TNZ M/20: 2003

SPECIFICATION FOR LONG-LIFE ROADMARKING MATERIALS

1. SCOPE

This specification sets out requirements for marking materials which have a long service life and which are typically applied at thicknesses of about 0.9 mm or more. The specification is applicable to these markings when applied over bituminous or concrete road surfaces.

The specification particularly applies to thermoplastic roadmarkings. For materials other than thermoplastic, test procedures need to be agreed with the testing agency.

2. MATERIAL REQUIREMENTS

2.1 Markings of Materials Other Than Thermoplastic

Markings of materials other than thermoplastic shall meet the field test requirements of clause 3 below. The packaging/labelling requirements shall meet the requirements of clauses 9 and 10. Additionally, when used, they must meet the requirements of TNZ P/12 for maximum thickness of markings.

Specific requirements for these materials will be defined as part of the Approval.

2.2 Markings of Thermoplastic Materials

Markings of thermoplastic materials must meet all clauses of this specification, with the exception of 2.1 above.

3. FIELD TESTING

3.1 General

Beaded test lines shall be applied in accordance with Appendix B, in a lane which is subjected to 1,500,000 vehicle passes within a period of more than three but less than nine months, and be assessed for skid resistance, retroreflectivity, degree of wear and colour after the stated numbers of vehicle passes.

3.2 Skid Resistance

When tested in the wheelpath in accordance with Roadnote 27 of Transport Road Research Laboratory at 1 hour after application and at any time thereafter, the skid resistance on a test line shall be not less than 50 BPN and no greater than 65 BPN.

3.3 Retroreflectivity Testing

When tested in accordance with Appendix C, the retroreflectivity of a test line, at any time in the period from 24 hours after application until 3,000,000 vehicle passes, shall be not less than 100 $mcd.m^{-2}.lux^{-1}$ for white material and not less than 80 $mcd.m^{-2}.lux^{-1}$ for yellow material, as assessed by a retroreflectometer which has equivalent characteristics to the "Mirolux 12", and which is referenced to a common base as described in Appendix 3 of TNZ P/20.

Note: drop-on beads may be required to achieve initial values

3.4 Degree of Wear

When assessed for degree of wear on a test line using the photographic scale of Appendix B after 3,000,000 vehicle passes the photographic rating shall not be less than 8.

3.5 Retention of Colour

When assessed in accordance with Appendix D, the colour of the marking after 3,000,000 vehicle passes shall not be more than 4.

3.6 Luminance Factor

When tested in accordance with Appendix H, after 3,000,000 vehicle passes the luminance factor of a test strip shall not be less than 45%.

4. REFERENCED DOCUMENTS

A list of documents referred to in this specification is given in Appendix A.

5. DEFINITIONS RELEVANT TO THERMOPLASTIC MATERIALS

For the purpose of this specification, the definitions below apply.

Materials

- Paint is a liquid product containing solids suspended in an organic solvent or in water. It can be supplied in single or multi-component systems. When applied by brush, roller, spray or any other appropriate method it produces a cohesive film by the process of solvent evaporation and/or by a chemical process.
- Thermoplastics is a solvent-free marking substance supplied in block, granular or powder forms. It is heated to a molten state and then applied with an appropriate hand or mechanical applicator. It forms a cohesive film by cooling.

- Cold Plastics is a marking substance which is supplied in single or multi-component forms. Depending on the type of system the components are mixed together in various ratios and applied with an appropriate applicator. It forms a cohesive film only by a chemical process.

Performance

- Retroreflectivity is the ability of a roadmarking to reflect back to a vehicle the light produced from the headlights making roadmarking visible at night. This retroreflective property is produced by incorporating solid glass beads in roadmarking materials.
- Luminance Factor is the ratio of the luminance of a reflecting surface in a given direction to that of an ideal white diffusing surface when viewed in the same direction and illuminated in the same way, expressed as a percentage.

Thermoplastic Components

- Aggregates comprise calcite, quartz and calcined flint.
- Calcite is a naturally occurring form of crystalline calcium carbonate.
- Quartz is a naturally occurring form of crystalline silica.
- Calcined Flint is a prepared material made by heating pure flints to a sufficiently high temperature to enable a change to the crystalline state, with an accompanying colour change from black to white.
- Pigment is a fine powder added primarily to impart colour and opacity to the mixture.
- Extender is a powder added to assist the dispersion of the pigment and impart body to the mixture.
- Binder is a thermoplastic resinous material, which, with any included oils or other plasticisers, provides adhesion to the road surface and cohesion between the other components (i.e. extender, pigment, aggregate and solid glass beads).
- Synthetic Hydrocarbon Resin is a synthetic product, resembling in some ways natural resin, used as a binding material.
- Modified Resin Esters are synthetic maleic modified ester of resin used as a binding material. Normally it is only recommended for use in thermoplastics other than sprayable grades.
- Maximum Safe Heating Temperature is the temperature specified by the manufacturer, above which the material is not to be heated at any time.

Cold-Applied Plastic Definitions and Components

- Cold-Applied Plastic is a cold hardening 2-part methyl methacrylate (PMMA) resin material. The material may be either water or solvent based and applied using a variety of methods.
- Products are covered by patents and licensing agreements
- Poly methyl methacrylate (PMMA) resin
- Typically virtually 100percent volume solids

- Contain titanium dioxide, inorganic and organic colour pigments
- Yellow may contain Lead Chromate
- Part B typically contains the hardener

6. RETROREFLECTIVITY OF THERMOPLASTIC MATERIALS

Solid glass beads that are incorporated in thermoplastic roadmarking materials by the manufacturer shall be of the intermix type specified in AS 2009 or the corresponding BS/EN specification.

Note: Freshly applied thermoplastic material without "drop-on" beads has low initial retroreflective properties. Solid glass beads applied in situ to roadmarkings, to provide adequate initial retroreflectivity, should be of the "drop-on" type specified in AS 2009.

7. COMPOSITION OF THERMOPLASTIC MARKING MATERIAL

7.1 Aggregate

The aggregate shall consist of light coloured calcite, quartz or calcined flint.

7.2 Pigment

White pigment material shall consist solely of titanium dioxide, either type A (anatase) or type R (rutile) complying with ISO 591.

7.3 Binder

The binder shall comprise plasticised synthetic hydrocarbon resin or modified resin esters.

7.4 Composition Proportions

When samples of the marking material, prepared in accordance with Appendix F, are tested in accordance with Appendix K for binder content and Appendix G for glass bead content, the proportions of the constituents of the mixture obtained by the analysis shall meet the requirements of Table 1.

Table 1: Proportions of Constituents of Marking Materials

Constituent	Percentage by Mass of Total Mixture (%)
Binder	20 ±2
Solid glass beads	20 min*
Aggregate together with pigment, extender and solid glass beads	80 ±2

* At least 20% by mass is to be maintained even in the case of material to which solid glass beads are to be applied to the surface by pressure or by gravity.

7.5 Composition Grading

When tested in accordance with Appendix G, using test sieves in accordance with AS 1152, the grading of the aggregate, pigment, extender and solid glass beads in the marking material shall be as follows:

(a) 100% by mass shall pass a 2.80 mm test sieve;

(b) 65-95% by mass shall pass a 600 μm test sieve.

8. PROPERTIES OF THERMOPLASTIC MARKING MATERIAL

8.1 Colour

When a test panel, which has been prepared in accordance with Appendix F, is assessed in accordance with AS 1580.601.1, the colour match shall be as follows:

White: Equivalent to or whiter than Y35 Off White of AS 2700S.

Yellow: Equivalent to Y14 Golden Yellow of AS 2700S.

8.2 Luminance

8.2.1 White Marking Material

When tested in accordance with Appendix H, the luminance factor of white material as delivered, prepared in accordance with Appendix F, shall be not less than 75%.

8.2.2 Yellow Marking Material

When tested in accordance with Appendix H, the luminance factor of yellow material as delivered, prepared in accordance with Appendix F, shall be not less than 45%.

8.3 Heat Stability

When tested in accordance with Appendix I, the luminance factor shall not fall below 70% for white materials, or 40% for yellow materials.

8.4 Softening Point

When tested in accordance with AS 2341.18, the softening point shall be between 75°C and 95°C.

8.5 Flow Resistance

When a sample is tested in accordance with Appendix J, the flow resistance, measured as the mean slump, shall be not more than 10% at 40°C.

9. PACKAGING

The roadmarking materials shall be supplied packed in containers made of material that does not contaminate the contents and also protects the contents from contamination.

10. LABELLING

Each container shall be legibly and permanently marked with the following information:

(i) the name, trademark or other means of identification of the manufacturer, together with address;

(ii) the words "thermoplastic roadmarking material" or equivalent wording, and the type and grade of material;

(iii) the net contents by mass in kilograms;

(iv) any specific warnings required by regulatory authorities;

(v) date of manufacture and batch number;

(vi) colour of material;

(vii) for thermoplastic materials: maximum safe heating temperature;

(viii) for thermoplastic materials: maximum recommended application temperature;

(ix) application format suitability e.g. sprayed, screeded, extruded, or for use in profiled markings.

Note: Manufacturers making a statement of compliance with this specification on a product, or on packaging or promotional material related to that product, are advised to ensure that such compliance is capable of being verified.

APPENDIX A

LIST OF REFERENCE DOCUMENTS

AS 1141	Methods for Sampling and Testing Aggregates
AS 1141.2	Method 2, Basic Testing Equipment
AS 1141.11	Method 11, Particle Size Distribution by Dry Sieving
AS 1152	Test Sieves
AS 1580	Paint and Related Materials - Methods of Test
AS 1580.101.1	Method 101.1, Air Drying Conditions
AS 1580.104.1	Method 104.1, Recommended Materials for Test Panels
AS 1580.601.1	Method 601.1, Colour - Visual Comparison
AS 1627	Metal Finishing - Preparation and Treatment of Surfaces
AS 1627.4	Part 4, Abrasive Blast Cleaning
AS 2009	Glass Beads for Roadmarking Materials
AS 2341	Methods of Testing Bitumen and Related Roadmarking Products
AS 2341.18	Method 18, Determination of Softening Point of Tar (Ring and Ball Method)
AS 2378	Density Bottles
AS 2700S	Colour Standards for General Purposes (Swatch)
AS 4049.2	Paints and Related Materials – Roadmarking Materials – Thermoplastic Roadmarking Materials
ISO 591	Titanium Dioxide Pigments for Paints
ISO 105 A03	Grey Scale
CIE 15.2	Colorimetry
BS 3262 (withdrawn)	Hot Applied Thermoplastic Roadmarking Materials
TNZ T/12	Specification for Long-Life Pavement Marking Material Applicator Testing
TNZ P/12	Specification for Pavement Marking

TNZ P/22	Specification for Reflectorised Pavement Marking
TNZ P/20	Performance Based Specification for Roadmarkings
MOTSAM	Transit New Zealand's Manual of Traffic Signs and Markings
CoPTTM	Transit New Zealand's Code of Practice for Temporary Traffic Management
TRRL Road Note 27	Instructions for Using the Portable Skid-Resistance Tester
AS =	Australian Standard
ISO =	International Standards Organisation
CIE =	Commission Internationale De L elairage
BS =	British Standards
TNZ =	Transit New Zealand
TRL =	Transport Research Laboratory

APPENDIX B

FIELD TESTS FOR LONG-LIFE ROADMARKINGS

B1 SCOPE

This Appendix sets out procedures for the field testing of roadmarkings including thermoplastic roadmarkings. Properties assessed are wear, retroreflectivity, on-road colour and colour retention, and skid resistance.

B2 PRINCIPLE

Material is applied as line markings, transverse to the traffic flow, on the test site. At the end of a specified number of vehicle passes: the retroreflectivity of the line is determined; the degree of wear of the test markings is evaluated; skid resistance of the thermoplastic is measured; and the colour and luminance of the thermoplastic is assessed.

B3 TEST SITE

The test site location shall be a section of road, sufficiently far from intersections to avoid the effects of traffic turning, and carrying 1,500,000 vehicles per lane within a period of more than three but less than nine months. The test site should be distant from activities such as quarries, which can induce excess dirt, gravel and the like to be tracked over the test area. To demonstrate performance on all surfaces the road surface shall be a stable chipseal of grade 3 preferably, or grade 4, chip which has been in place for at least six months . To demonstrate performance on smooth road surface only, the surface may be either open graded or dense graded asphalt.

B4 APPARATUS

B4.1 Marking Application

Non-thermoplastic materials are to be applied by equipment and methods as defined by the supplier, but must replicate the manner in which the material would normally be used.

For thermoplastic materials, the equipment listed below is required for marking application:

- Line marking equipment that complies with the current TNZ T/12 specification. Hand screeding is acceptable where products are to be used in service with this method of application.
- At least four panels, with nominal surface dimensions 200 mm x 150 mm x 1.5 mm prepared from electro-coated steel plate Zintex.

- Film Thickness Gauges
  - Micrometer dial gauge with an anvil area of at least 10 mm^2 and capable of measuring to an accuracy of 0.01 mm.

  or as an alternative

  - A non-destructive thickness gauge. Suitable gauges are Elcometer 355 or similar. The thickness gauge shall meet the following minimum requirements:

    (i) Accuracy of ± 3% in the range of thickness 0.5 mm to 13.0 mm when calibrated at zero and either end of the range

    (ii) The probe tip shall be hemispherical and have a maximum diameter of 2 mm ± 0.2 mm.

    Film instruments shall be calibrated with standard shims having calibration traceable to National Standards and with a range of values relevant to the expected film thickness being measured.

- Meteorological Measurement Devices providing means of measuring air and road temperature, relative humidity and wind velocity at the time of marking application.
- Heavy paper or a metal sheet or similar which can be used as a temporary surface when test spraying to adjust film thickness, so as to avoid unwanted markings at the test site.

  Note: Bitumen impregnated paper, such as Sisal Kraft Grade 300, is noted in AS 4049.1 as having been found to be suitable.

- Signs, cones, etc in accordance with Transit New Zealand's requirements for temporary traffic management to control traffic and protect line marking personnel during the application and hardening of the marking.

B4.2 Assessing Retroreflectivity

The following equipment is required to assess retroreflectivity:

- Retroflectivity can be assessed by a retroreflectometer which has equivalent characteristics to the "Mirolux 12", and which is referenced to a common base as described in Appendix 3 of TNZ P/20.

B4.3 Assessment of Wear (see AS 4049.2) Using the Photographic Method

The following aids are required:

- pictorial standards - a set of four photographic standards* , providing scale readings of 2 to 8.

* Available from Opus International Consultants Central Laboratories, 138 Hutt Park Road, Gracefield, Lower Hutt, New Zealand.

B4.4 Assessment of Colour

Standard colour cards as follows:

AS 2700S, Y35 for white
AS 2700S, Y12 for yellow
ISO 105 A03 for grey scale for assessing staining

B5 APPLICATION PROCEDURE

The procedure shall be as follows:

(a) Divert traffic from the test site in accordance with Transit New Zealand's requirements for temporary traffic management.

(b) Confirm that the air temperature is between 8°C and 30°C, the relative humidity not less than 25%, the road surface temperature less than 45°C and wind speed less than 10 m/sec. Record these results and any unusual features of the weather at the time of the test.

(c) Thoroughly clean all loose particles and foreign material from test area.

(d) Place a pair of test panels across the width of the intended line. Ensure that these test panels do not encroach upon the assessment area (i.e. wheelpaths) or affect the thickness of the applied film.

(e) Apply two strips of the marking material, including surface applied "drop-on" beads, to the road surface to give strips of width 100 ±5 mm having thicknesses as follows:

(i) thermoplastic material on chipseal: 2.5 ± 0.2 mm

(ii) thermoplastic material on asphalt: sprayed, screeded, extruded at 2 ± 0.2 mm

(iii) for preformed thermoplastic material: apply the material as supplied

(iv) non-thermoplastic materials are to be applied at the thickness typical of use.

(f) Place a metal sheet, of minimum thickness 1.5 mm and of minimum dimensions 150 mm long and of sufficient width to suit the method of application, on the road surface. Apply thermoplastic material, without "drop-on" beads, to the metal sheet during one pass of the equipment and, after hardening, verify the thickness of the material using the film thickness equipment described in Section B4.1. The method of measure should be as described in TNZ P/12.

(g) Place an identifying mark or number of the test line.

(h) On completion of work, visually inspect for application anomalies.

(i) Allow for a drying time of at least one hour before removing all safety barriers to let traffic flow freely over the test areas.

B6 ASSESSMENT INTERVALS

B6.1 Minimum Life

An assessment to determine minimum life shall be at 3,000,000 vehicle passes. Compliance with field tests at the interim assessments and after 3,000,000 vehicle passes is required for approval. To ensure compliance over the full life of the material, assessments shall be also made at about 1 hour after application, and after 1 million, then 2 million vehicle passes.

B7 REPORT

The report shall include the following information:

(a) Unique identification of the test material

(b) Name of the testing laboratory, and the period over which the test was conducted.

(c) Location of the test site, and the surface type.

(d) Commencement and completion dates of the assessment period.

(e) Average monthly rainfall recorded at the closest relevant meteorological station during the assessment period.

(f) Average monthly maximum daily temperature recorded at the closest relevant meteorological station during the assessment period.

(g) The dry film thickness as the mean of the test plate.

(h) The retroreflectivity of the beaded test line, expressed as the mean result for each line.

(i) The wear assessment result expressed as a number of a photograph.

(j) The colour of the line as related to the colour chart and ISO 105 A03.

(k) The skid resistance expressed as BPN units.

(l) A description of the general appearance of the completed line, including any anomalies.

APPENDIX C

DETERMINATION OF RETROREFLECTIVITY

C1 SCOPE

This Appendix describes the procedure for determining the retroreflectivity of roadmarking material.

C2 PRINCIPLE

The retroreflectivity is measured using a suitable photometer or retroreflectometer. For field measurements, readings are taken at five positions and the results are averaged.

C3 APPARATUS

- A Photometer or Retroreflectometer with equivalent characteristics to the Mirolux 12 photometer is required. The retroreflectometer is to be referenced to a common base as set out in Appendix 3 of TNZ P/20.
- A Skirt of plastic foam to exclude light from the test area.

C4 PROCEDURE

The test procedure shall be as follows:

(a) Apply a test strip of the test material onto a road surface in accordance with the procedure in Appendix B.

(b) Operate the retroreflectometer in accordance with the manufacturer's instructions.

(c) Using the retroreflectometer, measure and record the retroreflectivity value of the test strip using an observation angle of 1.5° and an illumination angle of 86.5° from the normal.

(d) For field tests, obtain at least four retroreflectivity readings at five positions within the wheelpath, with approximately one position reading per one half linear metre of line marking.

(e) Record the results.

C5 REPORT

The following information shall be reported:

(a) The mean, standard deviation and range of the retroreflectivity readings, in mcd.lux-1.m-2.

(b) Reference to this test method, i.e. Appendix C of TNZ M/20 : 2003.

APPENDIX D

DETERMINATION OF RETENTION OF COLOUR

D1 SCOPE

This Appendix provides for a method for determining the retention of colour with service of a roadmarking material.

D2 PRINCIPLE

The colour of the roadmarking is compared to the range of colours encompassed by the minimum specified colour, e.g. Y35, and the permitted degree of discoloration, e.g. as measured by the grey scale.

D3 APPARATUS

- Colour standards of AS 2700S as appropriate, i.e. Y35 for white, and Y12 for yellow.
- Grey scale for assessing staining, ISO 105 A03 : 1978.

D4 PROCEDURE

The test procedure shall be as follows:

(a) Brush any loose surface material from the wheelpath of the test strip.

(b) Employing two assessors, classify the colour in terms of a discoloration or staining of the minimum specified colour.

(c) Record the result as an average for the wheelpaths.

D5 REPORT

The following information shall be reported:

(a) The discoloration to the nearest half step.

(b) Reference to this test method, i.e. Appendix D of TNZ M/20 : 2003.

APPENDIX E

SAMPLING

E1 SAMPLING

E1.1 Powdered Material

Select at random three bags of the material, each bag bearing the same batch number. Divide each bag separately using a sample divider complying with AS 1141.2 and having a maximum aperture of 50 mm, to obtain three samples, each having a mass of approximately 2 kg. Combine the three 2 kg samples. Keep the remainder of the three bags until the tests are complete.

Note: Where "self-melt" bags are used to contain the material, an appropriate portion of the bag material should be included in the determination of the constituents of the mix.

E1.2 Thermoplastic Compound

Select at random three containers of the thermoplastic compound from the same batch number. Break up the material from all three containers and discard any pieces that, by visual examination, are not uniform in texture and colour. Take a portion of not less than 2 kg from the material near the centre of each of the three containers; combine these portions in a clean container clearly labelled with the relevant details, e.g. supplier, batch number, type and date. Do not apply heat at any stage of the sampling process.

Keep the unused remainder from the three containers until the tests are completed.

For preformed material, select at random not less than 2.5 kg of material from the same batch number.

E1.3 Labelling

Samples should be clearly identified by markings on the container.

The following particulars should be shown on the container or label:

(a) product identification;

(b) batch number;

(c) date of sampling.

Further information required for identification of the samples should be supplied on a separate sampling form. The additional information should include the following:

(a) suppliers;

(b) place and date of sampling;

(c) quantity of material represented by sample;

(d) type and identifying number of container or vehicle from which the sample was taken.

APPENDIX F

PREPARATION OF TEST MATERIAL

F1 SCOPE

This Appendix describes the procedure for preparing material used in the test methods described in Appendices H, I, J, K and also Appendix G which is carried out using the residue from the tests of Appendix K.

F2 PRINCIPLE

At least 2.5 kg of sampled material is collected, uniformly mixed by heating above the softening point of the material, and then poured to form appropriate specimens for testing.

F3 APPARATUS

- Containers of clean, heat resistant glass or metal.

  Note: Suitable metal containers are unused 4 litre paint tins or aluminium dishes 150 mm diameter x 7 mm deep, in clean and as-new condition.

- A hot plate that will hold the containers. The heating device shall be capable of heating the filled containers to 200°C within 2 hours and shall also be capable of holding a preset temperature to an accuracy of 10°C.

  Note: A short temperature recovery time is beneficial.

- A thermometer accurate and readable to ±2°C.

- A suitable stirrer, such as a spatula.

- Test panels of a non-stick surface of metal or glass in accordance with AS 1580.104.1. The test panels shall be flat and free from distortion, ridges or cracks. Except where otherwise specified, the nominal panel size shall be 150 x 100 x 5 mm for glass and 200 x 200 x 2 mm for aluminium panels. All panels shall be prepared by solvent cleaning.

  Note: Paint tin lids may provide a suitable test panel.

F4 PROCEDURE FOR PREPARATION OF TEST MATERIAL

F4.1 General

Test material shall be prepared in accordance with the method below for powdered material by breaking off sufficient pieces each not more than 50 grams. For block or preformed material, a sub-sample should be obtained.

The representative sample is selected using an appropriate sampling technique, such as that described in Appendix E.

F4.2 Hot Plate Heating

The procedure is as follows:

(a) Preheat the hot plate to a surface temperature of 250-270°C and place at least 2.5 kg of the test sample in a suitable container on the hot plate. Stir continuously to ensure homogeneity and even heating, and measure the temperature at 5-minute intervals. When the temperature of the sample has reached 185 ±5°C and the sample is homogenous, pour the material onto a suitable non-stick surface, such as a test panel, or pour a test specimen in accordance with clause F5 below. The time from commencement of heating to pouring shall not exceed 1 hour.

(b) If a sample is not homogenous at 185 ±5°C, continue heating, remove the sample at 5 minute intervals, and stir and measure temperature as in step (a). When the sample is homogenous, pour the material onto a suitable non-stick surface, such as a test panel, or pour a test specimen in accordance with clause F5 below.

(c) If a sample is not homogenous at 220°C, reject the batch.

Note: For block or preformed material the time from commencement of heating to pouring should not exceed 2 hours.

F5 PREPARATION OF TEST SPECIMENS

Test specimens appropriate to the test shall be prepared as shown in Table F1. The procedure shall be as follows:

(a) If not already at pouring temperature, heat the thermoplastic material prepared in clause F4 to a temperature of 185 ±5°C and mix to an even consistency.

(b) Where a circular specimen is required, pour the thermoplastic material onto a test panels until a disk of approximately 100 mm diameter and 2 mm minimum thickness is formed.

(c) Allow the specimen to harden in conditions of 23 ±3°C and 60 ±15% RH, out of direct sunlight and with protection to avoid deposition of dust.

Table F1: Size of Test Specimens

Test	Appendix	Size of Test Specimen	Test Panel
Binder content: - method A - method B	K	 30 g 100 mm dia x 10 mm	 " "
Luminance factor	H	100 mm dia	Metal or glass
Heat stability	I	250 g	"
Flow resistance	J	Cone of height 100 mm and angle of 60 degrees	"
Colour	Clause 8.1	Minimum 100 mm dia	Metal or glass

APPENDIX G

DETERMINATION OF THE GRADING OF CONSTITUENTS AND GLASS BEAD CONTENT

G1 SCOPE

This Appendix describes the methods for determining the grading of the constituents and the glass bead content of marking materials, which have been already subjected to a test for binder content using one of the methods described in Appendix K.

G2 PRINCIPLE

Marking material prepared in accordance with Appendix F and subsequently tested in accordance with Appendix K is graded using test sieves, and then regraded through the sieves to determine the glass bead content.

G3 APPARATUS

- Test Sieves 2.80 mm, 600 μm and 425 μm test sieves complying with AS 1152.
- Electrical Vibrator vibrating at 50 cycles per second with adjustable amplitude with a glass panel fitted to its holder, as specified in AS 2009. The panel shall be of nominal dimensions 380 mm x 150 mm and, during operation of the vibrator, the slope of the panel shall be one part in 20, or 2.9°, to the horizontal.

Note: A suitable apparatus is the "Syntron" feeder type FT01, code 59-D-193 or equivalent.

- A small, soft brush.
- A balance capable of weighing to an accuracy of 0.005 g.

G4 DETERMINATION OF GRADING OF CONSTITUENTS*

The procedure shall be as follows:

(a) Carry out the grading test using 2.80 mm and 600 μm test sieves in accordance with AS 1141.11. If the glass bead content is to be determined, use a 425 μm test sieve also.

(b) Calculate the mass passing each sieve as a percentage of the combined mass of the aggregate, pigment, extender and glass beads.

* If the hot extractor method of BS 3262 was used, first ignite the filter paper and thoroughly mix the ash with the main bulk of the aggregate

G5 DETERMINATION OF GLASS BEAD CONTENT

The procedure shall be as follows:

(a) Recombine all the material retained in the three sieves in step G4 (b), place increments of 5-10 g on the upper end of the panel of the electric vibrator and gently brush the material until all the glass beads have been moved to the bottom of the tray.

(b) Determine the total mass (m_c) of the round glass beads collected, and calculate (m_c x 100/70) the mass of glass beads in the original sample of thermoplastic material.

Note: It is assumed that 70% of the glass beads are round.

Note: Refer to AS 2009 Appendix F for a more detailed description of this method of separation.

G6 REPORT

The following information shall be reported:

(a) The method used to prepare the test specimen, i.e. the hot extraction or ignition method.

(b) The mass of material as a percentage of the total mass, passing each sieve.

(c) The total mass of glass beads collected multiplied by 100/70 as a percentage of the original mass of material.

(d) Reference to this test method, i.e. Appendix G of TNZ M/20 : 2003.

APPENDIX H

DETERMINATION OF THE LUMINANCE FACTOR

H1 SCOPE

This Appendix provides a method for determining the luminance factor for a roadmarking material, in the laboratory or at a field site.

H2 PRINCIPLE

A measurement of the luminance of the test specimen is made using a spectrophotometer or a Tristimulus colorimeter, which has been calibrated against a white reference tile of low specular gloss.

H3 APPARATUS AND MATERIALS

- A Calibrated White Standard Reference Tile having a CIE Y value greater than 75 and calibrated against a perfect reflecting diffuser.
- A Test Panel and Specimen of metal or glass, with a 100 mm diameter specimen prepared in accordance with Appendix F.
- A Colorimeter or Spectrophotometer suitable for use under the following conditions:
  - (a) Diffuse illumination and a viewing angle within 10° of the normal, or diffuse viewing with illumination within 10° of the normal.
  - (b) Reference light sources, illuminant D65 or illuminant C.
  - (c) Conforming to the CIE colour matching function y10 or Y in CIE 15.2.

Note: A Minolta Chroma Meter II or equivalent has been found to be a suitable colorimeter.

H4 PROCEDURE

H4.1 General

The test procedure shall be in accordance with paragraph H4.2 for laboratory tests and paragraph H4.3 for testing performed on road trials.

H4.2 Method 1 Laboratory Method

The procedure shall be as follows:

(a) Remove the test specimen disk from the panel and turn it so that the underside faces up, to provide a smoother surface for measurement.

(b) Calibrate the instrument against the white reference tile.

(c) Place the instrument on the test surface and determine the luminance. Measurements shall be taken at five different locations on the test specimen surface.

H4.3 Method 2 Road Trials

The procedure shall be as follows:

(a) Clean an area of test strip at a distance of 500 ±75 mm from the near side kerb and allow it to dry.

(b) Taking precautions to shield the colorimeter from stray incident light, carry out the procedure described in paragraph H4.2 (b) and (c), but measure the luminance at only one location on the thermoplastic strip. Measure the luminance five times, rotating the instrument through approximately 72° with minimal lateral displacement between each measurement.

H5 CALCULATION

Calculate the mean luminance factor from the five readings and express it as a percentage.

H6 TEST REPORT

The following information shall be reported:

(a) Unique identification of the test roadmarking material.

(b) Name of testing laboratory.

(c) Date on which the test was conducted.

(d) Type of instrument used.

(e) The mean luminance factor to the nearest 1%.

(f) Reference to this test method, ie method 1 or method 2, Appendix H of TNZ M/20 : 2003.

APPENDIX I

DETERMINATION OF HEAT STABILITY OF THERMOPLASTIC MATERIAL

I1 SCOPE

This Appendix provides a method of determining the heat stability of thermoplastic roadmarking material by measuring the luminance factor after heating the material for an extended period.

I2 PRINCIPLE

After the material has been held at 200°C for 6 hours, the luminance factor is measured.

I3 APPARATUS

- An oil bath or a suitable recessed aluminium block on a hot plate, capable of maintaining the sample at 200 ±3°C.
- An electrically driven paddle stirrer capable of continuously stirring the molten sample at 150 ±10 r/min.
- A beaker of heat resistant glass with a capacity of 250 ml and having nominal dimensions 110 mm high x 65 mm diameter.
- A mould of silicone rubber, approximately 100 mm in diameter to cast sample disks.
- In addition apparatus as described in Appendix H.

I4 PROCEDURE

The procedure shall be as follows:

(a) Accurately weigh a specimen of the material prepared in accordance with Appendix F with a mass of approximately 250 g, and place it in the beaker.

(b) Control the temperature of the sample to within ±2°C, at 200°C or the maximum application temperature, whichever is the lower.

(c) Place the beaker either in the heated oil bath so that the surface of the sample, when molten, will be below that of the oil, or below the rim of the block if the recessed aluminium block is used.

(d) When the sample is molten, lower the stirrer to within 15 mm of the base of the beaker and commence stirring.

(e) Maintain the test conditions for 6 hours, and then remove the beaker and pour the contents onto a clean, flat silicone rubber mould.

(f) When the material has cooled to room temperature, remove it from the mould, invert it and measure the luminance factor in accordance with Appendix H.

I5 REPORT

The following information shall be reported:

(a) The luminance factor to the nearest 1%.

(b) Reference to this test method, ie Appendix I of TNZ M/20 : 2003.

APPENDIX J

DETERMINATION OF FLOW RESISTANCE

J1 SCOPE

This Appendix provides a method for determining the flow resistance of roadmarking materials prepared in accordance with Appendix F.

J2 PRINCIPLE

Two conical test specimens are held at 40°C for 48 hours and the percentage reduction in height is calculated.

J3 APPARATUS

J3.1 Hot Box

A room, container or oven which may be controlled at 40 ±2°C for 48 hours.

J3.2 Measuring Device

Capable of measuring the height of the test cones.

J3.3 Metal Cones

Two split or hinged conical metal moulds, of height 100 ±5 mm and with an included angle nominally 60° at the apex, open at the base.

J4 PROCEDURE

The procedure shall be as follows:

(a) Heat the test material, prepared in accordance with Appendix F, to 90 ±5°C above its softening point measured by AS 2341.18.

(b) Cast two conical specimens of the material so that each has an angle of nominally 60° at its apex and a vertical height of 100 ±5 mm.

(c) After 24 hours at room temperature, remove each specimen from its mould and place it point upwards on a flat level surface in the hot box maintained at a temperature of 40 ±2°C for 48 hours.

(d) Measure and record the height of the cone to the nearest millimetre.

(e) Measure and record the height of the cone after a period of 48 hours conditioning in the hot box.

J5 REPORT

The report shall contain the following information:

(a) The percentage mean slump in the height of the test cones.

(b) Reference to this test method, ie Appendix J of TNZ M/20 : 2003.

APPENDIX K

DETERMINATION OF THERMOPLASTIC BINDER CONTENT

K1 SCOPE

This Appendix describes a method for determining the binder content of thermoplastic roadmarking materials prepared in accordance with Appendix F.

K2 PRINCIPLE

Determine the percentage of binder within the thermoplastic material by weight of loss.

K3 APPARATUS

- Crucibles made of porcelain or other suitable material; two are required.
- An Electric Muffle Furnace with a temperature range of up to 800°C and capable of maintaining 500 ±25°C.

Note: A muffle furnace with a nominal internal volume of 2.4 litres and a maximum power rating of 1.5 KW is suitable.

- A Desiccator containing silica gel or other suitable drying agent.
- A Balance capable of weighing up to 100 g to an accuracy of 0.005 g.
- A metal spatula.

K4 PROCEDURE

The procedure shall be as follows:

(a) Take a test piece of material, prepared in accordance with Appendix F, approximately 100 mm in diameter and 10 mm thick.

(b) Break the material into small pieces and weigh (m1), to an accuracy of 0.01 g, duplicate specimens, each of approximately 10 g, into separate pre-weighed dry crucibles.

(c) Place the weighed specimens contained in the crucible on a hot plate in a fume cupboard and char until no further fumes evolve. Remove from the hot plate and, with a spatula, break up the material remaining in the crucible to a powder, taking care to avoid any loss of material from the crucible.

(d) Place the crucible with its contents in the centre of the muffle furnace and heat at a temperature of 500°C, for a minimum of 1 hour, to constant mass. To avoid decomposition of any inorganic carbonates, do not heat the specimens to a temperature in excess of 550°C.

(e) After the ignition in step (d), cool the specimens in a desiccator and reweigh (m2), to an accuracy of 0.01 g.

K5 CALCULATION

Calculate the binder content from the loss in mass using the following equation:

$$B = 100 \times \frac{m_1 - m_2}{m_1}$$

where: B = binder content, in percent
m_1 = mass of sample, in grams
m_2 = mass after ignition, in grams

Express the result as a percentage of the original sample mass for each specimen, and calculate the mean result.

If the difference between the results is greater than 0.3%, repeat the binder content determination.

K6 REPORT

The following information shall be reported:

(a) The percentage binder content, to one decimal place, of the mean of the results of the duplicate specimens.

(b) Reference to this test method, ie Appendix K TNZ M/20 : 2003.

Note: Two alternative methods which are also acceptable are described in Appendix C of BS 3262 : 1989, Part 2.