Transport Canada Transports Canada

DRAFT

RTD 10

ROAD/RAILWAY GRADE CROSSINGS

TECHNICAL STANDARDS and INSPECTION, TESTING and MAINTENANCE REQUIREMENTS

October 24, 2002

Canada

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Foreword

The requirements of this document are incorporated by reference in the *Grade Crossings Regulations* made pursuant to the *Railway Safety Act*. Every party responsible for a road or a railway line involving a grade crossing should consult the *Grade Crossings Regulations*.

Minimum safety criteria are set out for construction or alteration, maintenance, including inspection and testing, of grade crossings, and of their 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 would 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 Director General, Rail Safety, Transport Canada, 330 Sparks Street, Ottawa, Ontario, K1A 0N5.

PART A
Introduction

SECTION 1 -

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SECTION 2 - TERMINOLOGY

Definitions

2.1 The following definitions apply in this Manual:

"maximum railway operating speed" in respect of a grade crossing means the actual maximum speed of trains taking into account speed restrictions due to gradients, slow orders, passenger stations, or track configuration, operating on the line of railway while approaching to enter the grade crossing. («vitesse maximale sur la ligne de chemin de fer»)

"maximum road operating speed" in respect of a grade crossing means the actual maximum vehicle speed at the safe stopping sight distance, and is:

a) the posted speed:

b) the speed indicated on an Advisory Speed Sign; or

c) the reported operating speed, where constraints such as traffic control devices at intersections on the road approaches, or physical restrictions such as curves restrict speed, or where the mean or 85th percentile speed exceeds the posted speed. («vitesse maximale sur la route»)

"travelled way" means that part of a road intended for vehicular, pedestrian, or cycle use, excluding shoulders. («chaussée»)

"warning signal" means the assemblies set out in Figures 18-1, 18-2, and 18-3. («signal d'avertissement de passage a niveau»)

Interpretations

2.2 (a) 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 adjacent land use and not only to jurisdictional boundaries or features of typical cross section of a road.

(b) Particular standards, procedures, guidelines, and recommended practices of other organizations are incorporated by reference into the requirements of this document. If differences exist, the criteria of this document shall prevail.

Incorporated Standards

2.3 In this manual:

"AREMA Communications and Signals Manual" is 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, as amended from time to time; («AREMA Communications and Signals Manual»)

"ASTM D4956-01", is the *Standard Specification for Retroreflective Sheeting for Traffic Control* published by the American Society for Testing and Materials, as amended from time to time; *(«ASTM D4956-01»)*

"CGSB 62-GP-11M" is the *Standard for Marking Material, Retroreflective Elements, Adhesive Backing*, published by the Canadian General Standards Board (CGSB), as amended from time to time; *(«CGSB 62-GP-11M»)*

"CROR" is the Canadian Rail Operating Rules; («Règlement d'exploitation ferroviaire du Canada »)

"Geometric Design Guide" is the *Geometric Design Guide for Canadian Roads* published by the Transportation Association of Canada (TAC), as amended from time to time; («Normes de conception geômetriques des routes»)

"ITE Preemption Practices" is the recommended practice of the Institute of Transportation Engineers (ITE) - *Preemption of Traffic Signals at or Near Railroad Grade Crossings*, as amended from time to time; («Pratique Preemption of Traffic Signals de l'ITE»)

"Traffic Control Devices Manual" means the *Manual of Uniform Traffic Control Devices for Canada (TAC)* published by Transportation Association of Canada, as amended from time to time. («Manuel Canadien de la signalisation routière»)

"NCHRP Report 350 - Recommended Procedures for the Safety Performance Evaluation of Highway Features", is the National Cooperative Highway Recommended Procedure published by the Transportation Research Board of the United States National Research Council; («NCHRP Report 350»)

Units of Measurement

2.4 Standards respecting distances along railway rights of way and speed of trains are in imperial units, because imperial measures continue to be used by the railway industry.

SECTION 3 - GRADE CROSSING SAFETY ASSESSMENTS

Detailed Safety Assessment

3.1 A detailed safety assessment of a grade crossing shall include a review for compliance with the requirements of the Road Railway Grade Crossing Regulations , and an evaluation of all factors that may impact on the safety of the crossing. The factors that may need to be reviewed include:

(a.1) for a proposed new crossing, diversion of the traffic to an existing crossing;

(a) volumes and types of vehicle traffic in the area;

(b) volumes of pedestrian traffic, including persons using assistive devices;

(c) operating characteristics of the grade crossing design vehicle;

(d) maximum road operating speed on each road approach;

(e) vertical clearance requirements for any special vehicles using the grade crossing where cantilever structures are used;

(f) road traffic patterns, including an assessment of the potential for:

(i) conflicts between the indications given by road and railway signs and signals, for example: between crossing signals and nearby traffic signals; parking signs where parked vehicles would obstruct sightlines of crossing signs or signals, or an approaching train; maximum speed limit signs on the road approaches to a crossing where a stop is required;

(ii) queuing of vehicles within 2.4 metres of the nearest rail, for example, from road intersections, entranceways, bus stops, or on congested roadways; and

(iii) queuing of vehicles from the grade crossing onto roads intersecting the grade crossing approach road;

(g) road geometry within the minimum safe stopping sight distances of the grade crossing;

(h) physical surroundings, both within and outside the road and railway rights of way, that may distract driver attention from the grade crossing, for example, intersections on the road approaches, merging traffic lanes, vehicle parking, bus stops, highway or commercial information signs or messages;

(i) volumes and types of railway traffic in the area;

(j) railway operations and railway traffic patterns within the area of the required sightlines and the control circuits of the grade crossing warning system;

(k) maximum railway operating speed on each approach;

(l) sightlines, including grade crossing warning system, and signs;

(m) potential for two or more trains to be operating on or in the vicinity of the grade crossing at the same time;

(n) whether the area including the grade crossing meets the requirements prescribed for the cessation of routine train whistling, where such whistling is proposed to be or has been eliminated;

(o) 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*, and any specific instructions of the railway company issued with respect to the crossing;

(p) accident history at the grade crossing; and

(q) establishment of the time of the next safety assessment within a period shorter than maximum interval specified in the Grade Crossing Regulations if conditions are identified during the safety assessment that could develop into a situation that affects the safety of the grade crossing.

PART B
Design Standards

SECTION 4 - DESIGN CONSIDERATIONS

4.1 The design of a grade crossing and its approaches for vehicles depends significantly upon the design vehicle braking and acceleration characteristics, as well as the vehicle length. The design vehicle characteristics are very important, along with the road approach gradient and the length of the grade crossing clearance zone for determining safe stopping sight distances, sightline requirements along the rail line, and the advance warning time and gate descent time requirements of a grade crossing warning system.

A design vehicle must be established for a detailed safety assessment of a grade crossing for vehicular use.

4.1.1 The design of a grade crossing and its approaches for pedestrians, cyclists, and persons using assistive devices depends upon their abilities and the characteristics of the devices they use.

Vehicle Classifications

4.2 The Transportation Association of Canada includes vehicle classes and characteristics in the *Geometric Design Guide.*

The general classes and vehicle lengths are described in Table 4-1. The *Geometric Design Guide* provides further clarification or details that may be required for the detailed safety assessment of particular grade crossings.

The *Geometric Design Guide* also describes four categories of special vehicles operating on some public roads but for which the design vehicle dimensions and characteristics are excluded.

In addition, there are other special vehicles not described in the *Geometric Design Guide* which routinely operate on some private roads and public roads over grade crossings. These additional special vehicles include those in service for agricultural, industrial, and natural resources. The most common of these special vehicles are described in Table 4-2.

Table 4-1: General Vehicles

Class	*General Vehicle Descriptions*	*Length (m)*
Passenger Car	1. Passenger Cars, Vans, and Pickups (P)	5.6
Trucks		
Single-Unit Trucks	2. Light Single-Unit Trucks	6.4
	3. Medium Single-Unit Trucks	10.0
	4. Heavy Single-Unit Trucks	11.5
Tractor Trailers	5. WB-19 Tractor-Semitrailers	20.7
	6. WB-20 Tractor-Semitrailers	22.7
Combination Vehicles	7. A-Train Doubles (ATD)	24.5
	8. B-Train Doubles (BTD)	25.0
Buses		
	9. Standard Single-Unit Buses (B-12)	12.2
	10. Articulated Buses (A-BUS)	18.3
	11. Intercity Buses (I-BUS)	14.0

Table 4-2: Special Vehicles

Design Vehicle Descriptions	*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 (LCV's)	To be determined in the detailed safety assessment. May be up to 38m in length in Canada.	Standard road width
Recreational Vehicles (RV's) and towed recreational trailers	To be determined in the detailed safety assessment.	Standard road width
Industrial Equipment, including quarrying, sand & gravel, mining	To be determined in the detailed safety assessment.	To be determined in the detailed safety assessment. To be assessed for the area.

Selecting a Design Vehicle

4.3 In selecting the design vehicle, consideration is to be given to vehicles that are expected to routinely use the grade crossing. It is not practical to design each grade crossing for all road vehicles.

Table 4-3 may be used as a guide for the selection of a grade crossing design vehicle.

Table 4-3: Design Vehicle Selection

Road Use	***Descriptions***	***Design Vehicles***
Local roads serving seasonal residences	summer and winter areas	single-unit trucks
Tourist area	self propelled or towed recreational vehicles	single unit trucks, special vehicle - recreation
Agricultural area	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 vehicle - recreational
Industrial	private roads	single-unit trucks, truck tractors with semi-trailers, A or B train doubles, or special vehicle - machinery or long combination vehicle
	public grade crossings within an industrial area	combination vehicles
	resource road	single-unit trucks, tractor trailers, combination vehicles, special vehicle - 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 vehicle route		Special vehicle - long load logging truck or long combination vehicle

Stopping Sight Distance

4.4 Stopping sight distance is the sum of the distance travelled during perception and reaction time and braking distance. Braking distance is the distance that it takes to stop the vehicle once the brakes have been applied.

The following tables and formulae are derived directly from the *Geometric Design Guide*, so as to apply to the general design vehicles described in Table 4-1 approaching and departing from grade crossings. The stopping sight distance for special vehicles included in Table 4-2, or for any other vehicle, are to be calculated in accordance with the principles included in the *Geometric Design Guide* or measured.

$$d = \frac{V^2}{2gf} = \frac{V^2}{2(9.81)f} \times \frac{1000^2}{3600^2} = \frac{V^2}{254f}$$ [*Geometric Design Guide* Formula 1.2.4]

Where d = braking distance (m)
V = maximum road operating speed (km/h)
f = coefficient of friction between tires and the roadway [Table 4.4]
g = 9.81 m/s^2

Then SSD = 0.278tV + d [*Geometric Design Guide* Formula 1.2.5]

Where SSD = stopping sight distance (m)

t = 2.5 seconds perception and reaction time (s)

Table 4-4: Coefficient of Friction for Wet Pavements and Gravel

Maximum Road Operating Speed (km/h)	*Coefficient of Friction (f)*
30	0.40
40	0.38
47 - 50	0.35
55 - 60	0.33
63 - 70	0.31
70 - 80	0.30
77 - 90	0.30
85 - 100	0.29
91 - 110	0.28
98 - 120	0.28

Table 4-5 gives the minimum stopping sight distances on level grade, on wet pavement and gravel, for the general design vehicles included in Table 4-1. These values are used for design of the road approaches, assessment of stopping sight distances for existing grade crossings, sightlines, and the placement and alignment of signs and grade crossing warning signals.

The stopping sight distances in Table 4- 5 may require an increase or may be decreased for a variety of reasons related to grade, vehicle braking capability, and road surface condition.

Variation for Trucks

While a truck driver can generally see further than a passenger car driver due to an eye height advantage, in some instances the driver eye height is a disadvantage - for example, a sag curve where visibility is cut off by an overpass. Also, truck braking characteristics are highly variable and often increase effective braking distance and, thus, stopping sight distance.

The Effect of Grade on Braking Distance

Braking distance will increase on downgrades and decrease on upgrades. When the roadway is on a grade, the formula for braking distance is:

$$d = \frac{V^2}{254\,(f \pm G)}$$ [*Geometric Design Guide* Formula 1.2.6]

Where G = the per cent grade divided by 100 (up is positive, down is negative).
V = maximum road operating speed (km/h)
f = coefficient of friction between tires and the roadway (Table 4-4)

Table 4-5: Stopping Sight Distances *(level grade, on wet pavement and gravel surfaces)*

Maximum Road Operating Speed (km/h)	***Stopping Sight Distances (SSD)***	
	Passenger Car Class (m)	***Truck Class (m)***
40	45	70
50	65	110
60	85	130
70	110	180
80	140	210
90	170	265
100	210	330
110	250	360

Grade Crossing Clearance Distance

4.5 The grade crossing clearance distance is the distance between a point in advance of the grade crossing, 5 m or more from the closest rail, to the point 2.4 m beyond the farthest rail. Factors that increase the length of the clearance distance include:

- a crossing angle greater or less than 90°
- multiple tracks
- significant spacing between multiple tracks
- placement of a crossing sign, signal, stop sign, or stop line pavement marking

Drivers are expected to stop their vehicle, and pedestrians, cyclists and persons using assistive devices are expected to locate themselves, 5 m from the nearest rail, or 2 m in advance of a stop sign, railway crossing sign, warning signals, or gate arm, where they exist.

Normally, where the crossing angle is 90°, a railway crossing sign, warning signals, or gate arm is located 3 m from the nearest rail, measured perpendicular to the rail and the stopped position of the front of a vehicle would be 5 m for the calculation of clearance distance.

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 m, and the stopped position of the front of a vehicle would be greater than 5 m for the calculation of clearance distance.

The grade crossing clearance distance (cd) is calculated as shown in Figure 4-1.

Vehicle Travel Distance

4.6 The total distance the vehicle must travel to pass completely through the clearance distance in Figure 4-1 is computed using the following formula:

$$s = cd + L$$

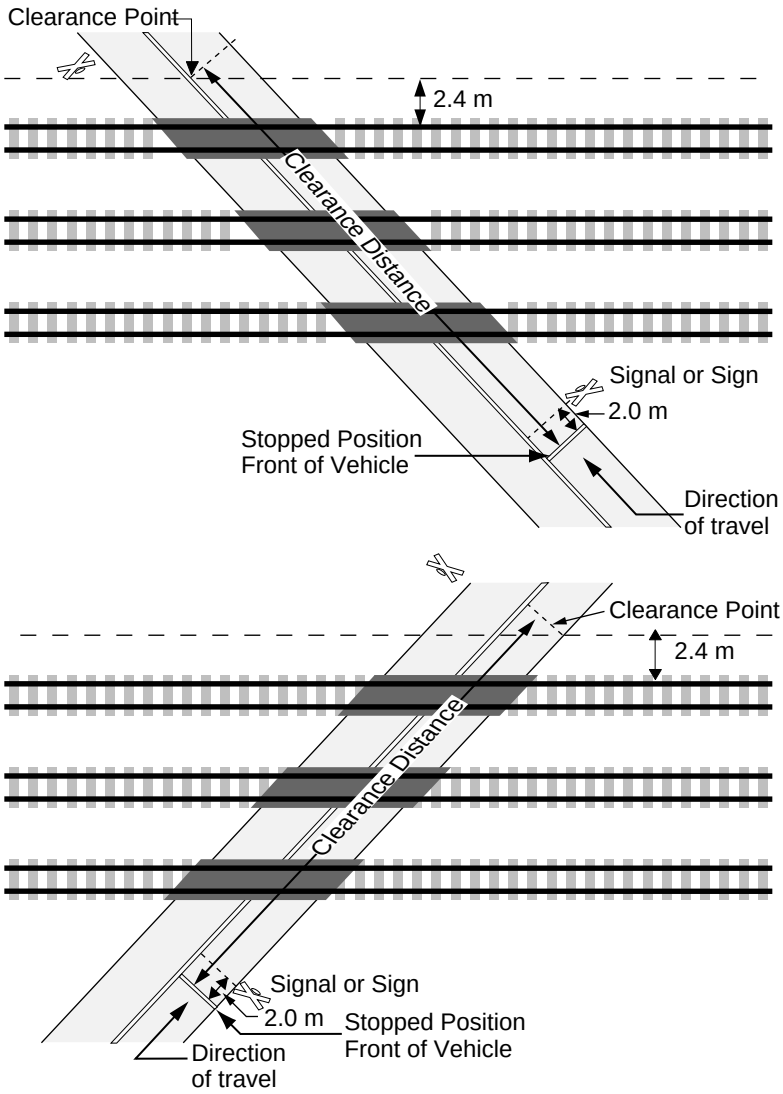
Where: s = distance the road vehicle must travel to pass through the grade crossing clearance distance, (m)

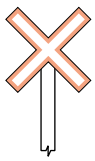
cd = grade crossing clearance distance [Figure 4-1]

L = length of the grade crossing design vehicle [Table 4-1]

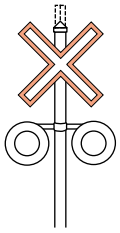
Figure 4-1: Clearance Distance for Grade Crossings

(a) Signs or Signals





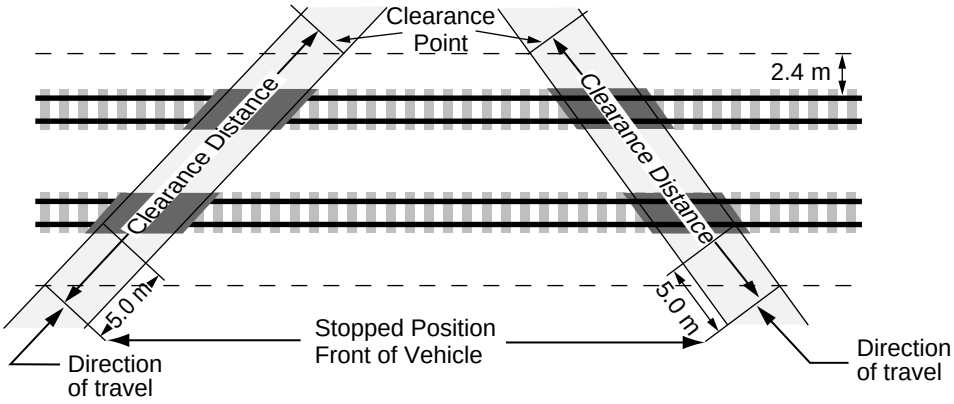
Railway Crossing Sign located In accordance with section 9.1.



Grade Crossing Warning Signal located In accordance with AREMA Communications and Signal Manual

Stop Sign located in accordance with section 9.8.

(b) No Signs or Signals



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Departure Time - 'Design Vehicle'

4.7 The time required for the design vehicle to pass completely through the clearance distance must be assessed. This is the design vehicle departure time (T_d). It includes the time required for the driver to look in both directions along the rail line and to start the vehicle in motion, and to pass completely through the clearance distance.

The design vehicle departure time depends upon the clearance distance, the length of the design vehicle, and the vehicle acceleration.

Vehicle acceleration from a stop and its time to pass over the grade crossing is dependent upon a number of factors.

a) 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.

b) Design vehicles have very different rates of acceleration related to their mass/power ratios.

c) Factors may be present at grade crossings that increase the time required for vehicles to pass through the grade crossing clearance distance. These factors must be considered and include:
   - condition of the road surface
   - superelevated track
   - an intersection on the far side of the grade crossing where vehicles are required to stop, which will slow vehicle acceleration over the crossing
   - restrictions on the vehicle operator from shifting gears while passing over the grade crossing.
   - non-standard placement of stop line pavement markings.

d) Road gradient on the approach side of the grade crossing within the stopped position of the design vehicle, and on the departure side within the distance required for the vehicle to clear the grade crossing, will affect vehicle acceleration, and therefore departure time.

Acceleration Curves for the General Design Vehicles

Assumed acceleration curves for the general design vehicles and long load logging trucks, starting from a stop on level and smooth roads, are provided in the *Geometric Design Guide*. These curves are reproduced in Figure 4-2 and can be used to assist in the determination of the time for the general design vehicles and long load logging trucks to travel through 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).

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 4-2 are for level smooth, continuous road surfaces and are provided for guidance only.

Additional time shall be added to the time calculated in accordance with the acceleration curves of Figure 4-2 to account for reduced acceleration caused by the crossing surface, taking into account the number of tracks, surface roughness, superelevation of the tracks, any unevenness created by the crossing angle, and restrictions on shifting gears while crossing tracks.

Road Gradient Effect

Adjustment for gradient can be made to the acceleration time for a *general design vehicle* on level ground by multiplying the acceleration time on level ground by a constant ratio relating to the road gradient. Ratios for increasing or decreasing the acceleration time along continuous grades of 2% and 4% are provided in the *Geometric Design Guide*. This Table is reproduced in Table 4-6 and can be used to assist in the determination of the time for a *general design vehicle* and *long load logging trucks* to travel through the grade crossing clearance distance.

Because road gradients are not consistent within the vehicle travel distance over a grade crossing, the effect of the gradient may be approximated within the travel distance affected by the gradient by applying the ratio in Table 4-6 only to the travel time through that portion of the road including the gradient and using the maximum gradient in any area of transition.

Table 4-6: Ratios of Acceleration Times on Grades

Design Vehicle	***Road Grade %***				
	-4	***-2***	***0***	***+2***	***+4***
Passenger Car	0.7	0.9	1.0	1.1	1.3
Single Unit Truck and Buses	0.8	0.9	1.0	1.1	1.3
Tractor- Semitrailer	0.8	0.9	1.0	1.2	1.7

Determination of Design Vehicle Departure Time

The *design vehicle departure time* (T_v) is given by the expression;

$$T_v = J + T$$

Where J = 2 seconds perception reaction time of the driver to look in both directions, shift gears if necessary, and prepare to start

T = the time for the design vehicle to travel completely through the clearance distance.

T may be obtained through direct measurement of time required for the selected design vehicle to travel through the grade crossing clearance distance either at the grade crossing, or an equivalent alternative.

Alternately, T may be calculated using the following formula;

$$T = t + G + K$$

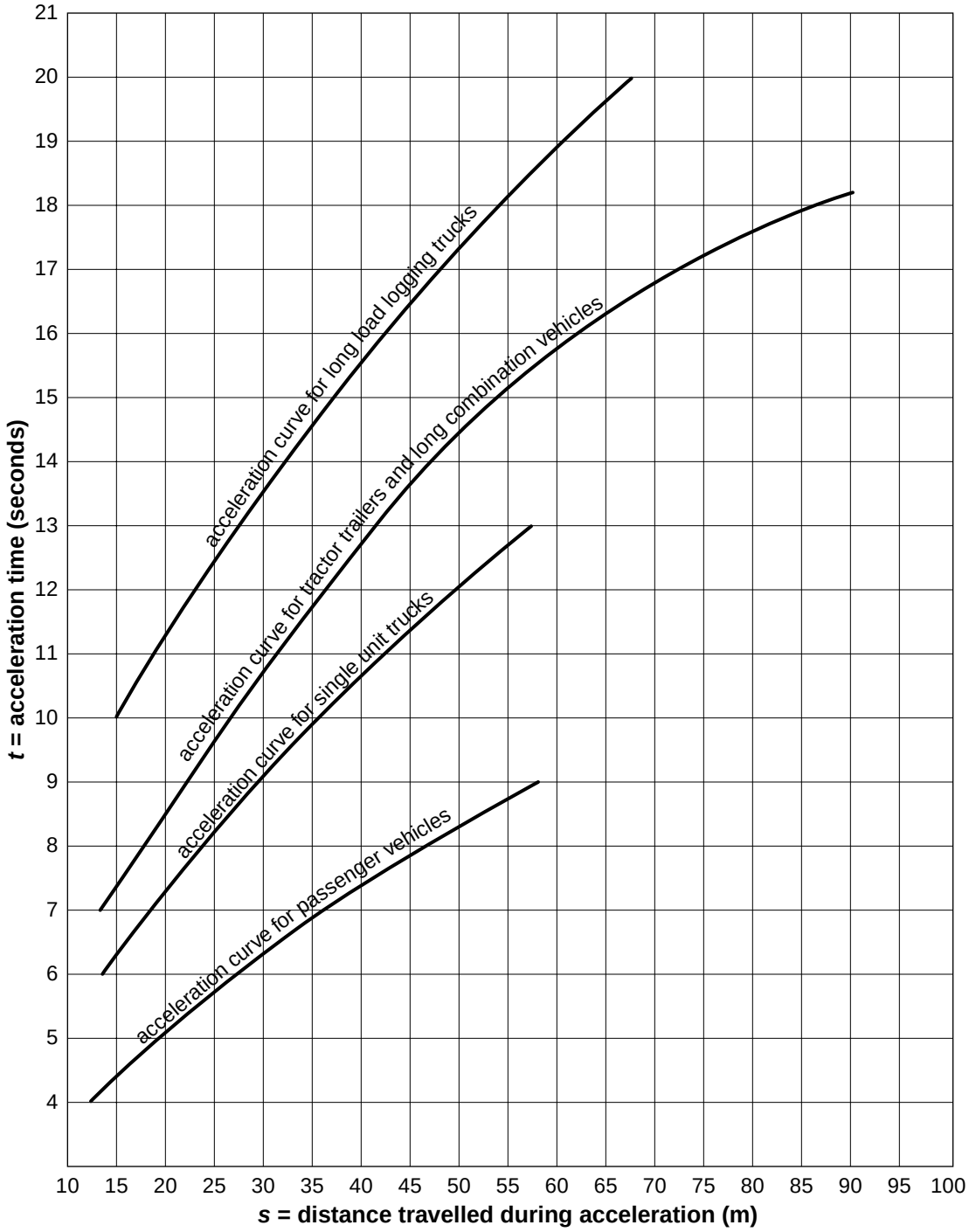
Where values for *t*, G and K may be reasonably estimated by a qualified person.

Where *t* = time for the design vehicle to accelerate through the distance *s* from Figure 4-2

G = the increase or decrease in *t* due to the effect of any road gradient

K = the additional time required for design vehicle acceleration through the clearance distance due to the grade crossing conditions.

Figure 4-2 Assumed Acceleration Curves - General Design Vehicles
(Geometric Design Guide)



Special Vehicles

The departure time for a special vehicle must be assessed independently of Figure 4-2 and Table 4-6. It may be that this can only be done practically by actual measurement of the departure time for the special vehicles using the grade crossing.

Departure Time - Pedestrians, Cyclists and Persons using Assistive Devices

4.8 Pedestrians, cyclists and persons using assistive devices travel at an assumed speed of 4.4 km/h or 1.22 m/s.

Crossing Clearance Distance for pedestrians, cyclists and persons using assistive devices is the distance between 5 m from the closest rail where there are no signs or signals, and 2 m in advance of a crossing sign, stop sign or signal, to the point where the person is 2.4 m beyond the farthest rail.

The grade crossing clearance distance (cd) is calculated as shown in Figure 4-1.

Determination of Departure Time - Pedestrians, Cyclists and Persons Using Assistive Devices

The departure time for pedestrian time (T_p) is calculated by the expression:

$$T_p = \frac{cd}{V_p} = \frac{cd}{1.22} \text{ (s)}$$

Where cd = clearance distance (m) (Section 4-5)
V_p = travel speed pedestrians, cyclists, and persons using assistive devices of 1.22 m/s.

The time required to travel some clearance distances are given in Table 4-7.

Table 4-7: Departure Time - Pedestrians, Cyclists, Persons Using Assistive Devices

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

Gate Arm Delay

4.9 (a) Time is required for the design vehicle to pass by the gate arm of a grade crossing warning system before the gate arm descends to block the vehicle path, if the driver is committed to continue over the crossing at the time that the flashing lights of a grade crossing warning system commences to operate.

Consideration is to be given to two circumstances when the flashing lights commence:

- at a time the design vehicle is past the stopping sight distance; and,
- at a time after the design vehicle starts up to go over the grade crossing from its stopped location 2 m in advance of the gate arm.

(b) The gate arm clearance *distance* from the safe stopping distance (SSD) is calculated as follows:

Gate Arm Clearance Distance from SSD = SSD + 2 m + Design Vehicle Length (*metres*)

Where: SSD is obtained from section 4.4
Design Vehicle Length is obtained from Table 4-1

The gate arm clearance *time* from the SSD:

Gate Arm Clearance Time from SSD = Gate Arm Clearance Distance/Maximum Road Operating Speed (*seconds*)

(c) The gate arm clearance distance from a stop is calculated as follows:

Gate Arm Clearance Distance from a stop = 2 m + Design Vehicle Length (*metres*)

Where: Design Vehicle Length is obtained from Table 4-1

Gate Arm Clearance Time from a stop equals the time for the design vehicle to accelerate and travel completely through the gate clearance distance. While Stopping Sight Distance includes perception reaction time, a driver stopped at a crossing, the decision to proceed would be made only after determining that the warning lights are not flashing. At this point in time, the driver should be set and begin to move without delay. There should be sufficient time for the vehicle to clear the gate arm before it would strike the vehicle.

Calculation of the Gate Arm Clearance Time for stopped vehicles should be done at the same time as calculation of the Design Vehicle Departure Time for the grade crossing under section 4.7.

The time required for stopping or accelerating vehicles on descending or ascending grades must be considered. Refer to sections 4.4 and 4.7 of RTD 10 and the Geometric Design Guide for calculating the effect of gradient on stopping sight distance or acceleration, and to calculate the gate delay requirement for other special vehicles.

(d) The delay of gate arm descent from the time of commencement of the start of the flashing lights is provided in Table 4-8 for level road approaches.

Table 4-8: Gate Delay Times on Level Road Approaches

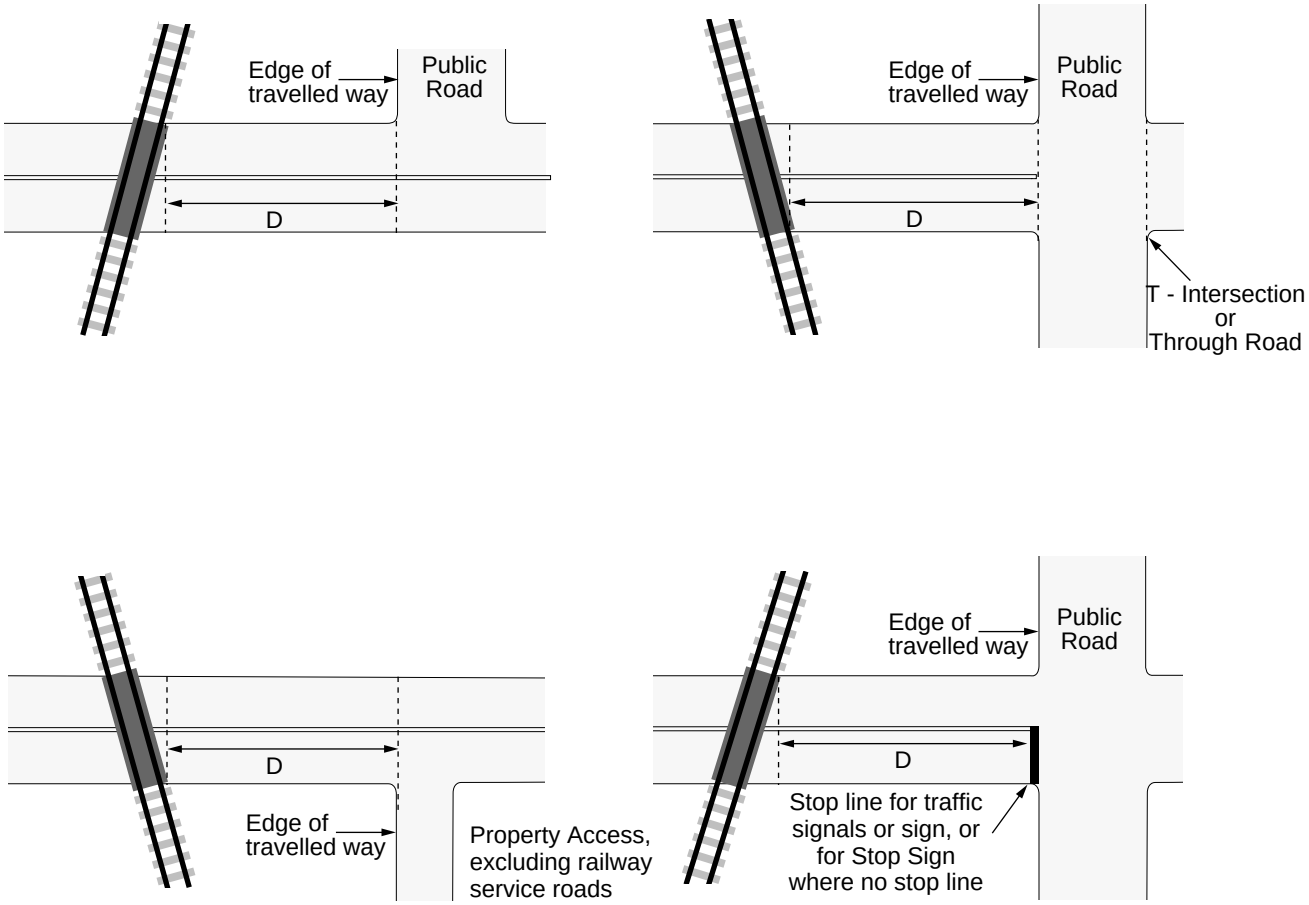
Design Vehicle *(Refer to section 4.2)*	***(seconds)***
Passenger Cars, Vans, Pick-ups	7
Light Single-Unit Trucks	7
Medium Single-Unit Trucks	7
Heavy Single-Unit Trucks	7
WB-19 Tractor-Semitrailers	10.5
WB-20 Tractor-Semitrailers	10.5
A-Train Doubles	10.5
B-Train Doubles	10.5
Standard Single-Unit Buses	7
Articulated Buses	10.5
Intercity Buses	7
Long Load Logging Trucks	14
Other Special Vehicles	To be assessed separately

Notes:
1. Stopping Sight Distance (SSD) and vehicle acceleration may be significantly affected by the gradient of the road and road surface. The requirement for a special vehicle needs to be assessed independently.
2. Refer to section 4.9 of RTD 10 and the *Geometric Design Guide* for calculating the effect of gradient on stopping sight distance or acceleration, and to calculate the gate delay requirement for other special vehicles.

SECTION 5 - LOCATION OF GRADE CROSSINGS

5.1 When an unrestricted grade crossing, or a road intersection or a property access on the road approach to an unrestricted grade crossing, is to be constructed, the location shall be such that no part of the travelled way of the intersecting road or entranceway, or the stop line or position for a traffic control device, shall be closer than 30 m to the nearest rail of the grade crossing, where the maximum railway operating speed exceeds 15 mph. Railway service roads are excluded from this restriction. (see Figure 5-1).

Figure 5-1: Restrictions on the Proximity of Intersections and Entranceways to Unrestricted Grade Crossing



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NOTE:

D not less than 30 m where the maximum railway operating speed exceeds 15 mph.

SECTION 6 - GRADE CROSSING SURFACE

6.1 Subject to subsection 6.2 and 6.2.1, crossing surfaces shall be as shown in Figures 6-1 and 6-2.

6.2 Crossing surfaces of public grade crossings constructed before (CIF) shall be as shown in Figures 6-1 and 6-2, with the exception that, until the first renewal of the crossing surface:

- the maximum flangeway width may be not less than 2.5 inches (63.5 mm) and not more than 4.75 inches (120.6 mm); and
- the height of rail may extend up to 1 inch (25.4 mm) above or below the top of the crossing surface;

6.2.1 Crossing surfaces of private grade crossings constructed before (CIF) shall be as shown in Figure 6-1, with the exception that, until the first renewal of the crossing surface, it shall be smooth and continuous so that vehicles can use the grade crossing safely at the maximum road operating speed.

6.2.2 Notwithstanding sections 6.1, 6.2, and 6.2.1, the crossing surface of a sidewalk, path, trail, or any other route identified for regular use by a person using an assistive device shall be constructed with:

(a) a smooth surface made of metal, concrete, a composite material of rubber or fibreglass, or any other smooth continuous material; and

(b) an area of sufficient width on each side of each track to allow a person using an assistive device, without hesitation, to approach and cross each track at a right angle.

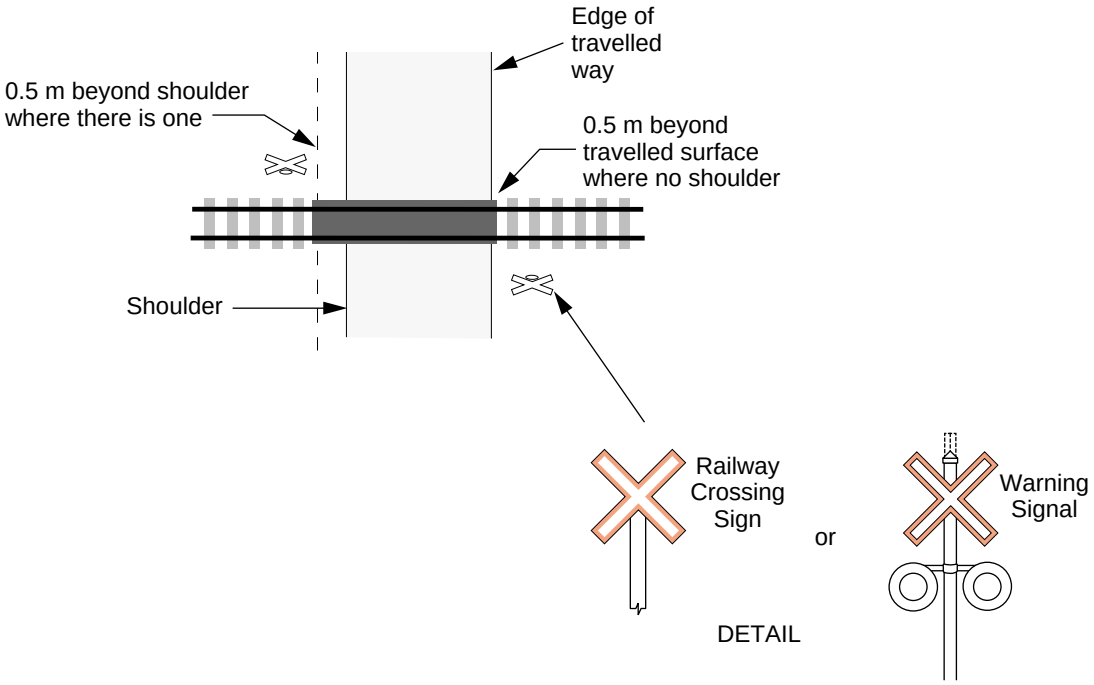
6.3 (a) When the elevation of a grade crossing surface is altered, a matching adjustment shall be made to the road approaches. Similarly, when the elevation of the road is altered, a matching adjustment shall be made to the grade crossing surface. A matching adjustment means that elevations and suitable vertical curves are provided so that the surfaces run in a smooth and continuous manner and vehicles can use the grade crossing safely at the maximum road operating speed.

(b) If the gradient of a road approach to a grade crossing constructed before (CIF) exceeds the requirements set out in sections 7.2 and 7.4, there shall not be any increase in that gradient.

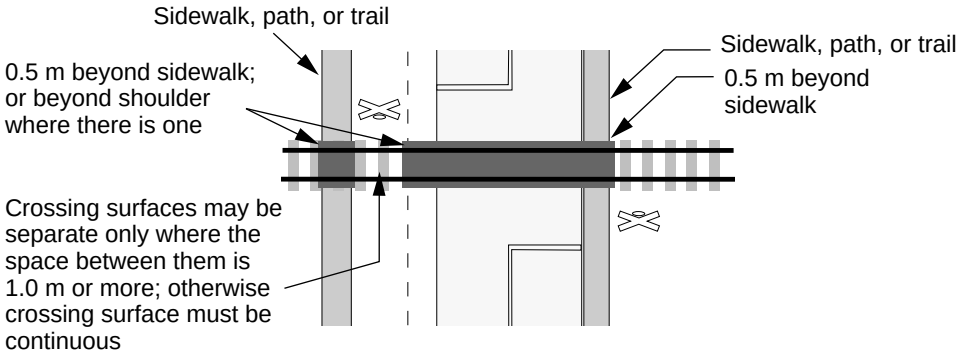
(c) The requirements of paragraphs (a) and (b) apply to both road and track maintenance work.

Figure 6-1: Grade Crossing Surface - Plan View

a) ROAD, INCLUDING A PATH OR TRAIL



b) SIDEWALK, PATH, OR TRAIL ALONGSIDE A ROAD

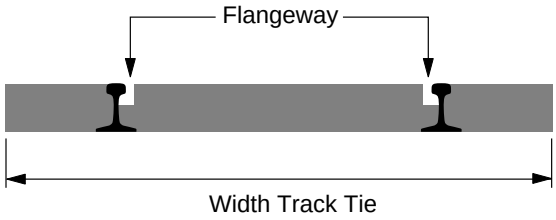


Drawing not to scale

NOTES:

1. The minimum width of grade crossing surface for public roads for vehicle use is 8 m (i.e. measured at right angle to the centre line of the road).
2. The minimum width of the grade crossing surface for a sidewalk, path, trail, or any other route for a person for regular use by a person using an assistive device is 1.5 m measured at right angles to the centreline of the sidewalk, path, trail, or route.

Figure 6-2: Grade Crossing Surface - Cross Section



a) Flangeway:		
Width:	Installation all grade crossings	65-76 mm
	Maximum wear limit Grade crossings regularly used by a person using an assistive device	76 mm
	All other grade crossings	100 mm
Depth:	Minimum	50 mm
	Maximum: Urban areas and any other grade crossing regularly used by a person using an assistive device	76 mm
	All other grade crossings	none
b) Space for Field Side Rail Grinding: A space is permitted on the outer side of the rail at locations where there is frequent rail grinding, except for grade crossings regularly used by a person using an assistive device.		
	Maximum width:	50 mm
	Minimum depth:	38 mm
c) Elevation of Top of Rail with respect to the Crossing Surface: The top of rail shall be installed as close as possible to the crossing surface, with the exception of a grade crossing regularly used by a person using an assistive device, where the top of rail may be installed above the crossing surface within the wear limit.		
Wear limits:	Any route identified for regular use by a person using an assistive device	
	Maximum distance above crossing surface	+13 mm
	Minimum distance below crossing surface	-7 mm
	Unrestricted grade crossings for vehicle use, and other grade crossings if used regularly by passenger cars, trucks other than off-road trucks, and recreational vehicles.	± 25 mm
	All other grade crossings	± 50 mm

Drawing not to scale

SECTION 7 - ROAD GEOMETRY (Grade Crossing and Road Approaches)

7.1 (a) The horizontal and vertical alignment of the road approach and the road over the grade crossing shall be smooth and continuous within the safe stopping sight distance.

(b) The horizontal alignment of the road over the tracks shall be straight extending beyond the outside rails for a distance equal to the length of the design vehicle.

(c) The profile and elevation of the grade crossing surface and the rest of the road shall match and safely accommodate the maximum road operating speed in accordance with the design standards of the *Geometric Design Guide*.

7.2 Subject to the conditions in subsection 7.1 and except to provide for vehicular grade crossings of super-elevated track as required in subsection 7.4, the maximum gradients for roads at a grade crossing shall 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 unrestricted 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 any other grade crossing for vehicular use;

(c) ratio of 1:50 (2 per cent) within 5 m of the nearest rail at grade crossings for pedestrian or cyclist use only; and

(d) ratio of 1:100 (1 per cent) within 5 m of the nearest rail at grade crossings specifically identified as a route for persons using assistive devices.

7.3 Roads in grade crossings constructed before(CIF), shall conform to the following:

a) in the case of a public grade crossing for vehicular use, the ascending or descending gradients of roads shall not exceed a vertical to horizontal ratio of 1:20 (5 per cent), unless authorized by the National Transportation Agency prior to January 1, 1989 under the *Railway Act*, or the Minister of Transport for Canada after that date, under the *Railway Safety Act*; and

b) in the case of other grade crossings, the ascending or descending gradients shall be safe for the use to which the grade crossing is put.

7.4 At vehicular grade crossings incorporating superelevated track, the difference between the gradient of the grade crossing surface on superelevated track and the gradient of the adjacent road shall not exceed the limits specified in the *Geometric Design Guide*.

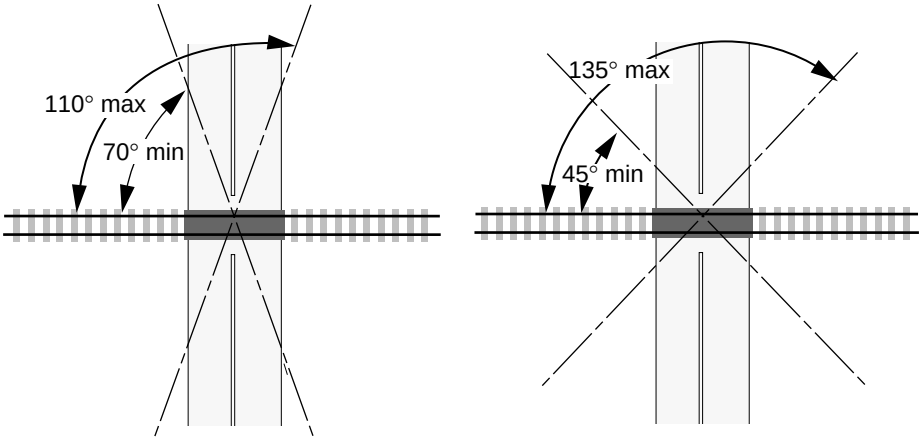
7.5 The width of the travelled road lanes and shoulders at the grade crossing surface shall not be less than on the road approaches.

7.6 A grade crossing where the maximum railway operating speed exceeds 15 mph shall be constructed as specified in Figure 7-1, with the angle of intersection between the road and the track of:

(a) not less than 70 nor greater than 110 degrees without a grade crossing warning system; or

(b) not less than 45 nor greater than 135 degrees with a grade crossing warning system.

Figure 7-1: Maximum Crossing Angle: Grade Crossings



a) Crossings without Grade Crossing Warning System.

b) Crossing with Grade Crossing Warning System.

Drawing not to scale

7.7 The surface of the road approaches and that part of the road forming the grade crossing shall be maintained in good condition for the maximum road operating speeds, including clearance of snow and ice or adequate treatment with abrasives, in a manner to permit vehicles:

(a) to stop safely within safe stopping sight distance of the grade crossing; and

(b) to start from a stopped position at the grade crossing and proceed safely over the tracks.

SECTION 8 - SIGHTLINES

8.1 (a) The rail line within 50 ft. (15 m) of the track(s) or up to the right of way limits, whichever is less, shall be clear of brush, trees, and other vegetation for a minimum distance of 100 ft. (30 m) along the track(s) from the grade crossing surface; and

(b) The road right of way shall be clear of brush, trees, and other vegetation for a minimum of 15 m along the road from the grade crossing surface.

8.2 Sightlines are measured from a point above the road of 1.05 m for drivers of passenger vehicles, vans, pickups and snowmobiles, and pedestrians, cyclists and persons using assistive devices, 1.8 m for buses and single unit trucks, and 2.1 m for large truck and truck trailer combinations, to a point 1.2 m above top of rail.

Sightlines for grade crossings without grade crossing warning system

8.3 Sightlines at a grade crossing without a grade crossing warning system shall be as specified in Figure 8-1. If clearing of sightline obstructions for existing train and vehicle speeds is impracticable, it may be practicable to attain sightlines in accordance with Figure 8-1 by reducing vehicle or train speeds, reducing road gradients or the crossing clearance distance, or restricting use by heavy or long vehicles. Alternately, the crossing may be closed or access to the grade crossing may be restricted in accordance with the Grade Crossing Regulations.

Sightlines for grade crossings with a grade crossing warning system

8.4 (a) Sightlines at grade crossings with a grade crossing warning system shall be provided in accordance with Figure 8-2.

(b) In Figure 8-2,

Trees, brush, and other vegetation within the railway right or way must be removed, and signal, communication or other equipment housings, tool sheds or any other building, or materials can not be placed within $D_{Stopped}$ where it would obscure the sightlines of approaching trains for a person stopped at the crossing.

[Note: Sightlines of approaching trains are a safety benefit at grade crossings with grade crossing warning systems and are to be provided along the rail line where practicable.

These sightlines are of benefit because, according to the rules of the road, while drivers are required to stop when warning signals are flashing, they are permitted to proceed where there is a grade crossing warning system without gates if they conclude that they can do so in safety. In most instances, drivers do not know the maximum railway operating speed, nor can they know how far they must see along the track to make this judgment.

Grade crossing warning systems are designed for the optimum warning time for routine train operations, but nevertheless the signals may be flashing for extended periods of time due to slower moving or stopped trains. They are also designed for continuous operation of the flashing lights, and lowered gate arms where they exist, during warning system malfunctions. A warning system may be operating for extended periods, lasting for several hours, during which time the railway company may be unaware that there is a problem and the warning system credibility and dependability is lessened for drivers. Additional sightlines that may be provided are of benefit to persons who are attempting to determine whether or not it is safe to cross.]

8.5 In Figures 8-1 and 8-2,

(a) SSD is the stopping sight distance and is calculated in accordance with Section 4.4. It is the minimum distance from the stopped position in advance of the crossing within which a driver of a vehicle approaching the crossing must be able to see, without obstruction:

(i) a railway crossing sign,

(ii) a stop sign

(iii) a grade crossing warning signal, and

(iv) a train occupying the grade crossing.

(b) D_{SSD} is the minimum distance along the rail line that a driver must see an approaching train from the safe stopping distance, unless the grade crossing is equipped with a stop sign or warning signals.

D_{SSD} is equal to the greater of the distances that a train at the maximum railway operating speed will travel in 10 seconds, and during the time required for the design vehicle at its maximum operating speed to go from the safe stopping distance completely past the clearance point on the side of the grade crossing.

$$D_{SSD} = 1.47V_T \times T_{SSD}$$

where,

V_T = maximum railway operating speed in mph, and

T_{SSD} = the greater of [(SSD + cd + L)/(0.28V)] and 10 seconds.

where,

V = maximum road operating speed in km/h
cd = grade crossing clearance distance
L = length of design vehicle

D_{SSD} may be obtained directly from Table 8-1 using T_{SSD}.

(c) $D_{Stopped}$ is the distance along the rail line from the grade crossing that a train operating at the maximum railway operating speed will travel during the Departure Time for the grade crossing design vehicle calculated in accordance with Section 4.7, or the Departure Time for pedestrians, cyclists, and persons using assistive devices calculated in accordance with Section 4.8.

$D_{Stopped}$ may be calculated by the following formula:

$$D_{Stopped} = 1.47V \times T_d \quad \text{(ft.)}$$

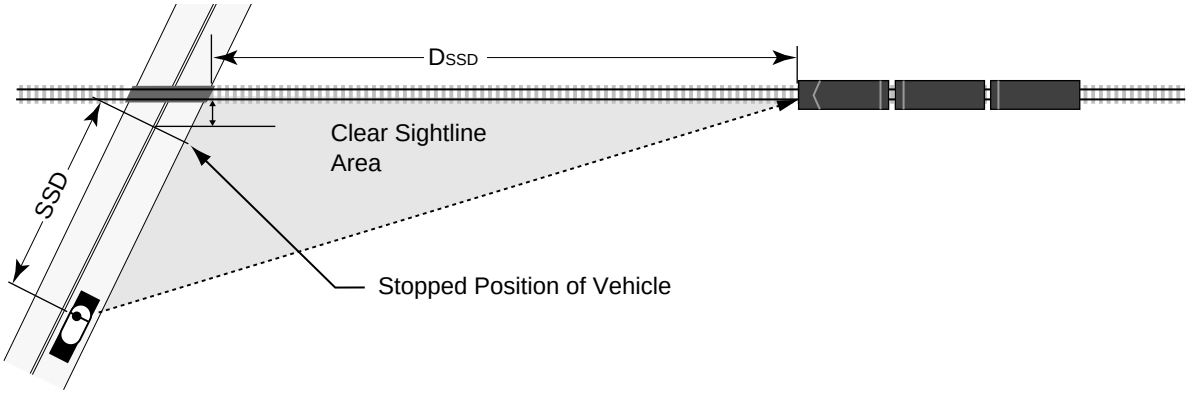
where,

V = the maximum railway operating speed along the rail line (mph)
T_d = the Departure Time, calculated in accordance with Section 4.7 or 4.8.

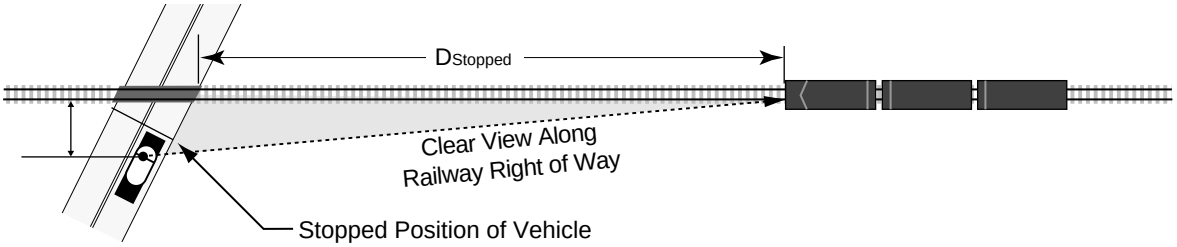
$D_{Stopped}$ may be obtained directly from Table 8-1 using T_d.

Figure 8-1: Minimum Sightlines - Grade Crossings Without A Grade Crossing Warning System

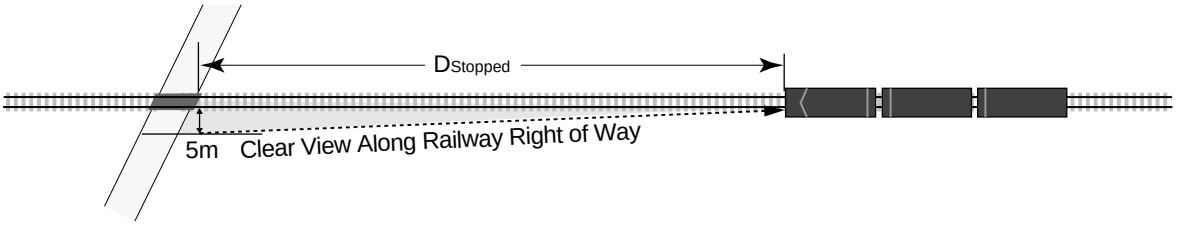
(A) Minimum Sightlines for Drivers Approaching a Grade Crossing



(B) Minimum Sightlines for Drivers Stopped at the Grade Crossing



(C) Minimum Sightlines for Pedestrians and Cyclists Stopped at the Grade Crossing

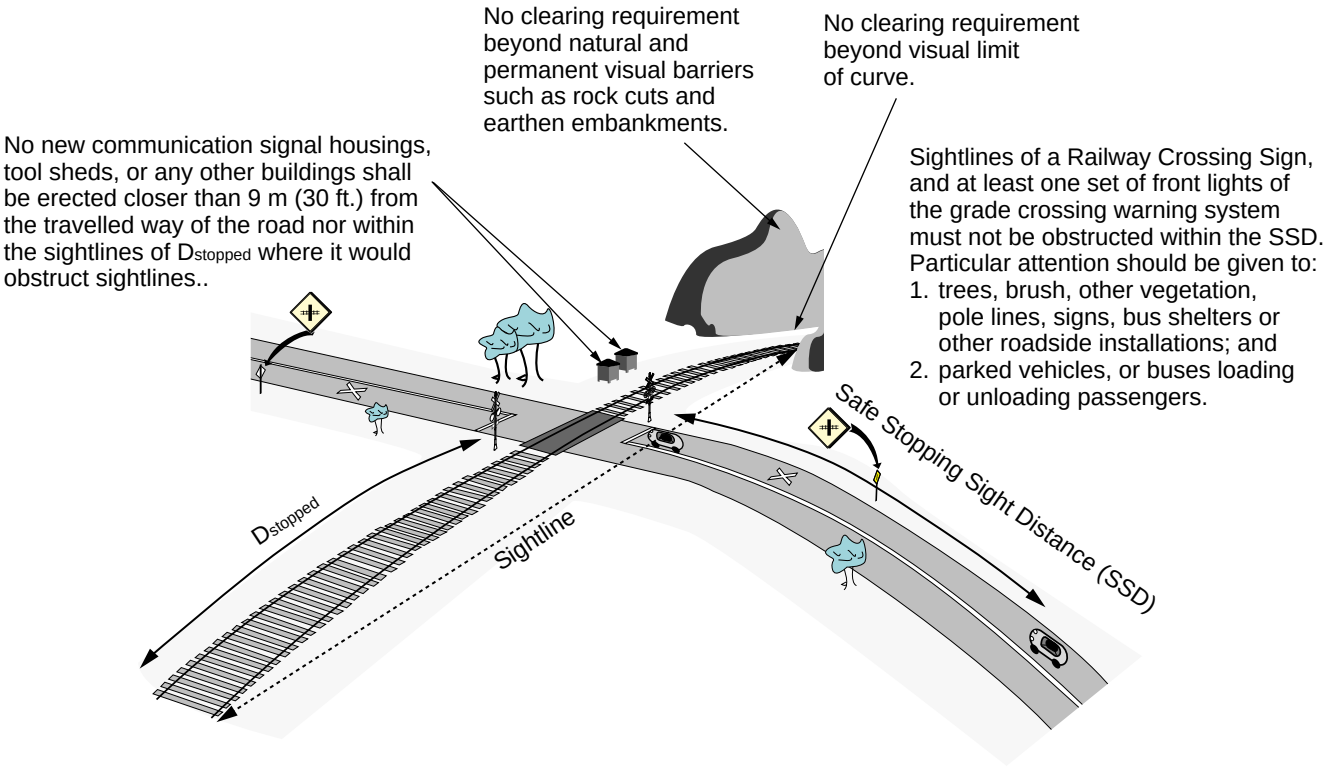


Drawing not to scale

NOTE:

1. SSD is calculated in accordance with section 4.4.
2. D_{SSD} and $D_{Stopped}$ are obtained in accordance with section 8.5.

Figure 8-2: Minimum Sightlines - Grade Crossings with a Grade Crossing Warning System



Drawing not to scale

NOTES:

1. SSD and $D_{Stopped}$ are obtained in accordance with section 8.5.
2. For a grade crossing with a grade crossing warning system, subject to the conditions included in subsection 8.4(b), sightlines of an approaching train within the distance $D_{Stopped}$ must not be obstructed by:
   (i) trees, brush, other vegetation, or materials stored on the railway right of way; and
   (ii) the installation of additional equipment housings, tool sheds or any other building or structure.

Table 8-1: Required Sightlines Along the Rail Line (D_{SSD} and $D_{Stopped}$)
Fig. 8-1 and Fig. 8-2

Maximum Railway Operating Speed V_t	**Required Sightlines Along Rail Line** (D_{SSD} and $D_{Stopped}$) Departure time T_V and T_P (seconds) minimum to 10	11	12	13	14	15	16	17	18	19	20	Above 20 seconds add for each additional second
mph	metres											
STOP	30	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
1-10	45	50	55	60	65	70	72	76	80	85	90	+5
11-20	90	100	110	120	125	135	145	155	165	170	180	+10
21-30	135	150	165	175	190	205	215	230	245	255	270	+15
31-40	180	200	220	235	250	270	285	305	325	340	360	+20
41-50	225	250	270	290	315	335	360	380	405	425	450	+25
51-60	270	300	325	350	380	405	430	460	485	510	540	+30
61-70	315	350	380	415	445	470	505	535	565	595	630	+35
71-80	360	395	435	465	505	540	580	610	650	680	720	+40
81-90	405	445	490	535	570	605	650	685	730	765	810	+45
91-100	450	500	540	580	630	670	715	760	805	850	895	+50

Note: To use Table 8-1, it is necessary to first calculate the departure time required for the crossing in accordance with this section and to determine the maximum railway operating speed. Then selecting the horizontal line in the Table corresponding to the maximum railway operating speed, move to the right to the column under the departure time required for the crossing, in which the sightline distance along the railway is found.

8.6 (a) Sightlines along the railway and road rights of way, and over any other property within the limits established in sections 8.3 and 8.4 must not be obstructed by:

(i) signs, utility poles, or other roadside installations;

(ii) parked vehicles, or buses stopped to load or unload passengers; or

(iii) trees, brush, crops, hedges, or other vegetation, plowed snow, or stored materials.

(iv) any other thing that might, by obscuring clear vision of the road, the line of railway or traffic control devices, constitute a threat to safe operations at its grade crossings.

(b) Road signs and utility poles along the road approaches, or poles along the railway right of way, are not normally considered obstructions to sightlines between persons on the road and approaching trains. They are to be considered an obstruction when obscuring sightlines between persons on the road and railway crossing signs or warning signals.

8.7 In determining whether sightline requirements are met, consideration must be given to the ability to maintain sightlines on an ongoing basis. Where minimum sightlines cannot be assured on an ongoing basis, some other means of positive control of road or rail traffic over the crossing must be provided.

SECTION 9 - SIGNS AND ROAD MARKINGS

Railway Crossing Sign

9.1 Railway Crossing Signs as specified in Figure 9-1 shall be erected at all unrestricted grade crossings.

9.1.1 Number of Tracks Signs as specified in Figure 9-1 shall be erected at all unrestricted grade crossings with more than one track.

9.1.2 Railway Crossing Signs and Number of Track Signs shall be located:

(a) for grade crossings without grade crossing warning systems, as specified in Figures 9-3 and 9-4; or

(b) for grade crossings with grade crossing warning systems, as specified in Figure 18-1.

9.1.3 Retroreflective material shall be applied at all unrestricted grade crossings without a grade crossing warning system, to the back of each blade of the Railway Crossing Sign and to the front and back of each sign post, as specified in Figure 9-2.

9.2 Railway Crossing Sign supporting posts for crossings without a grade crossing warning system shall be of such construction that an 820 kilogram vehicle striking them at speeds from 32 km/h to 100 km/h will not have a change in velocity greater than 4.57 m per second. This performance shall be established in accordance with the criteria of NCHRP Report 350 - Recommended Procedures for the Safety Performance Evaluation of Highway Features.

Railway Advance Warning Sign (AWS)

9.3 (a) AWS as specified in the *Traffic Control Devices Manual* shall be installed on all road approaches for vehicles leading to grade crossings with an AADT exceeding 100, including roads intersecting the road in the grade crossing where the intersection is between the AWS on the crossing road and the grade crossing.

(b) Section 9.3(a) does not apply to a grade crossing in a commercial sector of an urban area if the grade crossing is equipped with a grade crossing warning system which is clearly visible to approaching drivers for the minimum distance specified in Table 19-1, or if approaching vehicles are required to stop within the limit specified in the *Traffic Control Devices Manual* for the location of an AWS.

(c) AWS shall be located as specified in the *Traffic Control Devices Manual.*

Advisory Speed Sign

9.4 Advisory Speed Signs shall be as specified in the *Traffic Control Devices Manual.*

Stop Ahead Signs

9.4.1 Stop Ahead Signs shall be specified in the *Traffic Control Devices Manual*.

Do Not Stop on Track Sign

9.5 A sign warning drivers not to stop on the grade crossing shall be erected in advance of the grade crossing where it has been determined that queued traffic would otherwise encroach routinely closer than 5 m from the crossing surface.

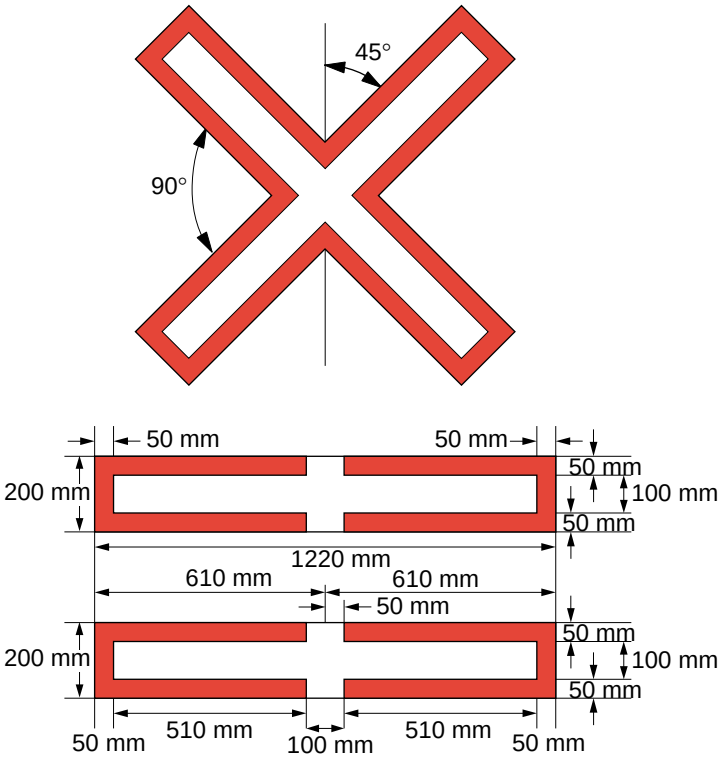
Pavement Markings

9.6 Pavement markings as specified in the *Traffic Control Devices Manual* shall be applied at unrestricted grade crossings with paved road approaches.

9.7 Lines shall be applied within 8 m of the nearest rail to delineate the edge of the travelled surface of sidewalks and pedestrian paths with paved surfaces (i.e. asphalt, concrete, etc.), specifically identified as a route for persons using assistive devices.

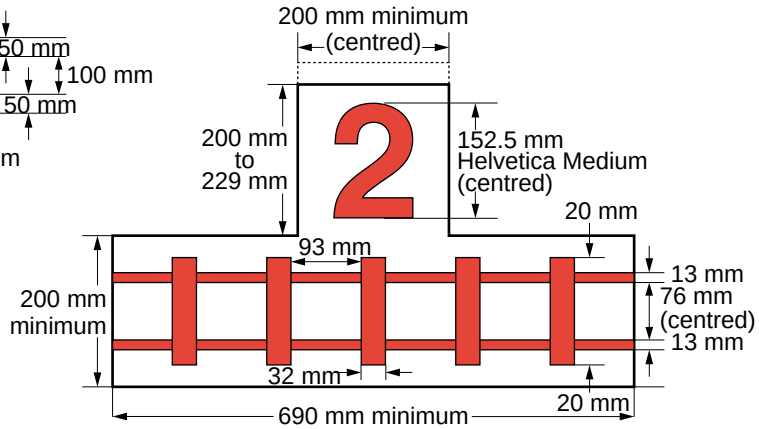
Figure 9-1: Railway Crossing Sign and Number of Tracks Sign

(a) RAILWAY CROSSING SIGN



Scale 1:20

(b) NUMBER OF TRACKS SIGN

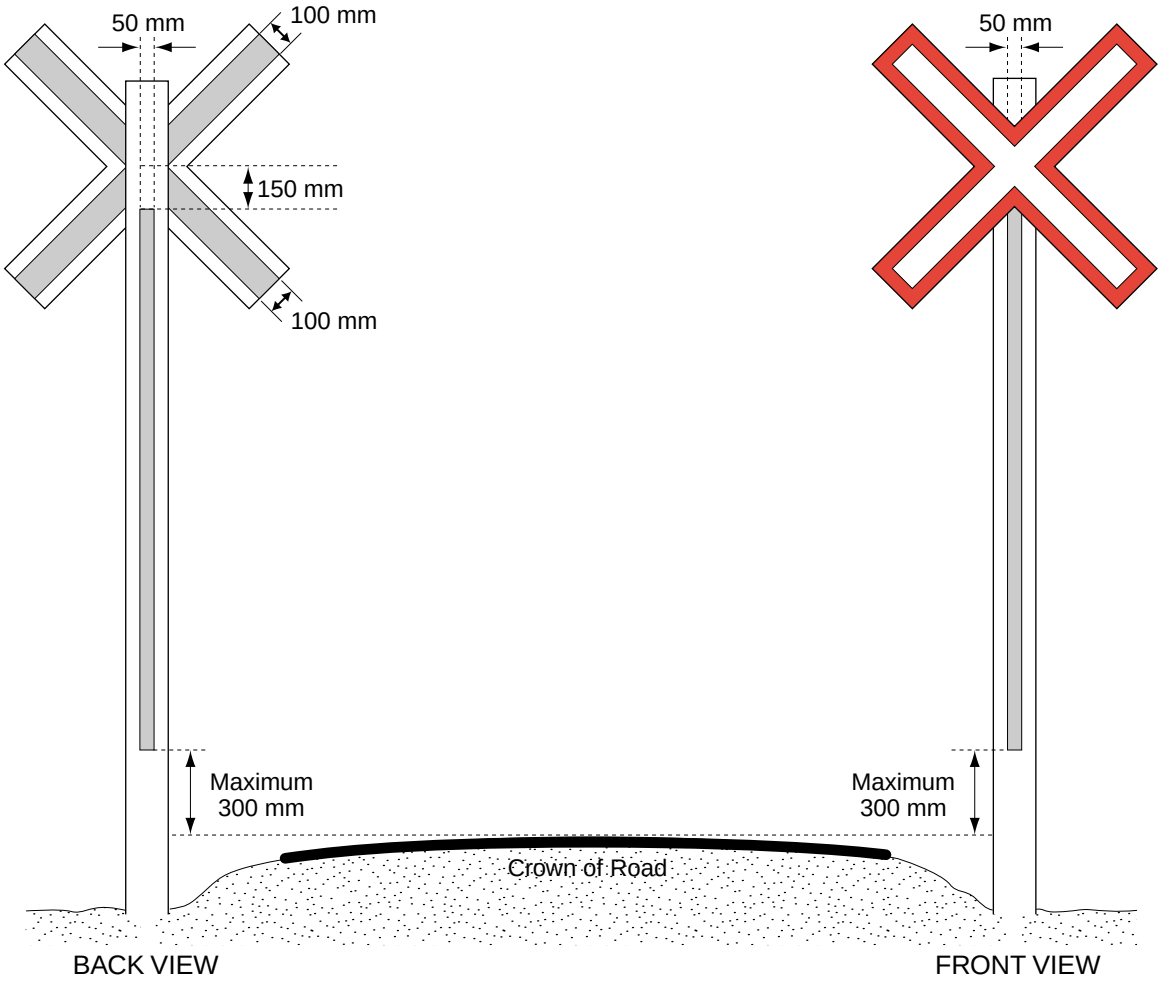


Scale 1:10

NOTES:

1. Silver white sheeting to cover entire surface.
2. Sheeting material specification for crossing sign and number of tracks sign: CGSB 62-GP-11M , Reflectivity Level 1, or better.
3. Railway Crossing Sign 50 mm border: transparent red ink silk-screen processed over sheeting material. Number of Tracks Sign digit and illustration to be transparent red inked silk-screened processed, or black lettering.
4. Sheeting material is to be maintained above 50 per cent of the reflectivity value specified in Note 2.
5. Crossing mileage shall be identified on the back of at least one Railway Crossing Sign or on the side of the sign post facing the road. It may be placed on the surface of reflectorized material shown in Figure 9-2.
6. The digit on the Number of Tracks Sign shall indicate the number of tracks to be crossed.

Figure 9-2: Retroreflective Material on the Back of the Railway Crossing Sign and on the Post (unrestricted grade crossing without grade crossing warning system)

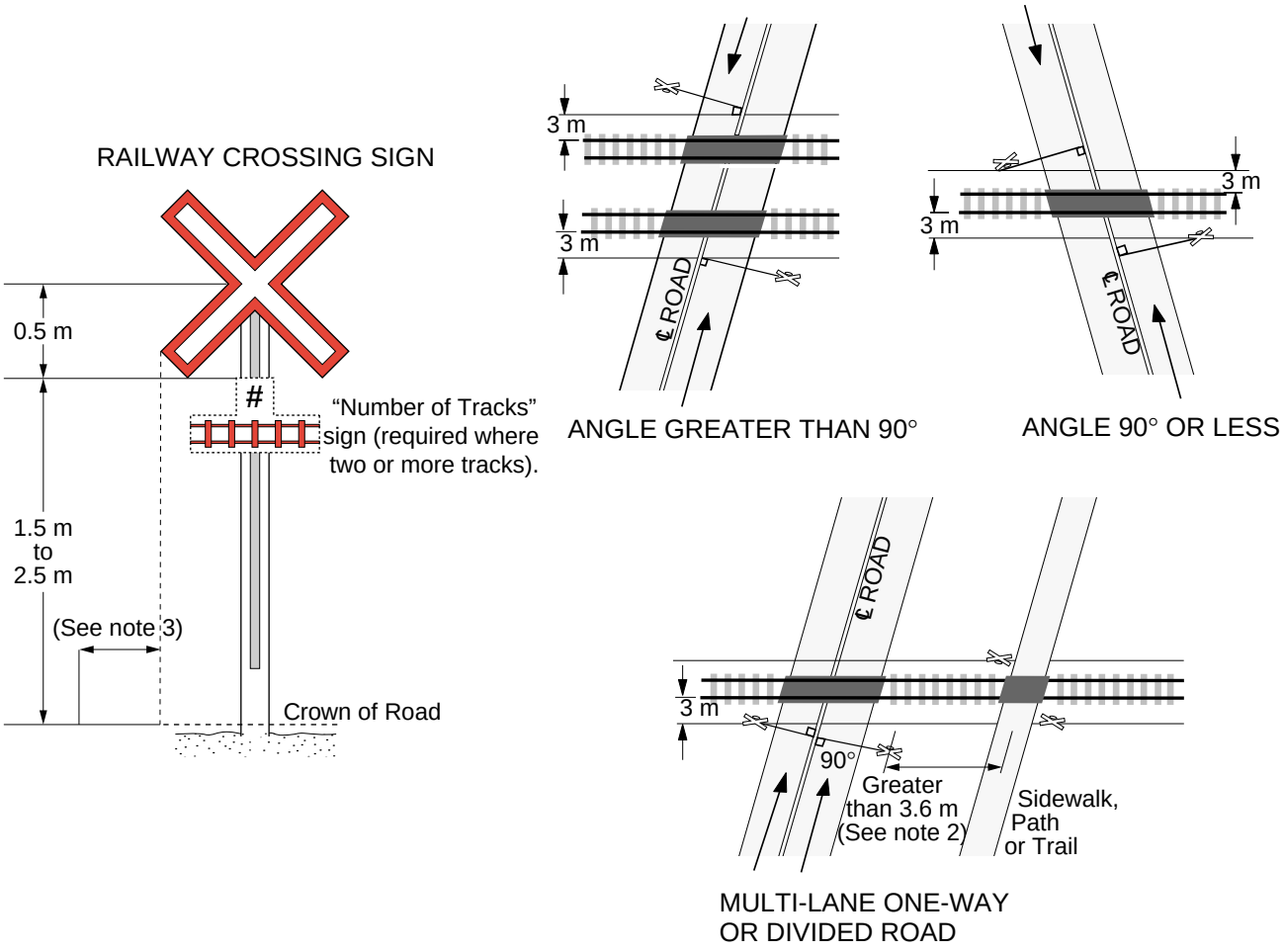


Drawing not to scale

NOTES:

1. A 100 mm strip of silver white sheeting shall be applied on the back of each blade of the Railway Crossing Sign, for the full length of each blade.
2. A 50 mm strip of silver white sheeting shall be applied on the front and back of the Railway Crossing Sign supporting posts, extending from no higher than 300 mm above the crown of the adjacent road surface to 150 mm below the centre of the Railway Crossing Sign.
3. Sheeting material specification for the back of crossing sign and on the post: *ASTM D4956-01, Reflectivity Level VII.*
4. Sheeting material is to be maintained above 50 per cent of the reflectivity value of the levels specified in Note 3.

Figure 9-3: Location of Railway Crossing Signs and Number of Tracks Signs (unrestricted grade crossings without grade crossing warning systems)



Drawing Not To Scale

NOTES:

1. Where a road crosses adjacent tracks and the minimum distance between track centre lines, measured along the travelled surface parallel to the axis of the road, is more than 30 m, each track or set of tracks so separated shall have separate Railway Crossing Signs.
2. A sidewalk, pedestrian or bicycle path, or trail with its centreline more than 3.6 m (12 ft.) from a Railway Crossing Sign supporting post beside a road for vehicle traffic shall have separate Railway Crossing Signs.
3. Signs shall be located between 0.75 m and 1.25 m from the face of curb, or outer edge of road shoulder; or, where there is no curb or shoulder, 2.0 m to 2.5 m from the edge of travelled way.
4. Railway Crossing Signs shall be located as close as possible to the travelled way of the road, within the limits shown, to be clearly visible to all persons approaching the grade crossing on the grade crossing road or intersecting roads. Location outside the limits specified is permissible to the extent necessary to make the sign visible to approaching drivers, pedestrians, cyclists and persons using assistive devices.

Stop Sign

9.8 (a) Stop Signs as specified in the *Traffic Control Devices Manual* shall be installed at unrestricted grade crossings without a grade crossing warning system where it is impossible for drivers to see a train approaching within the sightline limits specified in Figure 8-1, without first:

- slowing down to a speed of less than 15 km/h; or
- stopping at the Railway Crossing Sign

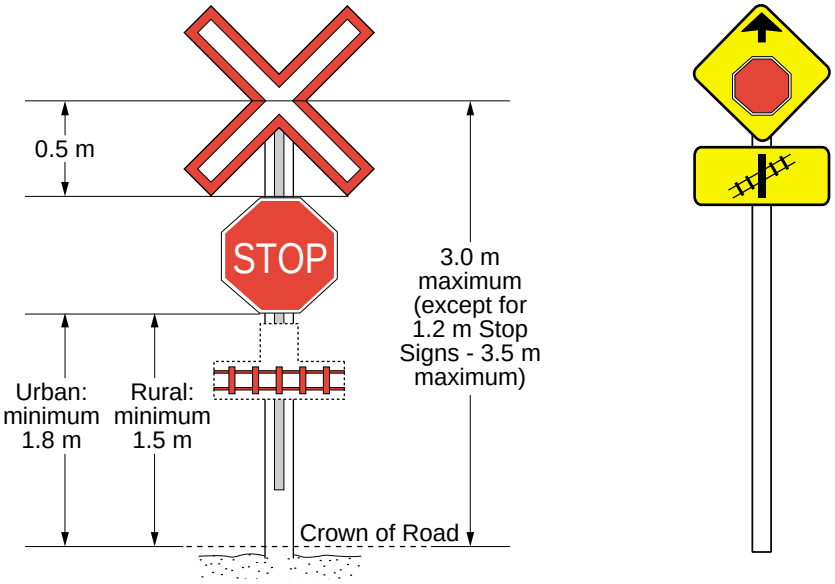
(b) Stop Signs shall not be installed at an unrestricted grade crossing in circumstances other than those indicated in 9.8 (a), except where a detailed safety assessment or safety review of the grade crossing indicates conditions that usage of Stop signs is warranted.

(c) When a Stop Sign is to be installed at an unrestricted grade crossing, it shall be placed on the same post as the Railway Crossing Sign as illustrated in Figure 9-4, located so as to be clearly seen by persons approaching the grade crossing within safe stopping sight distances.

(d) When a Stop Ahead Sign is to be installed, it shall be placed on the same post as the Railway Advance Warning Sign.

9.9 Stop Signs shall not be installed at grade crossings equipped with a grade crossing warning system.

Figure 9-4: Stop Signs and Stop Ahead Signs



Note:

1) Top of stop sign should be at the elevation of the lowest points of crossing sign.

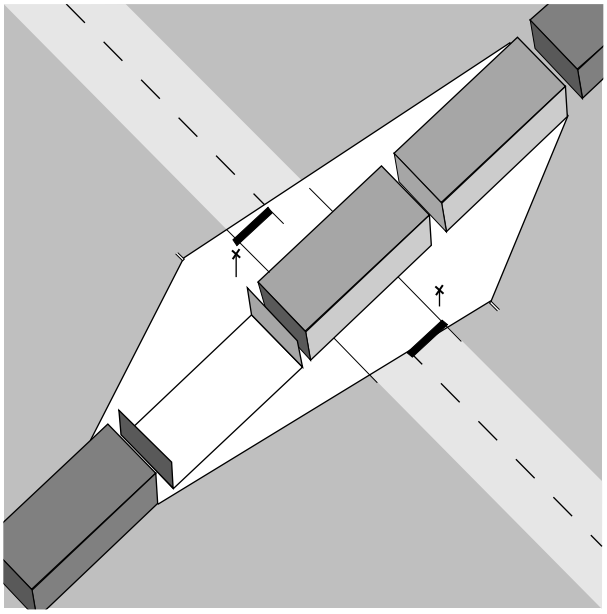
Drawing not to scale

SECTION 10 - TRAIN ILLUMINATION

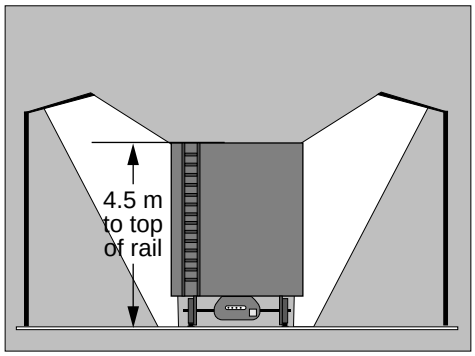
10.1 A grade crossing for vehicular use shall be equipped with lighting fixtures to illuminate the sides of trains occupying the grade crossing at night if all of the following conditions exist:

- unrestricted grade crossing
- no grade crossing warning system or traffic signals
- road speed limit is 50 km/h or more
- routinely, during hours of darkness, there are switching operations, or trains, engines, or other railway equipment which stop on the grade crossing or travel over it at speeds of 15 mph or less.

Figure 10-1: Train Illumination:
Grade Crossings without Grade Crossing Warning Systems



Plan View



Height to be covered by luminaire

Drawing not to scale

10.2 (a) At least one luminaire shall be provided on each side of the railway track(s) at the grade crossing.

(b) Luminaires shall be oriented towards the railway track(s) so that the sides of trains are illuminated for approximately an equal distance on each side of the road centreline. A minimum of 11 lux (one foot-candle) of illumination is required across the vertical plane which is:

(i) located 1.5 m from the centre line of track;

(ii) parallel to the track extending at least 1.5 m beyond the travelled way on each side of the road: and

(iii) extending from the road surface to 4.5 m height above the top of rail.

(c) Poles holding luminaires shall be designed and positioned on the side of the roadway in accordance with the normal design criteria of the road authority.

GRADE CROSSING WARNING SYSTEMS

SECTION 11 - GRADE CROSSING WARNING SYSTEMS

Vehicles

11.1 Unrestricted grade crossings for vehicular use shall have a grade crossing warning system if:

(a) (i) the forecast cross-product is 1,000 or more; or

(ii) the grade crossing does not include a sidewalk and the maximum railway operating speed exceeds 80 mph; or

(iii) the grade crossing includes a sidewalk and the maximum railway operating speed exceeds 60 mph; or

(iv) there are two or more tracks and trains may be passing one another; or

(v) the sightlines or alternative measures specified in section 8-3 are not provided, including where trains, engines, railway cars, or other railway equipment, standing or stored, may obscure driver or pedestrian sightlines of a train approaching the grade crossing.

Alternatively, if the grade crossing is located where trains stop before entering the grade crossing, train movements over the grade crossing may be manually protected, or traffic signals may be installed in lieu of a grade crossing warning system. The normal display of such traffic signals shall be a green light for road traffic, while trains will be required to stop until given an indication that they are to proceed.

(b) the maximum railway operating speed exceeds 15 mph, there is a Stop Sign or traffic signals controlling vehicular traffic on that part of the road leading away from the grade crossing, and the distance between the front of a vehicle in the first stopped position at the Stop Sign or traffic signals and a rail in the grade crossing surface is:

(i) less than 30 m for a Stop Sign (refer to Figure 11-1 a); or

(ii) 30 m or more for a Stop Sign, unless a traffic study indicates that queued traffic will not encroach within 2.4 m of the rail nearest the road intersection (refer to Figure 11-1, a); or

(iii) less than 60 m for traffic signals, (refer to Figure 11-1 b); or

(iv) 60 m or more for traffic signals, unless a traffic study indicates that queued traffic will not encroach within 2.4 m of the rail nearest the road intersection (refer to Figure 11-1, b).

Pedestrian or Cyclist Paths

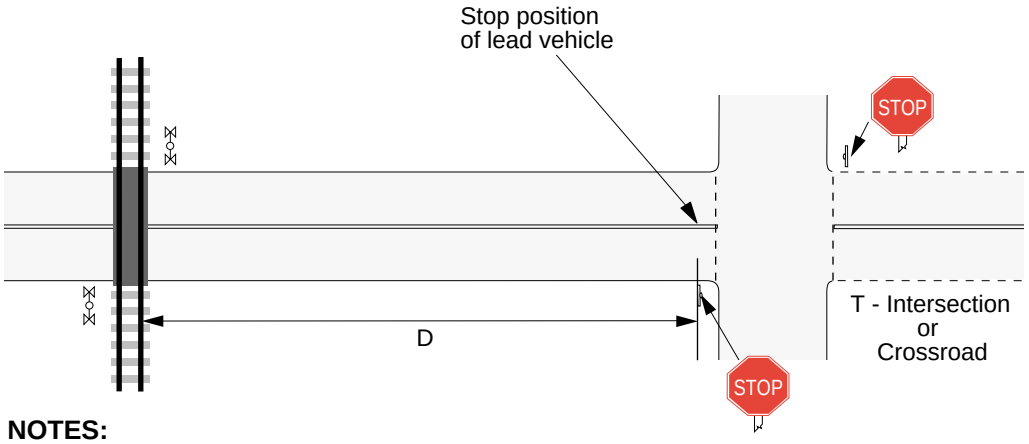
11.2 Unrestricted grade crossings for pedestrian or cyclist use only, shall have a grade crossing warning system where:

(a) the maximum railway operating speed exceeds 60 mph; or

(b) the maximum railway operating speed exceeds 15 mph and there are two or more tracks at the grade crossing where trains may be passing one another.

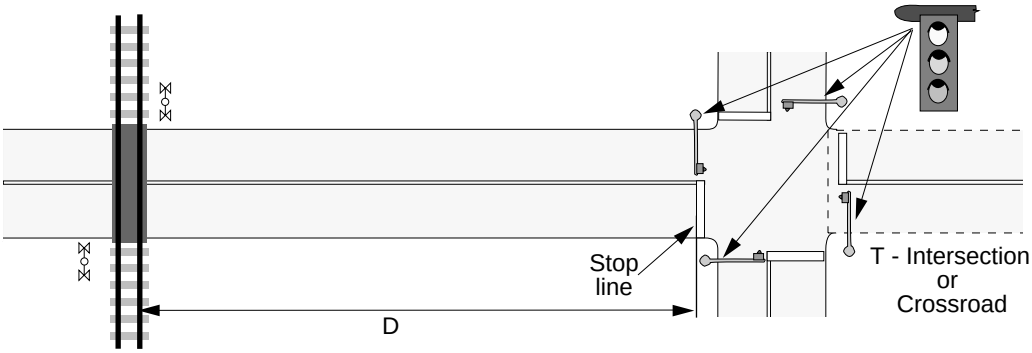
Figure 11-1: Proximity of Grade Crossing Warning Systems to Stop Signs and Traffic Signals

a) NEAR STOP SIGNS



NOTES:
Where the maximum railway operating speed exceeds 15 mph:
- if D is less than 30 m, a grade crossing warning system including gates is required;
- if D is 30 m or greater, a grade crossing warning system including gates is required unless a traffic study indicates that traffic will not normally queue to within 2.4 m of the rail nearest the road intersection. For grade crossings or road intersections nearby an existing grade crossing, where the maximum railway operating speed exceeds 15 mph:

b) NEAR TRAFFIC SIGNALS



NOTES:
For grade crossings or road intersections nearby an existing grade crossing, where the maximum railway operating speed exceeds 15 mph:
- if D is less than 60 m, a grade crossing warning system including gates is required;
- if D is 60 m or greater, a grade crossing warning system including gates is required unless a traffic study shows that traffic will not queue to within 2.4 m of the rail nearest the road intersection.

Drawing not to scale

SECTION 12 - GATES

12.1 Where grade crossing warning systems are installed, they shall include gates if:

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

(b) the maximum railway operating speed is 50 mph or more; or

(c) there are two or more tracks where trains may be passing one another; or

(d) the sightlines along the railway right of way for a driver or pedestrian stopped at the grade crossing are not at least equal to the distance $D_{Stopped}$, determined in accordance with subsection 8.3, including where trains, engines, railway cars or other railway equipment, standing or stored, may obscure the driver's or pedestrain's sightlines of a train approaching the grade crossing; or

(e) the maximum railway operating speed exceeds 15 mph, and the distance between the front of a vehicle in the first stopped position at a Stop Sign or traffic signal on that part of the road leading away form the grade crossing and a rail in the grade crossing surface is:

(i) less than 30 m for a Stop Sign, or less than 60 m for traffic signals; or

(ii) 30 m or more for a Stop Sign, or 60 m or more for traffic signals, unless a traffic study indicates that queued traffic will not encroach within 2.4 m of the rail nearest the road intersection (refer to Figure 11-1).

SECTION 13 - FLASHING LIGHT UNITS

Number and Location of Light Units

13.1 (a) The effectiveness of a grade crossing warning system is dependent upon the capability of the warning lights to attract the attention of a driver looking ahead along the road.

Cone of vision describes the driver's lateral vision. A driver has excellent lateral vision up to 5 degrees on each side of the centre line of the eye position (a cone of 10 degrees) and adequate lateral vision up to 20 degrees of each side. Figure 13-1 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 the need for overhead light units at the minimum height of 5.2 m, to be placed at least 15 m in advance of the stopped position for vehicles. Figure 13-2 illustrates vertical limits.

The number of light units and positioning may be affected by the horizontal and vertical curvature of the road approach, the proximity of intersecting roads and entranceways, as well as the width of the road at the crossing.

(b) Sufficient light units shall be provided in a grade crossing warning system and located to ensure that while a driver is approaching the grade crossing within the distances specified for the primary set of light units in Table 19-1, or from a road intersection or a property access:

(i) flashing light units are located within, or as close as possible to, 5 degrees horizontally of the centreline of the road ; and

(ii) the approaching driver is within the effective distribution pattern of luminous intensity of a set of flashing light units;

(c) Sufficient back lights shall be provided in a grade crossing warning system and located to ensure that all drivers stopped at the grade crossing are within the effective distribution pattern of luminous intensity of a set of back lights

Cantilevered Light Units

13.2 Cantilevered light units shall be provided in grade crossing warning systems if:

(a) subject to the exception in subsection 13.5(b), the distance between the farthest edge of the travelled way of the road lane(s) approaching the grade crossing and a grade crossing warning signal mast exceeds 7.7 m, when measured at right angles to the road (see Figure 13-4); or

(b) the front light units of the grade crossing warning signal (i.e. those on the same side of the track as approaching traffic) are not clearly visible within the minimum safe stopping sight distance specified in Table 19-1 in section 19, and cantilevered light units will bring the visibility of the lights into specification.

13.3 Cantilevered light units, subject to the exception in subsection 13.5(b), shall be provided in grade crossing warning systems installed on roads that meet the criteria for a "freeway" or "expressway" classification in the *Geometric Design Guide*.

Horizontal and Vertical Curvature of Road Approaches

13.4 Additional light units shall be installed where the horizontal curvature in the road approaches make them necessary to provide complete coverage between the back light units and the primary front light units.

Intersections on Approaches

13.5(a) Additional pairs of light units shall be provided either on the main, cantilevered, or separate masts, where necessary so that the driver is within the effective light distribution of a pair of flashing lights as the driver begins to turn onto the road approach to a grade crossing from intersecting roads, lanes, parking lots or other property access. Figure 13-3 illustrates typical light unit arrangement for an intersection where additional light units are required to provide adequate light units for drivers turning from an intersecting road towards the grade crossing.

(b) The requirements for cantilevered light units in sections 13.2 and 13.3 do not apply to a road approach to a grade crossing which comes from a T-intersection such that light units located on a cantilever structure would be above the cone of vision of drivers at the point on the intersecting road where they begin to turn towards the grade crossing.

The vertical limit of the cone of vision of drivers is to be determined in accordance with Figure 13-1.

Multiple Lane Approaches

13.6(a) On roads with multiple lanes approaching a grade crossing, front lights shall be provided, so that at least one set of front light units is clearly visible to drivers in each lane as they approach the crossing.

(b) Back lights shall be provided so that at least one set of back lights is clearly visible to drivers in each lane while stopped at the grade crossing, except for the presence of a train.

Back Lights on One Way Roads

13.7 Back lights shall be provided so that at least one set of back lights is clearly visible to drivers in each lane while stopped at the grade crossing, except for the presence of a train.

Sidewalks and Paths

13.8(a) A sidewalk, pedestrian or bicycle path, or trail with its centre line more than 3.6 m (12 feet) from a warning signal mast beside the travelled way of a road for vehicles shall have separate light units, as shown in Figured 13-5.

(b) Front lights and back lights shall be provided on the standard signal masts for persons travelling in the direction opposite to vehicle traffic where there are sidewalks or paths along one-way roads as shown in Figure 13-5.

Figure 13-1: Horizontal Cone of Vision

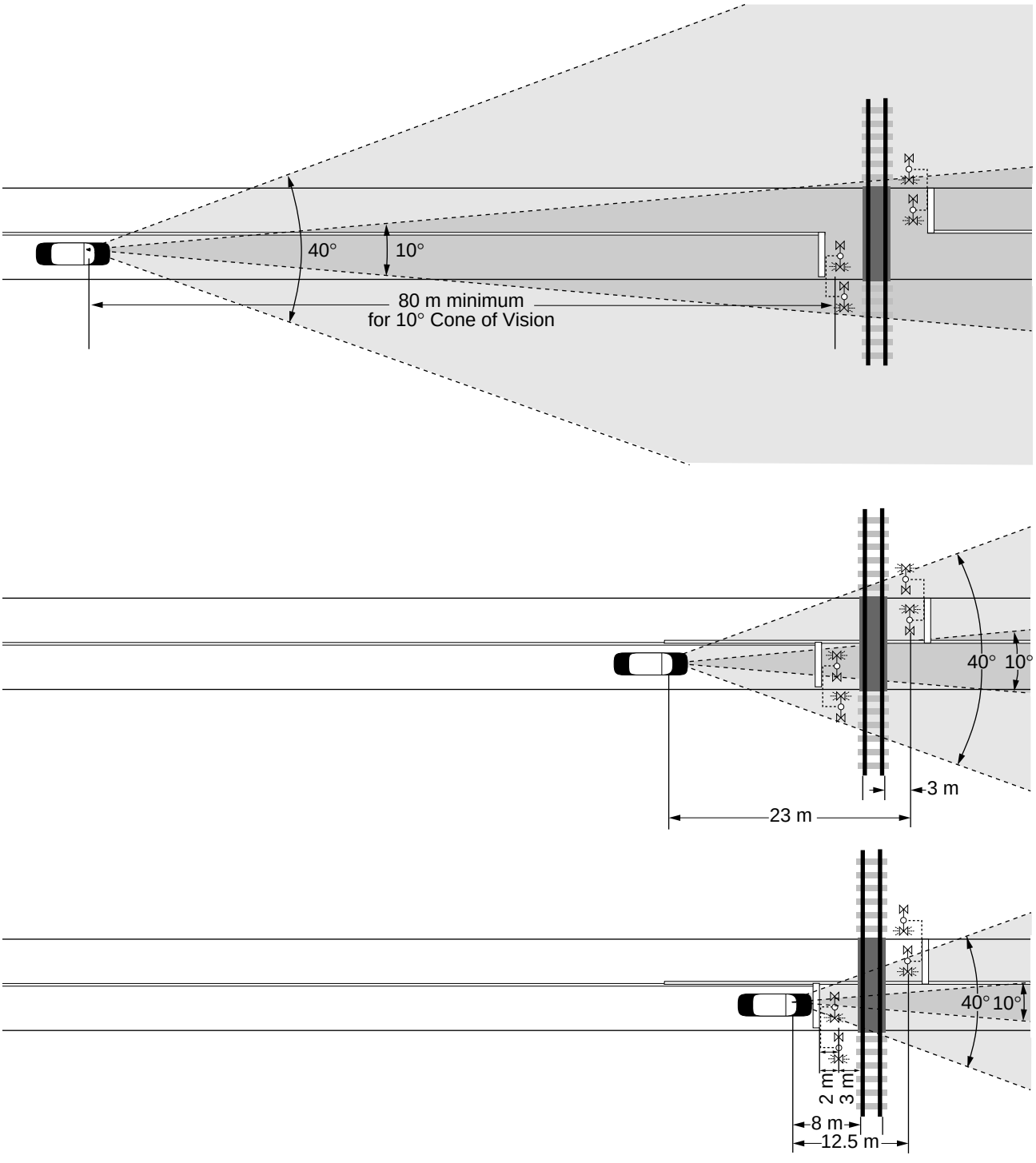


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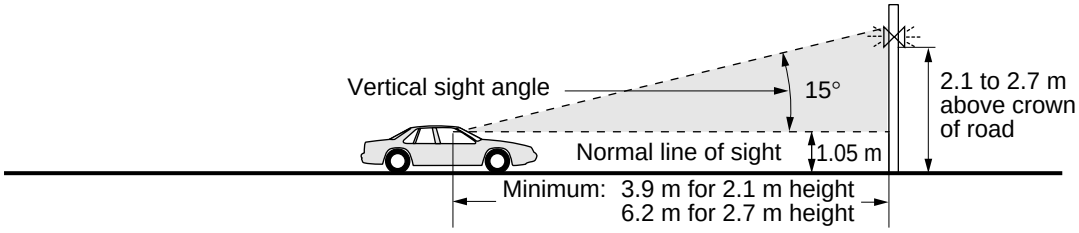
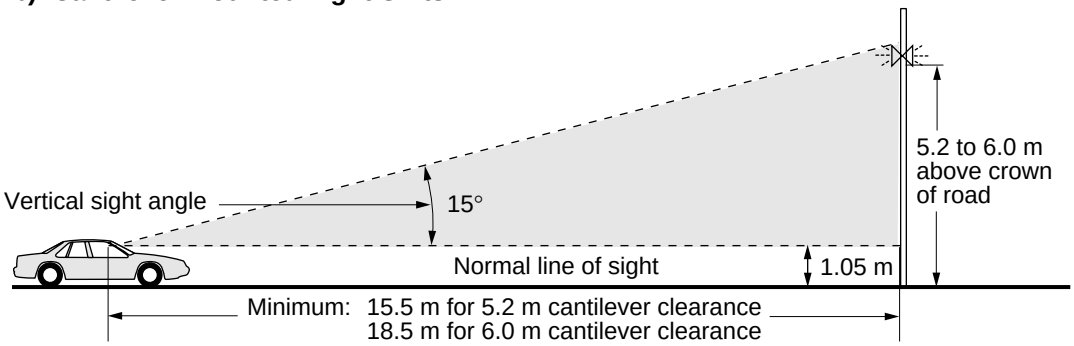
Figure 13-2: Vertical Cone of Vision

a) Mast Mounted Light Units



b) Cantilever Mounted Light Units



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NOTE:

Vertical cone of vision is limited to 15° by the top of the windshield.

Figure 13-3: Typical Light Unit Arrangement for an Adjacent Intersection

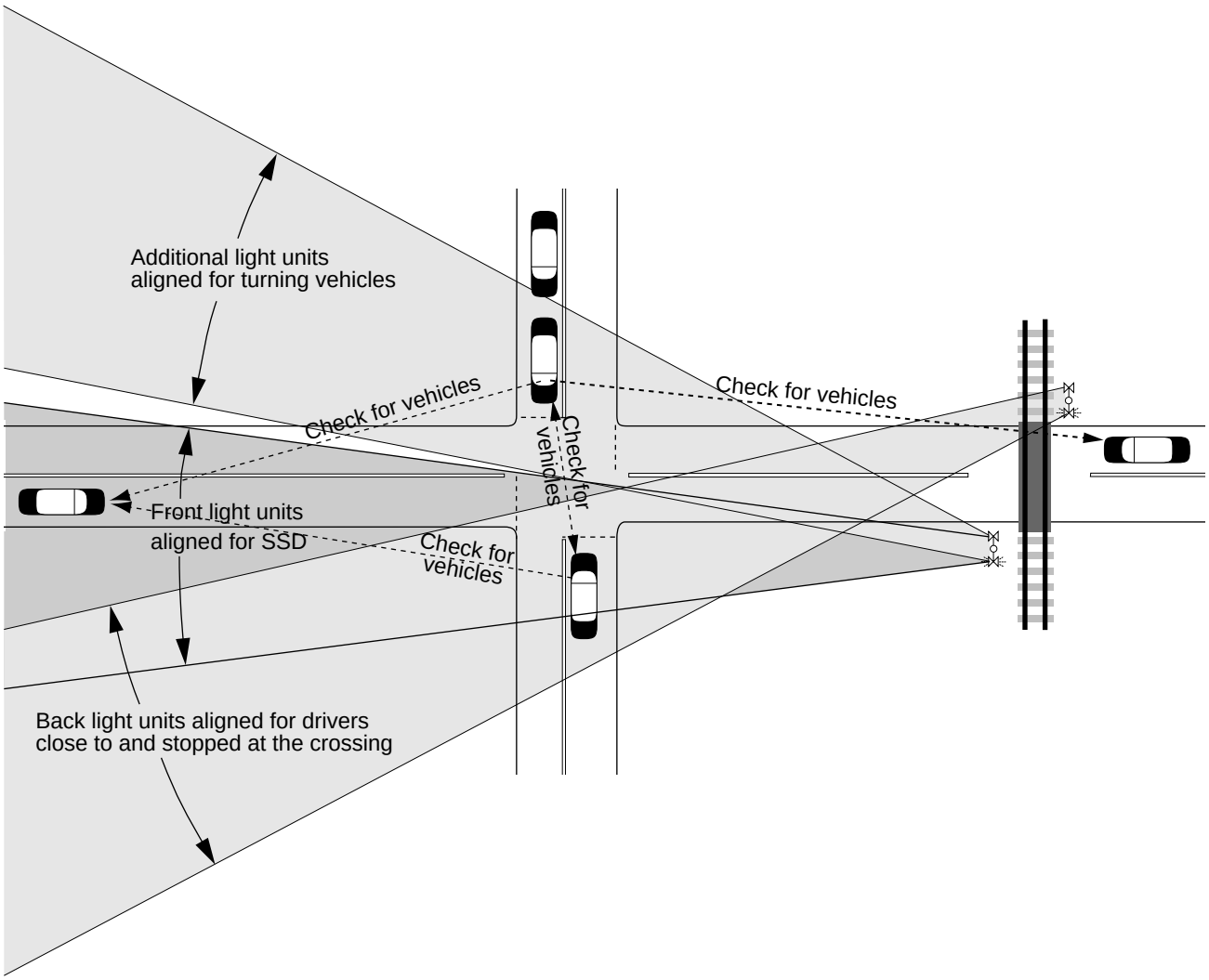

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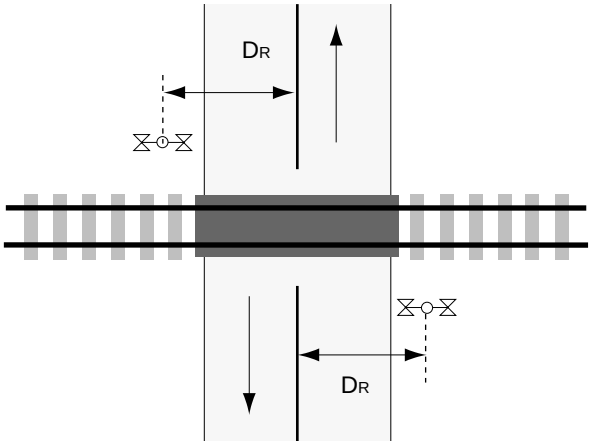
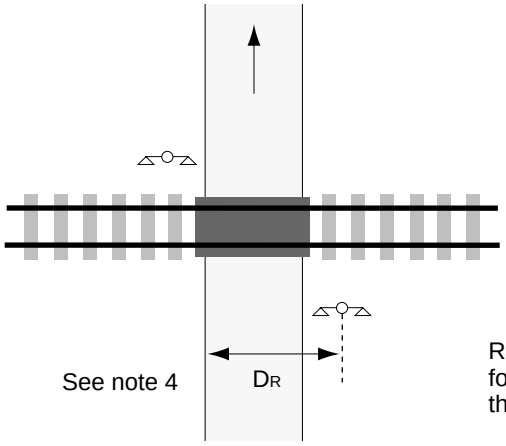
Figure 13-4: Warning Signal Offsets Requiring Cantilevered Light Units

a) TWO-WAY



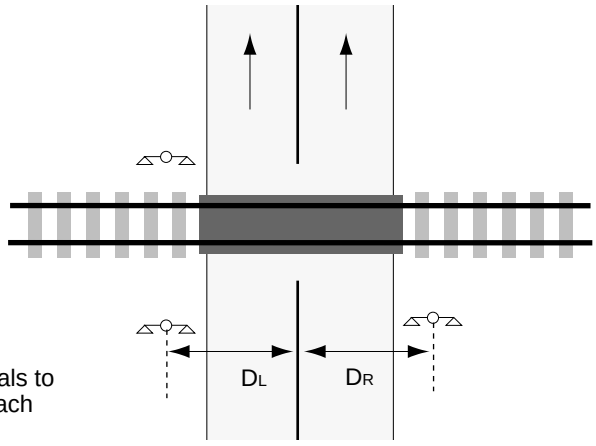
2 - Lane

b) ONE-WAY or DIVIDED



1 - Lane

Refer to Note 4,
for warning signals to
the left of approach



2 - Lane

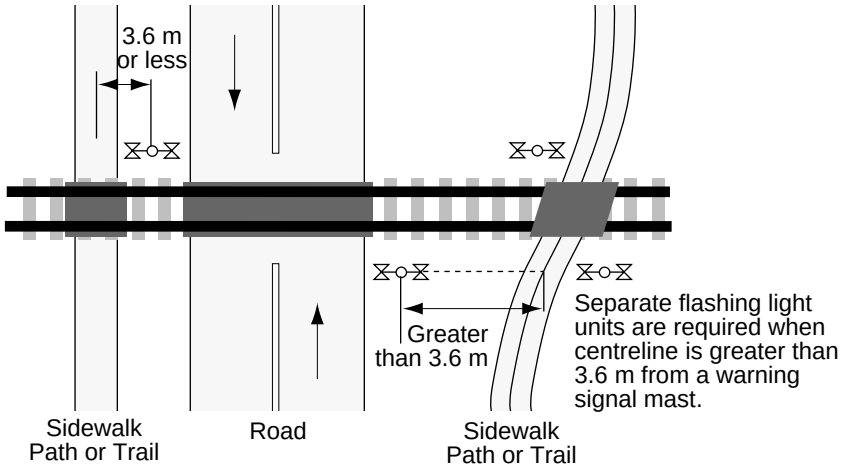
Drawing not to scale

NOTES:

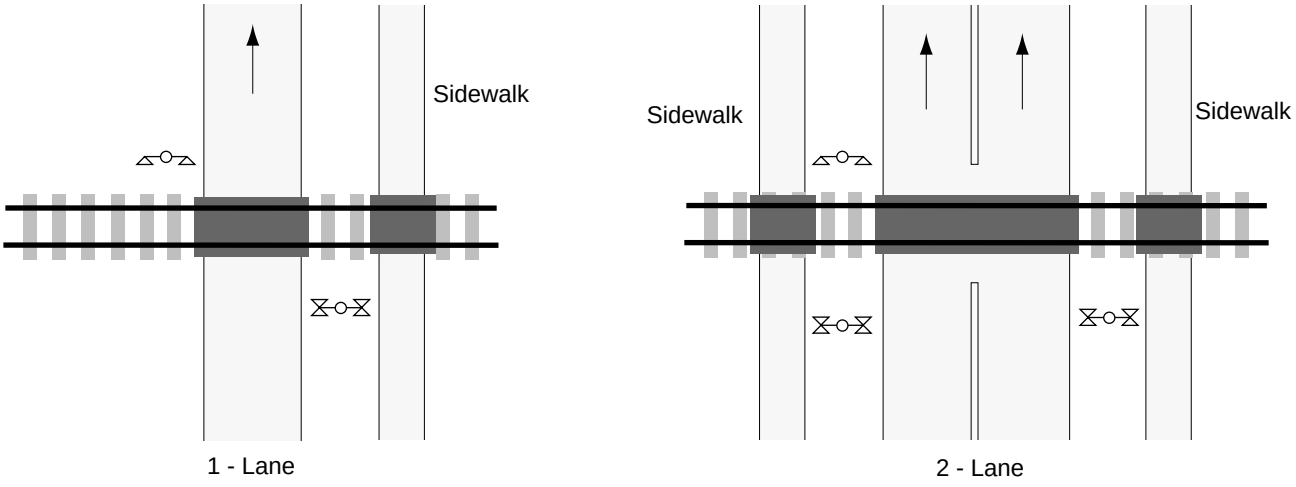
1. Where "D_R" exceeds 7.7 m, cantilevered light units are required.
2. Where "D_L" exceeds 8.7 m, cantilevered lights units are required.
3. Distances measured at 90° to the centre line of the road.
4. The addition of cantilevered light units may be avoided by installing a second grade crossing warning signal on the left side of the road in the case of one-way or divided roads.
5. For requirements respecting the number and configuration of light units, refer to section 19.

Figure 13-5: Sidewalks, Paths and Trails

a) TWO-WAY



b) ONE-WAY



NOTES:

1. One set of front lights or backlights is required to face sidewalk traffic in the direction opposite to vehicle traffic.

SECTION 14 - PREPARE TO STOP AT RAILWAY CROSSING SIGN

14.1 A Prepare to Stop at Railway Crossing Sign as specified in the *Traffic Control Devices Manual*, shall be installed:

(a) on a road approach where at least one set of front light units on a warning signal or on a cantilever at the grade crossing cannot be seen clearly within the minimum distance specified in Table 19-1; or

(b) on the road approaches to a grade crossing on a freeway or an expressway, as defined in the *Geometric Design Guide;* or

(c) where adverse local environmental conditions which obscure grade crossing warning signal visibility frequently occur.

14.2 The Prepare to Stop at Railway Crossing Sign shall provide warning:

(a) during the time of the operation of the flashing lights of the grade crossing warning system;

(b) in advance of the operation of the flashing lights of the grade crossing warning system for the time required for a vehicle travelling at the maximum road operating speed to pass the Prepare to Stop at Railway Crossing Sign that is not activated and to:

i) clear the grade crossing in advance of the arrival of all trains where there is a grade crossing warning system without gates; or

ii) clear the grade crossing before the start of the descent of the gate arms where there is a grade crossing warning sytem with gates; and

(c) following completion of the operation of the flashing lights of a grade crossing warning system for the time required for vehicles queued for the grade crossing to resume the maximum road operating speed on all roads that meet the criteria for a “freeway” or “expressway” classification in the *Geometric Design Guide* and on any other road approach where visibility at a safe stopping sight distance of vehicles queued for the grade crossing is restricted.

SECTION 15 - PREEMPTION OF TRAFFIC SIGNALS BY GRADE CROSSING WARNING SYSTEMS

15.1 The operation of traffic signals on a road approach shall be preempted by a grade crossing warning system:

(a) where there is less than 60 m between the stop line for the traffic signals and the rail nearest the road intersection; or

(b) if it has been determined that traffic queued for the traffic signals regularly encroaches closer than 2.4 m to the rail nearest the road intersection.

15.2 Except where otherwise specified in this standard, the preemption of traffic signal operation by a grade crossing warning system shall be designed and operate in accordance with the *ITE Preemption Practices* and the *AREMA Communications and Signals Manual*.

15.3 The preemption of traffic signal operation by a grade crossing warning system shall:

(a) provide sufficient time to clear the grade crossing of road traffic before the train's arrival at the grade crossing;

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

SECTION 16 - AREAS WITHOUT TRAIN WHISTLING AT GRADE CROSSINGS

16.1 The requirements in this section are prescribed for an area where the train whistle on railway equipment is not to be used in accordance with section 23.1 of the *Railway Safety Act*.

Public Grade Crossings

16.2 Public grade crossings within the area shall meet the standards set out in Table 16-1.

All Grade Crossings

16.2.1 All grade crossings, both public and private, within an area where the train whistle on railway equipment is not to be used in accordance with subsection 23.1 of the Railway Safety Act shall meet the standards applicable to them under the Road Railway Grade Crossing Regulations prior to the elimination of the train whistle signal.

16.3 The operating control circuits of all grade crossing warning systems shall meet the criteria of section 20.

16.4 The road approaches to grade crossings shall include additional signs, signals, road markings or a combination of these, where necessary to provide instruction for the orderly control of traffic over the grade crossing.

16.5 Traffic signals at an intersection on the road approach to a grade crossing with a grade crossing warning system shall be preempted by the grade crossing warning system in the circumstances specified in subsection 15.1.

16.6 Measures shall be in place to mitigate unsafe conditions at all grade crossings within the area.

Access Control

16.7 There shall be no routine unauthorized access on the rail line within the area.

Table 16-1: Requirements for Public Grade Crossings Within an Area Without Train Whistling

Maximum Railway Operating Speed	Grade Crossings for Vehicle Use		Grade Crossings Exclusively for Pedestrians, Cyclists or Assistive Devices; and Sidewalks, Paths, or Trails with the centreline no closer than 3.6 m (12 ft) to a warning signal for vehicles (Refer to Figure 13-5)	
	No. of Tracks		No. of Tracks	
	1	2 or more	1	2 or more
Stop & proceed	Manual protection or FLB	Manual protection or FLB	----------	----------
Up to 15 mph	FLB	FLB or FLB & G (Note 1)	'Z' barriers & guide fencing (Note 3)	'Z' barriers & guide fencing (Note 3)
16 - 49 mph	FLB or FLB & G (Note 2)	FLB & G	FLB, 'Z' barriers & guide fencing (Note 3)	FLB & G
50 mph or more	FLB & G	FLB & G	FLB & G	FLB & G

Where:

Manual protection is by a member of the train crew in accordance with the Canadian Rail Operating Rules.

FLB is a grade crossing warning system consisting of flashing lights and a bell.

FLB & G is a grade crossing warning system consisting of flashing lights, gates, and a bell.

NOTES:

1. Gates are required where the maximum railway operating speed is 15 mph or less if there is a possibility of two trains approaching on the operating control circuits of the grade crossing warning system at the same time.
2. Gates are required if the maximum railway operating speed is 16 to 49 mph, and:
   (a) the cross-product is 50,000 or more; or
   (b) trains, engines, railway cars or other equipment, standing or stored, or any other obstacle may obscure driver or pedestrian sightlines of trains approaching the grade crossing within the limits of $D_{Stopped}$ in Figure 8-2 ; or
   (c) a rail in the grade crossing surface is closer than 30 metres to the stop location for a Stop Sign, or closer than 60 m to the stop location for traffic signals; or
   (d) a rail in the grade crossing surface is 30 metres or more from the stop location for a Stop Sign or is 60 m or more from the stop location for traffic signals, unless a traffic study indicates that queued vehicles will not encroach within 2.4 metres of the rail nearest the road intersection (refer to Figure 11-1, b); or
3. The design of 'Z' barriers shall be site specific. They are to gain attention of pedestrians and ensure that cyclists dismount.

   Guide fencing is for the purpose of discouraging detours around the 'Z' barriers where roads or pathways parallel the rail line, or persons approach the rail line from adjacent property.

PART C - GRADE CROSSING WARNING SYSTEM TECHNICAL REQUIREMENTS: DESIGN and OPERATION

SECTION 17 - GENERAL

17.1 Except when otherwise specified in this Standard or the *ITE Preemption Practices:*

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

of grade crossing warning systems shall conform to the requirements and recommended practices of the *AREMA Communications and Signals Manual* at the time of their installation.

SECTION 18 - GRADE CROSSING WARNING SYSTEMS

18.1 Grade crossing warning signals, gates, or cantilevered light units respectively shall have:

(a) warning signals assemblies in accordance with Figure 18-1;

(b) gates in accordance with Figure 18-2; and

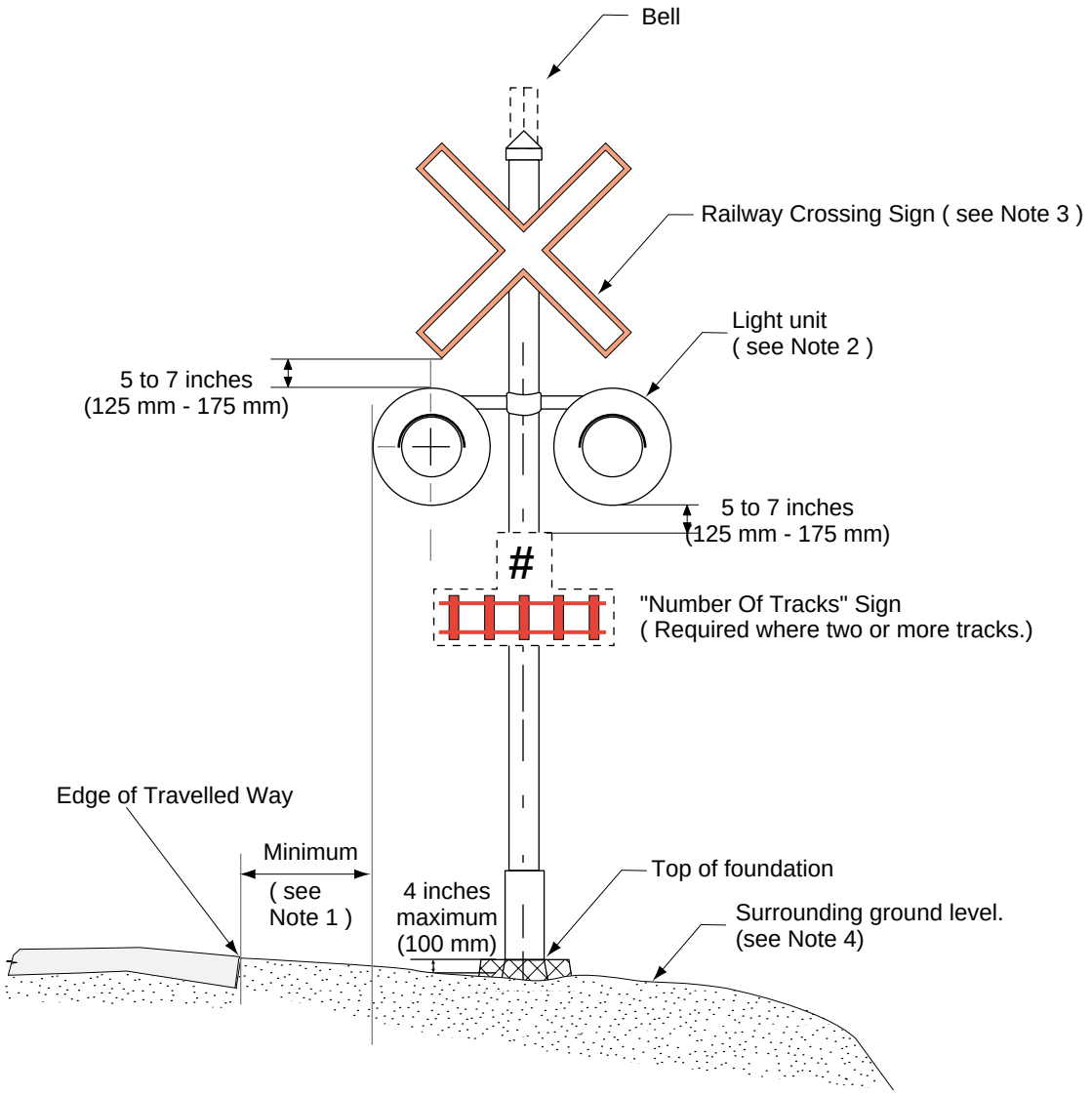
(c) cantilevers in accordance with Figure 18-3.

18.2 Grade crossing warning system instrument housings shall be located:

(a) no closer than 9 m (30 ft.) from the travelled way of the road, and no closer than 8 m (26 ft.) from the nearest rail, unless restricted by the width of the railway right of way, rock cuts, high fills, or water, in which case, they shall be placed as far from the nearest rail as conditions allow; and

(b) on the side of the track to the outside of the curve where there is rail line curvature within the sightline limits, except that where topography such as rock or high fills or the width of the railway right of way prevents such a location, or interconnection of the grade crossing warning system with traffic signals, a Prepare to Stop at Railway Crossing Sign or other equipment of another railway company renders such a location impractical, the housing shall be located as close as possible to these limits.

Figure 18-1: Warning Signal Assemblies

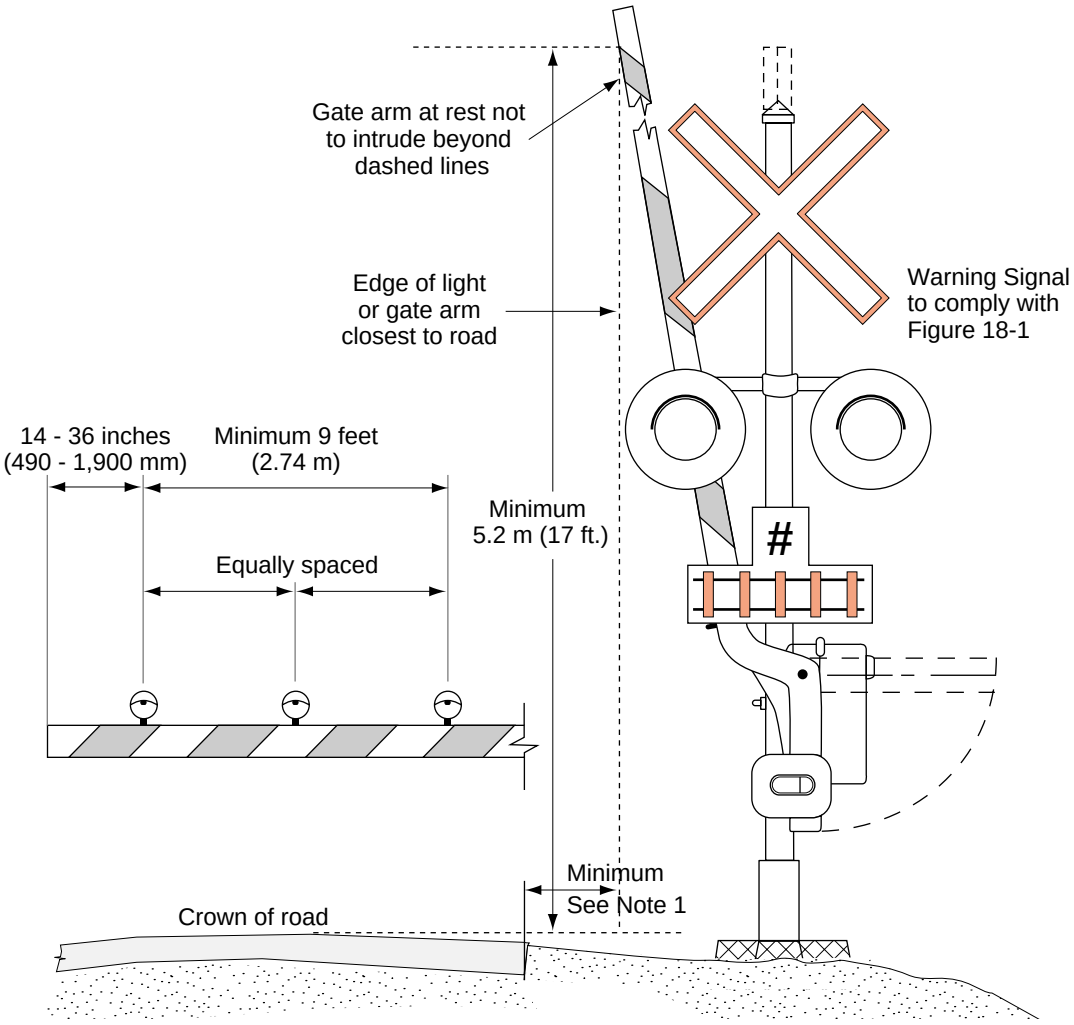


Drawing not to scale

NOTES:

1. Minimum of 625 mm (2 ft) from the face of a curb; minimum of 625 mm (2 ft) from the outer edge of a shoulder and a minimum of 1.875 m (6ft) from the edge of the travelled way.
2. Additional light units on the warning signal may be required in accordance with sections 13 and 19.
3. The Railway Crossing Sign must be clearly visible to all approaching drivers.
4. The top of the warning signal foundation shall be not more than 100 mm (4 inches) above the level of the surrounding ground. The slope away from the foundation of the surrounding ground towards the travelled portion of the road and the road shoulders shall not exceed the ratio of 4:1.

Figure 18-2: Gates



Drawing not to scale

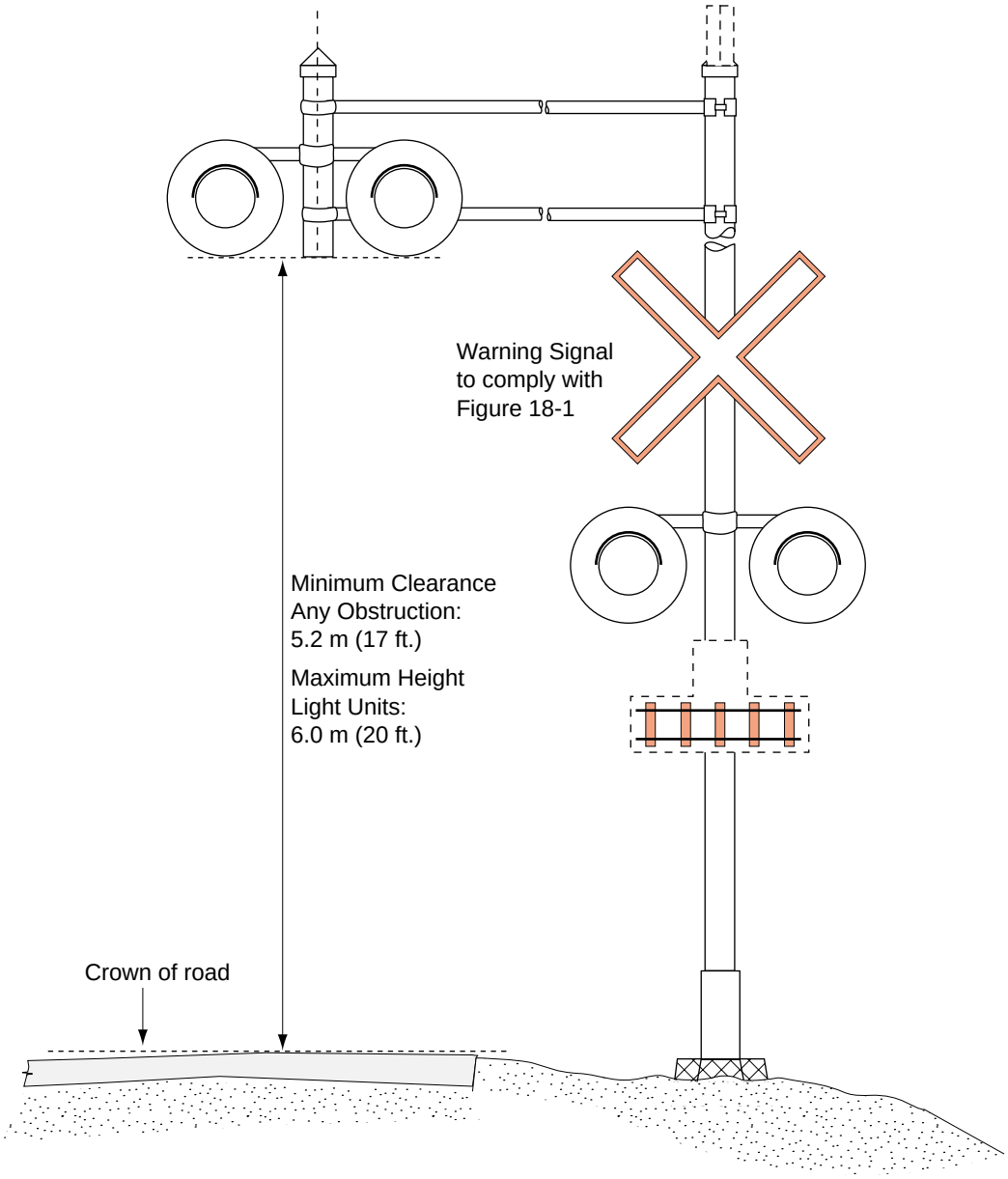
NOTES:

1. Minimum of 625 mm (2 ft.) from the face of a curb; minimum of 625 mm (2 ft.) from the outer edge of a shoulder and a minimum of 1.875 m (6 ft.) from the edge of the travelled way.

2. Gate arm reflective materials:
   (a) Stripes shall be white and red and may be vertical or diagonal.
   (b) Sheeting material specification: *CGSB 62-GP-11M*, Reflectivity Level 1, or better. Red stripes may be red sheeting or transparent red ink, silk screened processed over white sheeting; and
   (c) Sheeting shall be replaced before the reflectivity falls below 50 per cent of the reflectivity value of Level 1 material specified in (b).

3. Where gates are installed for grade crossings exclusively for pedestrians, cyclists, or both:
   (a) Each gate arm shall extend across the full width of the travelled way.
   (b) When the travelled way 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 travelled way into thirds. The two gate arm lights shall flash alternately.

Figure 18-3: Cantilevers



Drawing not to scale

NOTE:

Cantilevered lights are required in accordance with section 13.

SECTION 19 - BELLS, GATES AND FLASHING LIGHT UNITS

Bells

19.1 (a) A bell is required for all grade crossing warning systems.

(b) Where there is one sidewalk along a road for vehicles, the bell shall be located on the signal mast adjacent to the sidewalk.

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

(d) All bells shall continue to operate until the train has cleared the crossing.

Gates

19.2 The descent of the gate arm shall take 10 to 15 seconds and its ascent shall take 6 to 12 seconds.

General - Light Units

19.3 (a) Light units shall be of the incandescent type.

(b) Pairs of light units of grade crossing warning systems shall flash alternately at the rate of not less than 45 nor more than 65 flashes per minute.

Light Unit Alignment

19.4 The alignment point of the axes of the beams of sets of light units shall be appropriate for the conditions at each grade crossing. They shall be aligned for approaching drivers, taking into consideration the maximum road operating speed and the distance at which the light units first can be seen.

Alignment Height - Front and Back Lights

19.5 Light units shall be aligned so that the axis of the light units pass through a point 1.6 m above the road surface at the required distance.

Alignment Distance- Primary Front Light Units for Vehicles

19.6 (a) Grade crossing warning system light unit visibility distance is defined as the distance in advance of the stop line or vehicle stop position from which a set of light units must be continuously visible for various approach speeds.

Sets of primary front light units on the warning signal, and on a cantilever structure where provided, shall be aligned through the centre of the approaching traffic lane, or lanes, for which they are intended, at:

- the recommended distance, adjusted for gradient of the road, specified in Table 19-1; or
- the point at which the light units are first clearly visible, if this point is less than the recommended distance specified in Table 19-1.

Additional light units as required by section 13 shall be aligned to provide intermediate coverage of the road approach.

(b) Where at least one set of front light units on a warning signal or a cantilever at the grade crossing is not clearly visible to drivers in each lane of the road approach at the minimum distance, adjusted for gradient of the road, as specified in Table 19-1, refer to section 14 regarding requirements for a Prepare To Stop at Railway Crossing Sign.

Table 19-1: Alignment - Front Light Units

Maximum Road Operating Speed (km/h)	Recommended Distance Primary Set of Light Units (m)	Minimum Distance Primary Set of Light Units for Passenger Cars and Light Trucks (m)	Minimum Distance Primary Set of Light Units for Heavy Trucks (m)	Add for % Downgrade (m)		Subtract for % Upgrade (m)	
				5%	10%	5%	10%
40	100	65	70	3	6	3	5
50	125	85	110	5	9	3	6
60	160	110	130	7	16	5	9
70	195	135	180	11	23	8	13
80	235	165	210	15	37	11	20
90	295	195	265	* For speeds exceeding 80 km/h, distance shall be adjusted for gradient in accordance with section 4.			
100	360	235	330				
110	390	275	360				

Alignment - Intermediate Front Light Units for Vehicles

19.7(a) Additional light units shall be aligned to cover any intermediate areas of the road approaches between the coverage provided by the primary front light units aligned as required in section 19.6 and the back lights aligned as required in subsection 19.5.

(b) Additional pairs of light units provided for a driver turning onto the road approach to a grade crossing from intersecting roads, lanes, parking lots or other property access shall be aligned through the point above the road at which the drivers begin their turns.

(c) Once the requirements of (a) and (b) are satisfied, any remaining front or back lights shall be aligned to reinforce the coverage along the road approach.

Alignment - Front Light Units Dedicated to Sidewalks, Recreation Trails, and Pedestrian and Bicycle Paths

19.8 Front light units for persons on sidewalks, recreation trails, and pedestrian and bicycle paths, including sets of light units provided for persons approaching the crossing from the direction opposite to the vehicular traffic on one-way roads, shall be aligned through a point 1.6 m above the centre of the sidewalk, trail or path 30 m (100 ft) in advance of the warning signal or the point at which the set of lights units first become visible if less than 30 m.

Alignment - Back Lights

19.9 At least one set of back lights shall be aligned through the centre of the approaching lanes, or separate traffic lanes for which they are intended, 15 m (50 ft) in advance of the crossing warning signal on the opposite approach.

SECTION 20 - OPERATING CONTROL CIRCUITS

"Design Approach Warning Time"

20.1 The Design Approach Warning Time of each approach to a grade crossing warning system shall be based upon the maximum railway operating speed on the approach. The Design Approach Warning Time shall be the greatest of:

(a) 20 seconds. If the grade crossing clearance distance (Figure 4-1) exceeds 35 ft (10.67 m), the 20 seconds is increased by one second for each additional 10 ft (3.05 m), or fraction thereof;

(b) the Departure Time for the grade crossing 'design vehicle' (subsection 4.7);

(b.1) the Departure Time for pedestrians, cyclists, and persons using assistive devices (subsection 4.9);

(c) the time of delay of gate arm descent, plus the time to complete gate arm descent, plus 5 seconds;

(d) the minimum warning time required for traffic signal preemption;

(e) the minimum programmable warning time of the constant warning time device; or

(f) the time for the design vehicle travelling at the maximum road operating speed to travel from the stopping sight distance (refer to subsection 4.4) and pass completely through the clearance distance.

20.2 The time of operation of the flashing lights before a train movement operating at the maximum railway operating speed enters the crossing shall be the Design Approach Warning Time, plus the additional equipment response time of 2 seconds, or the equipment response time recommended by the manufacturer.

Gate Arms

20.3(a) The onset of the descent of the gate arm shall be delayed a minimum of 3 seconds after the lights of the grade crossing warning system begin to flash. Additional time shall be added to the delay of the onset where required for in accordance with section 4.9.

(b) A gate arm shall rest in the horizontal position not less than 5 seconds before the arrival of trains at the grade crossing except where the trains enter the grade crossing at 15 mph or less, in which case the gate arm shall rest in the horizontal position by the time trains arrive at the grade crossing.

Consistency of Warning Times

20.4(a) Operating control circuits shall provide reasonably consistent approach warning times for trains routinely operating over the grade crossing. Subject to the limits in subsection 20.4(c), and excluding temporary slow orders, track units or equipment used in connection with construction or work on, or inspection of, a line of railway, the operating control circuits shall be designed so that the approach warning time for trains operating routinely in the vicinity of the grade crossing is not more than 13 seconds longer than the Design Approach Warning Time.

(b) Where the maximum railway operating speed has been reduced, other than for a temporary slow order, the approach warning times for trains routinely operating over the grade crossing, including trains operating at the maximum operating speed, may be up to 13 seconds longer than the Design Approach Warning Time, but shall not exceed the limits in subsection 20.4(c).

(c) Operating control circuits shall be designed so that the operation of the flashing lights in advance of the arrival of a train travelling at the maximum railway operating speed does not exceed:

(i) 35 seconds, for grade crossing warning systems without gates; and

(ii) 55 seconds, for grade crossing warning systems with gates.

Cut-Outs

20.5 Where trains routinely stop, or railway cars are left standing, within the activating limits of a grade crossing warning system, the grade crossing warning system shall be equipped with a special control feature to minimize the operation of the flashing lights.

Directional Stick Circuits

20.6 Where a grade crossing warning system is equipped with directional stick circuits and the maximum railway operating speed exceeds 15 mph, the design shall include a device to activate the crossing warning system after a preset time if there is failure of an approach circuit, or the grade crossing warning system operating control circuit must cause a signal system to give a signal aspect indicating a train speed of no greater than 15 mph.

PART D - MAINTENANCE, INSPECTION, and TESTING:

Grade Crossing Warning Systems, Preempted Traffic Signals, and Prepare to Stop at Railway Crossings Signs

SECTION 21 - GRADE CROSSING WARNING SYSTEMS

General

21.1(a) Except when otherwise specified in this PART, inspection, testing, and maintenance of grade crossing warning systems shall be in accordance with the recommended practice of the *AREMA Communications and Signals Manual*.

(b) In each instance the term "as instructed" is used in the *AREMA Communications and Signals Manual*, specific instructions are required with respect to maintenance, inspection, and testing.

(c) Any subsystem or component of a grade crossing warning system not addressed in the *AREMA Communications and Signals Manual* requires specific instructions with respect to maintenance, inspection, and testing.

Grade Crossing Warning Systems

21.2 Grade crossing warning systems shall be maintained, inspected and tested to ensure that they operate as intended.

Frequency of Inspection and Testing

21.3(a) Except as noted in (b), and (c), the maximum intervals between inspections and tests of grade crossing warning systems are specified in Table 21-1. Local circumstances may require inspection and testing more frequently than the maximum intervals specified.

(b) Grade crossing warning systems consisting of only a bell and danger signs, or mechanical gates, or wigwags, shall be inspected and tested at least once a day, except during weekends and legal holidays when not more than 2 days may elapse on which no test is made.

(c) If the maintenance, inspection and testing of a grade crossing warning system has been suspended because of no demand for railway operations, inspection and testing shall be carried out as follows before the line of railway is operated again:

(i) suspension up to 3 years, all inspections and tests that were not undertaken in accordance with Table 21-1; and

(ii) suspension of 3 or more years, all inspections and tests required for newly installed grade crossing warning systems.

21.4(a) Light unit voltage shall be adjusted as closely as possible to the rated voltage under normal operating conditions. It shall be maintained between 90 and 100 per cent of the rated voltage under standby power conditions.

(b) Incandescent light units shall be inspected to ensure that the various components are in good condition, each light unit produces a full beam of parallel light with the proper intensity, and they are properly aligned.

Plans, Forms and Records

21.5(a) Plans required by the Grade Crossing Regulations, for maintaining, inspecting, and testing a grade crossing warning system, shall be legible and up to date.

(b) A plan or a form shall include the lens type and the alignment point of each pair of light units.

(c) The record required by the Grade Crossing Regulations of each scheduled maintenance, inspection and test of a grade crossing warning system shall be kept for at least one year. Where one year or more elapses between an inspection or test, records of the last two inspections or tests shall be kept.

(d) The record of each unscheduled maintenance, inspection or test of a grade crossing warning system, including the cause shall be maintained for a period of at least two years from the date of the unscheduled maintenance.

Table 21-1: Maximum Intervals: Inspection and Test of Grade Crossing Warning Systems

RTD 10 sub-section 21.3	*Components*	*Maximum Interval*	*Reference*
21.3.1	Grade crossing warning system following installation, repair, adjustment, maintenance or testing.	Immediately	AREMA Parts 2.4.1 & 3.3.1
21.3.2	Grade crossing warning systems for operation of lights, bell, gates, power off light	7 days before the operation of trains or locomotives	
21.3.3	Check light units for obvious misalignment and for physical damage; check cleanliness of roundels	One month	
21.3.4	Standby power: operating bank voltage	One Month	
21.3.5	Flashing light units, gates, and signs for damage, cleanliness, and visibility	One Month	AREMA Part 3.3.1
21.3.6	Bell operation	One Month	AREMA Parts 3.3.1, 3.2.60, & 3.2.61
21.3.7	Gate arm operation	One Month	AREMA Part 3.2.15
21.3.8	Surge protection	One Month, and as soon as possible following electrical storm activity.	AREMA Part 3.3.1
21.3.9	Switch circuit controller adjustment for spring switches	One Month	AREMA: Part 12.5.1
21.3.10	Switch circuit controller adjustment for all switches other than spring switches	Three months	AREMA: Part 12.5.1
21.3.11	Circuit grounds	Three Months	AREMA Part 3.3.1
21.3.12	Battery isolation faults	Three Months	AREMA Part 3.3.1
21.3.13	Storage batteries: voltage, current, electrolyte level, and plate deterioration where plates are visible	Three Months	AREMA Part 9.5.1
21.3.14	Primary batteries: degree of exhaustion, voltage and current	Three Months	AREMA Parts 9.1.25 & 9.1.26
21.3.15	Components of a grade crossing warning system for interconnection with traffic signals or a Prepare to Stop at Railway Crossing Sign	Three Months	AREMA Part 3.1.10
21.3.16	Fouling circuits	Three Months	AREMA: Parts 8.1.1 & 8.6.1
21.3.17	Direct Current relays visual check	Six Months	AREMA: Part 6.4.1
21.3.18	Bond wires, track connections, insulated joints, and other insulated track appliances	Six Months	AREMA Parts 8.1.1, 8.6.1, & 8.6.35
21.3.19	Cut-out circuits (any circuit that overrides the operation of a grade crossing warning system)	Six Months	AREMA Parts 16.30.5 & 16.30.9
21.3.20	Gate mechanism and circuit controller: visual inspection	Six Months	AREMA: Part 3.2.15

RTD 10 sub-section 21.3	*Components*	*Maximum Interval*	*Reference*
21.3.21	Check control circuits of Traffic Signals installed at a grade crossing in lieu of a grade crossing warning system.	Six Months	
21.3.22	Check lights for proper alignment, focus, and visibility utilizing a method of opening light units and checking the focus of the lamp and reflector by observing the parallel the beam of light at the prescribed distance, and checking the cleanliness and condition of the reflector and lens	Twelve Months	RTD10 Part D, subsection 19 AREMA: Part 3.3.1
21.3.23	Incandescent lamp voltage	Twelve Months	RTD10 Part D, subsection 21.4 (a)
21.3.24	Track circuits (proper functioning)	Twelve Months	AREMA Parts 8.1.1 & 8.6.1
21.3.25	Flash rate and associated device	Twelve Months	AREMA Part 3.3.1
21.3.26	Battery load test	Twelve Months	AREMA Part 9.5.1
21.3.27	Approach warning time	Twelve Months	AREMA Part 3.3.10
21.3.28	Electronic train detection devices	Twelve Months	AREMA Part 3.1
21.3.29	Timing relays and timing devices: check time	Twelve Months	AREMA Part 3.3.1
21.3.30	Cable and wire entrances	Twelve Months	AREMA Part 10.4.1(D)
21.3.31	Switch circuit controller centering device	Twelve Months	AREMA Part 12.5.1
21.3.32	Pole line and attachments	Two Years	AREMA: Part 10.4.1(E1)
21.3.33	Joint inspection by railway company and road authority of interconnected grade crossing warning systems and traffic signals	Two Years	AREMA: Part 3.1.10 *ITE Preemption Practices Traffic Control Devices* Manual
21.3.34	Joint inspection by railway company and road authority of interconnected grade crossing warning systems and Prepare to Stop at Railway Crossing Sign	Two Years	AREMA: Part 3.1.10 *Traffic Control Devices Manual*
21.3.35	Gate mechanism electrical values, mechanical clearances and torque	Two Years	AREMA Part 3.2.15
21.3.36	DC Polar, AC Vane, and Mechanical Timer relays: electrical values and operating characteristics	Two Years	AREMA Parts 6.1.15 & 6.4.5
21.3.37	Relays that affect proper functioning of a grade crossing warning system (except for DC polar, AC Vane and Mechanical Timer): check electrical values and operating characteristics	Four Years	AREMA Section 6
21.3.38	Ground resistance	Four Years	AREMA Parts 3.3.1 & 11.4.1
21.3.39	Wire and cable insulation resistance	Ten Years	AREMA Part 10.4.1

SECTION 22 - PREPARE TO STOP AT RAILWAY CROSSING SIGN, TRAFFIC SIGNAL PREEMPTION, AND TRAFFIC SIGNALS INSTALLED IN LIEU OF A GRADE CROSSING WARNING SYSTEM

General

22.1 Except where otherwise specified in this PART, inspection, testing, and maintenance of the preemption of traffic signals by grade crossing warning systems shall be in accordance with the *ITE Preemption Practices* and the *AREMA Communications and Signals Manual*.

22.2(a) Prepare to Stop at Railway Crossing Sign and traffic signal preemption, shall be maintained, inspected, and tested to ensure operation as intended when activated by a grade crossing warning system.

(b) Traffic signals installed at a grade crossing in lieu of a grade crossing warning system shall be maintained, inspected, and tested to ensure operation as intended.

22.3 The maximum intervals between inspections and tests of a Prepare to Stop at Railway Crossing Sign, a traffic signal preemption, and traffic signals installed at a grade crossing in lieu of a grade crossing warning system are specified in Table 22-1. Local circumstances may require inspection and testing more frequently than the maximum intervals specified.

Plans

22.4 The plans required by the Grade Crossing Regulations, for maintaining, inspecting, and testing of Prepare to Stop at Railway Crossing Signs and traffic signal preemption, shall be legible and up to date.

Records

22.5(a) The record required by the Grade Crossing Regulations, of each inspection and test of a Prepare to Stop at Railway Crossing Sign, traffic signal preemption, and traffic signals installed at a grade crossing in lieu of a grade crossing warning system, shall be kept for at least one year. When one year or more elapses between inspections or test, records of the last two inspections or tests shall be kept.

(b) The record of each unscheduled maintenance, inspection or test shall include the cause, and shall be maintained for a period of at least two years.

Table 22-1: Maximum Intervals: Inspection and Test of "Prepare to Stop at Railway Crossing Signs" and Traffic Signal Preemption

RTD 10 sub-section 22.3	*Components*	*Maximum Interval*	*Reference*
22.3.1	Prepare to Stop at Railway Crossing Signs and Traffic Signal Preemption following installation, repair, adjustment, or maintenance.	Immediately	
22.3.2	Check operation of Prepare to Stop at Railway Crossing Sign and for cleanliness, visibility of light units, and physical damage.	Six Months	
22.3.3	Check operation of traffic signal preemption cycles	Six Months	
22.3.4	Check the operation of Traffic Signals installed at a grade crossing in lieu of an grade crossing warning system, and for cleanliness, visibility of signal heads, and physical damage.	Six Months	
22.3.5	Joint inspection and testing by railway company and road authority of traffic signal preemption by Grade Crossing Warning Systems.	2 Years	AREMA: Part 3.1.10 *ITE Preemption Practices* *Traffic Control Devices Manual*
22.3.6	Joint inspection and testing by railway company and road authority of the activation of a Prepare to Stop at Railway Crossing Sign by a grade crossing warning system.	2 Years	AREMA: Part 3.1.10 *Traffic Control Devices Manual*