

TNZ F/7: 2003

SPECIFICATION FOR GEOTEXTILES

1. SCOPE

This specification sets out the material and construction requirements for geotextiles for use as separation and/or filtration applications in highway earthworks and pavements.

2. REFERENCED DOCUMENTS

A list of documents referred to in this specification is given in Appendix A.

3. DEFINITIONS

For the purpose of this specification, the definitions below apply:

EOS	= Equivalent Opening Size defined as O_{95} taken to be the mean value of the test results in accordance with AS 3706.7.
ψ	= Permittivity (sec^{-1}) determined in accordance with AS 3706.9.
Q_{100}	= Flow rate under 100mm constant head conditions determined in accordance with AS 3706.9.
D_{85}	= Nominal Maximum Soil Particle Size defined as the sieve through which 85% by mass of the soil being sieved will pass when tested in accordance with NZS 4402:1986, Test 2.8.1.
G	= Geotextile strength rating determined by $(L \times h_{50c})^{1/2}$ based on the characteristic values of the Lot.
L	= Characteristic value of the geotextile CBR plunger failure load determined in accordance with AS 3706:4. If the strain at failure exceeds 80% then the characteristic CBR load L_{80} at 80% strain is used in the calculation of G.
h_{50c}	= Characteristic value of the geotextiles' puncture resistance determined by the Drop Cone Method in accordance with AS 3706.5.
Batch	= A number of rolls of geotextile of the same grade that were manufactured in one continuous production run.

Slit film	= A filament produced by extruding a thermoplastic polymer filament in the form of a sheet or film, slitting the film into tapes and hot-stretching to induce molecular orientation and hence high longitudinal strength. (AS 3704).
Woven fabric	= A planar structure produced by interlacing two or more sets of yarns, fibres, rovings, or filaments where the elements pass each other essentially at right angles and one set of elements is parallel to the fabric axis. (AS 3704).
Non woven fabric	= A planar structure produced with filaments bonded by needle punching, heat or chemical bonding processes.
Lot	= Each initial 10,000 square metres of geotextile or part thereof and each subsequent 20,000 square metres from the same Batch.

4. QUALITY SYSTEM REQUIREMENTS

The contractors Quality Plan shall demonstrate that the geotextile, and the construction using the geotextiles, meet the requirements of this specification. The Quality Plan shall include periodic verification of process and product conformance during geotextile production and include Product Certification.

5. MATERIAL REQUIREMENTS

5.1 General

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

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 shall have retained strength of at least 50% after 672 hours of test exposure.

5.2 Geotextile Filtration Class Requirements

Geotextiles shall meet the relevant filtration requirements of Table 1.

Slit film woven type geotextile is not permitted for Filtration Classes 1, 2 and 3.

Table 1: Geotextile Filtration Class Requirements

Filtration Class	Flow Rate and Permittivity Q_{100} (l/m ² /s) ψ (s ⁻¹) (Note b)	EOS Requirements for Cohesive Soils (Note a)	EOS Requirements for Granular Soils (Note a, b)
Class 1	$Q_{100} \geq 50$ $\psi \geq 0.5$	$\leq 180\mu\text{m}$	$\leq 250\mu\text{m}$
Class 2	$Q_{100} \geq 30$ $\psi \geq 0.3$	$\leq 180\mu\text{m}$	$\leq 250\mu\text{m}$
Class 3	$Q_{100} \geq 50$ $\psi \geq 0.5$	$\leq 180\mu\text{m}$	$\leq 200\mu\text{m}$
Class 4	$Q_{100} \geq 10$ $\psi \geq 0.1$	$\leq 300\mu\text{m}$	$\leq 600\mu\text{m}$

Notes Accompanying Table 1:

- (a) Flow rate (Q_{100}) under a 100mm constant head and permittivity (ψ) determined in accordance with AS 3706.9.
- (b) Equivalent opening size (EOS) defined as O_{95} taken to be the mean value of the test results in accordance with AS 3706.7.

5.3 Geotextile Strength Class Requirements

Geotextiles for the applications of separation and/or filtration shall meet the relevant requirements of Table 2.

Table 2: Geotextile Strength Class Requirements

Geotextile Strength Class	Elongation (note d)	Grab Strength (N) (note a)	Tear (N) (note b)	G Rating (note c)
A	$\geq 30\%$	500	180	900
	$< 30\%$	800	300	1350
B	$\geq 30\%$	700	250	1350
	$< 30\%$	1100	400	2000
C	$\geq 30\%$	900	350	2000
	$< 30\%$	1400	500	3000
D	$\geq 30\%$	1200	450	3000
	$< 30\%$	1900	700	4500
E	$\geq 30\%$	1600	650	4500

Notes accompanying Table 2:

- (a) Grab strength shall be the characteristic value of grab strength for the Lot tested (i.e. mean grab strength – 0.83 x standard deviation) in accordance with Clause 9.1 of this specification. Mean grab strength and the

corresponding standard deviation shall be determined in accordance with AS 2001.2.3 Method B. For anisotropic geotextiles, the characteristic grab strength in the weaker direction shall be used. Ten test specimens from each direction are required to be tested to determine the characteristic grab strength. (Refer to Part 9 of this specification.)

- (b) Characteristic value of tearing strength for the Lot tested (i.e. mean tear strength – 0.83 x standard deviation) determined in accordance with AS 3706.3 and Clause 9.1 of this specification. For anisotropic geotextiles, the characteristic tearing strength in the weaker direction shall be used. Ten test specimens from each direction are required to be tested to determine the characteristic tear strength. (Refer to Part 9 of this specification.)
- (c) $G = \text{Geotextile Strength Rating determined to be } (L \times h_{50c})^{1/2}$ based on the characteristic values of the Lot. A minimum of ten test specimens is required to determine the characteristic CBR and h_{50} values. (Refer to Clause 9.1 of this specification). L is the characteristic value of CBR plunger failure load N for the Lot tested determined in accordance with AS 3706.4. (i.e. mean CBR plunger failure load N – 0.83 x standard deviation.) If the strain at failure exceeds 80% then the characteristic CBR load L_{80} at 80% strain shall be used in the calculation of G . h_{50c} is the characteristic value of h_{50} for the Lot (i.e. mean h_{50} – 0.83 x standard deviation), h_{50} shall be determined in accordance with AS 3706.5 (revised 1994).
- (d) The percent elongation corresponding to the maximum CBR burst strength determined in accordance with AS3706.4.

6. STORAGE, PACKAGING AND IDENTIFICATION

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

7. DELIVERY AND PRODUCT COMPLIANCE

Prior to, or with the delivery of the geotextile to site the Contractor shall provide a Certificate of Compliance certifying that the geotextile complies with all the requirements of this specification, together with IANZ endorsed, or equivalent, test documents. The Certificate of Compliance shall not be more than twelve months old.

Control testing shall have been carried out for each batch of geotextile to be delivered to site. This control testing shall be in accordance with the Contractors

quality systems and shall include the mean weight of the geotextile determined in accordance with AS3706.1, for the consignment to be delivered.

The geotextile shall be delivered to site at least 14 days prior to commencement of installation of the geotextile, unless in-warehouse sampling of the geotextile will be undertaken in accordance with Section 9.2,. The contractor shall provide the Engineer with the Certificate of Compliance and related test documents at least 14 days prior to commencement of installation of the geotextile.

8. CONSTRUCTION REQUIREMENTS

8.1 General

Geotextiles shall be installed as specified in the Drawings or Plans.

The site shall be prepared by clearing and grading the area required. All sharp objects and large stones shall be removed. Cut trees and shrubs shall be flush with the ground surface. The topsoil and vegetation mat may remain unless otherwise specified.

Geotextiles shall be placed just ahead of associated advancing construction work and be covered by relevant construction materials or suitable protective sheeting within 48 hours of being placed and without punctures or tears.

Geotextiles used in trench drains shall be placed so as to conform loosely to the shape of the trenches. The geotextile shall fully envelope the drainage material in the trench.

8.2 Initial Layer Thickness Requirements for Separation Applications

The minimum required initial layer thickness for fill material placed directly over the geotextile shall meet the following requirements:

Table 3: Minimum Initial Layer Thickness

	Minimum Initial Layer Thickness (mm)
< 150	The larger of 3 times maximum fill particle size or 200mm
150 to 225	450mm
225 to 400	Two times maximum fill particle size

8.3 Jointing

Jointing of geotextiles shall be by overlap or by sewing.

Unless otherwise specified the minimum overlap shall be 500mm. Where the geotextile is used for drainage blankets the encapsulated overlap shall be one metre unless otherwise specified.

As an alternative to overlapping, sewing of the joints is permitted. Sewing of the joints shall comply with:

- Seam type: J - seam or Double -J- seam
- Stitch type: Lock stitch. One or two lines of lock stitching to suit the application and site conditions.
- Thread type: Polyester thread 300 tex (minimum)

Other types of jointing are not permitted.

8.4 Filling Over Installed Geotextile

No construction equipment shall stand or travel directly on the laid geotextile without the Engineer's approval. A minimum cover of 200mm (uncompacted) of cover material shall be placed over the geotextile prior to construction equipment travelling over the area concerned.

Rock armour placed directly on geotextile must be placed with a drop height of less than 1.5m and placed in such a manner so as not to damage, puncture or tear the geotextile or compromise jointing.

The mechanical equipment used by the contractor shall be selected and operated so as not to result in rupture of the geotextile. Unless otherwise approved in writing by the Engineer vibratory and heavy compaction plant shall not be used on the initial lifts of filling materials to avoid damage to geotextiles.

9. ACCEPTANCE CRITERIA

9.1 Statistical Techniques

Statistical techniques shall be used as the basis for compliance with strength requirements. This procedure shall be based on the characteristic value of attribute Q for the Lot as defined in Appendix B to this Specification. The definition of a Lot together with sampling and testing requirements in respect of geotextiles is given in Clause 9.2 of this specification.

A Lot achieves conformance if Q is equal to or greater than the specified lower limit for the characteristic value of the attribute. For geotextile conformance for the relevant strength class, the attribute Q in terms of grab strength, tear strength and G Rating, shall be greater than or equal to the relevant specified limits in Table 1 of this Specification.

If Q is less than the specified lower limit for the characteristic value, the Lot being examined shall be resampled and retested to verify conformance. If, on retesting, Q is less than the specified value given in Table 1, then the Lot represented by the sample roll shall be rejected.

9.2 Site Sampling and Testing

Conformance testing on geotextiles delivered on-site shall be arranged by the Contractor for the range of tests specified in Tables 1 and 2 of this Specification. Testing shall include the mean weight of the geotextile determined in accordance with AS 3706.1.

The Engineer shall be given the option of being present during on-site sampling.

If the geotextile supplier operates a certified quality assurance system which meets or exceeds the requirements of TNZ TQS1, then the sampling may be from the supplier's New Zealand warehouse, instead of on-site. The quality assurance system shall ensure traceability of roll numbers to production Batches and to site deliveries. The Engineer or his representative shall be present during this sampling.

The on-site or in-warehouse sampling scheme shall be in accordance with the following requirements:

Order Size (sq metres) Defined as the Lot Size	Number of Rolls to be Sampled Representing that Lot
Initial 10,000 or part thereof	1
Each subsequent 20,000 (maximum)	1

Even if conformance testing has been conducted on geotextile sampled in-warehouse, the Engineer or his representative may request additional on-site sampling and conformance testing. If there is a disagreement in test results between the in-warehouse samples and the on-site samples, the results of the on-site samples shall take precedence.

Where site specific design has been undertaken, the Engineer may specify additional test methods to be undertaken and/or increase the frequency of testing.

The Lot characteristic grab and tear strength using AS 2001.2.3 and AS 3706.3 respectively shall be determined using 10 test specimens cut from the longitudinal direction and 10 specimens cut from the transverse direction of the sampled roll of geotextile. The Lot characteristic strength in the weaker direction shall be used to assess Lot conformance.

In the determination of CBR Burst Strength (AS 3706.4) and Drop Cone Puncture Resistance (AS 3706.5) a minimum of 10 test specimens is required for each test to assess Lot conformance. The test specimens shall be conditioned prior to test in accordance with AS 3706.1 using atmospheric conditioning in either a standard or a non-standard atmosphere.

On projects requiring less than 2500 sq metres of Geotextile the testing requirements may be relaxed. The Engineer may accept test certificates, demonstrating compliance with TNZ F/7, carried out for other projects. The contractors and suppliers quality system must ensure the specified minimum frequency of testing is maintained and ensures traceability of material to the

same Batch. In making this decision the Engineer will give due consideration to the risks of non compliance, the level of supporting data provided by the manufacturer and the condition of the geotextile delivered to site.

A representative sample covering approximately 15m² of geotextile (e.g. 3m by 5m) shall be cut from each sampled roll and not within 2m of the start or end of the roll. Where directed, samples shall also be cut and supplied to the Engineer.

Each sample must be clearly marked (e.g. large arrow) with the longitudinal direction of the geotextile. This is termed the warp direction if woven geotextiles are supplied.

The directional marking is required to identify strength tests in both longitudinal and transverse directions. This applies to both woven and non woven geotextiles.

The sampled geotextile shall be submitted for conformance testing to a laboratory that is IANZ accredited, or equivalent, for the range of tests given in Table 1 and Table 2. Associated documentation such as geotextile supplier, geotextile type, batch identification, order represented by sample, sample date, roll directional markings shall be supplied to the testing agency for their information and shown on or attached to the test reports. The location, date and time of sampling and the name of the person who sampled shall be supplied to the testing agency for their information and shown on or attached to the test reports.

Prior to the use of the geotextile in construction, the test results referred to in Clause 9.2 shall be supplied to the Engineer. The Engineer will consider the submitted test documents for materials compliance with the specification and may inspect the geotextile.

The geotextile shall not be used in construction until the Engineer gives approval in writing.

APPENDIX A

LIST OF REFERENCE DOCUMENTS

Australian Standards

- AS 2001.2.3 Physical Tests – Determination of Breaking Force and Extension of Textile Fabrics (Method B).
- AS 2001.2.4 Physical Tests – Determination of Bursting Pressure of Textile Fabrics – Hydraulic Diaphragm Method (Method A).
- AS 3704 Geotextiles – Glossary of Terms. 1990
- AS 3706.1 General Requirements, Sampling, Conditioning, Basic Physical Properties and Statistical Analysis. 1990.
- AS 3706.3 Determination of Tearing Strength – Trapezoidal Method. 2000.
- AS 3706.4 Determination of Burst Strength – California Bearing Ratio (CBR) Plunger Method. 1990.
- AS 3706.5 Determination of Puncture Resistance – Drop Cone Method. 2000.
- AS 3706.7 Determination of Pore Size Distribution – Dry Sieving Method. 1990.
- AS 3706.9 Determination of Permittivity. 2001.
- AS 3706.11 Determination of Durability – Resistance to Degradation by Light and Heat. 1990.

Australian/New Zealand Standards

- AS/NZS ISO 9002 Quality Systems – Model for Quality Assurance in production, installation and servicing. 1994.

New Zealand Standards

- NZS 4402 Methods of Testing Soils for Civil Engineering Purposes. 1986.

ASTM Test Methods

- ASTM D5261-96 Test method for measuring Mass per Unit Area of Geotextile.

TNZ Specifications and Standards

- TNZ Q/3 Normal QA Level Contracts. (1995).
- TNZ Q/4 High QA Level Contracts. (1995).
- TNZ TQS1 Transit New Zealand Quality Standard. 1995.
- TNZ TQS2 Transit New Zealand Quality Standard. 1995.

APPENDIX B

STATISTICAL CALCULATION FOR LOT CONFORMANCE

The calculation of the characteristic value of attribute (Q) for the Lot shall be as follows:

$$Q = x_m - ks$$

where x_m = arithmetic mean of attribute test results for all sub-Lots

s = standard deviation of sub-Lot attribute test results

$$= \sqrt{\frac{\sum_{i=1}^n (x_i - x_m)^2}{n-1}}$$

k = acceptance constant of 0.83 for a sample size of 10 tests of geotextile taken from the sampled roll representing Lot. (This value of k is based on 10% producers risk.)

n = 10 (i.e. number of specimens cut from the sampled roll and tested)

SCHEDULE A

SPECIFIC CONTRACT REQUIREMENTS FOR GEOTEXTILES

1. Strength Class Requirement for Geotextile	Class A / B / C / D / E Delete those not applicable
2. Soil type for Filtration Class	Cohesive / Non Cohesive Delete that not applicable
3. Filtration Class requirement for Geotextile	
<p>4. Specific Geotextile Requirements Where a standard filtration class is not applicable. The geotextile shall have:</p> <ul style="list-style-type: none"> • Flow rate Q_{100} greater than • Permittivity ψ greater than • EOS less than 	<p style="text-align: right;">$l/m^2/sec$</p> <p style="text-align: right;">sec^{-1}</p> <p style="text-align: right;">μm</p>