PART C — PAVEMENT MARKINGS

Division 1

GENERAL ASPECTS OF PAVEMENT MARKINGS

C1.1 TO C1.7

JANUARY 2014

C PAVEMENT MARKINGS

Part C of the Manual deals with pavement markings, and is organized into the following Divisions:

Division C1 General Aspects of Pavement Markings
Division C2 Longitudinal Pavement Markings
Division C3 Transverse Pavement Markings
Division C4 Symbol and Word Pavement Markings
Division C5 Coloured Surface Treatment

C1 GENERAL ASPECTS OF PAVEMENT MARKINGS

Division C1 describes the general aspects of pavement markings and their applications, and is organized as follows:

Section C1.1 Functions of markings
Section C1.2 Legal authority
Section C1.3 Classification of markings
Section C1.4 Principles of markings
Section C1.5 Standardization of markings
Section C1.6 Design standards for markings
Section C1.7 Installation and maintenance

C1.1 FUNCTIONS OF MARKINGS

Markings on the pavement are a major element in any system of traffic control. Pavement markings serve a variety of functions, including:

(a) lane definition;
(b) separation of opposing flows;
(c) passing control;
(d) lane usage and designation;
(e) pedestrian crosswalks;
(f) stop lines;
(g) parking areas; and
(h) word messages.

In some cases they are used to supplement the regulations or warnings of other devices, such as traffic signs or signals.

Under favourable conditions, pavement markings convey information to the driver without diverting the driver's attention from the road. However, they have limitations: they may be entirely obliterated by snow; they may not be clearly visible when wet; and they have limited durability.

C1.2 LEGAL AUTHORITY

Pavement markings must be installed by or under the authority of the road agency having official jurisdiction. All markings must be installed and maintained in accordance with the guidelines and standards set out in this Manual.

C1.3 CLASSIFICATION OF MARKINGS

The three basic configurations of markings are longitudinal markings, transverse markings, and symbol and word markings.

C1.3.1 Longitudinal Markings

Longitudinal markings delineate travelled lanes. They can be:

(a) Directional Dividing Lines which separate traffic flows in opposing directions;

(b) Lane Lines which separate traffic flows in the same direction;

(c) Edge Lines which mark the right edge of the right travelled lane or the left edge of the left travelled lane;

(d) Continuity Lines which are used across the entire length of merging or diverging areas of acceleration, deceleration or auxiliary lanes;

(e) Guiding Lines which are extensions of edge lines or lane lines through intersections; or

(f) Other lines which mark special operational characteristics of reversible lanes, two-way left-turn lanes, reserved lanes, bicycle lanes, roundabouts and bus bays.

C1.3.2 Transverse Markings

Transverse markings are installed across the pavement in the following situations:

(a) Crosswalk Lines which mark the location of pedestrian crosswalks;

(b) Stop Lines which indicate where vehicles stop at intersections or railway crossings;

(c) Gore Area Markings which indicate where traffic flows diverge or converge;

(d) Diagonal Lines which mark pavement areas which are not part of a travelled lane; or

(e) Lines which mark parking spaces.

C1.3.3 Symbols and Words

Symbols and words may be used on the pavement to supplement standard signs, or by themselves, for the purpose of regulating, warning or guiding traffic. These markings include:

(a) Arrows which indicate vehicle movements permitted in a lane;

(b) Diamonds which indicate that a lane is reserved in accordance with appropriate signing which explains the restrictions;

(c) "X" symbols which indicate the approach to a railway crossing;

(d) Other symbols; or

(e) Word and number messages.

C1.4 PRINCIPLES OF MARKINGS

Figures C1-1, C1-2 and C1-3 show the principles, colours, widths, and patterns for longitudinal and transverse pavement markings.

C1.4.1 Principles of Longitudinal Markings

The main purpose of longitudinal pavement markings is discussed in detail below.

(a) Longitudinal pavement markings, when used as dividing lines between traffic lanes, conform to the following basic principles:

(i) Yellow lines delineate the separation of traffic flows in opposing directions while white lines delineate the separation of traffic flows in the same direction.

(ii) Broken lines indicate permissive traffic regulations. Broken yellow lines indicate that adequate sight distance is available, and passing is permitted. Broken white lines indicate that lane changing is permitted.

(iii) Solid lines indicate restrictive traffic regulations. Solid yellow lines indicate that adequate passing sight distance is not available and that passing, therefore, is not permitted. Solid white lines indicate that lane changing is unsafe and is not permitted.

(b) Longitudinal pavement markings, when used as dividing lines between traffic lanes and shoulders, conform to the following basic principles:

(i) Solid yellow edge lines delineate the separation of traffic lanes and shoulders when the shoulder is to the left of the traffic lane in the direction of travel.

(ii) Solid white edge lines delineate the separation of traffic lanes and shoulders when the shoulder is to the right of the traffic lane in the direction of travel.

(c) A wide line is used for emphasis in those areas where standard markings require reinforcement.

C1.4.2 Widths and Patterns of Longitudinal Markings

The widths and patterns of longitudinal lines are as follows:

(a) A normal width line is 100 mm to 150 mm wide.

(b) A wide line is at least twice the width of a normal line.

(c) A double line consists of two normal line widths separated by a space that is at least the same width as a normal line. Where greater separation is necessary, either to move markings off the roadway crown to reduce damage by snowplows, or to create a central reserve (narrow painted median), this space may be increased as necessary, provided that minimum lane widths are maintained.

(d) A broken line is formed by segments and gaps, usually in the ratio of 1:2. A recommended standard is 3.0 m segments and 6.0 m gaps. This may be increased to 1:3 or 3.0 m segments and 9.0 m gaps for high speed roads.

(e) A dashed line is formed by shorter segments and gaps, in the ratio of 1:1. These are typically 0.5 m to 3.0 m each.

C1.4.3 Principles of Transverse Markings

Transverse markings are white, except for gore area markings and diagonal lines in medians, which are yellow.

Because of the low approach angle at which pavement markings are viewed, it is necessary that transverse lines be proportioned to give visibility equal to that of longitudinal lines.

Patterns and dimensions of transverse markings are illustrated in Figure C1-2.

LONGITUDINAL MARKINGS

	NAME OF LINE	LENGTH DIMENSIONS (m) WIDTH DIMENSIONS (mm)	USE
LONGITUDINAL	SOLID	100–150	EDGE LINES (WHITE OR YELLOW), DIRECTIONAL DIVIDING LINES (YELLOW), LANE LINES PROHIBITING LANE CHANGES (WHITE) BICYCLE LANE LINE (WHITE)
	BROKEN	3.0, 6.0, 3.0; 3.0, 9.0; 100–150; 100–150	DIRECTIONAL DIVIDING LINES (YELLOW) LANE LINES (WHITE) NOTE: LOW SPEED APPLICATION 3:6 HIGH SPEED APPLICATION 3:9
	SIMULTANEOUS SOLID AND BROKEN	3.0, 6.0, 3.0; 9.0; 100–150 (3); 100–150 (3)	DIRECTIONAL DIVIDING LINES, TWO-WAY LEFT TURN LANES (YELLOW). LANE LINES WHERE LANE CHANGES FROM ONE SIDE ARE PROHIBITED (WHITE) NOTE: LOW SPEED APPLICATION 3:6 HIGH SPEED APPLICATION 3:9
	DOUBLE SOLID	100–150 (3)	DIRECTIONAL DIVIDING LINES (YELLOW)
	DOUBLE BROKEN	3.0, 6.0, 3.0; 100–150 (3)	REVERSIBLE LANE (YELLOW), LANE LINES ON A WITH-FLOW PART-TIME RESERVED LANE (WHITE)
	WIDE SOLID	200	LANE LINES ON THE LEFT OF FULL-TIME RESERVED LANES (YELLOW FOR CONTRA-FLOW, WHITE FOR WITH-FLOW)
	WIDE SOLID	200–300	EDGELINES IN CRITICAL AREAS (WHITE ON THE RIGHT, YELLOW ON THE LEFT)
	WIDE BROKEN	6.0, 3.0, 6.0; 200–300	WHITE LANE LINE ON A WITH-FLOW RESERVED LANE IN ADVANCE OF AN INTERSECTION WITH PERMISSIBLE RIGHT TURNS
	DOUBLE WIDE BROKEN	100–150 MM GAP; 3.0 mm, 6.0 MM, 3.0 mm; TYPICAL 100–150 MM	YELLOW DOUBLE LINES ON BOTH SIDES OF A LANE WITH REVERSIBLE FLOW
	WIDE DASHED	3.0 (5); 200–300	CONTINUITY LINES IN MERGING AND DIVERGING AREAS AND TAPERS, SPECIAL FUNCTION LANE LINES (WHITE)
	DASHED	3.0 (7); 100–150	CONTINUITY LINES IN MERGING AND DIVERGING AREAS AND TAPERS FOR LEFT-TURN AND RIGHT-TURN LANES
		1.8 (3); 100–180	ROUNDABOUT CIRCULATORY LANE LINES (WHITE)
		1.5 (3); 100–150	BUS BAY (WHITE)
		1.0 (3); 100–150	BICYCLE LANES AT BUS STOPS, INTERSECTIONS (WHITE)
		0.5 (3); 100–150	GUIDING LINES (e.g. INTERSECTION MOVEMENTS) (YELLOW–EXTENSION OF DIRECTIONAL DIVIDING LINE) (WHITE–EXTENSION OF LANE LINE)

FIGURE C1-1

TRANSVERSE MARKINGS

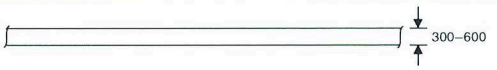
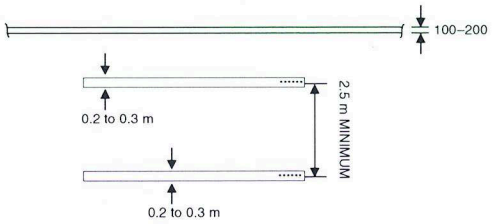
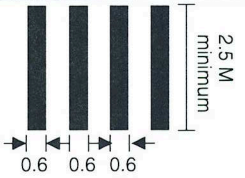
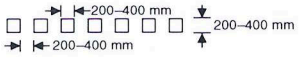
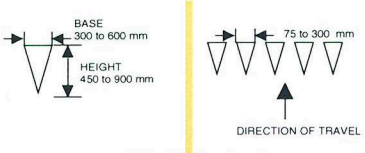
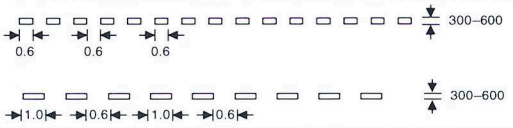
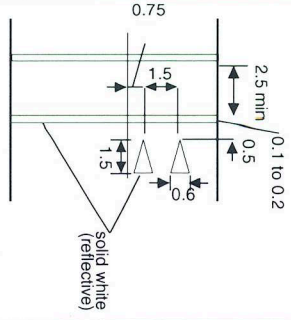
	NAME OF LINE	LENGTH DIMENSIONS (m) WIDTH DIMENSIONS (mm)	USE
TRANSVERSE	STOP		INTERSECTION STOP LINES (WHITE)
	CROSSWALK		CROSSWALKS (WHITE)
	CROSSWALK WITH LONGITUDINAL BARS		ZEBRA CROSSINGS (WHITE)
	BICYCLE CROSSINGS		ELEPHANTS'S FEET BICYCLE CROSSING (WHITE)
	YIELD LINES		ADVANCE YIELD TO PEDESTRIAN LINE (WHITE)
			ROUNDABOUT YIELD LINE - SINGLE LANE EXPRESS (WHITE) ROUNDABOUT YIELD LINE - MULTI LANE EXPRESS (WHITE)
	WARNING SYMBOLS		SPEED HUMP WARNING MARKINGS (WHITE)

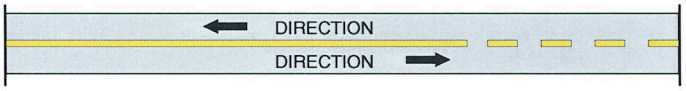
FIGURE C1-2

PRINCIPLES OF MARKINGS

(a) LONGITUDINAL PAVEMENT MARKINGS BETWEEN TRAFFIC LANES

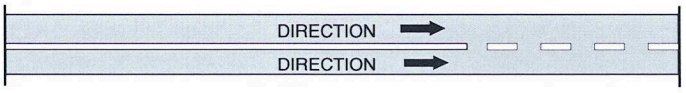
(i) COLOUR

YELLOW



TRAFFIC FLOWS IN OPPOSITE DIRECTIONS

WHITE



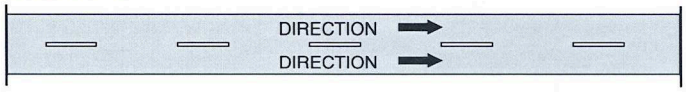
TRAFFIC FLOWS IN SAME DIRECTIONS

(ii) BROKEN

BROKEN YELLOW

PERMISSIVE, PASSING SIGHT DISTANCE AVAILABLE

BROKEN WHITE



PERMISSIVE, LANE CHANGES PERMITTED

(iii) SOLID

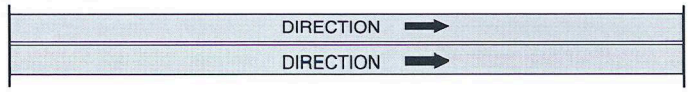
DOUBLE SOLID YELLOW

RESTRICTIVE, NO PASSING IN BOTH DIRECTIONS

SIMULTANEOUS SOLID AND BROKEN YELLOW

RESTRICTIVE, NO PASSING IN ONE DIRECTION

SOLID WHITE



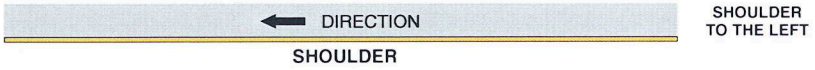
RESTRICTIVE, LANE CHANGES UNSAFE

FIGURE C1-3

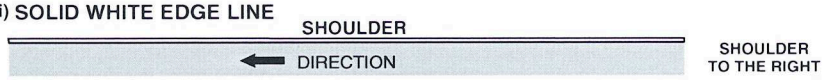
PRINCIPLES OF MARKINGS

(b) LONGITUDINAL PAVEMENT MARKINGS
BETWEEN TRAFFIC LANES AND SHOULDERS

(i) SOLID YELLOW EDGE LINE



(ii) SOLID WHITE EDGE LINE



(c) WIDE LINES

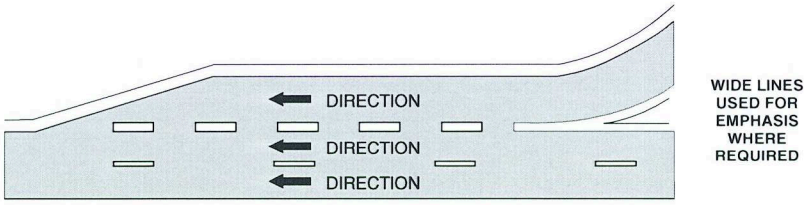


FIGURE C1-3 (CONT'D)

C1.4.4 Principles of Symbols and Words

The following principles apply to symbols and words:

(a) All symbols and words are white;
(b) The use of symbols is preferred to words;
(c) Where used, word messages should be as brief as possible; and
(d) Because of the low angle at which such markings are viewed, they must be elongated in the direction of traffic movement to provide adequate legibility.

Figures C1-4 to C1-6 illustrate standards and dimensions for commonly-used symbols, including arrows, diamond symbols and "X" markings. Standards for letters and numerals are illustrated in Figures C1-7 to C1-9. Table C1-1 sets out the dimensions.

Reduced size version of various symbols may be used to indicate to cyclists various messages where motorists are not required to see the symbol. These include reduced size arrows and reduced size railway crossing symbols, illustrated in Figure C1-10.

C1.5 STANDARDIZATION OF MARKINGS

Well-chosen and well-designed pavement markings provide guidance to drivers. Standardization and consistency are essential to provide safe operating conditions. As in the case of all other traffic control devices, markings must be uniform so that they may be easily recognized and understood.

C1.6 DESIGN STANDARDS FOR MARKINGS

Markings must be uniform in design, position and application.

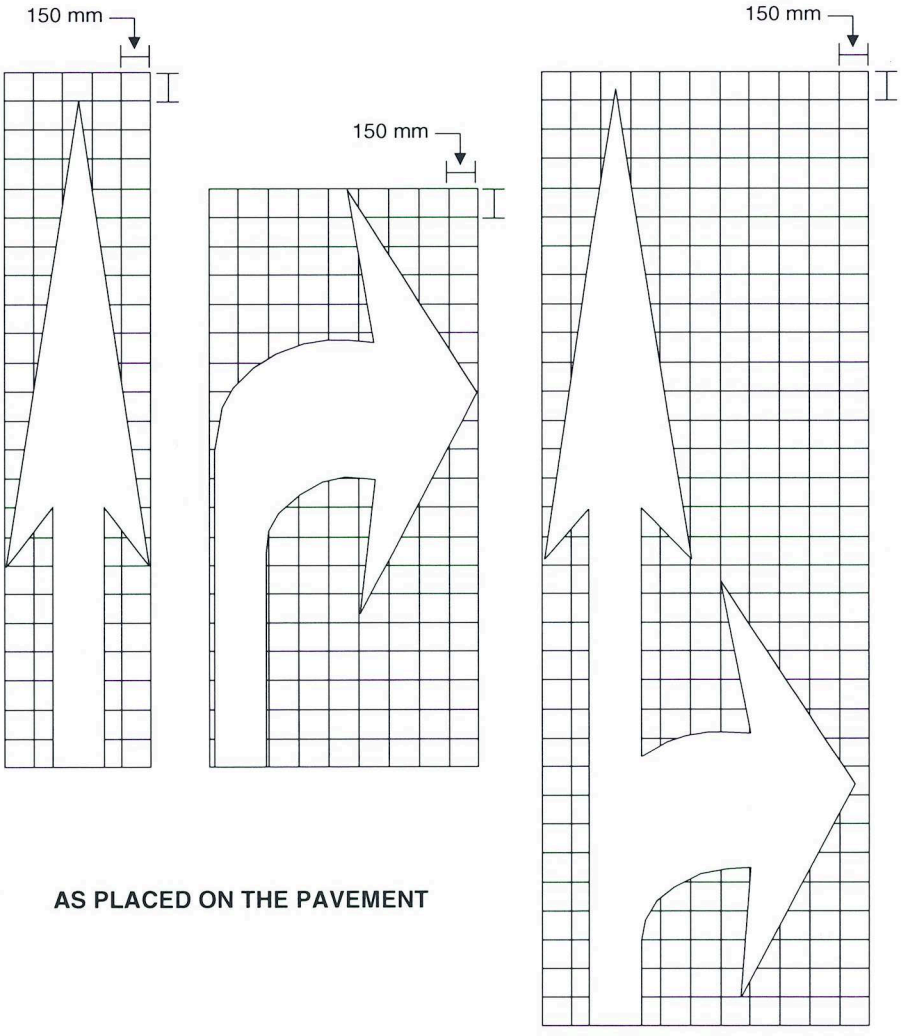
C1.6.1 Colour

Pavement markings are white or yellow as indicated in Section C1.4. Pavement marking colour standards are established by the road authority. Examples of standards for alkyd paint pavement marking colours are:

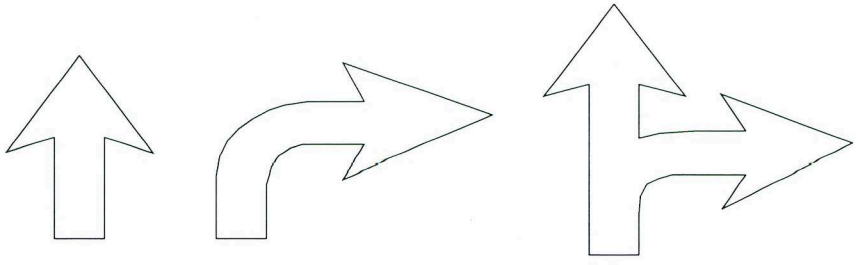
White: standard number 37875 of the standard U.S. FED-STD 595 B, *Colours Used in Government Procurement.*

Yellow: standard number 33538 of the standard U.S. FED-STD 595 B, *Colours Used in Government Procurement.*

PAVEMENT ARROWS



AS PLACED ON THE PAVEMENT



AS SEEN BY THE DRIVER

FIGURE C1-4

DIAMOND SYMBOL FOR RESERVED LANES

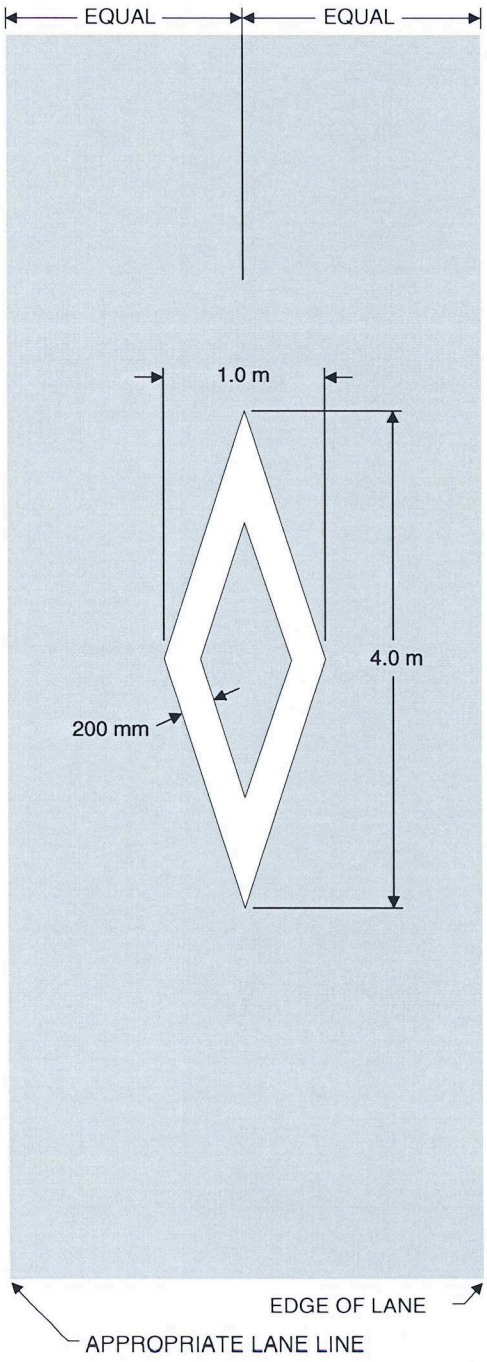


FIGURE C1-5

RAILWAY CROSSING OF ROAD AND BICYCLE LANE

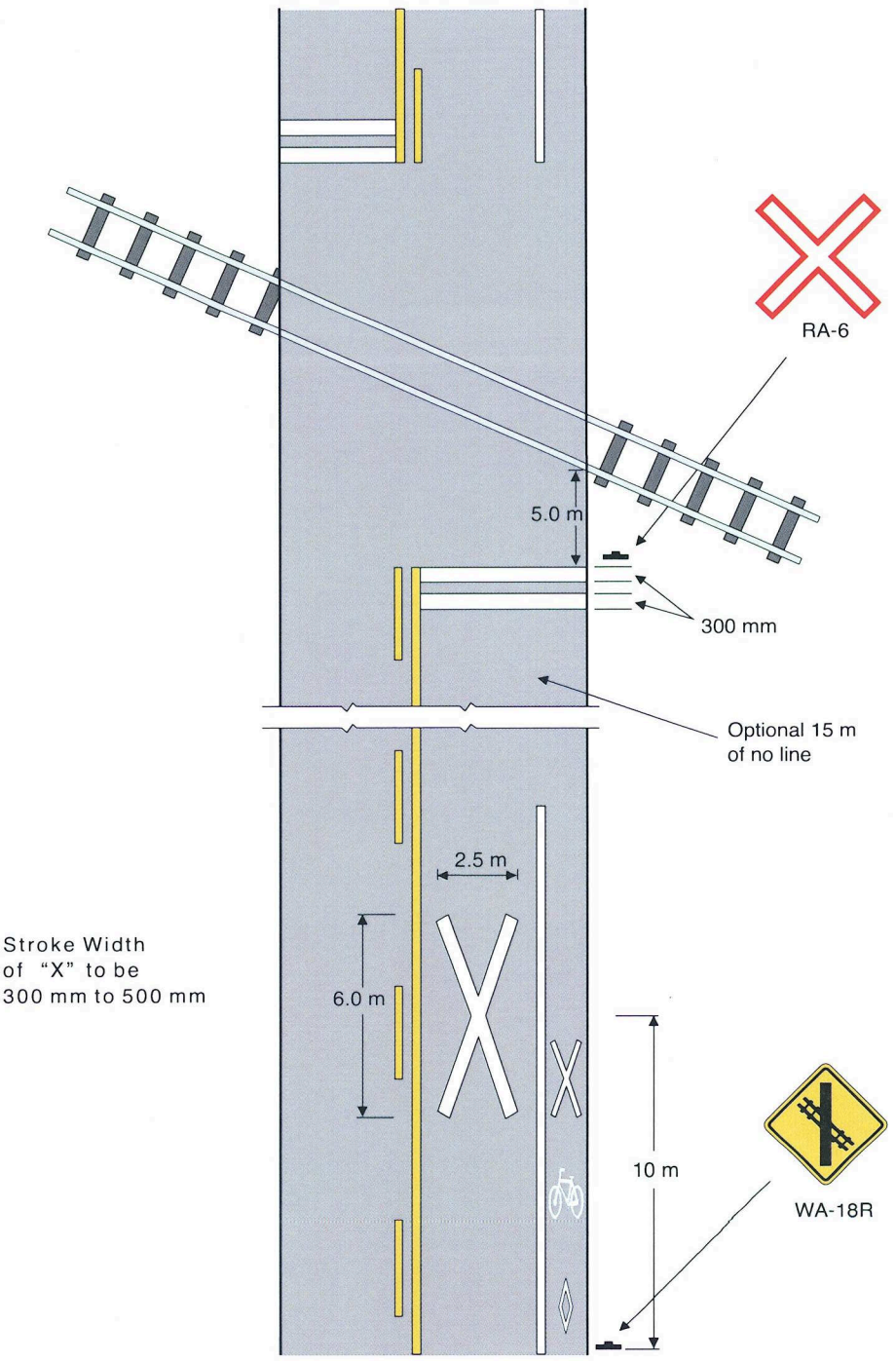


FIGURE C1-6

STANDARD PAVEMENT MARKING NUMERALS

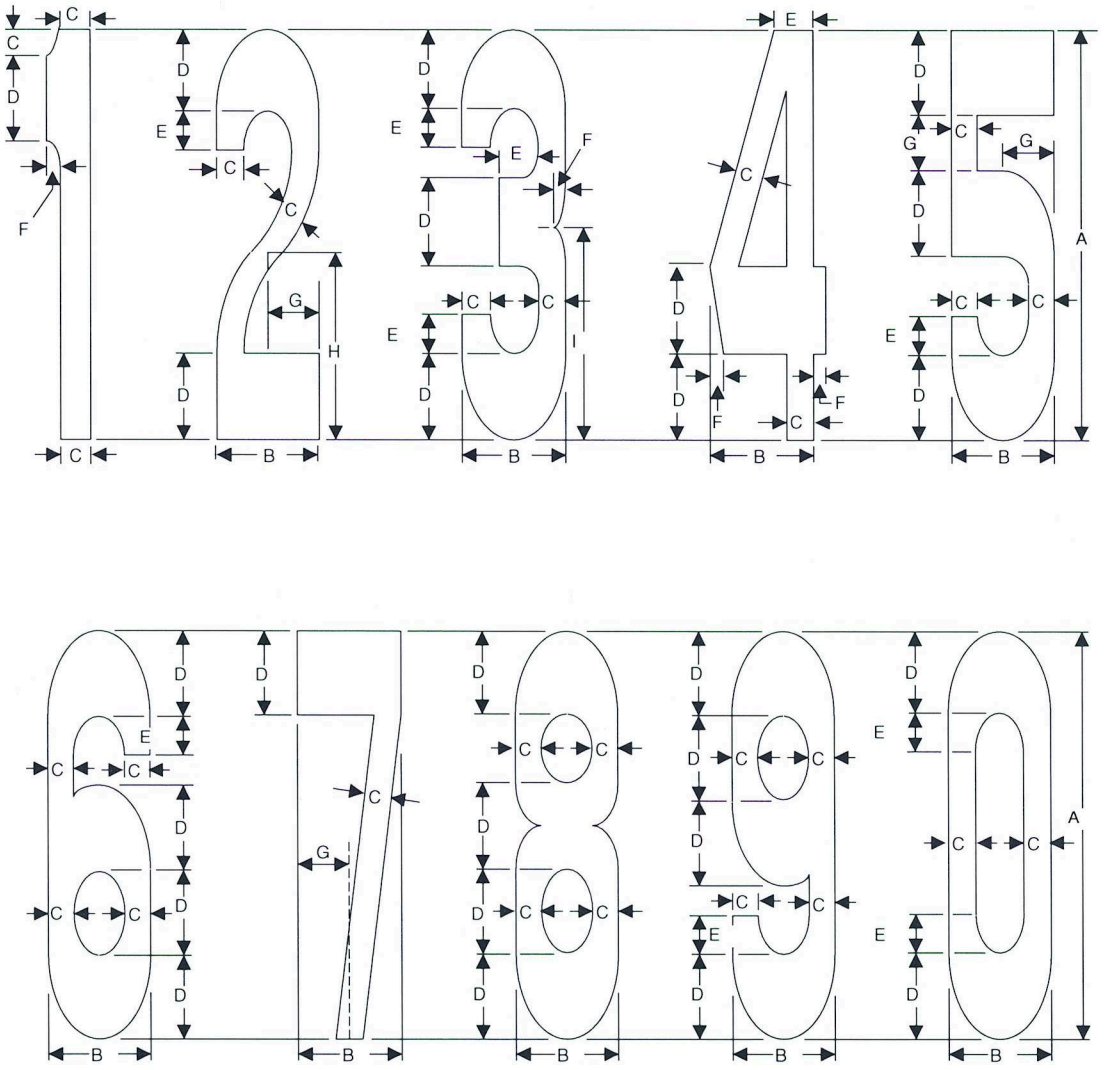


FIGURE C1-7

STANDARD PAVEMENT MARKING LETTERS

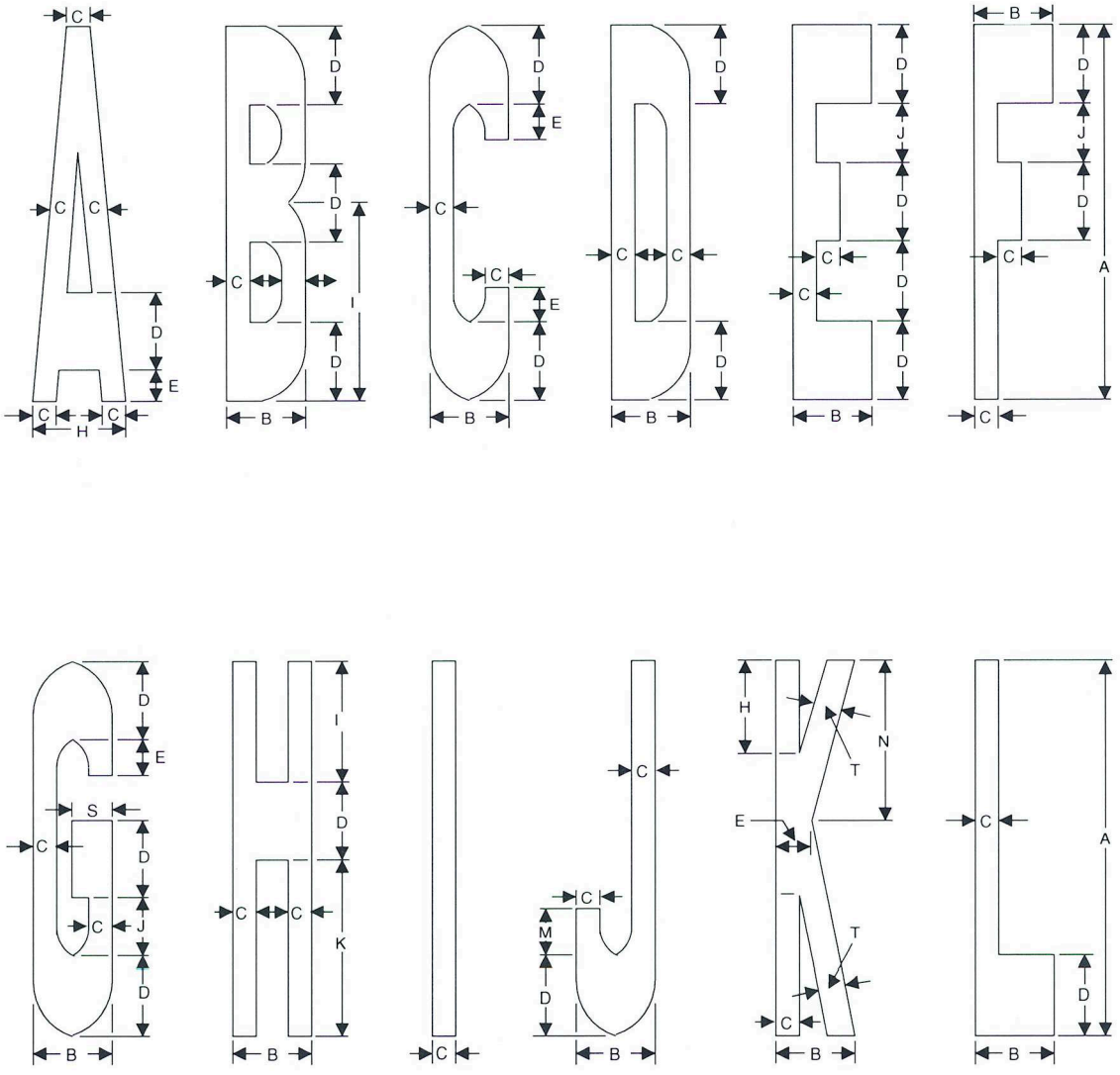


FIGURE C1-8

STANDARD PAVEMENT MARKING LETTERS

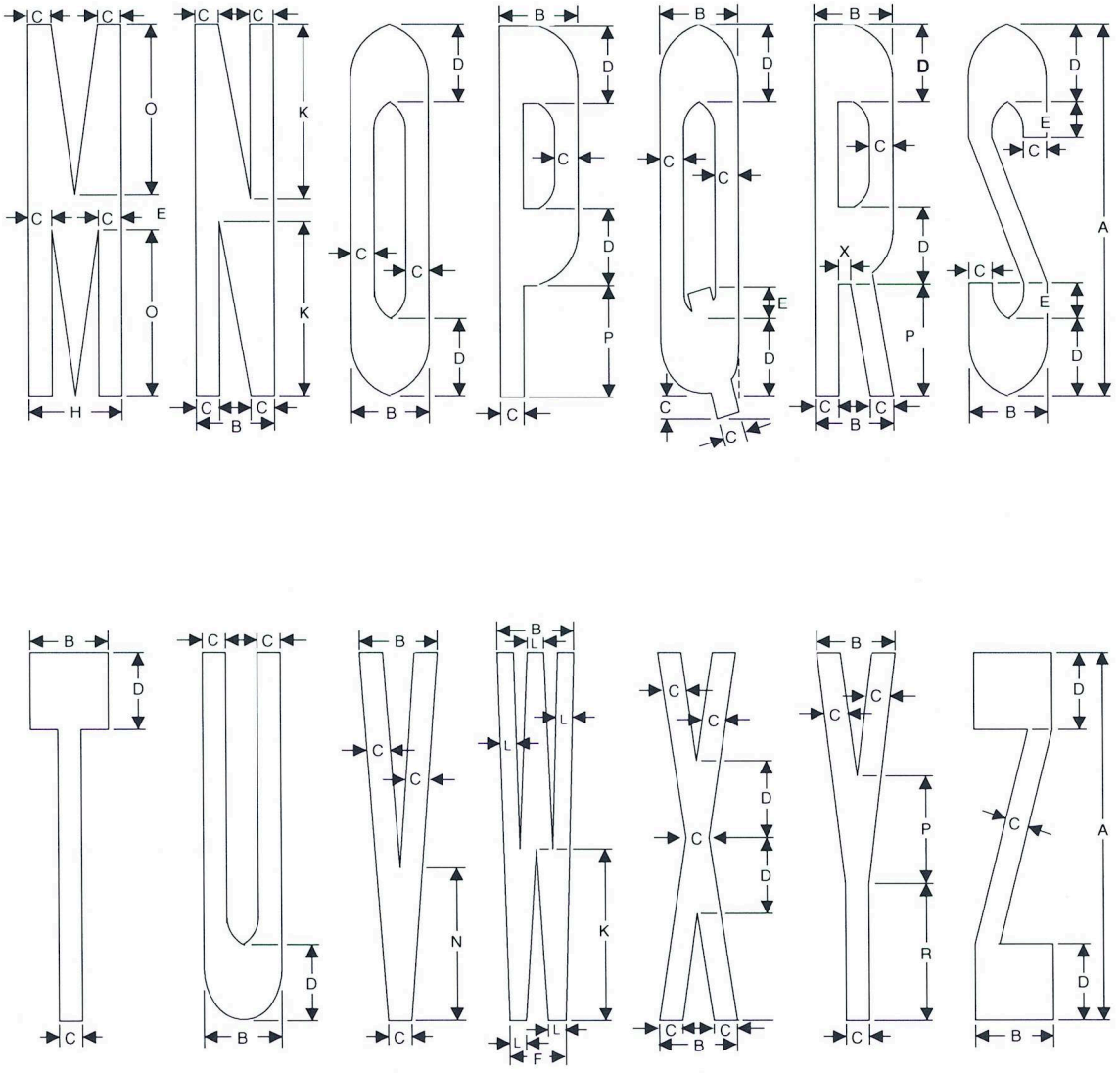


FIGURE C1-9

TABLE C1-1
STANDARD PAVEMENT MARKING DIMENSIONS

Dimension	Rural (mm)	Urban Recommended (mm)	Urban Minimum (mm)
Numerals (Figure C1-7)			
A	2400	1800	1200
B	600	450	300
C	150	110	75
D	500	375	250
E	225	165	110
F	75	55	40
G	300	225	150
H	1100	825	550
I	1125	925	625
Letters (C1-8 and C1-9)			
A	2400	1800	1200
B	500	450	300
C	150	110	75
D	500	375	250
E	225	165	125
F	350	290	200
G	200	110	75
H	600	500	350
I	775	580	390
J	375	280	190
K	1125	845	610
L	100	80	65
M	300	225	150
N	1025	850	510
O	1075	875	525
P	725	540	360
R	900	675	450
S	250	225	150
T	175	125	90
X	75	75	50

C1.6.2 Materials

Common materials used for pavement markings include alkyd (oil-based) and latex (water-based) paints. Products employing lead-free pigments and low levels of volatile organic compounds (VOCs) have gained prominence due to environmental concerns.

Other materials include thermoplastics, two-component reactive materials, and pre-formed marking tapes and symbols. Some products offer the advantage of significantly greater durability than paint.

When used, these products must conform to the guidelines contained in this Manual. Raised pavement markers may also be used as indicated in Subsection C1.6.4.

C1.6.3 Reflectorization

Pavement markings must provide for nighttime visibility.

Improved nighttime visibility is obtained by the use of minute glass beads embedded in the pavement marking material to produce a retroreflective surface. The glass-beaded surface returns a greatly increased proportion of the incident light in the direction of its source and causes the markings to appear luminous at night under normal headlighting.

C1.6.4 Raised Pavement Markers

Raised Pavement Markers may be used as positioning guides, or to supplement and enhance the visibility of pavement markings, or in some cases to substitute for other types of markings. The colour of Raised Pavement Markers must conform to the colour of the marking for which they serve as a positioning guide, a supplement, or a substitute.

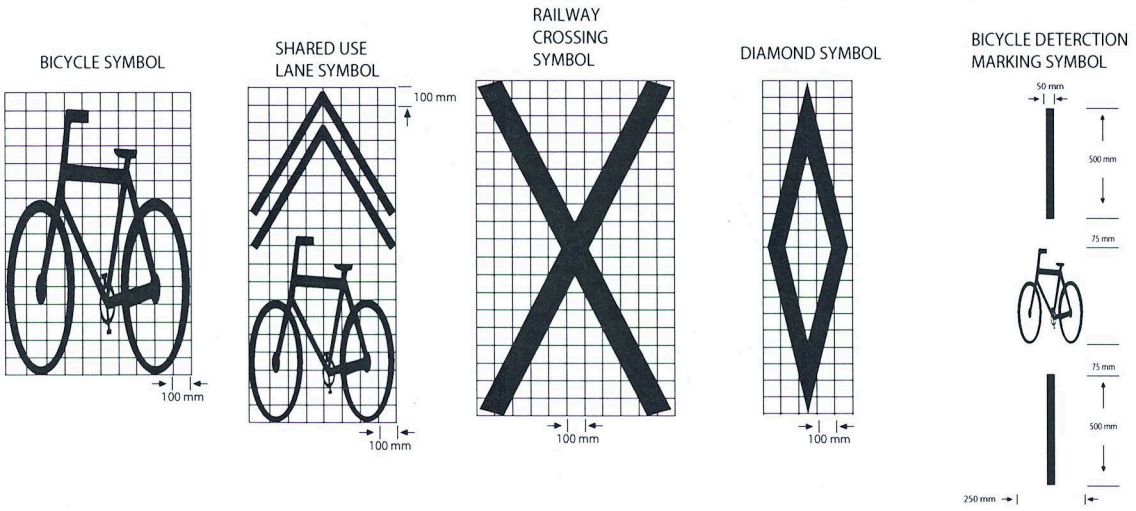
Retroreflective Raised Pavement Markers are preferable for most applications. Retroreflective Raised Pavement Markers are particularly effective at night during adverse weather conditions. However, winter maintenance practices should be considered before such devices are used. Consideration should also be given to using types of raised markers which are compatible with pavement grinding or milling operations. Non-retroreflective Raised Pavement Markers may be used with reflective markers as indicated in Subsection C2.9.3.

C1.7 INSTALLATION AND MAINTENANCE

All pavement markings should be adequately maintained for maximum effectiveness. The number of times it will be necessary to re-mark the lines will depend on such factors as the type of surface, climate and volume of traffic. In some cases, longitudinal markings may be placed off the pavement seam. On asphalt, this lessens the effect on the markings when crack sealing work is undertaken on the seam.

Whenever any road is changed in any way so that the old markings are no longer in the correct place, all obsolete markings which are sufficiently visible to cause confusion or uncertainty must be removed immediately. New markings should be installed as soon as possible.

SYMBOLS FOR USE ON BICYCLE FACILITIES



REDUCED SIZE CYCLIST DIRECTIONAL ARROWS

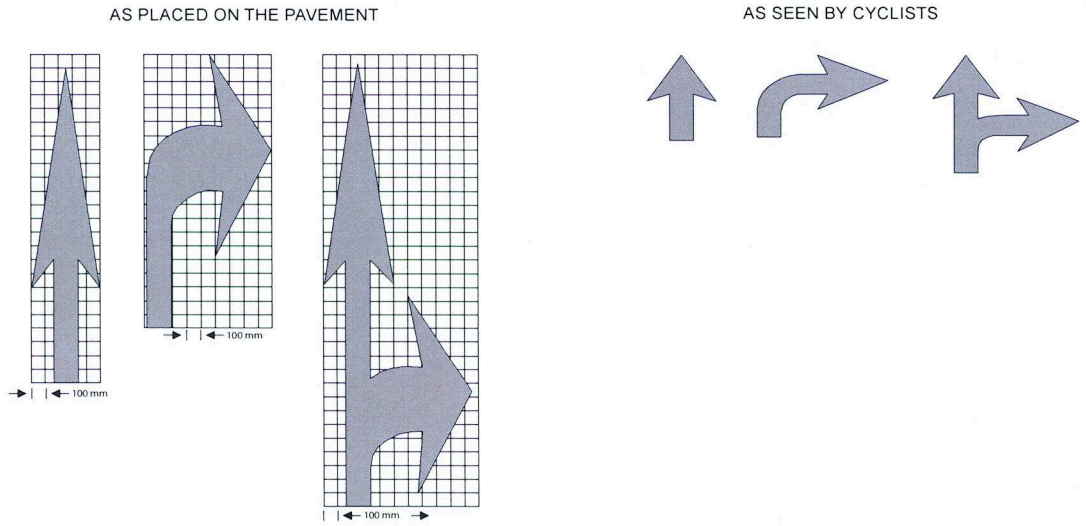


FIGURE C1-10