DRAFT SPECIFICATION FOR DENSE-GRADED, STONE MASTIC AND FINE GRADED ASPHALT PAVING MATERIALS
Foreword

The Australian Asphalt Pavement Association (AAPA) prepared the second edition of the National Asphalt Specification (NAS) based on the framework for specifying asphalt that was prepared in conjunction with Austroads and AAPA, and Roading New Zealand (formerly the New Zealand Pavement and Bitumen Contractors’ Association). The aim of the joint framework specification is to promote national uniformity and good practice in the specification and use of asphalt throughout Australasia.

The NAS edition 2 was subsequently been used in New Zealand, in conjunction with an interim Supplement with considerable success. This document is a merging of the NAS edition 2 with the New Zealand Supplement, with some additional changes to reflect the contractual environment and philosophical approach to mix design found in New Zealand. Nonetheless the New Zealand version of the NAS is closely based on AAPA’s publication and their permission to use and amend NAS edition 2 is gratefully acknowledged.

The document is in two sections. Section 1 is a set of “Notes for Implementation and Use” that are provided as a guide to interpretation of the specification clauses and the selection of alternatives appropriate to particular applications or jurisdictions. Section 2 is a series of specification clauses that may be used directly in contract documentation. When used in contract documentation, the user must select the appropriate asphalt mix type, thickness and any special requirements that reflect the particular application.

The specification clauses are applicable to component materials, design and manufacture and placement of dense graded asphalt, stone mastic asphalt and fine gap graded asphalt. It is intended for application to most uses of asphalt although some specialist uses, such as heavy-duty, off-road applications (airfields, container terminals), major freeways, special mix types, and non-road applications may require further specific requirements.

The specification clauses are based on a quality system approach, with asphalt being specified in terms of performance-related mix design criteria as well as manufacture and construction standards. In this format it is targeted at a contracting environment where the Principal accepts the long term performance risks associated with selection of design and construction criteria, and acceptance and payment of works is made upon practical completion, and is followed by a defects liability period.

Australian Asphalt Pavement Association Limited (AAPA)
AAPA is a non-profit organisation formed to promote the economic use of asphalt based on sound technical grounds. The Association’s Mission Statement for Research and Development is to ensure the attainment of the optimum level of quality and long-term performance in flexible pavement design, construction and maintenance. The AAPA Technical Committee manages the AAPA R&D Program for Asphalt Research and Technology and works in close cooperation with the Austroads Pavement Reference Group. The research programs are coordinated and complementary.

Roading New Zealand
Roading New Zealand is the industry representative body for a wide range of contracting companies whose core business involves building and maintaining New Zealand’s roadway and land transport infrastructure. It is New Zealand’s only specialist roading industry organisation. This New Zealand version of NAS edition 2 was prepared by a working group of representatives from the asphalt industry.

Reproduction of extracts from this publication may be made subject to due acknowledgement of the source.

Disclaimer
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1 PREAMBLE

This specification for hot-mixed asphalt materials is closely based on the framework specification for asphalt published by Austroads, AGPT04B (Austroads 2007). However it has been amended to allow rapid implementation into the New Zealand contractual environment.

The specification closely follows the principles of AGPT04B and uses the Austroads method of mix design as a preferred method for designing hot-mixed asphalt materials, although legacy design procedures (Marshall) and asphalt mixes are accommodated.

At the time of writing, the Austroads method of mix design and Austroads mixes are in common use in some regions within New Zealand. This situation has been made contractually possible by using the National Asphalt Specification (AAPA 2004) in conjunction with a New Zealand supplement. This specification merges the National Asphalt Specification and the Supplement, providing for a smooth implementation in all New Zealand regions.

This specification is a living document and users are encouraged to provide comment and feedback.

The “KiwiNAS” working group believes that this document advances asphalt mix design and technology in New Zealand. Users are encouraged to adopt the specification particularly in respect of the Austroads method of mix design, but also to consider the range of asphalt materials specified, allowing the choice of materials that best suit the intended application.

“KiwiNAS” Working Group
October 2010
Section 1
NOTES FOR IMPLEMENTATION AND USE OF SPECIFICATION CLAUSES

2 GENERAL

2.1 Preliminary
These notes are for the guidance of the Engineer and Contractor and do not form part of the contract. Specification clauses are contained in section 2 of this document.

2.2 Scope
The specification has been prepared for the manufacture, supply and placing of dense graded hot mix asphalt (also referred to as asphaltic concrete or AC), stone mastic asphalt (SMA) and fine gap graded asphalt (FGG) for roadworks and related applications. Different criteria apply to quality of components and asphalt mix design according to the application. The nominal maximum aggregate size and types of mixes to be used should be specified in the Schedule of Job Details. A guide to the selection of mixes is given in clause 4.

The intended use of the materials may also involve the application of different construction requirements and these should also be nominated in the Schedule of Job Details. Guidelines for the application of such requirements are given in the notes to the relevant specification clauses.

Careful consideration of the Schedule of Job Details is required to ensure that asphalt is fit for purpose, of the appropriate type and quality, and provided in a cost effective manner.

This specification will normally be used as contract documentation in conjunction with a standard General Conditions of Contract such as NZS 3910. Contract documentation may also include other works. The terms used in the specification guidelines are generally consistent with NZS 3910, and include Principal, Engineer, and Contractor. Where these terms are in conflict with those otherwise used, a general interpretation clause should be inserted in the contract documents.

2.3 Quality Systems
Depending on project type and performance risk, the Principal may undertake an audit of a Contractor’s Quality System and/or Quality Plan as part of prequalification or contract acceptance procedures. The Principal may also establish additional procedures for surveillance of contract activity and audit/verification of quality of materials and testing.

3 MATERIALS

3.1 Aggregate
Coarse and Fine aggregate fractions are specified in accordance with existing practice in New Zealand. Criteria are identical to previous NZTA specifications (M/10, P/23) (see Table 14.1, Table 14.2 and Table 14.3).

3.2 Mineral Filler
Some asphalt specifications show confusion over the role and specification of filler in asphalt mixes. By strict definition, filler is that mineral matter passing the 75 micron sieve and includes filler sized particles derived from aggregates as well as added fine materials such as lime, fly ash, etc. In practice, materials used as added filler are comprised predominantly of particles smaller than 75 microns but may also contain a proportion of coarser particles. Tests applied to added filler materials apply to the complete sample, not just that portion passing the 75 micron sieve.

Added filler is specified by particle size distribution only as is normal practice in New Zealand.

3.3 Binder
A guide to selection of binder type is provided in Table N4.5, Table N4.6, or Table N4.7.
3.4 Reclaimed Asphalt Pavement (RAP)

A guide to the application of design and manufacturing requirements for RAP in asphalt is provided by clause 4.5.

4 MIX DESIGN

4.1 General

This specification has been prepared to incorporate performance–based design criteria developed through the national research programs of AAPA, Austroads and ARRB Transport Research.

The outcome of that research program has been published as Austroads AGPT04B Guide to Pavement Technology Part 4B Asphalt (an updated version of the former APRG 18 “Selection and Design of Asphalt Mixes: Australian Provisional Guide”). Guidelines for application of performance tests are given in Table N4.8

The Austroads mix design procedure has two main elements:

a) Laboratory compaction using gyratory compaction in place of Marshall or Hubbard Field
b) Performance–related tests on compacted materials.

While the Austroads method was developed around the Gyropac™ compaction apparatus, New Zealand laboratories have standardised on the later Servopac™ apparatus. Accordingly, asphalt mixes designed using gyratory compaction in accordance with this specification shall use the Servopac™ compaction apparatus.

The general volumetric requirements for asphalt mixes (requirements for component materials, grading limits, binder content, and voids relationships) remain largely unchanged so that asphalt mixes should therefore not change greatly from those previously used, particularly where there is a satisfactory record of performance. The new procedures should, however, provide greater reliability and prediction of performance behaviour.

Gyratory compaction enables ready selection of different compaction levels to match expected service conditions as well as being able to simulate long term heavy traffic loadings by extended compaction. Gyratory compaction is also considered to achieve particle alignment that is a better representation of field compaction of asphalt. The specification does, however, provide for the use of Marshall compaction where that method of compaction is preferred. It is important that only one set of criteria is applied, either Marshall or gyratory compaction. In due course it is expected that gyratory compaction will become more common than Marshall.

The mechanical properties of Marshall and Hubbard Field 'Stability' and 'Flow' do not directly measure fundamental properties but provide empirical relationships that have been found to correlate with asphalt mixes which provide suitable levels of field performance. The new mix design procedures provide for a range of tests on performance–based properties that include:

(a) Resilient modulus of laboratory compacted samples or cores using MATTA indirect tensile test
(b) Moisture sensitivity (ASTM D4867) of gyratory compacted samples.
(c) Wheel tracking of laboratory compacted slabs or field samples.
(d) Fatigue testing and flexural stiffness of beams cut from laboratory compacted slabs or field samples.

AGPT04B provides for three levels of design depending on the intended application. In summary, the major test requirements for each level, adapted for New Zealand, are outlined by Table N4.1 below.

<table>
<thead>
<tr>
<th>Design Level</th>
<th>Traffic</th>
<th>Standard Tests</th>
<th>Optional Tests</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 1</td>
<td>Light</td>
<td>Compaction, density and voids determinations</td>
<td>Voids at maximum cycles</td>
</tr>
<tr>
<td>Level 2</td>
<td>Medium</td>
<td>Resilient Modulus</td>
<td>Wheel tracking</td>
</tr>
<tr>
<td>Level 3</td>
<td>Heavy</td>
<td>Wheel tracking</td>
<td>Fatigue</td>
</tr>
</tbody>
</table>

Resilient Modulus testing is a tool for mix designers to use for mix optimisation. It should not be used as a specification criterion in asphalt specifications as raw material properties may not allow specified moduli to be met in an economic or technically viable manner. However reported modulus values may be considered...
Wheel tracking testing provides data on the deformation resistance of an asphalt mix. This testing is particularly relevant for heavily trafficked pavements (high wheel loadings, high traffic counts or both) or where trafficking is highly channelized. Refer to NZTA technical memorandum TM6003 located at http://www.nzta.govt.nz/resources/bitumen-testing/docs/bitumen-testing-tm-6003-v1.pdf

4.2 Legacy Mixes

Table 15.2 of this specification allows for the continued use of asphalt mixes designed under earlier iterations of this specification (i.e. NZTA M/10:2005). However mixes designed to comply with Table 15.2 may now be designed using differing compactive effort in the Marshall apparatus compared with traditional New Zealand practice where only 75-blow compaction was used. Table 15.6 allows reduced numbers of blows in the Marshall apparatus for reduced loadings. This will result in mixes with increased binder content, giving improved durability, but reduced resistance to deformation. Conversely, mixes designed using 75-blow of the Marshall apparatus will tend to have lower durability but better deformation resistance.

Consequently it is recommended that selection of the compactive effort used during the mix design process be based on the expected duty of the mix, as shown by Table 15.5 and Table 15.6.

4.3 Aggregate Grading and Binder Content

The aggregate grading and binder content ranges shown in Table 15.1, Table 15.2, Table 15.3 and Table 15.4 of the specification are targets for design purposes. Application of production tolerances may result in actual production being outside those limits. Table 15.1 restricts the proportion of finer materials in order to provide good texture for dense graded wearing course mixes for medium and heavy traffic and increased deformation resistance in heavier trafficked applications. Table 15.2 allows increased proportions of finer materials in dense graded mixes for all lesser trafficked applications.

The Engineer may allow the use of asphalt mixes with a design target outside the ranges shown where it can be shown that all the other performance requirements can be adequately met.

4.4 Mix Properties: Selection of Mix Type, Binder Type and Testing Requirements

The principle factors influencing the performance characteristics of asphalt mixes are the selection and quality of components, and the volumetric properties of the mix (nominal size, grading, binder content and voids relationships). External factors such as traffic, appropriate treatment selection and pavement condition must also be considered.

The specification provides for different criteria for aggregate quality and voids relationships for dense graded mixes (Level 1 of the Austroads design procedure) based on traffic categories. A guide to selection of traffic category is shown in the Table N4.2 below. The relevant traffic category should be nominated in the Schedule of Job Details.

The mix type, nominal mix size and binder type shall also be nominated in the Schedule of Job Details. For most wearing course and structural asphalt applications, dense graded asphalt mix types are used. Other mix types are used as wearing courses to provide particular surface characteristics for particular applications as follows:

(a) Open graded porous asphalt is used as a porous wearing course to reduce water spray and tyre noise levels on motorways and other high speed roads. Note that open graded porous asphalt will be specified in accordance with NZTA P/11 specification.

(b) Stone mastic asphalt (SMA) is used to provide good surface texture and good deformation resistance on heavily trafficked roads. Smaller nominal sizes can also be used as a durable, well-textured surface in lightly trafficked applications.

(c) Fine gap graded asphalt (FGG) provides a very fine textured surface in a mix that can be readily compacted to low air voids, thereby providing good durability in lightly trafficked pavements. The grading envelope for FGG provides for a wide choice of grading target but there is a design intent to produce a gap grading with limited intermediate sized aggregate fractions as described in Austroads Part 4B. It is suggested that Table 15.2 mixes also be considered for this type of application.

A detailed guide to selection of different wearing course types for particular surface characteristics is provided in the Austroads "Guide to the Selection of Road Surfacings" AP–G63.

The nominal size may be determined as a function of the layer thickness or the layer thickness selected on the basis of the nominal size required for a particular application. A guide to selection of layer thickness and nominal size is shown in Table N4.3.
Guides to selection of binder types for dense graded wearing and base course applications are shown in Table N4.5 and Table N4.6, and Table N4.7 for other mixes types. Not all binder types may be available in all locations. Modified binders require delivery in minimum quantities and special handling and storage requirements. The specification of modified binders may, therefore, not be practical for small projects or remote locations.

It should be noted that the compaction levels and design air voids for dense graded asphalt mixes differ depending on the traffic category and application (see Table 15.5 and Table 15.6). These differences are applied to both gyratory and Marshall compacted specimens. The contract shall specify the traffic category and mix application on the basis of the field conditions. The Contractor will select the mix design procedure (gyratory or Marshall) appropriate to the specified field conditions.

A minimum air void level of 2.0% at 250 cycles (Table 15.5) is specified as an indicator of the influence of long term compaction under heavy traffic and potential for in-situ voids to reach critical levels.

### Table N4.2 Guide to Traffic Category

<table>
<thead>
<tr>
<th>Indicative Traffic Volume</th>
<th>Structural design level</th>
<th>Traffic Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>Commercial vehicles/lane/day</td>
<td>Structural design level</td>
<td>Traffic Category</td>
</tr>
<tr>
<td>&lt; 100</td>
<td>&lt; 5 x 10⁸ ESAs</td>
<td>Light</td>
</tr>
<tr>
<td>100 – 500</td>
<td>5 x 10⁸ – 5 x 10⁹ ESAs</td>
<td>Medium</td>
</tr>
<tr>
<td>500 – 1000</td>
<td>5 x 10⁹ – 2 x 10¹⁰ ESAs</td>
<td>Heavy</td>
</tr>
<tr>
<td>&gt; 1000</td>
<td>&gt; 2 x 10¹⁰ ESAs</td>
<td>Very heavy</td>
</tr>
</tbody>
</table>

**Note:** Traffic category is based on Austroads vehicle classification system.

### Table N4.3 Guide to selection of nominal size of dense graded light traffic mixes

<table>
<thead>
<tr>
<th>Nominal size (mm)</th>
<th>Previous Designation</th>
<th>Typical Layer thickness (mm)</th>
<th>Typical Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>Mix 10</td>
<td>20 – 35</td>
<td>Commonly used for surfacing residential streets and foot traffic areas where thin layers and fine surface texture are required.</td>
</tr>
<tr>
<td>10</td>
<td>Mix 15</td>
<td>30 – 50</td>
<td>General purpose wearing course in light and medium traffic applications.</td>
</tr>
<tr>
<td>15</td>
<td>Mix 20</td>
<td>45 – 75</td>
<td>Wearing course mix for heavier traffic applications. Also some intermediate course applications depending on layer thickness.</td>
</tr>
<tr>
<td>20</td>
<td>Mix 25</td>
<td>60 – 100</td>
<td>General purpose base and intermediate course mix for wide range of use.</td>
</tr>
</tbody>
</table>

**Notes:**
(a) The minimum typical layer thicknesses above are based on 3 times the nominal size. Placement of mixes at this minimum layer thickness may result in increased layer permeability.
(b) Minimum layer thicknesses must be increased for coarser asphalt mixes. Refer to Table 15.1, Table 15.2, Table 15.3 for minimum layer thicknesses for specific asphalt mixes.
(c) The use of modified binders may require the use of thicker layer thicknesses for workability reasons.

### Table N4.4 Guide to selection of nominal size of dense graded heavy traffic asphalt and SMA mixes

<table>
<thead>
<tr>
<th>Nominal size (mm)</th>
<th>Typical Layer thickness (mm)</th>
<th>Typical Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>40 – 50</td>
<td>General purpose wearing course in light and medium traffic applications.</td>
</tr>
<tr>
<td>14</td>
<td>55 – 75</td>
<td>Wearing course mix for heavier traffic applications. Also some intermediate course applications depending on layer thickness.</td>
</tr>
<tr>
<td>20</td>
<td>80 – 100</td>
<td>General purpose base and intermediate course mix for wide range of use.</td>
</tr>
<tr>
<td>28</td>
<td>100 – 150</td>
<td>Base and intermediate course but less commonly used than 20 mm. Control of segregation can sometimes be an issue.</td>
</tr>
</tbody>
</table>

**Notes:**
(a) The minimum typical layer thicknesses above are based on 4 times the nominal size.
(b) The use of modified binders may require the use of thicker layer thicknesses for workability reasons.
Table N4.5  Guide to selection of binder type for dense graded wearing course applications

<table>
<thead>
<tr>
<th>Traffic Category</th>
<th>Typical Binder Penetration Grade</th>
<th>Recommended Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Light</td>
<td>80/100</td>
<td>Residential streets, carparks and foot traffic</td>
</tr>
<tr>
<td>Medium</td>
<td>80/100</td>
<td>Normal conditions and lower traffic ranges. Good general purpose mix for wide range of applications.</td>
</tr>
<tr>
<td>Heavy</td>
<td>60/70</td>
<td>High performance mixes for more critical traffic applications or where elastomer polymers are required to improve flexibility. Stiffer binders require strong, stiff base.</td>
</tr>
<tr>
<td>Very Heavy</td>
<td>60/70</td>
<td>Special applications such as very heavily trafficked intersections and heavy-duty industrial pavements.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Traffic Category</th>
<th>Binder Grade</th>
<th>Recommended use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Light and Medium</td>
<td>80/100</td>
<td>General purpose mixes for cooler conditions. General purpose mixes for most light and medium traffic applications.</td>
</tr>
<tr>
<td>Medium/Heavy (high fatigue base)</td>
<td>80/100, 60/70</td>
<td>Special high bitumen content sub-base layer providing high fatigue resistance. To avoid rutting, this mix should not be used within 125 mm of surface. The layer thickness should not generally exceed 70 mm or one third of the structural pavement depth.</td>
</tr>
<tr>
<td>Heavy</td>
<td>60/70, 40/50</td>
<td>General purpose mix for heavy traffic applications. High stiffness base for use in heavy duty pavements.</td>
</tr>
<tr>
<td>Very Heavy</td>
<td>60/70, 40/50, Multigrade or PMB</td>
<td>Special applications such as heavy-duty industrial pavements and hard standing areas</td>
</tr>
</tbody>
</table>

Table N4.7  Guide to selection of binder type for other mix types

<table>
<thead>
<tr>
<th>Mix Type</th>
<th>Traffic Category</th>
<th>Binder Grade</th>
<th>Recommended use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stone Mastic Asphalt</td>
<td>Light or medium</td>
<td>60/70</td>
<td>Wearing course for light and medium trafficked roads where well textured mix is required</td>
</tr>
<tr>
<td></td>
<td>Heavy or Very Heavy</td>
<td>60/70, 40/50</td>
<td>Wearing course for heavily trafficked roads providing high levels of texture and rut resistance</td>
</tr>
<tr>
<td></td>
<td>Very Heavy (Special applications)</td>
<td>PMB</td>
<td>Enhanced wearing course performance in heavily trafficked applications</td>
</tr>
<tr>
<td>Fine Gap Graded Asphalt</td>
<td>Light</td>
<td>80/100</td>
<td>Fine textured, durable wearing course for use in residential streets, pedestrian areas, and other low traffic applications</td>
</tr>
</tbody>
</table>

### 4.5 Design and Manufacture of Asphalt Mixes Incorporating Reclaimed Asphalt Pavement (RAP)

As a general rule, no special requirements need apply to the use of RAP in hot mix asphalt where the percentage of RAP does not exceed 15% of the total mix.

Where RAP is to be added in proportions greater than 15%, but not more than 30% of the total mix, a mix design must be completed. The use of bitumen binder of one class or grade softer than that otherwise specified will generally provide suitable compensation for the influence of hardened binder in the RAP and produce asphalt mixes of comparable stiffness, fatigue resistance and deformation resistance to mixes manufactured with virgin materials.

The use of RAP in proportions greater than 15% of the total mix should only be permitted where the Contractor can demonstrate suitable manufacturing plant and quality control procedures. Manufacture should only be carried out in asphalt plants specifically designed to handle such proportions of RAP without overheating and damage to binder in the RAP or new mix. The quality plan should indicate the procedures for monitoring the consistency of grading and binder properties of incoming RAP materials, the use of softer
binders or rejuvenating agents to achieve a binder of comparable performance to that otherwise specified, and testing to validate the properties of the manufactured asphalt.

A guide to blending of binders or rejuvenating agents to achieve a target binder viscosity is provided in the "Austroads Asphalt Recycling Guide" (AP-44/97) and "Austroads Framework Specifications for Asphalt Recycling" (AP-T02). Caution must be used in determining targets for blending of binders as fresh binder or rejuvenator may not be fully combined with the aged binder during the asphalt manufacture process. Consequently, mix performance characteristics imparted by binder stiffness, particularly fatigue and rutting resistance, may be somewhat intermediate between that of the fresh binder and that predicted from the stiffness or viscosity calculated or determined by extraction and testing of the blended binder.

4.6 Approval of Job-mix formula

In addition to the tests listed in Table 15.11 of the specification that are required to be reported from a production trial batch, the Contractor may also be required to report the results of Moisture Sensitivity Testing. A typical minimum value for the Moisture Sensitivity test is a Tensile Strength Ratio of 75%.

A guide to applications where Level 2 and Level 3 tests (see AGPT04B) may be relevant is provided in Table N4.8 below. Some of these tests are expensive and only capable of being performed in a limited number of research laboratories. Specifiers should therefore consider the balance between the cost of providing test data and the use to which the information is to be put. Where testing is required, the tests should be nominated in the Schedule of Details and a separate schedule item provided for the cost of testing.

### Table N4.8 Guide to applications where Level 2 and Level 3 Mix Design tests may be considered

<table>
<thead>
<tr>
<th>Mix Type</th>
<th>Traffic Category</th>
<th>Application</th>
<th>Resilient Modulus at 25°C</th>
<th>Moisture Sensitivity</th>
<th>Fatigue Life at 20°C and 400 micro strain</th>
<th>Wheel Tracking Test at 60°C</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Light</td>
<td>Wearing and base</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>Medium</td>
<td>Wearing and base</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td></td>
<td>High fatigue base</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>Heavy</td>
<td>Wearing and base</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>High fatigue base</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>Very Heavy</td>
<td>Wearing and base</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

5 MANUFACTURE AND STORAGE

Guidance for binder storage and mixing temperatures may be obtained by reference to AAPA Advisory Note 7: "Guide to the Selection, Heating and Storage of Binders for Sprayed Sealing and Hot Mixed Asphalt".

The length of time that manufactured asphalt may be held in hot storage bins will vary according to the type of mix, type of binder and construction of storage bins. Maximum storage times are generally applicable to standard dense graded asphalt mixes, standard bitumen binder and well insulated bins that may also include supplementary heating. Shorter storage periods apply to high binder content mixes, polymer modified binders and poorly insulated bins. Additional guidelines for storage of polymer modified binders at elevated temperatures may be provided by the manufacturers of polymer modified binders. Other problems caused by extended storage may be assessed by monitoring mix temperature variation and segregation.

6 SAMPLING AND TESTING OF ASPHALT PRODUCTION

6.1 General

The purpose of inspection and testing is to provide reasonable assurance to the purchaser that the quality of component materials comply with the standards specified, and that the manufactured asphalt is in accordance with the designated job-mix formula design.

Manufacturing compliance may be assessed at two levels:
(a) Verification that the job-mix formula has been replicated, i.e. use of conforming components and
combination in the design proportions to achieve the job–mix formula grading and binder content.

(b) Verification that the design targets have been met, i.e. testing of compacted samples for volumetric properties and other specified properties.

For many applications, compliance with the job–mix formula grading and binder content is adequate. It is considered best practice in New Zealand to monitor production consistency by also using the Maximum Specific Gravity (MSG).

The manufacturer should not rely solely on the sampling and testing done for compliance purposes as the measures of process quality control. The specification provides an incentive to the manufacturer to undertake suitable measures to improve the level of conformity and consistency of manufactured product by reducing the frequency of testing for compliance purposes where the manufacturer is using a suitable statistical process control system and where the results of compliance tests show an appropriate level of consistency in meeting the specification requirements.

A guide to statistical process control systems is provided in AAPA Implementation Guide IG-3: Asphalt Plant Process Control Guide.

The use of statistical process control and other measures, such as the Roading New Zealand Asphalt Plant Accreditation Scheme (APAS), are strongly encouraged as a means of reducing the uncertainties associated with interpretation of test results from single samples. The use of risk assessment procedures to define where variation may occur is also recommended.

7 DELIVERY

The rate of delivery should be matched to paving output to maintain consistent spreading to achieve good ride quality and uniform compaction and to avoid unnecessary delays in spreading operations and loaded asphalt being held on site for long periods.

Asphalt should arrive on site at a suitable temperature for spreading and compaction.

The Contractor’s quality plan shall establish procedures to ensure that asphalt mixes are placed and compacted on site in such a way that the specified finished pavement properties are achieved.

8 PLACING

8.1 Preparation of Surface

Road surfaces must be clean to ensure a good bond between new asphalt and the existing surface.

8.2 Tack Coating

Tack coating for normal asphalt applications comprises a light application of bitumen emulsion to ensure adequate adhesion between layers. The type of bitumen emulsion for normal applications should suit the conditions of use. Generally, rapid setting cationic emulsion is used in cooler regions where damp conditions may be encountered. In warmer or drier conditions, slower setting cationic emulsions and anionic emulsions may combine easier handling with satisfactory performance. Bitumen emulsion used for tack coating may be diluted with water to assist uniform coverage, provided that the residual binder application rate is achieved.

Tack coating is generally not necessary when placing over newly placed, untrafficked asphalt.

In cases where the existing surface has questionable water resistance, such as when placing new Open Graded Asphalt over an existing Open Graded Asphalt layer, New Zealand practice has been to apply a membrane first. This is generally 1.0 L/m² of penetration grade bitumen, but this may be increased in some instances. This sheet of binder is then covered with a sparse layer of fine sealing chip, normally NZTA M/6 Grade 5, to keep the asphalt laying plant’s tyres from contacting the membrane binder. The need for a membrane or tack coat should be specified in the contract specification.

Consideration should be given to the binder selection, to reduce the risk of flushing and loss of texture.

8.3 Spreading

The specification provides for asphalt to be placed when pavement surface temperatures are as low as 5°C. Placing in cool conditions increases the difficulty in obtaining good standards of work and, where practicable, work involving thin layers (40 mm or less) or PMB binders should be programmed to be done when such conditions are less likely to occur.

The selection and use of automatic level control for asphalt paving should normally be determined by the
Contractor, taking into account the applicability to site conditions and the geometric requirements of the finished result. The Schedule of Job Details provides for specification of particular level control devices, if required.

Typical applications of automatic controls are as follows:
(a) **Joint Matcher.** Suitable for use on most classes of work to reduce manual effort
(b) **Travelling Beam (Generally 9.0 m).** Assists in removing minor irregularities within the length of the beam. Suitable for a wide range of work, except for short runs and restricted working space.
(c) **Cross-fall.** Limited applications where a set crossfall is desired from a reference on one side of the paver.
(d) **Computerised Electronic Control (e.g. “Paveset”).** Enables paver to operate to predetermined profile. Needs accurate survey and well-maintained equipment.
(e) **Fixed Stringline.** Enables paver to operate to set profile. Requires accurate survey and additional personnel for setting up and maintaining lines. Presence of stringlines can severely restrict movement of spreading vehicles.

8.4 Compaction
Selection of compaction equipment is the responsibility of the Contractor, provided that it is capable of achieving the required standards of compacted density, surface shape and finish.

8.5 Joints
Joints are the weakest part of the pavement. Cold joints should be minimised by planning of works to achieve a minimum number of construction joints and, where practicable, maximum use of hot or warm joints.

9 PRODUCTION AND CONSTRUCTION TRIAL
A production and construction trial is usually only applicable to major projects where a transportable plant is specifically set up for the project. Preliminary trials may also be called for on major project works to be supplied from fixed plants, where a plant has not been used to supply that class of work or where the use of new sources of materials and mix designs are involved.

A separate schedule item should be included for payment for production and construction trials.

10 FINISHED PAVEMENT PROPERTIES
Finished Pavement Properties requirements to be specified in contract documents. To date the guidelines specified in the Austroads guide have not been used in New Zealand. NZTA Technical Memorandum TM7003 specifies roughness requirements for finished pavement construction for New Zealand highway pavements.

11 MEASUREMENT AND PAYMENT
Payment is normally on the basis of mass determined from an approved weighing system. Alternatively, on new works where asphalt is being placed to a specified thickness, the mass may be determined on the basis of measured area, thickness and density.

Additional clauses may also be inserted to apply a scheduled rate of reduction in payment for failure to comply with manufacturing targets, compacted density and ride quality requirements to compensate for reduced service life.

12 APPENDIX (SCHEDULE OF JOB DETAILS)

12.1 General
The following items should be considered when schedule contract specific job details:

12.1.1 Asphalt Mix Requirements
Insert type/traffic category of mix, binder type, nominal size and thickness, where applicable (clauses 13.4.1, 14.3, 15.2, 15.3).
12.1.2 Measurement and Payment
Indicate the method of measurement applicable (clause 22).

12.1.3 Special Job Requirements
If specific job conditions require changes to this specification, special clauses should be prepared and inserted in the schedule of job details for the following.

(a) Any special design requirements, if applicable (clause 15.3);
(b) Reporting requirements for mix design tests other than standard volumetric data. A separate schedule item should be provided for the cost of such testing (clause 15.3);
(c) Any particular conditions or restrictions to mix types or applications of RAP in asphalt (clause 14.4)
(d) Any special requirements for use of automatic paver control, if applicable (clause 20.5.3)
(e) Requirements for production and construction trial, if applicable. A separate schedule item is also required for the cost of such trial (clause 19);
(f) Special requirements for measurement of ride quality, if applicable. A separate schedule item should be provided for the cost of testing, where testing is to be provided by the Contractor (clause 21.4);
(g) Special requirements for payment for non complying materials, if applicable (clause 22.1).
Final Draft 9.0

Section 2
SPECIFICATION CLAUSES
13 GENERAL

13.1 Scope
This specification covers dense graded, stone mastic and fine gap graded asphalt for roads and related applications.

The areas covered by this specification include:
(a) Asphalt materials
(b) Asphalt mix design requirements
(c) Process control in manufacture and placement of asphalt
(d) Acceptance criteria for asphalt
(e) Quality systems, minimum process standards, plant requirements and sampling and testing frequencies.

This section is to be read in conjunction with the Appendix (Schedule of Job Details). Where there is conflict between the requirements of this section and the Appendix, the requirements of the Appendix shall apply.

13.2 Contracting Environment
This document is a method specification. As such, the Principal accepts the long-term performance risks associated with the selection of design and construction criteria.

13.3 References

13.3.1 Austroads
(a) Austroads Guide to Pavement Technology Part 4B Asphalt AGPT04B.
(b) Austroads Specification Framework for Polymer Modified Binders, AP-T04
(c) Austroads Provisional Specification for Multigrade Binders AP-T01
(e) AGPT/T220 Sample preparation – compaction of asphalt slabs
(f) AGPT/T231 Deformation resistance of asphalt mixtures by the wheel tracking test
(g) AGPT/T233 Fatigue life of compacted bituminous mixes subject to repeated flexural bending
(h) AGPT/T235 Asphalt binder drain−off
(i) AGPT/T236 Asphalt particle loss
(j) AGPT/T237 Binder film index

13.3.2 New Zealand Transport Agency
(a) NZTA M/1 Specification for Roading Bitumens
(b) NZTA M/6 Specification for Sealing Chip
(c) NZTA P/11 Specification for Open Graded Porous Asphalt
(d) NZTA P/23 Performance Based Specification for Hotmix Asphalt Wearing Course Surfacing

13.3.3 Standards New Zealand
(a) NZS 3910 Conditions of Contract for Building and Civil Engineering Construction
(b) NZS 4407 Methods for Sampling and Testing Aggregates
(c) AS/NZ ISO 9001 Quality Systems – Requirements
(d) AS/NZS 2891.3.3 Bitumen Content and Grading – Pressure Filter Method
(e) AS/NZS 2891.14.2 Methods of sampling and testing asphalt – Field density tests – Backscatter mode

13.3.4 Standards Australia
(a) AS 1141.11 Particle Size Distribution – Sieving Method
(b) AS 2891.13.1 Determination of the Resilient Modulus of Asphalt – Indirect Tensile Method
(c) AS 2981.2.2 Compaction of Asphalt test Specimens Using a Gyratory Compactor

13.3.5 American Society for Testing and Materials (ASTM)
(a) ASTM C117 Materials Finer than 75−μm Sieve in Mineral Aggregates by Washing
(b) ASTM C127 Density, Relative Density (Specific Gravity) and Absorption of Coarse Aggregate
(c) ASTM C128 Density, Relative Density (Specific Gravity) and Absorption of Fine Aggregate
(d) ASTM C136 Sieve Analysis of Fine and Coarse Aggregates
(e) ASTM D979 Sampling of Bituminous Paving Mixtures
(f) ASTM D1188 Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Coated Samples
(g) ASTM D2041 Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures
13.4 Definition of Terms

13.4.1 Asphalt Mix Types

For the purposes of this specification dense graded asphalt mixes have been classified in terms of wearing course and base and four traffic categories of Light, Medium, Heavy and Very Heavy. Where relevant, the same traffic categories shall apply to other mix types. The particular mixes to be used shall be nominated in the Appendix or, if not otherwise specified, selected in accordance with the guidelines and traffic categories given in Austroads Part 4B.

Dense graded hot mix asphalt is also known as asphaltic concrete and designated by the abbreviation AC. The specification also includes requirements for lighter duty asphaltic concrete designated DG, stone mastic asphalt (SMA) and fine gap graded asphalt (FGG).

Open Graded Porous Asphalt is specified by NZTA P/11 specification.

13.5 Quality System

The Contractor shall establish, implement and maintain a Quality System in accordance with this Specification and the requirements of AS/NZS ISO 9001, or a recognised equivalent.

Where required in the Contract general clauses, the Contractor shall submit a Quality Plan prior to commencement of any works. The Quality Plan shall take into account the specific requirements for inspection and testing, acceptance/rejection criteria, details of proposed methods and other quality requirements that are contained in the Contract Documents. No part of the Quality System shall be used to pre-empt or otherwise negate the technical requirements of the Contract Documents.

13.6 Testing

All testing of properties required by the Specification shall be undertaken in a laboratory accredited to ISO 17025.

14 MATERIALS

14.1 Aggregate

14.1.1 General

Coarse aggregate shall consist of crushed stone or crushed gravel or a combination of the two, produced from hard durable rock or river boulders unless otherwise approved by the Engineer.

Fine aggregate shall consist of particles of sand, crushed stone or crushed gravel or a mixture of these...
Aggregates may also be comprised of, or contain synthetic or recycled materials, such as slag or glass. The use of such materials is subject to the Engineer’s approval if they do not comply with the requirements of Table 14.1, Table 14.2, Table 14.3 below. Such approval may be conditional on additional testing relative to the proposed materials.

14.1.2 Coarse Aggregate
Coarse aggregate is comprised of particles that are predominantly retained on the 4.75 mm sieve. Coarse aggregate shall comply with Table 14.1 or Table 14.2 as appropriate, except that the Engineer may approve the use of non-complying materials from sources of proven performance.
### Table 14.1 Coarse Aggregate Requirements for Dense Graded Asphalt

<table>
<thead>
<tr>
<th>Test Property</th>
<th>Test Method</th>
<th>Requirements</th>
<th>Frequency</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>NZTA M/10 requirements</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Crushing Resistance</td>
<td>NZS 4407 Test 3.10</td>
<td>200kN min</td>
<td>As per RNZ 9805 Quality Assurance of Aggregates for Chipseals and Bituminous Mixes</td>
<td>Current requirements for NZTA M/10</td>
</tr>
<tr>
<td>Weathering Quality Index</td>
<td>NZS 4407 Test 3.11</td>
<td>AA or BA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Single Broken Faces</td>
<td>NZS 4407 Test 3.14</td>
<td>98% min</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Two Broken Faces</td>
<td>NZS 4407 Test 3.14</td>
<td>60% min</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Polished Stone Value</td>
<td>BS EN 1097 Part 8</td>
<td>As per Specific Contract Requirements</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Additional Requirements (see Note below)**

<table>
<thead>
<tr>
<th>Test Property</th>
<th>Test Method</th>
<th>Requirements</th>
<th>Frequency</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Los Angeles Abrasion Loss</td>
<td>AS 2758 Part 5 or NZS 4407 Test 3.12</td>
<td>Report Value</td>
<td></td>
<td>A number of new tests have been introduced in order to explore alternative means of assessing aggregate quality for use in dense graded asphalt.</td>
</tr>
<tr>
<td>Wet/Dry Strength Variation</td>
<td>AS 2758 Part 5</td>
<td>Report Value</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water Absorption</td>
<td>AS 1141 or ASTM C127</td>
<td>Report Value</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Note:**
Values for the “Report Value” criteria will be agreed on the basis of field performance as data accumulates.
Table 14.2  Coarse Aggregate Requirements for Stone Mastic Asphalt

<table>
<thead>
<tr>
<th>Test Property</th>
<th>Test Method</th>
<th>Requirements</th>
<th>Frequency</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>NZTA M/6 requirements</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Crushing Resistance</td>
<td>NZS 4407 Test 3.10</td>
<td>230kN min</td>
<td>As per RNZ 9805 Quality Assurance of Aggregates for Chipseals and Bituminous Mixes</td>
<td>Current requirements for NZTA M/6</td>
</tr>
<tr>
<td>Weathering Quality Index</td>
<td>NZS 4407 Test 3.11</td>
<td>AA or BA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weak Particles Test</td>
<td>AS 1141.32</td>
<td>1% max</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Polished Stone Value</td>
<td>BS EN 1097 Part 8</td>
<td>As per Specific Contract Requirements</td>
<td>Current requirements for NZTA P/11</td>
<td></td>
</tr>
<tr>
<td>Particle Shape</td>
<td>NZS 4407 Test 3.13</td>
<td>2.25 max</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Two Broken Faces</td>
<td>NZS 4407 Test 3.14</td>
<td>98% min</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Additional Requirements</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Los Angeles Abrasion Loss</td>
<td>AS 2758 Part 5 or NZS 4407 Test 3.12</td>
<td>Report Value</td>
<td>Representative test values of the aggregate(s) to be used in the contract</td>
<td>A number of new tests have been introduced in order to explore alternative means of assessing aggregate quality for use in stone mastic asphalt.</td>
</tr>
<tr>
<td>Wet/Dry Strength Variation</td>
<td>AS 2758 Part 5</td>
<td>Report Value</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water Absorption</td>
<td>AS 1141 or ASTM C127</td>
<td>Report Value</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Note:**
Values for the “Report Value” criteria will be agreed on the basis of field performance as data accumulates.
14.1.3 Fine Aggregate

Fine aggregate shall consist of crushed rock particles predominantly finer than the 4.75 mm sieve and manufactured from an approved source complying with the requirements of Table 14.3.

If natural (i.e. uncrushed) sands are used in significant proportion (i.e. greater than 5% of the aggregate blend) in mixes for medium, heavy or very heavy traffic categories then Wheel Tracking testing may be carried out to demonstrate that the mix is resistant to plastic deformation (rutting).

The fine aggregate shall be clean, hard, durable and free from pumice and lumps of clay and other aggregations of fine materials, organic material and any other deleterious material.
### Table 14.3 Fine Aggregate Requirements

<table>
<thead>
<tr>
<th>Test Property</th>
<th>Test Method</th>
<th>Requirements</th>
<th>Frequency</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crushing Resistance</td>
<td>NZS 4407 Test 3.10</td>
<td>200kN min</td>
<td>As per RNZ 9805 Quality Assurance of Aggregates for Chipseals and Bituminous Mixes</td>
<td></td>
</tr>
<tr>
<td>Sand Equivalent, or Clay Index (&lt;0.075mm)</td>
<td>NZS 4407 Test 3.6</td>
<td>35 min, or 3 max</td>
<td>Current requirements for NZTA M/10</td>
<td></td>
</tr>
</tbody>
</table>

**Additional Requirements (see Note below)**

<table>
<thead>
<tr>
<th>Test Property</th>
<th>Test Method</th>
<th>Requirements</th>
<th>Frequency</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water Absorption</td>
<td>AS 1141 or ASTM C128</td>
<td>Report Value</td>
<td>Representative test result of the aggregate(s) to be used in contract</td>
<td></td>
</tr>
<tr>
<td>Degradation Factor</td>
<td>AS 1141.25.3</td>
<td>Report Value</td>
<td>A number of new tests have been introduced in order to explore alternative means of assessing aggregate quality for use in hot mixed asphalts.</td>
<td></td>
</tr>
</tbody>
</table>

**Notes:**
(a) Values for the "Report Value" criteria will be agreed on the basis of field performance as data accumulates.
(b) The fine aggregate is defined as the fraction of the blended aggregate passing the 4.75-mm sieve excluding added mineral filler (if any).
14.2 Mineral Filler

Mineral filler is that portion of mineral matter passing a 75 micron sieve, and includes rock dust derived from coarse and fine aggregates used in the production of asphalt in accordance with this specification, and any other materials added to supplement the quantity and properties of filler in the mix.

Filler shall be consistent in mineral composition. It shall be dry, and free from lumps, clay, organic matter or other material deleterious to asphalt.

Added filler (material not derived from the aggregate components) shall comply with Table 14.4.

Table 14.4 Requirements for Mineral Filler

<table>
<thead>
<tr>
<th>Sieve Size (mm)</th>
<th>Percentage passing Sieve</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.600</td>
<td>100</td>
</tr>
<tr>
<td>0.150</td>
<td>&gt; 90</td>
</tr>
<tr>
<td>0.075</td>
<td>&gt; 65</td>
</tr>
</tbody>
</table>

14.3 Binder

14.3.1 Bitumen

Standard Penetration Grades of bitumen shall comply with the requirements of NZTA M/1.

Multigrade bitumen shall comply with the Austroads Provisional Specification for Multigrade Binders.

14.3.2 Other Binders

Polymer modified binder shall be specified by the Contract Specification.

14.3.3 Additives

The type and proportion of additives to be used in the mix, other than those specified elsewhere in this specification, shall be in accordance with an approved specification. An approved specification may be a manufacturer’s recommendation, purchaser’s specification or as agreed between the parties.

14.3.4 Rejuvenating Agent

Rejuvenating agent, if required in mixes incorporating recycled asphalt, shall be a low volatility oil capable of combining with bitumen to counteract hardening and produce a lower viscosity grade of binder. Rejuvenating agent shall comply with recognised standards for such materials.

14.4 Reclaimed Asphalt Pavement

Reclaimed asphalt pavement (RAP) shall be crushed and screened as necessary to ensure a maximum size no greater than the maximum size of asphalt being produced and to achieve a reasonably well graded, free flowing, and consistent product.

15 MIX DESIGN

15.1 General

The Contractor shall provide all mix designs. Where specified, the Contractor’s mix design shall be assessed by the Engineer for compliance with the requirements of this specification. In such cases, the mix design shall be approved by the Engineer prior to its use.

The procedures contained in Austroads Part 4B (related document 13.3.1 (a)) or Asphalt Institute “MS-2” Mix Design Methods for Asphaltic Concrete (related document 13.3.6(b)) shall be used for the mix design. The preferred method of mix design for dense graded asphalt mixes is AGPT04B (Austroads Part 4B).

The Contractor may select either of the above methods of mix design for SMA mixes.

The types of mixes shall be as listed in the schedule of job requirements, or as shown on drawings.
15.2 Aggregate Grading and Binder Content

Unless otherwise specified, asphalt mixes shall be designed with a target combined aggregate grading (including filler) and binder content complying with the relevant limits given in Table 15.1, Table 15.2, Table 15.3 or Table 15.4. Binder content shall be expressed as a percentage by mass of the total mix.

Note that the binder content ranges specified in Table 15.1, Table 15.2, Table 15.3 or Table 15.4 may need to be adjusted for non-natural aggregates such as steel slag, where those materials have very high densities. Where the aggregate has a specific gravity greater than 2.70 then the binder content range may be adjusted by the following factor:

\[ \text{GravitySpecificBulkDryAggregate} = \frac{\text{Gravity}}{\text{Specific Bulk}} \times \frac{\text{Dry Aggregate}}{\text{Specific Gravity}} \]

Table 15.1 Dense Graded Asphalt (Medium, Heavy and Very Heavy Traffic Heavy Wearing Course and all Base Course Mix Types)

<table>
<thead>
<tr>
<th>Sieve Size (mm)</th>
<th>Mix designation</th>
<th>AC10</th>
<th>AC14</th>
<th>AC20</th>
<th>AC28</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Percentage passing sieve size (by mass)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>37.5</td>
<td>-</td>
<td>-</td>
<td>100</td>
<td>90-100</td>
<td>100</td>
</tr>
<tr>
<td>26.5</td>
<td>-</td>
<td>-</td>
<td>100</td>
<td>90-100</td>
<td>90-100</td>
</tr>
<tr>
<td>19.0</td>
<td>-</td>
<td>100</td>
<td>90-100</td>
<td>73-88</td>
<td>73-88</td>
</tr>
<tr>
<td>13.2</td>
<td>100</td>
<td>90-100</td>
<td>71-86</td>
<td>58-76</td>
<td>58-76</td>
</tr>
<tr>
<td>9.5</td>
<td>90-100</td>
<td>72-83</td>
<td>58-75</td>
<td>47-67</td>
<td>47-67</td>
</tr>
<tr>
<td>6.7</td>
<td>68-82</td>
<td>54-71</td>
<td>46-64</td>
<td>37-58</td>
<td>37-58</td>
</tr>
<tr>
<td>4.75</td>
<td>50-70</td>
<td>43-61</td>
<td>37-55</td>
<td>30-50</td>
<td>30-50</td>
</tr>
<tr>
<td>2.36</td>
<td>32-51</td>
<td>28-45</td>
<td>24-42</td>
<td>20-37</td>
<td>20-37</td>
</tr>
<tr>
<td>0.600</td>
<td>15-30</td>
<td>13-27</td>
<td>10-24</td>
<td>9-22</td>
<td>9-22</td>
</tr>
<tr>
<td>0.300</td>
<td>10-22</td>
<td>9-20</td>
<td>7-17</td>
<td>6-16</td>
<td>6-16</td>
</tr>
<tr>
<td>0.150</td>
<td>6-14</td>
<td>6-13</td>
<td>4-12</td>
<td>4-10</td>
<td>4-10</td>
</tr>
<tr>
<td>0.075</td>
<td>4-7</td>
<td>4-7</td>
<td>3-6</td>
<td>3-6</td>
<td>3-6</td>
</tr>
</tbody>
</table>

Minimum Layer Thickness (mm): 40, 55, 80, 100

Binder Content (% by mass): 4.5-6.5, 4.0-6.0, 3.8-5.8, 3.5-5.5

NOTES:
(a) For high fatigue base course mix types, the maximum binder content may be increased by 1 percentage point.
Table 15.2  Dense Graded Asphalt (Light to Medium Traffic Wearing Course Mix Types)

<table>
<thead>
<tr>
<th>Sieve Size (mm)</th>
<th>Mix designation</th>
<th>DG7</th>
<th>DG10</th>
<th>DG15</th>
<th>DG20</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percentage passing sieve size (by mass)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>26.5</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>100</td>
</tr>
<tr>
<td>19.0</td>
<td>-</td>
<td>-</td>
<td>100</td>
<td>86–100</td>
<td>68–87</td>
</tr>
<tr>
<td>13.2</td>
<td>100</td>
<td>79–100</td>
<td>70–90</td>
<td>58–78</td>
<td></td>
</tr>
<tr>
<td>9.5</td>
<td>80–100</td>
<td>68–87</td>
<td>54–79</td>
<td>46–69</td>
<td></td>
</tr>
<tr>
<td>6.7</td>
<td>70–87</td>
<td>50–76</td>
<td>43–70</td>
<td>37–61</td>
<td></td>
</tr>
<tr>
<td>4.75</td>
<td>44–75</td>
<td>32–61</td>
<td>28–55</td>
<td>24–49</td>
<td></td>
</tr>
<tr>
<td>2.36</td>
<td>29–60</td>
<td>22–48</td>
<td>19–43</td>
<td>15–38</td>
<td></td>
</tr>
<tr>
<td>0.600</td>
<td>19–47</td>
<td>15–36</td>
<td>13–32</td>
<td>10–28</td>
<td></td>
</tr>
<tr>
<td>0.300</td>
<td>12–33</td>
<td>10–26</td>
<td>9–23</td>
<td>7–21</td>
<td></td>
</tr>
<tr>
<td>0.075</td>
<td>5–12</td>
<td>4–11</td>
<td>4–10</td>
<td>3–9</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Minimum Layer Thickness (mm)</th>
<th>20</th>
<th>30</th>
<th>45</th>
<th>60</th>
</tr>
</thead>
<tbody>
<tr>
<td>Binder Content (% by mass)</td>
<td>5.0–7.0</td>
<td>4.5–6.5</td>
<td>4.3–6.3</td>
<td>3.8–6.0</td>
</tr>
</tbody>
</table>

Notes:
(a) The particle size distribution envelopes in Table 15.2 above merge the requirements of M/10:2005 and NAS 2000. Hence legacy mixes designed to comply with M/10:2005 should remain compliant.
(b) Table 15.2 uses the “nominal maximum particle size” convention in contrast to the “all passing” designation previously used. Thus a legacy “Mix 10” is equivalent to a DG 7 above.
(c) Table 15.2 mixes will typically be used in light to medium duty applications where rut resistance and surface texture are not primary requirements.
(d) Table 15.2 mixes will typically be more binder-rich than Table 15.1 mixes, for increased durability and fatigue life.
(e) Table 15.2 mixes will normally be designed using 80–cycle gyratory or 50 blow compaction. For heavier duty or structural applications, 120–cycle or 75–blows may be used. The compaction requirements should be specified by the specific contract requirements.
(f) NZTA P/11 Specification is to be used for the specification of Open Graded Porous Asphalt.

Table 15.3  Stone Mastic Asphalt

<table>
<thead>
<tr>
<th>Sieve Size AS (mm)</th>
<th>Mix designation</th>
<th>SMA7</th>
<th>SMA10</th>
<th>SMA14</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percentage passing sieve size (by mass)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19.0</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>100</td>
</tr>
<tr>
<td>13.2</td>
<td>100</td>
<td>90–100</td>
<td>30–55</td>
<td></td>
</tr>
<tr>
<td>9.5</td>
<td>85–100</td>
<td>30–55</td>
<td>20–35</td>
<td></td>
</tr>
<tr>
<td>6.7</td>
<td>30–62</td>
<td>20–40</td>
<td>18–30</td>
<td></td>
</tr>
<tr>
<td>4.75</td>
<td>20–35</td>
<td>15–28</td>
<td>15–28</td>
<td></td>
</tr>
<tr>
<td>2.36</td>
<td>16–28</td>
<td>13–24</td>
<td>13–24</td>
<td></td>
</tr>
<tr>
<td>0.600</td>
<td>14–24</td>
<td>12–21</td>
<td>12–21</td>
<td></td>
</tr>
<tr>
<td>0.300</td>
<td>12–20</td>
<td>10–18</td>
<td>10–18</td>
<td></td>
</tr>
<tr>
<td>0.150</td>
<td>10–16</td>
<td>9–14</td>
<td>9–14</td>
<td></td>
</tr>
<tr>
<td>0.075</td>
<td>8–12</td>
<td>8–12</td>
<td>8–12</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Minimum Layer Thickness (mm)</th>
<th>30</th>
<th>40</th>
<th>55</th>
</tr>
</thead>
<tbody>
<tr>
<td>Binder Content (% by mass)</td>
<td>6.0–7.3</td>
<td>6.0–7.0</td>
<td>5.8–6.8</td>
</tr>
</tbody>
</table>

Stone Mastic Asphalt shall be designed using one of the following methods to establish “stone on stone contact” unless agreed otherwise with the Engineer:
(a) Stone Mastic Asphalt Design and Application Guide, Implementation Guide No. 4 (AAPA)
(b) Designing and Constructing SMA Mixtures NAPA QIS 122

Note:
Alternative particle size distributions may be used if appropriate in agreement with the Engineer.
Table 15.4  Fine Gap Graded Asphalt

<table>
<thead>
<tr>
<th>Sieve Size (mm)</th>
<th>Mix designation</th>
<th>Percentage passing sieve size (by mass)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>FGG7</td>
<td>FGG10</td>
</tr>
<tr>
<td>13.2</td>
<td>-</td>
<td>100</td>
</tr>
<tr>
<td>9.5</td>
<td>100</td>
<td>85-100</td>
</tr>
<tr>
<td>6.7</td>
<td>85-100</td>
<td>60-86</td>
</tr>
<tr>
<td>4.75</td>
<td>65-85</td>
<td>55-74</td>
</tr>
<tr>
<td>2.36</td>
<td>55-72</td>
<td>50-70</td>
</tr>
<tr>
<td>1.18</td>
<td>45-65</td>
<td>45-65</td>
</tr>
<tr>
<td>0.600</td>
<td>30-60</td>
<td>30-60</td>
</tr>
<tr>
<td>0.300</td>
<td>18-40</td>
<td>18-40</td>
</tr>
<tr>
<td>0.150</td>
<td>8-18</td>
<td>8-18</td>
</tr>
<tr>
<td>0.075</td>
<td>6-12</td>
<td>5-11</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

15.3  Mix Properties

15.3.1  General
Asphalt mixes shall comply with the relevant target volumetric design criteria and other properties listed in sections 15.3.2, 15.3.3 or 15.3.4 as appropriate provided that alternative design targets may be specified or agreed for particular applications. Laboratory preparation and compaction of asphalt mixes may be undertaken using either gyratory compaction using the Servopac™ apparatus or the Marshall Method. The design criteria shall apply to only one method of compaction.

15.3.2  Dense Graded Asphalt
Dense graded asphalt mixes shall comply with the volumetric (Level 1) volumetric design criteria listed in either Table 15.5 or Table 15.6 as appropriate and the Voids in the Mineral Aggregate (VMA) requirements listed in Table 15.7. Gyratory compaction using the Servopac™ apparatus is the preferred method of preparation of laboratory samples for mix design.

Table 15.5  Level 1 Design Requirements for Dense Graded Asphalt Mixes Prepared Using Gyratory Compaction

<table>
<thead>
<tr>
<th>Traffic Category</th>
<th>Application</th>
<th>Laboratory Compaction Level (cycles)</th>
<th>Design Air Voids – target (%)</th>
<th>Air Voids at 250 cycles – min (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Light</td>
<td>Wearing and base</td>
<td>80</td>
<td>4.0</td>
<td>Report</td>
</tr>
<tr>
<td>Medium</td>
<td>Wearing and base</td>
<td>80</td>
<td>4.0</td>
<td>Report</td>
</tr>
<tr>
<td></td>
<td>High fatigue base</td>
<td>80/120</td>
<td>3.0</td>
<td>–</td>
</tr>
<tr>
<td>Heavy</td>
<td>Wearing and base</td>
<td>120</td>
<td>4.0</td>
<td>Report</td>
</tr>
<tr>
<td></td>
<td>High fatigue base</td>
<td>80/120</td>
<td>3.0</td>
<td>–</td>
</tr>
<tr>
<td>Very Heavy</td>
<td>Wearing and base</td>
<td>120</td>
<td>5.0</td>
<td>2.0</td>
</tr>
</tbody>
</table>

Note: (a) The pavement designer shall nominate the specimen compaction level for high fatigue bases.
Table 15.6  Level 1 Design Requirements for Dense Graded Asphalt Mixes Compacted by the Marshall Method

<table>
<thead>
<tr>
<th>Traffic Category</th>
<th>Application</th>
<th>Compactive Effort (blows)</th>
<th>Design Air Voids – target (%)</th>
<th>Stability – min (kN)</th>
<th>Flow (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Light</td>
<td>Wearing and base</td>
<td>50</td>
<td>4.0</td>
<td>5.5</td>
<td>2 – 4.5</td>
</tr>
<tr>
<td>Medium</td>
<td>Wearing and base</td>
<td>50</td>
<td>4.0</td>
<td>6.5</td>
<td>2 – 4.5</td>
</tr>
<tr>
<td></td>
<td>High fatigue base</td>
<td>50/75</td>
<td>3.0</td>
<td>6.5</td>
<td>-</td>
</tr>
<tr>
<td>Heavy</td>
<td>Wearing and base</td>
<td>75</td>
<td>4.0</td>
<td>6.5</td>
<td>2 – 4.5</td>
</tr>
<tr>
<td></td>
<td>High fatigue base</td>
<td>50/75</td>
<td>3.0</td>
<td>6.5</td>
<td>-</td>
</tr>
<tr>
<td>Very Heavy</td>
<td>Wearing and base</td>
<td>75</td>
<td>5.0</td>
<td>7.0</td>
<td>2 – 4.5</td>
</tr>
</tbody>
</table>

Notes:
(a) The recommended compactive effort for Marshall specimens differs from traditional New Zealand practice. Caution and judgment is advised when using lower compactive efforts.
(b) The pavement designer shall nominate the specimen compaction level for high fatigue bases.

Table 15.7  Voids in the Mineral Aggregate (VMA) Requirements for Dense Graded Asphalt

<table>
<thead>
<tr>
<th>Mix Nominal Size (mm)</th>
<th>Design Target Air Voids</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3.0 %</td>
</tr>
<tr>
<td>7</td>
<td>15</td>
</tr>
<tr>
<td>10</td>
<td>14</td>
</tr>
<tr>
<td>14</td>
<td>13</td>
</tr>
<tr>
<td>20</td>
<td>12</td>
</tr>
<tr>
<td>28</td>
<td>11</td>
</tr>
</tbody>
</table>

All mixes shall be designed to have a minimum effective binder film index of 7.5 microns except mixes specified in Table 15.2 and Table 15.4.

Table 15.8  Level 3 Design Wheel Tracking Requirements for Heavy and Very Heavy Duty Dense Graded Asphalt

<table>
<thead>
<tr>
<th>Traffic Category</th>
<th>Maximum Rut Depth (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heavy, Very Heavy</td>
<td>6.0</td>
</tr>
</tbody>
</table>

Note:
(a) This maximum rut depth is based on draft requirements of the Victorian State Roading Authority (VicRoads) and may be reviewed as experience and data accumulates.

15.3.3  Stone Mastic Asphalt
Stone mastic asphalt mixes shall comply with the volumetric (Level 1) design criteria listed in Table 15.9.

Table 15.9  Level 1 Design Requirements for Stone Mastic Asphalt Mixes

<table>
<thead>
<tr>
<th>Mix Size (mm)</th>
<th>Laboratory compaction</th>
<th>Design Air Voids – target (%)</th>
<th>VMA – minimum (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>80</td>
<td>50</td>
<td>4.0</td>
</tr>
<tr>
<td>10</td>
<td>80</td>
<td>50</td>
<td>4.0</td>
</tr>
<tr>
<td>14</td>
<td>80</td>
<td>50</td>
<td>4.0</td>
</tr>
</tbody>
</table>

SMA shall have a maximum binder drain-off test value, at 10ºC above the manufacturing temperature, of 0.3% by mass.

15.3.4  Fine Gap Graded Asphalt
Fine gap graded asphalt mixes shall comply with the volumetric (Level 1) design criteria listed in Table 15.10.
Table 15.10  Level 1 Design Requirements for Fine Gap Graded Asphalt Mixes

<table>
<thead>
<tr>
<th>Traffic Category</th>
<th>Laboratory compaction</th>
<th>Design Air Voids – target (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Gyrotary (cycles)</td>
<td>Marshall (blows)</td>
</tr>
<tr>
<td>Light</td>
<td>50</td>
<td>35</td>
</tr>
</tbody>
</table>

15.4  Design of Asphalt Mixes Incorporating Reclaimed Asphalt Pavement (RAP)

15.4.1  General
Separate mix designs, or a single-point design verification, should be prepared for mixes containing RAP. Binder in RAP shall be included as binder in the total mix. Alterations to the proportion of RAP shall constitute a design change.

Mixes shall generally comply with the design and manufacture requirements specified elsewhere in this specification with the additional requirements specified in Clause 3.4 and the following sub-clauses.

Addition of up to 15% RAP to current mix designs should be validated at the original design job-mix formula by volumetric and mechanical testing.

15.4.2  Asphalt mixes containing not more than 15% of RAP by mass of total mix
Unless otherwise specified, RAP in proportions up to 15% by mass of the total mix shall be permitted in all dense graded asphalt mixes.

15.4.3  Asphalt mixes containing more than 15% but not more than 30% of RAP by mass of total mix
RAP in proportions greater than 15%, but not exceeding 30%, may be used in dense graded asphalt mixes except for Heavy and Very Heavy Duty Wearing Course Mixes, mixes containing polymer modified binder, or where excluded in the Schedule of Job Details. In addition to the requirements specified in Clause 15.4.1, allowance may be made for increase in binder stiffness due to hardened binder in RAP by adoption of bitumen binder one class or grade lower in viscosity than that otherwise specified. A new laboratory mix design shall be required where the RAP content exceeds 15%.

15.4.4  Asphalt mixes containing more than 30% of RAP
Asphalt mixes containing more than 30% of RAP shall only be accepted where the Contractor can demonstrate suitable manufacturing plant and quality control procedures to ensure consistent production of hot mix asphalt of a standard not less than that otherwise specified. A new laboratory mix design shall be required where the RAP content exceeds 30%.

15.5  Approval of Job-Mix Formula

15.5.1  General
The Contractor shall provide the information listed in Table 15.11 for approval by the Engineer at least seven (7) days prior to commencement of production.

Table 15.11  Information to be Submitted by Contractor for Approval of Job-mix formula

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Properties of constituent materials required under this Specification including aggregates, filler, binder, additives (if used) and source of materials</td>
</tr>
<tr>
<td>2</td>
<td>The nominated grading, binder content, design air voids</td>
</tr>
<tr>
<td>3</td>
<td>Test results of trial mixes made in the laboratory at varying binder contents to arrive at the design mix</td>
</tr>
<tr>
<td>4</td>
<td>Test results in accordance with the design requirements specified in Section 15.3.</td>
</tr>
<tr>
<td>5</td>
<td>The following test results performed on a batch of each mix proposed to be used, and produced from the mixing plant for design verification from which the asphalt is to be supplied: (a) Grading (b) Binder Content (c) Maximum Specific Gravity (d) Air voids at laboratory design compaction level (e) Air voids at 250 cycles (Heavy and Very Heavy Traffic Category mixes only)</td>
</tr>
</tbody>
</table>
Where specified in the Schedule of Job Details (clause 23), the Contractor shall also report the results of the nominated performance tests conducted in accordance with the Level 2 and Level 3 Mix Design procedures described in AGPT04B.

Specifiers should consider the balance between the cost of providing test data and the use to which the information is to be put. Where testing is required, the tests should be nominated in the Schedule of Job Details and a separate schedule item provided for the cost of testing.

### 15.5.2 Approval to Use Previously Designed Mix

The Engineer may accept a Job–mix formula used by the Contractor under other Contracts for the supply of asphalt of the particular type and nominal size specified subject to the following conditions:

(a) The project work is undertaken within a two-year period of mix design work for the Job–mix formula.
(b) The type, quality and sources of all constituent materials remain substantially unchanged.
(c) The proportions of aggregates and filler are not varied by more than 20% of the proportion of that component in the original Job–mix formula.
(d) Confirmation of volumetric and mechanical properties from plant–produced mix sampled within the previous 8 weeks;
(e) The in–service performance of the Job–mix formula materials has been satisfactory.

### 16 MANUFACTURE AND STORAGE

#### 16.1 General

Asphalt manufacturing plant shall be of sound design and construction and capable of consistently producing asphalt mixes with the properties specified and at a rate suitable for smooth, continuous asphalt placing.

#### 16.2 Storage of Raw Materials

Raw materials shall be stored at the mixing site in sufficient quantities to ensure continuity of production and enable effective sampling and testing prior to use. The facilities for handling particular materials shall comply with the following:

(a) **Aggregates.** Aggregates shall be handled and stored in such a manner as to prevent contamination and avoid segregation.
(b) **RAP.** RAP shall be placed in separate stockpiles prior to use.
(c) **Filler.** Filler shall be handled and stored in such a manner as to keep it dry and free flowing at all times. Where more than one type of filler is to be used, each shall be handled and stored separately.
(d) **Additives.** Additives, including cellulose or mineral fibre, shall be protected from moisture or contamination. Materials that have become wet shall not be used.
(e) **Binder.** Tanks for heating and storage of binder shall be thermostatically controlled and each shall be fitted with a thermometer that is located so that the temperature can be read conveniently. Bitumen binder shall not be heated to more than 185°C. Multigrade and Polymer Modified binders shall not be heated or stored contrary to the temperature and time combinations specified by the manufacturer’s written instructions.

#### 16.3 Mixing Temperatures

Temperature of bitumen and aggregates at the mixing plant, and the temperature of asphalt as it is discharged from the asphalt plant, shall be specified in the quality plan.

#### 16.4 Moisture Content

After completion of mixing the moisture content of the mix shall not exceed 0.5%.

#### 16.5 Production Tolerances

Production tolerances for test results for grading and binder content shall comply with Table 16.1 or Table 16.2 as appropriate. Refer to clause 17.2 for sampling and testing frequencies.
Table 16.1 Production Tolerances for Dense Graded Asphalts (AC, DG, FGG grades)

<table>
<thead>
<tr>
<th>Description</th>
<th>Maximum Tolerance on Job-mix formula</th>
<th>Percentage for individual test results</th>
<th>Percentage for rolling mean of three test results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sieve size one size larger than nominal size</td>
<td>Nil</td>
<td>Nil</td>
<td>Nil</td>
</tr>
<tr>
<td>1.18 mm sieve and larger</td>
<td>± 8</td>
<td>± 5</td>
<td></td>
</tr>
<tr>
<td>0.600, 0.300 mm sieves</td>
<td>± 6</td>
<td>± 4</td>
<td></td>
</tr>
<tr>
<td>0.150, 0.075 mm sieves</td>
<td>± 3</td>
<td>± 2</td>
<td></td>
</tr>
<tr>
<td>Binder Content: Percent by mass</td>
<td>± 0.5</td>
<td>± 0.3</td>
<td></td>
</tr>
</tbody>
</table>

Table 16.2 Production Tolerances for Stone Mastic Asphalts

<table>
<thead>
<tr>
<th>Description</th>
<th>Maximum Tolerance on Job-mix formula</th>
<th>Percentage for individual test results</th>
<th>Percentage for rolling mean of three test results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sieve size one size larger than nominal size</td>
<td>Nil</td>
<td>Nil</td>
<td>Nil</td>
</tr>
<tr>
<td>1.18 mm sieve and larger</td>
<td>± 5</td>
<td>± 3</td>
<td></td>
</tr>
<tr>
<td>0.600, 0.300 mm sieves</td>
<td>± 3</td>
<td>± 2</td>
<td></td>
</tr>
<tr>
<td>0.150, 0.075 mm sieves</td>
<td>± 2</td>
<td>± 1</td>
<td></td>
</tr>
<tr>
<td>Binder Content: Percent by mass</td>
<td>± 0.5</td>
<td>± 0.4</td>
<td></td>
</tr>
</tbody>
</table>

Notes:
(a) The acceptance criteria above are based on previous practice in New Zealand. However they should be regarded as interim and subject to future review based on process control systems such as APAS.
(b) If compliance errors occur that appear to be random rather than systematic, a statistical approach to quality management and acceptance is recommended.
(c) Careful management of raw material quality is essential for SMA mixes as minor changes in aggregate particle size distribution or particle shape can significantly affect the properties of the SMA.

16.6 Storage of Mixed Asphalt

Asphalt may be stored prior to delivery to the purchaser, subject to the following requirements being observed.

The mix may be stored in an insulated storage bin. The Contractor shall nominate in the quality plan the maximum storage time appropriate to the contract, production plant and mix type.

16.7 Manufacture of Stone Mastic Asphalt

The following particular requirements shall apply to the production of stone mastic asphalt.
(a) Filler systems shall be designed or modified to provide for the appropriate quantity of added filler. In drum mix plants, loss of filler shall be minimised by feeding direct into the mixer alongside addition of binder.
(b) Fibre shall be added in a manner that ensures good dispersion of fibres, avoids loss of fibre through dust collection systems and avoids damage to fibre by overheating.
(c) Mixing times shall be increased, where necessary, to ensure adequate dispersal and mixing of fibre.

16.8 Asphalt Mixes Incorporating Reclaimed Asphalt Pavement (RAP)

RAP shall only be used from stockpiles that have been tested for consistency in grading and binder content. Maximum Specific Gravity may also be advisable if the stockpile contains RAP from different sources.

In batch mixing plants, the RAP shall be either:
(a) Metered into the asphalt plant after heating and drying of aggregates
(b) Added directly to the weigh hopper with the other aggregate materials, for each batch
(c) Weighed separately and added direct to the pugmill.

Batch mixing time shall be increased, if necessary, to ensure adequate heat transfer and dispersion of RAP.

In drum mix plants, RAP shall be protected from excessive temperatures by a combination of entry point to the drum and shielding from direct flame contact.
17 SAMPLING AND TESTING OF ASPHALT PRODUCTION

17.1 General

The Contractor shall arrange for all relevant testing.

Samples from asphalt production shall be randomly selected (random sampling) by a recognised statistical technique from fresh production asphalt at the asphalt plant. Separate samples shall not be combined.

Production asphalt shall be tested for the following:
(a) Grading (Particle Size Distribution)
(b) Binder content
(c) Maximum Specific Gravity (for use in calculating core air voids)
(d) Temperature as per the quality plan.

17.2 Frequency of Sampling and Testing

Unless otherwise specified frequency of sampling and testing shall be not less than that shown in Table 17.1 and Table 17.2 with a maximum of three samples per production lot. Acceptance of the mix will be based on lots. A production lot will normally consist of a days or a shift production or as detailed in the Contractor’s Quality Plan. When a day’s output is less than 100 tonnes and the same hot mixed asphalt mix is to be produced on subsequent days for the same pavement section, the lot considered for acceptance will include the next day’s production.

Table 17.1 provides for two levels of minimum frequency. The reduced frequency may only be adopted where the process is demonstrated to be under statistical control as specified in Section 17.3. Where a non-conformance occurs in any test requirement, the frequency of sampling and testing for that particular property shall be increased to the normal level until conforming results have been obtained on five consecutive samples.

<table>
<thead>
<tr>
<th>Test</th>
<th>Normal Minimum Frequency</th>
<th>Reduced Minimum Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Particle Size Distribution</td>
<td>One test per 200 t of asphalt plant production</td>
<td>One test per 300 t of asphalt plant production</td>
</tr>
<tr>
<td>Binder Content</td>
<td>One test per 200 t of asphalt plant production</td>
<td>One test per 300 t of asphalt plant production</td>
</tr>
<tr>
<td>Maximum Specific Gravity</td>
<td>One test per 200 t of asphalt plant production</td>
<td>One test per 300 t of asphalt plant production</td>
</tr>
<tr>
<td>Temperature</td>
<td>One test per 200 t of asphalt plant production</td>
<td>One test per 300 t of asphalt plant production</td>
</tr>
</tbody>
</table>

Table 17.2 Frequency of Testing of Component Materials

<table>
<thead>
<tr>
<th>Test</th>
<th>Minimum Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Particle size distribution</td>
<td>As per RNZ 9805</td>
</tr>
<tr>
<td>Broken Faces (blend fraction coarser than 4.75-mm)</td>
<td>As per RNZ 9805</td>
</tr>
<tr>
<td>Sand Equivalent (blend fraction passing 4.75-mm)</td>
<td>As per RNZ 9805</td>
</tr>
<tr>
<td>Crushing Resistance</td>
<td>As per RNZ 9805</td>
</tr>
<tr>
<td>Weathering Resistance</td>
<td>As per RNZ 9805</td>
</tr>
<tr>
<td>Polished Stone Value (where applicable)</td>
<td>As per RNZ 9805</td>
</tr>
<tr>
<td>Los Angeles Abrasion</td>
<td>As per RNZ 9805</td>
</tr>
<tr>
<td>Weak Particles Test (where applicable)</td>
<td>Once per annum</td>
</tr>
<tr>
<td>Wet/Dry Strength Variation (where applicable)</td>
<td>Once per annum</td>
</tr>
<tr>
<td>Degradation Factor</td>
<td>Once per annum</td>
</tr>
<tr>
<td>Added filler (Table 14.4)</td>
<td>Certification from the supplier</td>
</tr>
<tr>
<td>Binder Penetration</td>
<td>As per RNZ 9803</td>
</tr>
<tr>
<td>RAP grading and binder content</td>
<td>One test per 500 t of RAP</td>
</tr>
</tbody>
</table>

Notes:
(a) The Polished Stone Value test is applicable to wearing course mixes only.
(b) The Weak Particles and Wet/Dry Strength Variation tests are applicable to aggregates with Polished Stone Value of
60 or higher.

(c) The Degradation Factor test may be deleted for fine aggregates that have a proven service history.

17.3 Process Control
The Contractor shall implement suitable measures for control of the asphalt manufacturing process. Process control measures may include the use of statistical process control charts for some, or all, of the tests required in Section 17.2 and suitable decision rules for determining that the process is under statistical control and therefore subject to reduced minimum frequency of test in agreement with the Engineer.

18 DELIVERY
Asphalt shall be transported to the point of delivery in vehicles complying with the following requirements:
(a) The inside of vehicle bodies shall be kept clean and coated with a thin film of an appropriate release agent to prevent asphalt sticking to the body of the vehicle. Care shall be taken to remove surplus release agent before loading asphalt into the vehicle.
(b) After loading with asphalt, suitable covers shall be used to prevent contamination and reduce the rate of cooling of the mix.
(c) Where the length of the haul or the weather is such that the temperature of the asphalt may drop below a suitable placing temperature, or where excessive local cooling of the mix may occur, the vehicles shall be suitably insulated.

19 PRODUCTION AND CONSTRUCTION TRIAL

19.1 General
Where a production and construction trial is specified in the Schedule of Job Details, and not less than two days before the site work is due to commence, all the Contractor’s plant and personnel proposed for use on the job shall carry out a production and construction trial in the presence of the Engineer. If more than one asphalt mix is specified, each mix shall be subjected to the trial not less than 24 hours before the proposed commencement of production of that mix.

Asphalt manufactured in the production trial may also be used in the construction trial provided that it meets the requirements of the specification.

19.2 Manufacture
The mixing plant shall be operated at approximately the rate intended for full scale production to produce the following quantities:

Sufficient asphalt shall be produced to give two paver runs at least 30-m long, placed at specified thickness with one longitudinal joint.

The Contractor shall sample and test the asphalt in accordance with Clause 17. Unless otherwise specified constituent (binder content and particle size distribution) and volumetric analysis shall be carried out to confirm the properties of the produced asphalt mix.

If the tests on the samples indicate that the asphalt does not conform to the Specification, the Contractor shall make such alterations in the procedures or adjustments to the plant and equipment as necessary to produce asphalt in accordance with this Specification. The mixing trial shall be repeated as necessary until asphalt of the quality specified is being consistently produced.

19.3 Placing, Compaction and Finishing
The Contractor shall subject all of the placing, compaction and finishing equipment and operating personnel, proposed for use in the works, to a trial using the construction procedures proposed for the work. The trial shall consist of at least two adjacent lanes 3 metres wide and at least 30 metres long and shall be constructed in the designated area, in accordance with all the requirements of this Specification, or as directed.

The joint between the lanes shall be a warm joint where the temperature of mix at the first run edge is greater than 60°C. Otherwise the joint is a cold joint and is to be treated as detailed in Clause 20.6.2.
19.4 Testing of Trial Section

The Contractor shall test the trial section for the finished pavement properties of this Specification. In the event that the tests indicate that the asphalt in the test section does not conform to the specification requirements, the Contractor shall make any necessary adjustments and, if necessary, repeat the production and construction trials, as specified above, until the Engineer is satisfied that asphalt of uniform quality is being consistently produced, placed, compacted and finished in accordance with the requirements of this Specification. Testing shall include in-situ air voids by drilling and testing core specimens and mat thickness.

A hold point shall be designated in the Contractor’s Quality System at the conclusion of the trial and the Contractor shall not commence full scale production of any asphalt for the works until the hold point has been lifted.

20 PLACING

20.1 General

The asphalt paving shall be constructed in conformity with the lines, grades and typical cross-sections shown on the plans. The type of course or courses to be laid shall be as defined in the “Specific Contract Requirements” or as outlined in the contract documents.

20.2 Preparation of Area to be Paved

Where the construction of the layer or existing surface on which the paving is to be laid is not part of the contract, the road will be handed over in a condition ready to be prepared for paving unless specified otherwise in the job specification. The Engineer will define the date of handing over after consideration of the Contractor’s proposed timing and sequence of operations. From the date of handing over the work necessary to retain or reinstate the surface shall be at the Contractor’s expense.

When a correction layer is not specified, depressions and other irregularities shall be patched or corrected in a manner as directed by the Engineer. All fatty and unsuitable patches, excess crack or joint filler, and all surplus bituminous material shall be removed from the area to be paved. Blotting of surplus bituminous material with sand or stone will not be permitted.

The surface on which the paving is to be laid shall free from standing water, and any loose material, dust, clay or foreign matter shall be removed by sweeping.

20.3 Surface Pretreatment

20.3.1 Tack Coating

Tack coat shall be applied to the cleaned surface prior to placing asphalt.

Tack coat shall consist of bituminous emulsion. The type and breaking rate shall be suitable to the climatic and surface conditions of use such that it is fully broken, free of surface water and intact before the commencement of asphalt spreading.

Unless otherwise directed, tack coat shall be applied to provide a uniform application rate of residual binder of between 0.10 and 0.20 L/m².

Precautions shall be taken to protect kerbs, channels, adjoining structures, traffic and parked vehicles from tack coat spray.

Where asphalt is to be spread over clean, freshly placed asphalt, the Engineer may direct the Contractor to omit the tack coat.

20.3.2 Membrane Sealing

A membrane seal may be applied to surfaces that require additional waterproofing. Unless otherwise directed these shall consist of a uniform application of at least 1.0 L/m² of residual binder and covered with a sparse layer of fine sealing chip, normally Grade 5.

The use of volatile diluents in membrane seal binders can cause thin layers of dense asphalt mixes to flush. Membrane seal binders must be carefully chosen to minimise this risk.
Membrane seals are recommended for placement under permeable mixes such as open-graded porous asphalt.

20.3.3 Blinding
It is recommended to spread a blinding layer of fine chip or a very thin layer of lean asphalt mix over tack coat applied to new granular basecourse to prevent pickup of the binder by construction traffic.

20.4 Protection of Services
The Contractor shall prevent tack coat, binder, aggregate, asphalt or other material used on the work from entering, adhering or obstructing gratings, hydrants, valve boxes, inspection pit covers, kerbs and other road fixtures.

20.5 Spreading and Trimming

20.5.1 General
Paving shall be carried out with the prior agreement of the Engineer for the method of construction to be used. The Contractor shall set out true line markings to be closely followed by the paver in constructing longitudinal joints and edges. The Contractor shall supply the Engineer with a detailed paving plan to be followed by the paver in placing individual lanes. Unless otherwise specified, self-propelled mechanical pavers shall be employed to place asphalt except for areas where the use of a paver is impracticable.

20.5.2 Ambient Conditions for Placing
The surface on which the asphalt is to be placed shall be essentially dry and free from free-standing water.

Wearing course asphalt shall not be placed when the pavement surface temperature is less than 10°C except that placing at lower temperatures may be permitted subject to agreement on procedures used to compensate for rapid cooling of asphalt materials.

20.5.3 Level Control
The method of paver level control shall be as specified in the Schedule of Job Details. If no method is specified in the Schedule of Job Details, the Contractor shall apply suitable automatic or manual screed level controls to achieve the standards specified in Clause 21.

20.5.4 Operational Requirements
The hot mixed asphalt material shall be spread and struck off with an approved self-powered and propelled paving machine capable of spreading and finishing the mix true to line, grade and cross-section without the use of forms or side supports. The paving machine shall be capable of laying courses in thicknesses as specified, and it shall be equipped with a suitably controlled screed heating device. The screed shall strike off the mix to the elevation and cross-section required and shall provide a smooth and uniform texture without segregation, tearing, shoving or gouging. Equipment which leaves tracks or indented areas which cannot be corrected in normal operation, or which produces flushing or other permanent blemishes or fails to produce a satisfactory surface, shall not be used. A fully trained and experienced operator shall be in direct charge of the paving machine.

If the delivery of material to the paving machine ceases for a time sufficient to allow the temperature of the unrolled portion of the freshly laid mix to drop below 100°C then the paving machine shall be withdrawn and rolling of the mix completed. Paving shall be recommenced from a transverse joint which is located in a fully compacted area. Where the paving is to be laid to conform to the level of an adjacent finished surface, the mix shall be spread sufficiently high so that when compacted, the finished surface will be true and uniform across the joint.

As soon as the first load of material has been spread, the texture of the unrolled surface shall be checked to determine its uniformity. The adjustment of the screed, tamping bars, feed screws, hopper feed, etc shall be checked frequently to assure uniform spreading of the mix to proper line and grade and adequate initial compaction. Segregation of materials shall not be permitted. If segregation occurs, the spreading operation shall be immediately suspended until the cause is determined and corrected. Any area of segregation which is not corrected prior to rolling shall subsequently be removed and replaced with material supplied and compacted to specification requirements by the Contractor at their own expense.

Any irregularities in horizontal alignment left by the paver shall be corrected by trimming directly behind the
machine. Immediately after trimming, the edges of the course shall be thoroughly compacted by tamping. Distortion of the pavement during this operation shall be avoided.

Paving machines shall be operated so that material does not accumulate and remain along the sides of the receiving hopper. Material which accumulates and cools along the sides of the receiving hopper of the paving machine shall be removed from the work site.

In small areas where the use of mechanical finishing equipment is not practical, the mix may be spread and finished by hand. Approved wood or steel forms, rigidly supported to assure correct grade and cross-section, may be used. In such instances, measuring blocks and intermediate strips shall be used to aid in obtaining the required cross-section.

20.6 Joints

20.6.1 General

Joints shall be provided as follows:
(a) Longitudinally, if the width of the pavement is such that more than one paving run is necessary.
(b) Transversely, after the completion of a day’s paving operations, or where a delay in paving operation allows asphalt to cool and adversely affect placing, and elsewhere if a break in a longitudinal run is required.

The location of joints shall be planned before work commences.

The number of joints shall be minimised by adopting good asphalt paving practices.

All joints shall be well constructed and comply with the shape requirements specified in Clause 21.

20.6.2 Longitudinal Joints

Longitudinal joints in the wearing course shall coincide with traffic lane lines unless otherwise specified or agreed. Longitudinal joints shall be offset from layer to layer by not less than 150mm provided that no joint is placed directly below a trafficked wheel path.

Where asphalt is placed against the edge of a preceding lane that has not cooled below 100°C it shall be considered a hot joint. Hot joints shall be constructed by leaving an approximately 150mm strip of asphalt unrolled along the free edge until the adjoining lane is placed, and then compacting the unrolled strip simultaneously with the material in the adjoining lane.

Where asphalt is placed against the edge of a preceding lane that has not cooled below 60°C it shall be considered a warm joint. Warm joints shall be constructed by rolling the full width of the first lane being placed, prior to placing the adjoining lane.

Where asphalt is placed against the edge of a preceding lane that has cooled below 60°C it shall be considered a cold joint. Asphalt placed against a cold edge should overlap the previous edge by 25mm to 50mm. The overlap should be pushed back using lutes, immediately after spreading, to form a slight ridge that is compacted with the steel wheel roller.

20.6.3 Transverse Joints

Transverse joints shall be offset from layer to layer by not less than 2m in adjoining paver runs.

20.7 Thickness and Surface Requirements

The final surface shall be of a uniform texture conforming to the line and grade shown on the plans. Before final acceptance of the project, or during the progress of the work, the thickness of the various courses shall be determined by the Engineer, and any unsatisfactory work shall be repaired, replaced or corrected by the Contractor at his own expense.

Density and thickness and surface shape shall be carefully controlled during construction and shall be in full compliance with plans and specifications. During compaction, preliminary tests as an aid for controlling the thickness shall be made by inserting a flat blade, correctly graduated through the material to the top of the previously placed base, or by other means acceptable to the Engineer.

The cutting of test holes to check the depth of paving, the refilling with acceptable material, and proper compaction of this material shall be done by and at the expense of the Contractor.
Geometric design considerations excepted, the finished surface on surface courses, the finished surface may be tested using a 3 m straight edge. The straight edge shall be held in successive positions parallel to the road centreline in contact with the surface, and the entire area checked from one side to the other. Advance along the pavement shall be in successive stages of not more than half the length of the straight edge. The transverse truth of the surface shall be checked with a 3 m straight edge over the straight cross-fall portion of the cross-section. For surface courses any irregularities which vary more than 5 mm under this straight edge longitudinally or transversely shall be corrected by means approved by the Engineer.

Note: Where asphalt pavements are constructed using multiple asphalt layers, it is advisable to monitor pavement shape using the 3 m straight edge as each layer is completed. Corrections to irregularities may then be made prior to the placement of additional asphalt layers.

To achieve a satisfactory finished surface it is essential that the pavement be checked regularly before and during the final compaction operation with the aid of the 3 m straight edge. The Contractor will be required to have such a straight edge on the site of the works and to use it in the control of his final rolling operation.

20.8 Compaction

Asphalt shall be uniformly compacted to the standards specified in Clause 20.8.1 as soon as the asphalt has cooled sufficiently to support the rollers without undue displacement. Compaction shall be achieved using suitable sized steel wheeled or vibratory rollers or a combination of steel wheeled or vibratory rollers and pneumatic tyred rollers.

Pneumatic tyred rollers shall not be used in the compaction of stone mastic asphalt. The method of compaction of stone mastic asphalt shall avoid damage to aggregate or drawing of binder to the surface of stone mastic asphalt. Generally no more than two vibratory passes using high frequency and low amplitude shall be applied to prevent loss of surface texture. Additional static roller passes may be necessary to achieve adequate compaction.

Compliance testing of asphalt shall be undertaken on a lot-by-lot basis. A pavement lot shall be an essentially homogeneous section of work completed within a shift of production, unless otherwise specified in the contract specification.

Specific gravity (relative density) testing for core specimens shall not be performed on:
(a) Lots of less than 30 tonnes
(b) Layers with a nominal thickness less than 30 mm
(c) Hot mix asphalt layers with a nominal thickness less than three times the nominal mix size or
(d) SMA layers thinner than four times the nominal maximum aggregate size.

Specific gravity testing shall not be performed for asphalt less than 40mm thick placed over granular basecourse as representative core specimens can not be readily obtained.

SMA materials can be used in thinner layers (less than four times the nominal maximum aggregate size) for texture requirements. In these instances the density requirements are waived. The Contractor shall include in the Quality Plan details of the rollers and rolling procedure and minimum mix temperatures that will be used. It is strongly recommended that the client’s representative be present on site to witness the compaction of the thin SMA wearing course.

For core sample tests, the layer thickness is the mean thickness of the core samples and for nuclear gauge tests, the layer thickness is the specified thickness. All core holes shall be repaired by an appropriate method that is compatible with the pavement from which the cores have been taken. Sampling rates may be reduced with the agreement of the Engineer. Sampling and testing shall be performed by a laboratory accredited to NZS ISO/IEC 17025.

Cores of a 150 mm minimum diameter shall be taken.

The air voids of the core shall be determined in accordance with the requirements of ASTM D3203 for dense bituminous paving mixtures. For the initial determination of compliance the maximum specific gravity (MSG) used in the above calculation can be taken as the average of all samples taken from the production of that particular lot of asphaltic concrete mix. The testing of cores shall be carried out within 24 hours of them being cut from the pavement.

If core heights permit trimming, it is recommended that cores drilled from a highly textured material such as coarse asphalt mixes or SMA are trimmed top and bottom. This is of particular importance if alternative
methods to water displacement are used to determine core volume (i.e. methods such as ASTM D1188, D3549 or D6752).

As an alternative to taking cores, nuclear methods of density measurement will be acceptable provided that the Contractor can justify the method with statistically validated comparative test data on the mix being produced. If nuclear methods are to be used a fully detailed testing plan must be submitted to the Engineer for agreement. The methods of AS/NZS 2891.14.2 or ASTM D2950 should be used.

20.8.1 Mat Density
If required, cores shall be cut from the pavement at a rate of one core for every 300 m² with a minimum of four cores representing each lot. The lot shall be divided into an appropriate number of approximately equal sub–lots and a core shall be taken randomly within each sub–lot. Random numbers shall be used for locating each core position as required by ASTM D5361.

The relevant sub–lot shall be deemed acceptable in terms of density if the characteristic value for air voids for the mat are between the air voids value established during the mix design process plus the offset values in Table 20.2 (i.e. mix design air voids value +3, -2).

Note that mat core testing may not be appropriate for smaller jobs, or for exception cases noted in 20.8 above.

20.8.2 Joint Density
If required, cores shall be taken from randomly located distances along joints at the rate of one per 100 m of joint with a minimum of three representing each lot. The cores shall be located within a distance of 150 mm either side of the joint line.

The relevant sub–lot shall be deemed acceptable in terms of density if the characteristic value for air voids for the joint are between the air voids value established during the mix design process plus the offset values in Table 20.2 (i.e. mix design air voids value +5, -2).

Note that joint core testing may not be appropriate for smaller jobs, or for exception cases noted in 20.8 above.

20.8.3 Density Requirements
The upper and lower characteristic values for the mat cores air voids, and the characteristic values for the joint cores air voids are calculated as follows.

The upper characteristic value of in–situ air voids is calculated as \( V_U = \text{Mean} + K \times S \) and the lower characteristic value of in–situ air voids is calculated as \( V_L = \text{Mean} - K \times S \) where:

- \( \text{Mean} \) = The mean of the in–situ air voids results (either mat or joint cores)
- \( S \) = The sample standard deviation of the in–situ air voids results (either mat or joint cores)
- \( K \) = A factor that depends on the number of tests as shown in Table 20.1.
Table 20.1  Acceptance Constants

<table>
<thead>
<tr>
<th>Number of Tests or Measurements</th>
<th>Acceptance Constant (K)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>0.138</td>
</tr>
<tr>
<td>3</td>
<td>0.335</td>
</tr>
<tr>
<td>4</td>
<td>0.444</td>
</tr>
<tr>
<td>5</td>
<td>0.519</td>
</tr>
<tr>
<td>6</td>
<td>0.575</td>
</tr>
<tr>
<td>7</td>
<td>0.619</td>
</tr>
<tr>
<td>8</td>
<td>0.655</td>
</tr>
<tr>
<td>9</td>
<td>0.686</td>
</tr>
<tr>
<td>10</td>
<td>0.712</td>
</tr>
<tr>
<td>11</td>
<td>0.734</td>
</tr>
<tr>
<td>12</td>
<td>0.754</td>
</tr>
<tr>
<td>13</td>
<td>0.772</td>
</tr>
<tr>
<td>14</td>
<td>0.788</td>
</tr>
<tr>
<td>15</td>
<td>0.802</td>
</tr>
<tr>
<td>16</td>
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<tr>
<td>17</td>
<td>0.827</td>
</tr>
<tr>
<td>18</td>
<td>0.839</td>
</tr>
<tr>
<td>19</td>
<td>0.849</td>
</tr>
<tr>
<td>20</td>
<td>0.859</td>
</tr>
</tbody>
</table>

The upper and lower characteristic values of in-situ air voids for that lot shall comply within the maximum and minimum characteristic limits specified in Table 20.2. Maximum and minimum characteristic values for air voids shall be calculated by adding the offset values to the mix design air voids established during the mix design process.

Table 20.2  Limits for Characteristic Values of In-situ Air Voids

<table>
<thead>
<tr>
<th>Asphalt Type and Thickness (mm)</th>
<th>Maximum Characteristic Offset Value (%)</th>
<th>Minimum Characteristic Offset Value (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asphalt layers greater than 150–mm from a joint</td>
<td>3</td>
<td>-2</td>
</tr>
<tr>
<td>Asphalt layers within 150–mm of a joint</td>
<td>5</td>
<td>-2</td>
</tr>
</tbody>
</table>

21  FINISHED PAVEMENT PROPERTIES

21.1  Level

The level at the top of each course of asphalt shall not differ from the specified level by more than 10 mm, except that where asphalt is placed against kerb and channel, the surface at the edge of the wearing course shall be flush with, or not more than 5 mm above, the lip of the channel, unless otherwise specified or shown on the Drawings.

21.2  Alignment

The horizontal location of any point on the pavement shall not vary by more than ±50 mm from the corresponding points shown on the documents, except where alignment with an existing pavement structure is necessary, when the new work shall be joined to the existing work or structure in a smooth manner.

21.3  Thickness

Unless otherwise specified by the contract, the average total compacted thickness of the combined asphalt courses shall be not less than the specified thickness. The average thickness of any individual course shall be not less than the specified thickness by more than 10%. Where confirmation of asphalt thickness is required, it shall be determined by coring to a recognised random sampling plan.

21.4  Ride Quality

The ride quality required shall be included in the contract specification.

Roundabouts shall not be measured under clause 20.7.
22 MEASUREMENT AND PAYMENT

The basis for payment shall be included in the contract specification.

22.1 Non Complying Materials

In the event that the material supplied is not within the tolerances and standards defined for manufacture or placing of asphalt, the Engineer may direct:

(a) The removal of non complying material; or,

(b) That the reduced service life arising from the non complying material is offset by reducing payment for the non complying material by the method defined in the Schedule of Job Details; or,

(c) With the consent of the Contractor, any other remedial treatment that is expected to provide the required level of service.

The basis for payment shall be included in the contract specification.

23 APPENDIX (SCHEDULE OF JOB DETAILS)

23.1 Asphalt Mix Requirements

(Clause 13.4.1, 14.3, 15.2, 15.3)

<table>
<thead>
<tr>
<th>Item</th>
<th>Layer/Course</th>
<th>Asphalt Mix Type/ Traffic Category</th>
<th>Binder Grade/Type</th>
<th>Nominal Size</th>
<th>Layer Thickness</th>
</tr>
</thead>
</table>