

| TNZ M/24: JULY 2006

SPECIFICATION FOR AUDIO TACTILE PROFILED ROADMARKINGS

1. INTRODUCTION

1.1 Scope of the Specification

This Specification applies only to audio tactile profiled (ATP) roadmarkings. These roadmarkings include rumble strips and are those that provide all three of audio *and* tactile (vibratory) *and* visual information to road users.

This Specification applies only to longitudinal ATP roadmarkings applied alongside the traffic lane. The Specification excludes transverse ATP roadmarkings applied across the traffic lane.

This Specification applies only to ATP roadmarkings where the profile is formed within the roadmarking material itself. The Specification excludes ATP roadmarkings formed by techniques such as paint over a textured road surface.

This Specification applies only to areas where ATP roadmarkings are required as identified in the Contract.

1.2 Outcome to be achieved

This Specification will ensure that ATP roadmarkings installed on New Zealand roads provide road users with effective audio, tactile, and visual information. The aim is for the performance of ATP roadmarkings to be consistent throughout the country and be reliable over the period of their design life.

When travelling upon ATP roadmarkings drivers will experience tactile effects felt within the vehicle, for example as vibrations felt through the vehicle and through the steering wheel. At the same time, drivers will experience audio effects in the vehicle, for example as a rumble-type noise. The combination of audio, tactile, and visual effects alerts drivers that they are crossing the edge of the travelled traffic lane. In addition, ATP roadmarkings will also provide drivers clear visual delineation information on the route ahead, in all lighting and weather conditions.

1.3 Definitions and abbreviations

The following definitions and abbreviations shall apply in this Specification:

- (a) *MOTSAM* is the "Manual of Traffic Signs and Markings".
- (b) *CoPTTM* is the "Code of Practice for Temporary Traffic Management".
- (c) *NZRF Line Removal Guide* is issued as an appendix to Section 12 of the New Zealand Roadmarkers Federation Inc. "Safety, Health and Environment Guide".

1.3.1 Audio tactile profiled (ATP) roadmarking terms

- (a) "Stripe" means the continuous line installed on the road surface.
- (b) "Blocks" means the intermittent raised bumps formed from material and installed on the road surface or stripe. The term block corresponds to the term "rib" in *MOTSAM*.

1.3.2 Dimensional terms

- (a) "Length" is measured along the road surface and parallel to the traffic flow.
- (b) "Pitch" means the length between consecutive blocks.
- (c) "Width" is measured along the road surface and perpendicular to the traffic flow.
- (d) "ATP roadmarking width" means the maximum width projected by a length of ATP roadmarking as provided by either block(s) or stripe or a combination of block(s) and stripe.
- (e) "Block height" means the maximum vertical distance between the top of the blocks and the immediate surface upon which the blocks are installed, whether that is the road surface or stripe.
- (f) "ATP roadmarking height" means the maximum vertical distance between the top of the blocks and the road surface upon which the ATP roadmarkings are installed.

1.3.3 Other terms

- (a) "High-wear situation" means a situation where roadmarkings are exposed to heavy trafficking, for example, ATP roadmarkings applied on a left-hand bending section of road as the edgeline of a traffic lane that is 3.5 m wide and is carrying 10,000 to 15,000 vehicles per day.
- (b) "Medium-wear situation" means a situation where roadmarkings are exposed to medium trafficking, for example, ATP roadmarkings applied on a straight section of road as the

edgeline of a traffic lane that is greater than 3.5 m wide and is carrying 2,000 to 5,000 vehicles per day.

- (c) "Engineer" includes any authorised representative of the Engineer to the Contract.

2. MATERIALS AND PROFILE-DESIGNS TO BE USED

All ATP roadmarkings to be installed must be of a material and of a profile-design Type-approved by Transit New Zealand and listed in the Notes to this Specification. The profile-design shown in *MOTSAM* is already approved. Therefore, ATP roadmarkings shall be either:

- (a) The profile-design as shown in *MOTSAM* and formed from a material that has been Type-approved by Transit New Zealand and listed in the Notes to this Specification. The basis for approval of a material is set out in Appendix A. *or*
- (b) A profile-design-and-material combination that has been Type-approved by Transit New Zealand and listed in the Notes to this Specification. The basis for approval of a profile-design-and-material combination is set out in Appendix B.

3. PLANT AND EQUIPMENT

The Contractor shall provide and maintain all plant and equipment required to complete the Contract. Temporary traffic management measures shall be in accordance with the specific Contract requirements.

ATP roadmarkings shall be installed by either machine-application or manual-application.

- (a) Plant and equipment for installing ATP roadmarkings by machine extrude, machine screed, or other machine-application methods shall comply with the requirements of *TNZ T/12: Specification for Long-life Pavement Marking Material Applicator Testing*.
- (b) Plant and equipment for installing ATP roadmarkings by manual screed, or other manual-application methods shall be approved in advance by the Engineer.

Each item of plant or equipment involved in the installation of the ATP roadmarkings shall, at the time of involvement, be certified compliant in accordance with the Standards or Specifications relevant to that item of plant or equipment.

At any time during installation and within three months of installation of ATP roadmarkings and within twelve hours of the Engineer's request, the Contractor shall provide free access to any item of plant or equipment involved in the installation of the ATP roadmarkings (including any certification of compliance for that item) for inspection by the Engineer.

4. QUALITY ASSURANCE OF INSTALLATION

The following requirements verify that the ATP roadmarkings have been installed as intended so that the ATP roadmarkings have the potential to deliver the expected performance.

4.1 Verification of achievement of Quality installation

The Contractor shall include in their Quality Control System processes that verify and report on the quality of the installation of the ATP roadmarkings. These processes would be expected to include coverage of all the issues identified in Clause 4.3, and 0. The timing of the reporting shall comply with Clause 4.4.3. The Contractor shall also maintain a Materials Record, as outlined in Clause 4.2 and detailed in Appendix C.

4.2 Materials Record

On each occasion that ATP roadmarkings are installed the Contractor shall maintain a Materials Record as part of the Quality Control System. The format and information required for the Materials Record shall be approved in advance by the Engineer. A sample of items that could be relevant for consideration within the Materials Record is set out in Appendix C.

The Contractor shall submit the Materials Record to support claims for payment. The Contractor shall also provide free access to the Materials Record for inspection by the Engineer.

4.2.1 Units

Throughout the Materials Record:

- (a) Volumes shall be recorded as litres or millilitres;
- (b) Mass shall be recorded as kilograms or grams;
- (c) Profile dimensions shall be recorded as millimetres;
- (d) Length of ATP roadmarkings installed shall be recorded as metres;
- (e) Temperature shall be recorded as degrees Celsius.

4.3 Pre-installation

Prior to commencing installation of any ATP roadmarkings within a new Contract, the Contractor shall conduct off-road trials to demonstrate to the Engineer that the ATP roadmarkings to be installed shall:

- (a) Match the dimensions of the nominated profile-design within the allowed dimensional tolerances; and

- (b) Be installed according to the material Supplier's directions.

4.4 Contractor's post-installation verification

4.4.1 Immediately post-installation

The Contractor shall perform a visual inspection of *all* newly installed ATP roadmarkings prior to the removal of any temporary traffic management measures. The inspection will verify the ATP roadmarkings that were installed:

- (a) Are correctly placed;
- (b) Match the dimensions of the nominated profile-design, including height, within the allowed dimensional tolerances; and
- (c) Contain on the surface those necessary ingredients properly distributed to impart properties such as skid-resistance and retroreflectivity.

If inspection of the ATP roadmarkings identifies any deficiency that could pose a significant hazard to road users then the temporary traffic management measures shall be left in place and the Engineer shall be advised immediately.

4.4.2 After 14 days, within 30 days

The Contractor shall perform an inspection of *all* ATP roadmarkings at least 14 days after installation but within 30 days of installation. The inspection will verify the installed ATP roadmarkings:

- (a) Are still in place and firmly adhered to the road surface;
- (b) Contain on the surface those necessary ingredients properly distributed to impart properties such as skid-resistance and retroreflectivity; and
- (c) Have maintained the original dimensions and profile.

4.4.3 Compliance and non-compliance

- (a) After the visual inspection of Section 4.4.1, the Contractor shall advise the Engineer of any installed ATP roadmarkings that are likely to comply within seven days of installation. This advice verifies that the Contractor considers the ATP roadmarkings have been installed as intended so that the ATP roadmarkings have the potential to deliver the expected performance.

- (b) The Contractor shall advise the Engineer of any installed ATP roadmarkings that may not comply within twelve hours of identification and of the steps that shall be taken to remedy any non-compliance or deficiency and the timing of these steps. The methodology of any remedy shall be agreed by the Engineer before the remedy is proceeded with.

Notwithstanding the above, if the Contractor identifies any deficiency that could pose a significant hazard to road users the Engineer shall be advised immediately.

4.5 Testing by the Engineer

4.5.1 After one month, within two months

The Engineer will inspect ATP roadmarkings at least one month after installation but within two months of installation. Inspection within each kilometre of ATP roadmarkings installed will verify:

- (a) Installed ATP roadmarkings produce both an audio effect and tactile effect inside a vehicle travelling upon a length of the ATP roadmarking at a speed appropriate for the road.

The audio and tactile effects experienced inside the vehicle will each be readily discernible above the levels of audio and tactile effects produced by travel upon the surrounding road surface.

Experience of the audio and tactile effects should start immediately on contacting the ATP roadmarking and be continuous through the period of contact.

Testing will be conducted using a car travelling upon ATP roadmarkings for about 3 seconds at a speed appropriate for the road.

- (b) When viewed from a vehicle during the day *and* also when viewed at night (in the absence of overhead lighting) with headlights on full beam, the installed ATP roadmarkings are clearly visible for a forward distance of the lesser of 150 m or as far forward as possible until obstructed by the road geometry.

If the site precludes use of headlights on full beam, when viewed from a vehicle during the night (in the absence of overhead lighting) with headlights on dipped beam, the installed ATP roadmarkings are clearly visible within the main illumination range of the dipped headlights or as far forward as possible until obstructed by the road geometry.

- (c) Any ingredients that were applied to the surface of the installed ATP roadmarkings to impart properties such as skid-resistance, audio effect, tactile effect, or retroreflectivity are still visually

detectable as properly distributed over the ATP roadmarking and securely held in the surface of the ATP roadmarking material.

The Engineer will also verify that:

- (d) Within any continuous five metres length of installed ATP roadmarkings no greater than five percent of the blocks will have lost firm adherence with the surface upon which they were installed.

If the Engineer identifies any non-compliance or deficiency of the installed ATP roadmarkings, the Engineer will investigate further in accordance with Transit New Zealand procedures.

The Engineer will confirm when it is deemed that the ATP roadmarkings have been installed as intended so that the ATP roadmarkings have the potential to deliver the expected performance.

4.5.2 Optional continued monitoring

Once the Engineer has confirmed the ATP roadmarkings have been installed as intended under Section 4.5.1, the Engineer may undertake continued monitoring of the installed ATP roadmarkings. This may include, and is not limited to, monitoring of aspects such as skid-resistance (for which a suggested methodology is set out in Appendix D), retroreflectivity (for which a suggested methodology is set out in Appendix E), forward visibility distance, profile dimensions, and other elements relevant to the performance of ATP roadmarkings.

4.6 Costs associated with providing Quality Assurance

All costs of tasks performed by the Contractor or on behalf of the Contractor for Quality Assurance of Installation shall be met by the Contractor.

All costs of tasks performed by the Engineer or on behalf of the Engineer for Quality Assurance of Installation that find compliance shall be met by the Engineer.

4.7 Remedial steps

The Engineer shall identify where the Contractor is responsible for correcting any installed ATP roadmarkings that do not comply with requirements. The Contractor shall advise the Engineer of the steps that shall be taken to remedy any non-compliance or deficiency and the timing of these steps.

The methodology of this remedy, including any material-installation or material-removal required, shall be approved by the Engineer before it is carried out. (Material-removal is discussed further in Section 5.5.2.)

5. INSTALLATION DETAILS

5.1 Traffic and public safety

At all times during the work or activities included in this Specification the Contractor shall take responsibility to ensure all traffic management is carried out in accordance with Transit New Zealand's requirements for temporary traffic management and any specific Contract requirements.

Control and protection of worksites shall also ensure that pedestrians and other road users are not exposed to hazards from installation of the ATP roadmarkings or associated operations.

When installing ATP roadmarkings as lane lines on multi-lane roads any plant or equipment shall not straddle the lane line being installed.

When installing ATP roadmarkings on roads having three lanes trafficked in the same direction any plant or equipment shall not travel in the centre lane.

When operating plant or equipment that requires air or material to be transported along flexible lines (hoses), these shall not cross any lane unless the lane is closed in accordance with Transit New Zealand's requirements for temporary traffic management and any specific Contract requirements.

For reasons of safety, or where excessive traffic delays are likely to occur, the Engineer may direct the Contractor regarding the type of plant or equipment to be used for installation or the material to be installed for specific ATP roadmarkings.

5.2 Preparation for installation

The Contractor is responsible for assessing that the installation surface and ambient conditions meet the requirements set in the Supplier's directions.

At the time of installing any ATP roadmarkings:

- (a) The installation area shall be free of all contamination, including moisture, oil, dirt, grease, curing compound and other matter that might adversely affect adhesion or durability of any ATP roadmarking;
- (b) The installation area shall be free of any accumulations of surplus chip or other coarse material; and
- (c) The Contractor is also responsible for assessing that the ambient weather and temperature conditions meet the requirements set in all directions from Suppliers.

5.2.1 Preparing existing roadmarkings prior to re-marking with ATP roadmarkings

Where ATP roadmarkings are to be installed as a re-mark of existing roadmarkings, prior to installation of the new ATP roadmarkings the existing roadmarkings shall be prepared as required to be compatible with the ATP roadmarkings to follow.

Preparation of the existing roadmarkings in readiness for the ATP roadmarkings to follow must be positive. It is not sufficient to rely on gradual incidental process, such as wear of the existing roadmarkings through trafficking or weathering, to produce the conditions that are compatible with the ATP roadmarkings to follow when this process allows roadmarkings to deteriorate well below normal acceptable. The existing roadmarkings must meet relevant requirements until installation of the new ATP roadmarkings begins or until that section of road is closed to allow surface preparation immediately prior to installation of the ATP roadmarkings.

5.2.2 Preparing existing profiled roadmarkings prior to re-marking

The Contractor shall seek approval from the Engineer for the technique by which the existing profiled roadmarkings shall be prepared to a condition that is compatible with the ATP roadmarkings to follow. The Engineer may request the Contractor to demonstrate the proposed technique and competence with that technique prior to granting approval.

Preparation techniques may deliver complete or partial removal of the existing profiled roadmarkings.

- (a) Complete removal of the existing profiled roadmarkings would leave the surface at the roadmarking locations matching the surrounding road surface; or
- (b) Partial removal could remove the raised profile "blocks" from the existing profiled roadmarking but leave the underlying "stripe".

5.2.3 Preparing a trafficked road surface for new ATP roadmarkings

Where ATP roadmarkings are to be installed upon an existing pre-trafficked road surface, prior to installation of the new ATP roadmarkings the road surface shall be prepared as required by the material Supplier's instructions to be compatible with the new ATP roadmarkings to follow.

5.2.4 Preparing a new road surface for ATP roadmarkings

When installing ATP roadmarkings on a newly laid road surface, the ATP roadmarkings shall be applied as soon as is recommended by the Suppliers of the ATP roadmarking material(s). If this is later than 48 hours after the new road surface is trafficable a temporary roadmarking shall be provided. Any temporary roadmarking that is installed shall be compatible with the ATP roadmarking to follow or

prior to installation of the ATP roadmarkings the temporary roadmarking and/or road surface shall be prepared as required to be compatible with the ATP roadmarkings to follow.

5.3 Setting out

Placement of ATP roadmarkings shall be in accordance with *MOTSAM* and as specified in the Contract.

All ATP roadmarking lines installed shall appear by eye to be straight or, where designed as a curve, a smooth curve.

5.3.1 ATP roadmarkings in previously unmarked locations

Where ATP roadmarkings are being installed at a location for the first time the Contractor shall set out the proposed roadmarking locations prior to installation of the ATP roadmarkings. The locations of proposed ATP roadmarkings shall be set out and pre-marked to ensure start, finish, and orientation are defined correctly and accurately.

5.3.2 ATP roadmarkings to re-mark or reinstate existing roadmarkings

Where ATP roadmarkings are being installed to re-mark or reinstate existing roadmarkings, the new ATP roadmarkings shall be placed at the same locations as the existing roadmarkings, within allowed tolerances (as in Section 6.1), unless specified otherwise. If any of the existing roadmarkings are obviously incorrect, the Contractor shall obtain clarification from the Engineer before proceeding.

If any of the existing roadmarking lines that are to be re-marked or reinstated with new ATP roadmarkings do not appear straight or as a smooth curve, the Contractor shall obtain clarification from the Engineer before proceeding.

5.4 Other installation details

- (a) Where adjacent passes are required to achieve the ATP roadmarking width or length required, the edges of passes shall be butted. Any overlapping of material between separate passes shall be avoided to prevent material build-up greater than that intended for the profile-design. In general, the ATP roadmarking width or length required should be achieved through the minimum number of passes.
- (b) Where moisture or material could accumulate along any continuous length of ATP roadmarking stripe, intermittent gaps shall be provided in the stripe in accordance with *MOTSAM* except that the gaps shall be spaced at 5 m intervals. Other methods to prevent accumulation of moisture or material along any continuous length of ATP roadmarking stripe are permissible but the method shall be approved by the Engineer before proceeding.

- (c) All ATP roadmarkings shall have an application of beads to impart initial visibility. The beads shall be dispensed to achieve optimum embedment. The beads shall be applied in such a way that they visually appear to provide the same visibility to traffic approaching from different directions and there is coverage of beads on the total surface area of the ATP roadmarking.
- (d) A suitable aggregate material may need to be added with the beads to ensure the initial skid-resistance values comply with Transit New Zealand requirements.
- (e) From the commencement and until the completion of installation of ATP roadmarkings, sufficient material and all necessary and associated plant and equipment shall be available such that installation of the ATP roadmarkings is achieved without unnecessary delays.
- (f) All relevant directions from Suppliers shall be adhered to.

5.5 Immediately following installation

5.5.1 Protection of newly installed ATP roadmarkings

Newly installed ATP roadmarkings shall be protected by means approved by the Engineer until the ATP roadmarking can be trafficked without effect to the ATP roadmarking.

5.5.2 Stray ATP roadmarking material

Any ATP roadmarking material installed outside of the ATP roadmarkings specified in the Contract (with tolerances of Section 6), as caused by mishap or the transfer of material by traffic or otherwise, shall be removed. Removal of this material must follow the principles outlined in the *NZRF Line Removal Guide* and the removal method must be approved by the Engineer before proceeding. The cover of stray ATP roadmarking material by another material will not be accepted. The Contractor shall be fully and solely responsible for removal of any stray ATP roadmarking material and the removal shall be completed to the Engineer's satisfaction.

Any ATP roadmarking material deposited onto any road feature, such as a raised pavement marker or service cover, shall be removed without damaging that feature. Following consultation with the Engineer, the Contractor shall be responsible for arranging replacement of any such feature that is either damaged in the course of installation of the ATP roadmarkings or damaged in the removal of stray ATP roadmarking material that was installed. The Contractor shall bear the costs of rectifying the consequences of stray material.

6. PLACEMENT AND DIMENSIONS

6.1 Placement

The placement requirements for ATP roadmarkings installed with respect to the specified locations are:

- (a) ± 15 mm in the transverse direction; and
- (b) ± 50 mm in the longitudinal direction.

Also:

- (c) Where raised pavement markers are placed on ATP roadmarkings the ATP roadmarking may be omitted for a length of 300 mm before and after the raised pavement marker.

6.2 Blocks

The blocks of an ATP roadmarking shall be formed with:

- (a) a block height not more than + 15 % and not less than – 5 % of the block height as per the approved profile-design, with a maximum ATP roadmarking height of 9 mm;
- (b) a block width not more than + 30 % and not less than – 20 % of the block width as per the approved profile-design, with a maximum ATP roadmarking width not more + 10 % and not less than - 5 % of the ATP roadmarking width specified;
- (c) a block length not more than + 30 % and not less than – 20 % of the block length as per the approved profile-design; and
- (d) a block pitch not more than + 5 % and not less than - 5 % of the pitch as per the approved profile-design.

6.3 Stripe

The stripe of an ATP roadmarking shall be formed with:

- (a) A stripe height or thickness not more than + 10 % and not less than – 5 % of the stripe height or thickness as per the approved profile-design, with a maximum ATP roadmarking height of 9 mm; and
- (b) A stripe width not more than + 10 % and not less than - 5 % of the stripe width as per the approved profile-design, with a maximum ATP roadmarking width not more than + 10 % and not less than - 5 % of the ATP roadmarking width specified.

7. PROGRAMMES OF WORK

The Contractor shall be provided with a Schedule to indicate the location, type of work, and the periods in which the work is to be carried out. Based on that information the Contractor shall submit a detailed Programme and shall obtain the approval of the Engineer before commencing work as specified in the Contract documents.

8. MAINTENANCE OF INSTALLED ATP ROADMARKINGS

8.1 Maintenance period

The maintenance period for ATP roadmarkings shall be a minimum of twelve months.

- (a) For Contracts of duration of three months or less, the maintenance period shall commence at the completion of all required ATP roadmarkings to the Engineer's satisfaction.
- (b) For Contracts longer than three months duration, the Contractor may apply at three-monthly intervals to have the maintenance period commence for any section of ATP roadmarkings completed to the Engineer's satisfaction.

8.2 Defects

Within the maintenance period, the Contractor shall be held responsible for ATP roadmarking defects of types including, but not limited to, installed roadmarkings that exhibit signs of:

- (a) Spalling, flaking, or any other form of deterioration (other than fair wear and tear) resulting in the ATP roadmarking not complying with the specified dimensional requirements;
- (b) Loss of surface beads or aggregate;
- (c) Loss of blocks or flattening of blocks;

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

- (d) On-road-operations such as gritting or snow-ploughing; or
- (e) Road/pavement-behaviour such as bleeding, cracking or rutting; or
- (f) Tampering by a third party or unreasonable and unexpected trafficking.

8.3 Maintenance requirements

ATP roadmarking defects shall be located by the Contractor (and/or the Engineer). Where the Contractor is responsible for the ATP roadmarking defects identified, the affected ATP roadmarkings shall be reinstated or re-marked in accordance with this Specification, at the expense of the Contractor.

Other ATP roadmarking defects shall be Scheduled for remedy.

The response time for reinstatement or re-marking, as maintenance operations, shall be 30 days or as agreed with the Engineer.

Appendix A: Material

Suppliers of material for use as ATP roadmarkings under this Specification shall seek Type-approval for the material from Transit New Zealand. Approved materials are listed in the Notes to this Specification. An Applicant seeking approval of a material shall submit to Transit New Zealand *either* of the following:

- (a) Documented evidence of a history of acceptable in-service use for the material.

The evidence shall show that ATP roadmarkings formed from the material had maintained their skid-resistance, audio, tactile, and visual performance for at least 12 months on a particular and stated type of road surface in a high-wear situation.

The evidence shall include test results of the material after at least 12 months service.

or

- (b) Documented evidence of successful trialling of the material.

The evidence shall give confidence that ATP roadmarkings formed from the material will maintain their skid-resistance, audio, tactile, and visual performance for at least 12 months on a particular and stated type of road surface in a high-wear situation.

Evidence shall include observations and measurements from periodic monitoring of the ATP roadmarking during the trial, for example at the time of the trial's initiation, 6 months after initiation, and then 12 months after initiation. The monitoring shall include measurement of skid-resistance, retroreflectivity, forward visibility distance, profile dimensions, and other elements relevant to the performance of ATP roadmarkings. Unless the profile-design formed for the trial is of standard design identified in *MOTSAM* the monitoring shall include measurements of the audio, tactile, and visual effects produced by the ATP roadmarkings.

The application for approval of a material shall include information on any known or likely incompatibilities with that material and any specific requirements for re-marking either likely existing roadmarkings or previous ATP roadmarkings formed from that material.

Opus International Consultants' Central Laboratories Report 03-527605: *Guidelines for Performance of New Zealand Markings* identifies suitable methods for measuring audio and tactile effects.

After 12 months in a high-wear situation, any diminishment of any of the skid-resistance, audio, tactile, or visual performance of the ATP roadmarkings formed from the material should only be minor.

All costs incurred for tasks performed within submitting an Application for approval of a material shall be met by the Applicant.

Approval for a material for use for forming ATP roadmarkings will only be granted by Transit New Zealand for a maximum period of ten years. When the approval expires, prior to continuing use of that material for forming ATP roadmarkings, another application seeking material approval must be submitted to Transit New Zealand in accordance with this Appendix.

Transit New Zealand may suspend approval for a material at any time if concerns about the material's performance arise. The Applicant who submitted the original application seeking approval for that material may submit additional evidence to Transit New Zealand, in accordance with this Appendix, to apply to have the material's original approval resumed. If this additional evidence is not approved or if additional evidence is not submitted, the original approval for the material will remain suspended. If additional evidence is submitted and approved, approval for the material will be resumed with the original approval expiration date remaining unchanged.

Appendix B: Profile-Design-and-Material Combination

A profile-design for ATP roadmarkings in addition to any identified in *MOTSAM* may be approved by Transit New Zealand and listed in the Notes to this Specification. An Applicant seeking approval of a profile-design must specify the material to be used in combination with that profile-design to form the ATP roadmarking. An Applicant seeking approval of a profile-design-and-material combination shall submit to Transit New Zealand *each* of the following:

- (a) A drawing of the profile-design equivalent to that of the profile-design drawing in *MOTSAM* with the dimensional tolerances with which that profile-design would be achieved;

and

- (b) The material to be used in combination with that profile-design to form the ATP roadmarking;

and

- (c) Evidence that the profile-design-and-material combination does not create any adverse effect for road users (including road users such as cyclists and motorcyclists) greater than any adverse effect produced by the profile-design in *MOTSAM* on a particular and stated type of road surface

LTNZ Research Report 273: *Balancing the Needs of Cyclists and Motorists* describes one method by which cyclist stability may be assessed.

and

- (d) Evidence that the profile-design-and-material combination delivers levels of skid-resistance, audio, tactile, and visual effects at least equivalent to those levels produced by the profile-design in *MOTSAM* on a particular and stated type of road surface in a high-wear situation;

The evidence submitted by an Applicant under (d) shall be *either* of the following:

- (e) Documented evidence of a history of acceptable in-service use for the profile-design-and-material combination.

The evidence shall show that ATP roadmarkings formed from the profile-design-and-material had maintained their skid-resistance, audio, tactile, and visual performance for at least 12 months on a particular and stated type of road surface in a high-wear situation with this assessment being by measurement.

or

- (f) Documented evidence of successful trialling of the profile-design-and-material combination.

The evidence shall give confidence that ATP roadmarkings formed from the profile-design-and-material combination will maintain their skid-resistance,

audio, tactile, and visual performance for at least 12 months on a particular and stated type of road surface in a high-wear situation.

Evidence shall include observations and measurements from periodic monitoring of the ATP roadmarking during the trial, for example at the time of the trial's initiation, 6 months after initiation, and then 12 months after initiation. The monitoring shall include measurement of skid-resistance, retroreflectivity, forward visibility distance, profile dimensions, and other elements relevant to the performance of ATP roadmarkings and shall include measurements of the audio, tactile, and visual effects produced by the ATP roadmarkings.

The application for approval of a material-and-profile-design combination shall include information on any known or likely incompatibilities with that material or profile-design and any specific requirements for re-marking either likely existing roadmarkings or previous ATP roadmarkings formed from that material or profile-design.

After 12 months in a high-wear situation, any diminishment of any of the skid-resistance, audio, tactile, and visual performance of the ATP roadmarkings formed from the profile-design-and-material combination should only be minor.

All costs incurred for tasks performed within submitting an Application for approval of a profile-design-and-material combination shall be met by the Applicant.

An approval granted by Transit New Zealand for a profile-design-and-material combination for use for forming ATP roadmarkings provides for ongoing approval of the profile-design. However, approval for the material of the profile-design-and-material combination only applies for a maximum period of ten years. When the material approval expires, prior to continuing use of that material for forming ATP roadmarkings, another application seeking material approval must be submitted to Transit New Zealand in accordance with Appendix A.

Transit New Zealand may suspend approval for a profile-design or material or profile-design-and-material combination at any time if concerns about performance arise. The Applicant who submitted the original application seeking approval may submit additional evidence to Transit New Zealand, in accordance with this Appendix, to apply to have the original approval resumed. If this additional evidence is not approved or if additional evidence is not submitted, the original approval will remain suspended. If additional evidence is submitted and approved, approval will be resumed with the original approval expiration date remaining unchanged.

Transit New Zealand will allow public disclosure of details of approved profile-designs.

Appendix C: Materials Record

This Appendix provides a sample of items that could be relevant for consideration within the Materials Record. The Materials Record should provide logical and successive details of the operations and materials used for the installed ATP roadmarkings with sufficient information to allow precise tracking, if required.

- (a) For each surface preparation method used, the records shall include:
- The nature of any materials that are to be removed or altered by the surface preparations;
 - Details of the method used;
 - The location of the surface prepared;
 - The type of road surface prepared;
 - The time and date that the surface was prepared.
- (b) For each material present in a tank prior to addition of another material and for each material added to a tank:
- The volume or mass of material;
 - The material Supplier's name and the batch number of the material;
 - The designation (class, type and/or grade) of material;
 - The time and date that the material was added to the tank.
- (c) For each time any tank of material(s) is heated, the records shall include:
- each temperature that the tank was heated to and maintain at, with
 - the time, date, and duration that each temperature was maintained.

Record of this item is not required if no tanks are heated during installation of the ATP roadmarkings.

- (d) For each time any tank of material(s) is mixed or agitated, the records shall include:
- the method used for mixing or agitation, with
 - the time, date, and duration that each mixing or agitation was maintained.

Record of this item is not required if no tanks are mixed or agitated during installation of the ATP roadmarkings.

- (e) For each time any material is installed as ATP roadmarkings, the records shall include:
- The volume or mass of each material installed or the total volume or mass of material installed and the proportional mix of materials in that total;

- Details of work by height, width, and length with details of the approved profile-design used;
- Conditions such as the ambient wind velocity, ambient humidity, ambient temperature, and the road surface temperature; and
- The location of installation, by State Highway and reference to Transit New Zealand's route position system;

Miscellaneous short lengths of ATP roadmarkings may be grouped as such provided the location is identifiable from the records.

- (f) For each material that is added to the surface of installed ATP roadmarkings (such as grit for skid-resistance or beads for retroreflectivity), the records shall include:
- The rate and direction of distribution of the material;
 - The material Supplier's name and the batch number of the material; and
 - The designation (class, type and/or grade) of material.

Appendix D: Measuring skid-resistance of ATP roadmarkings

Skid-resistance shall be measured with a portable skid-resistance tester, known as the pendulum tester and as described in *Instructions for using the portable skid resistance tester*, Road Note 27, Second Edition, Road Research Laboratory, Ministry of Transport (United Kingdom) 1969. The portable skid-resistance tester shall be in current calibration and operated by personnel who are competent in its use.

The portable skid-resistance tester involves a pendulum arm swinging a 70 mm wide slider across the surface to be tested for a distance between 123 mm and 127 mm. Where the profile-design of the installed ATP roadmarkings provides a continuous level surface of 70 mm by 250 mm, or greater, the portable skid-resistance tester shall be used to measure the skid-resistance. The skid-resistance of the flat stripe between the blocks is measured. Some profile-designs may not provide the continuous level area necessary for measurement using the portable skid-resistance tester and so skid-resistance for ATP roadmarkings of such profile-designs shall not be measured.

- (a) If the skid-resistance of the installed ATP roadmarkings cannot be measured using the portable skid-resistance tester due to limitations imposed by the profile-design, this shall be reported.
- (b) If the profile-design of the installed ATP roadmarkings allows measurement of skid-resistance using the portable skid-resistance tester, skid-resistance measurements shall be taken. A set of five skid-resistance measurements shall be taken within a ten-metre length of installed ATP roadmarkings at a rate of one set of measurements per five-kilometre length of installed ATP roadmarkings. The skid-resistance measurements shall be reported against the location of the set of measurements and with details (or a diagram) of the position upon the profile-design at which the set of measurements was taken.

Appendix E: Measuring retroreflectivity of ATP roadmarkings

When measuring the retroreflectivity of ATP roadmarkings, the retroreflectivity of the front face of the block is of the most interest. The retroreflectometer used must be able to measure this front face.

It is suggested that retroreflectivity shall be measured as described in *TNZ P/20: Performance-based specification for roadmarking*. The instrument used for measuring retroreflectivity shall be in current calibration and operated by personnel who are competent in its use.

Retroreflectivity measurements shall be reported against the location of the set of measurements and with detailed identification of the retroreflectometer used.