

SPECIFICATION FOR HIGH PERFORMANCE ROADMARKING

1 SCOPE

This specification sets out the requirements for high performance roadmarkings for road safety. This specification applies to specialised pavement markings installed on roads with a traffic volume of > 5,000 v/day and where a traffic safety strategy has identified the need for improved delineation.

2 RELATED DOCUMENTS

TNZ M/7:2006	Specification for Roadmarking Paint.
TNZ M/7: Notes 2007	Notes to the Specification for Roadmarking Paint.
TNZ M/12: 1998	Specification for Raised Pavement Markers.
TNZ M/12 Notes: 2007	Notes to the Specification for Raised Pavement Markers.
TNZ M/20:2003	Specification for Long-Life Roadmarking Materials
TNZ M/20 Notes: 2003	Notes: The Specification for Long-Life Roadmarking Materials.
TNZ M/24:2006	Specification for Audio Tactile Profiled Roadmarkings.
TNZ M/24 Notes:2007	Notes to the Specification or Audio Tactile Profiled Roadmarkings.
TNZ P/14: 1995	Specification for Installation of Raised Pavement Markers.
TNZ P/14 Notes: 1995	Notes to the Specification for Installation of Raised Pavement Markers
TNZ P/20P: 2006	Pilot Specification for Performance Based Pavement Marking.
TNZ P/22:2006	Specification for Reflectorised Pavement Marking.
NZTA/NZRF T/8: 2008	Specification for Roadmarking Paint Application Testing.
TNZ T/12: 2003	Specification for Long-Life Roadmarking Materials Application Testing.
TNZ / LTSA Manual of Traffic Signs and Markings (MOTSAM).	
Land Transport Rule: Traffic Control Devices 2004 (TCD Rule)	
TNZ Code of Practice for Temporary Traffic Management	
I.S. EN 1436:2007	Road Marking Materials – Road Marking Performance for Road Users
AS/NZS 2009:2006	Glass beads for pavement-marking materials
ASTM E2176-01	Standard Test Method for Measuring the Coefficient of Retroreflected Luminance (R_L) of Pavement Markings in a Standard Condition of Continuous Wetting
NZTA Requirements for heavy metals (in press)	

3 DEFINITIONS

In this specification the following definitions shall apply:

Audio Tactile Profiled (ATP) Roadmarkings: Roadmarkings that provide all three of audio and tactile (vibratory) and visual information to road users.

Discontinuous ATP Roadmarkings (“lumps only”): ATP roadmarkings which comprise only the block or rib component without the stripe.

High Performance Roadmarkings: Roadmarking with specific retroreflective properties in compliance with this specification, excluding markings with audio tactile properties.

High Performance Roadmarkings including Condition of Rain: High performance markings for which the Engineer has deemed a requirement for a prescribed retroreflectivity under conditions of rain.

Expected Life (or Roadmarking’s Expected Life): The expected period of time during which the roadmarking shall continue to comply with the minimum specified performance criteria. The minimum expected life is to be specified by the engineer in the contract documents.

30 Metre Geometry: Retroreflectivity measured using an instrument having an illumination (Entrance) angle of 88.76° and an observation angle of 1.05° , where Entrance Angle β is the angle between the illumination axis and the retroreflectometer axis and the Observation Angle α is the angle between the illumination axis and the observation axis.

Luminance: The property of reflecting light as measured by Q_d when viewed by a driver under diffuse illuminance. The units of measure for luminance are millicandella/m²/lux – mcd/m²/lx.

Retroreflectivity: The property of reflecting illuminating light from a source, (usually vehicle headlights), back towards the source. The units of measure for retroreflectivity are millicandella/m²/lux – mcd/m²/lx. May be measured under three conditions; Dry (R), Condition of wetness (RW), Condition of rain (RR).

Condition of Wetness (RW) – Retroreflectivity determined for a pavement surface which has been uniformly wetted and allowed to drain (i.e. retroreflectivity measured 60 seconds after being flooded)

Condition of Rain (RR) – Retroreflectivity determined for a pavement which is being subjected to rain at a controlled rate.

Structured Pavement Marking: A pavement marking made by the formation of patterns, profiles, random texture or other features which when viewed by a driver appears as a continuous line.

High wear areas: any areas of the contract area which have a significantly higher rate of wear than the rest of the contract area. High wear areas are predictable and identifiable at the start of the contract (e.g. the inside curve of left hand bends).

Abnormal wear areas: any areas of the contract area where the rate of wear will be unpredictable due to external factors which themselves are unpredictable in their severity or occurrence (e.g. areas where snow clearing and ice gritting may occur).

4 WARRANTY

4.1 Normal Areas

The installation and maintenance of the markings applied under this specification shall be guaranteed by the contractor under the terms described by a contract schedule. The contractor guarantee shall bind the contractor in agreement to the principal and warrant that the materials used are fit for the purpose and that the markings will satisfy the performance requirements for the warranted period as specified in the contract documents but limited to a maximum of four (4) years.

4.2 High Wear areas

High wear areas will have a shorter warranty period than normal areas, as agreed with the Engineer. The Engineer may agree to variations for any extra work required during the warranty period on abnormal areas.

5 MARKING SYSTEMS

Work carried out under this specification comprises the supply and placement of a system of markings meeting the performance criteria outlined in the following sections.

The system applied shall be one of or a combination of any of the following:

- Traditional (“flat”) roadmarkings delivering high performance in wet and dry night time conditions.
- Structured roadmarkings
- Discontinuous ATP roadmarkings
- Preform materials and tapes for roadmarking
- Profiled roadmarkings
- Markings designed for visibility in falling rain.

The locality of the markings to be placed and the systems to be used within the contract area shall be as specified in the contract documents and drawings.

Where a marking system consists of a combination of marking types, e.g. traditional flat markings in combination with audio tactile profile blocks only, the individual

marking types of the marking system must meet the relevant performance criteria of this specification.

5.1 MOTSAM and the TCD Rule

Markings shall be applied in accordance with MOTSAM and the TCD Rule or as otherwise specified, except that all markings shall be reflectorised so as to meet the performance requirements of this specification.

5.2 Inclusion of Condition of Rain Requirements

Where a traffic safety strategy has identified the need for improved delineation during periods of rain, the areas selected to have markings which require specified performance under “Condition of Rain” shall be specified in the contract.

For such areas the conditions specified under Section 7 shall apply in addition to those specified in Section 6.

6 REQUIREMENTS OF HIGH PERFORMANCE ROADMARKINGS

High performance markings shall meet the following requirements:

6.1 Width of Markings

All markings applied in accordance with this specification shall be at a minimum of 150mm wide.

6.2 Product

The markings applied shall be one of the following:

- (a) A Transit or NZTA type approved product, listed in the notes to either:
 - TNZ M/20:2003 Specification for long-life Roadmarking Materials.
 - TNZ M/7:2006 Specification for Roadmarking Paint, or.
- (b) A product given provisional approval by Transit or the NZTA and for which a trial of the product is being conducted, or will be conducted within the contract. Applications for provisional NZTA Type approvals may be made to the NZTA Engineering Policy Manager (engineeringpolicymanager@nzta.govt.nz).

The glass beads shall comply with the requirements of AS/NZS2009 and the current NZTA Policy and Testing Regime for Heavy Metals.

6.3 Performance Criteria

High performance roadmarkings at any time during the expected life of the markings shall comply with the following minimum performance criteria:

6.3.1 Night Time Visibility

Retroreflectivity (dry – R): A minimum of 150 mcd/m²/lux.

Retroreflectivity (condition of wetness – RW): A minimum of 80 mcd/m²/lux.

Retroreflectivity shall be measured and recorded in accordance with Appendix C of TNZ M/20.

Where retroreflectivity is surveyed by a mobile device, the instrument must be 30 metre geometry. Any areas of concern identified by a mobile retroreflectometer shall be validated by further testing by a hand-held retroreflectometer used in accordance with Appendix C of M/20.

6.3.2 Day Time Visibility

Qd of 100 mcd/m²/lux, or, when viewed dry or wet in daytime, the roadmarking shall be readily visible for a forward distance of 150 m, or as far forward as possible until obstructed by the road geometry if less than 150 m.

6.3.3 Colour

Daytime colour.

- (a) White roadmarkings: The colour of white roadmarkings must fall within the colour boundary described by discolouration of not more than 4/5 (using *ISO 105-A03: Grey scale for assessing staining*) from colour Y35 of *AS 2700S: Colour standards for general purposes*.
- (b) Yellow roadmarkings: The colour of yellow roadmarkings must fall within the colour boundary described by a discolouration of not more than 4/5 (using *ISO 105-A03: Grey scale for assessing staining*) from colour Y13 – Y14 of *AS 2700S: Colour standards for general purposes*.

The method of assessment for white and yellow roadmarkings is set out in Appendix 2 of M/20.

Night-time colour

When viewed under normal headlights at night-time, roadmarkings shall substantially retain their daytime colour.

6.3.4 Skid Resistance

The skid-resistance of the marking when applied to the pavement surface shall be either:

- (a) 45 BPN or greater for roadmarkings with a dry film thickness of less than 0.9 mm; or

- (b) 50 BPN or greater for roadmarkings with a dry film thickness of 0.9 mm or greater.

6.3.5 ATP Block Loss

Where ATP markings are part of the system:

- Maximum permitted block loss is 5% within each km, with no more than 10 missing blocks in sequence.

6.3.6 Loss of ATP Block Height

Where ATP markings are part of the system:

- Blocks shall remain at an effective height above the pavement surface of greater than 4mm.
- Maximum permitted non-complying blocks are 5% within each km, with no more than 10 non-complying blocks in sequence.

7 HIGH PERFORMANCE MARKINGS REQUIRING PERFORMANCE IN THE CONDITION OF RAIN (RR)

Where the contract documents specify high performance roadmarking including a requirement for performance in the Condition of Rain the contractor shall supply and place markings that meet the requirements specified in 6.3 with the following additional requirement:

7.1 Night Time Visibility in Condition of Rain

Reflectivity (condition of rain – RR): A minimum of 80 mcd/m²/lux.

Retroreflectivity shall be measured and recorded in accordance with

1. EN1436 Road Marking Materials – Road marking performance for road users B7 Condition of Rain (20mm/hr), or
2. ASTM E2176–01 : Standard Test Method for Measuring the Coefficient of Retroreflected Luminance (R_L) of Pavement Markings in a Standard Condition of Continuous Wetting (1inch/hr).

8 AUDIO TACTILE PROFILED MARKINGS

8.1 Audio Tactile Profile Marking Product

Where the contract documents call for audio tactile profiled markings, the markings applied shall be one of the following:

- (a) An approved product under TNZ M/24:2006 Specification for Audio Tactile Profiled Roadmarkings, or.
- (b) A product given provisional approval by Transit or the NZTA and for which a trial of the product is being conducted, or will be conducted within the contract. Applications for provisional NZTA Type Approvals

may be made to the NZTA engineering Policy Manager
(engineeringpolicymanager@nzta.govt.nz).

8.2 Audio Tactile Profile Marking Formats

Audio tactile profile markings shall be applied as described by MOTSAM and the TCD Rule, and in addition shall comply with the following requirements:

8.2.1 Audio Tactile Profile Marking Edgeline:

Edgeline dimensions:

- 150 mm wide profiles.
- Blocks to be placed on or beside the flat or structured marking, such that a minimum of 3.35 metres of lane width is maintained between centreline and edgeline ATP block edges. (i.e. not centre to centre).

Interblock spacing

The pitch of the blocks will be specified by the engineer for each section of the network and the pitch specified will be either 250 mm or 500 mm.

8.2.2 ATP Centrelines:

No Overtaking Lines:

- The ATP marking shall be superimposed on the no overtaking lines.
- If the ribs are wider than the no overtaking line then the ribs shall project into the traffic lane maintaining a clear 100mm gap between the double lines
- ATP may be applied to a single no-overtaking line, as specified by the Engineer.

White ATP Broken Centrelines:

- Interblock pitch is to be 250mm
- 200mm wide ATP block over 100 mm flat or structured marking, with the overhang clearly showing the existence of the profile.
- A raised retroreflective pavement marker (RRPM) is to be placed at the start of the intermittent stripe with a minimum spacing of 20 metres. The spacing of the RRPM's shall be specified in the contract documents.

9 COMPATIBILITY

Tenderers are required to provide information in their tenders confirming the generic roadmarking material types that their marking materials are compatible with (for use in the case of a remark over existing roadmarking). Tenderers shall note any special preparation that may be required to be applied to existing markings prior to remarking with the high performance roadmarking system proposed.

10 QUALITY ASSURANCE REQUIREMENTS

10.1 Documented System

The roadmarking work shall be carried out by a Contractor who has in place, an approved Quality Assurance System that has been certified by an Approved Agency and is available for inspection and review by the Engineer. Quality Assurance System means AS/NZS ISO 9001: Quality management systems incorporating the technical requirements of the New Zealand Roadmarkers Federation's Quality Assurance Programme.

Approved Agency, for certification of the Quality Assurance System, means either a Joint Accreditation System of Australia and New Zealand (JAS-ANZ) accredited agency or an agency approved by Transit New Zealand.

10.2 Verification of Achievement of Quality

The contractor shall include in their quality control system a process which verifies and reports on quality as follows:

10.3 Visual Inspection

The contractor shall inspect all new markings and remarking visually prior to the removal of temporary traffic control to ensure that the intended quality has been achieved. This inspection shall verify that the line is correctly placed, is of the correct dimensions including thickness, and contains on the surface those necessary ingredients properly distributed to impart properties such as skid resistance and retroreflectivity.

10.4 Reporting Compliance of Long-life or Audio Tactile Profiled Markings

(a) Complying Markings

The contractor will advise the engineer, within 7 days of application, of any areas at which complying new markings or remarking have been laid.

(b) Non Complying Markings

The contractor will advise the engineer of any markings laid which may not conform with the specification. Any markings that may not be compliant shall be identified and the engineer advised as stated below:

- Within 12 hours of detecting markings that may be non compliant, or
- Within 12 hours of receiving test reports showing non compliance.

The contractor will also advise the engineer, at the time of advising of the non-conforming marking, of the steps that will be taken to rectify any deficiencies and the timing of these steps.

Notwithstanding the above, if the contractor believes the deficiency is such that a significant major traffic hazard exists then the engineer shall be advised immediately.

11 PLANT AND EQUIPMENT

Roadmarking applications applying paint, long-life or audio tactile profiled markings shall comply with the following requirements:

- Paint shall be applied with applications holding a current T/8 Certificate issued in accordance with NZTA/NZRF T/8 Specification for Roadmarking Paint Applicator Testing.
- Long-life and audio tactile profiled markings shall be applied with applicators holding a current T/12 Certificate issued in accordance with TNZ T/12 Specification for Long-Life Roadmarking Applicator Testing.

12 TRAFFIC CONTROL

At all times during application of markings specified under this specification the contractor shall take responsibility to ensure all traffic control is carried out in accordance with NZTA's requirements for temporary traffic management and the contract documents.

13 SETTING OUT

Unless specified otherwise, markings shall be placed at the same location as the previous markings. If the existing markings are obviously incorrect, clarification shall be obtained from the Engineer before proceeding.

Before commencing installation of new roadmarking, the contractor shall set out all markings with paint spots or other appropriate methods to ensure start, finish, and orientation is defined. These spots shall be at a spacing of 10m or less on curves.

Location requirements for new marking with respect to specified location are:

1. transverse location ± 20 mm
2. longitudinal location ± 50 mm
3. all lines shall appear by eye to be straight, or where designed as a curve, curve is smooth between each transition from straight to curve.

14 DIMENSIONAL TOLERANCES

The maximum permitted dimensional tolerances shall be:

- (a) gap length between segments where:
 - (i) gap is 3.0 m or more ± 300 mm;
 - (ii) gap is less than 3.0 m but greater than 1.0 m ± 150 mm;
 - (iii) gap is 1.0 m or less ± 50 mm.

- (b) length of segments;
 - (i) segment is longer than 5.0 m ± 150 mm;
 - (ii) segment is shorter than 5.0 m but longer than 1.0 m ± 75 mm;
 - (iii) segment is 1.0 m or shorter ± 50 mm.

- (c) paint line width:
 - all line widths + 10 % 5 %

- (d) long-life or audio tactile profiled line width:
 - all line widths + 10 % - 5 %

- (e) when markings already exist, within 15 mm of the average centreline of the existing marking;
- (f) for new markings when spotting out is provided by the Engineer, within 15 mm of the pilot line;
- (g) separation of centreline and no overtaking lines to be between 100 mm and 130 mm;
- (h) where raised pavement markers are placed between double yellow lines, the separation of the lines may be increased to a maximum of 130 mm;
- (i) where raised pavement markers are placed on paint lines the paint may be omitted for a length of 150 mm before and after the marker;
- (j) where raised pavement markers are placed on long-life or audio tactile profiled lines the long-life or audio tactile profiled may be omitted for a length of 300 mm before and after the marker;
- (k) any deviation beyond these permitted tolerances shall be corrected at the Contractor's expense.

- (l) ATP marking dimensions shall be as required by Section 6 of NZTA M/24:2006.

15 MONITORING OF MARKINGS

The Contractor shall monitor the performance of the roadmarkings. For this Specification monitoring is the process by which the delivery of roadmarkings with the required properties is substantiated. Monitoring is the systematic assessment of performance of the roadmarkings, by examination of the roadmarkings, the taking of measurements, and recording and charting measurement results and comparing the performance being achieved with that expected as outlined in Section 6.3.

The Contractor shall establish Monitoring Site locations as described in Appendix 1 and shall undertake the specific testing as set out in that Appendix.

In addition to this testing the Contractor shall visually inspect the Contract Area roadmarkings at appropriate intervals to identify that the deterioration occurring at the Monitoring Sites is typical of the Contract Area and if not then schedule appropriate remedial action.

15.1 Reporting of Results

The results of all assessments and measurements made during assessments shall be reported to the Engineer in a timely manner. The Engineer may agree, or request, for these measurements to be appropriately summarised.

16 NON-CONFORMING MARKINGS

The contractor shall be responsible for identifying and correcting markings that do not comply with the contract conditions.

Records of non-conformance and remedial action shall be maintained.

Any roadmarking materials on the pavement surface, as a result of the contractor's operations, outside the area of the specified markings and tolerances shall be removed before any payment is made.

All roadmarking removal shall be carried out in accordance with the New Zealand Roadmarkers Federation Line Removal Guide.

The Contractor shall not be held responsible for roadmarking defects where it can be shown that the defect can be directly attributed to:

- On-road-operations such as gritting or snow-ploughing; or
- Road/pavement-behaviour such as bleeding, cracking or rutting; or
- Pavement surface or substrate failure such that ATP markings are punched into the pavement surface: or
- Tampering by a third party or unreasonable and unexpected trafficking
- Abnormal conditions.

17 DEFECTS LIABILITY PERIOD

The contractor shall carry out twelve monthly inspections of the completed works during the Defects Liability period and any work required to maintain the works to the specified standard.

If at any time during the defects liability period intervention by the Contractor is required due to loss of specified performance criteria the Contractor shall:

- respond within 48 hours with positive action to mitigate and control the risk to the road users.
- undertake corrective repairs when conditions permit the most appropriate repair to be successfully completed. These repairs must ensure the expected life of the markings is not compromised. If necessary these corrective repairs may be undertaken later in the defects liability period.

APPENDIX 1

TESTING OF ROADMARKINGS

1A. SCOPE

This Appendix outlines the monitoring and testing to be undertaken within NZTA P/30.

2A. INTRODUCTION

Testing for monitoring performance of the roadmarkings is undertaken at Monitoring Sites. The Monitoring Sites selected are to be representative of the roadmarking systems used for the normal, high-wear and low wear areas of the Contract Area.

3A. MONITORING SITE SELECTION

The monitoring site location can be any section of the network in the contract area but for high wear areas with a minimum of 2,000 AADT in the test lane, provided that (at the time of monitoring):

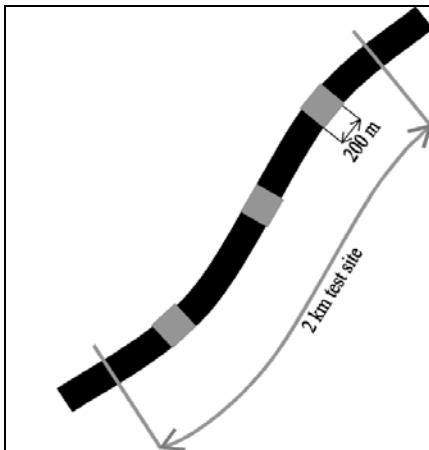
1. the road is subject to a speed limit of 80, 90, or 100 km/h;
2. the road should be trafficked by a minimum of 5 % heavy vehicles;

The contractor shall have full written authority from the Engineer and arrangements shall have been made such that:

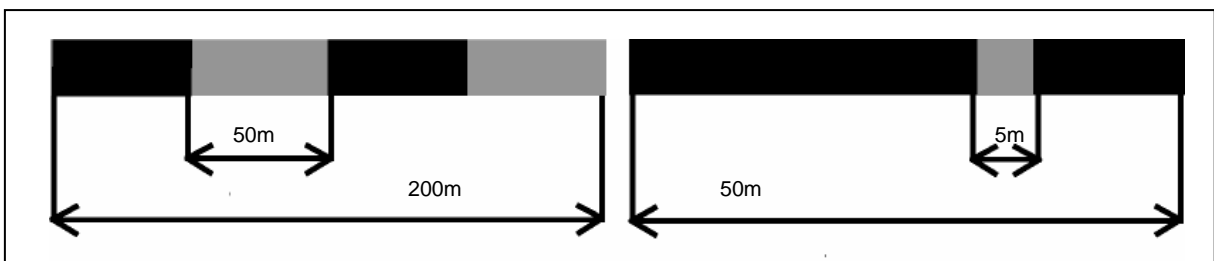
1. The roadmarkings will not be re-marked for the duration of the contract provided that the roadmarkings comply with Contractual requirements throughout the duration of the Defects Liability Period; and
2. The pavement at the test site will not be resurfaced for the duration of the contract provided that the condition of the pavement does not deteriorate to a condition requiring intervention throughout the duration of the contract period. (The risk of the resurfacing of the pavement at the test site during the trial period shall be carried by the roadmarking Contractor.)

4A. MONITORING SITE LAYOUT

1. Identify a 2 km test site.
2. Select three 200 m monitoring sites within the 2 km test site.



3. Divide each 200 m monitoring site into four 50 m sections.
4. Select a 5 m reading site within each 50 m section



The minimum continuous length for a monitoring site is to be 2 km and there must be three 200 m monitoring sites where the markings are subjected to medium wear. Medium wear areas will typically occur on edgelines and centrelines on straighter sections of road.

Test sites shall be selected to allow the testing of 150 m of forward view. This observation must be in the direction of the traffic flow. If 150 m forward visibility at the test site is obstructed by a curve, the observer may stand back from the start of the monitoring site to give the required 150 m of view into markings within the test site.

5A. MEASUREMENT EQUIPMENT

The measurement equipment shall be as set out in the methods of this Specification. All equipment shall be in current calibration when used to make performance assessment measurements.

6A. LOCATION OF MEASUREMENT POSITIONS WITHIN MONITORING SITES

Each 200 m monitoring site is to be divided into four 50 m sections. A 5 m length reading site typical of each 50 m section shall be selected. The location of the 200 m sections shall be defined by State Highway and reference to NZTA's route position system.

Site selection must avoid any unusual site conditions or constraints which may influence the field testing.

7A. PROCEDURE FOR ASSESSMENT OF RETROREFLECTIVITY

Retroreflectivity shall be measured and recorded in accordance with Appendix C of TNZ M/20.

Retroreflectivity shall be measured in the direction of the traffic.

Values for both R (dry) and RW (Condition of Wetness) are required.

Take 5 readings within the 5 metres and average to obtain 1 figure per reading site on both left hand edge line and right hand edge line. Record separately. Then average to obtain reading site result.

8A. OPTIONAL TEST: PROCEDURE FOR ASSESSMENT OF RETROREFLECTIVITY UNDER CONDITION OF RAIN

Retroreflectivity shall be measured and recorded in accordance with

1. EN1436 Road Marking Materials – Road marking performance for road users B7 Condition of Rain (20mm/hr), or
2. ASTM 2176– Test Method for Measuring Retroreflectivity of Pavement Markings in a Standard Condition of Continuous Wetting (1 inch/hr).

9A. PROCEDURE FOR ASSESSMENT OF COLOUR

The colour of the roadmarking shall be assessed by comparing under diffuse sunlight with the standard colour card and discolouration scale, and identifying the extent of discolouration from the standard colour.

10A. PROCEDURE FOR ASSESSMENT OF DAYTIME VISIBILITY

When viewed dry or wet in daytime the marking shall be readily visible for a forward distance of 150 m or a Qd of 100 mcd/m²/lux.

The method of measurement is set out in Appendix 2 of TNZ P/20 as test method B.

11A. PROCEDURE FOR ASSESSMENT OF ATP BLOCK LOSS AND BLOCK HEIGHT

The site is to be driven over in a passenger vehicle travelling at or near the 85percentile of the posted speed limit.

An observer is to note areas of significant blockloss for closer investigation.

If there is any concern with regard to audio tactile response, the height of the block from the pavement surface is to be determined using the block and wedge method or one having a similar or higher accuracy.

Take 5 readings within the 5 metres and average to obtain 1 figure per reading site on both left hand edge line and right hand edge line. Record separately. Then average to obtain reading site result.

12A. PROCEDURE FOR ASSESSMENT OF SKID-RESISTANCE

The skid-resistance shall be measured on the marking. The measuring shall be conducted using the instructions outlined in Instructions for using the portable skid-resistance tester, Road Note 27, Second Edition, Road Research Laboratory, Ministry of Transport (United Kingdom) 1969.