

GRI-GM22 Specification

Reinforced Polyethylene Geomembranes for Exposed Temporary Applications

- targeted lifetime is 5-10 years
- 20, 12, 8 mil (0.50, 0.30, 0.20 mm) thickness classes
- silent on method of manufacturing
- lists properties, test methods, test values, and testing frequencies
- covers twelve (12) different properties

Strength Categories

- qualitative categories
 1. severe; 20 mil (0.45 mm)
 2. moderate; 12 mil (0.30 mm)
 3. gentle; 8 mil (0.20 mm)
- categories refer to the following:
 1. type of subgrade
 2. manner of installation
 3. anchorage and tie downs
 4. site-specific conditions

Preliminary Comments

- definition of “formulation”

The mixture of a unique combination of ingredients identified by type, properties and quantity. For PE geomembranes a formulation is defined as the exact percentages and types of resin(s), additives and carbon black.

- values based on U.S. (English) units

- conversion to S.I. units is “soft”

Physical Properties

1. thickness

2. weight

Mechanical Properties

3. grab strength

5. strip strength

4. grab elongation

6. strip elongation

7. tongue tear

8. CBR puncture

9. hydrostatic resistance

10. WVT

Endurance Properties

11. OIT

12. UV Resistance

1. Thickness

- follows ASTM D751
- dead weight micrometer with flat tip
- includes scrim when reinforced
- 10-specimens across roll width
- required for each roll
- average must equal nominal
- lowest individual is -10%

D751
Thickness Test



2. Weight

- correct term is mass per unit area
- follows ASTM D751
- five specimens across roll width
- values averaged and compared to spec value stated as “min. ave.”
- straightforward test on every roll
- unit is lb/1000 ft² (kg/1000 m²)

ASTM D751
"Weight"



3/4 & 5/6. Grab and Strip Tensile Strength

- ASTM D7004; grab strength & elongation
- ASTM D7003; strip strength & elongation
- both tests are required
- min. ave. of both 5 MD and 5 XMD
- every 20,000 lb (9000 kg)



ASTM D7004 – Grab Tensile Test (Measures Strength and Elongation)



ASTM D7003 – Strip Tensile Test
(Measures Strength and Elongation)

7. Tongue Tear Test

- uses ASTM D5884
- specimen 8 × 4 × 3 in.
(200 × 100 × 75 mm slit)
- speed is 2.0 in./min (50 mm/min)
- average of 5MD and 5XMD
- every 20,000 lb (9,000 kg)



D5884
Tongue Tear

8. CBR Puncture Strength

- California Bearing Ratio (CBR) is a soil strength test adopted for geosynthetics puncture
- follows ASTM D6241 using the same device
- probe is 2.0 in. (50 mm) diameter
- container is 6.0 in. (150 mm) diameter
- 10 specimens across roll width
- take average value of each
- every 20,000 lb (9,000 kg)



D6241 - Puncture (CBR) Strength
(Evaluates Strength at Rupture and Accompanying Deformation)

9. Hydrostatic Resistance

- follows ASTM D751
- specimen inflated with water
- inflated diameter 1.24 in. (31 mm)
- pressure rate 6.0 in³.min (1.6 cm³/sec)
- every 45,000 lb (20,000 kg)



ASTM D751 – Hydrostatic Resistance Testing

10. Water Vapor Transmission (WVT)

- follows ASTM E96
- GM covers an aluminum cup
- encloses water or desiccant at 73°F (23°C) and 50% RH
- placed in relative humidity chamber
- loses weight (water) or gains (desiccant)
- slope of weight vs. time graph is WVT
- max. values are 0.4, 0.7, 1.2 g/m²-day

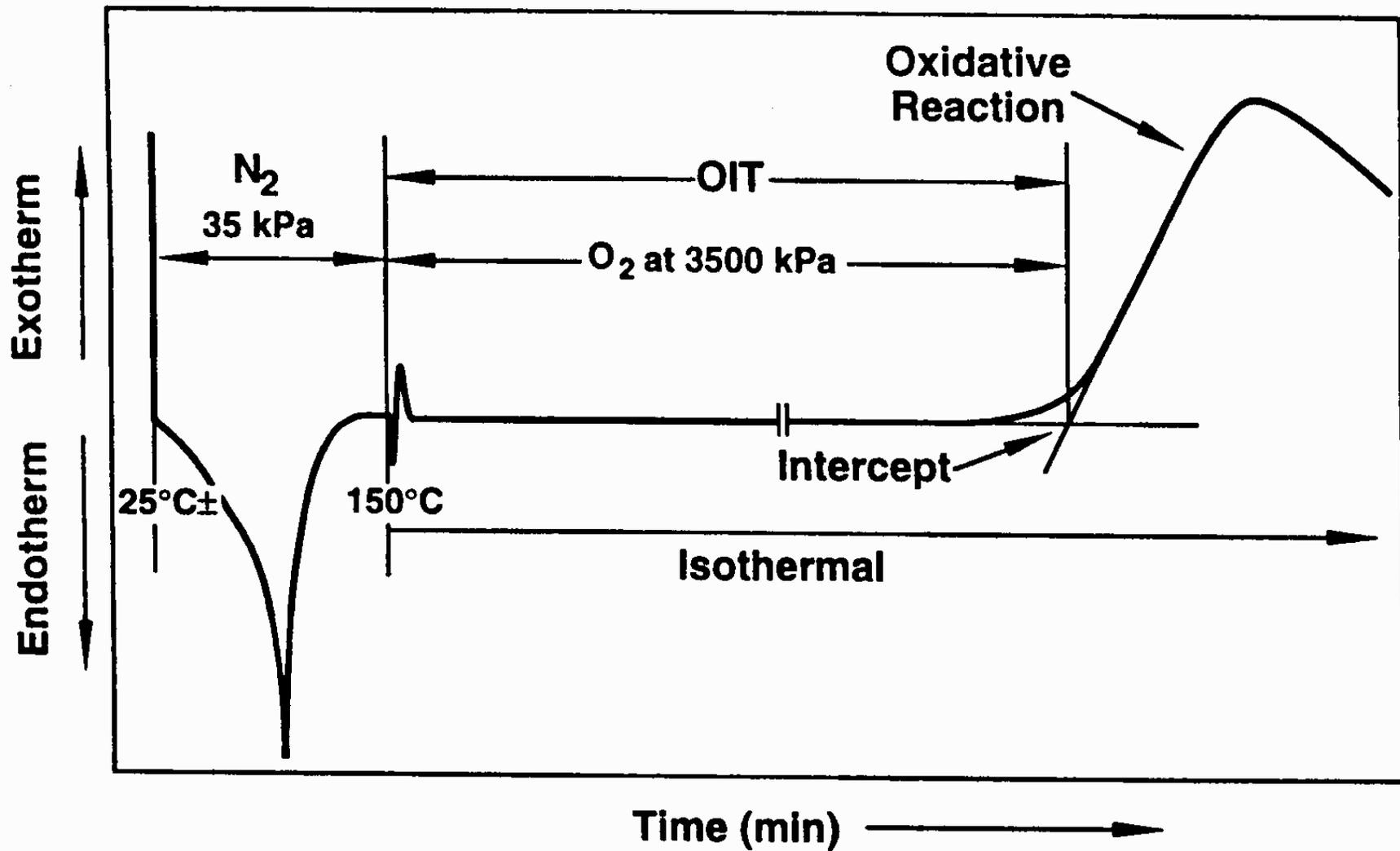


ASTM E96 – Water Vapor Transmission Test

11. Oxidative Induction Time

- OIT is an indirect measure of the amount of antioxidants in the formulation
- HP-OIT, per ASTM D5885, is required
- small specimen ≈ 2 mg
- pressure at 500 lb/in.² (3500 kPa)
- temperature at 150°C in N₂; 1-min. dwell; switch to O₂; record time; see following
- requires 1000 min. for as manufactured material

HP-OIT (ASTM D5885)





D5885
HP-OIT

12. Ultraviolet Resistance

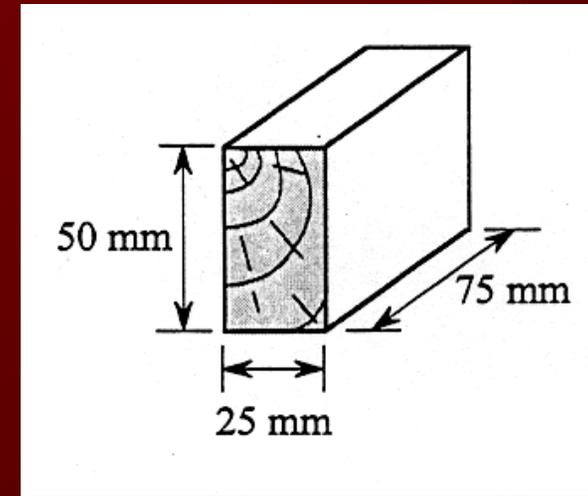
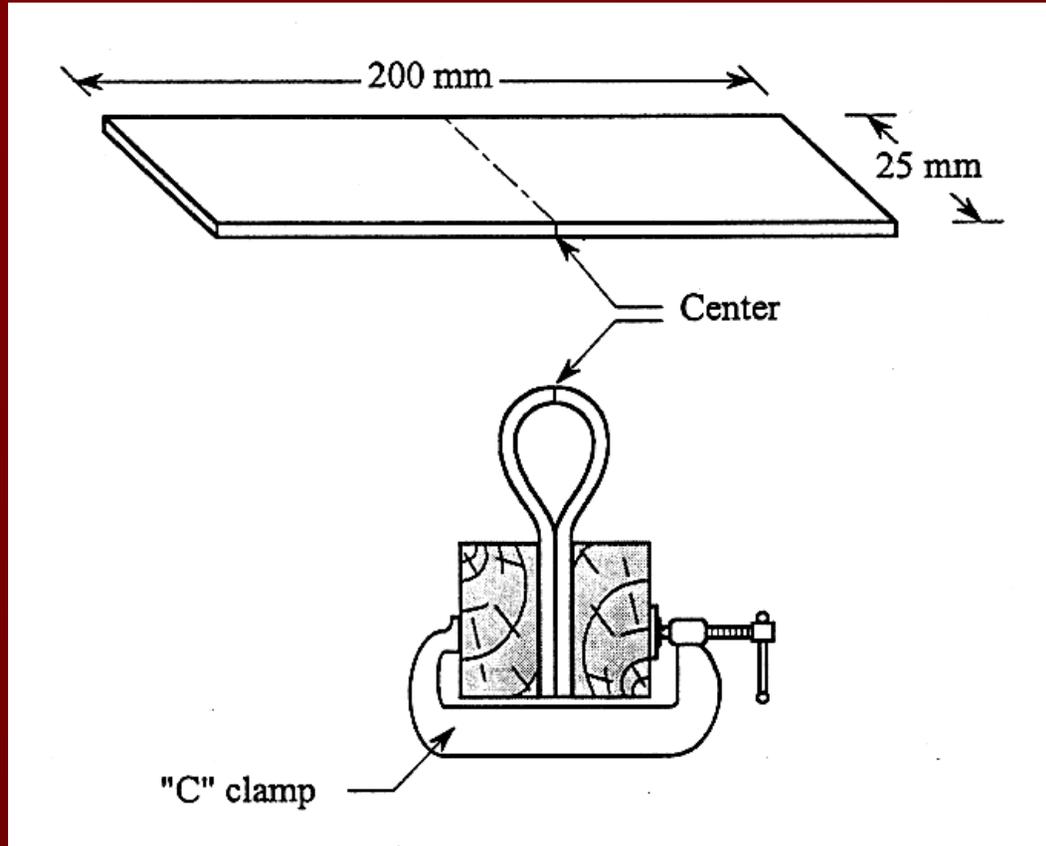
- assessment of UV stability of the AOs and CB (there should be synergy between them)
- uses a QUV laboratory weatherometer
- follows ASTM D7238
- called “ultraviolet fluorescent device”
- 20 hr. UV cycle at 75°C, then 4 hr. condensation at 60°C for 10,000 hr.
- $\geq 50\%$ grab strength and elongation to be retained
- also, no cracking after incubation per GRI GM16
- frequency is once per formulation



ASTM D7238 – Ultraviolet Fluorescent Weatherometer

In Addition to the OIT Criterion

- incubated specimen cannot crack
- follows GRI GM16 test method
- 180 deg. bending within a holder
- visual observation for cracks at 7X magnification resulting in a “go” or “no-go” decision



Test Specimen as Removed from Weathering Device, Bent 180 deg. and Clamped Between Two Wooden Blocks and One of the C-Clamp

Concluding Comments

- specification addresses reinforced polyethylene GMs for exposed installations
- this is MQC specification i.e., lists the manufacturers required tests, minimum values and frequencies
- if MQA project specific spec is more restrictive, manufacturer may ask for additional compensation

The Basic Tables Follow

PE-R – English Units
PE-R – SI Units

Note: The most recent version of this specification (text and tables) is available on the GSI Web Site at [<geosynthetic-institute.org>](http://geosynthetic-institute.org).

Table 1(a) – Specification Values for Exposed Scrim Reinforced Polyethylene Geomembranes

Property and Units ⁽¹⁾	ASTM or GRI Test Methods	Category 1 – Severe ⁽²⁾ (20 mil – nominal)	Category 2 – Moderate ⁽²⁾ (12 mil – nominal)	Category 3 – Gentle ⁽²⁾ (8 mil – nominal)	Testing Frequency
Thickness ⁽³⁾ (mils)	ASTM D751	17	10	6	per roll
Weight, (lb/1000 ft ²)	ASTM D751	94	53	34	20,000 lb
Grab Tensile Strength ⁽⁴⁾ (lb)	ASTM D7004	114	76	59	20,000 lb
Grab Tensile Elongation ⁽⁴⁾ (%)	ASTM D7004	15	15	15	20,000 lb
Strip Tensile Strength ⁽⁴⁾ (lb)	ASTM D7003	77	51	45	20,000 lb
Strip Tensile Elongation ⁽⁴⁾ (%)	ASTM D7003	15	15	15	20,000 lb
Tongue Tear (lb)	ASTM D5884	53	40	15	20,000 lb
CBR Puncture (lb)	ASTM D6241	320	220	150	45,000 lb
Hydrostatic Resistance ⁽⁵⁾ (lb/in. ²)	ASTM D751	130	85	60	45,000 lb
Water Vapor Transmission (WVT) (g/m ² -day) ⁽⁷⁾	ASTM E96	0.4	0.7	1.2	200,000 lb
Oxidative Induction Time (OIT)					
(a) Standard OIT (min.)	ASTM D3895	(6)	(6)	(6)	per each
(b) High Pressure OIT (min.)	ASTM D5885	1000	1000	1000	formulation
UV Resistance (fluorescent light method)	ASTM D7238				
(a) Str. & Elong. retained after 10,000 hrs	ASTM D7004	50%	50%	50%	per each
(b) Response to bending	GRI GM16	no cracking	no cracking	no cracking	formulation

Notes

- (1) All values are minimum, or minimum average, except WVT which is a maximum value.
- (2) The categories refer to the type of subgrade, manner of installation, anchorage/tie downs, and site-specific conditions.
- (3) The thickness value is measured in the valleys created by the scrim reinforcement, i.e., ply to ply thickness between scrim should be measured.
- (4) If the reinforcement is aligned in any direction other than the machine and transverse directions, specimen shall be cut such that reinforcing yarns are oriented parallel to the central axis of the tension testing machine.
- (5) The center of the circular test specimen should be equidistant between sets of parallel yarns.
- (6) Not recommended since the high temperatures of the STD-OIT test produces an unrealistic result for some of the antioxidants used in these materials.
- (7) Performed at 23° ± 0.5°C temperature and 50% ± 5% relative humidity.

SI (Metric) Units

Table 1(b) – Specification Values for Exposed Scrim Reinforced Polyethylene Geomembranes

Property and Units ⁽¹⁾	ASTM or GRI Test Methods	Category 1 – Severe ⁽²⁾ (0.50 mm – nominal)	Category 2 – Moderate ⁽²⁾ (0.30 mm – nominal)	Category 3 – Gentle ⁽²⁾ (0.20 mm – nominal)	Testing Frequency
Thickness ⁽³⁾ (mm)	ASTM D751	0.43	0.25	0.15	per roll
Weight, (kg/1000 m ²)	ASTM D751	0.50	0.28	0.18	9,000 kg
Grab Tensile Strength ⁽⁴⁾ (N)	ASTM D7004	510	340	260	9,000 kg
Grab Tensile Elongation ⁽⁴⁾ (%)	ASTM D7004	15	15	15	9,000 kg
Strip Tensile Strength ⁽⁴⁾ (N)	ASTM D7003	340	225	200	9,000 kg
Strip Tensile Elongation ⁽⁴⁾ (%)	ASTM D7003	15	15	15	9,000 kg
Tongue Tear (N)	ASTM D5884	235	180	65	9,000 kg
CBR Puncture (N)	ASTM D6241	1420	980	670	20,000 kg
Hydrostatic Resistance ⁽⁵⁾ (kPa)	ASTM D751	900	590	410	20,000 kg
Water Vapor Transmission (WVT) (g/m ² -day) ⁽⁷⁾	ASTM E96	0.4	0.7	1.2	200,000 kg
Oxidative Induction Time (OIT)					
(a) Standard OIT (min.)	ASTM D3895	(6)	(6)	(6)	per each formulation
(b) High Pressure OIT (min.)	ASTM D5885	1000	1000	1000	
UV Resistance (fluorescent light method)	ASTM D7238				
(a) Str. & Elong. retained after 10,000 hrs	ASTM D7004	50%	50%	50%	per each formulation
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