SPECIFICATION FOR PERFORMANCE-GRADED ASPHALT BINDER

1. Scope

This document has been prepared as a Supplement to AASHTO M 332 Standard Specification for Performance-Graded Asphalt Binders Using Multiple Stress Creep Recovery (MSCR) Test in order that the criteria of Table 1 of M 332 can be used to specify binders for asphalt paving materials in New Zealand.

AASHTO M 332 Table 1 sets out the performance characteristics to be met by the binders used in New Zealand for asphalt manufacture. This specification is blind to the binder composition.

Binders are described in relation to the site climate conditions (Table 1) and traffic loading (Table 2). “S”, “H”, “V” and “E” grades are specified for Standard, Heavy, Very Heavy and Extreme traffic loading respectively.

The binder grades in this specification are applicable to all dense graded asphalt mixes

2. Related Documents

2.1 AASHTO Standards:

(a) M 332, Performance-Graded Asphalt Binder Using Multiple Stress Creep Recovery (MSCR) Test
(b) R 28, Accelerated Aging of Asphalt Binder Using a Pressurized Aging Vessel (PAV)
(c) T 40, Sampling Bituminous Materials
(d) T 48, Flash and Fire Points by Cleveland Open Cup
(e) T 240, Effect of Heat and Air on a Moving Film of Asphalt Binder (Rolling Thin-Film Oven Test)
(f) T 313, Determining the Flexural Creep Stiffness of Asphalt Binder Using the Bending Beam Rheometer (BBR)
(g) T 314, Determining the Fracture Properties of Asphalt Binder in Direct Tension (DT)
(h) T 315, Determining the Rheological Properties of Asphalt Binder Using a Dynamic Shear Rheometer (DSR)
(i) T 316, Viscosity Determination of Asphalt Binder Using Rotational Viscometer
(j) T 350, Multiple Stress Creep Recovery (MSCR) Test of Asphalt Binder Using a Dynamic Shear Rheometer (DSR).

2.2 ASTM Standards:

(a) D92, Flash and Fire Points by Cleveland Open Cup Tester
(b) D140, Standard Practice for Sampling Bituminous Materials
(c) D2042, Standard Test Method for Solubility of Asphalt Materials in Trichloroethylene
(d) D2872, Effect of Heat and Air on a Moving Film of Asphalt (Rolling Thin-Film Oven Test)
(e) D4311, Standard Practice for Determining Asphalt Volume Correction to a Base Temperature
(f) D4402, Viscosity Determination of Asphalt at Elevated Temperatures Using a Rotational Viscometer
(g) D6521, Standard Practice for Accelerated Ageing of Asphalt Binder using a Pressurized Ageing Vessel (PAV)
(h) D6648, Determining the Flexural Creep Stiffness of Asphalt Binder Using the Bending Beam Rheometer (BBR)
(i) D6723, Determining the Fracture Properties of Asphalt Binder in Direct Tension (DT)
(j) D7175, Determining the Rheological Properties of Asphalt Binder Using a Dynamic Shear Rheometer.

2.3 NZTA Documents:
(a) NZTA M10, Specification for Dense Graded Asphaltic Concrete
(b) NZTA M27, Specification for Stone Mastic Asphalt
(c) NZTA P11, Specification for Open Graded Porous Asphalt

2.4 Standards New Zealand
(a) AS/NZS 2341.8, Determination of Matter Insoluble in Toluene

2.5 Civil Contractors New Zealand
(a) BPG04 Best Practice Guideline – Quality Assurance for Bituminous Binders

3. Materials and Manufacture

The binder must be derived from crude petroleum or natural asphaltic materials, excluding coal tar. Binders may include rheology modifiers (such as polymers) to improve their performance grade.

The binder must be homogenous, storage stable and free of water and deleterious materials. It shall not foam when heated to 175°C. The formation of a thin layer of bubbles is not considered to be foaming.

The binder shall be at least 99.5% soluble in trichloroethylene (ASTM D2042), or 99.0% in toluene (AS/NZS 2341.8).

This specification is only applicable for binders in which fibres or other particles are less than 250 micron in size.

4. Binder Grade Selection

4.1 Climate Zone

Identify the climate zone appropriate for the site location from the NZ Climate Zone Map for asphalt pavements in section 9 of this document. Select the binder performance grade appropriate for the site from Table 1 below.
The climate zone map provides general guidance for selecting the correct binder performance grade. Engineering judgement shall be used when interpreting the map and selecting the binder performance grade. If advice or further guidance is needed contact:

- The NZ Transport Agency Lead Advisor, Pavements, or;
- The NZ Transport Agency Principal Surfacings Engineer.

### Table 1: Binder Performance Grade

<table>
<thead>
<tr>
<th>Climate Zone</th>
<th>AASHTO M 332 Binder Performance Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cool</td>
<td>PG 52 –16</td>
</tr>
<tr>
<td>Moderate</td>
<td>PG 58 –16</td>
</tr>
<tr>
<td>Warm</td>
<td>PG 64 –16</td>
</tr>
</tbody>
</table>

**Note:**
If doubt exists in respect of the correct climate zone for a specific location, select the binder performance grade for the next warmer zone.

### 4.2 Traffic Category

Determine the expected traffic level for the asphalt pavement over its service life and select the appropriate binder grade category from Table 2 below. Refer to the flow chart in section 10 as an interpretation aid to Table 2.

### Table 2: Guide to traffic category

<table>
<thead>
<tr>
<th>Traffic Category</th>
<th>AUSTROADS</th>
<th>AASHTO M 332 Binder Grade Category</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Traffic Volume (ESA)</td>
<td>Traffic Speed (km/hr)</td>
</tr>
<tr>
<td>Light</td>
<td>&lt; 0.5 x 10⁶</td>
<td>&gt; 25</td>
</tr>
<tr>
<td>Medium</td>
<td>0.5 x 10⁶</td>
<td>&lt; 25</td>
</tr>
<tr>
<td></td>
<td>0.5 x 10⁶</td>
<td>&gt; 25</td>
</tr>
<tr>
<td>Heavy</td>
<td>&lt; 5 x 10⁶</td>
<td>&lt; 25</td>
</tr>
<tr>
<td></td>
<td>20 x 10⁶</td>
<td>&gt; 25</td>
</tr>
<tr>
<td>Very Heavy</td>
<td>&gt; 5 x 10⁶</td>
<td>&lt; 25</td>
</tr>
<tr>
<td></td>
<td>20 x 10⁶</td>
<td>&gt; 25</td>
</tr>
<tr>
<td></td>
<td>20 x 10⁶</td>
<td>&lt; 25</td>
</tr>
</tbody>
</table>

**Notes:**
(a) Traffic Levels in ESAs are based on Austroads structural design levels.
(b) Grades S, H, V, E applicable to dense-graded asphalts (AC and DG grades in M10).
(c) Sub-surface asphalt courses are layers deeper than 80mm.
(d) Based on experience to date, stone mastic asphalt mixes should use a binder equivalent to PG 64H (i.e. PG 64H, PG 58V, PG 52E) or stiffer. Refer to M1–A Notes.
(e) Refer to M1–A Notes for guidance in selecting binders for open-graded porous asphalt.

The binder shall conform to the properties specified in AASHTO M 332 Table 1 excepting Note b.

5. Ordering the Binder

When specifying, ordering or supplying binder under this specification, clearly identify in the documentation the grade based on site temperature zone (cool, moderate or warm) and traffic load (i.e. S, H, V or E).

Specify the bitumen using the following format: PG [Climate Zone Temperature] [Binder Grade Category], for example:
- For a binder required in a Moderate climate zone, with a Very Heavy grade category, order PG 58V.
- For a binder required in a Warm climate zone, with a Heavy grade category, order PG 64H

6. Sampling and Testing

Sampling shall be carried out in accordance with AASHTO T 40, ASTM D140, or equivalent.

Binders manufactured in, or imported into New Zealand or blended to meet the specified grades in M 332 shall have the following tests specified in M 332 Table 1 carried out at source or upon import:
- AASHTO T 48 Flash Point
- AASHTO T 316 Viscosity
- AASHTO T 315 Dynamic Shear
- AASHTO T 240 Accelerated aging in the Rolling Thin-Film Oven (RTFO)
- Mass change post-RTFO
- AASHTO T 350 post-RTFO Multiple Stress Creep Recovery (MSCR)

Testing frequency shall be:
- For New Zealand manufactured binders: once for each individual grade, or per production run, or if crude feedstock changes or if the composition of the bitumen changes;
- For imported bitumens: one full test per shipment for each PG grade imported or blended from imported bitumen;
- For binders blended to grade at bulk terminals, one full test for each PG grade supplied blended from samples drawn from each bulk delivery into the terminal.

AASHTO M 332 Table 1 specifies additional criteria for binders subjected to accelerated aging in the Pressure Aging Vessel (PAV, AASHTO R 28). The low temperature testing, Creep Stiffness and Direct Tension) are not readily available in New Zealand laboratories.

Low temperature testing to AASHTO T 313 and AASHTO T 314 shall be carried out on the highest performance grade (i.e. lowest Jm) binder as follows:
- Twice per annum for bitumen binders manufactured and blended in New Zealand;
- For imported binders, once per shipment for one PG grade imported, or blended from imported bitumen.
The low temperature results shall be reported to the NZTA Principal Surfacing Engineer for the purposes of data gathering and review of the applicability of the low temperature testing for New Zealand conditions.


In addition to the requirements of NZTA M1, the supplier shall develop a quality assurance plan outlining how they will comply with the requirements of CCNZ BPG04 ‘Quality Assurance for Bituminous Binders’. This plan shall be submitted for approval annually to NZTA Principal Surfacings Engineer.

8. Test Method Equivalency

AASHTO M 332 specification uses AASHTO methods for testing the bitumen which may not be offered by New Zealand laboratories. ASTM equivalent test methods are acceptable for use as in Table 3 below.

Table 3: ASTM equivalent test methods

<table>
<thead>
<tr>
<th>Test</th>
<th>Default method</th>
<th>Equivalent Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accelerated aging of asphalt binder using PAV</td>
<td>AASHTO R 28</td>
<td>ASTM D6521</td>
</tr>
<tr>
<td>Sampling asphalt materials</td>
<td>AASHTO R 66</td>
<td>ASTM D140</td>
</tr>
<tr>
<td>Solubility of bituminous materials</td>
<td>AASHTO T 44</td>
<td>ASTM D2042</td>
</tr>
<tr>
<td>Flash and fire points by Cleveland open cup</td>
<td>AASHTO T 48</td>
<td>ASTM D92</td>
</tr>
<tr>
<td>Effect of heat and air (RTFOT)</td>
<td>AASHTO T 240</td>
<td>ASTM D2872</td>
</tr>
<tr>
<td>Flexural creep stiffness using bending beam rheometer</td>
<td>AASHTO T 313</td>
<td>ASTM D6648</td>
</tr>
<tr>
<td>Fracture properties of asphalt binder in direct tension</td>
<td>AASHTO T 314</td>
<td>ASTM D6723</td>
</tr>
<tr>
<td>Rheological properties using dynamic shear rheometer</td>
<td>AASHTO T 315</td>
<td>ASTM D7175</td>
</tr>
<tr>
<td>Viscosity using rotational viscometer</td>
<td>AASHTO T 316</td>
<td>ASTM D4402</td>
</tr>
<tr>
<td>MSCR of asphalt binder using dynamic shear rheometer</td>
<td>AASHTO T 350</td>
<td>ASTM D7405</td>
</tr>
</tbody>
</table>
9. Appendix A: Climate Zone Map

Figure 1: New Zealand Climate Zone Map
10. Appendix B: Binder Grade Selector Flow Chart

Notes:
(a) The flow chart above is based on standard axle loadings. Where axle loadings are extreme, for example in industrial or aviation applications then the heavier duty grades of binder should be considered for use.
(b) For the selection of Grade E binders for surfacing mixes and Grade V binders for sub-surface mixes, slow traffic should be interpreted as stop–start traffic movements at sites such as intersections, toll plazas, roundabouts or other areas of very high stress and extended loading periods.