

GRI's Generic Specifications for Various Types of Geosynthetic Materials

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1. The 10-Step Process

- (i) Need expressed by GSI member(s)
- (ii) Initial discussion in focus group
- (iii) Presentation of draft property table(s)
- (iv) Further discussion in focus group
- (v) Eventually text is added to table(s)

- (vi) More discussion in focus group
- (vii) When close, draft spec is sent to all members
- (viii) Back to focus group for modification
- (ix) One more iteration, then daylight the original on GSI Web Site
- (x) Revise/maintain on a regular basis

2. Current Specifications (2015)

Geomembranes

GM13 – HDPE

GM17 – LLDPE

GM18 – fPP & fPP-R

GM19 – Seams

GM21 – EPDM & EPDM-R

GM22 – PE-R (exposed)

GM25 – LLDPE-R

GM28 – CSPE-R

Geotextiles

GT10 – Tubes

GT12 – Cushions

GT13 – Separators

Other GSs

GCL3 – GCL's

GS15 – Geocells

GC14 – TRMs

GRI-GM22 – Reinforced Polyethylene (PE-R) Geomembranes

- focuses on exposed and temporary application
- targeted lifetime is 5 to 10 years
- 20, 12, 8 mil (0.50, 0.30, 0.20 mm) thickness
- ten test methods are required:
 - physical: thickness and weight
 - mechanical: grab, strip, tear, puncture, burst and vapor transmission
 - endurance: OIT and UV resistance
- min. testing frequencies also listed

GRI-GM25 – Reinforced Linear Low Density Polyethylene (LLDPE-R) Geomembranes

- counterpoints GM17 on LLDPE (which is nonreinforced)
- difference is the scrim reinforcement
- 45, 36 and 24 mils (1.14, 0.91 and 0.61 mm) thicknesses
- nine test methods are required:
 - physical: thickness and weight
 - mechanical: grab, tear, puncture and ply adhesion
 - endurance: initial OIT, OIT after oven and UV incubations
- min. testing frequency also listed

GRI-GM28 – Reinforced Chlorosulphonated Polyethylene (CSPE-R) Geomembranes

- resin currently being imported to U.S.
- required weight (as with old NSF spec)
- flexibility and stability required
- CB content can be up to 36%
- UV stability incubations via D7238 (UV fluorescent tube device)
- min. testing frequencies also listed

GRI-GM19 – HDPE, LLDPE, fPP Seams

- specimen width is 25 mm
- except fPP-R, a grab test
- hot wedge values same as extrusion
- shear strengths > peel strengths
- shear elongation > 50% all cases
- peel separation < 25% all cases

GRI-GT10 – High Strength Geotextile Tubes

- typically woven PET or PP fabrics
- main tube separate from scour aprons
- aggressive and typical conditions
- circumference and fill port standardized
- wide width strength and elongation, tear, puncture and seam
- AOS and flux
- Xenon Arc UV resistance $\geq 65\%$ after 150 hr.

GRI-GT12 – Nonwoven GTs for Protection

- up to 2000 g/m²
- grab strength and elongation
- trapezoidal tear
- puncture (pin, pyramid or CBR)
- Xenon Arc UV resistance $\geq 70\%$ at 500 hrs
- all MARV except UV resistance

GRI-GT13 – Geotextile Separation for Roadways

- GT placed on subgrade with aggregate above
- firm subgrade application, i.e., paved roads
- three levels of survivability
- survivability guide is included
- test methods (both ASTM and ISO) required are grab, tear, puncture, permittivity, AOS, and UV stability by Xenon Arc
- augments AASHTO M288 specification

GRI-GCL3 – Geosynthetic Clay Liners

- reinforced and nonreinforced
- GT and GM related
- Clay; swell index and fluid loss
- GCL (as manufactured)
 - mass (of GCL and clay)
 - moisture content
 - thickness
 - grab (MD/XMD) and puncture
 - peel strength
 - flux and permeability
- GCL (long-term)
 - bentonite (draft GRI)
 - geotextile/yarns (draft GRI)
 - geomembranes (draft GRI)

GRI-GS15 – Geocells Made From HDPE

- thickness and density of strips included
- seam strip strength included
- friction angle of soil infill is prescribed
- OIT standard or high pressure required
- incubation by oven and UV necessary
- UV resistance uses fluorescent tubes
- min. testing frequencies are included

GRI-GC14 – Turf Reinforcement Mats

- only addresses polymeric TRMs
- does not include natural materials
- applies to soil slopes and channels/ditches
- subdivided into three categories
- resiliency and light penetration included
- UV incubation is via D7238
- min. testing frequency is via D4354

3. Draft Specifications

- GRI GGXX for Bidirectional Geogrids
- GRI GGXX for Unidirectional Geogrids
- GRI GNXX for Biplanar Geonet Composites
- GRI GCXX for Drainage Geocomposites

GRI-GGXX – Bidirectional Geogrids (Pavements)

- tensile strength @ 2%, 5%, ultimate
- XMD > MD
- pullout interaction coefficient > 0.8
- direct shear > 30 deg
- aperture size 15 to 75 mm
- torsional rigidity; draft GRI Test
- Xenon Arc UV resistance \geq 70% at 500 hrs.

GRI-GGXX – Unidirectional Geogrids (Wall & Slopes)

- three different categories
- monolithic PE; coated PET yarns; PET straps
- coating adhesion test for PET yarns (GRI draft)
- six ultimate strength classes
- junction efficiency (GRI-GG2)
- pullout interaction coefficient > 0.8
- direct shear > 30 deg
- default RFs for CR, ID, CBD and seams
- PE durability; OIT, CB, UV
- PET durability; UV, M_w , CEG

GRI-GNXX – Biplanar Geonets & Geocomposites

- focuses on waste containment
- GN & GT before lamination
- then the composite
- GN; ρ , t , CB, $\theta = f(t)$
- GT; Class 1 & 2 of AASHTO M288
- composite; single and double sided
- transmissivity for different thicknesses
- ply adhesion

GRI-GCXX – Drainage Geocomposites

- focuses on transp./geotech./private
- requires compressive strength
- core (t, comp, flow rate)
- GT: Class 1 and 2 of AASHTO M288
- composite: single and double sided
- uses flow rate (not θ) after lamination
- ply adhesion

Additional Aspects of Specs

- (a) minimum testing frequencies are generally included
- (b) the test methods are tightened-up whenever necessary
- (c) units are in SI and American
- (d) mostly ASTM methods (some ISO)
- (e) all are available free on the internet at [<geosynthetic-institute.org >](http://geosynthetic-institute.org)

Some Additional GS Specifications

- GTs in transportation applications
 - see AASHTO M288
- PVDs and Edge Drains
 - see Dutch and ASTM
- PVC Geomembranes
 - ASTM and GSI (working)
- Various types of plastic pipe
 - solid wall, see ASTM F17
 - profiled, see AASHTO

Some Potential Difficulties

- GRI specs are based on ASTM standards
- ISO is a worldwide standards-setting group
- most countries in Europe, Asia, Africa will probably go with ISO (an opinion)
- CEN (Vienna Agreement) controls ISO
- we will need dual ASTM/ISO tables

ITEM	ORGANIZATION		
	ASTM	ISO	CEN
Process	4 steps*	6 steps	6 steps
Voting	Each member**	1 country/1 vote	By country, but, weighted and based on gross national product, and population
Time Limit	No time limit	To Enquiry Stage within 3 years	To Enquiry Stage within 2 years
Voting Requirement	60% ballot return - 90% affirmative	2/3 affirmative for approval, no more than ¼ negative	76% of weighted vote for approval
Membership	Voting producer membership may not exceed voting user/general interest membership. Individual membership from 19 nations.	No membership balance required. 37 nations represented from Europe, Asia, Australia, Africa, N & S Amer.	No membership balance required. 15 EU member nations; 4 non-EU European nations that have signed the Vienna Agreement: 4 nations as observers
Support	Individual's employer	Other than USA, delegates may receive support from gov't., or national standards body.	Similar to ISO
Negatives	Stops progress until negative vote is resolved.	Enquiry negatives – revision prior to Stage 5 – Stage 5 is a Yes/No vote	Same as ISO
Review	Every 5 years after approval.	Every 5 years after approval.	Every 5 years after approval.

4. Endorsement via User Feedback

- our highest endorsement
“use latest modification of GRI GXXX”
- an intermediate endorsement
“use latest modification of GRI-GXXX,
except _____, _____, and
_____”
- the lowest, i.e., negative endorsement
“use NSF54 for XXXX”
“use Consultant XYZ Specification for XXXX”
“use Manufacturer ABC Spec for XXXX”

Alternative User Feedback

- direct contact to manufacturers
- direct contact to us
- indirect contact through literature
- use of alternative material!

5. Revisions and Maintenance

- adoption and revision dates are on last page of each specification
- revision schedule describes the specific action that was taken
- GM13 (12 rev.); GM17 (11 rev.); etc., etc.
- possible transition to ASTM or ISO
- GRI Standards meant to be permanent and are registered accordingly

6. Benefits to the Industry

- signifies a healthy maturing of the industry
- provides a comfort level to regulators
- designers can focus on the recommended values
- uninformed specifiers can use it directly
- informed specifiers can modify it directly
- test labs know exactly what to expect
- manufacturers can inventory material
- manufacturers can charge for atypical requirements
- resin and additive suppliers are not “blind sided” with unusual demands

7. The Tutorials

- each specification includes a ppt tutorial
- all tests are commented upon and illustrated by lab photos
- eventually a “You Tube-type” movie
- perhaps even a “Book of GS Tests”
- George Koerner’s GS Lab Accreditation program is extremely active (≥ 70 worldwide labs)
- www.geosynthetic-institute.org/gai/intro.pdf

Thanks for Using These Specs

And

**Please Let Us Hear from You
(both good and bad!)**