Technical Specification

Transport and Main Roads Specifications MRTS104 Asphalt Geosynthetics for Delaying Pavement Reflective Cracking

July 2022

Queensland Government

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1 Introduction

This Technical Specification applies to the material and construction requirements for asphalt geosynthetics used to delay reflective cracking in road pavement applications. The asphalt geosynthetic is installed to delay reflective cracking in the overlying asphalt layer(s), thereby reducing future maintenance activities. The asphalt geosynthetics types used in road pavements are described in Table 1.

Table 1 – Asphalt geosynthetic types

Asphalt Geosynthetic Type	Description
Geogrid without geotextile backing	A geogrid without a geotextile backing. The geogrid mesh structure typically has a self-adhesive backing (or glue) for assisting with installation and bonding to the underlying surface. A bituminous emulsion tack coat or bitumen bond coat may also be required to assist with installation and bonding.
Geogrid with geotextile backing	A geogrid with a geotextile backing. The geotextile backing is primarily for assisting with installation and bonding to the underlying surface. A bitumen bond coat is required to assist with installation and bonding. The geotextile backing typically has a mass of between 15 to 150 g/m². The geotextile backing may be made from temporary fibres with a melting point < 180°C, or permanent fibres with a melting point ≥ 180°C.

This Technical Specification shall be read in conjunction with MRTS01 *Introduction to Technical Specifications*, MRTS50 *Specific Quality System Requirements* and other Technical Specifications as appropriate.

This Technical Specification forms part of the Transport and Main Roads Specifications Manual.

Delaying reflective cracking

Reflective cracking in road pavements are typically induced by three failure modes:

1. thermal expansion
2. shear, and
3. bending (fatigue).

These failure modes cause cracking in the lower asphalt or stabilised pavement layers which eventually propagate to the surface of the pavement.

Figure 1(a) – Thermal expansion induced crack

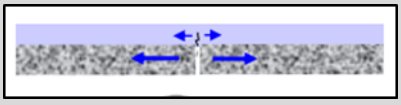


Figure 1(b) – Shear induced crack

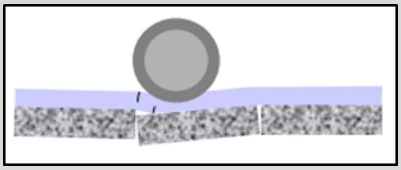
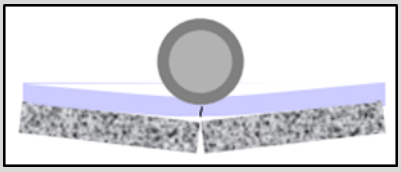


Figure 1(c) – Bending (fatigue) induced crack



Using an asphalt geosynthetic as an interlayer system, assists in delaying any cracking from propagating through the overlying asphalt layer(s). When designed and installed correctly, asphalt geosynthetics can provide a more effective crack mitigation treatment than a Strain Alleviating Membrane Interlayer (SAMI) seal, or Geotextile Reinforced Seal (GRS).

Figure 1(d) – Example of a typical asphalt overlay reflective cracking treatment

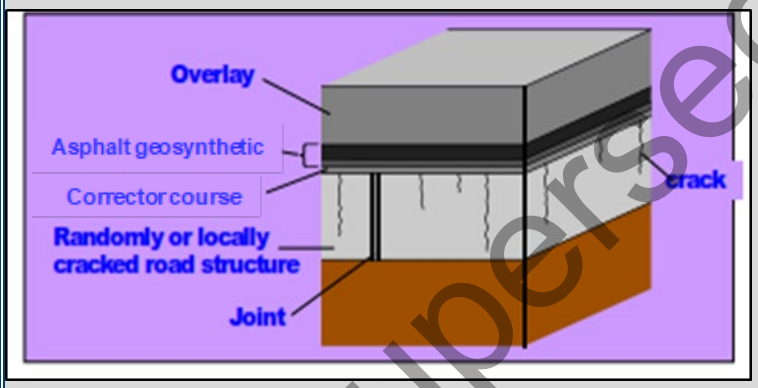
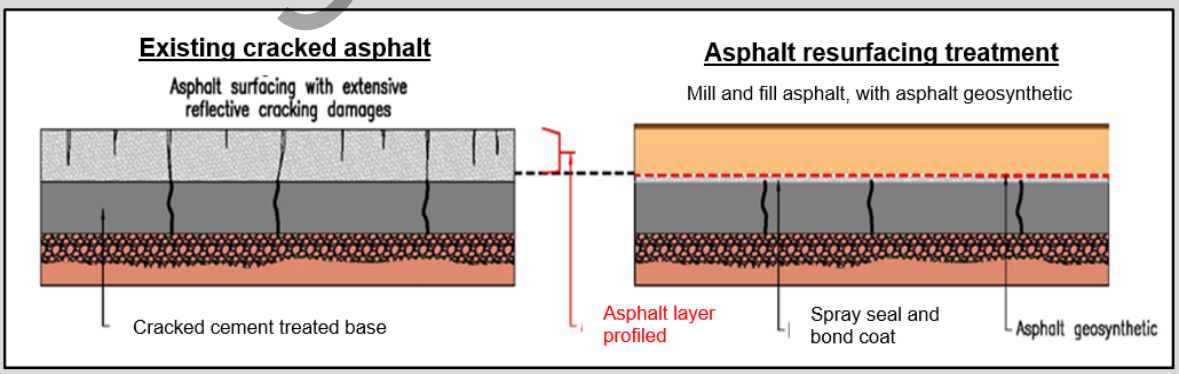


Figure 1(e) – Example of a typical asphalt inlay (or 'mill and fill') reflective cracking treatment



Reinforcement for improved fatigue performance

It is acknowledged that in addition to delaying reflective cracking in road pavements, asphalt geosynthetics may also provide a reinforcement function that can improve the fatigue performance of the overlying asphalt layer(s).

Transport and Main Roads currently has no published design approach for this reinforcement function and does not consider this function when determining a pavement's fatigue life. This Technical Specification only applies to asphalt geosynthetics used to delay reflective cracking in road pavements.

2 Definitions of terms

The terms defined in MRTS01 *Introduction to Technical Specifications* apply to this Technical Specification. Additional terminology relevant to this Technical Specification is defined in Table 2 below. Where indicated in Table 2, more complete definition is contained in the referenced clause.

Table 2 – Definitions of terms

Term	Definition
Asphalt geosynthetic	A geosynthetic type such as *geogrid without geotextile backing or geogrid with geotextile backing*. The asphalt geosynthetic is placed under overlying asphalt layer(s) to delay reflective cracking from propagating through the overlying asphalt layer(s).
Asphalt geosynthetic Manufacturer	The entity or company which is responsible for the manufacture of the asphalt geosynthetic materials. Currently, asphalt geosynthetic materials are manufactured overseas and imported into Australia for distribution.
Asphalt geosynthetic Supplier	The entity or company which is responsible for the supply and distribution of the asphalt geosynthetic rolls to Site.
Bitumen impregnation factor (I)	A percentage (%) of the geotextile backing's Bitumen Retention (B_r) which prescribes how saturated the geotextile shall be for installation purposes. It contributes to the calculation of the Bitumen Bond Coat Application Rate (B_t). Typically, it is 60 to 100% and shall be nominated by the *Supplier's Installation Guidelines*.
Bitumen retention (B_r)	The amount of bitumen required (in L/m²) to completely saturate the geotextile backing. It contributes to the calculation of the Bitumen Bond Coat Application Rate (B_t). It shall be determined using Test Method ASTM D6140 *Bitumen Retention*.
Bitumen bond coat	A bitumen bond coat sprayed onto the prepared pavement surface to ensure a good bond between the underlying pavement surface, the asphalt geosynthetic and the overlying asphalt layer. Typically, the binder is Class 170 or bituminous emulsion. The bitumen bond coat shall be sprayed from a sprayer. Hand spraying may be carried out only in those areas where it is impractical to use a sprayer.
Bitumen bond coat application rate (B_t)	Bitumen bond coat application rate (L/m²) is calculated and nominated as per Clause 9.5.2. It shall be measured as residual bitumen. It needs to consider the underlying prepared pavement surface texture and impregnation into the geotextile backing. Recommended bitumen bond coat application rates which are nominated in the *Supplier's Installation Guidelines,* shall be considered by the Contractor.
Bituminous emulsion tack coat	A grade of bituminous emulsion that complies with AS 1160. It may be required for a *geogrid without geotextile backing* and is typically applied at a low rate (0.1 to 0.3L/m² residual bitumen at 15ºC). Bituminous emulsion tack coat can also be applied (hand sprayed) at the overlapping joints of the asphalt geosynthetic.

Term	Definition
Construction bond strength	The resulting connection force (or bond strength) between the installed asphalt geosynthetic and the underlying pavement surface. It is measured after the placement of the asphalt geosynthetic and prior to asphalt paving. It shall be tested and measured as described in Clause 9.6.5 and 10.2.5.
Cross Machine Direction (CMD)	Direction of the asphalt geosynthetic that is perpendicular to the Machine Direction (MD).
Geogrid	A synthetic planar structure (or mesh) formed by a regular network of tensile strength elements, with relatively large apertures to allow for interlocking of particles. The geogrid shall be made from *polymeric* or *glass fibre* materials. A bituminous coating may be applied to the geogrid, to assist with bonding to the underlying pavement surface, the bitumen bond coat and the overlying asphalt layer. A polymer coating may be applied to the geogrid to reduce the construction damage. Refer to Table 7.2(a) for geogrid types and property requirements.
Geotextile (also referred to as geotextile backing)	A planar, permeable, polymeric (synthetic) textile material used in contact with the prepared pavement surface to assist with installation and bonding. The geotextile backing typically has a mass of between 15 g/m² to 150 g/m². It may be made from temporary fibres with a melting point < 180°C, or permanent fibres with a melting point ≥ 180°C. Refer to Table 7.2(b) for geotextile backing types and property requirements.
Glass fibre geogrid	A geogrid made of glass fibres. It has very high stiffness, very high temperature resistance and low elongation (less than 4%) at breaking point.
Levelling course	A term that is sometimes used by asphalt geosynthetic Suppliers. Refer to 'corrector course', as per MRTS30 *Asphalt Pavements*.
Machine Direction (MD)	The manufacture production direction of the asphalt geosynthetic.
Manufacture batch	The amount of geosynthetic produced under the same standard operating conditions. Each manufacture batch shall have a unique identification code which can be traced to the *manufacture sample* test reports and the asphalt geosynthetic rolls delivered to site.
Manufacture sample	A representative sample taken during a manufacture batch. This sample shall be tested in accordance with Clause 10.2.1.
Melting point	The temperature at which the elastic modulus of the geosynthetic material changes significantly. It shall be determined using Test Method ASTM D276 or ASTM E794-06 *Melting Point*.
Onsite sample	A representative sample taken from the asphalt geosynthetic product supplied to the Works. The sample shall be taken in accordance with Clause 10.2.2. The sample shall be tested in accordance with Clause 10.2.3.
Polyester (PET) geogrid	A geogrid made of polyester (PET). It has high temperature resistance and high elongation (up to 16%) at breaking point.
Polymeric geogrid	A polymeric geogrid made of polypropylene (PP), polyester (PET) or polyvinyl alcohol (PVA).
Polypropylene (PP) geogrid	A geogrid made of polypropylene (PP). If punched and drawn (extruded), it generally has memory issues when unrolled and placed. Therefore, holding pins / nails are typically required in conjunction with the geotextile backing placed on the bitumen bond coat to keep the geogrid in place during asphalt paving operations.
Polyvinyl alcohol (PVA) geogrid	A geogrid made of polyvinyl alcohol (PVA). It has high stiffness, high temperature resistance (similar to polyester), but low elongation (less than 6%) at breaking point. It has a high resistance to alkaline environments.

Term	Definition
Reflective cracking	Reflection cracks which arise from the underlying pavement layer(s) and propagate through the overlying pavement layer(s).
Resistance to construction damage	Damage during the construction process which can reduce the ultimate tensile strength of an asphalt geosynthetic. An asphalt geosynthetic's resistance to construction damage, shall be determined using Test Method ISO 10722 *Evaluate Construction Damage of Geosynthetics.*
Resistance to ultraviolet (UV)	Deterioration of geosynthetics through exposure to UV light. An asphalt geosynthetic's resistance to UV shall be determined using Test Method ASTM D4355 or EN 12224 *Resistance to UV*.
Self-adhesive backing	Typically, a glue-based non-bituminous adhesive backing which is laminated to the geogrid for assisting with installation and bonding. A geogrid can have a self-adhesive backing which covers the entire surface area, or, only laminated to the geogrid ribs.
Serviceability tensile strength / stiffness	The tensile resistance of the geosynthetic to deformation developed at a specified allowable serviceability level (at 2% strain). It shall be determined using Test Method ASTM D6637 or ISO 10319 *Tensile Properties*.
Strain	The ratio of extension to the original length.
Surface texture allowance (B_s)	A measure of the surface texture of the underlying prepared pavement surface which contributes to the calculation of the Bitumen Bond Coat Application Rate (B_t). It shall be determined using Test Method AGPT / T250 *Modified Surface Texture Depth (Pestle Method)*.
Ultimate tensile strength	The maximum tensile strength of the geosynthetic to deformation developed for a specific material when subject to tension by an external force. Tensile strength of the geosynthetic is the characteristic of a sample as distinct from a specimen and is expressed in force per unit width. It shall be determined using Test Method ASTM D6637 or ISO 10319 *Tensile Properties*.

3 Referenced documents

The requirements of the referenced documents listed in Table 3 below apply to this Technical Specification. Where there are inconsistencies between this Technical Specification and the referenced documents, the requirements specified in this Technical Specification shall take precedence.

Table 3 – Referenced documents

Reference	Title
AGPT Part 4G	Austroads *Guide to Pavement Technology Part 4G: Geotextiles and Geogrids*
AGPT Part 4K	Austroads *Guide to Pavement Technology Part 4K: Selection and Design of Sprayed Seals*
AS 1160	*Bituminous emulsions for the construction and maintenance of pavements*
AS 3705	*Geotextiles – Identification, marking and general data*
AS 3706.1	*Geotextiles – Methods of test – Method 1 – General requirements, sampling, conditioning, basic physical properties and statistical analysis*
MRTS01	*Introduction to Technical Specifications*
MRTS11	*Sprayed Bituminous Treatments (Excluding Emulsion)*
MRTS12	*Sprayed Bituminous Emulsion Surfacing*
MRTS17	*Bitumen and Multigrade Bitumen*

Reference	Title
MRTS21	*Bituminous Emulsion*
MRTS30	*Asphalt Pavements*
MRTS50	*Specific Quality System Requirements*
MRTS84	*Deck Wearing Surface*
PRM	Transport and Main Roads *Pavement Rehabilitation Manual*
TN175	*Selection and Design of Sprayed Bituminous Treatments*
-	*Supplier's Installation Guidelines*
-	*Supplier's Product Specifications*

4 Standard Test Methods

The standard Test Methods listed in Table 4 shall be used in this Technical Specification. Further testing details and requirements are given in Clauses 7 to 10.

Further details of Test Method Numbers and test descriptions are given in Clause 4 of MRTS01 *Introduction to Technical Specifications*.

Table 4 – Standard Test Methods

Property to be tested	Method No	Test description
Bitumen retention	ASTM D6140	Determines the bitumen retention of geotextiles used in road pavement applications.
Mass per unit area	AS 3706.1, ASTM D5261 or ISO 9864	Determines the mass per unit area of geotextiles for identification purposes and for use in technical data sheets.
Melting point	ASTM D276 or ASTM E794-06	Identification of fibres in geosynthetic materials.
Modified surface texture depth (pestle method)	AGPT T250	Determines the surface texture depth of road surfaces, by the sand patch technique. This method is only applicable to surface texture depths greater than 0.3 mm.
Resistance to construction damage	ISO 10722	Index test procedure for the evaluation of mechanical damage under repeated loading. For the test, the damage is simulated using granular materials.
Resistance to UV	ASTM D4355 or EN 12224	Deterioration of geosynthetics by exposure to light, moisture and heat.
Sampling of geosynthetics	ASTM D4354	Standard practice for sampling of geosynthetics for testing
Elongation (MD / CMD)	ASTM D6637 or ISO 10319	Determines the tensile strength properties of geogrids by the single or multi-rib tensile method.
Ultimate tensile strength (MD / CMD)		
Serviceability tensile strength (@ 2% strain) (MD / CMD)		

Resistance to construction damage

The placement and compaction of the asphalt on top of an asphalt geosynthetic may damage the asphalt geosynthetic. This damage is typically reflected by a reduction of the tensile strength properties of the asphalt geosynthetic.

Quantifying the amount of construction damage is determined by subjecting the asphalt geosynthetic to a placement and compaction cycle, exhuming the asphalt geosynthetic, and determining the ultimate tensile strength retained within the asphalt geosynthetic. The ultimate tensile strength of the uninstalled asphalt geosynthetic is compared to the ultimate tensile strength of the installed asphalt geosynthetic to derive at the construction damage reduction factor.

ISO 10722 nominates a granular material to be placed and compacted on the geosynthetic to simulate the expected construction damage. Even though asphalt materials are not used, this test is considered a fair indication of the construction durability of asphalt geosynthetics.

4.1 Accreditation of laboratories and technical facilities

All asphalt geosynthetic materials shall be manufactured under controlled conditions and shall have quality assurance to ensure a high standard of long-term performance. Testing under ASTM / EN / ISO Test Methods shall be conducted by a laboratory accredited under the following:

a) NATA

b) NATA's partners by Mutual Recognition Arrangements (MRA), or

c) GAI-LAP.

The requirement for the laboratory to be a registered Construction Materials Testing (CMT) Supplier in accordance with MRTS50 *Specific Quality System Requirements,* shall be relaxed.

There is a very limited number of accredited geosynthetic testing laboratories located in Australia, with most laboratories located overseas. Therefore, provided the geosynthetic testing laboratory meets the accreditation requirements of this clause, the requirement for the laboratory to be a registered CMT Supplier can be relaxed.

5 Quality system requirements

5.1 Hold Points, Witness Points and Milestones

General requirements for Hold Points, Witness Points and Milestones are specified in Clause 5.2 of MRTS01 *Introduction to Technical Specifications*.

The Hold Points, Witness Points and Milestones applicable to this Technical Specification are summarised in Table 5.1.

Table 5.1 – Hold Points, Witness Points and Milestones

Clause	Hold Point	Witness Point	Milestone
5.2	1. Acceptance of construction procedures		Supply of construction procedure (14 days)

Clause	Hold Point	Witness Point	Milestone
7.2	2. Acceptance of technical data sheets, test reports and certificates		Supply of technical data sheets, test reports and certificates (14 days)
8	3. Acceptance of onsite storage		Delivery of asphalt geosynthetic material to the Site (14 days)
9.1			Technical prestart meeting (3 days)
9.2	4. Placement trial (approval to proceed)		
9.3.3		1. Marking out of cracks to be filled	
9.3.4		2. Inspection of prepared pavement surface	
9.5.2	5. Confirmation of bitumen bond coat application rate		
9.5.3	6. Demonstration trials of bituminous emulsion bond coat (where applicable)		
9.5.6		3. Inspection of sprayed bitumen bond coat prior to placement of asphalt geosynthetic	
9.6.4		4. Inspection of asphalt geosynthetic joints and overlaps prior to asphalt paving	
9.6.5		5. Construction bond strength testing prior to asphalt paving	
9.6.7		6. Inspection of placed asphalt geosynthetic prior to asphalt paving	
10.2.2		7. Onsite sampling of asphalt geosynthetic material	
10.3	7. Acceptance		

5.2 Construction procedures

The Contractor shall prepare documented procedures for all construction processes as defined in Clause 6 of MRTS50 *Specific Quality System Requirements*.

The Contractor shall prepare documented procedures detailing all work described in this Technical Specification.

The Contractor's construction procedure should consider the details provided in the following documents:

- Transport and Main Roads *Pavement Rehabilitation Manual*
- Austroads *Guide to Pavement Technology Part 4G: Geotextiles and Geogrids*
- Asphalt geosynthetic *Supplier's Installation Guidelines*, and
- Asphalt geosynthetic *Supplier's Product Specifications*.

The construction procedure shall include, but not be limited to, the following:

a) Details of the nominated asphalt geosynthetic product.

b) Asphalt geosynthetic *manufacture sample* test reports and certificates (refer to Clauses 7.2 and 10.2.1).

c) Details of all bituminous materials to be used (refer to Clause 7.1).

d) Details for the transport, handling and onsite storage of the asphalt geosynthetic (refer to Clause 8).

e) Details for the onsite sampling and testing of the asphalt geosynthetic (refer to Clauses 7.2, 10.2.2 and 10.2.3).

f) Details for all aspects of the asphalt geosynthetic placement Works, including:

   i. Details of any construction contingencies and mitigating actions that may be associated with the Works, for example:

      - breakdown of plant (for example, sprayer or roller)
      - wet weather
      - extreme heat, or
      - reheating bitumen binder as it cools during the work shift.

   ii. Details for working up to or against to structures, kerbs, road safety barriers, access chambers, drainage gullies and other fixed infrastructure within or adjacent to the pavement.

   iii. Details of all plant and equipment associated with the Works, including the sprayer, application frame and roller(s) to be used to place the asphalt geosynthetic.

   iv. Details for the management of construction traffic over the prepared pavement surface, sprayed bitumen bond coat and installed asphalt geosynthetic to prevent contamination, damage and/or pick-up.

   v. Procedures for the preparation and inspection of the pavement surface (refer to Clause 9.3) and any contingencies and mitigating actions that may be associated with the Works, for example:

      - crack filling (refer to Clause 9.3.3)
      - complete removal of any thin delaminated stabilised or asphalt lens

- additional profiler passes to remove pavement height differentials (steps), or
- identification of areas of weak, saturated or otherwise unsuitable pavement materials, which will negatively impact the placement of the asphalt geosynthetic.

vi. Details for the management of pavement surface temperatures and weather conditions (refer to Clause 9.4).

vii. Details for the surface texture (sand patch) testing (refer to Clause 9.5.1).

viii. Calculation and nomination of the bitumen bond coat application rate (B_t) (refer to Clause 9.5.2).

ix. Procedures for the transport, handling, spraying and inspection of the bitumen bond coat or bituminous emulsion tack coat (refer to Clauses 9.4.2, 9.4.3, 9.4.4, 9.4.5 and 9.4.6).

x. Details on how the underlying pavement and bitumen bond coat temperatures will be managed as per the requirements of MRTS11 *Sprayed Bituminous Treatments (Excluding Emulsion)* or MRTS12 *Sprayed Bituminous Emulsion Surfacing*.

xi. Placement plan which details the lengths and widths of each asphalt geosynthetic placement run considering the pavement geometry, joint and overlap requirements (refer to Clause 9.6.2). Particular attention needs to be given to the placement of asphalt geosynthetic in challenging geometric areas such as steep grades, steep crossfalls, and small radius curves.

xii. Procedures for the placement and inspection of the asphalt geosynthetic (refer to Clause 9.6).

xiii. Procedures for the transport, loading and placement of the asphalt geosynthetic using a suitable application frame (refer to Clause 9.6.2).

xiv. Rolling pattern and estimated number of passes (refer to Clause 9.6.3).

xv. Procedures for joints and overlaps (transverse and longitudinal) of the asphalt geosynthetic (refer to Clause 9.6.4) including:

- details for staggering or offsetting multiple overlaps which are in the same area
- overlaps between work shifts, and
- overlaps at the centreline or crown.

xvi. Details for the construction bond strength testing (refer to Clause 9.6.5), and

xvii. Any procedures for the asphalt placement which will supplement the *Asphalt Quality Plan* (AQP) prescribed in the relevant asphalt Technical Specification (refer to Clauses 9.6.1 and 9.6.2).

g) Details for all material and construction compliance testing, including:

i. all materials compliance testing for the *manufacture sample*

ii. all materials compliance testing for the *onsite sample*, and

iii. all construction compliance testing.

The Contractor's construction procedure shall be submitted to the Administrator at least 14 days prior to the commencement of any Works related to the placement of the asphalt geosynthetic. **Milestone**

No Works related to the placement of asphalt geosynthetic shall commence until the construction procedure has been accepted by the Administrator, and the Administrator has given the Contractor permission to proceed. **Hold Point 1**

5.3 Conformance requirements

The conformance requirements that apply to the asphalt geosynthetic materials and construction processes covered by this Technical Specification are stated in Clauses 7 to 11.

5.4 Testing frequencies and lot sizes

The maximum lot sizes shall be as specified in Table A1 of Appendix A.

Material compliance testing requirements and minimum testing frequencies shall be as specified in Table A2(a) and A2(b) of Appendix A.

Construction compliance testing requirements and minimum testing frequencies shall be as specified in Table A3 of Appendix A.

6 Pre-construction considerations

6.1 Minimum asphalt cover

The Designer, Supplier and/or Contractor shall consider the minimum thickness of the overlying asphalt layer(s) with guidance provided in Figure 6.1.

High shear stress areas are where there are high horizontal shear forces induced by braking, slow moving and/or turning traffic. These areas include steep grades (>5%), signalised intersections and approaches, roundabouts and approaches, speed bumps and approaches, bus stops and turnarounds and other areas with very slow-moving heavy vehicles.

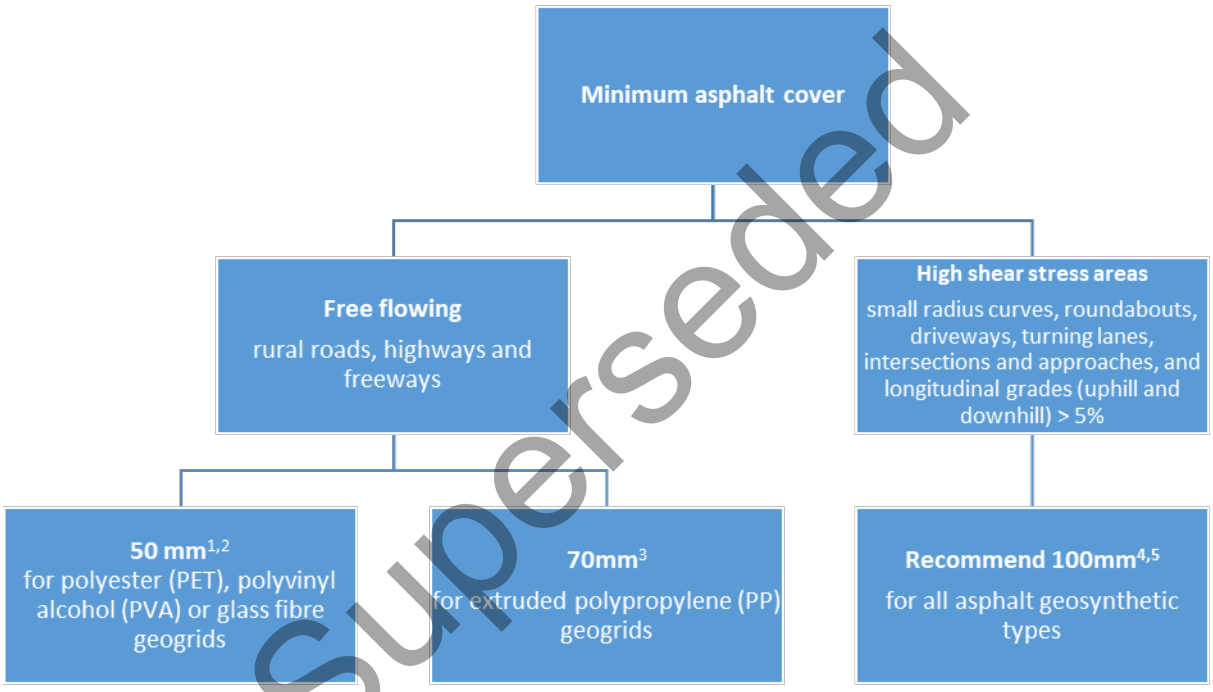
The Pavement Designer must carefully consider the installation of an asphalt geosynthetic underneath a thin asphalt surfacing layer in high shear stress areas, as it may contribute to the risk of the thin asphalt surfacing layer delaminating (or de-bonding). In high shear stress areas, there are many factors that can contribute to the risk of a thin asphalt surfacing layer delaminating. These include, but are not limited to, the following:

- Poor preparation of the underlying pavement surface (for example, wet and/or dusty pavement surface and minimal penetration of the bitumen binder into the underlying pavement surface).
- Poor spray sealing practises directly underneath the asphalt geosynthetic (for example, wet aggregate, insufficient rolling of the aggregate, inappropriate spray sealing binder selection, excessive spray rate, loose aggregate and not allowing sufficient time for the bitumen emulsion to fully break).
- Poor asphalt geosynthetic placement practises (for example, inappropriate bitumen bond coat binder selection, insufficient or excessive bitumen bond coat application rate, folding wrinkling and/or damaging of the asphalt geosynthetic, insufficient rolling of the asphalt geosynthetic and inadequate impregnation of the bitumen binder into the geotextile backing).

- Poor asphalt placement practises on top of the asphalt geosynthetic (for example, inappropriate mix design selection, asphalt temperature too low at the time of placement and insufficient compaction), and
- Very high environmental and pavement temperatures during the early stages of public trafficking.

To help manage and reduce the potential risk of a thin asphalt surfacing layer delaminating in high shear stress areas, a minimum of 100 mm asphalt cover is typically recommended on top of the asphalt geosynthetic (as shown in Figure 6.1).

Figure 6.1 – Minimum asphalt cover over asphalt geosynthetics



Notes:

[1] A minimum of 50 mm asphalt cover has been nominated as this thickness aligns with the minimum layer thicknesses prescribed in MRTS30 *Asphalt Pavements* for the most common asphalt surfacing types AC14 and SMA14.

[2] Installing an asphalt geosynthetic directly beneath an open graded asphalt surfacing shall be avoided as this will cause difficulties during the routine mill and resurfacing treatments. Where an open graded asphalt surfacing is nominated, the asphalt geosynthetic should be installed directly beneath a dense graded intermediate asphalt layer, or lower in the pavement structure.

[3] For extruded polypropylene (PP) geogrids, the minimum asphalt cover of 70 mm shall be used as per the *Supplier's Installation Guidelines*.

[4] A minimum of 100 mm asphalt cover is typically recommended for high shear stress areas to help manage and reduce the potential risk of a thin asphalt surfacing layer delaminating (or de-bonding). Further to this, by installing the asphalt geosynthetic lower in the pavement structure, it allows the asphalt geosynthetic to remain in place during future asphalt mill and resurface Works.

[5] For some Projects (for example, where there are cost and constructability constraints), the Pavement Designer may consider a minimum asphalt cover of 50 mm in high shear stress areas. Asphalt geosynthetic Supplier(s) shall provide laboratory test and/or field data that demonstrates adequate interlayer bonding and performance when asphalt geosynthetics have been correctly designed and installed underneath a thin asphalt surfacing layer in high shear stress areas.

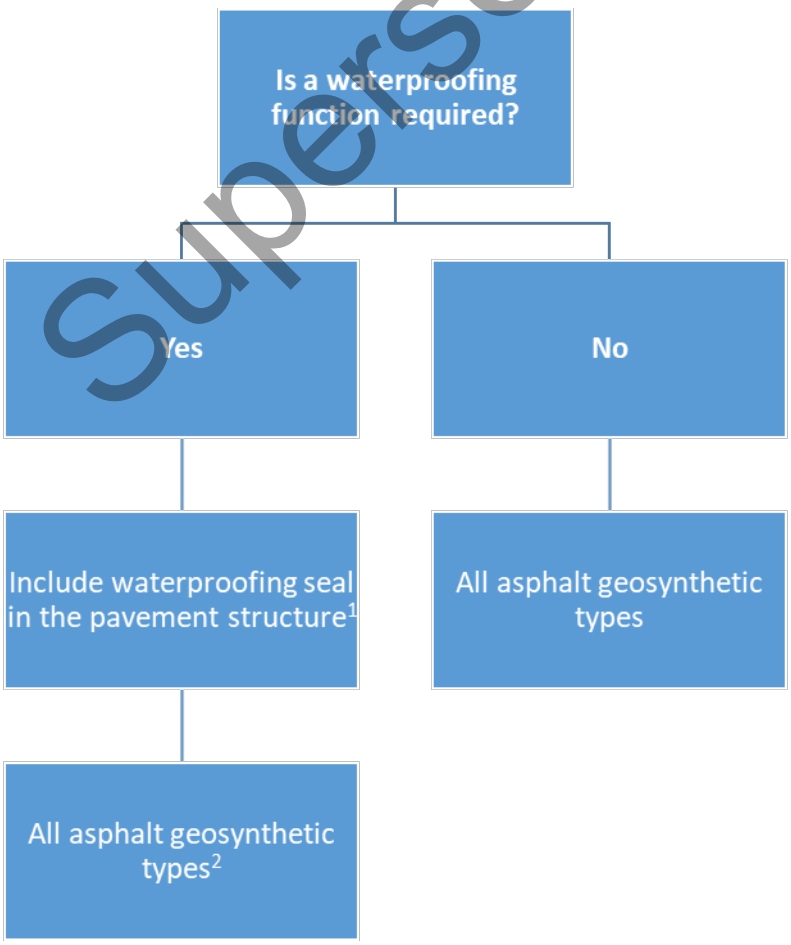
Where an asphalt geosynthetic is proposed under a thin asphalt surface in a high shear stress area, the Pavement Designer is required to seek further advice from the Director (Pavement Rehabilitation).

6.2 Waterproofing function

The Designer, Supplier and/or Contractor shall consider the waterproofing function needs of the pavement system with guidance provided in Figure 6.2.

Further research is required to better understand and quantify the waterproofing effectiveness of a permanent geotextile backing impregnated with bitumen. Therefore, to ensure waterproofing is achieved in the pavement structure, a waterproofing seal is recommended (as shown in Figure 6.2).

Figure 6.2 – Waterproofing function



Notes:

[1] Waterproofing seal shall be as per Transport and Main Roads Technical Note 175 *Selection and Design of Sprayed Bituminous Treatments* and Austroads *Guide to Pavement Technology Part 4K: Selection and Design of Sprayed Seals*. Typically, a waterproofing seal is applied directly beneath the asphalt surfacing layer. A waterproofing seal shall not be applied directly on top of the asphalt geosynthetic. An asphalt geosynthetic can be placed on top of a waterproofing seal (or other bitumen spray seal) prior to placement of the overlying asphalt.

[2] The potential for the bitumen binder to bleed through the asphalt surfacing layer shall be considered, particularly when the asphalt geosynthetic is installed on top of the waterproofing seal directly beneath the asphalt surfacing layer. To mitigate the risk of bleeding, the following could be considered:

a) the spray rate of the waterproofing seal could be lowered

b) extra care and attention need to be taken when nominating the bitumen bond coat application rate (refer to Clause 9.5.2). The bitumen bond coat application rate needs to account for the underlying prepared pavement surface texture and avoid over-saturating the geotextile backing, and

c) the asphalt cover above the waterproofing seal / asphalt geosynthetic can be increased to create a thicker barrier to bitumen bleeding.

The risk of the underlying bitumen binder to bleed through the asphalt surfacing is higher when SMA is used. The Pavement Designer can seek further advice from the Director (Pavement Rehabilitation) on the risks and mitigation of bitumen binder bleeding.

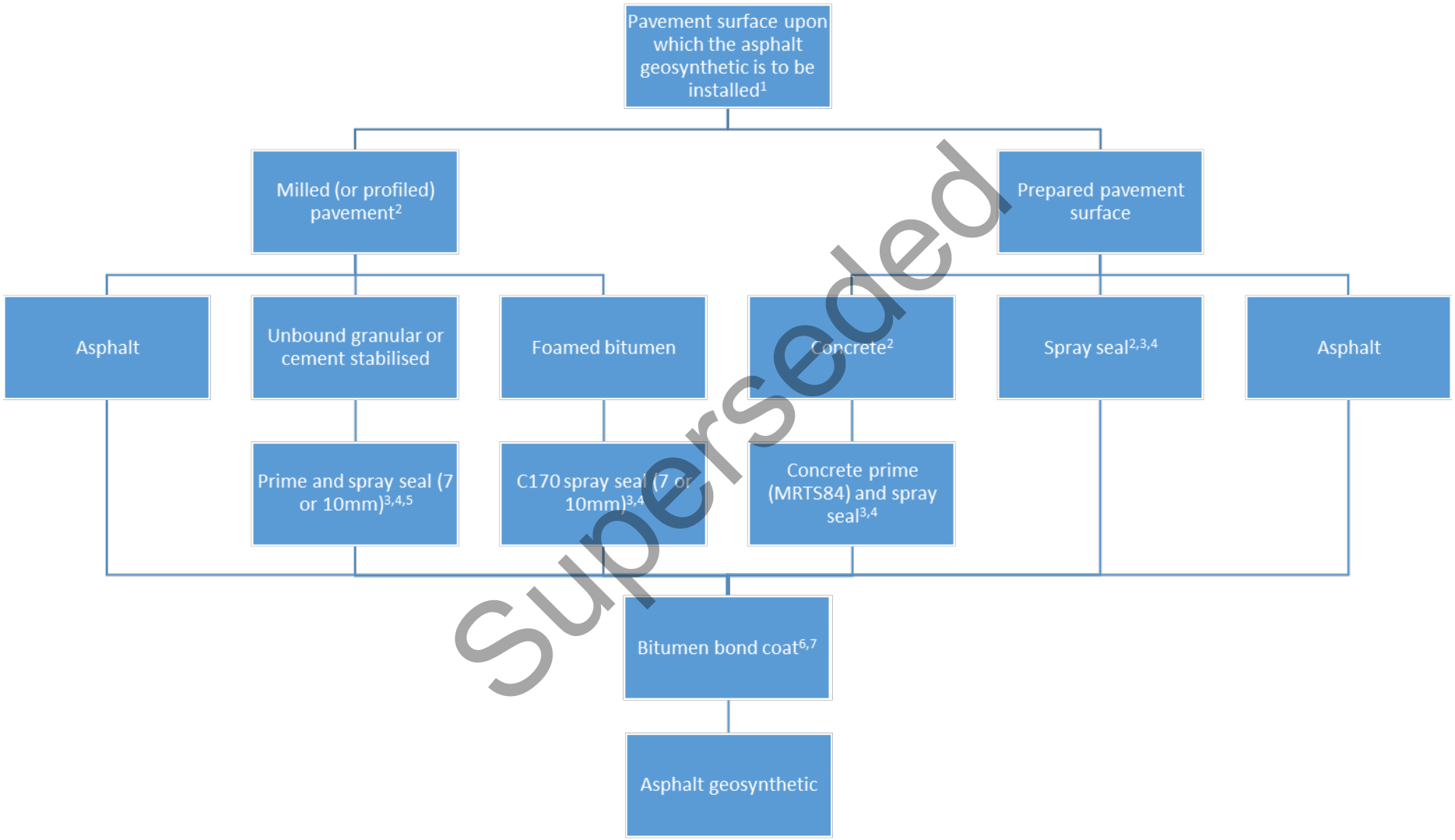
6.3 Surfaces upon which the asphalt geosynthetic is to be installed

The Designer, Supplier and/or Contractor shall consider the prepared pavement surface upon which the asphalt geosynthetic is to be installed with guidance provided in Figure 6.3.

The details provided in Figure 6.3 are recommended options based on project learnings which have achieved successful outcomes.

It is recommended to undertake an upfront pavement investigation during the design development to determine the underlying pavement profile, materials and strength.

Figure 6.3 – Installation of the asphalt geosynthetic on different pavement surfaces



Notes:

[1] All pavement surfaces shall be prepared in accordance with Clause 9.3.

[2] For a milled (or profiled) surface, a *geogrid with geotextile backing* is typically nominated to achieve a good bond. Where a glass fibre geogrid product is to be placed directly on a milled, spray seal or rough pavement surface, an AC10, AC14 or AC20 asphalt corrector layer, complying with the relevant Technical Specification, may be required prior to installing the glass fibre geogrid. The requirement for an asphalt corrector layer shall be prescribed in the *Supplier's Installation Guidelines*.

[3] Where a waterproofing function is required within the pavement system (refer to Clause 6.2), the spray seal elements (binder type, spray rate and aggregate size) shall be designed in accordance with MRTS11 *Sprayed Bituminous Treatments (Excluding Emulsion)*.

[4] It is critical to ensure that the sprayed seal surface is adequately designed and constructed, with the binder bonded to the underlying pavement surface and the sealing aggregate bonded to the binder. Where the bitumen spray seal is 'fresh' and has had limited curing or exposure to traffic, there may be a risk of the asphalt geosynthetic instability (that is, moving or slipping) when paving the overlying asphalt. Care needs to be taken during asphalt paving operations to not wrinkle or fold the asphalt geosynthetic. Additional roller passes of the spray seal aggregate and/or placed asphalt geosynthetic, may be required to improve the asphalt geosynthetic's stability when paving the overlying asphalt.

[5] Best practice is to spray cutback bitumen prime and initial seal the underlying unbound granular or cement stabilised prepared pavement surface to achieve a good bond. However, a cutback bitumen prime will require minimum curing times before being covered. As an alternative, a prime with bitumen emulsion binder could be considered to improve the penetration into the prepared pavement surface. However, the time required for the emulsion to completely break shall be allowed for in the construction programming. Where there are construction programming and traffic management constraints, a C170 spray seal (7 or 10 mm) on the prepared pavement surface typically provides a satisfactory outcome while avoiding the need for a cutback bitumen prime or bitumen emulsion.

The recommendations provided for the bitumen sealing of a milled pavement surface are based on project learnings which have achieved successful outcomes. For unique and/or challenging asphalt inlay Works, the Pavement Designer can seek further advice from the Director (Pavement Rehabilitation).

[6] The Bitumen Bond Coat Application Rate (B_t) is calculated and nominated as per Clause 9.5.2. The bitumen bond coat (C170 or emulsion) shall be sprayed from a sprayer (refer to Clause 9.5.3). Where *geogrid without geotextile backing* is used, a bituminous emulsion tack coat may be applied at a low rate (typically 0.1 to 0.3L/m² residual binder at 15ºC). Recommended bitumen bond coat / bituminous emulsion tack coat requirements and application rates are detailed in the *Supplier's Installation Guidelines* and shall be considered by the Contractor.

[7] The potential for the bitumen binder to bleed through the asphalt surfacing layer shall be considered, particularly when the asphalt geosynthetic is installed on top of the bitumen spray seal directly beneath the asphalt surfacing layer. To mitigate the risk of bleeding, the following could be considered:

a) the spray rate of the bitumen binder could be lowered
b) extra care and attention need to be taken when nominating the bitumen bond coat application rate (refer to Clause 9.5.2). The bitumen bond coat application rate needs to account for the pavement surface texture and avoid over-saturating the geotextile backing, and

c) the asphalt cover above the bitumen spray seal / asphalt geosynthetic can be increased to create a thicker barrier to bitumen bleeding.

The risk of the underlying bitumen binder to bleed through the asphalt surfacing is higher when SMA is used. The Pavement Designer can seek further advice from the Director (Pavement Rehabilitation) on the risks and mitigation of bitumen binder bleeding.

7 Material requirements

7.1 Bituminous materials

7.1.1 Bitumen bond coat

Typically, the bitumen bond coat binder is either Class 170 (refer to Clause 7.1.1.1) or bituminous emulsion (refer to Clause 7.1.1.2).

An alternative bitumen bond coat binder (for example, M500) may be nominated by the Contractor to better suit project specific constraints and environmental conditions. In this case, the Contractor must demonstrate to the Administrator's satisfaction that the alternative binder does not negatively impact the placement of the asphalt geosynthetic and overlying asphalt.

Polymer modified binder (including crumb rubber modified binder) should not be used in any part of the placement of the asphalt geosynthetic.

7.1.1.1 Class 170 bitumen

Unless otherwise approved by the Administrator, Class 170 bitumen shall comply with MRTS17 *Bitumen and Multigrade Bitumen*.

7.1.1.2 Bituminous emulsion

Unless otherwise approved by the Administrator, bituminous emulsion shall comply with MRTS21 *Bituminous Emulsion*. Cationic Rapid Setting (CRS) emulsion shall be used.

7.1.2 Bituminous emulsion tack coat

Unless otherwise approved by the Administrator, bituminous emulsion tack coat shall comply with AS 1160. The Contractor shall select a grade of bituminous emulsion that provides a strong bond between the existing surface, the asphalt geosynthetic and new asphalt layer and results in minimal pick-up on truck tyres or paving equipment during paving operations.

7.2 Asphalt geosynthetics

The asphalt geogrid shall have high tensile modulus in relation to the material being reinforced and shall also have high continuity of tensile strength through the entire geogrid structure to absorb transient stress in machine direction (MD) and cross machine direction (CMD). The asphalt geogrid shall maintain its tensile strength under repeated dynamic loads while in service and shall also be resistant to UV induced deterioration and to damage during construction practices. More importantly, asphalt geogrid shall have a high melting point characteristic as it is placed under hot mix asphalt paved at high temperatures.

The asphalt geogrid material to be used in the Works shall be as stated in Clause 1 of Annexure MRTS104.1. Where it is not so stated in the Annexure or shown in the Drawings, it shall be nominated by the Contractor and be *glass fibre or polymeric*.

The asphalt geosynthetic type to be used in the Works shall be as stated in Clause 1 of Annexure MRTS104.1. Where it is not so stated in the Annexure or shown in the Drawings, it shall be *geogrid with geotextile backing*.

Identification and traceability information including asphalt geosynthetic type, materials source, Manufacturer, manufacture batch identification code, sample date and roll directional markings shall be shown on or attached to the test reports.

Test reports and certificates demonstrating compliance with this Technical Specification shall be provided by the Contractor to the Administrator for each asphalt geosynthetic product to be used in the Works. The testing can be undertaken through the asphalt geosynthetic Manufacturer, asphalt geosynthetic Supplier and/or Contractor.

All *manufacture sample* test reports and certificates (refer to Clause 10.2.1) shall be submitted to the Administrator at least 14 days prior to the commencement of any Works related to the placement of the asphalt geosynthetic material(s). **Milestone**

No asphalt geosynthetic products shall be incorporated into the Works until all *manufacture sample* test reports and certificates (refer to Clause 10.2.1) have been accepted by the Administrator, and the Administrator has given the Contractor permission to proceed. **Hold Point 2**

The asphalt geosynthetic shall conform in all respects to the property requirements listed in Tables 7.2(a) and 7.2(b).

Table 7.2(a) – Property requirements of asphalt geosynthetic: geogrids

Property	Test Method	Unit	Polymeric geogrid	Glass fibre geogrid
Geogrid aperture size (MD and CMD)	'centre of geogrid rib' to 'centre of geogrid rib'	mm	25 – 50	
Melting point[1]	ASTM D276 or ASTM E794-06	°C	≥ 180	
Resistance to construction damage	EN ISO 10722	%	≥ 90	
Resistance to UV[2]	ASTM D4355 or EN 12224	%	≥ 90[3]	
Elongation (MD / CMD)[4]	ASTM D6637 or EN ISO 10319	%	≤ 16	≤ 4
Serviceability tensile strength (@ 2% strain) (MD / CMD)[4]	ASTM D6637 or EN ISO 10319	kN/m	≥ 6	≥ 40
Ultimate tensile strength (MD / CMD)[4]	ASTM D6637 or ISO 10319	kN/m	≥ 20	≥ 50

Notes:

[1] If the melting point of the asphalt geogrid is less than 180ºC but more than 140ºC, then the geogrid may be used, provided when placing asphalt, the contact temperature between the asphalt layer and the geogrid shall be less than geogrid melting point.

[2] UV resistance shall be measured and reported at 500 hours of exposure for ASTM D4355, or, at 50 MJ/m² radiant exposure for EN 12224.

[3] As an alternative, the asphalt geogrid's reduced ultimate tensile strength shall be ≥ 20 kN/m for a polymeric geogrid, and ≥50 kN/m for a glass fibre geogrid.

[4] Tensile strength tests shall be carried out on the finished manufactured product. Testing products or elements prior to their final manufacture processing, may not be representative of the finished manufactured product.

Table 7.2(b) – Property requirements of asphalt geosynthetic: geotextile backings

Property	Test Method	Unit	Temporary geotextile backing	Permanent geotextile backing
Melting point	ASTM D276 or ASTM E794-06	°C	< 180	≥ 180
Mass per unit area	AS 3706.1, ASTM D5261 or ISO 9864	g/m²	15 – 30	15 – 150
Bitumen retention[1]	ASTM D6140	L/m²	0.3 – 1.5	
Bitumen impregnation factor	-	%	Nominated by the asphalt geosynthetic Supplier[2,3]	

Notes:

[1] Testing shall be completed in accordance with ASTM D6140 with the following amendment: where possible, Class 170 bitumen complying with MRTS17 *Bitumen* shall be used, and testing shall be undertaken at 160°C.

[2] 60-100% bitumen impregnation typically results in a successful placement, with minimal pick-up on truck tyres or paving equipment during asphalt paving operations. The actual *Bitumen Impregnation Factor* percentage shall be nominated in the *Supplier's Installation Guidelines*.

[3] The Bitumen Bond Coat Application Rate (B_t) is calculated and nominated as per Clause 9.5.2.

[4] For a *geogrid without geotextile backing* which has a self-adhesive backing, there are no property requirements for the self-adhesive backing.

8 Identification, packaging, delivery, storage and protection

Asphalt geosynthetic material shall be delivered to the Site at least 14 days prior to commencement of installation. **Milestone**

14 days has been nominated to allow enough time for onsite sampling and testing, as described in Clauses 10.2.2 and 10.2.3 respectively. Where a Contractor has a limited Site establishment period (for example, road maintenance activities), the Administrator may choose to reduce the 14 days requirement. However, based on the Contractor's limited Site establishment period, the Contractor will need to consider the risks of placing the asphalt geosynthetic without confirmation of the *onsite sample* test results.

The asphalt geosynthetic materials used for the Works shall be new and shall not have been exposed to UV radiation or moisture (for example, during transportation or storage). Asphalt geosynthetic materials which have been affected by UV radiation or moisture (for example, prior to or during supply and onsite storage) shall not be used. Any asphalt geosynthetic materials delivered to the Site which has evidence of prolonged exposure to UV radiation or moisture or any other damage, shall be removed from Site and replaced with conforming asphalt geosynthetic materials at no additional cost to the Principal.

All asphalt geosynthetic rolls delivered to the Site shall comply with AS 3705 for identification and marking. Each asphalt geosynthetic roll supplied to Site shall have a unique identification code and a reference to its representative manufacture batch code. If the asphalt geosynthetic product to be used for the Works has difficulties with labelling / printing, the asphalt geosynthetic Supplier shall propose a method of identification to be considered by the Administrator.

It is imperative that there is clear traceability between the asphalt geosynthetic rolls delivered to the Site, its representative *manufacture batch* and test reports provided to the Administrator.

Rolled asphalt geosynthetic materials may be laid flat or stood on end. Asphalt geosynthetic materials shall be stored under protective cover or wrapped with a waterproof, opaque UV protective sheeting to avoid any exposure and damage prior to installation. Asphalt geosynthetic materials shall not be left directly exposed to sunlight. The asphalt geosynthetic materials shall not be stored directly on the ground or in any way that it may be affected by heat or moisture. The method of storage shall be in accordance with any other recommendations set by the Manufacturer and/or Supplier.

Where a *geogrid without geotextile backing* with a self-adhesive backing is supplied, these shall be stored in a dust-free environment and kept dry on the job Site.

The *Supplier's Product Specifications* and/or *Installation Guidelines,* shall be adhered to with regards to protection and storage.

All asphalt geosynthetics shall be transported and stored at a temperature range between -15°C and 80ºC.

No asphalt geosynthetic products shall be incorporated into the Works unless it has been stored correctly onsite and the Administrator has given the Contractor permission to proceed. **Hold Point 3**

9 Construction requirements

9.1 Technical prestart meeting

At least three days prior to the commencement of any Works related to the placement of the asphalt geosynthetic, the Contractor shall facilitate a *Technical Prestart Meeting*. **Milestone**

At the *Technical Prestart Meeting* the Contractor's Construction Procedure which has been deemed suitable by the Administrator (refer to Clause 5.2) and the *Supplier's Installation Guidelines* shall be read through and discussed in detail.

Attendees to the *Technical Prestart Meeting* shall include (but not be limited to) the following:

- Contractor Representative(s)
- Administrator and/or Administrator Representative(s)
- Asphalt Geosynthetic Supplier Representative(s)
- Spray Seal Sub-Contractor Representative(s)
- Asphalt Placement Sub-Contractor Representative(s), and
- Pavement Designer Representative(s) (where possible).

All agreed outcomes and actions from the *Technical Prestart Meeting* shall be recorded and distributed to the attendees.

9.2 Placement trial

Clause 2 of Annexure MRTS104.1, specifies whether a placement trial of the asphalt geosynthetic shall be undertaken by the Contractor. If no indication is given, the placement trial shall be undertaken.

For the placement trial, the Contractor shall undertake the construction and compliance requirements in accordance with this Technical Specification.

After completing the placement trial, construction Works shall not proceed until the Administrator is satisfied that the requirements of this Technical Specification have been met. **Hold Point 4**

If the placement trial does not conform to the requirements of this Technical Specification, the Contractor shall review their construction procedure and a further placement trial may be undertaken at the direction of the Administrator.

It is recommended that the first asphalt geosynthetic placement lot be nominated as a small placement area to check and refine the bitumen bond coat and asphalt geosynthetic placement procedure.

The placement trial will provide the Contractor with the opportunity to demonstrate to the Administrator that the Contractor's construction procedures and processes are suitable.

It is recommended that an *Asphalt Geosynthetic Supplier's Representative* should be onsite for the asphalt geosynthetic placement trial(s) to observe and provide guidance to the Contractor.

9.3 Pavement surface preparation

9.3.1 General

Refer to Clause 6.3 for guidance on what to consider when assessing the surface upon which the asphalt geosynthetic is installed.

In all cases, the pavement surface shall be adequately prepared prior to spraying the bitumen bond coat and placing the asphalt geosynthetic.

Any additional surface preparation as specified in the Contract and/or Drawings, shall be adhered to by the Contractor.

Any additional surface preparation as outlined in the *Supplier's Installation Guidelines,* shall be adhered to by the Contractor.

9.3.2 Preparation

The pavement surface shall be prepared in accordance with the relevant Technical Specification.

For an existing or milled asphalt surface, the pavement surface is prepared in accordance with MRTS30 *Asphalt Pavements.*

For bitumen spray sealing and bitumen bond coat Works, the pavement surface is prepared in accordance with MRTS11 *Sprayed Bituminous Treatments (Excluding Emulsion)* or MRTS12 *Sprayed Bituminous Emulsion Surfacing* as applicable.

The pavement surface shall not be wet. The pavement surface shall be thoroughly swept using a rotary broom or suction sweeper to remove any loose material, loose spray sealing aggregate, or other deleterious material in order to provide a dry, even, clean surface reasonably free of dirt and other loose material.

The pavement area adjacent or surrounding the construction lot, shall also be thoroughly swept to prevent construction traffic dragging contaminants onto the prepared pavement surface, sprayed bitumen bond coat and installed asphalt geosynthetic.

Manhole covers, gully pits, kerb / channels and other structures shall be identified and have surfaces cleaned free of any extraneous material.

For a milled (or profiled) pavement surface, the Contractor shall identify and report to the Administrator any areas of weak, saturated or otherwise unsuitable pavement materials, which will negatively impact the placement of the asphalt geosynthetic.

For an asphalt overlay, all raised extruded thermoplastic road markings and raised pavement markers (RPMs), shall be removed prior to spraying the bitumen bond coat or emulsion tack coat.

9.3.3 Crack filling

Existing cracks between 3 mm and 10 mm shall be filled prior to spraying the bitumen bond coat and placing the asphalt geosynthetic.

The Contractor shall mark out, in the presence of the Administrator, the extent of crack filling to be carried out. **Witness Point 1**

Prior to filling of cracks, the existing cracks shall be cleaned with compressed air or vacuumed.

Cracks shall be filled level with the surrounding surface using a polymer modified bituminous sealant approved by the Administrator.

Strain alleviating fabric strips shall not be applied to existing cracks directly underneath or on top of the asphalt geosynthetic.

Potholes or larger cracks shall be treated with proper backfill and compaction as per the Drawings and/or Contract requirements prior to spraying the bitumen bond coat and placing the asphalt geosynthetic.

9.3.4 Inspection of the prepared pavement surface

Prior to spraying the bitumen bond coat and placing the asphalt geosynthetic, the prepared pavement surface shall be inspected by the Administrator to ensure that the prepared pavement surface is in accordance with this Technical Specification. **Witness Point 2**

9.4 Pavement temperature and weather conditions

Spraying of bitumen and placement of asphalt geosynthetic shall not be undertaken during rainfall or when the rainfall is expected.

Spraying of bitumen bond coat (refer to Clause 9.5), placement of asphalt geosynthetic (refer to Clause 9.6) and placement of asphalt (refer to Clause 9.7) shall not commence until the surface temperature of the pavement is above the temperature limits specified in MRTS30 *Asphalt Pavements*, unless otherwise directed by the Administrator.

Spraying of the bitumen bond coat and placement of the asphalt geosynthetic, shall not be undertaken when the surface temperature of the pavement exceeds 50°C, unless otherwise directed by the Administrator.

Where there are high environmental and pavement temperatures, there is an increased the risk of pick-up and instability during the placement of the asphalt geosynthetic and overlying asphalt. Additional care and attention is required by the Contractor when completing the Works in hot conditions. For example, undertaking the Works at night, or during the cooler periods of day, and/or, using an alternative bitumen bond coat binder (as per the guidance provided in Clause 7.1.1).

In warm and hot environments, Transport and Main Roads has successfully used M500 multigrade bitumen for geotextile reinforced seals.

9.5 Bitumen bond coat

9.5.1 Surface texture (sand patch)

Once the pavement has been adequately prepared as per the requirements of Clause 9.3, surface texture testing shall be undertaken by the Contractor in accordance with Clause 10.2.4.

9.5.2 Bitumen bond coat application rate

The *Supplier's Installation Guidelines* shall be referred to, and any recommended bitumen bond coat application rates shall be considered by the Contractor and adjusted on Site as required.

As a guide, the *bitumen bond coat application rate* (B_t) measured as residual bitumen, can be estimated using the equation below:

$$B_t = B_s + (B_r \times I)$$

B_t = bitumen bond coat application rate (L/m^2)

B_s = surface texture allowance from sand patch results (L/m^2) refer to guidance given in Table 9.5.2 below

B_r = the geotextile backing bitumen retention (L/m^2) to be submitted to the Administrator at least 14 days prior to the commencement of Works (refer to Clause 7.2)

I = Supplier's nominated bitumen impregnation factor (%) to be submitted to the Administrator at least 14 days prior to the commencement of Works (refer to Clause 7.2)

Table 9.5.2 – Guidance on surface texture allowance from sand patch results

Surface texture depth (mm) (refer to Clause 9.5.1)	Estimated surface texture allowance (B_s) (L/m² of residual bitumen)
0.3 to 0.6	0
0.7 to 0.9	0.1
1.0 to 1.3	0.2
1.4 to 1.6	0.3
1.7 to 2.0	0.4
> 2	0.5
Milled (or profiled) surface	0.5[1]

Notes:

[1] In case of a milled (or profiled) surface, additional amount of bitumen bond coat may be required to ensure adequate bonding is achieved.

The bitumen bond coat application rate shall be confirmed with the Administrator prior to commencement of spraying. **Hold Point 5**

The bitumen bond coat application rate is a critical element in achieving a successful asphalt geosynthetic installation. Too much bitumen bond coat can lead to pick-up and instability when paving the overlying asphalt. Too little bitumen bond coat can lead to poor bonding between the underlying pavement surface, the asphalt geosynthetic and the overlying asphalt.

To avoid contributing to the risk of pick-up, instability and excess binder bleeding through the asphalt, typically the maximum bitumen bond coat application rate is limited to 1.5 L/m² (residual bitumen). Higher application rates may be considered by the Administrator, provided that demonstrated evidence of performance is submitted.

After nominating the bitumen bond coat application rate (B_t), check that the sprayer can successfully spray the nominated spray rate. This is particularly critical when the nominated bitumen bond coat application rate is low (< 0.5 L/m²), as common sprayers may not be able to spray at this low rate effectively or safely.

9.5.3 Spraying bitumen bond coat

The relevant bitumen spraying requirements detailed in MRTS11 *Sprayed Bituminous Treatments (Excluding Emulsion)* or MRTS12 *Sprayed Bituminous Emulsion Surfacing,* shall be adhered to by the Contractor.

For each spray run, the Contractor shall record all details of the spraying operations on a suitable Spray Sheet and provide it to the Administrator.

The sprayer shall avoid driving through already sprayed bitumen, or undertaking multiple spray runs over the same location.

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

If a bituminous emulsion product used, the asphalt geosynthetic material shall not be installed until the emulsion completely breaks. The actual required application rate and time required for breaking, shall be verified and adjusted for specific Site conditions through field trial(s). **Hold Point 6**

As a guide, the bitumen bond coated surface shall have a 'mirror' effect, which can be observed and assessed by the Administrator.

Figure 9.5.3 – Example of C170 bitumen bond coat sprayed on a prepared pavement surface

9.5.4 Bituminous emulsion tack coat or bitumen bond coat for *geogrid without geotextile backing*

For most *geogrid without geotextile backing* products, a bituminous emulsion tack coat is specified. The bituminous emulsion tack coat shall be applied at a low rate (typically 0.1 to 0.3L/m² residual binder at 15ºC), and shall be:

a) evenly applied to the prepared pavement surface at a rate specified in the *Supplier's Installation Guidelines*

b) spayed using a job-truck or hand spray, and

c) allowed to break and be dry to touch prior to placing the geogrid.

For some *geogrid without geotextile backing* products, a bitumen bond coat (refer to Clause 9.5.3) is specified.

In all cases, the *geogrid without geotextile backing* shall be installed as per *Supplier's Installation Guidelines.* Any bituminous emulsion tack coat, bitumen bond coat and additional surface preparation requirements, as outlined in the *Supplier's Installation Guidelines* (for example, asphalt corrector layer required directly underneath certain glass fibre geogrid products), shall be adhered to by the Contractor.

9.5.5 Trafficking the bitumen bond coat

The bitumen bond coated (or emulsion tack coated) surface shall not be opened to public traffic. Trafficking of the bitumen bond coat (or emulsion tack coat) shall be restricted to the asphalt and asphalt geosynthetic placement machinery vehicles only.

9.5.6 Inspection of the bitumen bond coat

Prior to installation of the asphalt geosynthetic material, the Administrator shall inspect the bitumen coated surface to ensure even coverage and complete breaking of emulsion (where applicable).
Witness Point 3

9.6 Placement of asphalt geosynthetic placement

9.6.1 General

The asphalt geosynthetic material shall not be placed during rainfall or when the rainfall is expected.

Where a Class 170 bitumen bond coat is used, placement of the asphalt geosynthetic shall commence immediately following spraying of the bitumen bond coat. The bitumen bond coat temperature shall not exceed 145ºC when the asphalt geosynthetic material is placed.

Where a bituminous emulsion bond coat is used, sufficient time shall be allowed for the emulsion to completely break prior to placing the asphalt geosynthetic (refer to Clause 9.5.3).

9.6.2 Placing asphalt geosynthetic

As part of the Contractor's construction procedure (refer to Clause 5.2), a placement plan shall be prepared which considers the pavement geometry (lane widths, grades, crossfalls and so on), joints and overlaps.

Placement shall be undertaken mechanically using the *Asphalt Geosynthetic Supplier's* recommended specialised application frame capable of handling full roll widths. Manual hand installation shall be carried out only in areas where it is impractical to use machinery.

The asphalt geosynthetic material shall be placed in accordance with the lines and grades as shown on the Drawings and/or Contract. The asphalt geosynthetic material shall be oriented such that the roll length runs parallel to the road direction. Where practical, the asphalt geosynthetic material shall be laid across the full width of the pavement lot prior to asphalt paving.

> Using inappropriate application frames will result in an unsuccessful placement of the asphalt geosynthetics.
>
> Project learnings have shown that a front-steer tractor fitted with a suitable application frame is typically adequate for the successful placement of the asphalt geosynthetic.

Figure 9.6.2 – Examples of installation of asphalt geosynthetics using application frame

Asphalt geosynthetic material shall be laid flat and smooth directly on the prepared pavement surface, bitumen bond coat or emulsion tack coat.

A roller (or rollers) shall follow the placement of the asphalt geosynthetic, to ensure a flat and smooth product and where applicable, adequate impregnation of the bitumen bond coat into the geotextile backing (refer to Clause 9.6.3).

Extruded polypropylene (PP) asphalt geogrids, shall use pins / nails to hold the asphalt geosynthetic in place, during placement and subsequent asphalt paving operations.

For *geogrid without geotextile* backing with a self-adhesive backing, the product shall be placed as per *Supplier's Installation Guidelines* to ensure that the adhesive side is facedown. After the initial bedding roller pass, multiple passes with a multi-tyre roller shall be undertaken to activate the adhesive face.

Asphalt geosynthetic shall be installed by the Contractor to avoid wrinkles and folds. Any wrinkles and folds shall be removed and replaced by the Contractor at no additional cost to the Principal.

9.6.3 Rolling asphalt geosynthetic

A roller (or rollers) shall follow the placement of the asphalt geosynthetic to ensure a flat and smooth product and adequate adhesion to the underlying bitumen bond coat / prepared pavement surface.

Initial bedding roller pass

A small CC10 smooth drum roller is recommended for the initial bedding roller pass(es) immediately after placement of the asphalt geosynthetic. A rubber coated drum / combination roller is further recommended as it significantly reduces the risk of crushing any spray seal cover aggregate, and significantly reduces the risk of damaging the asphalt geosynthetic. Vibration shall not be used during the initial bedding roller pass(es).

Large tandem asphalt rollers are not recommended for the initial bedding roller pass as they tend to crush any spray seal cover aggregate and may also damage the asphalt geosynthetic.

Multi-tyre rollers are also not recommended for the initial bedding roller pass as they tend to 'pull in' the edges of the asphalt geosynthetic.

Figure 9.6.3(a) – Example of roller being used for the initial bedding of the asphalt geosynthetic

Subsequent roller passes

A multi tyre roller is recommended for the subsequent roller passes, to ensure adequate adhesion of the asphalt geosynthetic to the underlying bitumen bond coat / prepared pavement surface.

Large tandem asphalt rollers are not recommended for the subsequent roller passes, as they tend to crush any spray seal cover aggregate and may also damage the asphalt geosynthetic.

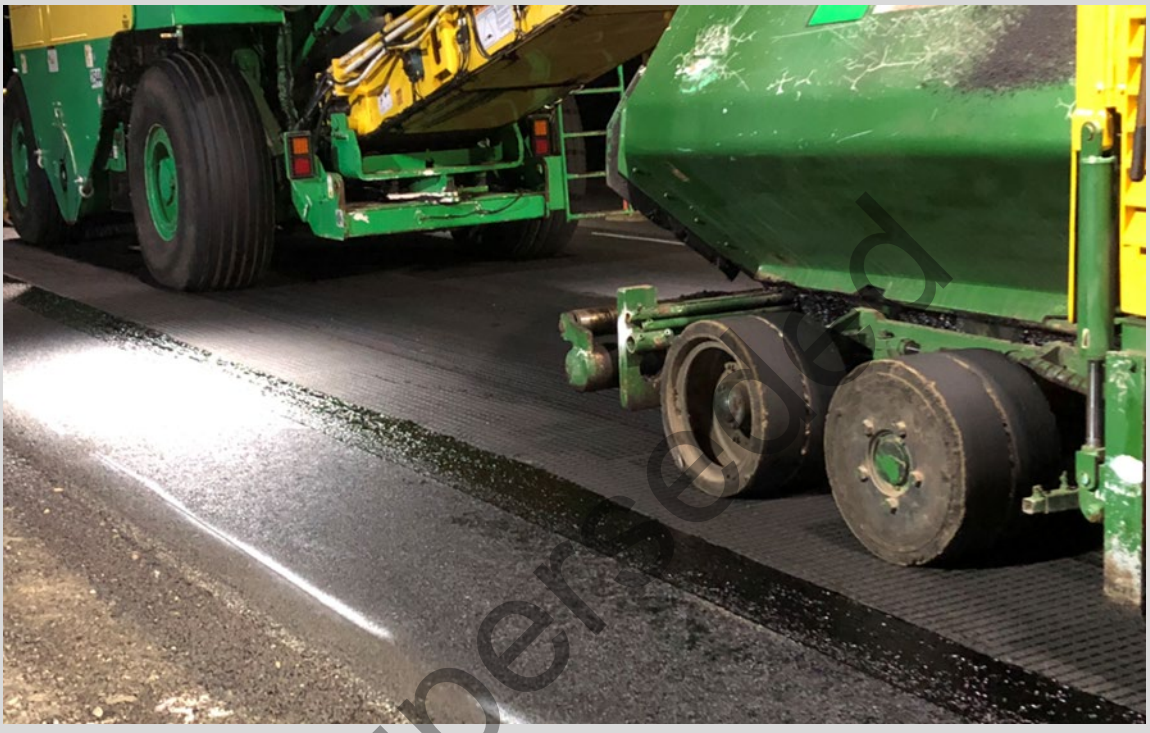
The roller should travel at walking speed in the reverse direction for its first pass, and then double-back on rolled section. This should be repeated on the subsequent passes, until the entire asphalt geosynthetic has been rolled in. Vibration should not be used during the subsequent roller passes.

For asphalt geosynthetics installed using a bitumen bond coat or bituminous emulsion tack coat, there shall be minimal pick-up on truck tyres or paving equipment during asphalt paving operations.

As a guide for some asphalt geosynthetic products, the black boot prints of workers over the freshly installed geosynthetic, can be considered as a good indication that sufficient bitumen bond coat has impregnated into the permanent geotextile backing.

The Contractor should implement controls to prevent tracking bitumen up the road.

Figure 9.6.3(b) – Example of minimum bitumen pick-up on truck tyres or paving equipment



9.6.4 Joints and overlaps

The *Supplier's Installation Guidelines* shall be referred to for details regarding the asphalt geosynthetic joint requirements.

Joints and overlaps shall be staggered or offset from each other to avoid this having multiple overlaps coinciding in the same area.

Where possible, the asphalt geosynthetic shall be placed in such a manner that longitudinal joints occur at centreline, lane line, edge line or in the shoulder. Longitudinal joints shall avoid being located underneath wheel paths, unless otherwise directed by the Administrator.

A minimum overlap of 150 mm is required for both longitudinal and transverse joints for all asphalt geosynthetics (refer to Figure 9.6.4), unless otherwise directed by the Administrator.

The overlaps shall be made in the direction of asphalt paving (refer to Figure 9.6.4).

Due to memory issues, extruded polypropylene (PP) asphalt geogrids shall be connected with ties or butt jointing at overlapping joints.

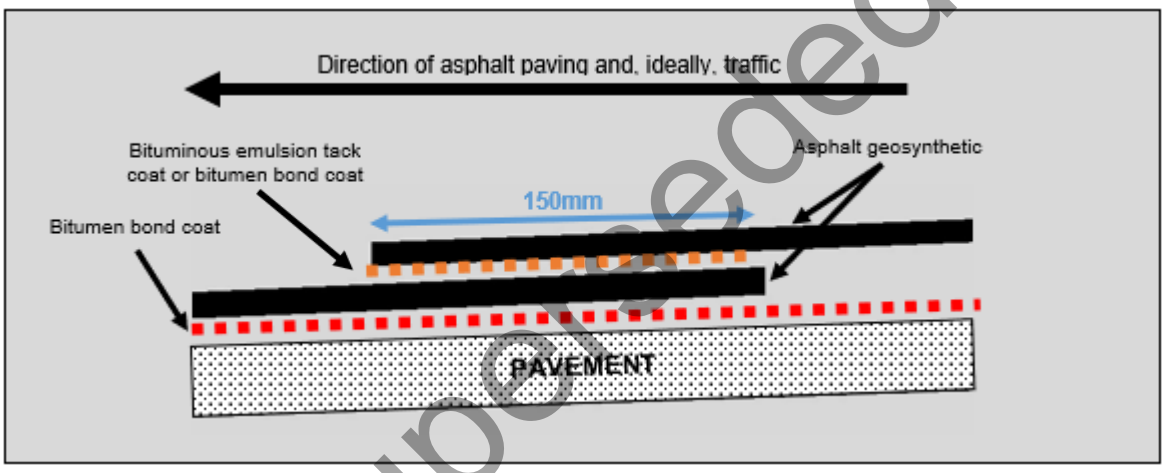
Bituminous emulsion tack coat or bitumen bond coat shall be applied at the overlapping joints to provide adequate bonding but not exceed the asphalt geosynthetic's bitumen retention rate (L/m²) submitted to the Administrator (refer to Clause 7.2).

The Administrator shall inspect the completed asphalt geosynthetic joints and overlaps.
Witness Point 4

The Contractor needs to consider how to manage overspray when applying the bituminous emulsion tack coat or bitumen bond coat at the overlapping joints. Excess binder can lead to pick-up and instability when paving the overlying asphalt.

Alternative methods for applying the bituminous emulsion tack coat or bitumen bond coat at the overlapping joints can be demonstrated by the Contractor to the Administrator. For example, 150 mm wide paint roller.

Figure 9.6.4 – Asphalt geosynthetic overlaps



9.6.5 Construction bond strength

After the placement of the asphalt geosynthetic, construction bond strength testing shall be undertaken by the Contractor in accordance with Clause 10.2.5. **Witness Point 5**

9.6.6 Trafficking the asphalt geosynthetic

The placed asphalt geosynthetic shall not be opened to public traffic. Trafficking of the asphalt geosynthetic shall be restricted to the asphalt paving machine and asphalt delivery vehicles only. Sharp braking and turning on the asphalt geosynthetic material shall be avoided.

Where possible, the asphalt Material Transfer Vehicle (MTV) should not traffic the asphalt geosynthetic. Further to this, the MTV should avoid parking for long periods of time on the asphalt geosynthetic as the belly can reheat and liven the bitumen bond coat.

The asphalt delivery trucks should have clean tyres to avoid dragging contaminants onto the asphalt geosynthetic. Further to this, the asphalt delivery trucks should avoid parking on the asphalt geosynthetic as the hot tyres can reheat and liven the bitumen bond coat.

9.6.7 Inspection of the asphalt geosynthetic

Prior to placement of the asphalt, the asphalt geosynthetic material shall be inspected by the Administrator to ensure that the asphalt geosynthetic is installed as per the requirements of this Technical Specification and is not damaged, wrinkled or folded. **Witness Point 6**

Any damaged, wrinkled or folded asphalt geosynthetic, shall be removed and replaced by the Contractor at no additional cost to the Principal prior to asphalt placement.

9.7 Asphalt placement

9.7.1 General

Placement of the asphalt shall commence immediately following the placement of the asphalt geosynthetic.

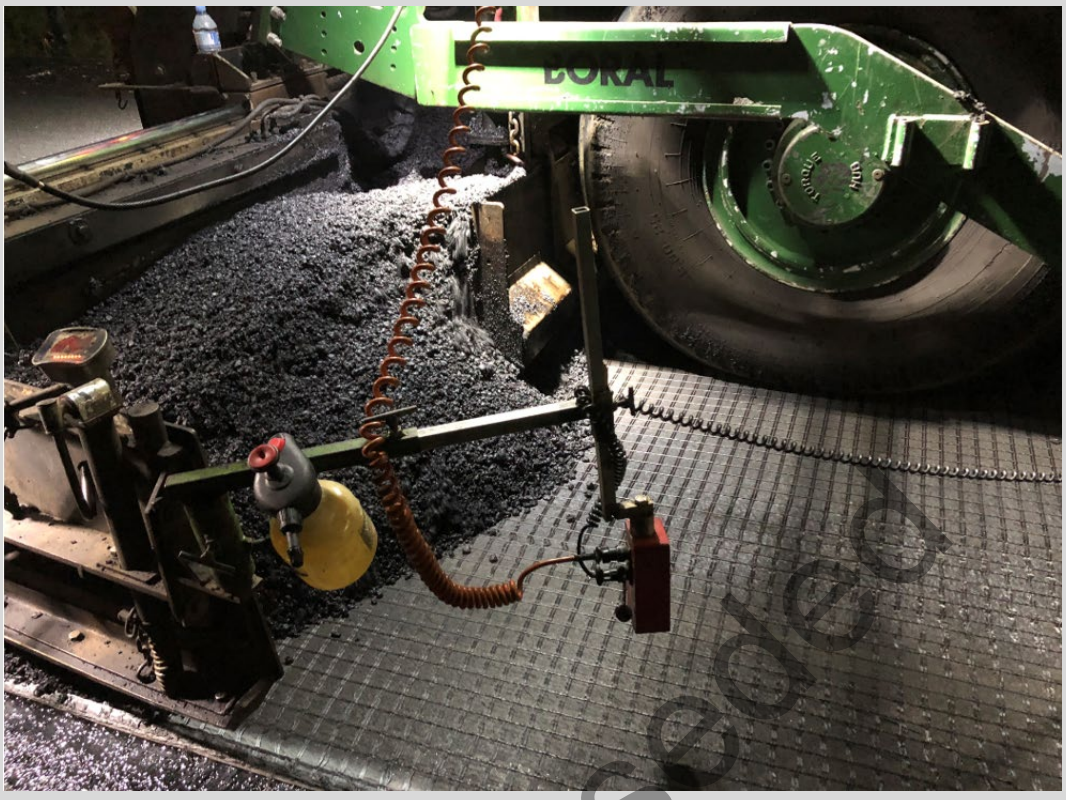
Asphalt shall be placed in accordance with the Drawings, Contract and the relevant Technical Specifications.

The asphalt shall be laid at the temperature lower than the melting point of the asphalt geogrid specified in Table 7.2(a) to prevent melting of the asphalt geogrid.

Warm mix asphalt additive may be added to the asphalt, to reduce the asphalt manufacturing temperature and/or to improve workability during the paving and compaction operations. Warm mix asphalt additive may be used on any project subject to the requirements of the relevant Technical Specification being met.

During paving operations, the asphalt geosynthetic shall not bow-wave, wrinkle or fold. Any wrinkles and folds shall be rectified by the Contractor at no additional cost to the Principal.

Figure 9.7.1 – Example of asphalt being paved on asphalt geosynthetic with no bow-waves, wrinkles or folds



9.7.2 Trafficking the asphalt

The asphalt layer shall not be open to public traffic until the greater of the following asphalt thicknesses has been laid over the asphalt geosynthetic:

a) minimum asphalt layer thickness in accordance with the relevant Technical Specification, or

b) minimum overlying asphalt thickness prescribed in the *Supplier's Product Specifications* and/or *Installation Guidelines*.

The minimum overlying asphalt thickness (or cover) is to ensure the following:

a) the overlying asphalt layer thickness complies with the relevant Technical Specification, and

b) there is enough dead load placed upon the asphalt geosynthetic product to resist any uplifting and premature cracking.

9.8 Installation damage and replacement

During construction, some degree of damage may occur to the asphalt geosynthetic material caused by asphalt delivery trucks, wheel loads from the paver or compaction of the asphalt. In case excessive damage occurs prior to or during construction, the damaged geosynthetic shall be removed and replaced by the Contractor at no additional cost to the Principal. The degree of damage should be assessed and determined by the Administrator, Designer and Supplier's Representative prior to replacement.

10 Compliance testing

10.1 General

Compliance testing of asphalt geosynthetics shall be undertaken on a lot basis in accordance with MRTS01 *Introduction to Technical Specifications*.

For each lot, the Contractor is responsible for undertaking sufficient testing to ensure that the asphalt geosynthetic complies in all regards with the requirements of this Technical Specification.

The Contractor shall ensure that sufficient, clearly documented construction compliance records are provided to the Administrator to ensure that traceability of the asphalt geosynthetic materials from its manufacture to the constructed pavement.

Maximum lot sizes, minimum test frequencies and the minimum number of tests required are specified in Appendix A.

10.2 Compliance testing requirements

10.2.1 Testing requirements for manufacture sample

A representative sample shall be taken during a manufacture batch and tested. The manufacture batch and corresponding test results shall be clearly traceable to the asphalt geosynthetic rolls supplied for the Works.

The following properties of the manufacture sample shall be tested as per the requirements of Appendix A Table A2(a):

- Bitumen retention (geotextile backing only)
- Mass per unit area (geotextile backing only)
- Melting Point (geotextile backing and geogrid)
- Elongation
- Ultimate tensile strength
- Serviceability tensile strength / stiffness (@ 2% strain)
- Resistance to UV, and
- Resistance to construction damage.

Refer to Tables 7.2(a) and 7.2(b) for minimum requirements for abovementioned property tests.

The testing can be undertaken through the asphalt geosynthetic Manufacturer, asphalt geosynthetic Supplier and/or the Contractor.

Identification and traceability information including asphalt geosynthetic type, materials source, Manufacturer, manufacture batch identification code, sample date and roll directional markings shall be shown on or attached to the test reports.

All *manufacture* sample test reports and certificates shall be provided to the Administrator as per the requirements of Clause 7.2 (Hold Point 2).

10.2.2 Onsite sampling

Where the total size supplied for the Works is less than 2000 m², the requirements for onsite sampling and subsequent testing, shall be relaxed by the Administrator, provided the *manufacture sample* test reports and certificates (refer to Clause 10.2.1) comply with the requirements of Tables 7.2(a) and 7.2(b).

Where the total size supplied for the Works is more than 2000 m², onsite sampling shall be carried out in accordance with ASTM D4354 at the frequency stated in Appendix A Table A2(b).

Upon delivery of the asphalt geosynthetic material to the Site (refer to Clause 8), a representative sample shall be taken from the roll(s) to be tested in accordance with ASTM D4354. The representative sample shall be no less than four linear metres along the roll for the full production width, but not within two metres of the start or end of the roll. **Witness Point 7**

Each sample shall be clearly marked with a large arrow, showing the longitudinal direction (Machine Direction) of the asphalt geosynthetic products. The directional marking shall be used to identify the direction of samples for tensile strength tests in both longitudinal and transversal (Cross Machine Direction) directions.

The Administrator may select additional samples to be taken at the Site for audit testing (refer to Clause 10.4).

10.2.3 Testing requirements for onsite sample

The following properties of the *onsite sample* asphalt geosynthetic material shall be tested as per the requirements of Appendix A Table A2(b):

- Ultimate tensile strength, and
- Serviceability tensile strength / stiffness (@ 2% strain).

Refer to Tables 7.2(a) and 7.2(b) for minimum requirements for abovementioned property tests.

The testing can be undertaken through the asphalt geosynthetic Supplier and/or the Contractor.

All *onsite sample* test reports and certificates shall be provided to the Administrator as soon as practical.

10.2.4 Surface texture

Minimum testing frequencies for surface texture (sand patch) testing shall be as specified in Appendix A Table A3.

The surface texture for each construction lot shall be represented by an average of the individual results.

10.2.5 Construction bond strength

Minimum testing frequencies for construction bond strength testing (pull out) shall be as specified in Appendix A Table A3.

Practical 'pull-upfield tests shall be undertaken for the verification of the bitumen bond coat application rate, and, to ensure adequate bonding of the asphalt geosynthetic to the underlying pavement surface has occurred.

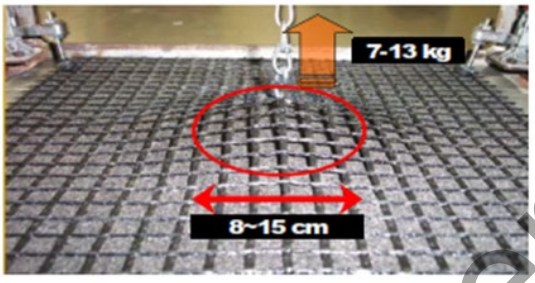
A spring balance test shall be conducted on a minimum 1 m² section of the asphalt geosynthetic, placed on the area to be paved, to ensure that adequate bonding is achieved.

The construction bond strength for each construction lot shall be represented by an average of the individual results.

Spring balance testing

Insert the hook of a spring balance through the asphalt geosynthetic in the centre of the test section. Pull the spring balance upward until the asphalt geosynthetic material starts to pull from the surface. Record these results in 'kg' and if the reading is 9 kg or greater, continue to pave asphalt. If less than 9 kg is achieved, the Contractor and Administrator should apply corrective action in line with Supplier's recommendation.

Figure 10.2.5 – Spring balance test to measure the construction bond strength



10.3 Acceptance

An asphalt geosynthetic supply and placement lot, shall be deemed to achieve conformance and be accepted by the Administrator if all material and construction requirements comply with this Technical Specification. **Hold Point 7**

If an asphalt geosynthetic lot fails to comply with the properties defined in Tables 7.2(a) and 7.2(b), this will constitute a Nonconformance under the Contract. As part of the corrective action, the asphalt geosynthetic lot can be re-sampled in accordance with Clause 10.2.2 and retested in accordance with Clause 10.2.3 to verify whether the lot conforms or not. If upon retesting the asphalt geosynthetic lot fails to achieve conformance, then the lot should be rejected.

For spray sealing and asphalt Works, any Nonconformances are to be raised and actioned as per the relevant Technical Specifications.

10.4 Audit testing

The Administrator may select samples from the Site and make arrangements for audit testing to be carried out, regardless of the quantity of asphalt geosynthetic material supplied.

11 Supplementary requirements

The requirements of this Technical Specification are varied by the supplementary requirements specified in Clause 3 of Annexure MRTS104.1.

Appendix A: Maximum lot sizes and minimum testing frequencies

Table A1 – Maximum lot size requirements

Construction Activity	Maximum Lot Size
Supply of asphalt geosynthetic (*onsite sample*)	10,000 m²
Placement of asphalt geosynthetic	The area (in m²) of placement achieved during a single work period

Table A2(a) – Material testing compliance requirements for manufacture samples

Material Property	Test Method	Normal Testing Level	
		Minimum Testing Frequency	**Minimum No. of Tests**
Geotextile backing			
Bitumen retention	ASTM D6140	The currency of test reports and certificates shall be no older than 12 months from the date of the supply to the Works.	1 test on the manufacturing batch for the rolls supplied to the Works.
Mass per unit area	AS 3706.1, ASTM D5261 or ISO 9864		
Melting Point	ASTM D276 or ASTM E794-06		
Geogrid			
Melting Point	ASTM D276 or ASTM E794-06	The currency of test reports and certificates shall be no older than 12 months from the date of the supply to the Works.	1 test on the manufacturing batch for the rolls supplied to the Works.
Elongation	ASTM D6637 or ISO 10319		
Ultimate tensile strength			
Serviceability tensile strength (@ 2% strain)			
Resistance to UV	ASTM D4355 or EN 12224	The currency of test reports and certificates shall be no older than 5 years from the date of the supply to the Works.	1 test on a manufacturing batch which is representative of the rolls supplied for the Works.
Resistance to construction damage	EN ISO 10722		

Table A2(b) – Material testing compliance requirements for onsite samples

Material Property	Test Method	Normal Testing Level		Reduced Testing Level	
		Minimum Testing Frequency	Minimum No. of Tests	Minimum Testing Frequency	Minimum No. of Tests
Geogrid					
Ultimate tensile strength	ASTM D6637 or ISO 10319	1 test per 5,000 m²	1 test per lot	1 test per 10,000m²	1 test per lot
Serviceability tensile strength (@ 2% strain)					

Table A3 – Construction compliance testing requirements

Material Property	Test Method	Normal Testing Level		Reduced Testing Level	
		Minimum Testing Frequency	Minimum No. of Tests	Minimum Testing Frequency	Minimum No. of Tests
Surface texture	AGPT T250	1 test per 500 m²	4 tests per lot	1 test per 1000 m²	2 tests per lot
Construction bond strength	Refer to Clauses 9.5.5 and 10.2.5	1 test per 500 m²	4 tests per lot	1 test per 1000 m²	2 tests per lot