# GEOMEMBRANE TEST RESULTS
## TRI Client: Gecat Plastic Factory
## Project: MQA

**Material: 2mm Single Sided Textured Geomembrane**
**TRI Log No.: A16-281**

**Sample Date(s):** 23/11/2016
**Test Date(s):** 24-11-2016 - 30-01-2017

**Sample conditioning for tests that require specific conditions**

| | Standard | | Laboratory | |
|---|---|---|---|---|
| | t (°C) | RH (%) | t (°C) | RH (%) |
| Thickness (ASTM D 5199) | 21 ± 2 | 60 ± 10 | 22 | 46 |
| Thickness (ASTM D 5994) | 21 ± 2 | 60 ± 10 | 22 | 46 |
| Asperity Height (ASTM D 7466) | 21 ± 2 | 60 ± 10 | 22 | 46 |
| Tensile (ASTM D 6693) | 21 ± 2 | n/a | 22 | 46 |
| Puncture Strength (ASTM D 4833) | 21 ± 2 | 65 ± 5 | 22 | 46 |
| Tear Resistance (ASTM D 1004) | 23 ± 2 | 50 ± 10 | 22 | 46 |

The laboratory temperature and relative humidity measurement is an average over the period during which the conditioning and testing was carried out.

All samples have been conditioned for a minimum of 24 hours unless otherwise stated.

Note
ASTM D6693-2010, Page 2 Note 5 states — *A humidity requirement has intentionally been left out of the test conditions due to the fact that polyolefins are not significantly affected by large fluctuations in humidity thereby making such a restriction unnecessary.*

Tests were performed as directed in each individual standard, unless otherwise stated.



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**Material: 2mm Single Sided Textured Geomembrane**
**TRI Log No.: A16-281**
**Sample Identification:** 3766 SS 3/3

| PARAMETER | TEST REPLICATE NUMBER | | | | | | | | | | MEAN | | GRI GM13 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | | | |
| **Thickness (ASTM D 5994)** | | | | | | | | | | | | | |
| Thickness (mm) | 1.975 | 1.850 | 1.900 | 1.950 | 1.975 | 1.875 | 1.900 | 1.850 | 1.875 | 1.925 | **1.900** | | ≥1.9 |
| | | | | | | | | | | | **1.850** | << min | ≥1.7 |
| Equipment used: AEI TG3. | | | | | | | | | | **STD. DEV.** | | **0.05** | |
| Sample dimensions: 125mm circle. | | | | | | | | | | **CV.** | | **2.6%** | |
| **Asperity Height (ASTM D 7466)** | | | | | | | | | | | | | |
| Asperity Height (mm) - Side A | 0.500 | 0.625 | 0.750 | 0.675 | 0.875 | 0.800 | 0.800 | 0.625 | 0.800 | 0.750 | **0.725** | | ≥0.4 |
| | | | | | | | | | | **STD. DEV.** | | **0.11** | |
| Equipment used: AEI TG3. | | | | | | | | | | **CV.** | | **15.5%** | |
| **Density (ASTM D 1505 @ 23°C)** | | | | | | | | | | | | | |
| Density (g/cm$^3$) | 0.949 | 0.949 | 0.949 | | | | | | | | **0.949** | | ≥0.94 |
| **Carbon Black Content (ASTM D 4218)** | | | | | | | | | | | | | |
| % Carbon Black | 2.11 | 2.06 | | | | | | | | | **2.09** | | 2 - 3 |
| **Carbon Black Dispersion (ASTM D 5596, Method: Microtome)** | | | | | | | | | | | | | |
| | | | | | | | | | | | | | ≥ 90% |
| Rating* - 1st field view | 1 | 1 | 1 | 1 | 1 | | | | | | | | 1 - 2 |
| Rating* - 2nd field view | 1 | 1 | 1 | 1 | 1 | | | | | | | | ≤ 10% |
| * PCN: 12-0455960-38 - Carbon dispersion classification chart for geosynthetics was used to rate agglomerate size range. | | | | | | | | | | | | | 3 |



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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | | | |
| **Tensile Properties (ASTM D 6693)** | | | | | | | | | Test speed: 50 mm/min | | | | |
| MD Yield Strength (N/mm) | 36.9 | 37.5 | 35.7 | 36.9 | 37.5 | | | | | | **36.9** | | ≥29 |
| | | | | | | | | | | **STD. DEV.** | | **0.73** | |
| TD Yield Strength (N/mm) | 37.4 | 37.4 | 37.1 | 38.1 | 37.6 | | | | | | **37.5** | | ≥29 |
| | | | | | | | | | | **STD. DEV.** | | **0.37** | |
| MD Break Strength (N/mm) | 56.4 | 59.0 | 57.1 | 44.9 | 54.7 | | | | | | **54.4** | | ≥21 |
| | | | | | | | | | | **STD. DEV.** | | **5.54** | |
| TD Break Strength (N/mm) | 50.1 | 50.0 | 54.0 | 52.0 | 57.9 | | | | | | **52.8** | | ≥21 |
| | | | | | | | | | | **STD. DEV.** | | **3.29** | |
| MD Yield Elongation (%) | 15 | 15 | 15 | 15 | 16 | | | | | | **15** | | ≥12 |
| TD Yield Elongation (%) | 15 | 14 | 15 | 17 | 17 | | | | | | **16** | | ≥12 |
| MD Break Elongation (%) | 644 | 667 | 663 | 533 | 622 | | | | | | **626** | | ≥100 |
| TD Break Elongation (%) | 588 | 585 | 634 | 596 | 659 | | | | | | **612** | | ≥100 |
| **Puncture Resistance (ASTM D 4833)** | | | | | | | | | | | | | |
| Puncture Strength (N) | 812 | 787 | 768 | 797 | 808 | 824 | 827 | 813 | 805 | 763 | **800** | | ≥534 |
| | | | | | | | | | | **STD. DEV.** | | **21.80** | |
| | | | | | | | | | | **CV.** | | **2.7%** | |
| **Tear Resistance (ASTM D 1004)** | | | | | | | | | Machine Used: AEI TM2-TRI 5-Station | | | | |
| MD Tear Strength (N) | 303 | 302 | 308 | 303 | 293 | 306 | 306 | 297 | 307 | 295 | **302** | | ≥249 |
| | | | | | | | | | | **STD. DEV.** | | **5.19** | |
| TD Tear Strength (N) | 291 | 305 | 295 | 310 | 289 | 307 | 297 | 300 | 296 | 292 | **298** | | ≥249 |
| | | | | | | | | | | **STD. DEV.** | | **7.12** | |
| **Oxidative Induction Time (ASTM D 3895)** | | | | | | | | | | | | | |
| OIT (minutes) | 181 | 185 | | | | | | | | | **183** | | ≥100 |
| **High Pressure Oxidative Induction Time (ASTM D 5885)** | | | | | | | | | | | | | |
| HPOIT (minutes) | 1185 | | | | | | | | | | **1185** | | ≥400 |

MD Machine Direction TD Transverse Direction



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**Oven Aging (ASTM D 5721)**

The geomembrane was exposed to 90 days of elevated temperature exposure in an air oven maintained at 85°C ± 0.5°C in accordance with ASTM D 5721, Standard Practice for Air-Oven Aging of Polyolefin Geomembranes. Oxidative Induction Time (OIT) was tested after exposure and compared to values generated for unexposed material. The results are provided below.

| | | | MEAN | PERCENT RETAINED |
|---|---|---|---|---|
| OIT (minutes) - Baseline | 157 | 172 | **164.5** | |
| OIT (minutes) - After Oven Aging | 90 | 92 | **91** | 55 |
| HPOIT (minutes) - Baseline | 953 | | **953** | |
| HPOIT (minutes) - After Oven Aging | 919 | | **919** | 96 |

Note: No surface cracking was observed.

**UV Resistance (ASTM D 7238)**

The resistance to degradation due to exposure to ultraviolet light and moisture was determined in accordance with GRI-GM11, Accelerated Weathering of Geomembranes Using a Fluorescent UVA Device. This standard covers the basic principles for using the QUV apparatus to accelerate the weathering of geomembranes using UVA bulbs and condensation. To comply with specification GRI GM13, the sample was exposed to 1600 hours of UV exposure composed of 80 cycles of UVA at 75°C for 20 hours followed by condensation at 60°C for 4 hours. The High Pressure Oxidative Induction Time (HPOIT) was evaluated before and after the exposure and results were as follows.

| | | MEAN | PERCENT RETAINED |
|---|---|---|---|
| HPOIT (minutes) - Baseline | 953 | **953** | |
| HPOIT (minutes) - After QUV Aging | 950 | **950** | 100 |

Note: No surface cracking was observed.

MD Machine Direction TD Transverse Direction

**End of Report**



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