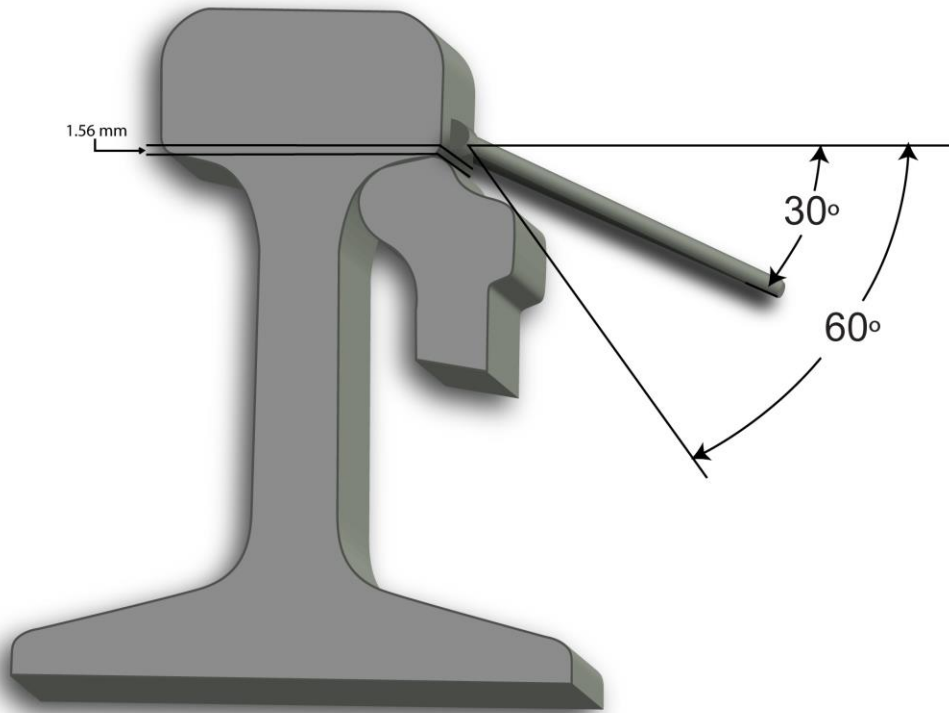
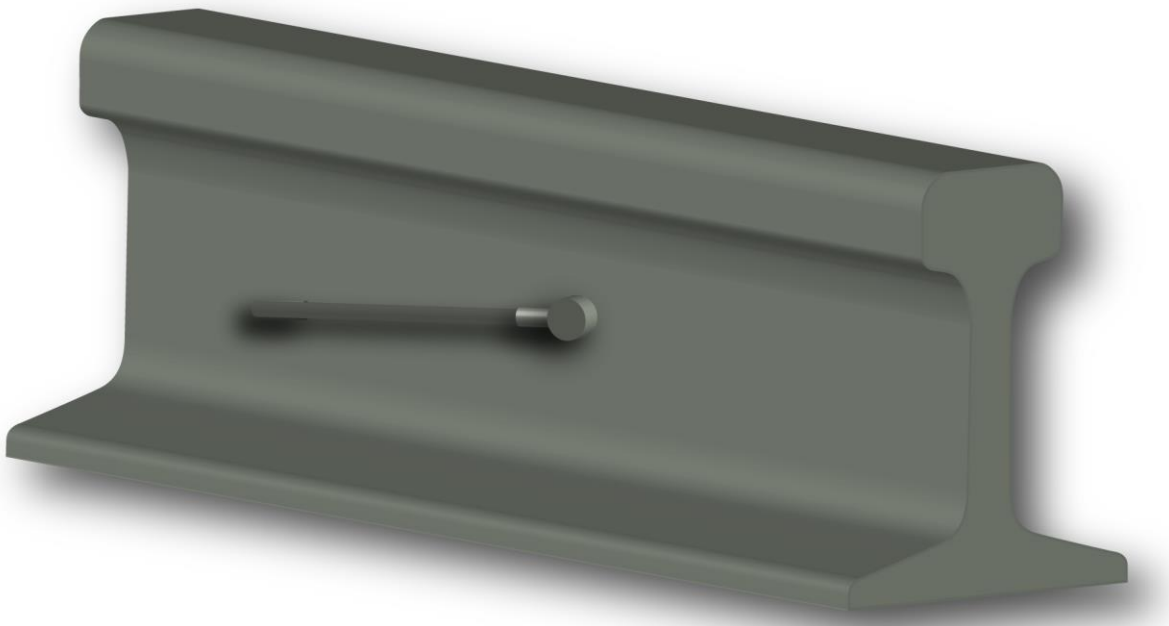


Figure 3



All damaged bond wires, track connections and insulation must be repaired or replaced.

**Item 17 Cut-out circuits (any circuit that overrides the operation of a warning system):
for operation**

Frequency: Twice annually.

Purpose

To ensure that the cut-out circuit overrides the operation of the automatic warning system in a safe and reliable manner.

When a switch is equipped with a switch circuit controller connected to the point and interconnected with the crossing warning system circuitry, it should be maintained in such a way that the warning system can be cut out only when the switch point is within ½ inch of the full reverse position.

Process

Verify that

1. Cut-out features do not bypass island circuits (AREMA 3.1.15 C 3);
2. Warning system controls are designed to provide a reactivation of the warning system before any railway equipment enters the crossing surface;
3. Devices that enable railway personnel to manually override the operation of the warning system are labeled to explain their intended function.

Place a shunt on the approach circuit: verify that the crossing activates.

Move the switch points to the full reverse position: verify that the reverse contacts make and that the crossing recovers (de-activates). (A minimum activation time may have to lapse before the crossing recovers.)

Insert a 12.7-mm (½ inch) gauge in the reverse point: verify that the crossing activates. Make adjustments as needed.

Throw the switch to the normal position, verifying that the cut-out circuit remains non-effective between 12.7 mm (½ inch) from reverse and the full normal position.

Remove the shunt activating the warning system.

Locations equipped with older motion sensor equipment

At certain older motion sensor locations, track relays are used in series at the battery end of the approach circuit to provide positive indication of track occupancy for the motion sensor cut-out logic. These relays (US&S Type DNL-4 and GRS Type W) are configured to energize when the track is occupied and de-energize when the track is unoccupied.

These DC series track relays must be tested to verify that the pick-up current value of the relay exceeds the normal current by a sufficient headroom. The drop-away current for these relays is approximately 0.200 A lower than the pick-up value. It is therefore imperative that the pick-up current setting of the relay under **all** ballast conditions exceed the track circuit normal current by more than 0.300 A.

Process

1. Apply a 0-Ω shunt at the rails, and adjust the shunt current to 1.300 A.
2. Remove the 0-Ω shunt and note the normal current (e.g. 0.300 A).
3. Add the shunt current value to the normal current value and divide by 2 (e.g. $1.300\text{ A} + 0.300\text{ A} / 2 = 0.800\text{ A}$).
4. Place a jumper across the track leads in the equipment housing.
5. Re-adjust the shunt current to the value calculated in Step 3 (0.800 A in the example).
6. Using the two locked screws on the outside of the relay cover, adjust the air gap on the relay until the relay just picks up with the jumper still applied.
7. Remove the jumper and apply the 0-Ω shunt at the rails, and restore the shunt current to 1.300 A.
8. Remove the 0-Ω shunt, and verify that the serial relay drops out and the regular track relay picks up.
9. Apply a 0.06-Ω shunt at the rails, and verify that the series relay picks up, and the regular track relay drops.

Locations equipped with push buttons

Devices that allow personnel to manually override the operation of the automatic warning system should be tested to verify that they operate as intended, then reset in accordance with the circuit logic.

A record of the inspection and any deviations from the GCS must be kept for a minimum of two (2) years (GCR 109).

Item 18 Gate Mechanism and circuit controller: for condition

Frequency: Twice annually.

Purpose

To verify that gate mechanisms, including hold clear or braking devices and the circuit controller, are operating properly.

Process

The following visual tests are to be completed prior to opening the gate mechanisms.

Step 1 Visually inspect gate mechanisms for damage to housing, covers or mounting hardware.

Verify that

- All hardware is tight, with either lock washers or locknuts installed;
- The mechanisms are locked with an adequate lock;
- All cotter pins are in place;

- All vents are in place and free of any obstruction;
- Covers are tightly closed, with no visible opening allowing foreign debris, rodents or insects to enter;
- The area where the gate mechanism is mounted to the mast shows no signs of looseness or having shifted as a result of an impact;
- The counter-weight arms and conversion brackets are secure and undamaged.

Step 2 Observe that there are no objects that can bind the conversion bracket, counterweight arms or gate during movement in all positions;

Step 3 Unlock and open the gate mechanism.

- While opening gate mechanism cover, door or lid, verify that the pivot pins or hinges are not seized or stiff, and lubricate as needed;
- Verify that the gaskets are intact and sealing properly against water, dust and foreign debris.

Step 4 While the gate mechanism is open, verify the following:

Hold clear / brake devices

- Manufacturers' mechanical clearances are respected (free from foreign materials);
- Teeth and pawl on hold clear devices are not worn or burred;
- All covers are installed securely and not obstructing mechanical parts;
- The hold clear device is mounted securely.

Gate Motor

- The motor commutator is clean and in good condition (brush contact area should be somewhat smooth and coffee-coloured);
- The length of brushes is at least the minimum specified by manufacturer;
- The motor is mounted securely, along with all covers, plugs and attachments.

Gear Compartment

- Lubrication meets manufacturer specifications (remove any excess);
- The gear compartment is free of foreign materials, dust, debris and moisture;
- The gears are not obstructed or damaged, and they appear to mesh properly and smoothly in transition;
- The gears are mounted securely.

Relays

- The relays are seated properly;

- The plug couplers or chairs are intact;
- Relay seals are installed and are intact;
- All electrical contacts are free of dirt, grease and corrosion (slivers or articles of metal on or near the armature or permanent magnetic extension);
- The moving parts of relays are not rubbing against the cover (indicator arm, rivets, armature);
- Screw nuts and binding posts are securely fastened;
- Contacts are not burned or pitted to the point where there is the potential for circuit failure.

Contact compartment (circuit controller)

- All contacts are securely mounted;
- All electrical contacts are free of dirt, grease and corrosion;
- Contact surfaces are not excessively worn;
- Roller cams are not worn excessively or showing excessive movement;
- Mechanism contacts are wiping properly when the gate is in motion;
- Controller contacts are adjusted as per the design plan;
- Screw nuts and binding posts are securely fastened;
- Gate heaters are intact and are operational during months required by the railway.

A record of the inspection and any deviations from the GCS must be kept for a minimum of two (2) years (GCR 109).

Item 19 Traffic signals installed at a grade crossing in lieu of a warning system: for control circuit operation

Frequency: Twice annually. (Not applicable to limited-use warning systems.)

Purpose

To ensure the control circuits operate as designed and activate the traffic signals within the prescribed time interval when railway equipment is detected.

Process

Verify that the railway detection equipment activates traffic signal pre-emption as designed. After the prescribed advanced activation time lapses, verify that all traffic signal indications are at red, preventing road users from using the crossing. Verify that the applicable railway equipment indication device is operational.

A record of the inspection and any deviations from the GCS must be kept for a minimum of two (2) years (GCR 109).

Item 20 Light units: for proper alignment focus and visibility

Frequency: Annually.

Purpose

To ensure that all light units installed as part of the warning system are visible to road users throughout the required distance and that their alignment coordinates are as indicated on the design plan.

Process

A means should be provided for manually operating either lamp in a flashing lamp pair to verify alignment.

Light units must be aligned and visible within the stopping sight distance (SSD) specific to the grade crossing, and aligned so that the axis of the light units pass through a point of 1.6 metres above the road surface at the SSD. If this is not possible, a Prepare to Stop at Railway Crossing sign must be installed.

- Step 1** Obtain the design plan for the grade crossing's warning system, and determine the alignment coordinates for each light unit at the grade crossing.
- Step 2** Using a measuring wheel or other approved measuring device, safely measure each light unit to verify that they are focused as per the alignment coordinates provided on the design plan.
- Step 3** Activate the light units and verify from within SSD that
- Both light units of a flashing lamp pair provide the appropriate clarity and intensity for the lane for which they are intended, and there is no difference in clarity or intensity between them;
 - Each light unit produces a distinct, round, red light with no major dark spots or distortions (e.g. caused by the light unit hood, or other obstructions).
- Step 4** Begin to approach the grade crossing. While approaching, verify that
- The front light units are visible throughout the entire road approach lane for which they are intended;
 - The front lights for that lane begin to dim as the back light units begin to come into view, and the front lights remain clearly visible until the back lights are illuminated;
 - All gate lights are clearly visible to road users.

A record of the inspection and any deviations from the GCS must be kept for a minimum of two (2) years (GCR 109).

Item 21 Light unit: for voltage

Frequency: Annually.

Purpose

To ensure that light units are maintained so as to provide maximum visibility of the warning system and maximum intensity and clarity for pedestrian and vehicular traffic, in both AC and DC modes of operation.

Process

Note: This test should only be conducted **after** the annual battery load test is completed (**Item 24**), before AC power is restored.

A means should be provided for manually operating either lamp in a flashing lamp pair to verify light voltage.

Incandescent lamps: Voltage at the light unit must be maintained between 90%–110% of the rated lamp voltage (GCS 13.0).

LED lamps: Voltage at the light unit must be maintained within the manufacturer's recommended operating range. If the voltage of the power supplied to the LED light unit is adjustable, it must be set to as close to the maximum operating voltage as possible.

Light units must be designed to operate when powered by either an AC source of 10 volts RMS or a DC source of 10 volts. Units must be designed to not sustain damaged by voltages of up to 115% of their design voltage.

To accurately read light unit voltages, a True RMS AC + DC multimeter must be used.

If only a conventional multimeter is available, the value displayed on the meter must be adjusted by adding the adjustment value to obtain the true value, depending on the battery type used, the number of cells in the bank, and whether the battery charger is on or off.

The tables below show adjustment values for both digital and analog meters.

Table 1

Digital Meter Adjustment Value			
Battery Bank Details		Meter Reading Adjustment Value	
Number of Cells	Type of Cells	AC Off	AC On
11	Nickel-Cadmium	1.10	2.70
10		2.00	2.20
7	Lead Acid or Valve Regulated Lead Acid (VRLA)	2.30	2.60
6		0.90	1.50

Table 2

Analog Meter Adjustment Value			
Battery Bank Details		Meter Reading Adjustment Value	
Number of Cells	Type of Cells	AC Off	AC On
11	Nickel-Cadmium	0.90	2.40
10		0.50	1.10
7	Lead Acid or Valve Regulated Lead Acid (VRLA)	1.20	2.10
6		0.40	0.70

Incandescent light unit voltage test

- Step 1** Immediately after completing the battery load test (**Item 24**), with the AC power still off, manually operate the light units such that one unit in each pair is steady-lit.
- Step 2** At each illuminated light unit that is part of the grade crossing warning system, note the true lamp voltage and verify that it has not fallen to below 90% of its rated voltage and that it is not adjusted to above 110% of its rated voltage. Adjust, lubricate hinges and clean the light units as needed.
- Step 3** Manually operate the light units such that the other unit in each pair is steady-lit.
- Step 4** At each illuminated light unit that is part of the grade crossing warning system, note the true lamp voltage and verify that it has not fallen to below 90% of its rated voltage and that it is not adjusted to above 110% of its rated voltage. Adjust, lubricate hinges and clean the light units as needed.
- Step 5** Restore AC power and verify that the rectifiers restore battery charge levels to normal conditions.
- Step 6** If the light unit circuits are not AC/DC lit, the test is complete. A record of the inspection and any deviations from the GCS must be kept for a minimum of two (2) years (GCR 109).
- Otherwise, note the AC voltage at the illuminated light units, and verify that it is as close to 100% of its rated light unit voltage as possible. Adjust the AC lighting transformer as required and as per the manufacturer's instructions or the railway's procedures.
- Step 7** Manually operate the light units such that the other unit in each pair is steady-lit, and repeat **Step 6** for those units.
- Step 8** Manually switch the light units from steady-lit to their normal state, and operate the warning system to verify that all components are working as intended, as described at **Item 1**.
- A record of the inspection and any deviations from the GCS must be kept for a minimum of two (2) years (GCR 109).

LED light unit voltage test

- Step 1** Manually operate the light units such that one light unit in each pair is steady-lit. Check that all illuminated LED light units are operating within the manufacturer's voltage specifications with the AC on by obtaining the true voltage.
- Step 2** Manually operate the light units such that the other light unit in each pair is steady-lit. Check that all illuminated LED light units are operating within the manufacturer's voltage specifications with the AC on by obtaining the true voltage.
- Step 3** Manually switch the light units from steady-lit to their normal state, and operate the warning system to verify that all components are working as intended.
- Step 4** Turn off AC power.
- Step 5** Immediately after completing the battery load test (**Item 24**), manually operate the light units such that one light unit in each pair is steady-lit.
- Step 6** At each illuminated LED light unit that is part of the warning system, note the true lamp voltage and verify that it has not fallen to below the minimum operating voltage and that it is not adjusted to above its maximum rated voltage. Adjust, lubricate hinges and clean light units as needed.
- Step 7** Manually operate the light units such that the other light unit in each pair is steady-lit.
- Step 8** At each illuminated LED light unit that is part of the warning system, note the true lamp voltage and verify that it has not fallen to below the minimum operating voltage and that it is not adjusted to above its maximum rated voltage. Adjust, lubricate hinges and clean light units as needed.
- Step 9** Manually switch the light units from steady-lit to their normal state.
- Step 10** Restore AC power, and verify that the rectifiers restore battery charge levels to normal.
- Step 11** Operate the warning system to verify that all components are working as intended, as described at **Item 1**.

A record of the inspection and any deviations from the GCS must be kept for a minimum of two (2) years (GCR 109).

Item 22 Track circuits: for proper functioning

Frequency: Annually.

Purpose

To ensure that all track circuits operate as intended and are installed in accordance with the design plan and manufacturer-recommended practices.

Process

- Verify that the track circuit being tested is installed in accordance with the design plan and that track leads are plugged into the correct rail location.
- Verify that all bonding is intact and installed in accordance with the design plan.
- Verify that insulated hardware, bonding and track leads are intact, with no signs of wear, pumping, or loose parts. Carry out inspection **Item 16**, above.
- Report any head-of-rail contamination immediately to the appropriate supervisor or manager. Section 103 of the GCR must be complied with to ensure safety at the grade crossing until repairs are made to resolve the issue.
- Verify that all insulated joint bypass couplers are adjusted and installed as per the design plan and manufacturers specifications.
- Verify that that each track circuit affecting the route of each grade crossing being tested is operative with a 0.06-Ω shunt and, where applicable, that indication of track occupancy is provided to the Rail Traffic Control Office.
- If termination shunts are used, note the “distance” voltage (ED, EZ, RX), and disconnect the termination shunt to verify that the termination shunt identifies the end of the warning system approach circuit. Verify that the distance voltage increases to a noticeably higher level (EZ, ED, RX). Reconnect the termination shunt once this is verified, and verify that the distance voltage has returned to the noted value.
- Verify that all fouling circuits are operating properly, and verify continuity through (0.06-Ω) shunt tests, as described in **Item 14**, above.
- Where loss-of-shunt protection is used on track circuits, verify that it is working as per the design plan and manufacturer specifications.
- Verify that all relays are adjusted to pick up and drop away as directed by the railway, in both wet and dry conditions.

A record of the inspection and any deviations from the GCS must be kept for a minimum of two (2) years (GCR 109).

Item 23 Flash controller: for flash rate

Frequency: Annually.

Purpose

To ensure that the warning system light units alternate at a steady and consistent pace and provide maximum intensity and clarity to vehicular and pedestrian traffic.

Process

- Step 1** Operate the warning system.
- Step 2-** For warning systems equipped with gates (for vehicular traffic), verify that there is a steady-lit tip light and that the other two lights are flashing alternately in unison with the lights on the warning system mast.
- Step 3-** At sidewalks paths or trails less than 3.5 meters wide, if gates are equipped with only two lights over the two points dividing the travelled way into thirds, verify that the two lights flash alternately in unison with the lights on the warning system mast.
- Step 4** Verify that all light unit sets that are part of the warning system are flashing alternately in unison with each other.
- Step 5** Count the number of times that a pair of lights alternate (flash) from one light to the other within a 60-second period. If at a grade crossing installed before November 28, 2014, verify that the light units alternate between 35 and 65 times per minute. If at a grade crossing installed on or after November 28, 2014, verify that the light units alternate between 45 and 65 times per minute.

A record of the inspection and any deviations from the GCS must be kept for a minimum of two (2) years (GCR 109).

Items 24 Batteries: load test

Frequency: Annually.

Purpose

Anticipating end-of-life is a key factor in preventing catastrophic failures. With many battery types, it is difficult to visually inspect a cell for signs of approaching end-of-life. Discharge testing is the most effective method for determining a battery's true capacity. The integrity of a battery's conduction path can be verified by a short-term load test while monitoring battery and cell.

Process

- Step 1** Connect a voltmeter to the battery bank being tested. Note the bank voltage.
- Step 2** Disconnect the AC power supply to the charging circuit of the battery bank to be tested.
- Step 3** Apply the load bank or dummy resistor which draws at least 10A from the battery directly to the bank.

Step 4 Allow the battery to discharge for about 30 minutes.

Step 5 Check the individual cells to verify that none varies by more than 0.03 V (NiCad) or 0.05 V (VRLA or flooded lead acid). If this variation is exceeded, obtain instruction from the appropriate supervisory officer.

Operate the warning system to verify that all components are working as intended, as described in **Item 1**, above.

Restore AC power and stop the warning system.

A record of the inspection and any deviations from the GCS must be kept for a minimum of two (2) years (GCR 109).

Item 25 Warning time: for required time

Frequency: Annually.

Purpose

To ensure that the warning time being provided to road users is of sufficient length for the design vehicle, that it conforms to the design plan, and that it is no less than 20 seconds.

(Subsection 26.2 of the RSA states that the users of a road must give way to railway equipment at a road crossing if adequate warning of its approach is given.)

Process

Warning time must be measured for every route within the approach for verification that it conforms to the design plan; as well as for each (main and standby) constant-warning/motion-sensing unit.

CAUTION: Do not make any adjustment to motion-sensitive circuits without first confirming that there are no rail-to-rail short circuits.

If termination shunts are used, note the “distance” voltage (ED, EZ, RX), and disconnect the termination shunt to verify that the termination shunt identifies the end of the warning system approach circuit. Verify that the distance voltage increases to a noticeably higher level (EZ, ED, RX). Reconnect the termination shunt once this is verified, and verify that the distance voltage has returned to the noted value.

Verify that the maximum railway operating speed over the grade crossing is not greater than the design speed specified on the design plans. If this speed is exceeded, section 103 of the GCR must be complied with to ensure safety at the grade crossing until repairs are made to resolve the issue.

Option 1

The preferred way to verify warning time at a grade crossing is to have a train activate the warning system at maximum operating speed.

Option 2

If the warning system provides historical logs, review the last 10 train movements per direction of travel for short or excessive warning times, verifying that the warning time provided is as per the

design plan. If insufficient or excessive warning time is observed, apply GCR 103 and use **Option 1** or **Option 3** to confirm warning time.

Option 3

Verify that the length of the approach is appropriate for the warning time specified on the design plan using the following formula:

$$\text{WT distance} = 1.47 \times \text{WT} \times T$$

where:

WT = the warning time as per the design plan

T = the maximum railway operating speed

Shunt-test each approach being tested at the WT Distance.

WT distance is measured from the track circuit leads on either side of the grade crossings, and no closer than 50 feet from the edge of the travelled way.

- 1- For AFO, DC and Style C circuits, verify that when the WT distance is shunted with a 0.06-Ω shunt, the warning system activates. Once the shunt is removed, verify that the warning system recovers.
- 2- For constant-warning and motion-sensing equipment, check the EZ/ED/RX level, for all approaches to be tested prior to shunt-testing the WT distance, and compare them to previously recorded values.
 - 2.1- Verify that the approach length (WT distance) is as per the design plan.
 - 2.2- Test each approach with a 0-Ω shunt, and verify that the EZ/ED/RX level drops to within its acceptable shunted range. Once the shunt is removed, verify that the warning system recovers.

Note: A minimum activation time may be programmed into the crossing controller, which may cause a delay in warning system recovery.

A record of the inspection and any deviations from the GCS must be kept for a minimum of two (2) years (GCR 109).

Item 26 Electronic railway equipment detection devices, including processor-based systems: for programming and functional ability

Frequency: Annually.

Purpose

To ensure that all electronic railway equipment detection device circuits operate as intended, and are installed in accordance with the design plan and manufacturer-recommended practices.

Process

Verify that the track circuit being tested is installed as per the design plan and that track leads are plugged into the correct rail location.

Verify that all bonding is intact and installed in accordance with the design plan.

Verify that insulated hardware, bonding and track leads are intact and have no signs of wear, pumping, or loose parts. Complete **Item 16**, above.

Report any head-of-rail contamination to the appropriate supervisor or manager. Section 103 of the GCR must be complied with to ensure safety at the grade crossing until repairs are made to resolve the issue.

Verify that all insulated joint bypass couplers are adjusted and installed as per the design plan and manufacturer specifications.

Verify that each track circuit affecting the route of each grade crossing being tested is operational with a 0.06-Ω shunt and, where applicable, that indication of track occupancy is provided to the Rail Traffic Control Office.

If termination shunts are used, note the “distance” voltage (ED, EZ, RX), and disconnect the termination shunt to verify that the termination shunt identifies the end of the warning system approach circuit. Verify that the distance voltage increases to a noticeably higher level (EZ, ED, RX). Once this is done, reconnect the termination shunt and verify that the distance voltage has returned to the noted value.

Verify the proper operation of all fouling circuits, and verify continuity by means of shunt tests (0.06-Ω), as described in **Item 14**, above.

If loss-of-shunt protection is used on electronic railway equipment, verify that it is working as per the design plan and manufacturer specifications.

Verify that all electronic railway equipment detection devices are adjusted and calibrated as directed by the railway and as per manufacturer-recommended practices, in both wet and dry conditions.

A record of the inspection and any deviations from the GCS must be kept for a minimum of two (2) years (GCR 109).

Item 27 Timing relays and timing devices: for required time

Frequency: Annually.

Purpose

To ensure that timing relays and timing devices are maintained at no less than 90 per cent and no more than 110 per cent of the predetermined time interval, which must be indicated on the design plan.

Process

Verify that all relay apparatus seals are in place and intact.

Electronic timers

- Step 1** Consult the design plan, and energize the electronic relay circuit as it would normally be energized.
- Step 2** If there is an LED operating mode indicator, verify that it is either on or off, as designed. If there is no such indicator, proceed to **Step 3**.
- Step 3** Measure the time interval using a railway-approved watch or timing device.
- Step 4** Verify that the time interval is no less than 90 per cent and no more than 110 per cent of the time noted on the design plan. Consult the responsible supervisor if the results of this test not satisfy requirements, as adjustment may be required.
- Step 5** Inspect the grade crossing as described at **Item 1**, above. Verify that all stick circuits are in their normal state.

Thermal timers

- Step 1** Consult the design plan, and energize the thermal relay circuit as it would normally be energized.
 - Step 2** Measure the time interval using a railway-approved watch or timing device.
 - Step 3** Verify that the check contact returns to the de-energized (cool) position at the completion of the full time cycle.
 - Step 4** Verify that the time interval is no less than 90 per cent and no more than 110 per cent of the time specified on the design plan. Consult the responsible supervisor if the results of this test not satisfy requirements, as adjustment may be required.
- Note:** If adjustments are made, ensure that the relay is fully cooled before re-testing.
- Step 5** Inspect the grade crossing as described at **Item 1**, above. Verify that all stick circuits are in their normal state.

Motor timers

- Step 1** Consult the design plan, and energize the motor relay circuit as it would normally be energized.
- Step 2** Measure the time interval using a railway-approved watch or timing device.
- Step 3** Observe the mechanical action of the motor timer while the relay is in operation, and verify that it operates smoothly, without signs of sticking or jumping teeth, and that the contacts return to their normal position at the completion of the predetermined time cycle.
- Step 4** Verify that the time interval is no less than 90 per cent and no more than 110 per cent of the time specified on the design plan. Consult the responsible supervisor if the results of this test not satisfy requirements, as adjustment may be required.
- Step 5** Inspect the grade crossing as described at **Item 1**, above. Verify that all stick circuits are in their normal state.

A record of the inspection and any deviations from the GCS must be kept for a minimum of two (2) years (GCR 109).

Item 28 Cable and wire entrances: for condition

Frequency: Annually.

Purpose

To ensure that all wire entrances and all cables entering and within the housing are secured and in acceptable condition for the normal operation of the warning system.

Process

Wire entrances

Verify that all wire entrances are sealed where necessary and that all gaskets are properly placed (seated) and in good condition, so as to prevent water and moisture from infiltrating and rodents from entering.

Verify that conduits are properly clamped and fitted to equipment connections and that conduit plates are secured and sealed to cover wire chutes.

Verify that there is no evidence of excessive tension or strain on the wires entering the housing, and that any strain-relief equipment is functional and secured.

Verify that wires are not damaged (bare wires, cracked insulation, insulation wearing, pinched, etc.).

Cables

Verify that insulation on cables has not pulled away at any terminals, resulting in too much bare copper wire being exposed (Exceeding 6mm (1/4 inch))

Verify that all terminals are corrosion-free, tight and properly secured to the terminal bard in the housing, and that there is no excessive strain or wire tension on them.

Verify that all tags are properly installed as per the design plan.

Verify that all wires are tight and secured to the appropriate terminal, according to the design plan, and that wires are not damaged or loose. Torque terminal points if required by the manufacturer.

Verify that all wires are properly locked, soldered or crimped.

A record of the inspection and any deviations from the GCS must be kept for a minimum of two (2) years (GCR 109).

Item 29 Switch circuit controller centering device: for condition

Frequency: Annually.

Purpose

To ensure that the centering device operates properly, forcing the operating cams of the controller to the centre position.

Process

Remove the compartment cover and observe the centering device (whether part of the switch circuit controller or contained in a separate compartment) while all tests are being performed.

Verify that the mechanism of the centering device is intact and free of wear, corrosion, damage and obstruction.

Disconnect the point rod from the controller camshaft, and move the circuit controller camshaft to the full normal and full reverse position. Verify that when the camshaft is released in either position, it assumes the neutral position.

When the circuit controller is forced in the neutral position by the centering device, verify that the contacts are open in a normal or reverse closed circuit and closed if part of the shunting circuit.

Reconnect the point rod to the circuit controller camshaft. Make proper contact adjustments as per **Item 15**, above, and as instructed.

Verify that the cut-out circuits are working as designed and are adjusted as described at **Item 17**, above.

Replace the compartment inspection covers.

A record of the inspection and any deviations from the GCS must be kept for a minimum of two (2) years (GCR 109).

Item 30 Interconnection between warning system(s) and traffic control device(s): for operation

Frequency: Annually. (Not applicable to limited-use warning systems.)

Note: This inspection should be conducted jointly with the road authority.

Purpose

To ensure that the control circuits operate as designed and provide adequate warning by activating the traffic signals when railway equipment is detected.

Process

Confirm that the applicable recorded pre-emption times or synchronization (as the case may be for the crossing) are in accordance with the design plans for interconnected traffic signals and Prepare to Stop at Railway Crossing signs.

Traffic Signals

Confirm that the interconnection functions as designed by simulating an operation (test switch, train movement, deactivation of the FR relay, etc.). All phases of the interconnection should be tested as per the worst-case operation scenario.

Note: Train movement is a preferred method for testing.

When the warning system is activated, the interconnected traffic signals must prevent all road traffic from travelling over the Railway Crossing before railway equipment actually arrives at the crossing surface. The traffic signals must not give road users any indication to proceed towards the 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.

A record of the inspection and any deviations from the GCS must be kept for a minimum of two (2) years (GCR 109).

Prepare to Stop at Railway Crossing signs

Confirm that the interconnection functions as designed by simulating an operation (test switch, train movement, deactivation of the FR relay, etc.).

Note: Train movement is a preferred method for testing.

Verify during the simulation that the light units of the Prepare to Stop at Railway Crossing sign are illuminated and flashing in unison.

A record of the inspection and any deviations from the GCS must be kept for a minimum of two (2) years (GCR 109).

Item 31 Pole line and attachments: for condition

Frequency: Every two years.

Purpose

To ensure that the pole line is properly maintained and in good condition.

Process

Verify that line wires have approximately the same amount of sag relative to one another and that they do not sag more than what is considered standard practice (the local road authority may have clearance requirements).

Note: Too little sag can result in the line wire being broken or pulled apart.

Verify that line wires, cable poles and attachments meet clearance requirements for safe train operation as per TC-E-05 (*Standard Respecting Railway Clearance*).

Verify that wooden appliances are aligned and in good physical condition (including poles, crossarms, and insulator pins).

Check for:

- Impact damage
- Splitting or cracking
- Breaks
- Surface rot and cracks caused by weather over time

Note: If the poles sound hollow, it may be necessary to drill a 12.7mm (½-inch) hole into the centre of the poles, just above ground level, and inspect the shavings for signs of rot. After inspection, the hole must be stopped with a wooden plug.

Where poor pole conditions may extend below the ground level, the dirt from around the pole should be removed to a depth of 304.8 mm (one (1) foot), and a sharp object driven into the surface of the pole to determine if the rot extends below the ground. The dirt must be replaced once this test is complete.

Verify that all crossarm braces, lags, bolts and plates are properly placed and secure.

Verify that all guy wires used are properly installed and positioned.

Verify that all insulators are not broken and are securely attached to their mounting pins.

Verify that line wires are properly attached to the insulators.

Verify that pole steps (if used) are securely fastened, properly spaced and in good condition.

Verify that all pole attachments such as junction boxes, transformers and arresters are secured and in good condition.

Ensure all unauthorized attachments are removed from poles.

Verify that all line wires, line drops and aerial cables show no signs of weather deterioration (damaged, cracked, etc.), that cable grips are properly attached or adjusted, and that the messenger is properly attached to the pole and cable.

Verify that ground wire, where used, is properly connected and is continuous to the ground electrode.

CAUTION: Pay extra attention to ground wires, which are often removed by unauthorized persons since the increase in scrap copper prices. The removal of ground wires can create a potentially unsafe condition for employees.

Verify that all crossarm markers (where used) identify AC supply circuits, are installed as instructed, and are not faded or damaged.

Ensure vegetation does not obstruct the line wires or pole line attachments and is cleared from the immediate perimeter of the pole and throughout the line.

A record of the inspection and any deviations from the GCS must be kept for a minimum of two (2) years (GCR 109).

Item 32 Gate mechanisms: for electrical values, mechanical clearances and torque

Frequency: Every two years.

Purpose

To ensure that electrical values, mechanical clearances and torque are within specifications.

Process

Electrical values

Verify that the normal battery operating voltage at the gate mechanism terminals is within operating specifications with the gate up and the warning system not active.

Verify that the battery voltage at the gate mechanism motor terminals during the gate-up cycle does not drop below 11 volts or the manufacturer's recommendation.

Verify that hold-clear operating characteristics are within manufacturer-recommended ranges for both drop-away and pick-up.

Verify that electro-mechanical brake operating characteristics are within manufacturer-recommended ranges.

Verify that the operating characteristics of relays in the gate mechanism are in are within manufacturer-recommended ranges.

Mechanical clearances

Refer to manufacturer specifications when inspecting hold-clear or electro-mechanical brake devices and verify that the minimum and maximum brake air gap are met.

Verify that there are no objects that can impede the hold-clear device or any gears in the gate mechanism.

Verify that the gate vertical angle is not greater than 89 degrees.

Verify that horizontal and vertical gate buffer clearances are in accordance with the manufacturer's specifications.

Verify that the bottom edge of the gate, when in the full horizontal position, is at a height of 1.1 to 1.4 metres from the crown of the road.

Torque

Measure the vertical and horizontal torque adjustments, and verify that they are within the manufacturer's recommended tolerances for the length of gate being tested.

A record of the inspection and any deviations from the GCS must be kept for a minimum of two (2) years (GCR 109).

Item 33 DC polar, AC vane, and mechanical timer relays: for electrical values and operating characteristics

Frequency: Every two years.

Purpose

To ensure that electrical values of DC polar and AC vane and mechanical timer relays are within appropriate ranges and that they operate within those ranges.

Process

Before testing electrical values, visually inspect the condition of all relays as described at **Item 15**, above.

AC vane

If measured values do not fall within manufacturer-specified ranges, section 103 of the GCR must be complied with to ensure safety at the grade crossing until repairs are made to resolve the issue.

Pick-up values

Apply a reduced current to relay coils, and gradually increase it just until the front contacts close.

Note: For a three-position relay, this test must be performed in both the normal and the reverse position.

Verify that the current applied to pick the front contacts is within manufacturer specifications.

Normal working values

After measuring the pick-up values, gradually increase the current from pick-up value until the moving element strikes its front or normal stop position.

Note: For a three-position relay, this test must be performed in both the normal and the reverse position.

Verify that the current applied to pick the front contacts is within manufacturer specifications.

Drop-away values

From the full normal position, gradually reduce the current just until the contacts open.

Note: For a three-position relay, this test must be performed in both the normal and the reverse position.

Verify that the current applied to the coils to drop away the contacts is within manufacturer specifications.

DC polar relay

If measured values do not fall within manufacturer-specified ranges, section 103 of the GCR must be complied with to ensure safety at the grade crossing until repairs are made to resolve the issue.

To determine the drop-away current without contact pressure, follow the instructions in Article 6.1.10 L 1 of the AREMA Communications and Signals Manual.

For DC polar relays with a silicon steel magnetic structure, the drop-away value must be as per manufacturer and AREMA specifications for 2- Ω relays, or 32 mA for 4- Ω relays.

For DC polar relays with a silicon steel magnetic structure, the drop-away value must be as per manufacturer and AREMA instructions for line relays.

For DC polar relays with an iron magnetic structure, the drop-away value must be as per manufacturer and AREMA instructions for track relays, 2- Ω relays and 4- Ω relays.

For DC polar relays with an iron magnetic structure, the drop-away value must be as per manufacturer and AREMA instructions for line relays.

Verify that the current applied to the coils is within manufacturer specifications for drop-away current.

Neutral pick-up value

These values should be obtained using AREMA procedures and must fall within manufacturer-recommended operating ranges and meet AREMA standards.

Normal working value

These values should be obtained using AREMA procedures and must fall within manufacturer-recommended operating ranges and meet AREMA standards.

Reverse polar pick-up and working value

These values should be obtained using AREMA procedures and must fall within manufacturer-recommended operating ranges and meet AREMA standards.

Reverse working value

These values should be obtained using AREMA procedures and must fall within manufacturer-recommended operating ranges and meet AREMA standards.

Normal polar pick-up and working value

These values should be obtained using AREMA procedures and must fall within manufacturer-recommended operating ranges and meet AREMA standards.

Neutral armature reverse working value

These values should be obtained using AREMA procedures and must fall within manufacturer-recommended operating ranges and meet AREMA standards.

Mechanical timer relays

- Step 1** Consult the design plan, and energize the motor relay circuit as it would normally be energized.
- Step 2** Measure the time interval with a railway-approved watch or timing device.
- Step 3** Observe the mechanical action of the motor timer while the relay is in operation, and verify that it operates smoothly, without signs of sticking or jumping teeth, and that the contacts return to their normal position at the completion of the predetermined time cycle.
- Step 4** Verify that the time interval is no less than 90 per cent and no more than 110 per cent of the time specified on the design plan. Consult the appropriate supervisor for instruction if the results of this test not meet the requirements, as adjustment may be required.
- Step 5** Inspect the grade crossing as described at **Item 1**, above. Verify that all stick circuits are in their normal state.

A record of the inspection and any deviations from the GCS must be kept for a minimum of two (2) years (GCR 109).

Item 34 Relays that affect proper functioning of a warning system (except DC polar, AC vane and mechanical timer): for electrical values and operation

Frequency: Every four years.

Purpose

To ensure that the electrical values of relays essential to the proper functioning of a warning system, other than DC polar and AC vane relays, as well as mechanical timer relays, meet requirements and to ensure that they operate within manufacturer-recommended ranges.

Process

Before measuring electrical values, visually inspect the condition of all relays as described at **Item 15**, above. Verify that the relays used are as specified on the design plan.

Verify that the relays operate as required according to the design plan and that their electrical operating characteristics are within manufacturer-recommended ranges.

A record of the inspection and any deviations from the GCS must be kept for a minimum of two (2) years (GCR 109).

Item 35 Ground: for resistance value

Frequency: Every ten years.

Purpose

To ensure that the warning system's ground network provides the lowest practical impedance to earth from equipment, so as to protect personnel while also ensuring the integrity of the grounding system. Impedance should not exceed 25 Ω during the driest months of the year.

Process

Damp or freezing weather conditions may adversely affect the results of the ground resistance test. Whenever possible, this test should be conducted in favorable and dry conditions.

CAUTION: Extreme care must be exercised at any time when connecting or disconnecting a ground wire at any part of an earth grounding system. Lightning-induced surges, apparatus connected to the AC supply, and discharge or leakage through the surge protectors can all cause the voltage on the disconnected part of the grounding system to reach dangerous levels, putting workers at risk.

Use only railroad-approved testing instruments, and follow the manufacturer's instructions for using them. Multimeters or other meters not designed to measure earth ground resistance will not provide an adequate reading and must not be used for this test.

Inspections and tests should be carried out only once all other grounds have been removed from the earth ground network. Multiple ground electrodes located at less than 305 mm (12 inches) from one another are to be considered a single rod cluster: only one reading can be taken per cluster.

Unless the clamp-on process is used, all tests should be conducted from the wire to the ground terminal in the equipment housing, not from any of the installed electrodes. The wire from the ground terminal must be isolated from the equipment housing to ensure an accurate reading.

Clamp-on meter process

Verify that there is more than one ground electrode in the earth ground network, including any service utility grounds electrodes; if not, the direct-reading method shown below must be used.

- Step 1** Clamp the railway-approved test instrument around any **ground electrode** in the earth ground network.
- Note:** Make sure there are no multiple grounding conductors at the clamp-on point and there are no bonding points linking the electrode and housing in between the clamp-on point and the earth ground network.
- Step 2** Follow the instructions in the test instrument manufacturer's manual to obtain the ground resistance reading.
- Step** Verify that the earth ground resistance is 25 Ω or less (1/R1). If it is greater than 25 Ω , and if there are other rods in addition to the two (2) previously inspected, repeat Step 1 for that pair of rods (1/R2);
- Step 4** Take the readings obtained from Step 3, and determine the total resistance (1/RT) by using the following formula:
- $$1/RT = 1/R1 + 1/R2$$
- Step 5** If the resistance determined in Step 4 is greater than 25 Ω , section 103 of the GCR must be complied with to ensure safety at the grade crossing until repairs are made to resolve the issue. If the resistance determined in Step 4 is 25 Ω or less, proceed to Step 6.
- Step 6** Reconnect all conductors to the ground terminal bus in the signal housing.
- Step 7** Inspect the grade crossing as described at **Item 1**, above.

Direct reading from ground bus (where available)

- Step 1** Remove all conductors from the ground terminal bus in the signal housing.
- Step 2** Connect the railway-approved test instrument to the ground wire connected to the electrodes.
- Step 3** Follow the instructions in the test instrument manufacturer's manual to obtain the ground resistance reading.
- Step 4** Verify that the earth ground resistance is 25 Ω or less. If it is greater than 25 Ω , section 103 of the GCR must be complied with to ensure safety at the grade crossing until repairs are made to resolve the issue.
- Step 5** Reconnect all conductors to the ground terminal bus in the signal housing.
- Step 6** Inspect the grade crossing as described at **Item 1**, above.

Direct reading at locations without ground bus

- Step 1** Isolate the main service by opening the first control device upstream from the load centre or panel, following the railway's lockout and tag-out procedure.
- Step 2** Disconnect the ground and neutral wire in the load centre or panel as instructed.
- Step 3** Connect the railway-approved test instrument to any exposed ground wire connected to the electrodes or to the electrodes themselves.
- Step 4** Verify that the earth ground resistance is 25 Ω or less. If it is greater than 25 Ω , section 103 of the GCR must be complied with to ensure safety at the grade crossing until repairs are made to resolve the issue.
- Step 5** Reconnect the ground and neutral wires in the load centre or panel.
- Step 6** Remove the lockout and tag-out equipment.
- Step 7** Inspect the grade crossing as described at **Item 1**, above.

Verify that the buried bare grounding ring around the signal housing is intact, that connections to ground rods (electrodes) are secure, and that all ground rods are bonded together.

Verify that electrodes are located no closer than 0.914m (3 feet) from the signal housing, post or pole and are separated from one another by at least twice the electrode length.

Verify that electrodes are installed such that the upper end is flush with or below the finished grade unless suitably protected to prevent personnel hazards or damage to bonding wires.

Verify that the bonding connector between the signal housing and the electrodes is no less than No. 6 AWG or equivalent copper strap, and that wires are run as directly as practical, and are of sufficient length to avoid breakage from the effects of frost.

A record of the inspection and any deviations from the GCS must be kept for a minimum of two (2) years (GCR 109).

Item 36 Wire and cable insulation: for resistance

Frequency: Every ten years. (Not applicable to limited-use warning systems.)

Purpose

To ensure that cable and wire insulation is maintained at a resistance level that will not compromise the integrity of the grade crossing warning system.

Note: This inspection does not include wires connected to the rail, line wires, or case wiring, which should be inspected as part of inspection **Item 28**, Cable and wire entrances.

Process

Because an accurate insulation resistance test depends on a good connection between the meter and the earth ground, this inspection must be conducted after conducting **Item 35**, above.

Damp or freezing weather conditions may adversely affect the results of the insulation resistance test. Whenever possible, this test should be conducted in dry and favorable conditions.

Cable wires must be tested for insulation resistance condition from wire to wire and from wire to ground to verify individual wires are not shorted together or shorted-to-ground underground, at cable entrances, masts, etc.

If possible, avoid removing wires directly from terminals. If more than one wire is removed from a terminal, operational tests must be conducted when the wires are restored to verify that the warning system works as intended.

- Step 1** Before starting, verify that the instruments used are appropriate for the operating voltages of the circuits (wires) being tested. Next, test the insulation resistance tester (e.g. Megger) by turning it on and verifying that it indicates infinite resistance when the test leads are separated and zero resistance when the test leads are in contact with one another.
- Step 2** Verify that the earth ground network is bonded between the housing ground network (bus) and the round rods, and that the bonding is secure and intact.
- Step 3** Identify the cables to be tested, and disconnect and isolate both ends of all wires to be tested.
- Step 4** Test each wire in each cable against the other wires in that cable by touching one test lead of the Megger to one wire in the cable and, with the other lead, touching each remaining wire in the cable, one after the other, including the ground bus.
- Step 5** Continue moving the connected Megger lead to the next wire within the cable, while operating the Megger, then progressively touch the remaining wires in the cable with the opposite lead and repeat this procedure until all wires within the cable have been tested in every wire combination including the ground bus.
- Step 6** Reconnect all isolated cables or disconnected cables, and inspect the grade crossing as described at **Item 1**, above. Verify that all stick circuits are in their normal state.

Wires with a wire-to-wire or wire-to-ground reading of between 500 kΩ and 200 kΩ should be monitored on an annual basis and reported to the appropriate Signals and Communications (S&C) official.

All wires that have a wire-to-wire or wire-to-ground reading of less than 200 k Ω must be removed from service immediately, and a plan made to eliminate the short.

A record of the inspection and any deviations from the GCS must be kept for a minimum of two (2) years (GCR 109).

APPENDIX K – TESTING REQUIREMENT (ROAD AUTHORITY)

Note: The items listed below are those of 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 by 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 (as the case may be 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 actually 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.

ANNEX L – GUIDELINE FOR INSPECTING AND TESTING PRE-EMPTION OF INTERCONNECTED TRAFFIC CONTROL SIGNALS AND GRADE CROSSING WARNING SYSTEMS

Being developed