

# Main Roads Technical Standards

## **MRTS27**

### **Geotextiles (Separation and Filtration)**

**June 09**

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# Geotextiles (Separation and Filtration)

## 1 INTRODUCTION

This Technical Standard describes the physical, material and construction requirements for geotextiles for use as separation and/or filtration elements in earthworks and pavement construction.

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

This Technical Standard forms part of the Main Roads Specifications and Technical Standards Manual.

## 2 DEFINITION OF TERMS

The terms used in Technical Standards are as defined in Clause 2 of MRTS01 *Introduction to Technical Standards*.

The following additional definitions apply in respect of terms used to specify the physical and mechanical properties of geotextiles –

- $C_u$  = Coefficient of Uniformity =  $D_{60}/D_{10}$  in accordance with AS 1726;
- $D_n$  = nominal particle size of material defined as the sieve through which n % by mass of the particles will pass when tested in accordance with AS 1289.3.6.1;
- EOS = equivalent opening size of the geotextile material defined as  $O_{95}$  taken to be the mean value of the test results obtained in accordance with AS 3706.1, AS 3706.7 or ISO 12956;
- G Rating = geotextile strength rating =  $(L \times h_{50})^{1/2}$ ,
- L = burst strength (N) of geotextile material determined in accordance with AS 3706.4, except that, if the strain at failure exceeds 80%, the burst strength at 80% strain shall be used;
- $h_{50}$  = is the drop cone puncture resistance (mm) of the geotextile material determined in accordance with AS 3706.5;
- $Q_{100}$  = flow rate through the geotextile material, in  $l/m^2/s$ , under 100 mm constant head conditions in accordance with AS 3706.9; and
- $\Psi$  = permittivity of the geotextile material, in  $s^{-1}$ , determined in accordance with AS 3706.9 under 100 mm constant head conditions.

## 3 REFERENCED DOCUMENTS

Table 3 lists documents referenced in this technical standard.

**Table 3 – Referenced Documents**

Reference	Title
AS 1289.3.6.1	Soil Classification Tests – Determination of the Particle Size Distribution of a Soil – Standard Method of analysis by sieving
AS 1726	Geotechnical site investigations
AS 2001.2.3.2	Methods of test for textiles – Physical tests – Determination of maximum force using the grab method (ISO 13934-2:1999, MOD)
AS 3706.1	Geotextiles – Methods of test – General requirements, sampling, conditioning, basic physical properties and statistical analysis
AS 3706.3	Geotextiles – Methods of test – Determination of tearing strength – Trapezoidal method
AS 3706.4	Geotextiles – Methods of test – Determination of burst strength – California bearing ratio (CBR) – Plunger method
AS 3706.5	Geotextiles – Methods of test – Determination of puncture resistance – Drop cone method

Reference	Title
AS 3706.7	Geotextiles – Methods of test – Determination of pore-size distribution – Dry-sieving method
AS 3706.9	Geotextiles – Methods of test – Determination of permittivity, permeability and flow rate
AS 3706.11	Geotextiles – Methods of test – Determination of durability – Resistance to degradation by light, heat and moisture
AS 3706.12	Geotextiles – Methods of test – Determination of durability – Resistance to degradation by hydrocarbons or chemical reagents
AS 3706.13	Geotextiles – Methods of test – Determination of durability – Resistance to certain microbiological agents
ISO 12956	Geotextiles and geotextile-related products – Determination of the characteristic opening size

#### **4 STANDARD TEST METHODS**

The standard test methods given in Table 4 will be used in this Technical Standard.

Further details of test numbers and test descriptions are given in Clause 4 of MRTS01 *Introduction to Technical Standards*.

**Table 4 – Standard Test Methods**

Property to be Tested	Method No.
<b>SOIL / FILL / STONE</b>	
Sample preparation	Q101
Particle size distribution	Q103A and/or Q103C
<b>GEOTEXTILE</b>	
Sample preparation	AS 3706.1
Mean weight	AS 3706.1
Grab strength	AS 2001.2.3.2
Tearing strength	AS 3706.3
Burst strength	AS 3706.4
Drop cone puncture resistance	AS 3706.5
EOS	AS 3706.7
Flow rate and permittivity	AS 3706.9
Resistance to degradation by light, heat and moisture	AS 3706.11
Resistance to degradation by hydrocarbons or chemical reagents	AS 3706.12
Resistance to certain microbiological agents	AS 3706.13

#### **5 QUALITY SYSTEM REQUIREMENTS**

##### **5.1 Hold Points and Witness Points**

General requirements for Hold Points and Witness Points are specified in Clause 5.2 of MRTS01 *Introduction to Technical Standards*. There are no Milestones defined.

The Hold Points and Witness Points applicable to this standard are summarised in Table 5.1.

**Table 5.1 – Hold Points and Witness Points**

Clause	Hold Point	Witness Point
8.1	1. Ordering geotextile	
10.2		Site sampling of geotextile
10.4	2. Compliance of delivered geotextile	

## 5.2 Construction Procedures

The Contractor shall prepare documented procedures for all construction processes as defined in Clause 5 of MRTS50 *Specific Quality System Requirements*.

## 6 MATERIAL REQUIREMENTS

### 6.1 General

The fibres of the geotextile and thread used in joining lengths shall consist of long chain synthetic polymers composed of at least 95% by mass of polyolefins or polyesters.

The geotextile filaments shall be rot-proof, chemically stable and shall have low water absorbency. Filaments shall resist delamination and maintain their relative dimensional stability in the geotextile.

Non-woven geotextiles shall have filaments bonded by needle punching, heat or chemical bonding processes.

Woven geotextiles shall have filaments interlaced in two sets, mutually at right angles. One set shall be parallel to the longitudinal direction of the geotextile.

Geotextiles shall be free of any flaws which may have an adverse effect on the physical and mechanical properties of the geotextile.

Geotextiles shall be stabilised against ultraviolet radiation such that when tested in accordance with AS 3706.11 they shall have retained strength of at least 50% after 672 hours of test exposure. A certificate not more than 1 year old shall be provided by the manufacturer.

### 6.2 Geotextile Strength Classes

Geotextiles, where required for separation and/or filtration, are referenced by a Strength Class which shall meet the requirements of Table 6.2.

**Table 6.2 – Geotextile Strength Class Requirements**

Strength Class	Elongation (Note 1)	Grab Strength (N)	Tear Strength (N)	G Rating
A	≥ 30%	500	180	900
	< 30%	800	300	1350
B	≥ 30%	700	250	1350
	< 30%	1100	400	2000
C	≥ 30%	900	350	2000
	< 30%	1400	500	3000
D	≥ 30%	1200	450	3000
	< 30%	1900	700	4500
E	≥ 30%	1600	650	4500

Notes –

1. Elongation to differentiate woven from non-woven geotextiles shall be the % CBR elongation at puncture corresponding to maximum puncture strength determined in accordance with AS 3706.4. In general, woven geotextiles will puncture at elongations less than 30% and non-woven geotextiles will puncture at elongations equal to or greater than 30%.

### 6.3 Geotextile Filtration Classes

Geotextiles, where required for separation and/or filtration, are referenced by a Filtration Class which shall meet the requirements of Table 6.3.

Slit film woven type geotextile is not permitted for Filtration Classes I, II, III, IV, V and VI.

**Table 6.3 – Geotextile Filtration Class Requirements**

Filtration Class	Flow Rate $Q_{100}$ (l/m <sup>2</sup> /s) (Note 1)	Permittivity $\Psi$ (s <sup>-1</sup> ) (Note 1)	EOS (mm) (Notes 1 & 2)
Class I	≥ 50	≥ 0.5	≤ 0.12
Class II	≥ 50	≥ 0.5	≤ 0.25
Class III	≥ 30	≥ 0.3	≤ 0.12
Class IV	≥ 20	≥ 0.2	≤ 0.25
Class V	≥ 10	≥ 0.1	≤ 0.12
Class VI	≥ 10	≥ 0.1	≤ 0.25
Class VII	≥ 5	≥ 0.05	≤ 0.30
Class VIII	≥ 5	≥ 0.05	≤ 0.60

Notes –

1. Additional technical advice on EOS,  $Q_{100}$  and  $\Psi$  is required where water flow may undergo reverse flow characteristics.
2. Additional technical advice on EOS is required for highly dispersive clay soils, gap graded soils, fine silt soils or artificially derived soils such as fly ash. Combined soil/geotextile testing may be required and additional granular filters may be appropriate.

### 6.4 Application Categories

#### 6.4.1 Geotextiles Used Under or Within Embankments

Geotextiles used as filter / separation layers under / within embankments may be a woven or a non-woven type, except that, where the geotextiles are used under rockfill embankments or placed over rockfill or other uneven surfaces (e.g. broken mangrove stumps and roots), they shall have an elongation greater than 30%.

#### 6.4.2 Strength

Where a Strength Class is specified in the documentation for a specific installation, a geotextile with a Strength Class at least equal to that stated shall be used. Nevertheless, the strength requirements for the specific application shall also be checked and the geotextile shall also comply with the following requirements.

Where the height of drop of the fill is less than 1.5 m, the strength class shall, as a minimum, meet the requirements given in Table 6.4.2-A. Where the height of drop of the fill is greater than 1.5 m, specialist advice is required.

Where a Strength Class is not specified in the documentation for a specific installation, a geotextile complying with the above requirements shall be selected and used.

Table 6.4.2-A – Geotextile Application Categories

Application	Strength Class Requirements (Notes 1 and 2)	Filtration Class Requirements	
		D <sub>15</sub> ≤ 0.075 mm (Cohesive soils)	D <sub>15</sub> > 0.075 mm (Granular soils)
<p><b>Separation under/within embankments (unsaturated conditions)</b>                      To prevent mixing of dissimilar soil types during construction for unsaturated soils where CBR &gt; 3</p>	Strength Class stated in Table 6.4.2-B for CBR > 3 and the D <sub>85</sub> of the fill	VII	VIII
<p><b>Working platform/bridging layer applications</b>                      To prevent mixing of dissimilar soil types in saturated conditions in working platform /bridging layer applications for soils where CBR ≤ 3 and where filtration is not a critical function</p>	Strength Class stated in Table 6.4.2-B for CBR ≤ 3 and the D <sub>85</sub> of the fill	VI	IV
<p><b>Drainage and separation behind retaining structures including rock filled mattresses and joints of pipes and arches</b>                      To provide the combined functions of separation and filtration</p>	Strength Class stated in Table 6.4.2-D for the specific type of structure	III	II
<p><b>Under rock armour revetment layer in embankments</b>                      For cushioning layer requirements to minimise damage to geotextile due to excess drop height refer to Note 3 in Table 6.4.2-B</p>	Strength Class stated in Table 6.4.2-B	III	II

Application	Strength Class Requirements (Notes 1 and 2)	$D_{50} \leq 0.075$ mm (Predominantly silt and clay soils)	$D_{50} > 0.075$ mm and $D_{15} \leq 0.075$ mm (Predominantly granular soils with low permeability)	$D_{15} \leq 0.075$ mm (Predominantly pervious granular soils)
<b>Separation under/within embankments (saturated conditions)</b> To prevent mixing of dissimilar soil types in saturated conditions for soils where $CBR \leq 3$	Strength Class stated in Table 6.4.2-B for $CBR \leq 3$ and the $D_{85}$ of the fill	V	IV	II
<b>Drains</b> Trench drains, edge drains, drainage blankets, counterfort and cut-off drains	Strength Class stated in Table 6.4.2-C for the specific trench depth and the $D_{85}$ of the fill	V	IV	II

Notes –

1. Requirements for strength class for installation damage protection are based on a 1.5 metre drop height of material for the corresponding maximum nominal stone size.

Geotextile Strength Class to ensure survivability for the given application. Geotextile survivability refers to the ability of the geotextile to withstand the installation stresses during construction. It is related to construction method, subgrade condition, backfill material including stone size and other factors.

**Table 6.4.2-B – Selection of Strength Class for Mechanical Separation of Soil Layers including Drainage Blankets**

$D_{85}$ of Material (mm) (Note 1)	Strength Class	
	$CBR \leq 3$ (Note 2)	$CBR > 3$ (Note 2)
$\leq 37.5$	C	A
$\leq 75$	C	B
$\leq 200$	D	C
$\leq 400$ (Note 3)	E	D
$\leq 600$ (Note 3)	E	E

Notes –

1. Applies to the layer to be placed over geotextile.
2. Applies to the material on which the geotextile is placed.
3. For cushioning purposes a minimum thickness of 150 mm of material with a  $D_{85} < 75$  mm shall be used for the initial lift to protect the geotextile.

**Table 6.4.2-C – Selection of Strength Class for Trench Drain Applications**

D85 of Material (mm) (Note 1)	Strength Class	
	Trench Depth < 2 metres	Trench Depth < 3 metres
≤ 37.5	A	B
≤ 75	B	C
≤ 200	C	D

Notes –

1. Applies to layer to be placed over geotextile.

**Table 6.4.2-D – Selection of Strength Class for Drainage and Separation behind Retaining Structures including Rock Filled Mattresses and Joints of Pipes and Arches**

Type of Structure	Strength Class
Concrete retaining walls Segmental block walls Reinforced soil concrete panel walls	B
Gabion walls Crib walls Rock filled mattresses	C

### 6.4.3 Filtration

Where a Filtration Class is specified in the documentation for a specific installation, a geotextile with a Filtration Class at least equal to that specified shall be used. Nevertheless, the filtration requirements for the specific application shall be checked and the geotextile shall also comply with the following requirements.

Where water flow is predominantly unidirectional and  $C_u$  of the insitu material is greater than 3, the filtration class requirements of Table 6.4.2-A shall be used. Where water flow may undergo reverse flow characteristics, specialist advice is required. Additional technical advice on EOS requirements is required for the following soil types: highly dispersive clay soils, gap graded soils, fine silt soils and artificially derived soils such as flyash. Combined soil/geotextile testing may be required and additional granular filters may be appropriate. Special consideration is required for  $C_u$  of the insitu material less than 3.

Where a Filtration Class is not specified in the documentation for a specific installation, a geotextile complying with the above requirements shall be selected and used.

## 7 STORAGE, PACKAGING AND IDENTIFICATION

Geotextiles shall be stored under protective cover or wrapped with a waterproof, opaque UV protective sheeting to avoid any damage prior to installation.

Geotextiles shall not be stored directly on the ground or in any manner in which they may be affected by heat. The method of storage shall be in accordance with any other recommendations set by the manufacturer.

The protected geotextile rolls shall be clearly labelled showing manufacturer, type of geotextile and batch number identification number.

## 8 DELIVERY & PRODUCT COMPLIANCE

### 8.1 Ordering

Prior to ordering geotextile, the Contractor shall submit to the Administrator documentation which demonstrates that the design of the geotextile is in accordance with Clause 6. The Contractor shall not order material prior to acceptance of the design by the Administrator **Hold Point 1**.

## **8.2 Delivery**

With each batch of geotextile delivered to the Site, quality records shall include a certificate of compliance that the geotextile complies with all the requirements of this standard for its specified usage, together with test results reported on NATA endorsed test documents. The certificate shall not be more than twelve months old.

To allow time for on-site sampling and testing (as per Clause 9), geotextile shall be delivered to the Site at least 14 days prior to commencement of installation.

## **9 CONSTRUCTION REQUIREMENTS**

### **9.1 General**

Geotextiles shall be installed as specified in the Contract.

The area on which the geotextile is to be placed shall be prepared by clearing and grading and all sharp objects and large stones shall be removed. Cut trees and shrubs shall not protrude above the ground surface. The top soil and vegetation mat may remain unless otherwise specified.

Where necessary, localised excavations shall be carried out to permit installation of geotextiles.

Geotextiles shall be placed just ahead of associated advancing construction work. Geotextiles so placed shall be covered by relevant construction materials or suitable protective sheeting within 48 hours of being placed.

Geotextiles used in trenches shall be placed so as to conform loosely to the shape of the trenches.

Any punctures in the geotextiles shall be repaired to the satisfaction of the Administrator.

### **9.2 Initial Layer Thickness Requirements for Separation Applications**

The initial uncompacted layer thickness for fill material placed directly over the geotextile shall be not less than 200 mm or twice the  $D_{85}$  of the fill material, whichever is greater.

### **9.3 Jointing and Overlap Requirements**

Joints in geotextiles shall be made by overlapping, sewing, or other methods recommended by the manufacturer. Sewing, where carried out shall have seam strengths, as measured in accordance with AS 2001.2.3.2, equal or greater than 100% of the specified grab strength. Flat or "prayer" seams, J or Double J type or "butterfly" seams are permitted with a minimum number of two parallel rows of stitching required. If the amount of overlap is not specified, it shall be a minimum of 500 mm. Sewing shall be carried out using a suitable portable industrial sewing machine and a suitable durable polyester or polyester/cotton blend sewing thread, the thread to have minimum breaking load of 20 kg.

Where geotextiles are used to line subsoil drainage trenches, the textiles shall fully envelop the drainage material in the trench and be folded over that material with a minimum 300 mm overlap at the top of the trench.

### **9.4 Filling Over Installed Geotextile**

No construction equipment shall stand or travel directly on the laid geotextile. The initial layer of cover material shall be placed over the geotextile prior to construction equipment travelling over the area concerned.

Rock armour placed directly on geotextile shall be placed with a drop height not exceeding 1.5 metres.

Vibratory and heavy compaction plant shall not be used in the initial lifts of filling materials to avoid damage to geotextiles.

The procedure for filling over subsoil drainage trenches shall be such as to ensure that the 300 mm overlap at the top of the trench remains intact.

## **10 ACCEPTANCE CRITERIA**

### **10.1 General**

Conformance testing on geotextile delivered to the project shall be carried out as specified in Clause 10.

The Administrator may accept test certificates for tests carried out for other projects in accordance with this clause that verify compliance with Clause 10, provided that the Contractor's quality system ensures the specified minimum frequency of testing is maintained and ensures traceability of material to the same manufacturing batch.

### 10.2 Site Sampling

Where the total required batch size is less than 5,000 m<sup>2</sup>, sampling and testing need not be undertaken, provided that the nominal strength of the material supplied is 20% higher than the Strength Class requirements and the nominal filtration properties are 20% lower than the Filtration Class requirements.

On-site sampling shall be carried out at the frequency specified in Table 10.2. Control testing shall be carried out for each batch of geotextile in accordance with the provisions of Table 10.2.

**Table 10.2 – Sampling Frequency and Testing Requirements**

Batch or Order Size Defined as the Lot Size (m <sup>2</sup> )	Number of Rolls to be Sampled Representing the Lot	Testing by the Contractor
Initial 10,000 or part thereof	1	Grab strength, Tearing strength, Burst strength, Drop cone puncture resistance, EOS, Flow rate and permittivity
Each subsequent 20,000 or part thereof	1	

A representative sample covering approximately 15 m<sup>2</sup> of geotextile shall be cut from each sampled roll but not within 2 metres of the start or end of the roll. Where directed by the Administrator, samples shall also be cut and supplied to the Administrator **Witness Point**.

Each sample shall be clearly marked with a large arrow showing the longitudinal direction of the geotextile. This is termed the warp direction for woven geotextiles. The directional marking is required to identify strength tests in both longitudinal and transverse directions. This applies to both woven and non-woven geotextiles.

### 10.3 Testing of Site Samples

The sampled geotextile shall be tested by the Contractor for the range of properties specified in Table 6.2 and Table 6.3. The mean weight of the geotextile shall also be determined.

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

A minimum of 10 specimens from each sample shall be tested for each property.

The characteristic value shall be calculated in accordance Clause 13 of MRTS01 *Introduction to Technical Standards* except that for grab strength and tearing strength the acceptance constant k shall be taken as 0.83.

The characteristic value of the grab strength, as determined in accordance with AS 2001.2.3.2 Method B, and tearing strength, as determined in accordance with AS 3706.3, shall be calculated from the results of tests carried out on a minimum of 10 test specimens cut from the longitudinal direction and 10 specimens cut from the transverse direction of the sampled roll of geotextile. The characteristic value of the grab strength and tearing strength in the weaker direction shall be used to assess conformance of the lot.

The characteristic values of the burst strength (L) and the drop cone puncture resistance (h50) shall be used in the calculation of the G Rating.

### 10.4 Acceptance

For conformance with the relevant Strength Class, the characteristic value of the grab strength and tearing strength and the calculated G rating shall be greater than or equal to the relevant limits specified in Table 6.2.

For conformance with the relevant Filtration Class, the characteristic value of the flow rate and permittivity shall be greater than or equal to the relevant limits specified in Table 6.3 and the mean value of the EOS shall be less than or equal to the relevant limits specified in Table 6.3.

A lot shall be deemed to achieve conformance if all rolls tested conform with the specified limits. If a lot fails to achieve conformance, the lot may be re-sampled as specified in Clause 10.2 and retested to verify conformance. If on retesting, the lot fails to achieve conformance then the lot shall be rejected.

Geotextile shall not be placed prior to acceptance of the test results by the Administrator. **Hold Point 2.**

### **10.5 Audit Testing**

The Administrator may select samples from the Site for audit testing. The Administrator shall advise the Contractor who may be present and who may select additional samples when samples for audit testing are taken.

## **11 TESTING REQUIREMENTS FOR SOIL AND STONE**

Testing of the in situ soil material and/or imported fill or filter material to determine the material properties necessary to choose a geotextile for a specific application, shall be carried out in accordance with the Test Methods Q101, Q103A and/or Q103C.

The minimum testing frequency for testing of such material shall be 2 tests per 5,000 m<sup>3</sup>.