Technical Specification

Transport and Main Roads Specifications
MRTS104 Retarding Pavement Reflective Cracking using Asphalt Geosynthetics

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Queensland Government

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1 Introduction

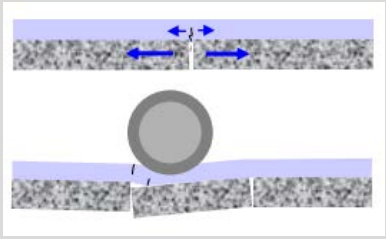
This Technical Specification applies to the physical, material and construction requirements for asphalt geosynthetic material used for retarding pavement reflective cracking in road pavement applications. The asphalt geosynthetic material is used to delay reflective cracking in the asphalt overlay thereby reducing future maintenance costs. Geogrids comprising of glass fibres or polymeric materials are the most common types of asphalt geosynthetics and will be covered in this Technical Specification.

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.

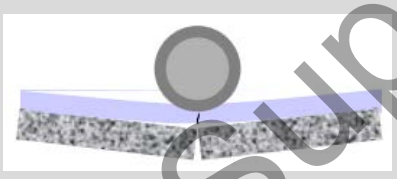
Reflective cracking and corrective treatment

Reflective cracking in a road pavement is generally due to three failure modes: bending, shear or thermal expansion. These cause cracks in the lower asphalt layers which soon propagate to the surface of the asphalt.



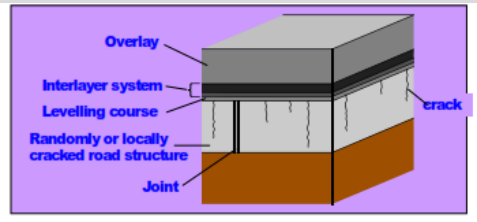
Thermally induced crack

Traffic Induced crack (shear)

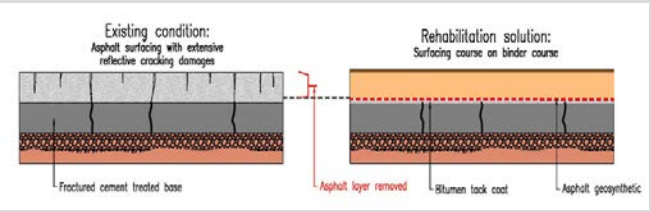


Bending induced crack

Use of conforming asphalt geosynthetic product as an interlayer system would assist in inhibiting/retarding the reflective cracking through asphalt overlay.



Schematic of reflective cracks treatment



Case example of reflective cracks treatments

2 Definition of terms

The terms used in this Technical Specification shall be as defined in Clause 2 of MRTS01 *Introduction to Technical Specifications*. Further definitions are defined in Table 2. Where indicated in Table 2, more complete definition is contained in the referenced clause.

Table 2 – Definition of terms

Term	Definition
Asphalt Geosynthetic Material	A reinforcing product such as polymeric geogrid or glass fibre geogrid or geocomposite, used in asphalt layers to delay reflective cracking, originating from lower layers.
Asphalt Interlayer	A geosynthetic reinforced seal specifically designed for use under/between asphalt layers. The geosynthetic interlayer shall consist of geosynthetic material, saturated with asphalt binder. The geosynthetic interlayer also provides a waterproofing function.
Bond Strength	The resulting connection force between the installed reinforcement and the surrounding asphaltic material.
Flexible Geogrid	A geogrid exhibiting a stiffness, or flexural rigidity, of less than 1000g-cm as tested via ASTM D1388. Flexible geogrids are generally made by a textile weaving process and generally involve polyester, polyvinyl alcohol or fiberglass yarns.
Geocomposite	Geocomposite consists of geogrid and geotextile. It is highly recommended for use as asphalt geosynthetic material as it performs as reinforcement and waterproofing.
Geogrid	A synthetic planar structure formed by a regular network of tensile strength elements with apertures of sufficiently large size to allow for interlocking with the surrounding soil so as to perform the primary function of reinforcement.
Geotextile	A planar, permeable, polymeric (synthetic or natural) textile material, which may be non-woven, knitted or woven, used in contact with soil/rock and/or any other geotechnical or pavement material in civil engineering applications.
Glass Fibre Geogrid	A flexible geogrid which has relatively high strength and high temperature resistance, but low elongation and is more brittle. This geogrid is typically knitted, coated with polymer, bitumen or having self-adhesive backing.
Installation Damage	Damage during the installation process which can reduce the ultimate tensile strength of an asphalt geosynthetic material.
Melting Point	The temperature at which the elastic modulus of the polymer/geogrid changes significantly.
Polymeric Geogrid	A polymeric geogrid made of polypropylene (PP) or polyester (PET) or polyvinyl alcohol (PVA), formed by a regular network of connected tensile elements with apertures of sufficient size to allow interlocking with surrounding to function primarily as reinforcement.
Polyester Geogrid	A flexible geogrid made of PET which has minimal memory issues when unrolled and placed onsite. A bituminous bond coat may be required to keep the geogrid in place during paving.
Polypropylene Geogrid	A stiff geogrid made of PP. If punched and drawn (extruded), it generally has memory issues when unrolled and placed onsite. The holding pins/nails may be needed in addition to the bituminous bond coat to keep the geogrid in place during paving.
Reflective Cracking	Reflection cracks which arise from underlying of the pavement, propagating through to the asphalt surface.

Term	Definition
Rigid Geogrid	A geogrid exhibiting a flexural rigidity of 1000g-cm or higher as tested via ASTM D1388. Rigid geogrids are made from punched and drawn continuous polymer sheets or welded straps of polypropylene or polyester.
Strain	The ratio of extension to the original length
Serviceability Tensile Strength/Stiffness	The tensile resistance of the geogrid to deformation developed at a specified allowable serviceability level (@ 2% strain).
Tack Coat	The bituminous bond coat which is used to bond the asphalt geosynthetic material to the existing road pavement and asphalt.
Ultimate Tensile Strength	The maximum tensile strength of the geogrid to deformation developed for a specific material when subject to tension by an external force. Tensile strength of the geogrid is the characteristic of a sample as distinct from a specimen and is expressed in force per unit width.

3 Referenced documents

Table 3 lists documents referenced in this Technical Specification.

Table 3 – Referenced documents

Reference	Title
AS 3705-2012	*Geotextile – Identification, marking and general data*
AS 3706.1-2012	*Geotextiles – Methods of test – Method 1 – General requirements, sampling, conditioning, basic physical properties and statistical analysis*
ASTM D276-00a	*Standard Test Method for Identification of Fibres in Textile*
ASTM D4355-07	*Standard Test Method for Determination of Geosynthetics by Exposure to Light, Moisture and Heat in a Xenon Arc Type Apparatus*
ASTM D6140-00	*Standard Test Method to Determine Asphalt Retention of Paving Fabrics Used in Asphalt Paving for Full-Width Applications*
ASTM D6637-11 or EN ISO 10319	*Standard Test Method for Determining Tensile Properties of Geogrids by the Single or Multi-rib Tensile Method*
EN ISO 10722:2007	*Geosynthetics. Index Test Procedure for the Evaluation of Mechanical damage under repeated loading. Damage caused by granular material*
MRTS01	*Introduction to Technical Specifications*
MRTS30	*Asphalt Pavements*
MRTS50	*Specific Quality System Requirements*

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 6 to 9.

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[1]	Test Descriptions
Bitumen retention	ASTM D6140-00	Standard Test Method to Determine Asphalt Retention of Paving Fabrics Used in Asphalt Paving for Full-Width Applications
Melting point	ASTM D276-00a	Standard Test Method for Identification of Fibres in Textile
Resistance to construction damage	EN ISO 10722:2007	Geosynthetics. Index Test Procedure for the Evaluation of Mechanical damage under repeated loading. Damage caused by granular material
Resistance to UV	ASTM D4355-07	Standard Test Method for Determination of Geosynthetics by Exposure to Light, Moisture and Heat in a Xenon Arc Type Apparatus
Ultimate tensile strength (MD/CD) Serviceability tensile strength (@ 2% strain) (MD/CD)	ASTM D6637-11 or EN ISO 10319	Standard Test Method for Determining Tensile Properties of Geogrids by the Single or Multi-rib Tensile Method

Notes:

[1] Refer to Clause 5.1 for details.

5 Quality system requirements

5.1 General

All asphalt geosynthetic materials should be manufactured under controlled conditions and should 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 MRA (Mutual Recognition Arrangements), or

c) GAI-LAP (USA).

5.2 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 5.2.

Table 5.2 – Hold Points, Witness Points and Milestones

Clause	Hold Point	Witness Point	Milestone
5.3	1. Approval of construction procedure		Supply of construction procedures (14 days)
6	2. Supply of certificate of compliance		Supply of technical data sheet and sample (14 days)
7	3. Delivery of asphalt geosynthetic material (14 days)		
8.1.1		1. Surface preparation prior to spraying bitumen or placing asphalt geosynthetic material	
8.1.2		2. Surface preparation prior to spraying bitumen or placing asphalt geosynthetic material	
8.1.3		3. Asphalt geosynthetic placement prior to asphalt paving	
8.1.6	4. Asphalt cover requirement achieved		
9.2		4. Site sampling of asphalt geosynthetic material	
9.4		5. Adhesion test verifying bonding requirements prior to asphalt paving	
9.5	5. Acceptance of delivered asphalt geosynthetic material		

5.3 Construction procedures

The Contractor shall prepare documented procedures for all construction processes in accordance with the quality system requirements of the Contract. The construction procedure described in this clause shall be submitted to the Administrator.

A construction procedure detailing all work, including content of the installation guideline of the specific chosen geogrid product described in this Technical Specification shall be prepared.

The proposed 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 material(s). **Milestone**

No works related to the placement of asphalt geosynthetic material(s) shall commence until the construction procedures have been approved by the Administrator and the Administrator has given the Contractor permission to proceed. **Hold Point 1**

5.4 Conformance requirements

The conformance requirements that apply to materials covered by this Technical Specification are given in Clauses 6 to 9.

5.5 Testing frequencies and lot sizes

The minimum testing frequencies for work covered by this Technical Specification shall be as defined in Clause 9.

6 Material

The asphalt geosynthetic material shall have high tensile modulus in relation to the material being reinforced and shall also have high continuity of tensile strength through all of the geogrid structure to absorb transient stress in all directions. The asphalt geosynthetic material shall maintain its reinforcing capabilities under repeated dynamic loads while in service and shall also be resistant to ultraviolet degradation and to damage under construction practices. More importantly, asphalt geosynthetic material shall have a high melting point characteristic as it is usually placed under hot mix asphalt layer which is paved at high temperature.

The asphalt geosynthetic material shall conform in all respects to the property requirements listed in Table 6. The values listed in Table 6 shall be met by material being supplied with a minimum value. **Milestone**

The asphalt geosynthetic material used in the Contract shall be new and not have been exposed to UV radiation (e.g. prior to or during supply). The material used in the Contract shall be completely dry when they are laid. The asphalt geosynthetic materials which are affected by water (e.g. prior to or during supply, during storage) shall not be used.

A certificate demonstrating compliance with this Technical Specification shall be provided by the Contractor to the Administrator for each asphalt geosynthetic material used, and proposed to be used, in the Contract. In addition, all test results on which the certificates are based shall not be more than a year old, measured from the date of supply to the site. **Hold Point 2**

Table 6 – Minimum property requirements of asphalt geosynthetic material

Property	Test Method	Unit	Polymeric Geogrid	Glass Fibre Geogrid	Geotextile[1]
Bitumen Retention[2]	ASTM D6140-00	L/m²	N/A	N/A	0.5 – 0.7[2]
Elongation (MD/CD)	ASTM D6637-11 or EN ISO 10319	%	≤ 16	≤ 4	N/A
Geogrid Aperture Size (MD/CD)	-	mm	30 – 50	30 – 50	N/A
Mass per unit area	AS 3706.1-2012	g/m²	N/A	N/A	80 –140
Melting Point[3]	ASTM D276-00a	°C	> 180	> 180	> 180
Resistance to construction damage	EN ISO 10722:2007	%	≥ 90	≥ 90	≥ 90
Serviceability Tensile Strength (@ 2% strain) (MD/CD)	ASTM D6637-11 or EN ISO 10319	kN/m	≥ 6	≥ 40	N/A
Ultimate Tensile Strength (MD/CD)	ASTM D6637-11 or EN ISO 10319	kN/m	≥ 20	≥ 50	N/A

Notes:

[1] The geotextile shall only be used as part of the geocomposite.

[2] Higher value beyond the limit may be considered by the Administrator provided that demonstrated evidence of performance is submitted.

[3] If the melting point of the asphalt geogrid is less than 180ºC but more than 140ºC, then the geosynthetics may be used, provided when placing asphalt, the contact temperature between the asphalt layer and the geosynthetics should be less than 170ºC.

Installation damage

The placement and compaction of the asphalt on top of an asphalt geosynthetics in the field can result in installation damage to the asphalt geosynthetic materials. This is typically reflected by a reduction of the tensile strength properties of the asphalt geosynthetic. The amount of installation damage is determined by subjecting the asphalt geosynthetic to a placement and compaction cycle, exhuming the material, and determining the tensile strength retained within the asphalt geosynthetics. The ultimate tensile strength of the uninstalled product is compared to the ultimate tensile strength of the installed product to derive at the installation damage reduction factor.

7 Packaging, delivery, storage and protection

All asphalt geosynthetic rolls delivered to the site shall comply with AS 3705-2012 for identification and marking. If the asphalt geosynthetic product proposed has difficulties with labelling/printing, the supplier is to propose a method of identification to be considered by the Administrator.

Asphalt geosynthetic material should be delivered to the site at least 14 days prior to commencement of installation. **Hold Point 3**

Store asphalt geosynthetic material under protective cover or wrapped with a waterproof, opaque UV protective sheeting to avoid any damage prior to installation. Do not store the asphalt geosynthetic material directly on the ground or in any manner in which it may be affected by heat. The method of storage must be in accordance with any other recommendations set by the manufacturer.

Some asphalt geosynthetic material have adhesive properties and these should be stored in a dust-free environment and kept dry on the job site. Likewise, these adhesive materials should not be transported or stored at temperatures greater than 80ºC.

Follow the manufacturer's recommendations regarding protection from exposure to sunlight. Asphalt geosynthetic materials should not be left directly exposed to sunlight for a period longer than the period recommended by the manufacturer.

All asphalt geosynthetics supplied under this Technical Specification shall comply:

- with a minimum UV resistance at 500 hours of at least 90% retained strength of the minimum, Ultimate Tensile Strength specified in Table 6 (or ≥ 18 kN/m for polymeric geogrid and ≥ 45 kN/m for glass fibre geogrid, when tested to ASTM D4355-07), and
- to a storage at temperature not less than – (minus) 15°C.

In addition, rolled materials may be laid flat or stood on end.

8 Construction requirements

8.1 Construction methods

8.1.1 Surface preparation

The pavement surface shall be prepared prior to asphalt geosynthetic material placement, providing a dry, even, clean surface reasonably free of dirt or other loose material. Cracks between 3 mm and 10 mm should be filled with a suitable bituminous sealant. Potholes or larger cracks need to be treated with proper backfill and compaction as per design requirements prior to placement of asphalt geosynthetic material. An asphalt regulating course may be required for certain asphalt geosynthetic products which are installed between two asphalt layers. If specified, the regulating course shall comply with MRTS30 *Asphalt Pavements*. Additional preparation as outlined in the product installation guidelines may be required. **Witness Point 1**

8.1.2 Bond coat and application

To ensure a good bond strength between the asphalt and asphalt geosynthetic material, a bituminous bond coat (generally tack coat with a 70% bitumen content) should be sprayed/applied to the pavement surface at a uniform rate as per manufacturer's installation guidelines. The spray rate is generally recommended between 0.5 and 1.2 kg/m². However, manufacturer's installation guidelines shall take precedence, and any recommended rates shall be adjusted on site as required.

In case of milled surface, additional amount of bituminous bond coat shall be applied to ensure sufficient bonding is achieved.

Prior approval from the Administrator is required, if bituminous emulsion is used in any part of the construction of the Asphalt Geosynthetics. This includes the tack coat and the bitumen sprayed during the placement of the geosynthetics. If bituminous emulsion is used, the asphalt geosynthetic material shall not be installed until the emulsion completely breaks. The actual required spray rate, breaking

rate and bonding of tack coat shall be verified and adjusted for specific site conditions using a field trial test explained in Clause 9.4.

Prior to installation of the asphalt geosynthetic material, the Administrator shall inspect the coated surface to ensure that the complete breakdown of emulsion and the requirements of bonding are achieved. The tack coat temperature shall not exceed 145ºC when the asphalt geosynthetic material is installed. **Witness Point 2**

8.1.3 Installation of asphalt geosynthetic material

To prevent de-bonding issues, the asphalt geosynthetic material shall not be installed during rainfall or when the rainfall is expected.

Before placement, assess whether the installation should require machinery or if it can be manually installed. For large pavements, a mechanical installation machine capable of handling full roll widths can be utilized for installing the asphalt geosynthetic material.

An installation plan should be considered for difficult and complicated pavement geometry. A manufacturer's representative should be present to support the initial installation of the asphalt geosynthetic material.

The asphalt geosynthetic material shall be installed in accordance with the lines and grades as shown on the plans and specifications. The asphalt geosynthetic material shall be oriented such that the roll length runs parallel to the road direction. Where practical, the asphalt geosynthetic material should be laid across the entire width of the pavement prior to paving. **Witness Point 3**

Asphalt geosynthetic material shall be laid flat and smooth directly on the prepared surface. All wrinkles and folds shall be removed. Extruded Polypropylene (PP) asphalt geogrids may contain memory while rolled and therefore requiring pins/nails to hold the geogrids in place as per design requirements.

For the asphalt geosynthetic products manufactured with self-adhesive characteristic, the products shall be installed as per manufacturer's guideline to ensure that the adhesive side is facedown. Rolling with a rubber tyred-roller is required to activate the adhesive face.

Trafficking of the asphalt geosynthetic material shall be restricted to the paving machine and delivery vehicles only. Sharp braking and turning on the asphalt geosynthetic material shall be avoided. Steel drum or other types of rollers shall not run over the installed asphalt geosynthetic material.

8.1.4 Joints and overlapping

An overlap of 100 mm to 150 mm is generally required for both longitudinal and transversal joints of polyester geogrids used as asphalt geosynthetic material. The overlapping requirements may vary depending on the product features as glass fibre geogrids require an overlap of 50 mm for longitudinal and 75 mm for transversal joints. The overlaps shall be made in the direction of asphalt paving. Due to prestress and memory issues, the polypropylene asphalt geogrids shall be connected with ties or butt jointing at the overlapping joints. Additional tack coat (≥ 30%) shall be required at the joints to provide adequate adhesion, but shall not exceed the bitumen retention rate specified in Table 6. The manufacturer's installation guidelines shall be referred to for details of joints requirements.

8.1.5 Placement of asphalt

Prior to placement of the Asphalt, the asphalt geosynthetic material shall be inspected by the Administrator, to ensure that the asphalt geosynthetic material is not damaged and is installed as per design requirements, manufacturer's installation guideline and this Technical Specification. Damaged products observed shall be removed and replaced prior to asphalt placement.

8.1.6 Minimum asphalt cover requirements

A minimum thickness of asphalt layer, laid over the asphalt geosynthetic material, shall be adhered with to provide sufficient resistance against the uplifting and premature cracking. **Hold Point 4**

In practice, the extruded polypropylene geogrids require thicker asphalt cover than the polyester geogrids. The minimum asphalt cover of 50 mm and 70 mm is generally required for polyester/ glass fibre geogrids, and polypropylene geogrids respectively. The manufacturer's product specification and installation guideline shall be referred to for details.

The asphalt shall be laid at the temperature lower than the melting point of the asphalt geosynthetic product specified in Table 6 to prevent melting of the asphalt geosynthetic materials.

8.2 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 geogrids shall be 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 manufacturer's representative prior to replacement.

9 Acceptance criteria

9.1 General

Conformance testing on the asphalt geosynthetic material delivered to the site shall be undertaken by the Contractor in accordance with the requirements of Clause 9.

The Administrator may accept test certificates, verifying compliance with Clause 6, for tests carried out, in accordance with this Technical Specification, on the asphalt geosynthetic material to be used for the specific project. In addition, Contractor's quality system shall demonstrate that the specified minimum frequency of testing has been maintained and ensuring traceability of the material.

The currency of the test certificates shall be no older than 12 months from the date of the supply to the site.

9.2 Site sampling

Where the total required batch size for the Contract is less than 3000 m², sampling and testing may not be necessary, provided that the tested minimum value for Ultimate Tensile Strength of the material supplied is higher than the requirements stated in Table 6. In addition, the asphalt geosynthetic material suppliers shall demonstrate compliance with the remainder of this Technical Specification.

On-site sampling shall be carried out in accordance with ASTM D4354 at the frequency stated in Table 9.2.

Table 9.2 – On site sampling frequency

Batch or Order Size Defined as the Lot Size	Number of Rolls to be Sampled Representing the Lot
The initial 10,000 m² or part thereof	1
Each subsequent 20,000 m² or part thereof	1

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 4**

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 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.

9.3 Testing of site samples

All of the following properties of the sampled asphalt geosynthetic material shall be tested by the Contractor:

a) Ultimate tensile strength

b) Serviceability tensile strength/stiffness (@ 2% strain)

Identification information including asphalt geosynthetic materials supplier, type, batch identification, and details of the order represented by sample, sample date and roll directional markings shall be shown on or attached to the test reports.

The following representative test results shall be calculated from the testing of a minimum number of five specimens or as specified by relevant test methods listed in Table 6:

a) ultimate tensile strength of the asphalt geosynthetic products, determined in accordance with EN ISO 10319 or ASTM D6637-11, and

b) serviceability tensile strength (@ 2% strain) of the asphalt geosynthetic material, determined in accordance with EN ISO 10319 or ASTM D6637-11.

Refer to Table 6 for minimum requirements for abovementioned compliance tests.

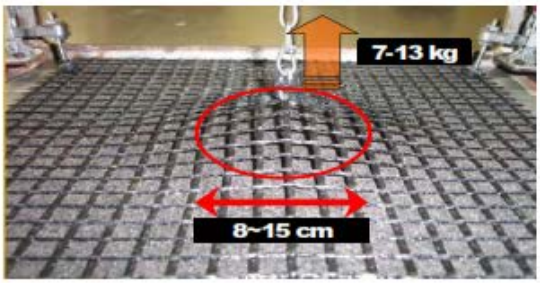
9.4 Bond strength/adhesion testing

A few alternative practical field test methods should be adopted for calibration of spray rate, breaking rate and bonding of bituminous bond coat during installation of asphalt geosynthetic material. **Witness Point 5**

A spring balance test shall be conducted on a minimum 1 m² section of the geogrids, placed on the area to be paved, to ensure that adequate adhesion is achieved. Apply sufficient pressure to fully activate the bond using installing machine or roller.

Spring balance testing

Insert the hook of a spring balance through the asphalt geosynthetic product 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 manufacturers recommendation.



For the asphalt geosynthetic product which is not self-adhesive products, two alternative control measures (indication only) are suitable in current practice. First, prior to the installation of asphalt geosynthetic material, the coated surface with full design spray rate shall have a mirror effect, which can be observed and assessed by the Administrator. After the installation of asphalt geosynthetic material, the black prints of footsteps of the installation team over the freshly installed reinforcing geogrids can be considered as good indication of sufficient bituminous bond coat to soak the geogrid.

9.5 Acceptance

A lot shall be deemed to achieve conformance, if all samples tested comply with the Technical Specification. If a lot fails to achieve conformance, the lot may be re-sampled in accordance with Clause 9.2 and retested in accordance with Clause 9.3 to verify whether the lot conforms or not. If on retesting the lot fails to achieve conformance, then the lot shall be rejected.

The asphalt geosynthetic material shall not be installed prior to the Administrator accepting the lot conforms to this Technical Specification. **Hold Point 5**

9.6 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.