

ROADS AND MARITIME SERVICES (RMS)

QA SPECIFICATION R141

PAVEMENT MARKING

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REVISION REGISTER

Ed/Rev Number	Clause Number	Description of Revision	Authorised By	Date
Ed 1/Rev 1			GM, CMS	Jan 91
Ed 2/Rev 1		Extensive changes. Thermoplastic material added.	GM, CMS (Neal/Pike)	09.12.91
Ed 2/Rev 2	R60.5.3	Cold film thickness of sprayed thermoplastic changed from 1.0 mm to 1.5 mm.	GM, CEC (R Pike)	15.12.92
Ed 3/Rev 0	Revision Register 1.2 1.4 2.1.2 2.1.3 2.1.4 2.1.5 2.2 3.1 3.2 3.3, 5.2, 4.1 4.3	Clause numbers and lists have been restructured to suit the new format. Notice added, warning on using R60 for maintenance purposes. References have been added. New clause added. First paragraph deleted, AS 4049.2 added. New clause has been included. Supplier's name deleted. First paragraph reworded. Clause has been reworded. Hold point has been reworded. Heading changed Three tolerances changed. New sentence has been added to the end of the clause. Consolidation and extension of Surface preparation requirements into Clause 3.3 from other clauses. Waterborne paints added. Paragraphs 1 and 2 reworded.	GM, CEC	24.07.95

Ed/Rev Number	Clause Number	Description of Revision	Authorised By	Date
Ed 3/Rev 0 (cont'd)	4.3 4.3, 5.2 4.4, 5.3 5 5.1 5.2 5.2 6 8 9 10 Annexure R60/2 Figure 11, Figure 12	Thickness specification applies to unbeaded line. Specified glass bead application rate is a minimum. Clauses deleted and consolidated into Clause 9. Heading changed. References to materials transferred to Clause 2, clauses renumbered. Oil bath kettle reference deleted. Last sentence reworded. Parts of clause reworded. Details for QUALITY PLAN. Thicknesses and tolerances changed. New clauses for Profile Thermoplastic Road Marking Material. Mechanical abrasion required for removal of markings. New clause for field testing. Payment for temporary lines clarified. Each item changed, two new items added. Chevrons and painted median markings are reflectorised.		
Ed 4/Rev 0		Specification Number changed from R60 to R141. Change to Word 6.0c format. General Revision of Specification.	GM, TM	02.08.96
Ed 4/Rev 1	Table R141.6	Content reformatted with tables, editorial changes. Table of areas added.	GM, TM	03.10.96
Ed 4/Rev 2	Revisions to Edition 2 1.2, 4 Figure 1 Figure 3 Figure 6	New clause. Reference to RTA R142 added. Line S3 added. Line E6 width changed from 0.15 m to 0.20 m. Change to UA\$(L) shape.	GM, TM (R Walsh)	05.03.97

Ed/Rev Number	Clause Number	Description of Revision	Authorised By	Date
Ed 4/Rev 3	2.1.5.1 2.1.5.2 11 Pay Item R141 P1	Clauses rewritten, brands deleted. Measurement redefined.	GM, TM (R Walsh)	21.04. 97
Ed 4/Rev 4	4 6 11.4 Annex R141/2	Minimum waterborne paint and bead application rates specified. Application rates amended. Lesser longitudinal application removed. Table R141.6 - some areas added, some amended. Minor editorial changes. Schedule of Identified Records added.	GM, TM (R Walsh)	11.04.00
Ed 4/Rev 5	1.2, Annex. R141/4	Minor changes.	GM, TM (R Walsh)	22.08.00
Ed 4/Rev 6		Type B beads replaced by Type A.	GM, TM (R Walsh)	29.11.00
Ed 4/Rev 7	4, 5, 6 4	Crushed quartz requirement standardised. Crushed quartz not excluded from longitudinal lines.	GM, TM	21.08.01
Ed 5/Rev 0	Various Foreword 1.2 1.3 1.5 2.1.1, Annex R141/M 2.1.6, Tables R141.2, .3, .4, Annex M 2.2 3.1 3.1.1 3.7 Table R141.3, .4, .5	Specification reformatted Text revised to direct imperative style "Superintendent" changed to "Principal", "Contractor" to "you" Minor editorial changes. New clause after the Table of Contents Expanded to describe structure. "you" and "your" defined. Replaced by Clause 1.2.4. Solvent based paint clause deleted AS 4049.1 deleted AS 4049.3 replaces RTA 3356. AS 2009 replaces RTA 3353. Approved state road authority added. Last paragraph revised EPA reference changed to DEC. Added Major changes and footnote added.	GM, TM (Paul Yu)	19.05.05

Ed/Rev Number	Clause Number	Description of Revision	Authorised By	Date
Ed 5/Rev 0 (cont'd)	9 11 Annexures Drawings	Procedure revised Transferred to Annexure R141/B. All Payment Items deleted. Rearranged and renumbered. Figure 2 added Figure 4A added Figure 19 added Figure 20 added Figures renumbered and revised		
Ed 5/Rev 1	3.1.1, 3.3, 4, 5, 6, 10.6, 10.7 2.1.6 4 5 5, 6, 7 5, 6, 7 5, 6 7 Table R 141.3, .4, .5 Drawings	Minor editorial changes Test beads in the uncoated state Use Type D standard glass beads Sprayed thermoplastic deleted for transverse lines Application rates changed Bead types changed Crushed quartz sizes changed Crushed quartz deleted Application rates, types of materials and footnote revised Figure 3, revised (L2 Lane line not recommended)	GM, TM (Paul Yu)	15.07.05
Ed 5/Rev 2	Annexure R141/B 1.2 Various	First paragraph revised Pay Items reinstated The words "and an Attachment" added Minor corrections	GM, RNIC	22.02.06
Ed 5/Rev 3	Pay Items P6 and P7	Pay Items corrected.	GM, IC	03.11.07
Ed 6/Rev 0	All sections Guide Notes 1.1, 1.4 2.1.2 2.1.4 2.1.7 2.2	Clauses rearranged, retitled and edited. Removed, text moved to other sections. Reworded. Reference to sprayed or extruded thermoplastic added. Reference to sprayed, trowelled, rolled-on and screeded two part cold applied material added. New clause on anti-skid material added. New clause "Materials Colours" inserted.	GM, IC	24.07.09

Ed/Rev Number	Clause Number	Description of Revision	Authorised By	Date
Ed 6/Rev 0 (cont'd)	3.1	New clause titled "General" added. Former clause 3.1.1 "Department Of Environment and Climate Change Requirements" deleted.		
	3.1.2	New sub-clauses on "Reinstatement After Road Works" and "New Installation" added.		
	3.1.7	New clause "Reinstatement of Pavement Markings after Road Works" added.		
	3.1.8	Requirement for sacrificial coat of pavement marking added.		
	3.1.9	New clause "Redundant Pavement Markings" added.		
	3.2, 3.3, 3.4	Reworded.		
	Tables 3 & 4	Typed D glass bead changed to Type D-HR.		
	3.5	Specific reference to thermoplastic material removed. Reference to "continuous" and "discontinuous" profile line types included.		
	Table 5	Type B glass bead changed to Type D-HR. Rate retained changed from $\geq 300\text{g/m}^2$ to $\geq 500\text{g/m}^2$. Requirement for intermix glass beads and anti-skid material included.		
	4.7	Reference to anti-skid material added.		
	Annexure E	New annexure on Guidelines for applying waterborne paint.		
	Annexure F	New annexure on Line marking Application Guide (previously located in Guide Notes).		
	Annexure O	New annexure on Glass Bead Calibration Guide (previously located in Guide Notes).		
Annexure M	References updated to include: AS/NZS 1580.601.1, AS 4049.4, RTA Delineation Manual, APAS 0042.			
Appendices	Figures 1 to 8 replaced by Appendices 1 to 4 to accord with RTA Delineation Manual.			
Ed 6/Rev 1	Global	Clauses rearranged and reworded. New subclause headings added.	GM, IC	19.04.11
	1.1	Exclusions to scope of spec added.		
	1.4	New clause added on "Painting Contractors Certification Program" (PCCP) accreditation requirement. Subsequent clause renumbered.		

Ed/Rev Number	Clause Number	Description of Revision	Authorised By	Date
Ed 6/Rev 1 (cont'd)	2.1	New clause incorporating 1st para of clause 3.1. Subsequent clauses renumbered.		
	2.1.1	Solvent-borne paint may be used only with written approval from Principal. Requirements for solvent-borne paint changed from Aust Std to RTA Material spec 3359.		
	2.1.2	Requirements for thermoplastic pavement marking material changed from Aust Std to RTA Material spec 3360.		
	2.5	Clause heading title changed to "Handling, Storage and Mixing".		
	3.1	New headings for subclauses 3.1.1 and 3.1.2 added.		
	3.2	New clause with heading "Position and Tolerances", incorporating previous subclauses 3.1.2 and 3.1.3, added.		
	3.4	Previously subclause 3.1.7.		
	3.5	Previously subclause 3.1.9. Individual subclauses rearranged and reworded. New headings for subclauses 3.5.1 to 3.5.6 added.		
	3.6	New headings for subclauses 3.6.1 to 3.6.3 added.		
	3.6.4	New subclause moved here from previous clause 3.1.8. Heading title changed from "Waterborne Paint" to "Two Stage Application for New Chip Seal Surfaces".		
	3.9	New Figure 3.5 showing profile longitudinal line marking dimensions.		
	5	New clause "Conformity" incorporating previous subclause 3.1.5.		
	Annex F	Form for determining waterborne line marking application rates deleted.		
	Annex G	Details corresponding to 80mm and 120mm widths removed (widths no longer used).		
	Annex M	Referenced documents updated.		
	Appendices 1, 2 and 3	Line marking lengths, widths and spacings amended.		
	Appendix 4	Deleted, as line types C2 and C3 shown in Appendix 1.		
Appendix 5	New appendix providing details of pavement markings at roundabouts.			

Ed/Rev Number	Clause Number	Description of Revision	Authorised By	Date
Ed 6/Rev 1 (cont'd)	Figures 14, 15 and 16	Dimensions of markings for chevrons, medians and left turn island amended.		
Ed 6/Rev 2	1.2.4 2.1 3.3.1 Annex B	Minor revisions to improve clarity or to make clause consistent with corresponding clause in R145.	GM, IC (M Andrew)	27.10.11
Ed 6/Rev 3	Appendix 2 Figure 10 Figure 16	Additional dimensions added to transverse pavement marking drawings to improve clarity. Arrow label, shown as RA3, corrected to RA2. Dimension added to infill length in chevron.	GM, IC (M Andrew)	09.11.11



PAVEMENT MARKING

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VERSION FOR: DATE:

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FOREWORD

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REVISIONS TO PREVIOUS VERSION

This document has been revised from RMS Specification R141 Edition 6 Revision 2.

All revisions to the previous version (other than minor editorial and project specific changes) are indicated by a vertical line in the margin as shown here, except when it is a new edition and the text has been extensively rewritten.

PROJECT SPECIFIC CHANGES

Any project specific changes have been indicated in the following manner:

- (a) Text which is additional to the base document and which is included in the Specification is shown in bold italics e.g. ***Additional Text***.
- (b) Text which has been deleted from the base document and which is not included in the Specification is shown struck out e.g. ~~Deleted Text~~.

RMS QA SPECIFICATION R141

PAVEMENT MARKING

1 GENERAL

1.1 SCOPE

This Specification sets out the requirements for the supply and application of pavement marking material including waterborne paint, thermoplastic, two part cold applied material, glass beads, and preformed pavement marking tape.

It covers maintenance and reinstatement of pavement markings when such work is nominated in Annexure R141/A.

This specification is applicable for all pavement marking work on State Roads and National Highways. The use of this Specification for work on Regional and Local Roads is encouraged.

This specification does not cover all the requirements for markings for School Zones.

For requirements regarding School Zones, contact the NSW Centre for Road Safety. For details of “Dragon’s Teeth” pavement markings at School Zones, refer to Centre for Road Safety Technical Direction TD 2009/SR02.

This specification includes the requirements for Bus Lane and Bicycle Lane markings. For requirements for Bus Lane and Bicycle Lane Surface Coatings, refer to Specification RMS R110 “Coloured Surface Coatings for Bus Lanes and Cycleways”.

1.2 STRUCTURE OF SPECIFICATION

This Specification includes a series of Annexures and Appendices that detail additional requirements.

1.2.1 Project Specific Information

Details of work, specific to this Contract, are shown in Annexure R141/A.

1.2.2 Measurement and Payment

The method of measurement and payment is detailed in Annexure R141/B.

1.2.3 Schedules of HOLD POINTS and Identified Records

The schedules in Annexure R141/C list the **HOLD POINTS** that must be observed. Refer to Specification RMS Q for the definition of **HOLD POINT**. The records listed in Annexure R141/C are **Identified Records** for the purposes of RMS Q Annexure Q/E.

1.2.4 Planning Documents

Provide to the Principal the information listed in Annexure R145/D as part of your PROJECT QUALITY PLAN. Where a PROJECT QUALITY PLAN has not been specified, provide the information at least 10 working days prior to commencement of pavement marking work.

1.2.5 Minimum Frequency of Testing

The Inspection and Test Plan must nominate the proposed testing frequency to verify conformity of the item, which must not be less than the frequency specified in Annexure R141/L. Where a minimum frequency is not specified, nominate an appropriate frequency. Frequency of testing must conform to the requirements of RMS Q.

1.2.6 Referenced Documents

Unless otherwise specified or is specifically supplied by the Principal, the applicable issue of a referenced document is the issue current at the date one week before the closing date for tenders, or where no issue is current at that date, the most recent issue.

Standards, specifications and test methods are referred to in abbreviated form (e.g. AS 1234). For convenience, the full titles are given in Annexure R141/M.

1.3 DEFINITIONS

The terms “you” and “your” mean “the Contractor” and “the Contractor’s” respectively.

The following definitions apply to this Specification:

- (a) **Stripe:** That part of longitudinal line marking comprising pavement marking material.
- (b) **Longitudinal line marking:** All lines that are generally parallel to the traffic flow, such as centre, lane, edge, turn, continuity and transition lines and outline markings.
- (c) **Transverse lines:** All lines that are marked at right angles to the general traffic flow, such as “Stop / Give Way” lines and pedestrian crosswalk lines.
- (d) **Other markings:** All diagonal and chevron markings, messages on the pavement including symbols, words, numerals and arrows, kerb markings and markings for parking.
- (e) **Pavement marking:** All longitudinal line marking, transverse lines and other markings used on the road pavement and kerbs for the purpose of guiding traffic, but excluding Raised Pavement Markers, which are covered in Specification RMS R142.

1.4 ACCREDITATION TO PAINTING CONTRACTORS CERTIFICATION PROGRAM

All work carried out for the RMS using this specification must be by pavement marking organisations accredited to the “Painting Contractors Certification Program” (PCCP) administered by CSIRO.

Provide evidence to the Principal that the work is being carried out by a pavement marking organisation holding PCCP accreditation.

1.5 TYPES OF MARKINGS

Details of the various types of pavement markings are shown in the Appendices and Figures at the back of this Specification, as follows:

- Appendix 1 Longitudinal Pavement Markings
- Appendix 2 Transverse Pavement Markings
- Appendix 3 Pavement Markings and Symbols for Bicycle Facilities
- Appendix 4 (Not Used)
- Appendix 5 Pavement Markings at Roundabouts

(Figures 1 to 8 are not used)

- Figure 9 Pavement Arrows for Through and Turning Lanes at Urban Junctions
- Figure 10 Pavement Arrows for Through and Turning Lanes at Rural Intersections
- Figure 11 Lane Change Arrow (Urban)
- Figure 12 Lane Change Arrow (Rural)
- Figure 13 Pavement Arrow for Use in One Way Roads
- Figure 14 Chevron Layout
- Figure 15 Pavement Marking Median
- Figure 16 Pavement Marking Left Turn Island
- Figure 17 Pavement Marking in Advance of Open Level Crossings
- Figure 18 Pavement Alphabet and Numerals
- Figure 19 Speed Numeral Pavement Patch
- Figure 20 E-TAG Pavement Marking

2 MATERIALS

2.1 GENERAL

All longitudinal lines on State Roads and National Highways must be painted using, as a minimum, waterborne paint with large glass beads (Type D).

For new work in high traffic volume areas, commonly in urban locations, long life materials, such as thermoplastic or two part cold applied material, must be used unless directed otherwise by the Principal.

All pavement markings must be in white colour, unless otherwise shown in the Drawings or directed by the Principal.

2.2 MATERIAL REQUIREMENTS

Materials for pavement markings must comply with the following:

2.2.1 Pavement Marking Paint

Waterborne paint must conform with the requirements of Specification RMS 3356.

You may use solvent-borne paint, conforming to the requirements of Specification RMS 3351, only with the written approval of the Principal.

2.2.2 Non-profile Thermoplastic Pavement Marking Material

Non-profile thermoplastic pavement marking material must conform with the requirements of Specification RMS 3357. Sprayed or extruded thermoplastic may be used for longitudinal line marking and must be applied uniformly. Screeded or preformed thermoplastic may be used for transverse lines and other markings.

2.2.3 Profile Thermoplastic Material

Profile thermoplastic road marking material for audible/tactile treatment must comply with the requirements of Specification RMS 3359.

2.2.4 Two Part Cold Applied Pavement Marking Material

Two part cold applied material must comply with the requirements of Specification RMS 3360.

Sprayed, two part cold applied materials may be used for longitudinal line markings. Trowelled, screeded, sprayed, or extruded two part cold applied materials may be used for transverse lines and other pavement markings where glass beads are required. Use roll-on two part cold applied materials for pavement markings where glass beads are not required.

2.2.5 Pavement Marking Tape

2.1.5.1 Temporary

Temporary pavement marking tape must be a strippable type and approved by the Principal.

2.1.5.2 Permanent

Permanent pavement marking tape must be approved by the Principal.

2.2.6 Reflective Glass Beads

Reflective glass beads must be used in all pavement markings covered by this specification, except pavement marking tapes or school zone markings, and must comply with the requirements of Specification RTA 3353, AS/NZS 2009 (when tested in the uncoated state) and APAS Specification 0042.

2.2.7 Anti-Skid Material

Anti-skid material must be angular, polishing resistant particles added to provide characteristics of skid resistance. The particles must be of a colour compatible to the marking colour.

2.3 MATERIAL COLOURS

When a sample pavement marking material panel is prepared in accordance with AS 4049.4 Appendix F and assessed visually in accordance with AS/NZS 1580.601.1, the colour must be an approximate match to the colour specified against AS 2700S, as follows:

White: Y35

Yellow: Y14

Red: R62

Green: G16

Where mixed colour markings are required, with different colours providing different daytime colour contrasts to deliver a message, assess each individual colour for compliance and clear definition, both between colours as well as with the pavement, as well as the retention of the message.

Each colour of the test marking must meet the following requirement:

when non-white pavement marking material is assessed for colour change against a reference sample in the wheel-path in accordance with AS 4049.4 Appendix G, the grey scale rating must be greater than 3.

2.4 MATERIALS CERTIFICATION

At least 7 days prior to their proposed use, submit a signed statement to the Principal verifying that the materials meet the respective requirements of Clause 2. The statement must include test results from a NATA accredited facility or laboratory approved by the Principal. Such certificates must be valid for tests conducted no later than 36 months previously.

2.5 HANDLING, STORAGE AND MIXING

Ensure that road marking materials are handled, stored, combined with other products, installed and used in accordance with the manufacturer's recommendations and that the materials are compatible with other products used in the works.

3 APPLICATION OF PAVEMENT MARKINGS

3.1 GENERAL

Apply all pavement marking materials strictly in accordance with the manufacturers' instructions and guidelines.

3.1.1 Method of Application

Apply all longitudinal lines using a self propelled machine. Certain exclusions may be granted at the discretion of the Principal. Apply the two sets of lines forming a one-way or two-way barrier concurrently except for enhanced barrier lines.

Hand applications with the use of templates to control the pattern and shape will be allowed for transverse lines, symbols, legends, arrows and chevrons.

Set the delivery rate of glass beads to ensure conformity to the application rates specified in Tables R141.2, R141.3, R141.4 and R141.5 for each respective type of pavement marking material. Record the speed of the vehicle to achieve the specified quantities.

3.1.2 Uniformity

Completed markings must be uniform in appearance, texture, width and thickness and the surface must be free from unbeaded areas, traffic damage or other defects.

Markings must be straight or with smooth even curves where intended. All edges must have a clean sharp cut off.

Remove at your cost any marking material beyond the defined marking, leaving a neat marking on the wearing surface of the pavement.

3.1.3 Provision for Traffic and Protection of Work

Carry out the work and provide for traffic in accordance with the requirements of Specification RMS G10. Protect the pavement markings until the material has hardened sufficiently to the extent that it will not be damaged by traffic.

3.2 SURFACE PREPARATION

Surface preparation is, at all times, your responsibility.

The surface area to be marked must be dry and free of dirt, gravel, flaking pavement marking material and other loose or foreign material. The area around the marking must also be free of dirt, gravel and other loose or foreign material so that tracking of such material on to the new marking is avoided. If any of these conditions are not met, delay the pavement marking work until the surface is fully dried or prepared as detailed below.

Where the existing material is flaking or chipping, is of a type or is in such a condition that adhesion of the new material to the road surface cannot be guaranteed for the required life of the marking, obtain the agreement of the Principal to the proposed method of surface preparation and its extent.

Where a pavement marking material is to be applied to a surface where it may be incompatible with the existing marking or surface, prepare the marking or surface suitably before applying the pavement marking material.

Where a curing compound has been applied to a new rigid concrete pavement surface, remove the curing compound by physical abrasive means such as grinding or blasting, from the areas where the pavement marking material is to be applied.

3.3 POSITION AND TOLERANCES

3.3.1 Position of Markings

3.3.1.1 Maintenance

Apply markings directly over the existing markings within the tolerances listed in Table R141.1.

At locations where the existing markings are so badly worn that the installation of new markings is required, set these out to achieve the correct shape and alignment of the markings within the tolerances listed in Table R141.1.

3.3.1.2 Reinstatement After Road Works

Where markings require reinstatement following pavement works by others, such as reseals, apply the reinstated markings according to the set out placed by others and within the tolerances listed in Table R141.1.

3.3.1.3 New Installation

The required position of all markings excepting symbols and legends shall be defined by a line of painted spots of minimum dimensions 50mm x 50mm. Hooks are to be used to mark the start and finish of each type of line except for Hold and Stop Lines. Except for Double White Lines, Hold Lines and Stop Lines, the type of each line is to be marked with the line code in 150mm high lettering adjacent to the hook. Upon completion of spotting, the Contractor shall advise the Superintendent, and a joint checking procedure shall be undertaken prior to application of final markings.

Notwithstanding the above, the Contractor shall, without additional cost to the Principal, remove and replace any markings which are deemed not to comply with the requirements of the Authorised Traffic Control Device Plans.

New installation refers to the application of markings other than for maintenance or reinstatement.

Set out the work to ensure that all markings are placed in accordance with the Drawings and/or the Figures at the back of this Specification and within the tolerances listed in Table R141.1.

HOLD POINT

Process Held: Installation of pavement markings.

Submission Details: Notification that set out is complete.

Release of Hold Point: The Principal may inspect the set out prior to authorising the release of the Hold Point.

3.3.2 Tolerances

Comply with the tolerances shown in Table R141.1 when installing the pavement markings.

Table R141.1 - Tolerances for Pavement Marking Location and Thickness

Dimension	Maintenance [NOTE 3]	Reinstatement and Installation [NOTE 4]
1. Longitudinal line marking (a) Distance between centreline of new and old line marking (b) Location of new line marking (c) Width of new line marking (and for maintenance: total width of new and old line marking, unless otherwise directed) (d) Length of new stripe (and for maintenance: total length of new and old stripe, unless otherwise directed) (e) Start of new stripe relative to start of old stripe (f) Gap between double lines	< 15 mm Width of old line marking ± 10 mm Lesser of: $\pm 5\%$ of old stripe length or old stripe length ± 100 mm Lesser of: $\pm 5\%$ of stripe length or ± 100 mm ± 10 mm	< 50 mm from locations shown on Drawings or Appendix 1 Widths shown in Appendix 1 ± 5 mm Lengths shown in Appendix 1 ± 50 mm
2. Transverse & other markings (a) Width of new marking (b) Length of new marking	Width of old marking ± 10 mm [NOTE 1] Length of old marking ± 10 mm [NOTE 1]	Widths shown in Appendices 2, 3 and 5 ± 10 mm Lengths shown in Appendices 2, 3 and 5 ± 10 mm
3. Markings in advance of open level crossings (a) Width of new marking (b) Length of new marking	Width of old marking ± 10 mm [NOTE 1] Length of old marking ± 10 mm [NOTE 1]	Width shown in Figure 17 ± 10 mm Length shown in Figure 17 ± 50 mm
4. Arrows, chevrons, painted medians, painted left turn islands and speed markings (a) Each dimension	[NOTE 1] Dimensions of old marking ± 50 mm	[NOTE 2] Dimensions shown in Figures 9 to 16 and 18 to 20 ± 50 mm
5. Thickness of all pavement markings, other than profile line marking	≤ 6 mm (unless otherwise directed by the Principal)	

NOTE 1: Where the existing markings exceed the dimensions permitted for Reinstatement, the dimensions for the new Maintenance markings must not increase the deviation from the dimensions permitted for Reinstatement, unless otherwise directed by the Principal.

NOTE 2: Place arrows and speed markings square to the direction of travel.

NOTE 3: The apparent line of longitudinal line markings must have a smooth and continuous alignment when viewed in the direction of the line.

NOTE 4: The markings applied during Reinstatement according to the set out by others are to be as close as practicable to those set out markings and the disruption to the marking pattern to which it links is minimised.

The ends of the set out of marking applied during Installation must be such that the disruption to the marking pattern to which it links is minimised.

3.4 REINSTATEMENT OF PAVEMENT MARKINGS AFTER ROAD WORKS

Reinstate the pavement markings as soon as possible after road works where the pavement markings have been removed or damaged to ensure that delineation for road safety is maintained.

Delineation using temporary raised pavement markers may be used for up to 10 days after opening to traffic, after which all pavement markings must be reinstated to satisfy the performance criteria specified in Clause 4 of this specification.

3.5 REDUNDANT PAVEMENT MARKINGS

3.5.1 General

Redundant pavement markings usually arise:

- (a) as part of traffic switches during road construction or reconstruction (temporary removal or masking). In most cases, a final pavement surface will be re-laid, over which permanent markings are installed.
- (b) as a result of a pavement marking/delineation scheme being changed due to traffic and road safety issues (permanent removal).

Remove or mask pavement markings which are no longer required, and leave behind a clean, undamaged pavement with a surface texture, reflectivity characteristics and colour comparable to the adjacent pavement surface.

The eradication of, or removal of pliant polymer markings shall be carried out by grinding or by a scraping and jabbing action using a suitable blade tool. Removal by burning will not be allowed.

When removing or masking pavement markings such as arrows, numerals, letters, or other pavement markings, the removal or masking must take the form of a rectangular area or block around such markings. When removing or masking longitudinal and transverse lines such as edge lines, centre lines, lane lines, holding lines, or other lines, the removal or masking must cover a minimum of 200% of the total area of existing lines; i.e. minimum 50% extra coverage on both sides of the existing lines. The eradication of painted road markings shall be carried out by abrasive blasting techniques. No alternative methods will be considered. ~~All numerals, letters, symbols, and arrows will be marked or removed in such a way to avoid any possible confusion of motorists in wet conditions~~ ***Markings to be eradicated shall be clearly identified with red paint prior to the commencement of eradication.***

Blasting of painted markings shall be carried out until at least ninety (90) percent of the original area of each road marking has been removed. Any marking remaining shall not be concentrated in any one or two places of the original marking.

Removal of pliant polymer markings shall proceed until all of the marking has been removed from the pavement.

Blasting, grinding, scraping or other eradication activity shall not continue after the markings have been removed and any excessive damage to the pavement shall be repaired to the satisfaction of the Principal at no additional cost.

'Blackout' will only be permitted if carried out by the use of 'Degadur' or an equivalent material with a colour and texture matched to the adjacent pavement surface and which minimises the possibility of misleading drivers under daylight/darkness and wet/dry conditions. The 'Blackout' treatment must be equal to or better than mechanically stripping the old marking. Prior to use of 'Blackout', you must obtain the approval of the Principal.

All linemarking tape shall be removed before 'Blackout' may be used.

At locations where residences, hospitals or TAFE colleges are exposed to the noise of stripping operations, such work shall be carried out from 7 a.m. to 10 p.m. When traffic conditions make it impractical to strip existing markings before 10 p.m., the Contractor shall notify affected residents at least twenty four (24) hours before commencing work that this work will be undertaken during the night. The Contractor shall limit the exposure of each noise-affected person to the minimum possible. The working hours remain subject to the hours specified in the Contract.

3.5.2 Pavement Surface Condition After Removal

Remove pavement markings in a manner that will not materially or structurally damage the surface or texture of the pavement. After removal of the markings, the pavement surface condition must be suitable for adequate bonding of new markings.

Promptly remove any material deposited on the pavement as a result of the markings removal as the work progresses, by the methods which are stated in the PROJECT QUALITY PLAN. When these operations are completed, clear the pavement surface of any residue or debris.

Abrasive materials shall not be allowed to accumulate on any position of roadways open to traffic.

Any road marking materials removed from the pavement surface shall be collected and disposed of in landfills licensed by the Environment ACT to receive such materials.

3.5.3 Repair of Damage

Pavement markings over expansion joints on concrete pavements must be removed by methods acceptable to the Principal.

Repair, by methods acceptable to the Principal and at your own cost, any damage to the pavement, pavement joint materials, or the pavement surface caused by the removal of pavement markings.

3.5.4 Time Limits for Removal of Redundant Pavement Markings

Remove within 48 hours of application any painted "blackout or overlay" that is applied as a temporary measure.

Remove within 6 months of application any pavement marking tape that is applied over existing markings as a temporary masking measure, unless otherwise directed by the Principal.

Where existing pavement markings are to be removed and replaced by other pavement markings, do not remove the pavement markings until adequate provision has been made to complete the installation of the replacement markings. Remove pavement markings in such order that the markings remaining in place at any time will not be in a pattern that will mislead or misdirect road users.

3.5.5 Measurement of Quantity

Before removal of pavement markings, determine the face area of the pavement markings to be removed. Obtain the Principal's agreement to the face area of the pavement markings to be removed.

Any markings incorrectly eradicated shall be remarked by you at no extra cost to the Principal.

3.6 APPLICATION OF WATERBORNE PAINT**3.6.1 General**

Apply waterborne paint uniformly. Apply beads uniformly to all markings and apply to the paint prior to surface skinning to produce a uniform, properly bonded coverage over the whole marking.

Apply anti-skid material uniformly to all transverse lines and other markings as specified.

3.6.2 Recommended Conditions for Application

As a guide, the recommended conditions for the application of waterborne paints with large glass beads to ensure long term performance are provided in Annexure R141/E1.

3.6.3 Application Rates

The application rates must be as specified in Table R141.2.

Table R141.2 - Application Rates - Waterborne Paint and Glass Beads

Material	Longitudinal Line marking	Transverse Lines and Other Markings
Dry paint thickness (excluding surface applied beads)	≥ 0.300 mm	≥ 0.200 mm
Surface applied glass beads: - Type (AS/NZS 2009) - Rate retained in the painted surface	Type D ≥ 400 g/m ²	Type B ≥ 300 g/m ²
0.4 – 0.7 mm anti-skid material: - if stirred into the paint prior to application - if surface applied	– –	≥ 500 g/litre ≥ 200 g/m ²

3.6.4 Two Stage Application for New Sprayed Bituminous Surfacing

To achieve the required marking performance when applying waterborne paint over new sprayed bituminous surfacings, a two stage process involving a sacrificial coat of pavement marking material is required. The first coat of paint is to be applied using Type B glass beads. After 2 months, but before 3 months has elapsed, a second coat of paint is to be applied using type D glass beads.

3.7 APPLICATION OF NON-PROFILE THERMOPLASTIC PAVEMENT MARKING MATERIAL

Where the surface of the pavement is concrete or is smooth or polished or where recommended by a manufacturer, apply a tack / primer coat in accordance with the manufacturer's recommendations.

Uniformly apply anti-skid material and glass beads onto the thermoplastic material immediately after it has been applied to the pavement and while the material is still molten.

For longitudinal lines, separate the bead applications. The method of application must ensure retention of the beads in the material.

As a guide, the recommended conditions for the application of sprayed or extruded thermoplastic with large glass beads to ensure long term performance are provided in Annexure R141/E2. Reflective glass beads must comply with the requirements of RTA 3353, AS/NZS 2009 (when tested in the uncoated state) and APAS specification 0042.

The application rates must be as specified in Table R141.3.

Table R141.3 - Application Rates – Non-profile Thermoplastic Pavement Marking Materials and Glass Beads

Material	Longitudinal Line marking	Transverse Lines and Other Markings	
	Sprayed or Extruded Thermoplastic	Screeded Thermoplastic	Preformed Thermoplastic
Thermoplastic cold film thickness	≥ 1.8 mm	3.0 mm ± 1.0 mm	--
Thermoplastic application thickness	--	--	2.5 mm ± 0.5 mm
Surface applied glass beads *:	--	--	--
- Type (AS/NZS 2009)	Type D-HR (adhesive coated)	Type B	Type B
- Rate retained in the surface	≥ 400 g/m ²	≥ 300 g/m ²	≥ 300 g/m ²
1.0 – 2.0 mm anti-skid material:	≥ 200 g/m ²	--	--
0.4 – 0.7 mm anti-skid material:	--	≥ 200 g/m ²	≥ 200 g/m ²

* Glass beads must be coated with a compatible coupling agent to form an improved adhesive bond with Thermoplastic or PMMA (two part cold applied) road marking material.

3.8 APPLICATION OF TWO PART COLD APPLIED PAVEMENT MARKING MATERIAL

Where the surface of the pavement is concrete or is smooth or polished or where recommended by a manufacturer, apply a primer / tack coat in accordance with the manufacturer's recommendations.

Uniformly apply anti-skid material and glass beads onto the two part cold applied material while fluid and immediately after it has been applied to the pavement.

For longitudinal lines, separate the bead applications. The method of application must ensure retention of the beads in the material.

The application rates must be as specified in Table R141.4.

**Table R141.4 - Application Rates - Two Part Cold Applied
Pavement Marking Materials and Glass Beads**

Material	Longitudinal Line marking	Transverse Lines and Other Markings	
	Sprayed Application	Trowelled, Screeded or Extruded	Sprayed
Cold applied material thickness (excluding surface applied beads)	0.50 ± 0.05mm (wet)	2.0mm ± 0.2mm (dry)	1.00mm ± 0.1mm (wet)
Completed marking thickness			2.00mm ± 0.2mm
Surface applied glass beads*: - Type (AS/NZS 2009) - Rate retained in the painted surface	Type D-HR (adhesive coated) ≥ 400 g/m ²	Type B ≥ 300 g/m ²	Type B ≥ 300 g/m ²
1.0 – 2.0 mm anti-skid material:	≥ 200 g/m ²		
0.4 – 0.7 mm anti-skid material:		≥ 200 g/m ²	≥ 200 g/m ²

* Glass beads must be coated with a compatible coupling agent to form an improved adhesive bond with thermoplastic or PMMA (two part cold applied) road marking material.

3.9 APPLICATION OF PROFILE LONGITUDINAL LINE MARKING MATERIAL

Profile (audio-tactile) longitudinal pavement marking may be either:

- (i) raised ribs of material applied at a regular interval, over a base layer of the same material (**continuous type**), or
- (ii) raised ribs only, placed directly on the road surface (**discontinuous type**).

The intervening area between the raised ribs may be joined by a suitable material approved by the Principal.

Pay particular attention to concrete or smooth or polished pavements. Carry out pavement assessment to determine the need for surface or other preparation such as grinding and/or the application of a tack coat prior to the application of the marking material to facilitate adhesion.

Where the surface of the pavement is concrete or is smooth or polished, apply a tack / primer coat in accordance with the manufacturer's recommendations prior to the application of the profile marking material.

Apply glass beads to the complete profile pavement marking immediately after application of the material(s). Set the actual application rate to overcome any loss of beads between the bead dispenser and the applied line.

The application rates and dimensions must be as specified in Table R141.5.

**Table R141.5 - Application Rates - Profile Longitudinal
Line marking Materials and Glass Beads**

Type	Requirement
Height of raised ribs, proud of pavement surface (excluding surface applied beads)	10 mm ± 2 mm
Thickness of the base coat or line joining rib sections (if applied)	≤ 2 mm
Spacing of raised ribs (along the line)	250 mm ± 50 mm
Length of raised ribs (along the line)	60 mm ± 10 mm
Slope angle of raised rib lead and trail faces	45° (approximately)
Surface applied glass beads: - Type (AS/NZS 2009) - Rate retained in the marked surface	Type D-HR ≥ 500 g/m ²
Intermix glass beads: - 20% by mass	Type D-HR
1.0 – 2.0 mm anti-skid material (only for continuous type)	≥ 200 g/m ²

Glass beads used for profile longitudinal pavement marking must have a proprietary adhesive coating to aid adhesion to the line material, and must be preheated to 185°C.

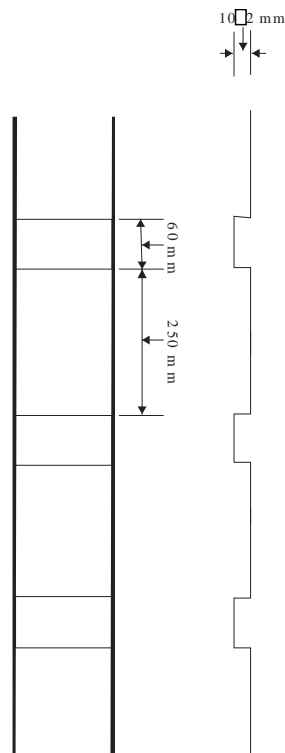


Figure 3.5: Profile Line on Motorways and Dual Carriageways

3.10 APPLICATION OF PAVEMENT MARKING TAPE

Apply the pavement marking tape in accordance with the manufacturer's recommendations, including those regarding surface preparation. Also remove the pavement marking tape, when necessary, in accordance with the manufacturer's recommendations.

4 FIELD TESTING

4.1 FREQUENCY OF TESTING

The minimum frequency of field testing is specified in Annexure R141/L. Unless otherwise specified in the Contract, keep records of all testing carried out for a minimum of twelve calendar months.

4.2 PAINT

Calculate the thickness of the unbeaded dry film applied to the wearing surface using Test Method RMS T841 and the percent volume solids of the paint used. Confirm this by measuring with a suitable dry film thickness gauge the thickness of the cured unbeaded material on a suitable metal test plate, and take the mean of at least six readings distributed over the test area.

4.3 NON-PROFILE THERMOPLASTIC

Verify the thickness of the cold film of unbeaded non-profile thermoplastic material applied to the road pavement using a vernier or suitable dry film thickness gauge. Measure the thickness of the thermoplastic material applied to a metal test plate and take the mean of at least six readings distributed over the test area.

4.4 TWO PART COLD APPLIED PAVEMENT MARKING MATERIAL

Verify the thickness of the unbeaded material applied to the road pavement using Test Method RMS T841.

4.5 PROFILE THERMOPLASTIC

Verify the thickness of the cold film of unbeaded profile thermoplastic material applied to the road pavement with a vernier or a suitable dry film thickness gauge. Measure the thickness of both the peak of the profile section and the line joining the profile sections applied to a suitable metal test plate.

4.6 GLASS BEADS

Verify for each line width applied and each vehicle speed, the application rate of glass beads applied to the surface of the markings and the loss of beads during application.

4.7 VERIFICATION OF QUANTITIES

Record the quantities of materials used for longitudinal line marking, as a minimum, for each Lot, and as follows:

- | | | |
|-----|---------------------------------|-----------|
| (a) | Paints | litres |
| (b) | Thermoplastic materials | kilograms |
| (c) | Two part cold applied materials | litres |
| (d) | Glass beads | kilograms |
| (e) | Anti-skid material | kilograms |

The quantity for each Lot must not be less than the area of marking applied multiplied by the specified minimum application rate.

5 NONCONFORMING WORK

Pavement markings which are not in accordance with the Specification and Drawings are nonconforming and must be dealt with in accordance with the quality management system requirements and/or your PROJECT QUALITY PLAN.

ANNEXURE R141/A – PROJECT SPECIFIC INFORMATION

Clause	Description	Required *
1.1, 3.3.1.1, Table R141.1	Maintenance is included in the scope of work.	Yes / No
1.1, 3.3.1.2, Table R141.1	Reinstatement is included in the scope of work.	Yes / No

Note *: Delete as applicable

ANNEXURE R141/B – MEASUREMENT AND PAYMENT

Payment for the activities associated with completing the work detailed in this Specification is made in accordance with the following Pay Items, including materials used as determined by the Principal.

A lump sum price for any of these items will not be accepted.

The cost of the provision for traffic and protection of work must be included in the various pay items for pavement markings.

The cost of the application, protection and removal of pavement markings provided as a temporary measure as part of your obligations undertaken in accordance with Specification RMS G10 will be made under the appropriate pay items in RMS G10.

If any item for which a quantity of work is listed in the Schedule of Rates has not been priced by you, it will be deemed that due allowance has been made in the prices of other items for the cost of the activity which has not been priced.

Calculate the areas of markings applied in accordance with Figures 9 to 13 from the areas shown in Table R141/B.1.

Table R141/B.1 - Areas of Other Markings- Figures 9 to 13

Figure No	Figure Type	Area (m²)
9	UA1	0.7
9	UA4 (L) or (R)	1.24
9	UA2	1.95
9	UA3 (L) or (R)	1.09
9	UA6	1.80
10	RA1	2.38
10	RA3 (L) or (R)	2.45
11	UA5 (L) or (R)	1.49
12	RA5 (L) or (R)	3.25
13	SA1 (painted area only)	3.11

Calculate the areas of markings applied in accordance with Figure 18 from the areas shown in Table R141/B.2.

The areas are based on letter and numeral characters 4000 mm high, that is $X = 100$ mm. For characters other than 4000 mm high, adjust the areas shown in Table R141.B.2 by the factor: (Actual height of character in mm) / 4000. Round the area of each character to the nearest 0.01 m².

Table R141/B.2 - Areas of Other Markings - Figure 18

Character	A	B	C	D	E	F	G	H	I	J
Area (m²)	0.91	1.29	0.80	1.06	1.02	0.78	0.89	1.01	0.40	0.64
Character	K	L	M	N	O	P	Q	R	S	T
Area (m²)	0.90	0.61	1.34	1.07	1.08	0.96	1.23	1.13	1.00	0.64
Character	U	V	W	X	Y	Z				
Area (m²)	0.94	0.84	1.52	0.76	0.64	1.08				
Character	1	2	3	4	5	6	7	8	9	0
Area (m²)	0.71	1.71	1.54	1.78	1.73	1.61	1.08	2.20	1.61	1.46

Pay Item R141P1 - Waterborne Paint - Longitudinal Lines

The unit of measurement is the linear metre for each line type as shown on the relevant Figures.

The length must be measured along the centreline of the longitudinal line(s) that constitute a line type. Where the line type is comprised of multiple lines, only one line must be measured. The length includes any longitudinal spaces between the lines, as required by the line type.

Pay Item R141P2 - Waterborne Paint - Transverse Lines and Other Markings

The unit of measurement is the square metre.

The face area of the line or marking applied is determined from the dimensions shown on relevant figures and Drawings unless otherwise directed by the Principal.

Pay Item R141P3 - Non-profile Thermoplastic Pavement Marking Material - Longitudinal Lines

The unit of measurement is the linear metre for each line pattern calculated from the actual length including spaces between lines measured along the centre line of the longitudinal line.

Pay Item R141P4 - Screeded or Sprayed Non-profile Thermoplastic Pavement Marking Material - Transverse Lines and Other Markings

The unit of measurement is the square metre.

The face area of the thermoplastic material applied is determined from the dimensions shown on relevant figures and Drawings unless otherwise directed by the Principal.

Pay Item R141P5 - Preformed Non-profile Thermoplastic Pavement Marking Material - Transverse Lines and Other Markings

The unit of measurement is the square metre.

The face area of the thermoplastic material applied is determined from the dimensions shown on relevant figures and Drawings unless otherwise directed by the Principal.

Pay Item R141P6 - Two Part Cold Applied Pavement Marking Material - Longitudinal Lines

The unit of measurement is the linear metre for each line pattern calculated from the actual length including spaces between lines measured along the centre line of the longitudinal line.

Pay Item R141P7 - Not Used

Pay Item R141P8 - Trowelled, Screeded or Extruded Two Part Cold Applied Pavement Marking Material - Transverse Lines and Other Markings

The unit of measurement is the square metre.

The face area of the line or marking applied is determined from the dimensions shown on relevant figures and Drawings unless otherwise directed by the Principal.

Pay Item R141P9 - Sprayed Two Part Cold Applied Pavement Marking Material - Transverse Lines and Other Markings

The unit of measurement is the square metre.

The face area of the line or marking applied is determined from the dimensions shown on relevant figures and Drawings unless otherwise directed by the Principal.

Pay Item R141P10 - Profile Thermoplastic Pavement Marking Material - Longitudinal Lines

The unit of measurement is the linear metre for each line pattern calculated from the actual length including spaces between lines measured along the centre line of the longitudinal line.

Pay Item R141P11 - Pavement Marking Tape - Longitudinal Lines

The unit of measurement is the linear metre for each line pattern calculated from the actual length including spaces between lines measured along the centre line of the longitudinal line.

Pay Item R141P12 - Pavement Marking Tape - Transverse Lines and Other Markings

The unit of measurement is the square metre.

The face area of the line or marking applied is determined from the dimensions shown on relevant figures and Drawings unless otherwise directed by the Principal.

Pay Item R141P13 - Removal of Longitudinal Line Markings, Transverse Lines and Other Symbols

The unit of measurement is the square metre.

The face area of the pavement markings removed must be determined prior to the work being carried out.

ANNEXURE R141/C – SCHEDULES OF HOLD POINTS AND IDENTIFIED RECORDS

C1 SCHEDULE OF HOLD POINTS

Clause	Description
3.1.2.3	Setting out of pavement markings

C2 SCHEDULE OF IDENTIFIED RECORDS

The records listed below are Identified Records for the purposes of RMS Q Annexure Q/E.

Clause	Description of the Identified Record
1.2.4	The information listed in Annexure R141/D.
2.3	Statement verifying that materials meet the respective requirements of Clause 2 including NATA endorsed test results.

ANNEXURE R141/D – INFORMATION TO BE SUPPLIED

Refer to Clause 1.2.4.

Clause	Description
3.5	Details of the equipment and methods, including the manufacturer's recommendations, to be used to satisfy this Specification in relation to removing or masking redundant pavement markings.
3.6	Details of the equipment and methods, including the manufacturer's recommendations, to be used to satisfy this Specification in relation to applying paint and glass beads.
3.7, 3.9	Details of the equipment and methods, including the manufacturer's recommendations, to be used to satisfy this Specification in relation to applying profile and non-profile thermoplastic material, glass beads and tack coat and the tack coat application rate.
3.8	Details of the equipment and methods, including the manufacturer's recommendations, to be used to satisfy this Specification in relation to applying two part cold applied material, glass beads and primer and primer application rate.
3.10	Details of the equipment and methods, including the manufacturer's recommendations, to be used to satisfy this Specification in relation to applying pavement marking tape.

ANNEXURE R141/E – RECOMMENDED CONDITIONS FOR APPLYING WATERBORNE PAINT AND THERMOPLASTIC MATERIALS

E1 Application of Waterborne Paint with Large Glass Beads (Type D) for Optimum Performance

To achieve the highest performance and durability, apply waterborne paint incorporating Type D glass beads under the following conditions:

- (a) Air temperature and pavement temperature > 15°C
- (b) Relative humidity < 70%
- (c) Air movement > 10 km/hr (reasonable air movement)
- (d) Adequate protection of lines from traffic during the drying process
- (e) Waterborne paint must not be applied when relative humidity is above 85% and when air or road temperatures are below 10°C.

E2 Application of Sprayed or Extruded Thermoplastic Materials

For application of thermoplastic materials, give particular attention to the manufacturer's recommended application temperature.

For example, field testing has shown that thermoplastic applied to concrete road pavement surfaces at a lower temperature than 195°C (measured at the spray or extrusion outlet on the application equipment) results in poor adhesion and significant marking delamination.

Application at the manufacturer's recommended temperature will assist in achieving the correct glass bead embedment depth, to aid bead retention and marking retro-reflectivity or night time visibility. This is an important consideration especially when using the large diameter type D glass beads.

Application of profile pavement markings at a temperature below the recommended temperature, to achieve a stiffer mix and to assist rib rigidity, will result in premature delamination of the marking material from the pavement.

ANNEXURE R141/F – (NOT USED)

ANNEXURE R141/G – GLASS BEAD CALIBRATION GUIDE**Calibration Guide for Dispensing Type D Glass Beads at 0.4 kg/m²**

Millilitres of Type D Glass Beads / 10 Seconds			
Line Width (mm) →	100	150	200
Speed (km/hr) ↓			
3	220	340	450
4	300	450	600
5	370	550	740
6	450	660	890
7	520	780	1040
8	590	890	1180
9	660	1000	1340
10	740	1110	1480
11	820	1220	1630
12	890	1340	1780
13	960	1440	1930
14	1040	1550	2070
15	1110	1660	2220
16	1180	1780	2370

Notes:

- (1) Maximum recommended speed for application of Type D glass beads is 16 km/hr (this will limit the amount of bounce and roll).
- (2) Low pressure (50 psi) or gravity delivery to a gravity dispenser will produce the best application results.
- (3) The figures above are for the dispensed bead rate of 0.4 kg/m².
No allowance has been made in this guide for bead loss during the application to achieve the retained bead rate of ≥ 0.4 kg/m², as specified in RMS R141.
- (4) Line widths 80 mm and 120 mm no longer used.

ANNEXURES R141/H TO R141/K – (NOT USED)

ANNEXURE R141/L – MINIMUM FREQUENCY OF TESTING

Clause	Characteristic Analysed	Test Method	Minimum Frequency of Testing
Pavement Marking Paint			
3.2	Wet Film thickness	RMS T841 See Clause 10	Two per day or one per site visit of line marker whichever is the greater AND after pressure or speed settings are changed.
3.2	Application rate of glass beads	RMS T1208	Two per day or one per site visit whichever is the greater AND after pressure or speed settings are changed.
4.7	Verification of Lot quantities	See Clause 4.7	Per tank fill or one per day, whichever is the greater.
Non-profile Thermoplastic Pavement Marking Material			
3.3	Thickness of Cold Film	See Clause 4	Two per day or one per site visit of line marker whichever is the greater AND after pressure or speed settings are changed.
3.3	Application rate of glass beads	RMS T1208	Two per day or one per site visit whichever is the greater AND after pressure or speed settings are changed.
4.7	Verification of Lot quantities	See Clause 4.7	Per tank fill or one per day, whichever is the greater.
Two Part Cold Applied Pavement Marking Material			
3.4	Thickness of Film	See Clause 4	Two per day or one per site visit of line marker whichever is the greater AND after pressure or speed settings are changed.
3.4	Application rate of glass beads	RMS T1208	Two per day or one per site visit whichever is the greater AND after pressure or speed settings are changed.
4.7	Verification of Lot quantities	See Clause 4.7	Per tank fill or one per day, whichever is the greater.
Profile Pavement Marking Material			
3.5	Thickness of Cold Film	See Clause 4	Two per day or one per site visit of line marker whichever is the greater AND after pressure or speed settings are changed.
3.5	Application rate of glass beads	RMS T1208	Two per day or one per site visit whichever is the greater AND after pressure or speed settings are changed.
4.7	Verification of Lot quantities	See Clause 4.7	Per tank fill or one per day, whichever is the greater.

ANNEXURE R141/M – REFERENCE DOCUMENTS

RMS Specifications

RMS Q	Quality Management System
RMS G10	Traffic Management
RMS R110	Coloured Surface Coatings for Bus Lanes and Cycleways
RMS R142	Raised Pavement Markers
RMS 3351	Road Marking Paint
RMS 3353	Glass Beads (for Application to Road Marking Materials)
RMS 3356	Waterborne Road Marking Paint
RMS 3357	Thermoplastic Road Marking Material
RMS 3359	Profile Thermoplastic Road Marking Material
RMS 3360	Two Part Cold Applied Road Marking Material

RMS Test Methods

RMS T841	Field Measurement of Wet Film Thickness of Road Marking Paint
RMS T1208	Measurement of Rate of Application of Spherical Glass Beads

Australian Standards

AS/NZS 1580.601.1	Paints and related materials - Methods of test - Colour - Visual comparison
AS/NZS 2009	Glass beads
AS 4049.4	High performance pavement marking systems

RMS Technical Documents

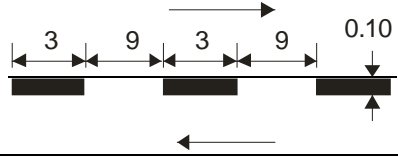
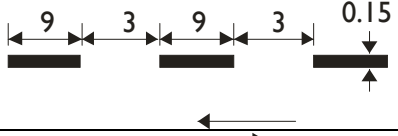
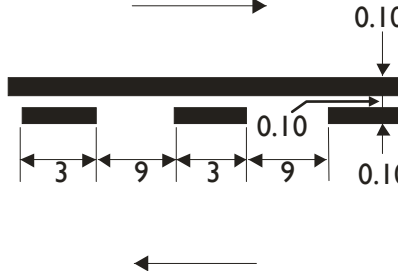
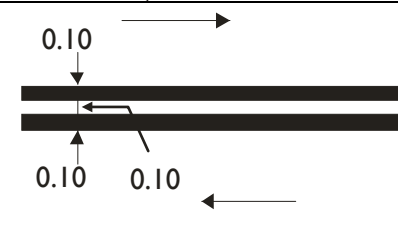
	RMS Delineation Manual
TD 2009/SR02	Dragon's Teeth at School Zones (RMS Centre for Road Safety)

Australian Paint Approval Scheme (APAS) Specifications

0042	Glass Beads for Pavement Marking Paint
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APPENDICES 1 TO 5

APPENDIX 1 - LONGITUDINAL PAVEMENT MARKINGS

Line	Type	Pattern and Dimensions	Reference Section*
DIVIDING LINES			
Dividing (Separation) line on 2-lane road	S1		4.2
	S2	NO LONGER USED	
Dividing (Separation) line on multi-lane road	S6		4.2
	BS		4.4
Dividing (Barrier) lines	BB		4.4

Notes:

(all dimensions in m unless otherwise stated)

* Section in RMS Delineation Manual

* Section in RMS Delineation Manual

NB: Longitudinal Pavement Markings must be according to ACT Standard Drawing DS9-01

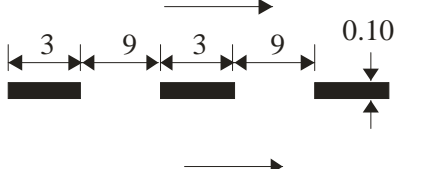
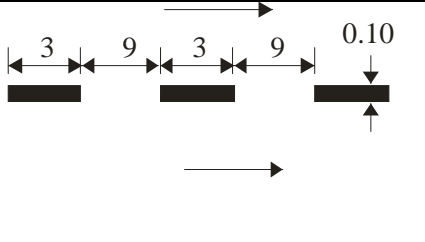
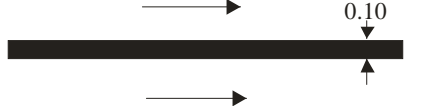
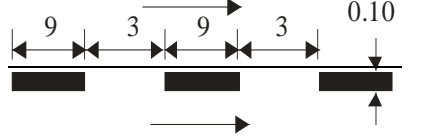
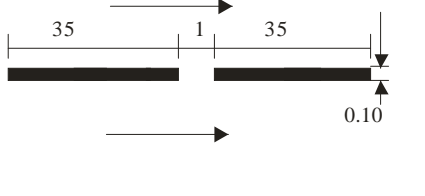
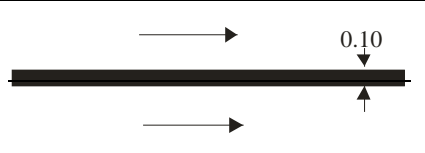
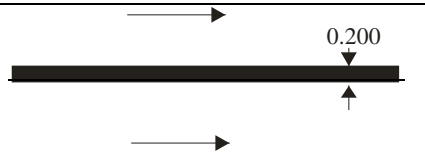
Line	Type	Pattern and Dimensions	Reference Section*
ENHANCED DIVIDING LINES #			
Dividing (Separation) line on 2-lane road	S3		5.2.2
Dividing (Barrier) lines (Restricted overtaking in one direction)	BS1		5.2.3
Dividing (Barrier) lines	BB1		5.2.3
Dividing (Barrier) lines	BB2		5.2.3

Notes:

(all dimensions in m unless otherwise stated)

* Section in RMS Delineation Manual

Use of enhanced dividing lines requires approval of GM, Traffic Management

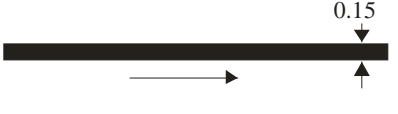





Line	Type	Pattern and Dimensions	Reference Section*
LANE LINES			
Lane lines on multi lane roads including motorways and dual carriageways	L1		4.6
Enhanced lane line (profile) on motorways, dual carriageways or on special locations such as bridges #	L2		4.6, 5.2.5
Lane line on multi lane road	L3		4.6
Exit lane line on multilane roundabouts	L4		4.6
Defines the edge of a Bus Lane and Bus Only lane adjacent to general traffic lane	L6		4.6
Defines the edge of a Bicycle lane adjacent to general traffic lane	L7		4.6
Enhanced Lane Lines	L5		4.6, 5.2.4

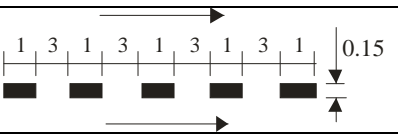
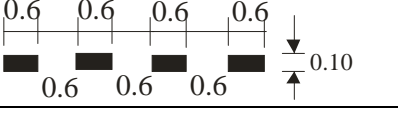
Notes:

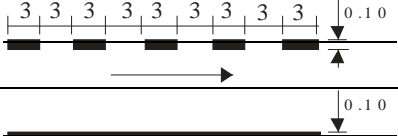
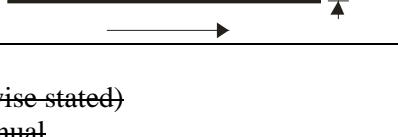
(all dimensions in m unless otherwise stated)

* Section in RMS Delineation Manual

| # Use of enhanced dividing lines requires approval of GM, Traffic Management

Line	Type	Pattern and Dimensions	Reference Section*
EDGE LINES			
Left hand edge line on general purpose road	E1		4.7
Left hand edge line on Motorway	E2		4.7
Right hand edge on divided carriageway	E3		4.7
Outline of traffic island or freeway ramp gore	E4		4.7
Outline of painted median	E5		4.7
Line applied to incline face of median kerb	E6		4.7

Line	Type	Pattern and Dimensions	Reference Section*
PROFILE LINES (Edge line, lane line and dividing lines)			5.2.6
Continuity Lines	C1		4.8
Turning Lines	T1		4.9

Line	Type	Pattern and Dimensions	Reference Section*
KERBSIDE PARKING RESTRICTION LINES			
Clearway Lines	C2		13.2
No Stopping lines	C3		13.3

Notes:

(all dimensions in m unless otherwise stated)

* Section in RMS Delineation Manual

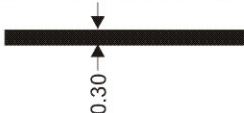
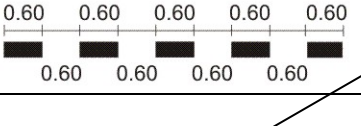
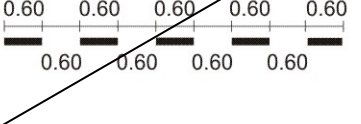
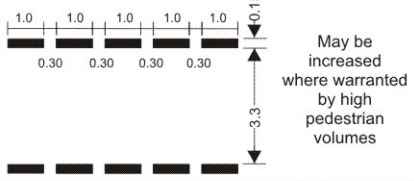
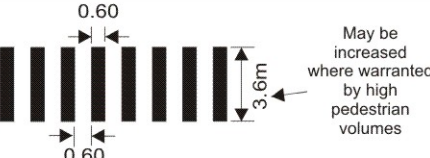
Line	Type	Pattern and Dimensions	Reference Section*
BICYCLE LINES			
Bicycle lane line	L7		4.10
Bicycle lane continuity line	C4		4.10
Bicycle separation line for off road bike path (with restricted visibility)	S4		4.10
Bicycle lane separation line for off road bike path (Straight sections)	S5		4.10
Bicycle edge line for off road bike paths & shared paths	E7		4.10

Notes:

(all dimensions in m unless otherwise stated)

* Section in RMS Delineation Manual

APPENDIX 2 - TRANSVERSE PAVEMENT MARKINGS

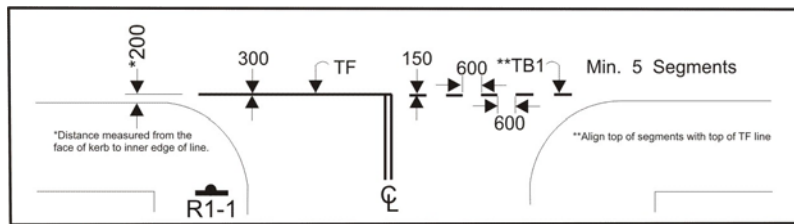
Line Type	Use	Dimensions (m)	Colour
TF	Stop line		White
TF1		NO LONGER USED	
TF2		NO LONGER USED	
TB	Give Way Line (Used with signs)		White
TB1	Give Way Line (Used on right side of road)		White
PCW	Pedestrian Cross Walk Lines		White
PX	Pedestrian Crossing		White

Dimensions are in mm unless otherwise stated

NB: Transverse Pavement Markings must be according to ACT Standard Drawing DS9-01

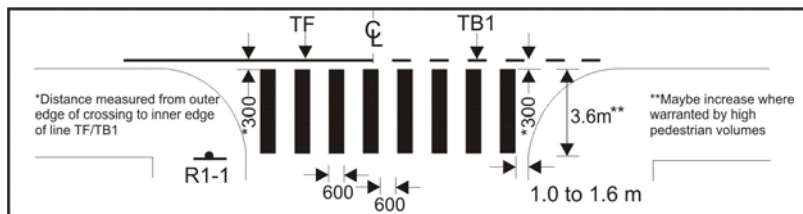
Transverse line at a stop sign

(all dimensions in mm unless otherwise stated)



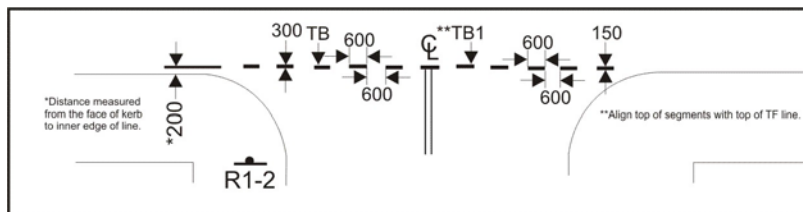
Transverse line at a stop sign with pedestrian crossing

(all dimensions in mm unless otherwise stated)



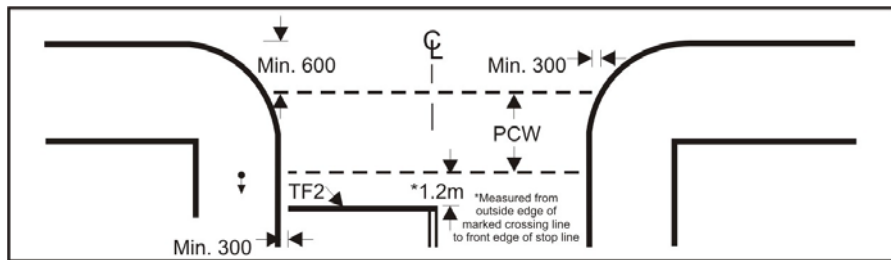
Transverse line at a give way sign

(all dimensions in mm unless otherwise stated)



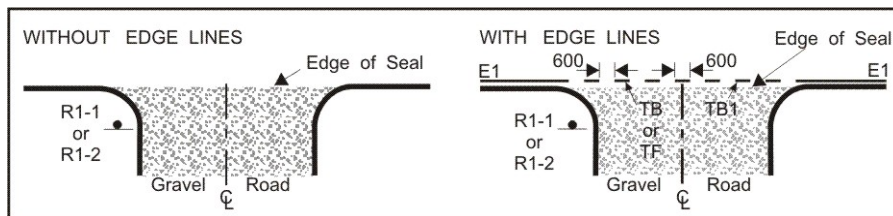
Transverse lines at traffic signals

(all dimensions in mm unless otherwise stated)

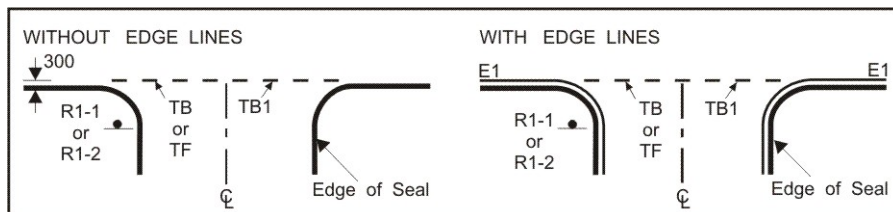


NB: Transverse Lines at Traffic Signals must be according to ACT Standard Drawing DS9-20

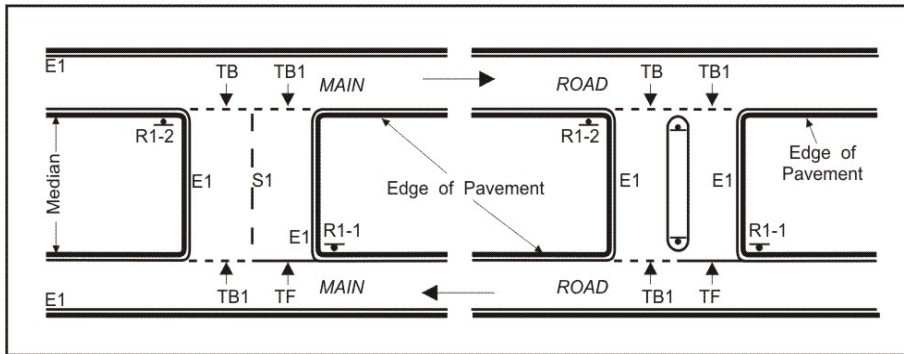
Transverse lines at a stop & give way sign at a junction with gravel road.



Transverse lines at a stop & give way sign at a junction with sealed road



Transverse line at a stop & give way sign connecting road on a dual carriageways.



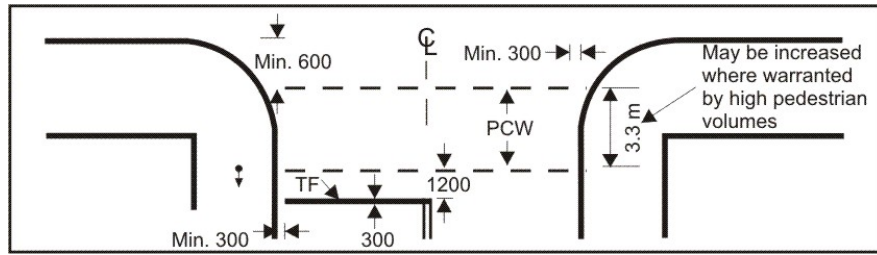
Transverse lines for other applications

(all dimensions in mm unless otherwise stated)

<ul style="list-style-type: none"> ● Ferry Approach ● Opening Bridge ● One Lane Bridge ● Level Crossing with Signals and/or Gate 	<p>* 5 - 10m Ferry Gate or Signals 3m Gate other than Ferry</p>
<ul style="list-style-type: none"> ● Level Crossing With Stop Sign 	
<ul style="list-style-type: none"> ● Open Level Crossing ● One Lane Bridge without Stop Signs or Signals 	<p>Give Way Sign or RLC - B Assembly</p>

Typical pedestrian crosswalk lines at an intersection with a marked foot crossing

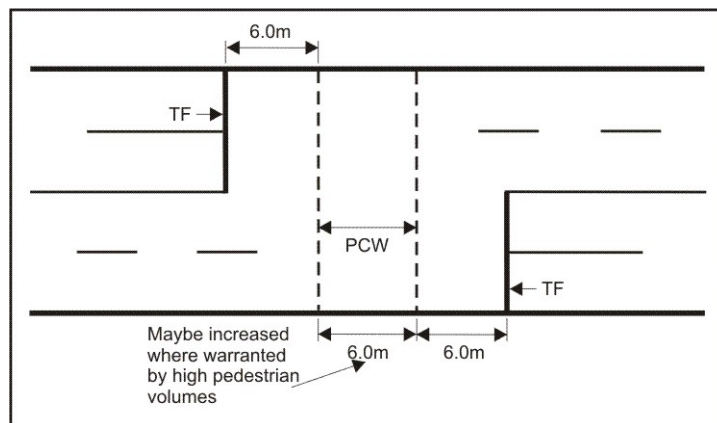
(all dimensions in mm unless otherwise stated)



NB: Children's and Zebra Crossings must be according to ACT Standard Drawing DS9-25

Typical pedestrian crosswalk lines at mid block marked foot crossing

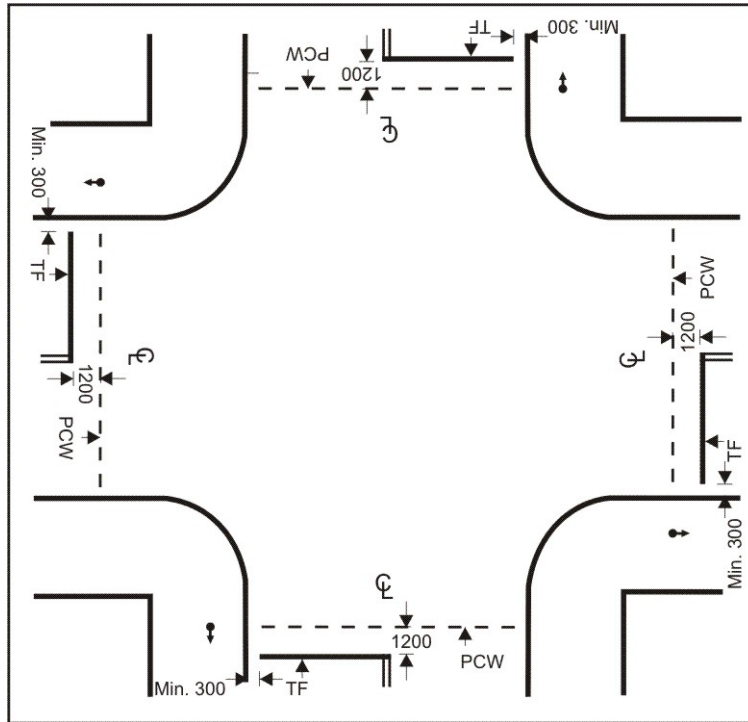
(all dimensions in mm unless otherwise stated)



NB: Children's and Zebra Crossings must be according to ACT Standard Drawing DS9-25

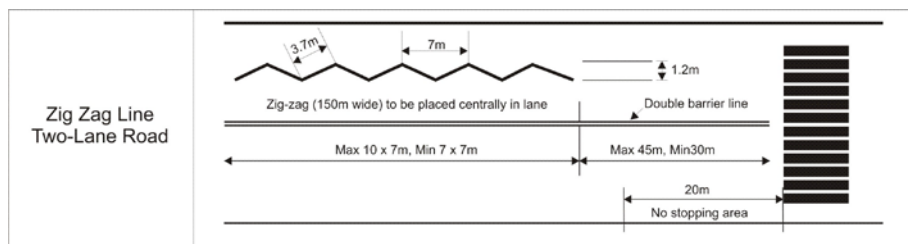
Transverse lines for scramble crossing

(all dimensions in mm unless otherwise stated)


















Zig Zag Markings

(all dimensions in mm unless otherwise stated)



Arrows – types, uses and shapes

Arrow Type	Use	Shape
GROUP 1 - URBAN SITUATIONS ($V_{85} < 80\text{km/h}$) Arrow Spacing approximately 20 m		
UA1	Traffic in lane must proceed straight ahead	
UA2	Used at 'T' junctions where traffic must turn either to the left or right from the lane but not proceed straight ahead.	
UA3(L)	Traffic in lane must turn left	
UA3(R)	Traffic in lane must turn right	
UA4(L)	Traffic in lane must turn left or proceed straight ahead	
UA4(R)	Traffic in lane must turn right or proceed straight ahead	
UA5(L)	Traffic in lane must move to the left	
UA5(R)	Traffic in lane must move to the right	
UA6	Traffic in lane must turn right, proceed straight ahead or turn left	
GROUP 2 - RURAL SITUATIONS ($V_{85} = 80\text{km/h}$ or more) Arrow Spacing approximately $0.5(V_{85})$ metres		
RA1	Traffic in lane must proceed straight ahead	
RA2(L)	Traffic in lane must turn left	
RA2(R)	Traffic in lane must turn right	
RA5(L)	Traffic in lane must move to the left	
RA5(R)	Traffic in lane must move to the right	
GROUP 3 - SPECIAL CIRCUMSTANCES		
SA1	To indicate one way movement at freeway off ramps and discourage wrong way entry	

NB: Arrow types and shapes must be according to ACT Standard Drawing DS9-02

APPENDIX 3 - PAVEMENT MARKINGS AND SYMBOLS FOR BICYCLE FACILITIES

Linemarking specifications

L7 Bicycle lane line
Continuous line 100 mm wide

C4 Bicycle lane continuity line
Dashed line 100mm wide, 1000mm long with 3000mm gap

S4 Off-road path continuous separation line
Continuous line 100mm wide (used on path sections with restricted visibility or at intersections)

S5 Off-road path broken separation line
Dashed line 100mm wide, 1000mm long with 3000mm gap (used on straight path sections)

E7 Edge line for off-road bicycle paths and shared paths
Continuous line 100 mm wide

TF Stop line
300mm wide

Stop and Give Way lines for off-road paths

TFB Stop line on path
200mm wide

TBB Give Way line on path
200mm wide, 200mm long with 200mm gap

Pavement symbols for on-road use

Bicycle lane pavement arrows and off-road bicycle path direction arrows use identical pattern to RTA urban road lane pavement arrows UA-1 to UA-6

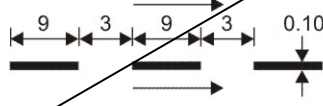
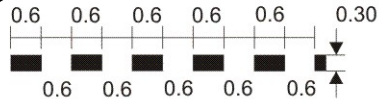
Bicycle lane traffic signal pavement arrows and symbols

Pavement symbols for off-road paths

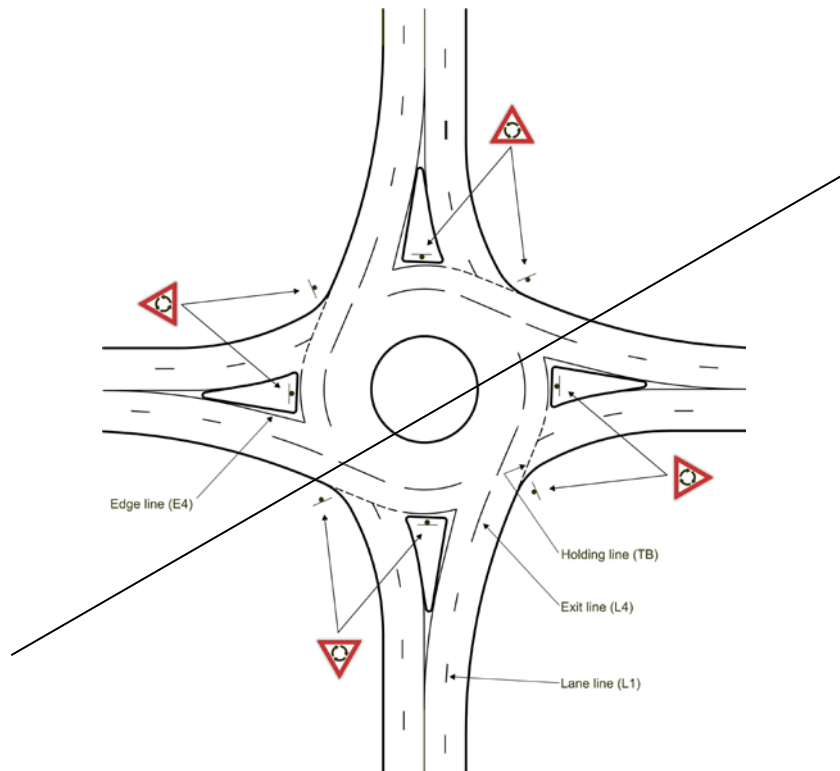
Pavement direction arrow symbols for off-road paths

APPENDIX 4 - (NOT USED)

APPENDIX 5 - PAVEMENT MARKINGS AT ROUNDABOUTS

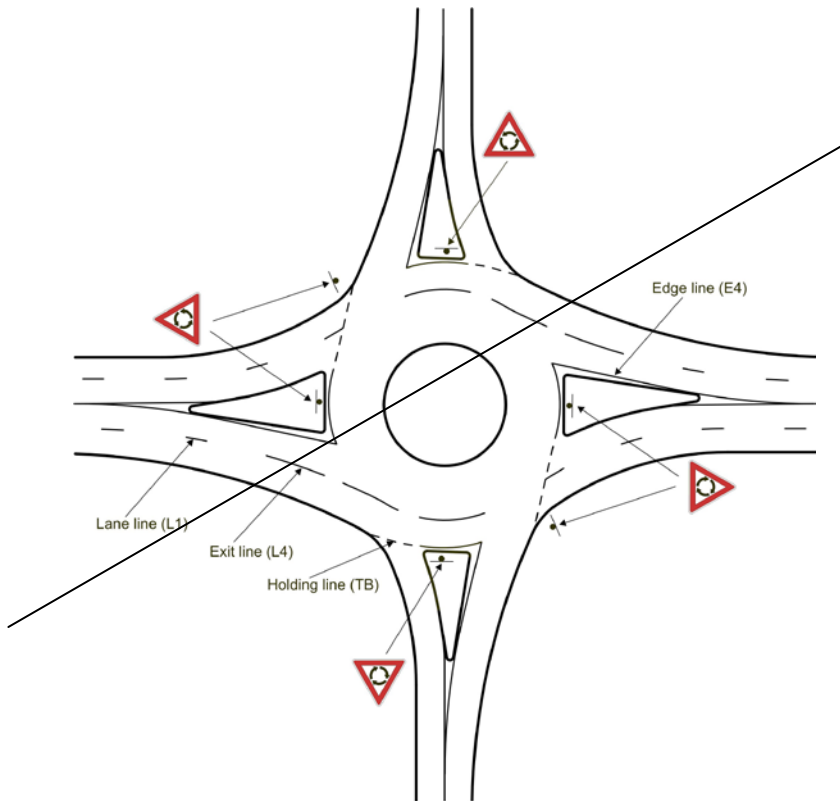
Line Type	Use	Dimensions (m) (for dimensions shown * see marker spacing column)	Colour
L4	Exit lane line on multilane roundabouts		White
TB	Holding Line		White

Roundabout Pavement Markings, four 2 lane entry/exits

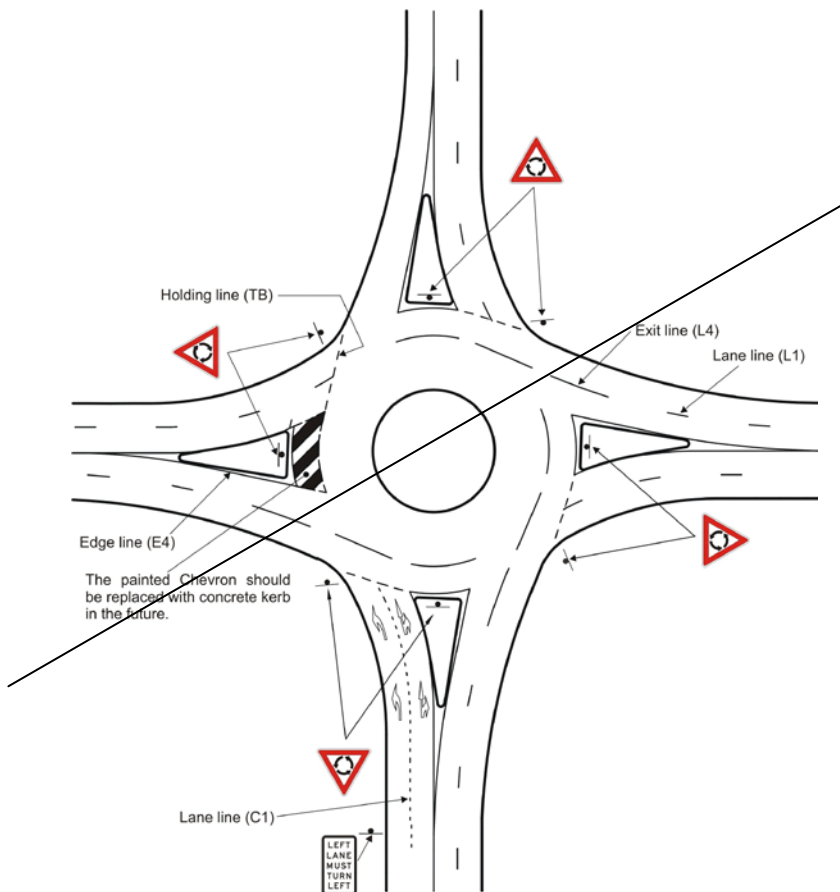


NB: Pavement Markings at roundabouts shall be according to ACT Standard Drawings DS9-23, DS9-24

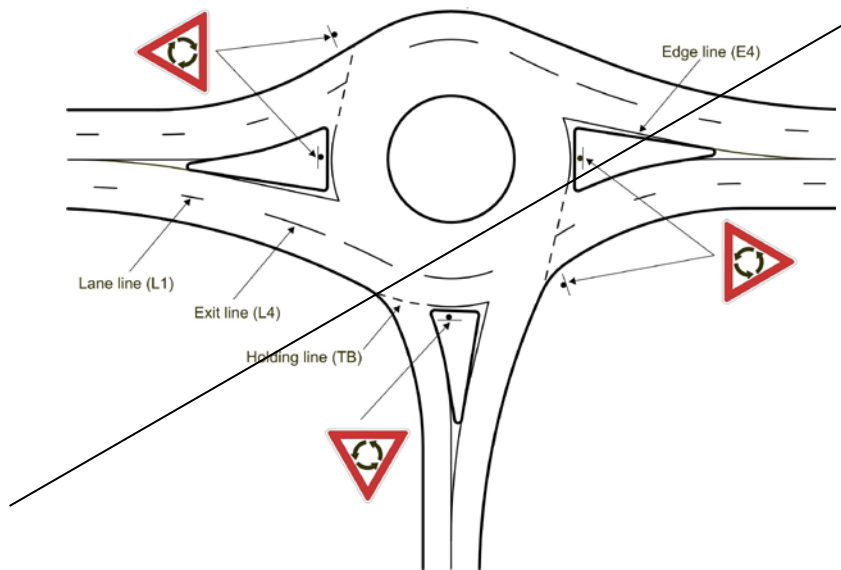
Roundabout pavement markings, two 2 lane entry/exits with two 1 lane entry/exits



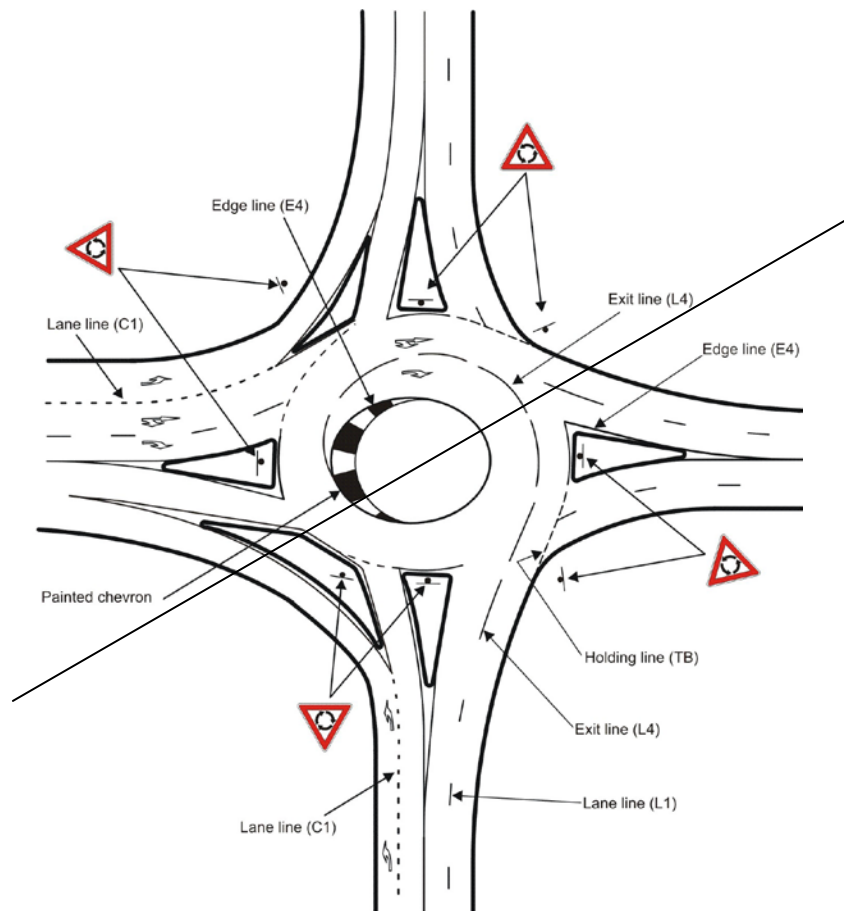
Roundabout pavement markings, four 2 lane entry/exit with one exclusive left turn lane



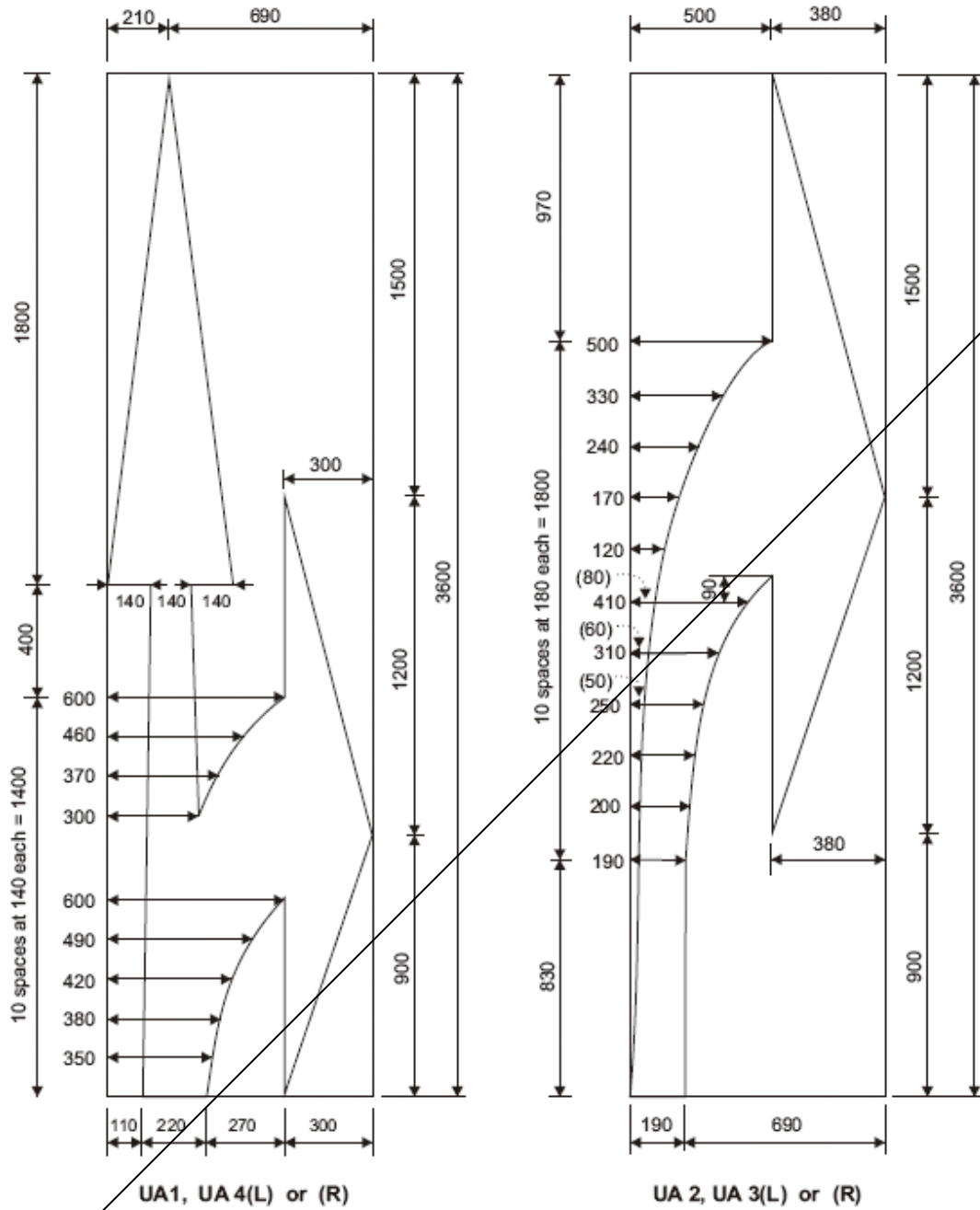
Roundabout pavement markings, T junction with two 2 lane and one 1 lane entry/exit



Roundabout pavement markings, dual right turn on one approach



FIGURES 9 TO 20

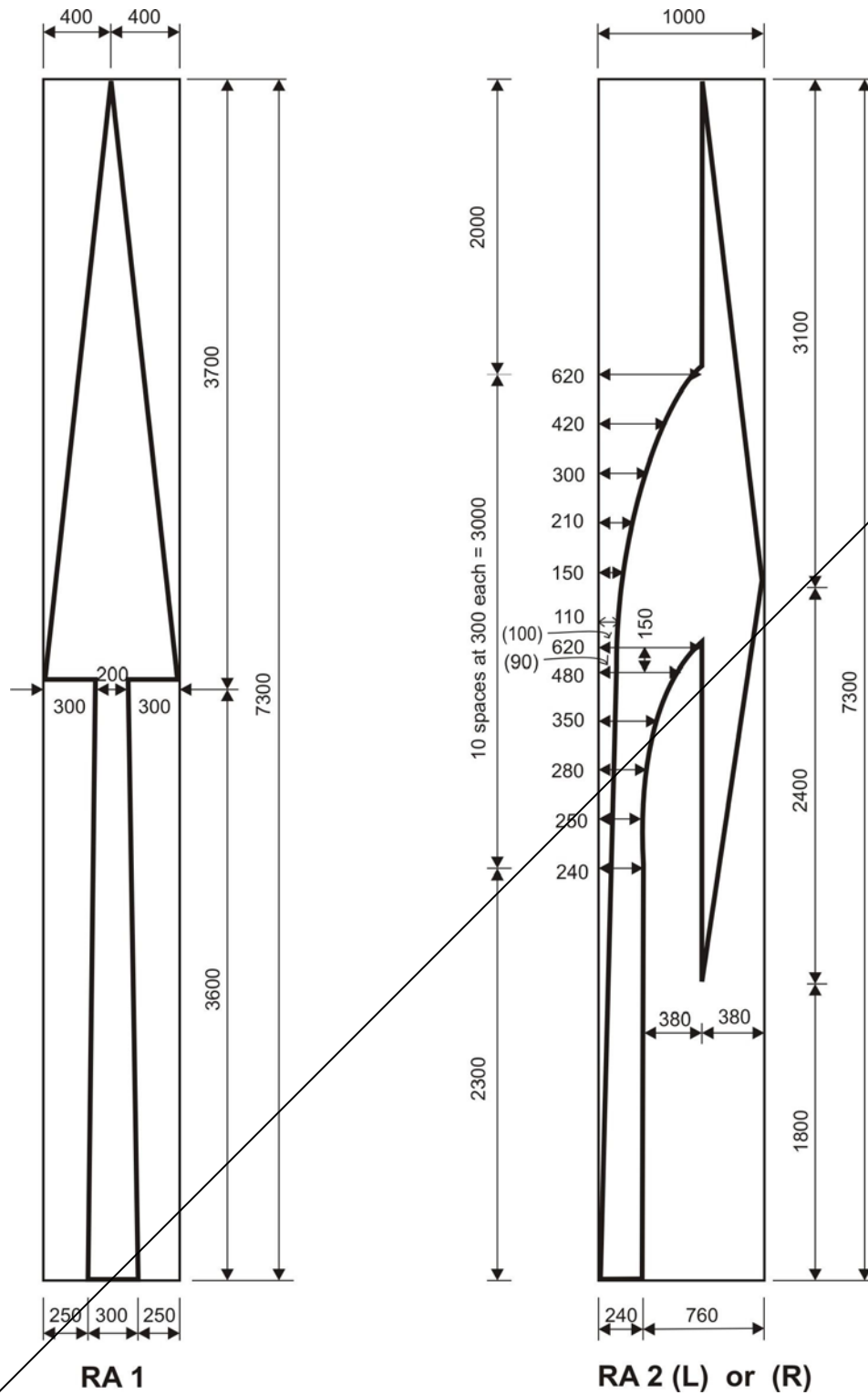


Measurements are in mm, unless otherwise stated

PAVEMENT ARROWS FOR THROUGH AND TURNING LANES AT URBAN JUNCTIONS

Figure 9

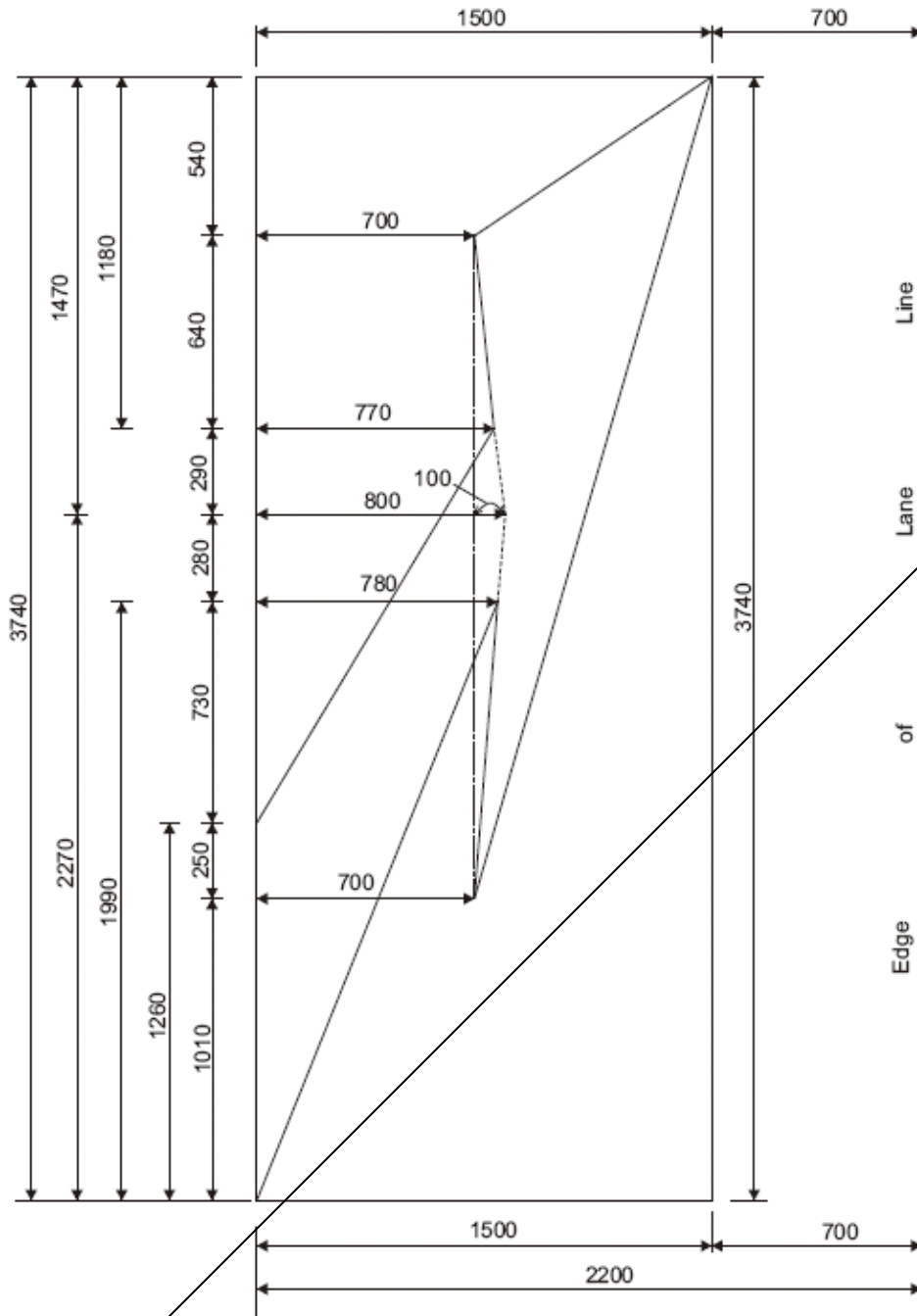
NB: Arrow sizes and shapes must be according to ACT Standard Drawing DS9-02



PAVEMENT ARROWS FOR THROUGH AND TURNING LANES AT RURAL INTERSECTIONS

Figure 10

NB: Arrow sizes and shapes must be according to ACT Standard Drawing DS9-02



NOTES

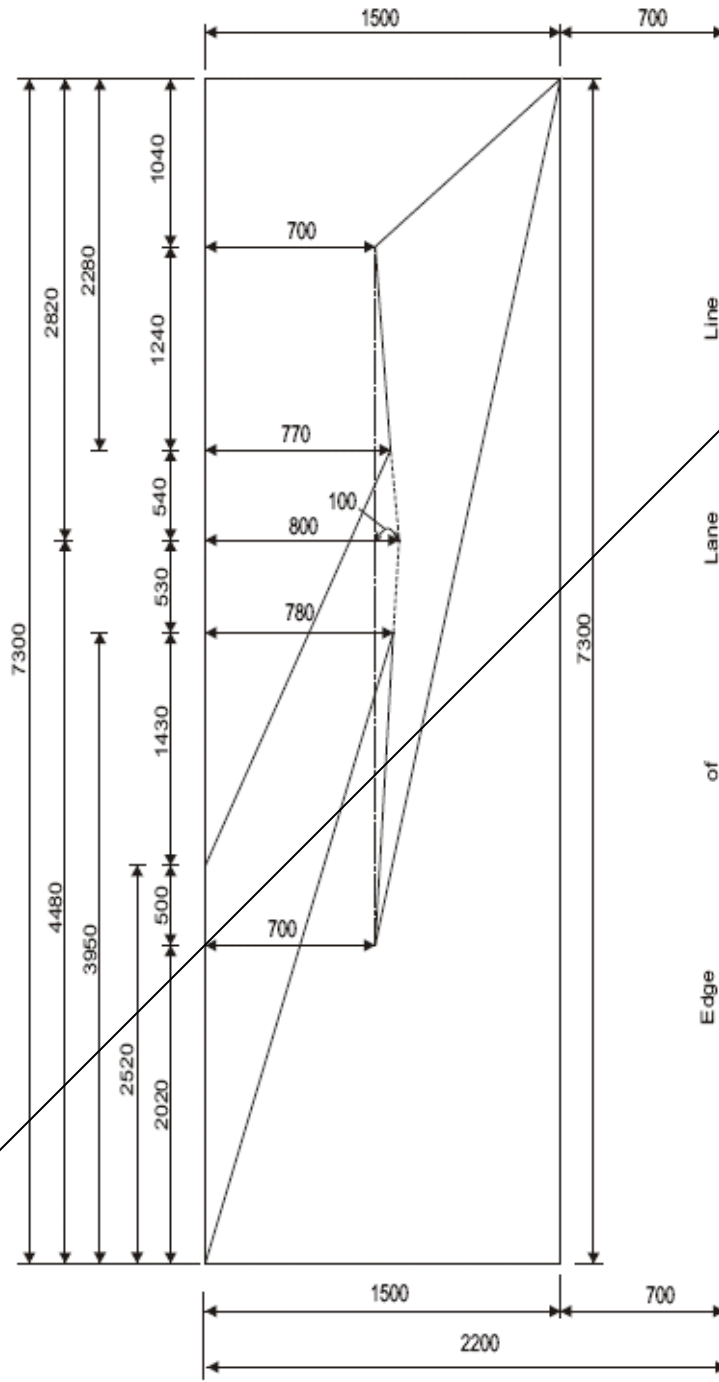
Measurements are in mm, unless otherwise stated

- If lane width differs from 3600mm, the distance to the base of the arrow should be varied from 2200mm, to be approximately 60% of the lane width.
- In installing the arrow it is suggested the head be laid first, then the tail. Dimensions to facilitate this are given on the sketch.

**LANE CHANGE ARROW (URBAN)
UA 5(L) or (R)**

Figure 11

NB: Arrow sizes and shapes must be according to ACT Standard Drawing DS9-02



Measurements are in mm, unless otherwise stated

NOTES

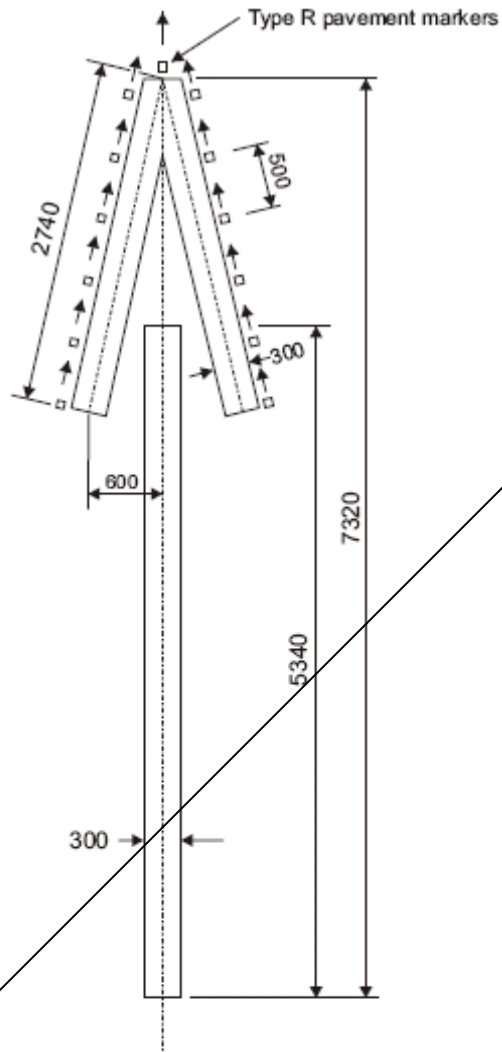
- If lane width differs from 3600mm, the distance to the base of the arrow should be varied from 2200mm, to be approximately 60% of the lane width.
- In installing the arrow it is suggested the head be laid first, then the tail. Dimensions to facilitate this are given on the sketch.

LANE CHANGE ARROW (RURAL)

RA 5(L) or (R)

Figure 12

NB: Arrow sizes and shapes must be according to ACT Standard Drawing DS9-02



Measurements are in mm, unless otherwise stated

PAVEMENT ARROW FOR USE ON ONE WAY ROADS
(For Restraint of Wrong Way Movements)

SA1

Figure 13

NB: Arrow sizes and shapes must be according to ACT Standard Drawing DS9-02

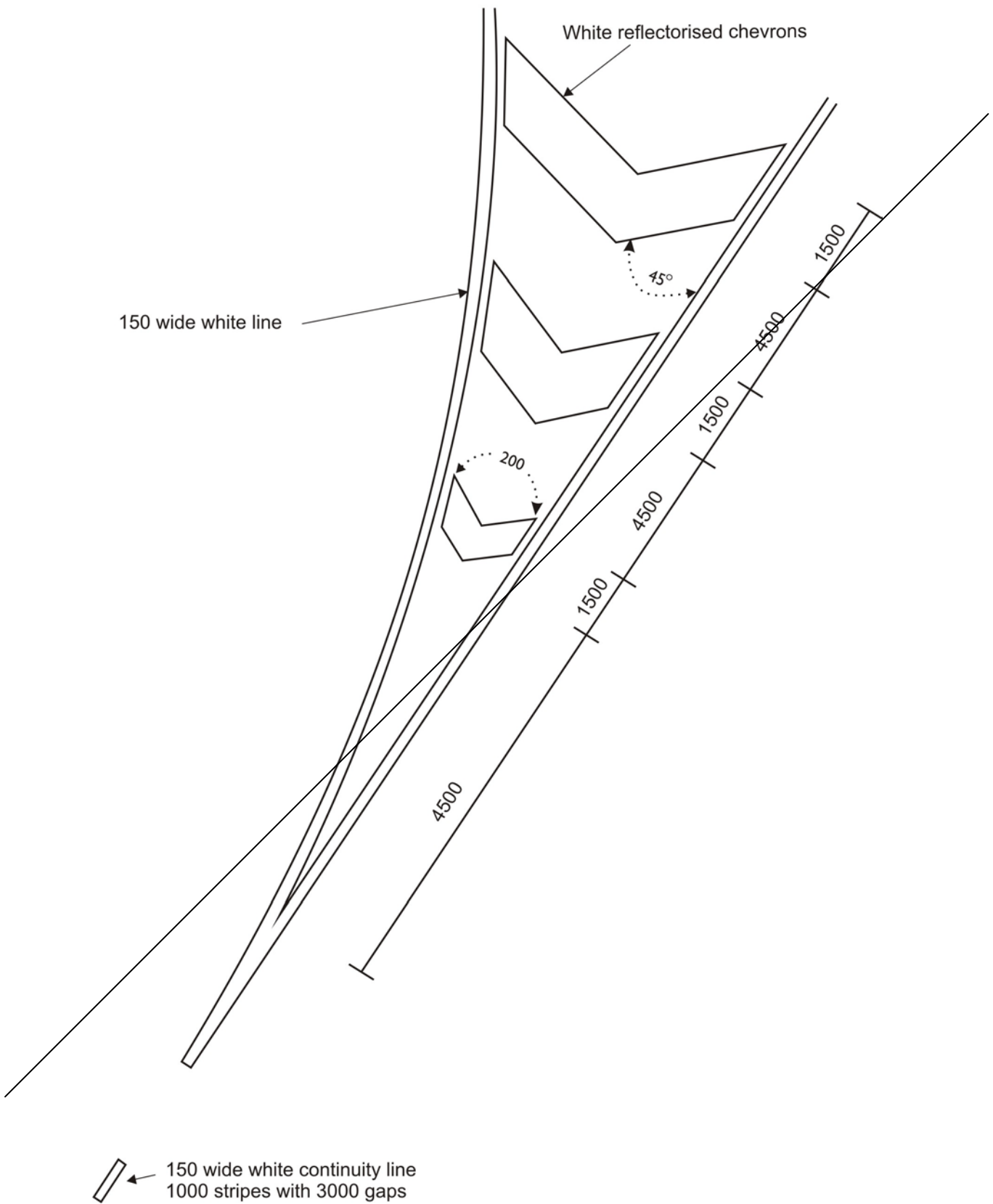


Figure 14

NB: Chevron details must be according to ACT Standard Drawings DS9-4 and DS9-05

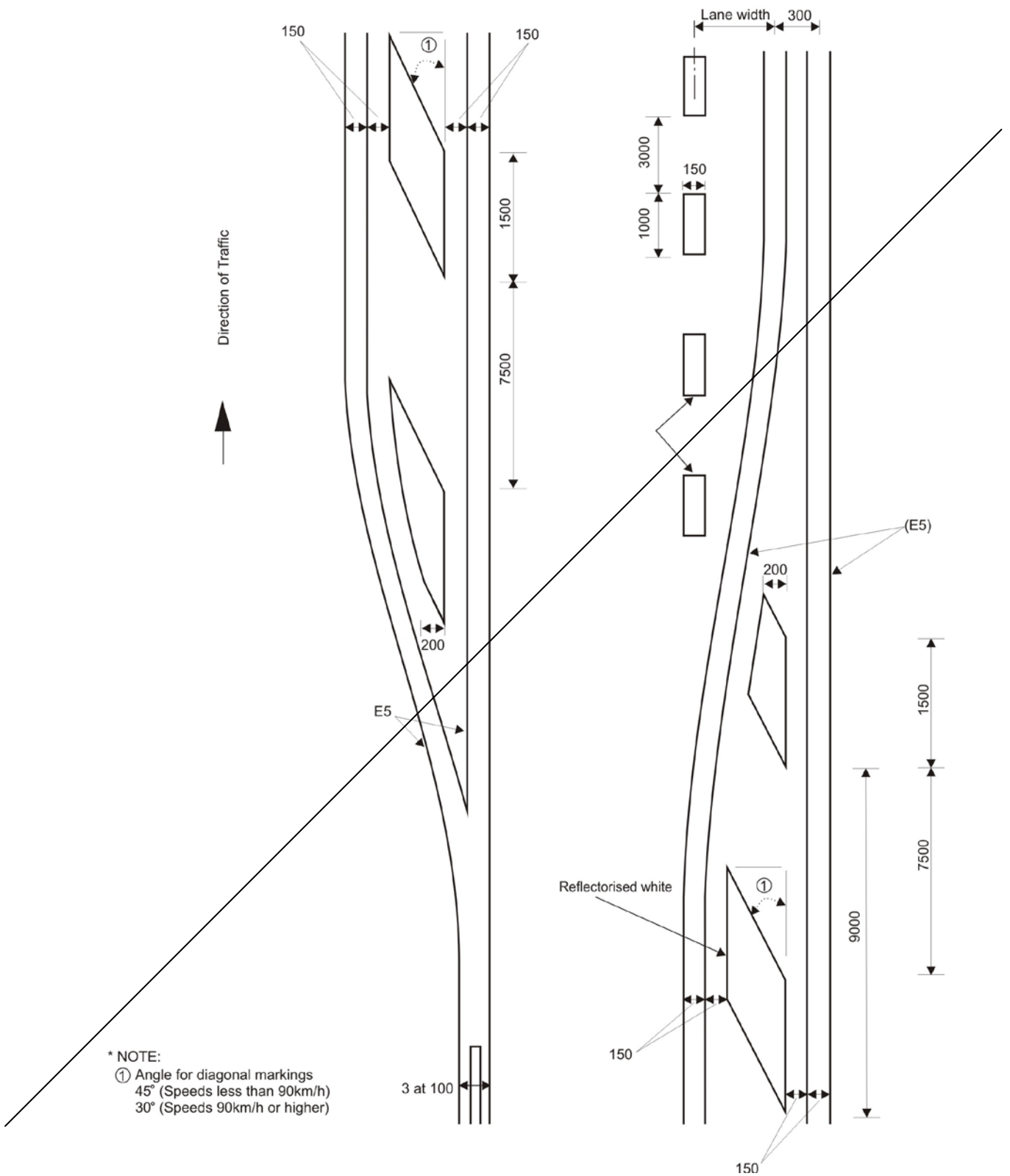


Figure 15

NB: Chevron details must be according to ACT Standard Drawings DS9-4 and DS9-05

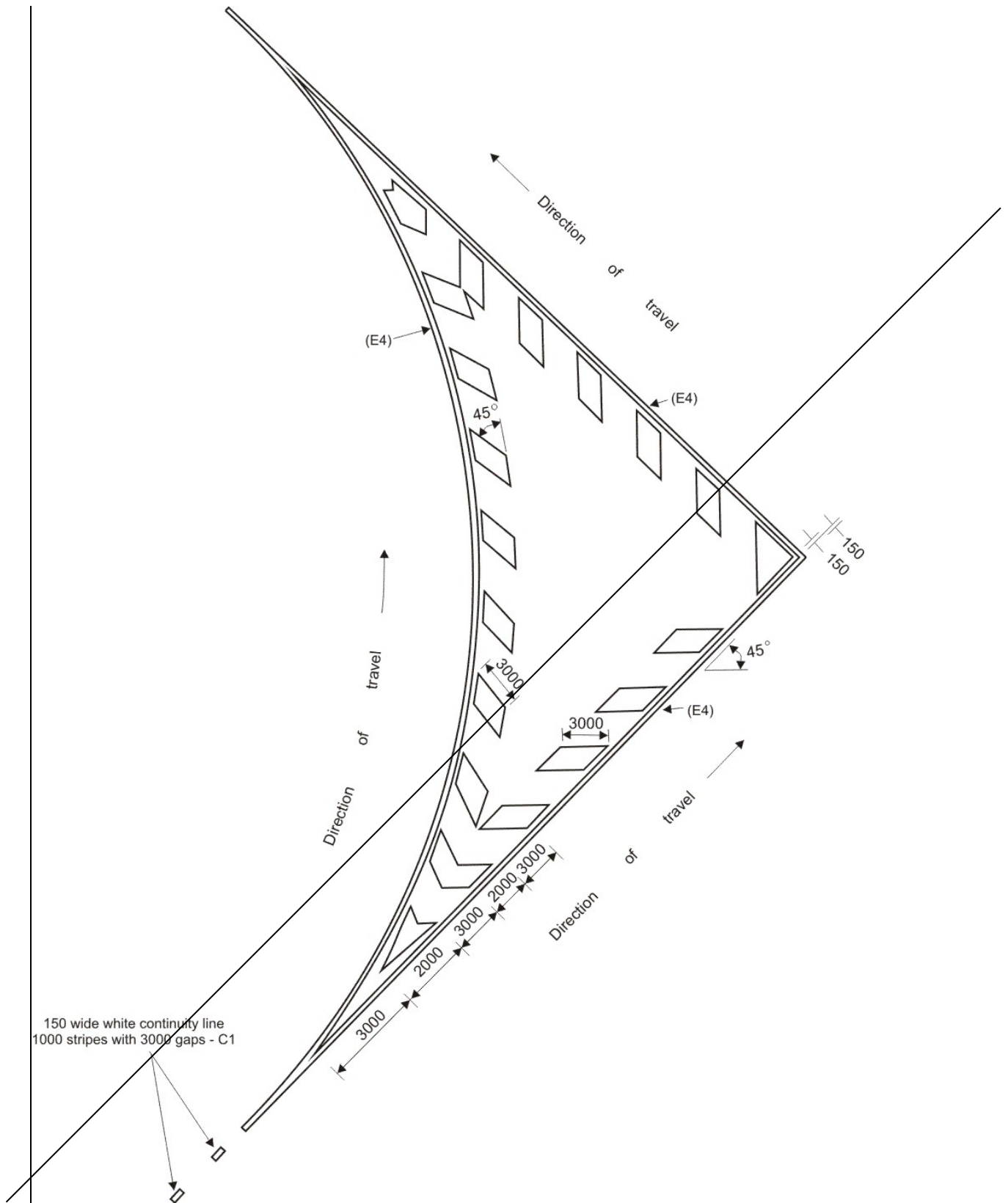
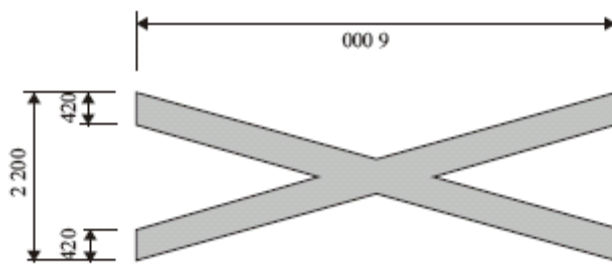


Figure 16

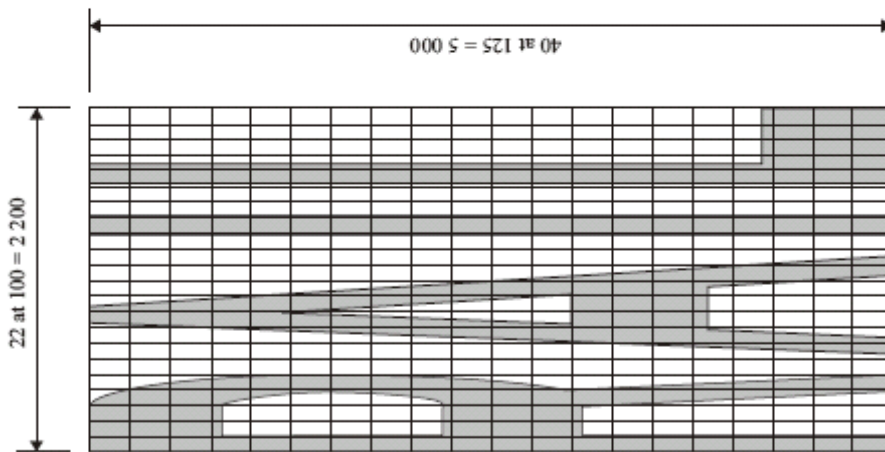
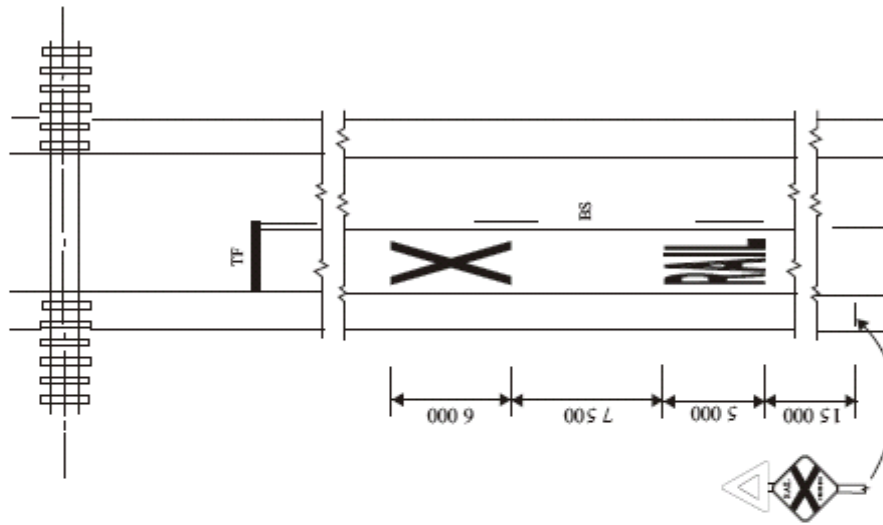
NB: Chevron details must be according to ACT Standard Drawings DS9-4 and DS9-05



SYMBOL
RAILWAY CROSSING
PAVEMENT WARNING SYMBOL

NOTES

1. Markings are to be located so that they will be visible to drivers of approaching vehicles for a distance of 150m.
2. The stop line shall be 300mm wide.
3. Except for the unbroken barrier line, all other pavement markings including the stop line shall be painted WHITE.

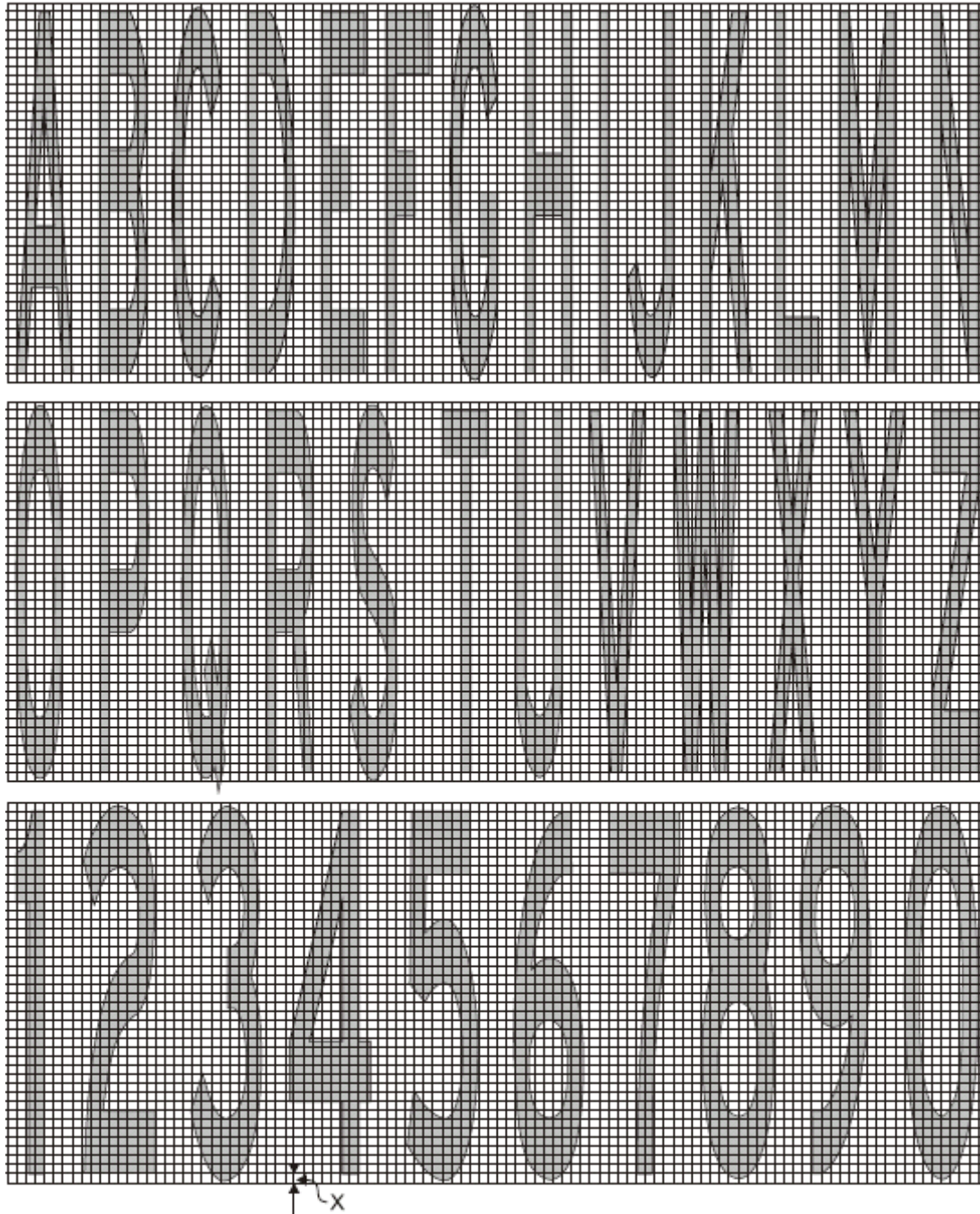


DEVELOPMENT OF LETTERS
RAILWAY CROSSING
PAVEMENT WARNING SYMBOL

Measurements are in mm, unless otherwise stated

**PAVEMENT MARKING IN ADVANCE OF
OPEN LEVEL CROSSINGS**

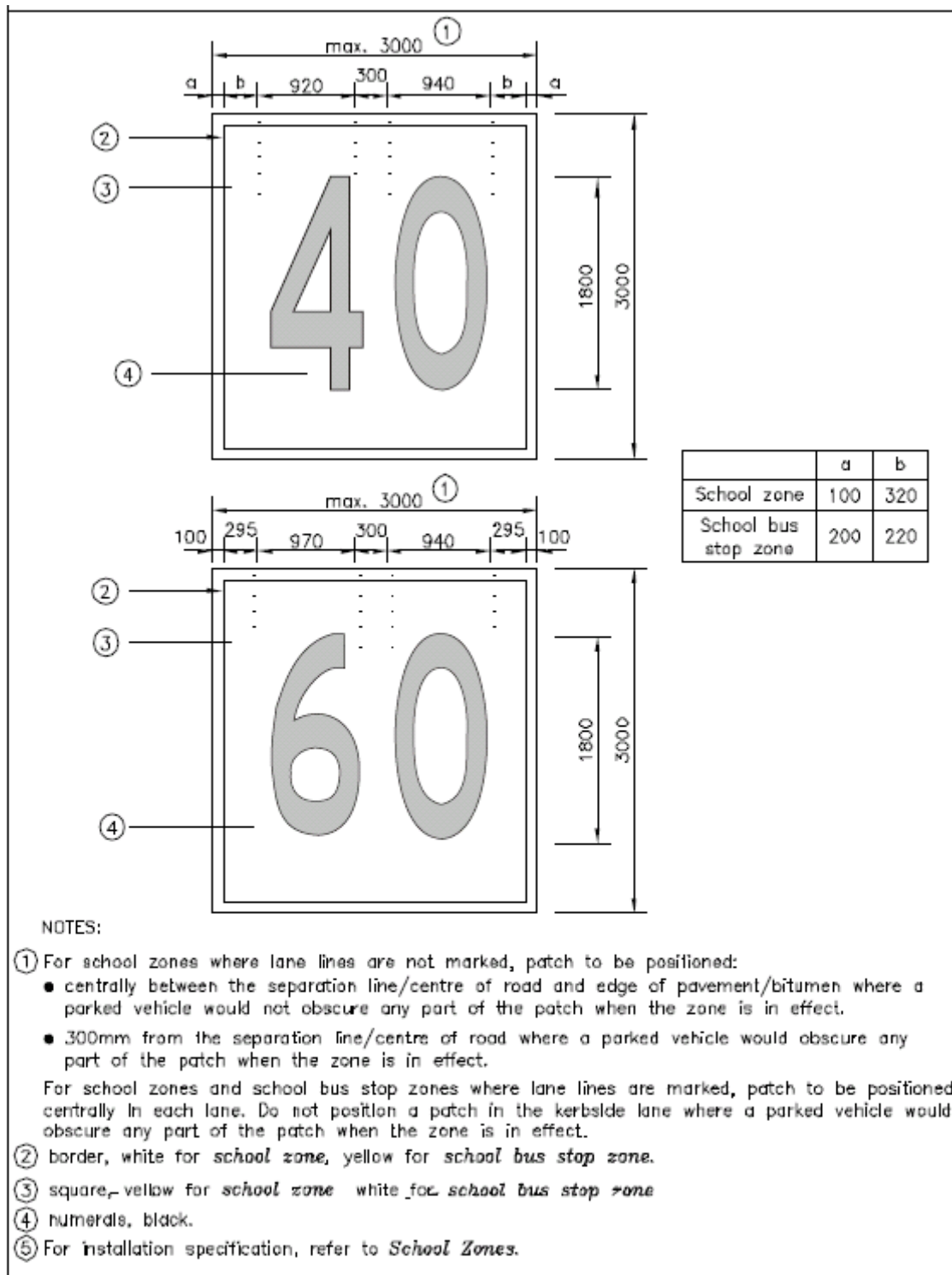
Figure 17



- Note: 1. The grid width is constant at 100mm but the grid height "X" may vary.
2. The grid height X = $\frac{\text{height of letter or numeral required in mm}}{40}$

PAVEMENT ALPHABET AND NUMERALS

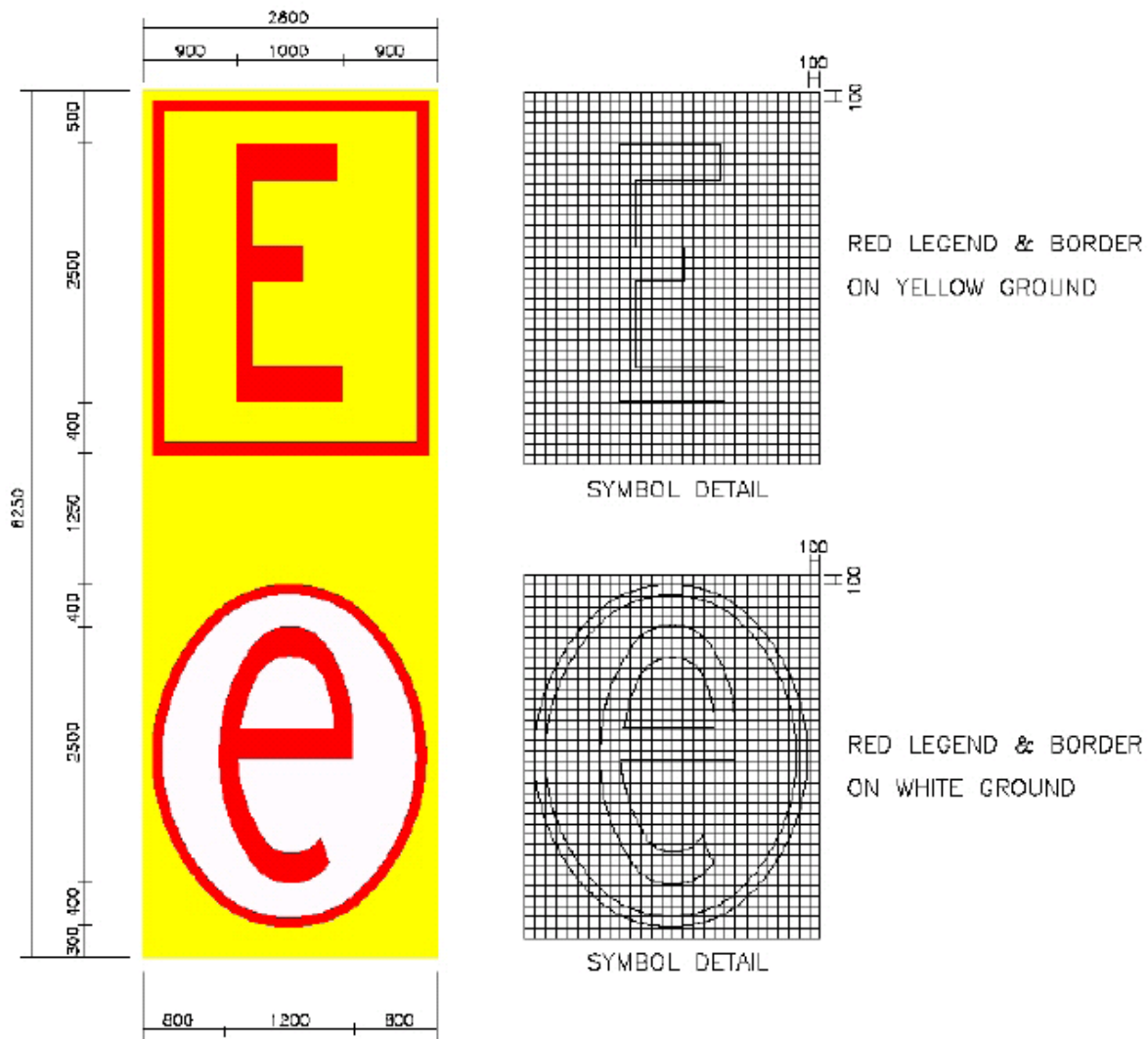
Figure 18



Measurements are in mm, unless otherwise stated

SCHOOL ZONE AND SCHOOL BUS STOP ZONE
SPEED NUMERAL PAVEMENT PATCH

Figure 19



RED LEGEND & BORDER ON YELLOW GROUND

The pavement marking shall be two (2) part cold applied plastic or thermoplastic material, conforming to RTA specifications 3360 or 3357 respectively. The pavement marking shall have retro-reflective and skid resistance properties as per Australian Standard AS4049.2

Measurements are in mm, unless otherwise stated

E-TAG PAVEMENT MARKING

Figure 20