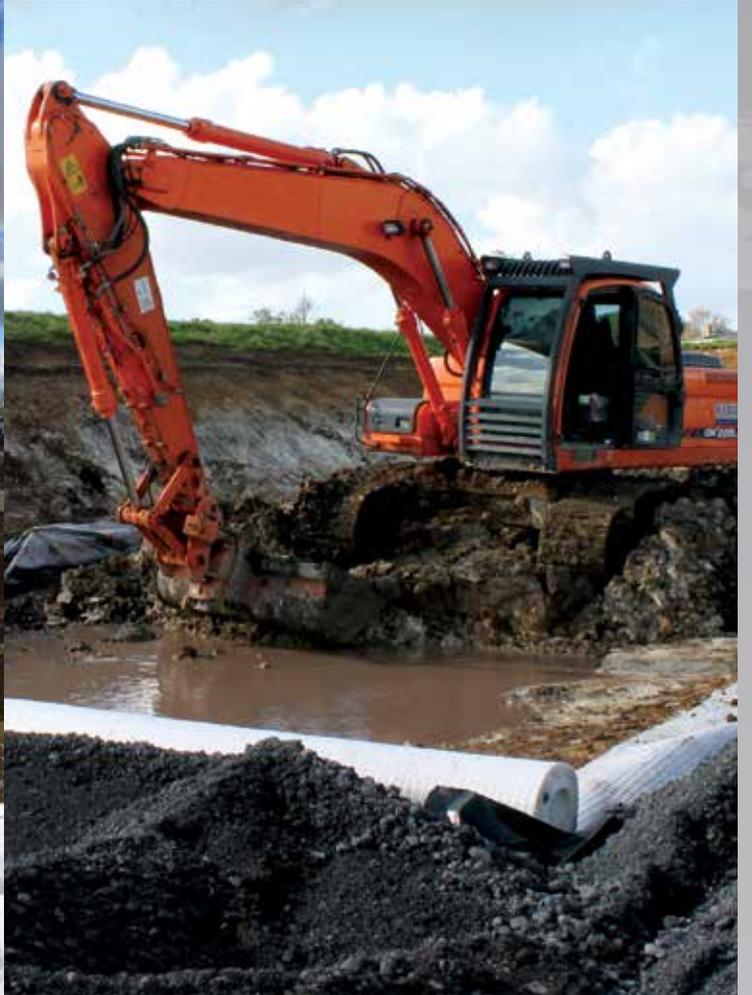


# Duraforce<sup>TM</sup>

## Non woven Geotextiles



**Technical guide on the selection and specification of Cirtex geotextiles for transportation applications**



# The challenge

To provide effective filtration, drainage and separation of engineering materials in a variety of construction structures associated with a range of transportation and associated infrastructure activities, the use of geotextiles has gained tremendous acceptance over the last 30 years. Geotextile materials, when selected appropriately, allow for the replacement of traditional granular filter and drainage layers, providing a significant environmental and economic benefit.

This guide is not meant to replace traditional engineering design principles, but rather indicate, based on long term experience, the candidate geotextile that has generally proven suitable for use in specific environments associated with factors such as temperature, chemical, soils type, damage and ground conditions. This guide does not address issues such as soil reinforcement. Cirtex can assist with additional advice regarding soil reinforcement under embankments, within slopes, over piles, wall design and pavement improvement, using additional specialist geosynthetic products, for such applications.

# Meeting the challenge

## Quality

Cirtex have relationships with manufacturers to ensure the best range of geotextiles to suit the widest range of applications. Our manufacturers have a commitment to quality with accreditation to both ISO Quality and International Test Facility endorsement, with sophisticated in house laboratory testing to ensure that product manufactured, meets or exceeds, required performance criteria.

## Materials

Cirtex have relationships with manufacturers of geotextiles that can use either polyester or polypropylene as the polymer of choice for manufacture of the geotextile. The choice of polymer is important to ensure the widest possible application range. In addition, both continuous filament and staple fibre filaments may be used in the production of our geotextiles that can provide performance benefits in specific applications. For further details on the benefits of a specific polymer or fabric type contact Cirtex.

## Testing

Cirtex is committed to testing our geotextiles to ensure compliance with NZTA strength and filtration classes. We test to AS/NZ standards at certified in house laboratories at our manufacturing plants and also independent 3rd party laboratories. Cirtex will also use internationally recognised test methods where no such AS/NZ standard exists for specific projects.

## History

Our experienced technical team can assist in the appropriate geotextile selection for your project. We can produce geotextile in wide width rolls and provide geotextile product in a mass range between 100g/m<sup>2</sup> to 2000 g/m<sup>2</sup>.

## Delivery

With large stock holdings held in all main centres , Cirtex can deliver product throughout New Zealand in a timely manner to meet construction schedules.

## 1.0 General

Geotextiles have had a long history of use in filtration, drainage, separation and protection applications in a range of civil, coastal and environmental engineering structures.

Geotextiles are a relatively inexpensive product, that when designed and installed correctly can replace traditional granular treatments with significant cost savings, both in aggregate quantities used and traditional labour costs to install such aggregate systems.

This technical note uses a well accepted New Zealand philosophical approach to the use and specification of these products by application type. This note has been documented to allow confidence in the use of Cirtex geotextiles for a variety of common construction structures used in transportation applications. This document does not replace good engineering design when required, in the detailing and specification of adequate drainage and filtration structures.

## 2.0 Geotextile types

Cirtex offers geotextiles manufactured in a variety of ways using a choice of polymers to maximise the potential product applications. Each manufacturing process and polymer type may offer some distinct advantages of one over the other.

The geotextile types offered by Cirtex in this document are for applications of simple drainage and separation construction activities generally associated with the construction of roads and related construction activities.

**VIRGIN POLYMER NONWOVEN POLYPROPYLENE GEOTEXTILE** Suitable for most applications dependent upon grade selected. Marketed under the Duraforce® product range. These are needle punched, virgin polypropylene, nonwoven geotextiles. The construction of the fabric is staple fibre which provides some improved abrasion resistance in situations, such as under rail track where there is movement of stone against fabric.

**VIRGIN POLYMER NONWOVEN POLYESTER GEOTEXTILE** Suitable for most applications dependent upon grade selected. The most common fabric construction type marketed here in this Region. These are needle punched, continuous filament, virgin polyester, nonwoven geotextiles. Some limitations exist where the environment of use for the geotextile is highly alkaline.

## 3.0 Polymer types & fabric construction types

It is not the intention of this document to give detailed information on polymer types and suitability other than some very general and well documented restrictions.

- Some International Standards state that the use of recycled polymers used in geotextile manufacture shall not be used, or if able to be used, shall only be used in applications of limited life span. Cirtex uses virgin polypropylene and polyester fibres in the production of their nonwoven geotextile range.
- Cirtex can provide the most commonly marketed geotextile type used both in New Zealand and the South Pacific Islands. It is a polyester nonwoven needle punched geotextile using virgin polymers in manufacture. This product is supplied in wide width rolls to 6m and is available in a range of strengths to satisfy all potential civil and environmental applications that require the use of a quality geotextile. **REFER TO Duraforce® TECHNICAL DATA SHEETS.**
- Polypropylene based geotextiles are best used where the geotextile is to be placed in, or in near contact to structures that are alkaline in nature. This alkaline environment may be as a result of some industrial treatment process, such as in some tailing dam systems, landfill leachate applications, applications of lime and cement stabilisation or where the geotextile is in contact with or within concrete structures (that are intrinsically alkaline from the cement paste constituents). Polypropylene has a much higher resistance to alkali environments than polyester fibre geotextiles. Polyester geotextiles can suffer catastrophic loss of function in such high alkali environments through a process known as hydrolysis. **REFER TO Duraforce® TECHNICAL DATA SHEETS FOR POLYPROPYLENE POLYMER GEOTEXTILES.**

The following information will give some guidance and confidence in the products distributed by Cirtex and allow the user to make informed choices about the proposed grade and type of product to be supplied that will provide satisfactory service levels at the minimum levels of cost. In all circumstances the user should engage the services of a qualified engineer that is knowledgeable in the design of such products and who has knowledge of the specific site and ground conditions that will ultimately determine the use of any product selected for use. For specific product compliance of the Cirtex products against any specification requirements the reader should always contact Cirtex for advice and confirmation. Virgin polymer allows for the use of some amounts of factory regrind material.

## 4.0 Drainage & filtration applications

In applications of drainage and filtration, the designer should consider the survivability of the geotextile against damage during the installation process, the soil type that the geotextile will be in contact with (considering the maximum particle size and grading), the type of drain to be constructed, the likely flow requirements of the geotextile and in some applications, the ground conditions on which the drainage structure is to be constructed.

### 4.1 Trench Drain Applications

This is the application when a geotextile is wrapped around the inside face of a trench to minimise soil movement from the adjacent ground into the drainage structure minimising the potential for blockage of the drainage aggregate and pipe systems by the soil, whilst allowing ground water to pass through the fabric and into the drain.

#### Case of 2m Trench Depth (max)

Stone Size – mm D <sub>85</sub>	Trench Depth- m	Suitable Cirtex Geotextile	Suitability of Cirtex Geotextile in Filtration of varying soil types
≤ 37.5	≤ 2	<b>Duraforce® AS240</b>	Grade suitable for filtration and drainage requirements of silt and clay soils, low permeability granular soils and pervious granular soils.
≤ 75	≤ 2	<b>Duraforce® AS280</b>	Grade suitable for filtration and drainage requirements of silt and clay soils, low permeability granular soils and pervious granular soils.
≤ 200	≤ 2	<b>Duraforce® AS410</b>	Grade suitable for filtration and drainage requirements of silt and clay soils, low permeability granular soils and pervious granular soils.

#### Case of 3m Trench Depth (max)

Stone Size (mm) D <sub>85</sub>	Trench Depth -m	Suitable Cirtex Geotextile	Suitability of Cirtex Geotextile in Filtration of varying soil types
≤ 37.5	≤ 3	<b>Duraforce® AS280</b>	Grade suitable for filtration and drainage requirements of silt and clay soils, low permeability granular soils and pervious granular soils.
≤ 75	≤ 3	<b>Duraforce® AS410</b>	Grade suitable for filtration and drainage requirements of silt and clay soils, low permeability granular soils and pervious granular soils.
≤ 200	≤ 3	<b>Duraforce® AS440</b>	Grade suitable for filtration and drainage requirements of silt and clay soils, low permeability granular soils and pervious granular soils.

1. Drop Height of rock from machine ≤ 1.5m from top of trench
2. Suitability of the offered geotextile w.r.t. suitable geotextile filtration and drainage requirements is based on most critical requirements of geotextile pore size ≤ 120µm, geotextile flow rate ≥ 50 l/m<sup>2</sup>/sec, minimum geotextile permittivity ≥ 0.5 for the range of soil types nominated.
3. D<sub>85</sub> refers to the rock size at which 85% of material is finer than.

## 4.2 Drainage Blanket Applications

This is an application where a drainage layer is placed under an embankment (may be either a fill or cut situation) such that water at the embankment underside may be directed to side discharge points. Generally a geotextile is placed at the embankment formation level. Granular, free draining fill, is placed on top of the geotextile and then an additional geotextile layer may be placed on the top of the aggregate layer to form what is known as a blanket drain. The bearing capacity of the existing ground will have some effect on the fabric grade to be selected. Obviously, the "softer" the ground the greater the need for more robust geotextiles to carry the imposed loads on this weak ground.

### Case of Drainage Blanket and CBR of ground > 3

Stone Size – mm $D_{85}$	Suitable Cirtex Geotextile	Suitability of Cirtex Geotextile in Filtration of varying soil types
≤ 37.5	Duraforce® AS240	Grade suitable for filtration and drainage requirements of silt and clay soils, low permeability granular soils and pervious granular soils.
≤ 75	Duraforce® AS280	Grade suitable for filtration and drainage requirements of silt and clay soils, low permeability granular soils and pervious granular soils.
≤ 200	Duraforce® AS410	Grade suitable for filtration and drainage requirements of silt and clay soils, low permeability granular soils and pervious granular soils.
≤ 400	Duraforce® AS440	Grade suitable for filtration and drainage requirements of silt and clay soils, low permeability granular soils and pervious granular soils.
≤ 600	Duraforce® AS640	Grade suitable for filtration and drainage requirements of silt and clay soils, low permeability granular soils and pervious granular soils.

### Case of Drainage Blanket and CBR of ground between 1 and 3

Stone Size – mm $D_{85}$	Suitable Cirtex Geotextile	Suitability of Cirtex Geotextile in Filtration of varying soil types
> 37.5	Duraforce® AS410	Grade suitable for filtration and drainage requirements of silt and clay soils, low permeability granular soils and pervious granular soils.
> 75	Duraforce® AS410	Grade suitable for filtration and drainage requirements of silt and clay soils, low permeability granular soils and pervious granular soils.
> 200	Duraforce® AS440	Grade suitable for filtration and drainage requirements of silt and clay soils, low permeability granular soils and pervious granular soils.
> 400	Duraforce® AS640	Grade suitable for filtration and drainage requirements of silt and clay soils, low permeability granular soils and pervious granular soils.
> 600	N/A	Specialist suggestions should be sought from Cirtex

1. Drop Height of rock from machine ≤ 1.5m from top of trench
2. Suitability of the offered geotextile w.r.t. suitable geotextile filtration and drainage requirements is based on most critical requirements of geotextile pore size ≤ 120µm, geotextile flow rate ≥ 50 l/m<sup>2</sup>/sec, minimum geotextile permittivity ≥ 0.5 for the range of soil types nominated.
3.  $D_{85}$  refers to the rock size at which 85% of material is finer than.



# 5.0 Retaining & scour structures

## 5.1 Retaining Structures

A geotextile is necessary to separate and filter under / behind retaining structures to ensure that soil particles cannot be transported by hydraulic action or ground water movement in such applications. Conventional retaining structures includes the drainage element associated immediately adjacent to the retaining wall such as masonry core filled blockwork, segmental concrete block walls, sleeper walls and crib retaining walls. The geotextile type(s) quoted are the minimum acceptable for such structures. The use of large drainage aggregate greater than 20mm in size, or extremely angular aggregate, for example, some recycled concrete products, will require a higher grade of fabric from a survivability aspect. These suggestions do not include chimney drains or similar large scale drainage structures that are generally subject to specialist detailed design.

Suitable Cirtex Geotextile	Suitability of Cirtex Geotextile in Filtration of varying soil types
Duraforce® AS280	Grade suitable for filtration and drainage requirements of silt and clay soils, low permeability granular soils and pervious granular soils.

## 5.2 Scour Systems and Gabion Walls - Proprietary Systems

Scour systems are defined as those products that can be somewhat proprietary in nature such as interlocking concrete block systems, wire rock mattress, gabion structures (hydraulic applications) and systems such as granular filled, interlocking tyres. The selection of the appropriate geotextile in such applications can be complex and will be a function of existing soils to be protected, the hydraulic environment and the scour product used.

Suitable Cirtex Geotextile	Suitability of Cirtex Geotextile in Filtration of varying soil types
Duraforce® AS410	Grade suitable for filtration and drainage requirements of silt and clay soils, low permeability granular soils and pervious granular soils.

## 5.3 Rock Armour Revetment Systems

Rock armour revetment systems are one of the most common methods of treatment of an exposed area against possible scour effects. Where the application is extreme such as in very severe hydraulic conditions such as coastal works and where reversing flow situations are in place there must be detailed design taken to ensure the adequacy of the geotextile recommended.

Rock Armour Size - $D_{85}$ mm	Suitable Cirtex Geotextile	Suitability of Cirtex Geotextile in Filtration of varying soil types
$\leq 200$	Duraforce® AS440	Grade suitable for filtration and drainage requirements of silt and clay soils, low permeability granular soils and pervious granular soils.
$\leq 400$	Duraforce® AS640	Grade suitable for filtration and drainage requirements of silt and clay soils, low permeability granular soils and pervious granular soils.

1. Drop Height of rock from machine  $\leq 1.5m$  from top of trench
2.  $D_{85}$  refers to the rock size at which 85% of material is finer than.
3. Suitability of the offered geotextile w.r.t. suitable geotextile filtration and drainage requirements is based on the most critical requirements of geotextile pore size  $\leq 120\mu m$ , geotextile flow rate  $\geq 50 l/m^2/sec$ , minimum geotextile permittivity  $\geq 0.5$  for the range of soil types nominated.
4. In some applications and to protect the geotextile, a layer of finer sized material may be placed on the geotextile prior to placement of the larger rock.
5. Careful design is required in situations where reversing flow situations are likely to be encountered, such as in coastal protection works.

# 6.0 Separation applications

## 6.1 Separation Applications to Prevent Intermixing of Dissimilar Materials

This is an application where generally high quality fills are being imported and are to be placed over lower quality in-situ materials to form either a short term structure such as an access road or for longer term applications where the embankment will form a longer term structure such as a permanent road. The geotextile type to be used will be largely a function of ground water conditions, ground support conditions (expressed in terms of a CBR value) and if filtration requirements are critical or not. Of course, like all geotextile applications, the survivability of the fabric to construction damage will be a function of the imported fill material stone size placed on the geotextile. The primary function of the geotextile is to prevent short and long term intermixing of the dissimilar materials with additionally, some secondary reinforcement benefit.

### Case of Separation Application and Unsaturated Ground and CBR > 3

Stone Size - $D_{85}$ mm	Suitable Cirtex Geotextile	Suitability of Cirtex Geotextile in Filtration of varying soil types
$\leq 37.5$	<b>Duraforce® AS240</b>	Grade suitable for filtration and drainage requirements of silt and clay soils, low permeability soils. $D_{15s} \leq 75\mu\text{m}$ .
$\leq 37.5$	<b>Duraforce® AS240</b>	Grade suitable for filtration and drainage requirements of predominately pervious granular soils. $D_{15s} \geq 75\mu\text{m}$ .
$\leq 75$	<b>Duraforce® AS280</b>	Grade suitable for filtration and drainage requirements of silt and clay soils, low permeability soils. $D_{15s} \leq 75\mu\text{m}$ .
$\leq 75$	<b>Duraforce® AS280</b>	Grade suitable for filtration and drainage requirements of predominately pervious granular soils. $D_{15s} \geq 75\mu\text{m}$ .
$\leq 200$	<b>Duraforce® AS410</b>	Grade suitable for filtration and drainage requirements of silt and clay soils, low permeability soils. $D_{15s} \leq 75\mu\text{m}$ .
$\leq 200$	<b>Duraforce® AS410</b>	Grade suitable for filtration and drainage requirements of predominately pervious granular soils. $D_{15s} \geq 75\mu\text{m}$ .
$\leq 400$	<b>Duraforce® AS440</b>	Grade suitable for filtration and drainage requirements of silt and clay soils, low permeability soils. $D_{15s} \leq 75\mu\text{m}$ .
$\leq 400$	<b>Duraforce® AS440</b>	Grade suitable for filtration and drainage requirements of predominately pervious granular soils. $D_{15s} \geq 75\mu\text{m}$ .
$\leq 600$	<b>Duraforce® AS640</b>	Grade suitable for filtration and drainage requirements of silt and clay soils, low permeability soils. $D_{15s} \leq 75\mu\text{m}$ .
$\leq 600$	<b>Duraforce® AS640</b>	Grade suitable for filtration and drainage requirements of predominately pervious granular soils. $D_{15s} \geq 75\mu\text{m}$ .

1.  $D_{15s}$  refers to the soil size at which 15% of material is finer than.
2. Where reference is made to filtration and drainage in this application of use for low permeability soils then suitability is based on the most critical requirements of geotextile pore size  $\leq 300\mu\text{m}$ , geotextile flow rate  $\geq 10 \text{ l/m}^2/\text{sec}$ , minimum geotextile permittivity  $\geq 0.10$  for the range of soil types nominated.
3. Where reference is made to filtration and drainage in this application of use for predominately pervious soils then suitability is based on the most critical requirements of geotextile pore size  $\leq 600\mu\text{m}$ , geotextile flow rate  $\geq 20 \text{ l/m}^2/\text{sec}$ , minimum geotextile permittivity  $\geq 0.2$  for the range of soil types nominated.
4.  $D_{85}$  refers to the rock size at which 85% of material is finer than.

## 6.1 Separation Applications to Prevent Intermixing of Dissimilar Materials (continued)

### Case of Separation Application and Saturated Ground and CBR between 1 and 3

Stone Size - $D_{85}$ mm	Suitable Cirtex Geotextile	Suitability of Cirtex Geotextile in Filtration of varying soil types
$\leq 37.5$	Duraforce® AS410	Grade suitable for filtration and drainage requirements of silt and clay soils, low permeability soils. $D_{15s} \leq 75\mu\text{m}$ .
$\leq 37.5$	Duraforce® AS410	Grade suitable for filtration and drainage requirements of predominately pervious granular soils. $D_{15s} \geq 75\mu\text{m}$ .
$\leq 75$	Duraforce® AS410	Grade suitable for filtration and drainage requirements of silt and clay soils, low permeability soils. $D_{15s} \leq 75\mu\text{m}$ .
$\leq 75$	Duraforce® AS410	Grade suitable for filtration and drainage requirements of predominately pervious granular soils. $D_{15s} \geq 75\mu\text{m}$ .
$\leq 200$	Duraforce® AS440	Grade suitable for filtration and drainage requirements of silt and clay soils, low permeability soils. $D_{15s} \leq 75\mu\text{m}$ .
$\leq 200$	Duraforce® AS440	Grade suitable for filtration and drainage requirements of predominately pervious granular soils. $D_{15s} \geq 75\mu\text{m}$ .
$\leq 400$	Duraforce® AS640	Grade suitable for filtration and drainage requirements of silt and clay soils, low permeability soils. $D_{15s} \leq 75\mu\text{m}$ .
$\leq 400$	Duraforce® AS640	Grade suitable for filtration and drainage requirements of predominately pervious granular soils. $D_{15s} \geq 75\mu\text{m}$ .
Larger Stone	N/A	Speak to Cirtex for Specialist Advice

- $D_{15s}$  refers to the soil size at which 15% of material is finer than.
- Where reference is made to filtration and drainage in this application of use for low permeability soils then suitability is based on most critical requirements of geotextile pore size  $\leq 300\mu\text{m}$ , geotextile flow rate  $\geq 10 \text{ l/m}^2/\text{sec}$ , minimum geotextile permittivity  $\geq 0.10$  for the range of soil types nominated.
- Where reference is made to filtration and drainage in this application of use for predominately pervious soils then suitability is based on most critical requirements of geotextile pore size  $\leq 600\mu\text{m}$ , geotextile flow rate  $\geq 20 \text{ l/m}^2/\text{sec}$ , minimum geotextile permittivity  $\geq 0.2$  for the range of soil types nominated.
- $D_{85}$  refers to the rock size at which 85% of material is finer than.

## 7.0 Installation

Geotextile rolls shall be stored in a secure location. The geotextile rolls shall be stored off the ground with the use of timber packers such that the bottom layer of rolls is clear of the ground and shall be placed such that the rolls may not be contaminated by oils or such other materials. All rolls shall be supplied in a highly UV stable wrapper that shall protect the geotextile from UV deterioration. All rolls shall be left in the wrapper until use. Any geotextile roll unwrapped shall not be left uncovered for extended periods of time.

Dependent upon ground conditions the minimum overlap in all applications (other than underwater) shall be 300mm. The minimum overlap of 300mm shall be for ground conditions that are firm and with a CBR of  $\geq 3$ . Overlaps for softer ground conditions ( $1 \leq \text{CBR} < 3$ ) shall have a minimum 500mm overlap. For conditions of placement underwater the overlap in all cases shall be 1m. For ground conditions with a  $\text{CBR} < 1$  the minimum overlap shall be 1m and may also require specialist advice.

## 8.0 Other Cirtex geotextiles

Duraforce® Woven, Duraforce® High Strength Woven, Filter Plus™ Small Roll Geotextiles Speak to Cirtex for further advice regarding these products.



## **VALUE ENGINEERING SOLUTIONS FOR:**

- **Subsoil Drainage Filtration**
- **Reinforced Soil Walls**
- **Slope Stability Systems**
- **Earth Anchoring Systems**
- **Pavements, Embankments and Raft Foundations**
- **Landfill and Environmental Barrier Systems**
- **Stormwater Management Systems**
- **Erosion and Sediment Control**
- **Coastal Protection**
- **Surfacing Reinforcement**
- **Dewatering**
- **Landscape edging and Paver Restraints**

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