

LAWTIG Seminar : What it takes to build a landfill

The Role of Geomembranes in Landfills

10 April 2019

Peter Hardie – Technical Manager AKS Lining Systems



Brief overview of the Manufacturing Process, Testing & Installation.

HDPE Liner (Barrier System)

- Its function & why is it generally always required.
- Product specification – what is GRI-GM13 & SANS 1526.
- Project specification – specific to Karwyderskraal.
- Materials testing prior to design – Shear interface calculations, Protection geotextile suitability.
- How we make the Liner – equipment and the extrusion process.
- Manufacturing QC
 - During manufacture
 - After manufacture
 - 3rd party independent testing
- Packaging, Handling and Transport
- Installation on site (SANS 10409)
 - Earthworks
 - Liner placement
 - Liner welding
 - Construction QC (liner specific)
 - 3rd Party Construction QC
 - Final handover (liner specific)
- Protection Geotextiles. – Handover to Deon.

HDPE Liner (Barrier System) - Its function & why it is required.

HDPE Liners offer the following benefits:

- They are Chemically Resistant.
 - In landfill site the main concept is to ensure that Leachate does not pollute.
 - Difficult to know exactly what is in Leachate. HDPE covers nearly everything.
- They are space saving,
 - Thin layer offers far greater carrying capacity from the same foot print.
- Better material quality control,
 - Made in factory environment
 - Consistency
- Better construction quality control,
 - Welding is all 100% testable
 - After installation can still be tested – leak survey
- Construction time saving,
 - Sheets are large and deployment and installation can be done relatively quickly.
- Cost savings,
 - Although the products are not ‘cheap’ when considering the above benefits, it will still be one of the most cost effective solutions.
- Longevity
 - The liner – if made well – will last a very very long time.

Product specification – what is GRI-GM13 & SANS 1526.

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Revision 14: January 6, 2016
Revision schedule on pg. 11

GRI Test Method GM13*

Standard Specification for

“Test Methods, Test Properties and Testing Frequency for
High Density Polyethylene (HDPE) Smooth and Textured Geomembranes”

ISBN 978-0-626-31404-0

SANS 1526:2015
Edition 3

SOUTH AFRICAN NATIONAL STANDARD

**Thermoplastics polyolefin sheeting for use
as a geomembrane**

WARNING
This document references other
documents normatively.

4.1 Requirements for polyolefin geomembranes

4.1.1 Polyolefin products supplied for use as geomembranes shall comply with one, or more, of the following standards, as required (see annex A):

- a) GRI Test Method GM13 (for HDPE products);
- b) GRI Test Method GM17 (for LLDPE products); or

Published by SABS Standards Division
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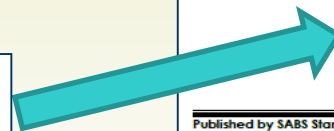


Table 2(b) – High Density Polyethylene (HDPE) Geomembrane –

| Properties | Test Method | Test Value | | | |
|---|--------------------------------|----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|
| | | 0.75 mm | 1.00 mm | 1.25 mm | 1.50 mm |
| Thickness mils (min. ave.) <ul style="list-style-type: none"> • lowest individual for 8 out of 10 values • lowest individual for any of the 10 values | D 5994 | nom. (-5%) -10% -15% | nom. (-5%) -10% -15% | nom. (-5%) -10% -15% | nom. (-5%) -10% -15% |
| Asperity Height mils (min. ave.) | D 7466 | 0.40 mm | 0.40 mm | 0.40 mm | 0.40 mm |
| Formulated Density (min. ave.) | D 1505/D 792 | 0.940 g/cc | 0.940 g/cc | 0.940 g/cc | 0.940 g/cc |
| Tensile Properties (min. ave.) (2) <ul style="list-style-type: none"> • yield strength • break strength • yield elongation • break elongation | D 6693 Type IV | 11 kN/m 8 kN/m 12% 100% | 15 kN/m 10 kN/m 12% 100% | 18 kN/m 13 kN/m 12% 100% | 22 kN/m 16 kN/m 12% 100% |
| Tear Resistance (min. ave.) | D 1004 | 93 N | 125 N | 156 N | 187 N |
| Puncture Resistance (min. ave.) | D 4833 | 200N | 267 N | 333 N | 400 N |
| Stress Crack Resistance (3) | D 5397 (App.) | 500 hr. | 500 hr. | 500 hr. | 500 hr. |
| Carbon Black Content (range) | D 4218 (4) | 2.0-3.0 % | 2.0-3.0 % | 2.0-3.0 % | 2.0-3.0 % |
| Carbon Black Dispersion | D 5596 | note (5) | note (5) | note (5) | note (5) |
| Oxidative Induction Time (OIT) (min. ave.) (6) (a) Standard OIT — or — (b) High Pressure OIT | D 3895 D 5885 | 100 min. 400 min. | 100 min. 400 min. | 100 min. 400 min. | 100 min. 400 min. |
| Oven Aging at 85°C (6), (7) (a) Standard OIT (min. ave.) - % retained after 90 days — or — (b) High Pressure OIT (min. ave.) - % retained after 90 days | D 5721 D 3895 D 5885 | 55% 80% | 55% 80% | 55% 80% | 55% 80% |
| UV Resistance (8) (a) Standard OIT (min. ave.) — or — (b) High Pressure OIT (min. ave.) - % retained after 1600 hrs (10) | D 7238 D 3895 D 5885 | N.R. (9) 50% | N.R. (9) 50% | N.R. (9) 50% | N.R. (9) 50% |

Tests specific to Karwyders Kraal

In real basic terms, the following was a deviation from SANS 1526.

The reasoning (although more in depth technical discussion needed) are as follows:

- **Thickness** – Minimum – More durable
- **Asperity Height** – >0.6mm. Based on Friction testing.
- **STD & HP OIT** – Better Life expectancy
- **ESCR** - >1000 Hr – Less chance of stress cracking.
- **BREAK ELONGATION** - >400% - Better product performance for deformation.

1. HDPE GEOMEMBRANES

- 1.1 THICKNESS TO BE MINIMUM, NOT NOMINAL
- 1.2 MINIMUM ASPERITY HEIGHT 0,6mm AS PER ASTM D7466 UNLESS OTHERWISE SHOWN ON DRAWINGS
- 1.3 TEXTURING TO BE EMBOSSED UNLESS OTHERWISE SHOWN ON THE DRAWINGS
- 1.4 BREAK ELONGATION FOR TEXTURED GEOMEMBRANES TO BE MINIMUM 400% AS PER ASTM D6693 TYPE IV
- 1.5 PUNCTURE RESISTANCE FOR TEXTURED GEOMEMBRANES TO BE MINIMUM 450 N FOR 1,5mm AND 600 N FOR 2mm AS PER ASTM D4833
- 1.6 STANDARD OIT TO BE 200 MINUTES AS PER ASTM D3895
- 1.7 HP OIT TO BE 600 MINUTES AS PER ASTM D5885
- 1.8 STRESS CRACK RESISTANCE TO BE MIN. 1000hrs AS PER ASTM D5397
- 1.9 THE FOLLOWING CONFORMANCE TESTS TO BE DONE AND APPROVED PRIOR TO SHIPMENT AND ALSO ON ARRIVAL OF MATERIAL ON SITE:

PARAMETER METHOD

THICKNESS:

SMOOTH ASTM D5199
TEXTURED ASTM D5994

| | |
|---|-------------------|
| DENSITY | ASTM D1505 |
| CARBON BLACK CONTENT | ASTM D1603 |
| CARBON BLACK DISPERSION | ASTM D5596 |
| STRESS CRACK RESISTANCE | ASTM D5397 (Mod.) |
| TENSILE PROPERTIES | ASTM D6693 |
| MODIFIED TENSILE TEST DONE AT A STRAIN RATE OF 300mm / min TO CONFIRM NO SIP DELAMINATION | ASTM D6693 (Mod.) |
| OXIDITIVE INDUCTION TIME (OIT) | ASTM D3895 |
| HIGH PRESSURE OIT | ASTM D5885 |
| ASPERITY HEIGHT | ASTM D7466 |

- 1.10 THE FOLLOWING DURIBILITY TESTS TO BE CONDUCTED AS SOON AS MATERIAL IS MANUFACTURED;

OVEN AGING AT 85° (ASTM D5721)
STANDARD OIT 55% RETAINED AFTER 90 DAYS (ASTM D3895)

OVEN AGING AT 85° (ASTM D5721)
HIGH PRESSURE OIT 80% RETAINED AFTER 90 DAYS (ASTM D5885)

UV RESISTANCE HIGH PRESSURE OIT 50% RETAINED AFTER 1600 HRS (ASTM D5885)

Tests Prior to design and after production or final sign off by regulator.

SHEAR TESTING – 3rd party

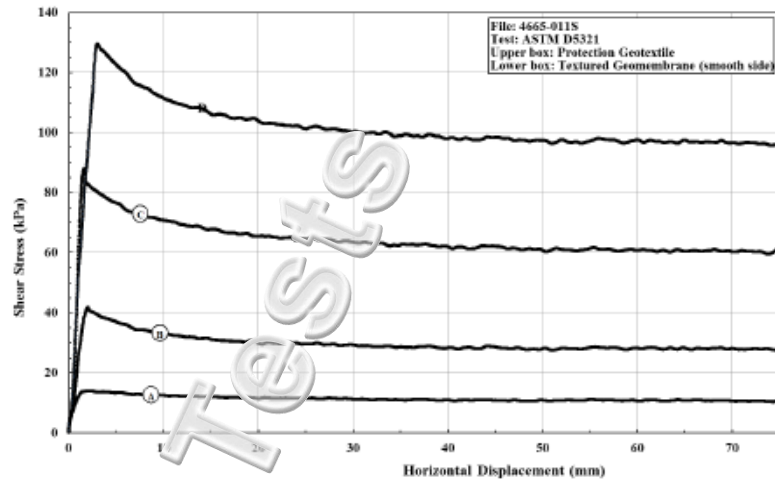
Samples of material are placed into a device that can replicate the potential loading that may take place on the liner layers. The products can be moved or sheared against each other in a full saturated state and the Peak Friction angles can be determined.

GEOMEMBRANE TESTING – 3rd Party

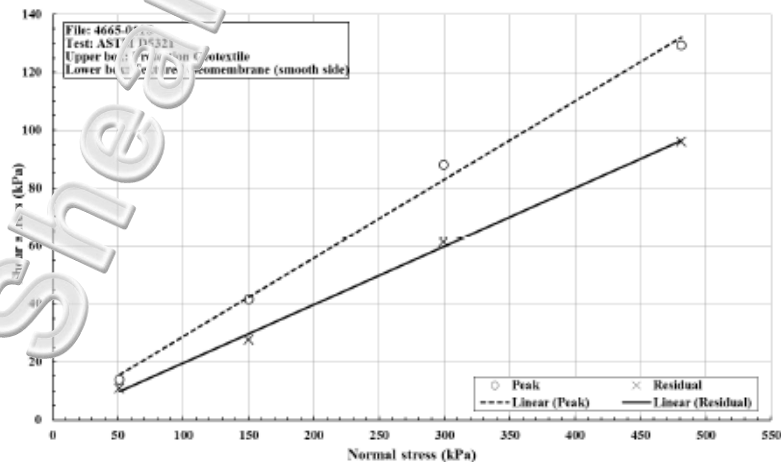
All of the MQC tests required in terms of GRI-GM13 and SANS 1526 are redone on a random material roll, selected from site. These tests include the Oven Aging and UV tests that must run for up to 3 months.

GEOTEXTILE TESTING – 3rd party

Protection – Deon will explain. Product test and Performance test
Separation – Deon will explain



Shear Stress vs Horizontal Displacement



Shear Stress vs Normal Stress



ANALYSIS REPORT
 SCC Accreditation No.: 40‡

Mr. Peter Hardie Date: January 4, 2019
 AKS Lining Systems (pty) Ltd Report: 4665-011S-1A-en

IDENTIFICATION: Textured geomembrane: 3M3837 - Tested at 50 mm/min 3M3837 - Tested at 300 mm/min
 Received: November 13, 2018, PO: 9920

STANDARD: ASTM D6693/D6693M-04(2015)e1

TEST: Tensile Properties of Nonreinforced Polyethylene and Nonreinforced Flexible Polypropylene Geomembrane

TEST CONDITIONS: Conditioning atmosphere: 21 ± 2°C; 5 die cut specimens per direction; Apparatus used: Dynamometer with a Constant Rate of Extension (CRE); Speed (mm/min): 50 and 300; Date of test: November 16, 2018

RESULTS: Technical Data Avg. S.D. % CV

| | 1 | 2 | 3 | 4 | 5 | Avg. | S.D. | % CV |
|-------------------------------------|------|------|------|------|------|------|------|------|
| 3M3837 - Tested at 50 mm/min | | | | | | | | |
| 1-MACHINE DIRECTION | | | | | | | | |
| 1-Strength at yield (kN/m): | 29.0 | 27.4 | 28.1 | 27.8 | 27.9 | 0.7 | 2.6 | |
| 1-Strength at yield (lb/in): | 165 | 155 | 157 | 160 | 159 | 4 | 2.4 | |
| 1-Elongation at yield (%): | 16 | 16 | 16 | 16 | 16 | 0 | 0.0 | |
| 1-Strength at break (kN/m): | 33.1 | 31.2 | 32.9 | 34.3 | 33.4 | 33.0 | 1.1 | 3.4 |
| 1-Strength at break (lb/in): | 192 | 178 | 188 | 196 | 191 | 188 | 7 | 3.5 |
| 1-Elongation at break (%): | 470 | 460 | 430 | 440 | 440 | 444 | 11 | 2.6 |
| 2-CROSS DIRECTION | | | | | | | | |
| 2-Strength at yield (kN/m): | 29.4 | 29.1 | 28.2 | 29.6 | 30.3 | 29.3 | 0.8 | 2.6 |
| 2-Strength at yield (lb/in): | 168 | 166 | 161 | 169 | 173 | 167 | 4 | 2.6 |
| 2-Elongation at yield (%): | 15 | 15 | 15 | 15 | 15 | 15 | 0 | 0.0 |
| 2-Strength at break (kN/m): | 39.5 | 33.6 | 31.5 | 31.7 | 36.8 | 34.6 | 3.5 | 10.0 |
| 2-Strength at break (lb/in): | 226 | 192 | 180 | 181 | 210 | 198 | 20 | 10.0 |
| 2-Elongation at break (%): | 610 | 520 | 500 | 480 | 550 | 532 | 51 | 9.5 |

Prepared by: Nancy Fontaine, Technician
 Approved by: Sylvie Dalpé, Project Leader-Laboratory
 Date: January 4, 2019

****For any information concerning this report, please contact Sylvie Dalpé.****
 The reports are identified by an alphanumeric code, the letter preceding "-en" refers to the revision number, emitted in ascending order. The electronic copy sent by CTT Group is the official report. The reported identification is based on what was observed on the received sample and/or information provided by the customer. The samples in relation to this report are retained for a period of 30 days following transmission of the report. The above reported results refer exclusively to the samples submitted for evaluation. This analysis report cannot be partly used or reproduced, unless in whole, without CTT Group prior written consent. ‡ The ISO/IEC 17025 Scope of Accreditation of CTT Group is available at www.gctg.com. In this report, the tests which number is followed by the symbol ‡ are not covered by this accreditation. For customer's complete address, please refer to the email.

ANALYSIS REPORT
 SCC Accreditation No.: 401

Mr. Peter Hardie
 AKS Lining Systems (pty) Ltd
 Date: December 19, 2018
 Report: 4665-0115-4A-en

IDENTIFICATION: Protection geotextile: Bsdim A15 A181009014 GKB-5
 Received: November 13, 2018, PO: 9920

STANDARD: ASTM D4632/D4632M-15a

TEST: Grab Breaking Load and Elongation of Geotextiles

TEST CONDITIONS: Apparatus used: Dynamometer with a Constant Rate of Extension (CRE)
 Grip surface texture: rubber;
 Speed: 300 mm/min;
 Full scale range used: 50kN
 10 test specimens per direction ;
 Condition of test specimens (wet or dry): Dry
 Date of test: November 20, 2018

| RESULTS: | Individual Data | | | | | Avg. | S.D. | % CV |
|-----------------------------|-----------------|--------|--------|--------|--------|----------------|-------|-------------|
| 1-MACHINE DIRECTION | | | | | | | | |
| 1-Grab Breaking Load (N): | 7082.0 | 7491.3 | 7225.3 | 7150.0 | 6679.7 | 7 522.6 | 584.8 | 7.8 |
| 1-Grab Breaking Load (lbf): | 1592.0 | 1681.2 | 1604.2 | 1607.3 | 1501.6 | 1 691.1 | 131.5 | 7.8 |
| 1-Elongation at break (%): | 107.4 | 112.0 | 109.0 | 99.6 | 109.5 | 107.1 | 6.8 | 6.3 |
| 2-CROSS DIRECTION | | | | | | | | |
| 2-Grab Breaking Load (N): | 7019.4 | 6163.8 | 6335.8 | 5558.2 | 5918.4 | 6 433.1 | 694.5 | 10.8 |
| 2-Grab Breaking Load (lbf): | 1575.5 | 1374.6 | 1406.4 | 1249.5 | 1330.4 | 1 446.2 | 156.1 | 10.8 |
| 2-Elongation at break (%): | 111.1 | 111.3 | 96.7 | 89.3 | 96.3 | 99.3 | 10.5 | 10.6 |

Prepared by: *Catherine Groleau Rivard*
 Catherine Groleau Rivard, Tech.
 Technicien
 Approved by: *Sylvie Dalpe*
 Sylvie Dalpe, Tech.
 Project Leader-Laboratory
 Date: December 19, 2018

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ANALYSIS REPORT
 SCC Accreditation No.: 401

Mr. Peter Hardie
 AKS Lining Systems (pty) Ltd
 Date: December 19, 2018
 Report: 4665-0115-3A-en

IDENTIFICATION: Separation geotextile: A3, GKB21 Stul. 530150 181101030
 Received: November 13, 2018, PO: 9920

STANDARD: ASTM D4632/D4632M-15a

TEST: Grab Breaking Load and Elongation of Geotextiles

TEST CONDITIONS: Apparatus used: Dynamometer with a Constant Rate of Extension (CRE)
 Grip surface texture: rubber;
 Speed: 300 mm/min;
 Full scale range used: 50kN
 10 test specimens per direction ;
 Condition of test specimens (wet or dry): Dry
 Date of test: November 20, 2018

| RESULTS: | Individual Data | | | | | Avg. | S.D. | % CV |
|-----------------------------|-----------------|--------|--------|--------|--------|--------------|-------|-------------|
| 1-MACHINE DIRECTION | | | | | | | | |
| 1-Grab Breaking Load (N): | 774.8 | 765.4 | 1068.1 | 1263.8 | 1175.0 | 976.6 | 170.4 | 17.4 |
| 1-Grab Breaking Load (lbf): | 174.2 | 172.1 | 240.1 | 284.1 | 264.1 | 219.5 | 38.3 | 17.4 |
| 1-Elongation at break (%): | 90.3 | 85.4 | 85.5 | 85.4 | 79.4 | 88.0 | 6.5 | 7.3 |
| 2-CROSS DIRECTION | | | | | | | | |
| 2-Grab Breaking Load (N): | 814.9 | 1064.9 | 860.6 | 859.7 | 995.8 | 946.7 | 115.4 | 12.2 |
| 2-Grab Breaking Load (lbf): | 183.2 | 237.9 | 193.5 | 193.3 | 223.8 | 212.8 | 25.9 | 12.2 |
| 2-Elongation at break (%): | 83.1 | 103.9 | 106.4 | 93.9 | 107.8 | 92.6 | 10.8 | 11.6 |

Prepared by: *Catherine Groleau Rivard*
 Catherine Groleau Rivard, Tech.
 Technicien
 Approved by: *Sylvie Dalpe*
 Sylvie Dalpe, Tech.
 Project Leader-Laboratory
 Date: December 19, 2018

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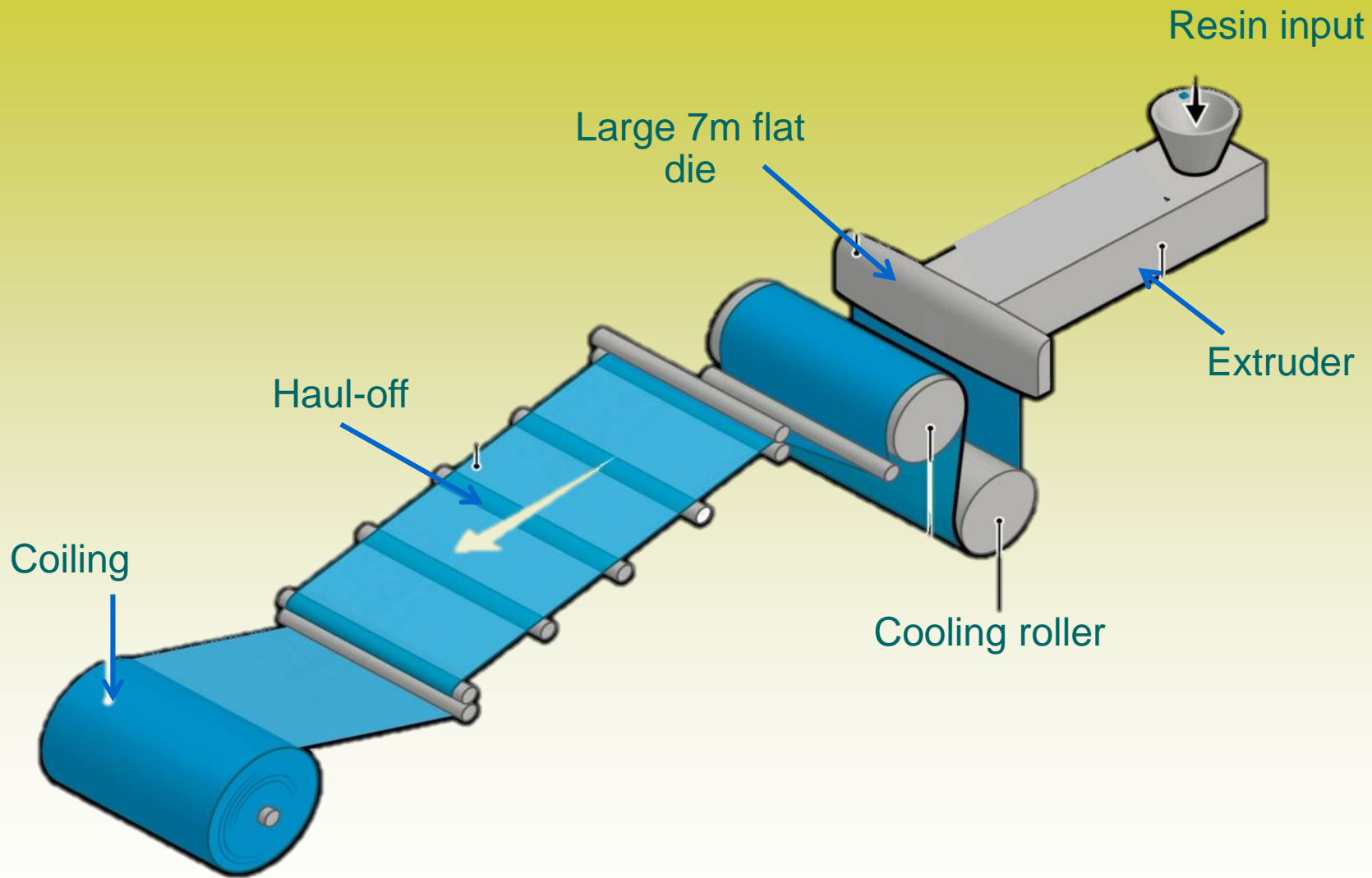
How we make the Liner – equipment and the extrusion process.

There are two or three main components that are used to make a GRI-GM13 grade HDPE liner

- Virgin Resin (beads or pellets)
- Anti-Oxidants
- Carbon Black
- Regrind



Flat die/ Cast extrusion process



The Resin, Anti-Oxidant & Carbon Black and Regrind are carefully (electronically) weight batched and blended at the exact right percentages. This is normally a computer controlled system.

Typical Maguire Blender equipment allowing for careful control blending of all the components.

Regrind – max 10%. Must be from within the plant (not sourced from outside). Must be the same resins. AT AKS the regrind is directly from the edge trim.

Anti-Oxidants and Carbon Black – Grouped together. For this project, we were required to increase the OIT levels in order to meet the specification. The Cabot MB allows us to adjust OIT levels.



After the components have been carefully weighed and blended, they are moved/air blown into the extrusion machines. Here they are melted and mixed at approx. 200 deg C and extruded out in a thin film.

Either blown film or flat die.

At AKS Lining Systems we use the Flat Die extruded material.

- Very accurate thickness control.
- The resin used in Flat Die is normally softer, easier to weld.
- Textured material and texturing process is 100% consistent.
- Textured material from Flat die also offers better break elongation.

For this project a 400% Break Elongation value was called for.



Large Single Barrel extruder.

Feeding into 7m wide Flat die.

Total extrusion plant approx.
55m in length.

Extrusion Die has 36 zones where the thickness is carefully monitored and controlled.

Each cooling roller is 1m Dia. and weighing approx. 18 ton.

The liner is marked along the welding edge to include specific roll number, the product description and the length, at 1m intervals.

7 m wide Flat Die. Molten HDPE exits the die and flows between the lower cooling rollers.



3 x cooling rollers. Here the thickness and surface texture of the sheet is determined.



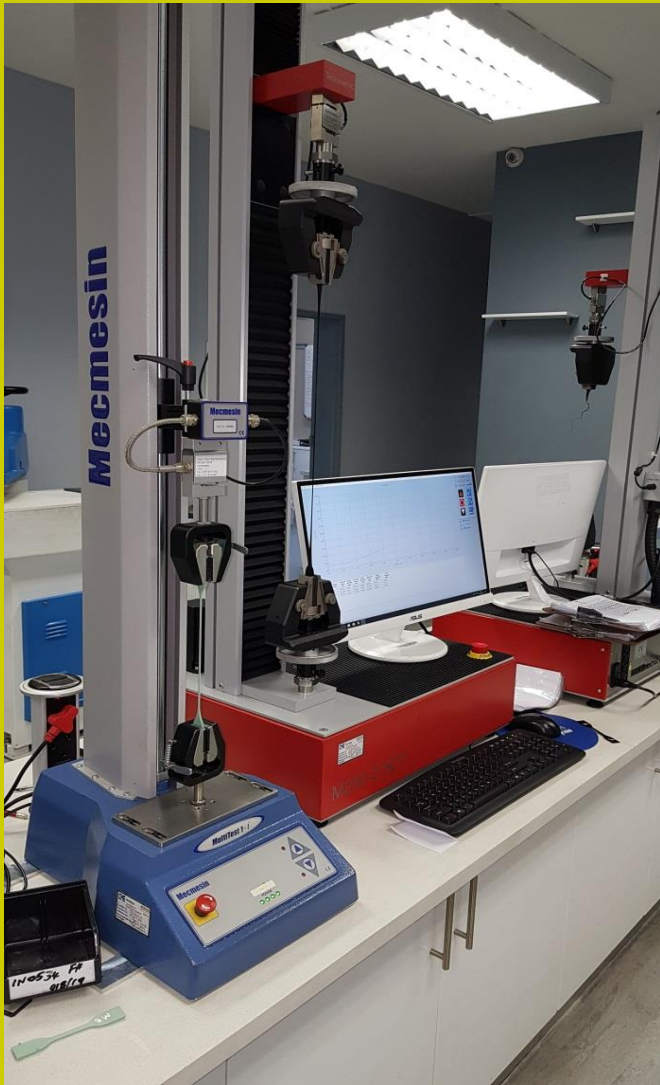
QC During Manufacturing and After manufacturing

Table 2(b) – High Density Polyethylene (HDPE) Geomembrane

| Properties | Test Method | Test Value | | | |
|--|--------------------------------|----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|
| | | 0.75 mm | 1.00 mm | 1.25 mm | 1.50 mm |
| Thickness mils (min. ave.) • lowest individual for 8 out of 10 values • lowest individual for any of the 10 values | D 5994 | nom. (-5%) -10% -15% | nom. (-5%) -10% -15% | nom. (-5%) -10% -15% | nom. (-5%) -10% -15% |
| Asperity Height mils (min. ave.) | D 7466 | 0.40 mm | 0.40 mm | 0.40 mm | 0.40 mm |
| Formulated Density (min. ave.) | D 1505/D 792 | 0.940 g/cc | 0.940 g/cc | 0.940 g/cc | 0.940 g/cc |
| Tensile Properties (min. ave.) (2) • yield strength • break strength • yield elongation • break elongation | D 6693 Type IV | 11 kN/m 8 kN/m 12% 100% | 15 kN/m 10 kN/m 12% 100% | 18 kN/m 13 kN/m 12% 100% | 22 kN/m 16 kN/m 12% 100% |
| Tear Resistance (min. ave.) | D 1004 | 93 N | 125 N | 156 N | 187 N |
| Puncture Resistance (min. ave.) | D 4833 | 200N | 267 N | 333 N | 400 N |
| Stress Crack Resistance (3) | D 5397 (App.) | 500 hr. | 500 hr. | 500 hr. | 500 hr. |
| Carbon Black Content (range) | D 4218 (4) | 2.0-3.0 % | 2.0-3.0 % | 2.0-3.0 % | 2.0-3.0 % |
| Carbon Black Dispersion | D 5596 | note (5) | note (5) | note (5) | note (5) |
| Oxidative Induction Time (OIT) (min. ave.) (6) (a) Standard OIT — or — (b) High Pressure OIT | D 3895 D 5885 | 100 min. 400 min. | 100 min. 400 min. | 100 min. 400 min. | 100 min. 400 min. |
| Oven Aging at 85°C (6), (7) (a) Standard OIT (min. ave.) - % retained after 90 days — or — (b) High Pressure OIT (min. ave.) - % retained after 90 days | D 5721 D 3895 D 5885 | 55% 80% | 55% 80% | 55% 80% | 55% 80% |
| UV Resistance (8) (a) Standard OIT (min. ave.) — or — (b) High Pressure OIT (min. ave.) - % retained after 1600 hrs (10) | D 7238 D 3895 D 5885 | N.R. (9) 50% | N.R. (9) 50% | N.R. (9) 50% | N.R. (9) 50% |



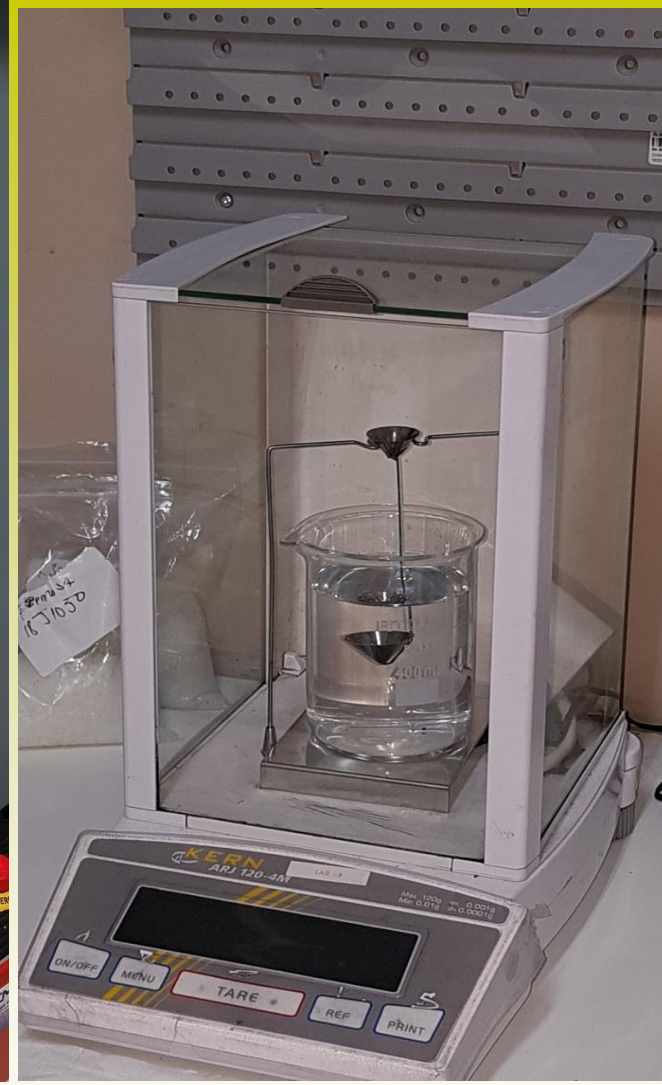
Thickness control
36 zones = 36 checks. GRI-GM13 = 10 checks.



Tensile tests



Puncture tests

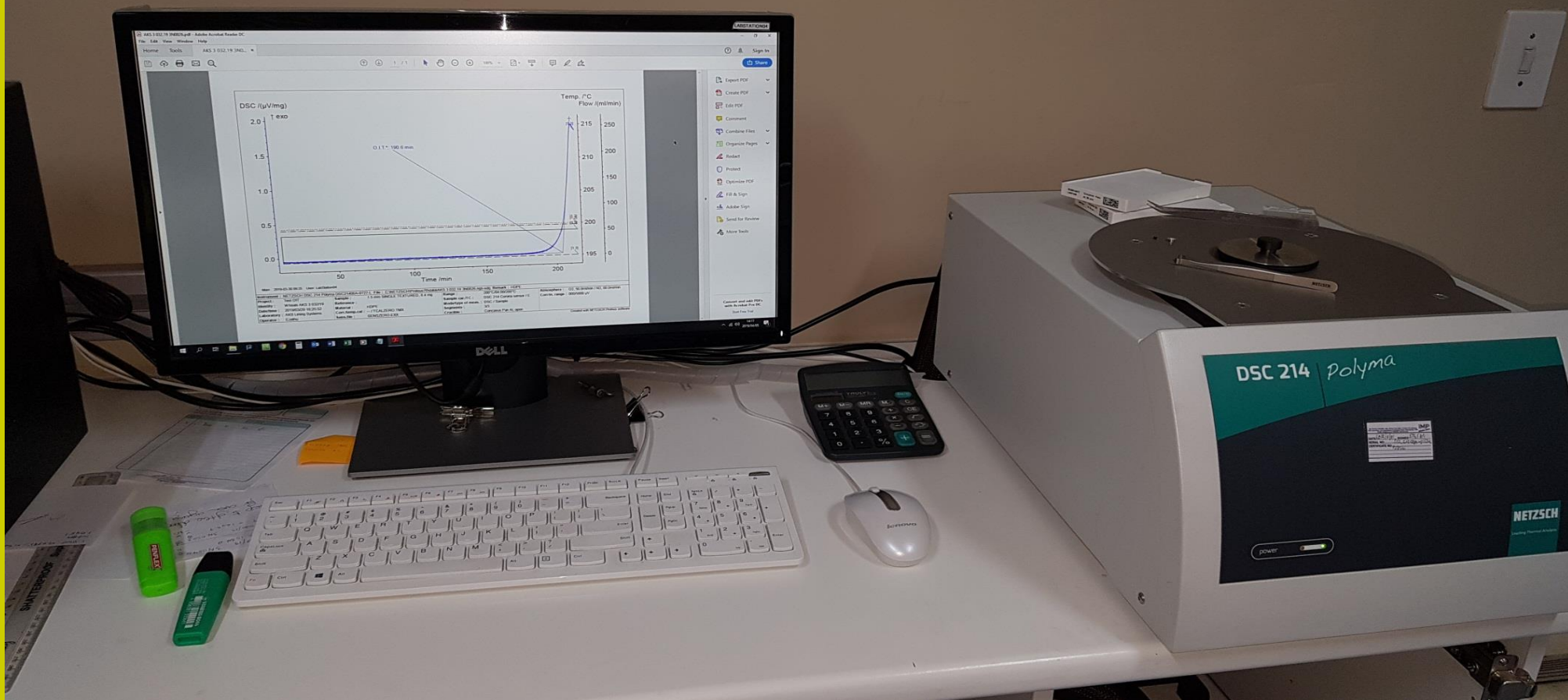


Density



- Carbon Black Content
- Carbon Black Dispersion
- Oven Ageing
- Dimensional Stability





Standard Oxidation Induction Time test

This test is to ensure that adequate Anti Oxidants are present in the liner. Test is performed at 200 Deg C. Test is performed in a pure Oxygen environment. This is a quick test at 100 min. For this project 200 min. This test measures the AO levels of high temp AO's



High Pressure Oxidation Induction Time test.

Test used to ensure correct Anti Oxidant levels are in the Liner. The test operates at 500 kPa. In a natural air environment, at lower temperatures than Std OIT test. The product is tested up to 1000 min. Project specification called for 600 min. GRI-GM13 calls for 400min.




AKS Lining Systems

ROLL CERTIFICATE – 1,5mm Mega double textured

| Roll Identification | | | | | | |
|--------------------------------------|-------------------|------------------------------------|----------------|-------------|--------|---------|
| Roll Number: 3N512 | | Size: 80 m x 7 m x 1.5 mm | | | | |
| Product: 1.5 mm Mega Double Textured | | Area: 560 m ² | | | | |
| Production Date: 05/03/2019 | | Weight: 1036 | | | | |
| Resin Information | | | | | | |
| Type: | | HDPE | | | | |
| M.I (190°C, 2.16 kg): | | 0.42 g/10min | | | | |
| Density: | | 0.934 g/cm ³ | | | | |
| Roll Properties | Unit | Test Method | Specification | Test Result | | |
| Thickness Minimum AVG | mm | ASTM D5199 | 1.5 | 1.74 | | |
| Density | g/cm ³ | ASTM D792 | 0.94 | 0.946 | | |
| Asperity Height | mm | ASTM D7466 | >0.95 | A | | B |
| | | | | >0.95 | | >0.95 |
| Tensile properties | | ASTM D6693 | | TD | MD | Average |
| Yield Strength | kN/m | Type IV Specimen at 50mm/min | 23 | 33.91 | 30.87 | 32.39 |
| Yield Elongation | % | | 13 | 15.39 | 19.89 | 17.67 |
| Break Strength | kN/m | | 16 | 33.77 | 30.80 | 32.29 |
| Break Elongation | % | | 400 | 455.34 | 456.21 | 455.77 |
| Tear Resistance | N | ASTM D1004 | 187 | 341.3 | | |
| Puncture Resistance | N | ASTM D4833 | 484 | 718.2 | | |
| Carbon Black Content | % | ASTM D4218 | 2 – 3 | 2.61 | | |
| Carbon Black Dispersion | Category | ASTM D5596 | Cat 1 or Cat 2 | Cat 1 | | |
| Dimensional Stability | % | ASTM D1204 | ± 2 | 1.74 | | |
| Standard OIT | min | ASTM D3895 | 200 | 227.0 | | |
| High Pressure OIT | min | ASTM D5885 | 600 | Pending | | |
| Oven Aging @ 85°C – 90 Days | | ASTM D5721 | 55 | Pending | | |
| OIT | % | ASTM D5885 | | | | |
| UV Resistance – 1600 Hours | | ASTM D7238 | 50 | >50 | | |
| OIT | % | ASTM D5885 | | | | |
| Stress Crack Resistance | hrs | ASTM D5397 | 1 000 | >1 000 | | |

Reviewed and Approved by:


 Jaqueline Sterrenberg
 Laboratory Manager

Date: 07/03/2019

MQC certificate,

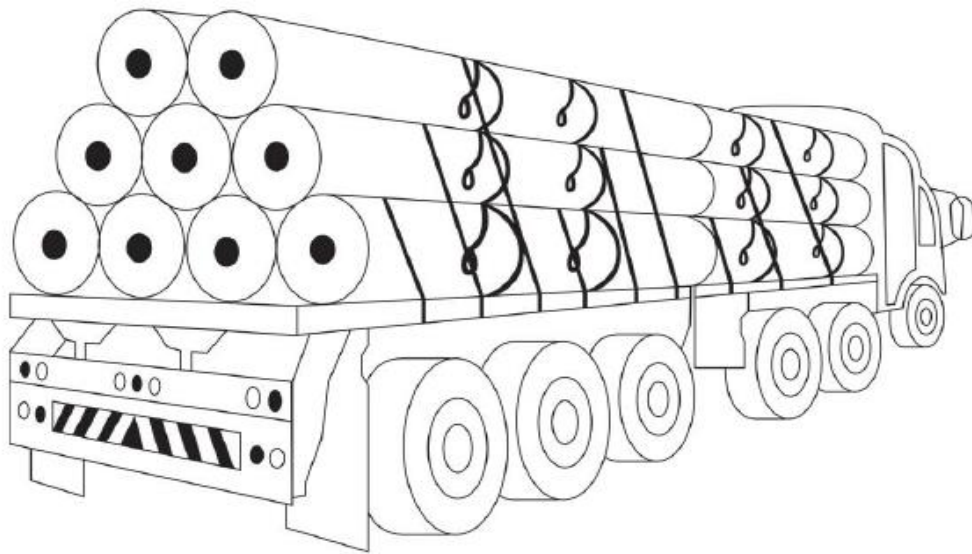
This certificate is generated from the in-house laboratory.

Some items take up to 3 – 4 months for the testing to be completed. This include the UV testing, Oven age testing, ESCR testing.

Each roll leaving the plant has a MQC Certificate.



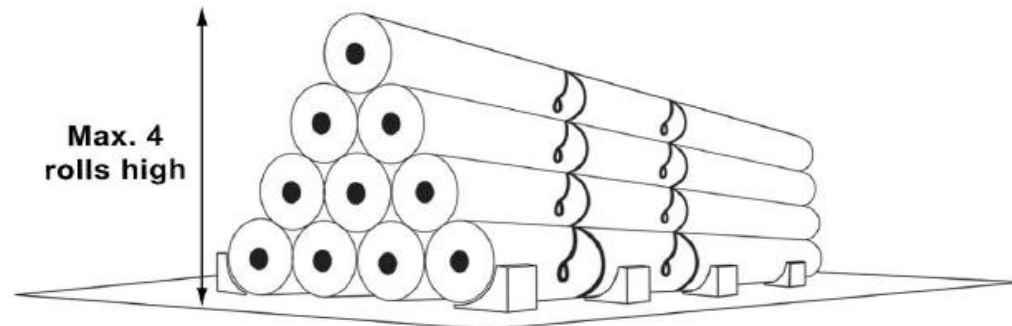
Storage and handling of the rolls



Side View

14m tri-axle truck,
maximum weight limit of 28 tons,
maximum of 18 rolls.

On-site Storage Recommendation



- Smooth, stone free, level and well-draining surface
- Adequate chocks to prevent rolling
- For prolonged storage in extreme heat, covering is recommended

Installation on site (SANS 10409)

- Earthworks
- Liner placement
- Liner welding
- Construction QC (liner specific)
- 3rd Party Construction QC
- Final handover (liner specific)

ICS 19.020; 59.080.70

ISBN 0-626-16609-8

SANS 10409:2005

Edition 1

SOUTH AFRICAN NATIONAL STANDARD

**Design, selection and installation of
geomembranes**

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9 Geomembrane installation

9.1 Earthworks

The civils contractor (if the installation contractor is a separate entity) shall be responsible for preparing and maintaining the subgrade or supporting surface in a condition suitable for installation of the liner.

9.1.1 Condition of supporting surface

9.1.1.1 The area to be lined shall be free from all protrusions, stones, roots, vegetation and other objects that might be detrimental to the performance of the geomembrane. Maximum particle size of objects shall typically not exceed 3 mm. If the *in-situ* soil is unsuitable, a sand or fine gravel blinding layer of thickness at least 2,5 times the largest dimension of the largest particle in the *in-situ* soil, or 50 mm (whichever is the thicker), or a suitable geotextile with properties sufficient to meet the above requirements, shall be placed over the entire area to be covered.

9.1.1.2 The subgrade shall be finished to the class of planar flatness as specified by the Engineer in the project specification.







W # 26
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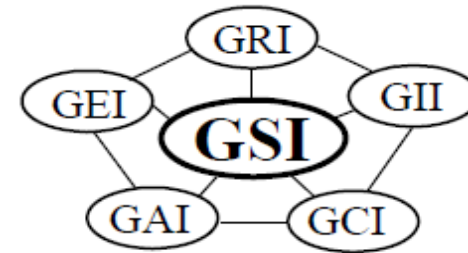


09/08/2007



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Revision 6: Oct. 3, 2011
Revision schedule is on pg. 12

GRI Test Method GM19*

Standard Specification for

**Seam Strength and Related Properties
of Thermally Bonded Polyolefin Geomembranes**

Once the liner installation is done and signed off by the RE on site, the protection geotextile is placed over the liner and the remainder of the layer works continues above.

Protection geotextiles need to have specific properties and performance criteria.

All of the work done in the Geomembrane specifying, manufacturing, testing, 3rd party testing, handling, delivery, deployment, welding and testing etc etc, can all be undone by poor geomembrane protection and rough construction processes.

Most importantly, if you do not protect the liner from mechanical damage during the construction process (and after), All of this effort will all be wasted.

Deon - Kaytech