SUPERSEDED BY EI 13-015 EFFECTIVE 1/9/14

To:

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New York State Department of Transportation

ENGINEERING INSTRUCTION

EI 10-025

Title: **SECTION 737 – GEOSYNTHETICS**

Distribution:
- ☐ Manufacturers (18)
- ☒ Local Govt. (31)
- ☒ Agencies (32)
- ☐ Surveyors (33)
- ☒ Consultants (34)
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- ☐ _____( )

Approved:

Robert L. Sack, P.E.
Deputy Chief Engineer (Research)

10 AUG 10
Date

ADMINISTRATIVE INFORMATION:

- This Engineering Instruction (EI) is effective beginning with projects submitted for the letting of January 6, 2011.
- This EI supersedes EI 08-005.
- The information transmitted by this issuance will be incorporated into a future revision to the Standard Specifications.

PURPOSE: The purpose of this EI is to issue new Section 737 *Geosynthetics* of the Standard Specifications.

TECHNICAL INFORMATION:

- Portions of Section 737 *Geosynthetics* issued via EI 08-005 are being revised. The entire section is being reprinted as part of this updated issuance of Section 737 *Geosynthetics* to organize and minimize proposal inserts.
- Specification §737-04 *Prefabricated Composite Structural Drains,* §737-05 *Prefabricated Composite Integral Abutment Drains* and §737-06 *Prefabricated Composite Edge Drains* are being revised to state for vertical applications (abutments, walls), the geotextile has to be bonded to the core. Whereas for horizontal applications (edge drains), the geotextile may be bonded to the core or tightly wrapped around the core.
- The Basis of Acceptance section in §737-01 *Geotextiles* is being revised to include the requirement of the material being subject to a visual inspection by the Regional Geotechnical Engineer. This requirement was omitted during the development of the Standard Specification Section 737 *Geosynthetics.* This is not a new requirement, as the Regional Geotechnical Engineers have used this requirement to maintain part of the Departments Quality Assurance (QA) program.
- The Basis of Acceptance section in §737-03 *Prefabricated Vertical Drains,* §737-04 *Prefabricated Composite Structural Drains,* §737-05 *Prefabricated Composite Integral Abutment Drains,* and §737-06 *Prefabricated Composite Edge Drains* are being revised to include the requirement of a letter, identifying the geotextile covering, to accompany the material certification to explicitly identify that the covering material is on the Approved List. This requirement was omitted during the development of the Standard Specification Section 737 *Geosynthetics.*

IMPLEMENTATION:

- The Main Office Design Quality Assurance Bureau will insert these revisions to the standard specifications into contract proposals beginning with projects submitted for the letting of January 6, 2011.

TRANSMITTED MATERIALS:

- Standard Specification revisions to *Section 737 Geosynthetics.*

BACKGROUND: The general term geosynthetics encompasses the subfamilies of geotextiles, geogrids, geocells, geocomposites, and geomembranes. Various construction practices incorporate geosynthetics to take advantage of their properties and ease of installation. Geosynthetics have six primary functions: filtration, drainage, separation, reinforcement, fluid barrier, and protection. The type of geosynthetic used on a particular project will depend on its intended primary function in the installation, and thus its critical properties.

The Department maintains an approved list for geotextiles, geocomposites, and geomembranes. Geotextiles are broken down into five application categories: bedding, separation, drainage, slope protection and stabilization. Geocomposites are broken down into four application categories: structural drains, integral abutment drains, vertical drains and edge drains.

CONTACT: Questions or comments regarding this issuance should be directed to Randall. J. Romer, P.E. of the Geotechnical Engineering Bureau at (518) 457-4714, rromer@dot.state.ny.us. Questions or comments regarding the technical aspects of the revisions to the Standard Specification should be directed to John Remmers of the Geotechnical Engineering Bureau at (518) 457-4704, jremmers@dot.state.ny.us.

Make the following changes to the Standard Specifications dated May 4, 2006:

Replace Section 737 in its entirety with the following:

SECTION 737 – GEOSYNTHETICS

QUALITY ASSURANCE PROGRAM. The Department maintains a Quality Assurance (QA) program for geosynthetics. For monitoring purposes, the Geotechnical Engineering Bureau will test a sample of the geosynthetic material delivered to the project site to compare its properties to those properties determined at the time of the product's initial approval, which may indicate a change has occurred in the manufacturer's process or Quality Control (QC) process.

Several scenarios may develop as a result of the QA testing.

1. The properties are shown to be the same as originally determined within the statistical validity of the test. No action will be taken.
2. The properties are shown to be significantly different than originally determined.
   a. If the results are within the acceptable minimum for approval, contact with the manufacturer will be made by the Geotechnical Engineering Bureau to determine what has changed.
   b. If the results are below the minimum acceptable for approval, the product's status on the Approved List will be re-evaluated. The manufacturer will be notified of the review.

737-01 GEOTEXTILES

SCOPE. This specification covers the material requirements and methods of testing geosynthetic materials used in highway construction. The following Geotextile Structure Types are evaluated in this specification:

737.0101 – Needle-Punched – Non-Woven	(NP – NW)
737.0102 – Heatbonded – Non-Woven	(HB – NW)
737.0103 – Monofilament - Woven	(MF – W)
737.0104 – Multifilament – Woven	(MuF – W)
737.0105 – Slit Film – Woven	(SF – W)
737.0106 – Combination Monofilament/Fibrillated Yarn – Woven	(C – W)
737.0107 – Recycled/ Reinforced Needle-Punched – Non-Woven	(R/R NP – NW)
737.0108 – Circular – Woven	(Cir – W)

GENERAL. The Department's evaluation of geotextiles submitted will be based on the following tests:

1. Soil Retention - The test to evaluate this characteristic will be performed in accordance with the Apparent Opening Size Test, ASTM D4751.
2. Flow Capacity - The test to evaluate this characteristic will be performed in accordance with the Permittivity Test, ASTM Method D4491.
3. Tensile Strength - The tests to evaluate this characteristic will be performed in accordance with the following:
   a. Grab Test Method, ASTM D4632
   b. Trapezoid Tear Test Method, ASTM D4533
   c. Static Puncture Strength Using a 50 mm Probe, ASTM D6241

Applications. Based on the above tests and criteria that follow, the Geotextiles may be accepted for the following:

- Geotextile Bedding
- Geotextile Separation
- Geotextile Drainage
- Geotextile Slope Protection
- Geotextile Stabilization
- Turbidity Curtains
- Silt Fence

MATERIAL REQUIREMENTS. Following is a table of the requirements by applications:

A. Geotextile Bedding. Geotextile bedding shall meet the requirements of Table 737-01A.

Table 737-01A Bedding Geotextile Requirements

Application	Geotextile Structure	Minimum Strength Class Requirements					Bedding Class Requirements			
		Class	Percent Elongation (%)	Grab Strength (N)	Tear Strength (N)	Puncture Strength (N)	Class	Apparent Opening Size (maximum) Sieve Size (mm)	Apparent Opening Size (maximum) Sieve Designation	Minimum Permittivity (sec^{-1})
Geotextile Bedding	C – W	1	< 50%	1400	500	2750	A	0.43	No. 40	0.7
			≥ 50%	900	350	1925	B	0.25	No. 60	0.2
	MF - W	2	< 50%	1100	250	2200	C	0.22	No. 70	0.1
			≥ 50%	700	250	1375				

B. Geotextile Separation. Geotextile separation shall meet the requirements of Table 737-01B.

Table 737-01B Separation Geotextile Requirements

Application	Geotextile Structure	Minimum Strength Class Requirements					Separation Class Requirements			
		Class	Percent Elongation (%)	Grab Strength (N)	Tear Strength (N)	Puncture Strength (N)	Class	Apparent Opening Size (maximum) Sieve Size (mm)	Apparent Opening Size (maximum) Sieve Designation	Minimum Permittivity (sec^{-1})
Geotextile Separation	Any type listed in §737-01Scope	2	< 50%	1100	400 [1]	2200	NA (X)	0.6	No. 30	0.02
			≥ 50%	700	250	1375				

Table 737-01B Notes:

[1] For woven monofilament geotextiles the minimum average value is 250 N.

C. Geotextile Drainage. Geotextile drainage shall meet the requirements of Table 737-01C.

Table 737-01C Drainage Geotextile Requirements

Application	Geotextile Structure	Minimum Strength Class Requirements					Drainage Class Requirements			
		Class	Percent Elongation (%)	Grab Strength (N)	Tear Strength (N)	Puncture Strength (N)	Class	Apparent Opening Size (maximum) Sieve Size (mm)	Apparent Opening Size (maximum) Sieve Designation	Minimum Permittivity (sec^{-1})
Geotextile Drainage	Non-Woven	2	< 50%	1100	400	2200	A	0.43	No. 40	0.5
			≥ 50%	700	250	1375	B	0.25	No. 60	0.2
							C	0.22	No. 70	0.1

D. Geotextile Slope Protection. Geotextile slope protection shall meet the requirements of Table 737-01D.

Table 737-01D Slope Protection Geotextile Requirements

Application	Geotextile Structure	Minimum Strength Class Requirements					Slope Protection Class Requirements			
		Class	Percent Elongation (%)	Grab Strength (N)	Tear Strength (N)	Puncture Strength (N)	Class	Apparent Opening Size (maximum) Sieve Size (mm)	Apparent Opening Size (maximum) Sieve Designation	Minimum Permittivity (sec^{-1})
Geotextile Slope Protection	NP - NW	1	< 50%	1400	500	2750	A	0.43	No. 40	0.7
			≥ 50%	900	350	1925	B	0.25	No. 60	0.2
							C	0.22	No. 70	0.1

E. Geotextile Stabilization. Geotextile stabilization shall meet the requirements of Table 737-01E.

Table 737-01E Stabilization Geotextile Requirements

Application	Geotextile Structure	Minimum Strength Class Requirements					Stabilization Class Requirements			
		Class	Percent Elongation (%)	Grab Strength (N)	Tear Strength (N)	Puncture Strength (N)	Class	Apparent Opening Size (maximum) Sieve Size (mm)	Apparent Opening Size (maximum) Sieve Designation	Minimum Permittivity (sec^{-1})
Geotextile Stabilization	Any type listed in §737-01Scope	1	< 50%	1400	500	2750	NA (X)	0.43	No. 40	0.05
			≥ 50%	900	350	1925				

F. Turbidity Curtain. Turbidity curtains shall meet the requirements of Table 737-01F.

Table 737-01F Turbidity Curtain Requirements

Application	Geotextile Structure	Minimum Strength Class Requirements					Turbidity Curtain Class Requirements			
		Class	Percent Elongation (%)	Grab Strength (N)	Tear Strength (N)	Puncture Strength (N)	Class	Apparent Opening Size (maximum) Sieve Size (mm)	Apparent Opening Size (maximum) Sieve Designation	Minimum Permittivity (sec^{-1})
Turbidity Curtain	Any type listed in §737-01Scope	2	< 50%	1100	400 [1]	2200	NA (X)	0.3	No. 50	0.4
			≥ 50%	700	250	1375				

Table 737-01F Notes:

[1] For woven monofilament geotextiles the minimum average value is 250 N.

G. Silt Fence. Silt fences shall meet the requirements of Table 737-01G.

Table 737-01G Silt Fence Requirements

Application	Geotextile Structure	Minimum Strength Class Requirements						Silt Fence Class Requirements			
		Max. Post Spacing (m)	Percent Elongation (%)	Grab Strength (N)	Orientation[3]	Fence Between Posts	Designation	Class	Apparent Opening Size (maximum) Sieve Size (mm)	Apparent Opening Size (maximum) Sieve Desig.	Minimum Permittivity (sec^{-1})
Silt Fence	Any type listed in §737-01 Scope	1.2	NA	400	MD	Supported [1]	s	NA (X)	0.6	No. 30	0.05
					XD						
		1.2	≥ 50% [2]	550	MD	Unsupported	us 1.2				
				450	XD						
		2.0	< 50% [2]	550	MD	Unsupported	us 2				
				450	XD						

Table 737-01G Notes:

[1] Silt fence support shall consist of 14 gage steel wire with a mesh spacing of 150 mm x 150 mm or prefabricated polymeric mesh of equivalent strength.

[2] As measured in accordance with ASTM D4632.

[3] MD = Machine Direction, XD = Cross-Machine Direction.

BASIS OF APPROVAL. All geotextiles, including those sold under a private label agreement, being submitted for testing and approval must be submitted through the American Association of State Highway and Transportation Officials (AASHTO) National Transportation Product Evaluation Program (NTPEP). The program has four submittal periods per calendar year. Information regarding submittal is available at the address shown below:

AASHTO-NTPEP Coordinator
444 N. Capitol St., NW, Suite 249
Washington, DC 20001

The approval criterion for geotextiles is based on AASHTO M-288 *Specification for Geotextiles* and the NTPEP Report.

Approved geotextiles will be added to the Approved List.

BASIS OF ACCEPTANCE. Geotextiles will be accepted on the basis of:

1. The roll of material being properly identified either by a label on the geotextile or the container. The container may be either the cover wrapping or the core around which the geotextile is rolled,
2. The material brand name and style appearing on the Approved List for the intended application,
3. The material certification submitted with the geotextile stating that the material conforms to the specification and that it is the same one appearing on the Approved List, and
4. The swatch of the submitted geotextile successfully passing a visual inspection by the Regional Geotechnical Engineer.

737-02 GEOMEMBRANES

SCOPE. This specification covers the material requirements and methods of testing geomembranes used in highway construction.

GENERAL. The Department's evaluation of geomembranes submitted will be based on the following tests:

1. Tensile Strength - Test in accordance with ASTM D4632, Grab Test Method.
2. Elongation - Test in accordance with ASTM D4632.
3. Trapezoidal Tear Resistance - Test in accordance with ASTM D4535, Trapezoid Tear Test Method.
4. Puncture - Test in accordance with ASTM D4833, Index Puncture Resistance.

MATERIAL REQUIREMENTS. Geomembranes shall meet the following requirements:

1. Ultimate Tensile Strength - 800 N[(1)]
2. Ultimate Elongation - 65%[(1)]
3. Trapezoid Tear Resistance - 265 N[(1)]
4. Puncture - 400 N[(2)]

(1) Minimum value in weaker principal direction. The average of the test results in the weaker principal direction shall be equal to or greater than the stated values.

(2) The average of the test results for puncture shall meet or exceed the stated value.

BASIS OF APPROVAL. Producers of geomembranes shall demonstrate the quality of their products before being placed on the Department's Approved List. The producer shall provide:

1. A completed Form Number SM 465 *Product Evaluation Form.*
2. A test data sheet identifying the geomembrane properties.
3. A 16 sq m sample of geomembrane to allow for testing by the Department.

Approved geomembranes will be added to the Approved List.

BASIS OF ACCEPTANCE. Geomembranes will be accepted on the basis of:

1. The roll of material being properly identified either by a label on the geomembrane or the container. The container may be either the cover wrapping or the core around which the geomembrane is rolled,
2. The material brand name and style appearing on the Approved List for the intended application, and
3. The material certification submitted with the geomembrane stating that the material conforms to the specification and that it is the same one appearing on the Approved List.

737-03 PREFABRICATED VERTICAL DRAINS

SCOPE. This specification covers the material requirements and methods of testing prefabricated vertical drains used in highway construction.

GENERAL. The Department's evaluation of prefabricated vertical drains submitted will be based on the following tests:

1. Prefabricated Vertical Drain:
    a. Equivalent Sand Drain Diameter - Test in accordance with NYSDOT - GEB Large Diameter Consolidation Test.
2. Cover Geotextile Wrapping:
    a. The requirements listed in Geotextile Drainage (Table 737-01C).

MATERIAL REQUIREMENTS. Prefabricated Vertical Drains shall meet the following requirements:

1. Prefabricated Vertical Drain:
    a. Equivalent Sand Drain Diameters - 40 mm minimum.(1)
2. Cover Geotextile Wrapping:
    a. The requirements listed in Geotextile Drainage (Table 737-01C). The geotextile shall be tightly wrapped around the core.

(1) The average of the test results shall meet or exceed the stated values.

BASIS OF APPROVAL. Producers of prefabricated vertical drains shall demonstrate the quality of their products before being placed on the Department's Approved List. The producer shall provide:

1. A completed Form Number SM 465 *Product Evaluation Form.*
2. A test data sheet identifying the cover geotextile and core and their properties.
3. A 10 m long sample of the prefabricated vertical drain to allow for testing by the Department.

Approved prefabricated vertical drains will be added to the Approved List.

BASIS OF ACCEPTANCE. Prefabricated vertical drains will be accepted on the basis of:

1. The roll of material being properly identified either by a label on the prefabricated vertical drain or the container. The container may be either the cover wrapping or the core around which the prefabricated vertical drain is rolled,
2. The material brand name and style appearing on the Approved List for the intended application,
3. The material certification submitted with the prefabricated vertical drain stating that the material conforms to the specification and that it is the same one appearing on the Approved List, and
4. The letter, accompanying the material certification, identifying the cover geotextile wrapping demonstrates that the geotextile appears on the Approved List for Geotextile Drainage.

737-04 PREFABRICATED COMPOSITE STRUCTURAL DRAINS

SCOPE. This specification covers the material requirements and methods of testing prefabricated composite structural drains (PCSD's)[1] used in highway construction.

GENERAL. The Department's evaluation of PCSD's submitted will be based on the following tests:

1. PCSD: Flow Capacity Under Load - Test in accordance with ASTM D4716, Test Method for Determining the (In-plane) Flow Rate per Unit Width and Hydraulic Transmissivity of a Geosynthetic Using a Constant Head.
2. Cover Geotextile Wrapping: The requirements listed in Geotextile Drainage (Table 737-01C).

MATERIAL REQUIREMENTS. The PCSD shall meet the following requirements:

1. PCSD:
    a. Hydraulic Transmissivity
        i. For impermeable cores, where flow is allowed on both sides, the hydraulic transmissivity shall be 0.8 L/sec./m of width under 72 kPa and a hydraulic gradient of 0.1[2].
        ii. For permeable cores, or one sided flow impermeable cores, the hydraulic transmissivity shall be 0.4 L/sec./m of width under 72 kPa and a hydraulic gradient of 0.1[2].
2. Cover Geotextile Wrapping:
    a. The requirements listed in Geotextile Drainage (Table 737-01C) Class A. The geotextile shall be bonded to the core.

(1) This includes prefabricated composite structural drains used as integral abutment drains.

(2) The average of the test results shall meet or exceed the stated values.

BASIS OF APPROVAL. Producers of PCSD's shall demonstrate the quality of their products before being placed on the Department's Approved List. The producer shall provide:

1. A completed Form Number SM 465 *Product Evaluation Form.*
2. A test data sheet identifying the properties of the protective geotextile and the core.
3. A 1.5 sq m sample of the PCSD drain to allow for testing by the Department.

Approved PCSD's will be added to the Approved List.

BASIS OF ACCEPTANCE. PCSD's will be accepted on the basis of:

1. The roll of material being properly identified either by a label on the PCSD or the container. The container may be either the cover wrapping or the core around which the PCSD is rolled,
2. The material brand name and style appearing on the Approved List for the intended application,
3. The material certification submitted with the PCSD stating that the material conforms to the specification and that it is the same one appearing on the Approved List, and
4. The letter, accompanying the material certification, identifying the cover geotextile wrapping demonstrates that the geotextile appears on the Approved List for Geotextile Drainage.

737-05 PREFABRICATED COMPOSITE INTEGRAL ABUTMENT DRAINS

SCOPE. This specification covers the material requirements and methods of testing prefabricated composite integral abutment drains (PCIAD's) used in highway construction.

GENERAL. PCIAD's shall meet the requirements of PCSD except that the minimum thickness of the PCIAD shall be 10 mm as measured by ASTM D5199.

BASIS OF APPROVAL. Producers of PCIAD's shall demonstrate the quality of their products before being placed on the Department's Approved List. The approval procedure for PCIAD's follows the approval procedure for PCSD's.

Approved PCIAD's will be added to the Approved List.

BASIS OF ACCEPTANCE. PCIAD's will be accepted on the basis of:

1. The roll of material being properly identified either by a label on the PCIAD or the container. The container may be either the cover wrapping or the core around which the PCIAD is rolled,
2. The material brand name and style appearing on the Approved List for the intended application,
3. The material certification submitted with the PCIAD stating that the material conforms to the specification and that it is the same one appearing on the Approved List, and
4. The letter, accompanying the material certification, identifying the cover geotextile wrapping demonstrates that the geotextile appears on the Approved List for Geotextile Drainage.

737-06 PREFABRICATED COMPOSITE EDGE DRAINS

SCOPE. This specification covers the material requirements and methods of testing prefabricated composite edge drains (PCED's) used in highway construction.

GENERAL. The Department's evaluation of PCED's submitted will be based on the following tests:

1. PCED:
    a. Flow Capacity - Test in accordance with ASTM D4716, Test Method for Determining the (In-plane) Flow Rate per Unit Width and Hydraulic Transmissivity of a Geosynthetic Using a Constant Head.

2. Cover Geotextile Wrapping:
    a. The requirements listed in Geotextile Drainage (Table 737-01C).

MATERIAL REQUIREMENTS. PCED's shall meet the following requirements:

1. PCED:
    a. Flow Capacity - 3 L/sec./m of width when tested at a 69 kPa load after 100 hours, at a hydraulic gradient of 0.1. If the flow channel is separated into two or more parts, only the flow rate of the section facing the pavement will be considered.
2. Cover Geotextile Wrapping:
    a. The requirements listed in Geotextile Drainage (Table 737-01C). The geotextile shall be bonded to the core or tightly wrapped around the core.

BASIS OF APPROVAL. Producers of PCED's shall demonstrate the quality of their products before being placed on the Department's Approved List. The producer shall provide:

1. A completed Form Number SM 465 *Product Evaluation Form.*
2. A test data sheet identifying the cover geotextile and core and their properties.
3. A 1.5 sq m sample of the PCED.

Approved PCED's will be added to the Approved List.

BASIS OF ACCEPTANCE. PCED's will be accepted on the basis of:

1. The roll of material being properly identified either by a label on the PCED or the container. The container may be either the cover wrapping or the core around which the PCED is rolled,
2. The material brand name and style appearing on the Approved List for the intended application,
3. The material certification submitted with the PCED stating that the material conforms to the specification and that it is the same one appearing on the Approved List, and
4. The letter, accompanying the material certification, identifying the cover geotextile wrapping demonstrates that the geotextile appears on the Approved List for Geotextile Drainage.

737-07 GEOGRIDS

SCOPE. This specification covers the material requirements and methods of testing geogrids used in highway construction.

GENERAL. Submit the geogrid material certification with the material. Include in the certification the geogrid manufacturer's name, the geogrid name, the test lot number, the minimum average roll value for Ultimate Tensile Strength, the long-term design tensile strength, and the reduction factors used to calculate the long-term design tensile strength. The following definitions apply:

A. T_D. Long Term Design Tensile Strength = T_{ULT}/RF.

B. T_{ULT}. Ultimate Tensile Strength. Determined in the primary strength direction in accordance with ASTM D4595 or D6637, based on the Minimum Average Roll Value (MARV), per ASTM D4759, for the product.

C. *RF*. Total Reduction Factor= RF_{CR} x RF_{ID} x RF_{DU}. The minimum RF value permitted is 3.0.

D. RF_{CR}. Reduction Factor for Creep Deformation for 100 Year Design Life. Calculated in accordance with Geosynthetic Research Institute Standard Practice GRI-GG4 using

ASTM D5262 to determine long term strength, T_{LT}, and ASTM D4595 to determine short term strength, T_{ST}.

E. ***RF_{ID}***. Reduction Factor For Installation Damage Calculated in Accordance with Geosynthetic Research Institute Standard Practice GRI-GG4. The minimum tested RF_{ID} value permitted is 1.1.

F. ***RF_{DU}***. Reduction Factor for Durability. Determined in Accordance with EPA9090 and ASTM D4595. The minimum tested RF_{DU} value permitted is 1.1.

MATERIAL REQUIREMENTS. Geogrid reinforcing shall be tested and certified to meet the minimum requirements for geosynthetic products in accordance with AASHTO Specifications for Highway Bridges, *Geosynthetic Reinforcement.*

BASIS OF ACCEPTANCE. Geogrids will be accepted on the basis of:

1. A material certification identifying:
    a. The geogrid manufacturer's name,
    b. The geogrid name,
    c. The test lot number,
    d. The minimum average roll value for Ultimate Tensile Strength,
    e. The long-term design tensile strength, and
    f. The reduction factors used to calculate the long-term design tensile strength.
2. An evaluation that the information on the material certification meets the minimum requirements for the geogrids stated in the contract documents.

737-08 GEOCELLS

SCOPE. This specification covers the material requirements and methods of testing geocells used in highway construction.

GENERAL. Submit the geocell material certification with the material. Include in the certification the geocell manufacturer's name, the geocell name, the test lot number, the minimum thickness, the cell seam peel strength, the ultraviolet stability, and the environmental stress crack resistance.

MATERIAL REQUIREMENTS. Geocells shall be made of High Density Polyethylene (HDPE) of the size(s) and dimensions shown in the contract documents. Geocells shall be tested and certified to meet the minimum requirements listed in Table 737-08 *Geocell Requirements.*

TABLE 737-08 GEOCELL REQUIREMENTS		
Property	**Test Method**	**Requirement**
Thickness	ASTM D 5199	1.1 mm minimum
Cell Seam Peel Strength	Per U.S. Army Corps of Engineers Technical Report GL-86-19 Appendix A	10.0 N per mm of cell depth, minimum
Ultraviolet Stability	ASTM D 1603 or ASTM D 4218	1.5 % by weight carbon black minimum
Environmental Stress Crack Resistance	ASTM D 1693	2000 hrs minimum

Geocells will be perforated with the exception of the fascia, which will be solid and green in color.

BASIS OF ACCEPTANCE. Geocells will be accepted on the basis of

1. A material certification identifying:
   a. The geocell manufacturer's name,
   b. The geocell name,
   c. The test lot number,
   d. The minimum thickness,
   e. The cell seam peel strength,
   f. The ultraviolet stability, and
   g. The environmental stress crack resistance.
2. An evaluation that the information on the material certification meets the minimum requirements for the geogrids stated in Table 737-08 and the contract documents.

Make the following changes to the Standard Specifications dated May 1, 2008:

Replace Section 737 in its entirety with the following:

SECTION 737 – GEOSYNTHETICS

QUALITY ASSURANCE PROGRAM. The Department maintains a Quality Assurance (QA) program for geosynthetics. For monitoring purposes, the Geotechnical Engineering Bureau will test a sample of the geosynthetic material delivered to the project site to compare its properties to those properties determined at the time of the product's initial approval, which may indicate a change has occurred in the manufacturer's process or Quality Control (QC) process.

Several scenarios may develop as a result of the QA testing.

1. The properties are shown to be the same as originally determined within the statistical validity of the test. No action will be taken.
2. The properties are shown to be significantly different than originally determined.
   a. If the results are within the acceptable minimum for approval, contact with the manufacturer will be made by the Geotechnical Engineering Bureau to determine what has changed.
   b. If the results are below the minimum acceptable for approval, the product's status on the Approved List will be re-evaluated. The manufacturer will be notified of the review.

737-01 GEOTEXTILES

SCOPE. This specification covers the material requirements and methods of testing geosynthetic materials used in highway construction. The following Geotextile Structure Types are evaluated in this specification:

737.0101 – Needle-Punched – Non-Woven	(NP – NW)
737.0102 – Heatbonded – Non-Woven	(HB – NW)
737.0103 – Monofilament - Woven	(MF – W)
737.0104 – Multifilament – Woven	(MuF – W)
737.0105 – Slit Film – Woven	(SF – W)
737.0106 – Combination Monofilament/Fibrillated Yarn – Woven	(C – W)
737.0107 – Recycled/ Reinforced Needle-Punched – Non-Woven	(R/R NP – NW)
737.0108 – Circular – Woven	(Cir – W)

GENERAL. The Department's evaluation of geotextiles submitted will be based on the following tests:

1. Soil Retention - The test to evaluate this characteristic will be performed in accordance with the Apparent Opening Size Test, ASTM D4751.
2. Flow Capacity - The test to evaluate this characteristic will be performed in accordance with the Permittivity Test, ASTM Method D4491.
3. Tensile Strength - The tests to evaluate this characteristic will be performed in accordance with the following:
   a. Grab Test Method, ASTM D4632
   b. Trapezoid Tear Test Method, ASTM D4533
   c. Static Puncture Strength Using a 2 in. Probe, ASTM D6241

Applications. Based on the above tests and criteria that follow, the Geotextiles may be accepted for the following:

- Geotextile Bedding
- Geotextile Separation
- Geotextile Drainage
- Geotextile Slope Protection
- Geotextile Stabilization
- Turbidity Curtains
- Silt Fence

MATERIAL REQUIREMENTS. Following is a table of the requirements by applications:

A. Geotextile Bedding. Geotextile bedding shall meet the requirements of Table 737-01A.

Table 737-01A Bedding Geotextile Requirements

Application	Geotextile Structure	Minimum Strength Class Requirements					Bedding Class Requirements			
		Class	Percent Elongation (%)	Grab Strength (lbf)	Tear Strength (lbf)	Puncture Strength (lbf)	Class	Apparent Opening Size (maximum)		Minimum Permittivity (sec^{-1})
								Sieve Size (in.)	Sieve Designation	
Geotextile Bedding	C – W	1	< 50%	315	112	618	A	0.0165	No. 40	0.7
			≥ 50%	202	79	433	B	0.0098	No. 60	0.2
	MF - W	2	< 50%	247	56	495	C	0.0083	No. 70	0.1
			≥ 50%	157	56	309				

B. Geotextile Separation. Geotextile separation shall meet the requirements of Table 737-01B.

Table 737-01B Separation Geotextile Requirements

Application	Geotextile Structure	Minimum Strength Class Requirements					Separation Class Requirements			
		Class	Percent Elongation (%)	Grab Strength (lbf)	Tear Strength (lbf)	Puncture Strength (lbf)	Class	Apparent Opening Size (maximum)		Minimum Permittivity (sec^{-1})
								Sieve Size (in.)	Sieve Designation	
Geotextile Separation	Any type listed in §737-01Scope	2	< 50%	247	90 [1]	495	NA (X)	0.0234	No. 30	0.02
			≥ 50%	157	56	309				

Table 737-01B Notes:

[1] For woven monofilament geotextiles the minimum average value is 56 lbf.

C. Geotextile Drainage. Geotextile drainage shall meet the requirements of Table 737-01C.

Table 737-01C Drainage Geotextile Requirements

Application	Geotextile Structure	Minimum Strength Class Requirements					Drainage Class Requirements			
		Class	Percent Elongation (%)	Grab Strength (lbf)	Tear Strength (lbf)	Puncture Strength (lbf)	Class	Apparent Opening Size (maximum) Sieve Size (in.)	Apparent Opening Size (maximum) Sieve Designation	Minimum Permittivity (sec^{-1})
Geotextile Drainage	Non-Woven	2	< 50%	247	90	495	A	0.0165	No. 40	0.5
			≥ 50%	157	56	309	B	0.0098	No. 60	0.2
							C	0.0083	No. 70	0.1

D. Geotextile Slope Protection. Geotextile slope protection shall meet the requirements of Table 737-01D.

Table 737-01D Slope Protection Geotextile Requirements

Application	Geotextile Structure	Minimum Strength Class Requirements					Slope Protection Class Requirements			
		Class	Percent Elongation (%)	Grab Strength (lbf)	Tear Strength (lbf)	Puncture Strength (lbf)	Class	Apparent Opening Size (maximum) Sieve Size (in.)	Apparent Opening Size (maximum) Sieve Designation	Minimum Permittivity (sec^{-1})
Geotextile Slope Protection	NP - NW	1	< 50%	315	112	618	A	0.0165	No. 40	0.7
			≥ 50%	202	79	433	B	0.0098	No. 60	0.2
							C	0.0083	No. 70	0.1

E. Geotextile Stabilization. Geotextile stabilization shall meet the requirements of Table 737-01E.

Table 737-01E Stabilization Geotextile Requirements

Application	Geotextile Structure	Minimum Strength Class Requirements					Stabilization Class Requirements			
		Class	Percent Elongation (%)	Grab Strength (lbf)	Tear Strength (lbf)	Puncture Strength (lbf)	Class	Apparent Opening Size (maximum)		Minimum Permittivity (sec^{-1})
								Sieve Size (in.)	Sieve Designation	
Geotextile Stabilization	Any type listed in §737-01Scope	1	< 50%	315	112	618	NA (X)	0.0165	No. 40	0.05
			≥ 50%	202	79	433				

F. Turbidity Curtain. Turbidity curtains shall meet the requirements of Table 737-01F.

Table 737-01F Turbidity Curtain Requirements

Application	Geotextile Structure	Minimum Strength Class Requirements					Turbidity Curtain Class Requirements			
		Class	Percent Elongation (%)	Grab Strength (lbf)	Tear Strength (lbf)	Puncture Strength (lbf)	Class	Apparent Opening Size (maximum)		Minimum Permittivity (sec^{-1})
								Sieve Size (in.)	Sieve Designation	
Turbidity Curtain	Any type listed in §737-01Scope	2	< 50%	247	90 [1]	495	NA (X)	0.0117	No. 50	0.4
			≥ 50%	157	56	309				

Table 737-01F Notes:

[1] For woven monofilament geotextiles the minimum average value is 56 lbf.

G. Silt Fence. Silt fences shall meet the requirements of Table 737-01G.

Table 737-01G Silt Fence Requirements

Application	Geotextile Structure	Minimum Strength Class Requirements						Silt Fence Class Requirements			
		Max. Post Spacing (ft.)	Percent Elongation (%)	Grab Strength (lbf)	Orientation[3]	Fence Between Posts	Designation	Class	Apparent Opening Size (maximum) Sieve Size (in.)	Apparent Opening Size (maximum) Sieve Desig.	Minimum Permittivity (sec^{-1})
Silt Fence	Any type listed in §737-01 Scope	4.0	NA	90	MD	Supported [1]	s	NA (X)	0.0234	No. 30	0.05
					XD						
		4.0	≥ 50% [2]	123	MD	Unsupported	us 4.0				
				101	XD						
		6.5	< 50% [2]	123	MD	Unsupported	us 6.5				
				101	XD						

Table 737-01G Notes:

1 Silt fence support shall consist of 14 gage steel wire with a mesh spacing of 6 in. x 6 in. or prefabricated polymeric mesh of equivalent strength.

2 As measured in accordance with ASTM D4632.

3 MD = Machine Direction, XD = Cross-Machine Direction.

BASIS OF APPROVAL. All geotextiles, including those sold under a private label agreement, being submitted for testing and approval must be submitted through the American Association of State Highway and Transportation Officials (AASHTO) National Transportation Product Evaluation Program (NTPEP). The program has four submittal periods per calendar year. Information regarding submittal is available at the address shown below:

AASHTO-NTPEP Coordinator
444 N. Capitol St., NW, Suite 249
Washington, DC 20001

The approval criterion for geotextiles is based on AASHTO M-288 *Specification for Geotextiles* and the NTPEP Report.

Approved geotextiles will be added to the Approved List.

BASIS OF ACCEPTANCE. Geotextiles will be accepted on the basis of:

1. The roll of material being properly identified either by a label on the geotextile or the container. The container may be either the cover wrapping or the core around which the geotextile is rolled,
2. The material brand name and style appearing on the Approved List for the intended application,
3. The material certification submitted with the geotextile stating that the material conforms to the specification and that it is the same one appearing on the Approved List, and
4. The swatch of the submitted geotextile successfully passing a visual inspection by the Regional Geotechnical Engineer.

737-02 GEOMEMBRANES

SCOPE. This specification covers the material requirements and methods of testing geomembranes used in highway construction.

GENERAL. The Department's evaluation of geomembranes submitted will be based on the following tests:

1. Tensile Strength - Test in accordance with ASTM D4632, Grab Test Method.
2. Elongation - Test in accordance with ASTM D4632.
3. Trapezoidal Tear Resistance - Test in accordance with ASTM D4535, Trapezoid Tear Test Method.
4. Puncture - Test in accordance with ASTM D4833, Index Puncture Resistance.

MATERIAL REQUIREMENTS. Geomembranes shall meet the following requirements:

1. Ultimate Tensile Strength – 180 lbf[(1)]
2. Ultimate Elongation - 65%[(1)]
3. Trapezoid Tear Resistance - 60 lbf[(1)]
4. Puncture - 90 lbf[(2)]

(1) Minimum value in weaker principal direction. The average of the test results in the weaker principal direction shall be equal to or greater than the stated values.

(2) The average of the test results for puncture shall meet or exceed the stated value.

BASIS OF APPROVAL. Producers of geomembranes shall demonstrate the quality of their products before being placed on the Department's Approved List. The producer shall provide:

1. A completed Form Number SM 465 *Product Evaluation Form.*
2. A test data sheet identifying the geomembrane properties.
3. A 20 sq yd sample of geomembrane to allow for testing by the Department.

Approved geomembranes will be added to the Approved List.

BASIS OF ACCEPTANCE. Geomembranes will be accepted on the basis of:

1. The roll of material being properly identified either by a label on the geomembrane or the container. The container may be either the cover wrapping or the core around which the geomembrane is rolled,
2. The material brand name and style appearing on the Approved List for the intended application, and
3. The material certification submitted with the geomembrane stating that the material conforms to the specification and that it is the same one appearing on the Approved List.

737-03 PREFABRICATED VERTICAL DRAINS

SCOPE. This specification covers the material requirements and methods of testing prefabricated vertical drains used in highway construction.

GENERAL. The Department's evaluation of prefabricated vertical drains submitted will be based on the following tests:

1. Prefabricated Vertical Drain:
   a. Equivalent Sand Drain Diameter - Test in accordance with NYSDOT - GEB Large Diameter Consolidation Test.
2. Cover Geotextile Wrapping:
   a. The requirements listed in Geotextile Drainage (Table 737-01C).

MATERIAL REQUIREMENTS. Prefabricated Vertical Drains shall meet the following requirements:

1. Prefabricated Vertical Drain:
   a. Equivalent Sand Drain Diameters – 1 ½ in. minimum.(1)
2. Cover Geotextile Wrapping:
   a. The requirements listed in Geotextile Drainage (Table 737-01C). The geotextile shall be tightly wrapped around the core.

(1) The average of the test results shall meet or exceed the stated values.

BASIS OF APPROVAL. Producers of prefabricated vertical drains shall demonstrate the quality of their products before being placed on the Department's Approved List. The producer shall provide:

1. A completed Form Number SM 465 *Product Evaluation Form.*
2. A test data sheet identifying the cover geotextile and core and their properties.
3. A 30 ft. long sample of the prefabricated vertical drain to allow for testing by the Department.

Approved prefabricated vertical drains will be added to the Approved List.

BASIS OF ACCEPTANCE. Prefabricated vertical drains will be accepted on the basis of:

1. The roll of material being properly identified either by a label on the prefabricated vertical drain or the container. The container may be either the cover wrapping or the core around which the prefabricated vertical drain is rolled,
2. The material brand name and style appearing on the Approved List for the intended application,
3. The material certification submitted with the prefabricated vertical drain stating that the material conforms to the specification and that it is the same one appearing on the Approved List, and
4. The letter, accompanying the material certification, identifying the cover geotextile wrapping demonstrates that the geotextile appears on the Approved List for Geotextile Drainage.

737-04 PREFABRICATED COMPOSITE STRUCTURAL DRAINS

SCOPE. This specification covers the material requirements and methods of testing prefabricated composite structural drains (PCSD's)[(1)] used in highway construction.

GENERAL. The Department's evaluation of PCSD's submitted will be based on the following tests:

1. PCSD: Flow Capacity Under Load - Test in accordance with ASTM D4716, Test Method for Determining the (In-plane) Flow Rate per Unit Width and Hydraulic Transmissivity of a Geosynthetic Using a Constant Head.
2. Cover Geotextile Wrapping: The requirements listed in Geotextile Drainage (Table 737-01C).

MATERIAL REQUIREMENTS. The PCSD shall meet the following requirements:

1. PCSD:
    a. Hydraulic Transmissivity
        i. For impermeable cores, where flow is allowed on both sides, the hydraulic transmissivity shall be 4.0 gal./min./ft. of width under 1500 psf and a hydraulic gradient of 0.1[(2)].

        ii. For permeable cores, or one sided flow impermeable cores, the hydraulic transmissivity shall be 2.0 gal./min./ft. of width under 1500 psf and a hydraulic gradient of 0.1[(2)].
2. Cover Geotextile Wrapping:
    a. The requirements listed in Geotextile Drainage (Table 737-01C) Class A. The geotextile shall be bonded to the core.

(1) This includes prefabricated composite structural drains used as integral abutment drains.

(2) The average of the test results shall meet or exceed the stated values.

BASIS OF APPROVAL. Producers of PCSD's shall demonstrate the quality of their products before being placed on the Department's Approved List. The producer shall provide:

1. A completed Form Number SM 465 *Product Evaluation Form.*
2. A test data sheet identifying the properties of the protective geotextile and the core.
3. A 16 sq. ft. sample of the PCSD drain to allow for testing by the Department.

Approved PCSD's will be added to the Approved List.

BASIS OF ACCEPTANCE. PCSD's will be accepted on the basis of:

1. The roll of material being properly identified either by a label on the PCSD or the container. The container may be either the cover wrapping or the core around which the PCSD is rolled,
2. The material brand name and style appearing on the Approved List for the intended application,
3. The material certification submitted with the PCSD stating that the material conforms to the specification and that it is the same one appearing on the Approved List, and
4. The letter, accompanying the material certification, identifying the cover geotextile wrapping demonstrates that the geotextile appears on the Approved List for Geotextile Drainage.

737-05 PREFABRICATED COMPOSITE INTEGRAL ABUTMENT DRAINS

SCOPE. This specification covers the material requirements and methods of testing prefabricated composite integral abutment drains (PCIAD's) used in highway construction.

GENERAL. PCIAD's shall meet the requirements of PCSD except that the minimum thickness of the PCIAD shall be 0.4 in. as measured by ASTM D5199.

BASIS OF APPROVAL. Producers of PCIAD's shall demonstrate the quality of their products before being placed on the Department's Approved List. The approval procedure for PCIAD's follows the approval procedure for PCSD's.

Approved PCIAD's will be added to the Approved List.

BASIS OF ACCEPTANCE. PCIAD's will be accepted on the basis of:

1. The roll of material being properly identified either by a label on the PCIAD or the container. The container may be either the cover wrapping or the core around which the PCIAD is rolled,
2. The material brand name and style appearing on the Approved List for the intended application,
3. The material certification submitted with the PCIAD stating that the material conforms to the specification and that it is the same one appearing on the Approved List, and
4. The letter, accompanying the material certification, identifying the cover geotextile wrapping demonstrates that the geotextile appears on the Approved List for Geotextile Drainage.

737-06 PREFABRICATED COMPOSITE EDGE DRAINS

SCOPE. This specification covers the material requirements and methods of testing prefabricated composite edge drains (PCED's) used in highway construction.

GENERAL. The Department's evaluation of PCED's submitted will be based on the following tests:

1. PCED:
    a. Flow Capacity - Test in accordance with ASTM D4716, Test Method for Determining the (In-plane) Flow Rate per Unit Width and Hydraulic Transmissivity of a Geosynthetic Using a Constant Head.

2. Cover Geotextile Wrapping:
    a. The requirements listed in Geotextile Drainage (Table 737-01C).

MATERIAL REQUIREMENTS. PCED's shall meet the following requirements:

1. PCED:
    a. Flow Capacity – 15 gal./min./ft. of width when tested at a 10 psi load after 100 hours, at a hydraulic gradient of 0.1. If the flow channel is separated into two or more parts, only the flow rate of the section facing the pavement will be considered.
2. Cover Geotextile Wrapping:
    a. The requirements listed in Geotextile Drainage (Table 737-01C). The geotextile shall be bonded to the core or tightly wrapped around the core.

BASIS OF APPROVAL. Producers of PCED's shall demonstrate the quality of their products before being placed on the Department's Approved List. The producer shall provide:

1. A completed Form Number SM 465 *Product Evaluation Form.*
2. A test data sheet identifying the cover geotextile and core and their properties.
3. A 16 sq. ft. sample of the PCED.

Approved PCED's will be added to the Approved List.

BASIS OF ACCEPTANCE. PCED's will be accepted on the basis of:

1. The roll of material being properly identified either by a label on the PCED or the container. The container may be either the cover wrapping or the core around which the PCED is rolled,
2. The material brand name and style appearing on the Approved List for the intended application,
3. The material certification submitted with the PCED stating that the material conforms to the specification and that it is the same one appearing on the Approved List, and
4. The letter, accompanying the material certification, identifying the cover geotextile wrapping demonstrates that the geotextile appears on the Approved List for Geotextile Drainage.

737-07 GEOGRIDS

SCOPE. This specification covers the material requirements and methods of testing geogrids used in highway construction.

GENERAL. Submit the geogrid material certification with the material. Include in the certification the geogrid manufacturer's name, the geogrid name, the test lot number, the minimum average roll value for Ultimate Tensile Strength, the long-term design tensile strength, and the reduction factors used to calculate the long-term design tensile strength. The following definitions apply:

A. T_D. Long Term Design Tensile Strength = T_{ULT}/RF.

B. T_{ULT}. Ultimate Tensile Strength. Determined in the primary strength direction in accordance with ASTM D4595 or D6637, based on the Minimum Average Roll Value (MARV), per ASTM D4759, for the product.

C. RF. Total Reduction Factor= $RF_{CR} \times RF_{ID} \times RF_{DU}$. The minimum RF value permitted is 3.0.

D. RF_{CR}. Reduction Factor for Creep Deformation for 100 Year Design Life. Calculated in

accordance with Geosynthetic Research Institute Standard Practice GRI-GG4 using ASTM D5262 to determine long term strength, T_{LT}, and ASTM D4595 to determine short term strength, T_{ST}.

E. ***RF_{ID}.*** Reduction Factor For Installation Damage Calculated in Accordance with Geosynthetic Research Institute Standard Practice GRI-GG4. The minimum tested RF_{ID} value permitted is 1.1.

F. ***RF_{DU}.*** Reduction Factor for Durability. Determined in Accordance with EPA9090 and ASTM D4595. The minimum tested RF_{DU} value permitted is 1.1.

MATERIAL REQUIREMENTS. Geogrid reinforcing shall be tested and certified to meet the minimum requirements for geosynthetic products in accordance with AASHTO Specifications for Highway Bridges, *Geosynthetic Reinforcement.*

BASIS OF ACCEPTANCE. Geogrids will be accepted on the basis of:

1. A material certification identifying:
    a. The geogrid manufacturer's name,
    b. The geogrid name,
    c. The test lot number,
    d. The minimum average roll value for Ultimate Tensile Strength,
    e. The long-term design tensile strength, and
    f. The reduction factors used to calculate the long-term design tensile strength.
2. An evaluation that the information on the material certification meets the minimum requirements for the geogrids stated in the contract documents.

737-08 GEOCELLS

SCOPE. This specification covers the material requirements and methods of testing geocells used in highway construction.

GENERAL. Submit the geocell material certification with the material. Include in the certification the geocell manufacturer's name, the geocell name, the test lot number, the minimum thickness, the cell seam peel strength, the ultraviolet stability, and the environmental stress crack resistance.

MATERIAL REQUIREMENTS. Geocells shall be made of High Density Polyethylene (HDPE) of the size(s) and dimensions shown in the contract documents. Geocells shall be tested and certified to meet the minimum requirements listed in Table 737-08 *Geocell Requirements.*

TABLE 737-08 GEOCELL REQUIREMENTS		
Property	**Test Method**	**Requirement**
Thickness	ASTM D 5199	0.04 in. minimum
Cell Seam Peel Strength	Per U.S. Army Corps of Engineers Technical Report GL-86-19 Appendix A	56 lbf per inch of cell depth, minimum
Ultraviolet Stability	ASTM D 1603 or ASTM D 4218	1.5 % by weight carbon black minimum
Environmental Stress Crack Resistance	ASTM D 1693	2000 hrs minimum

Geocells will be perforated with the exception of the fascia, which will be solid and green in color.

BASIS OF ACCEPTANCE. Geocells will be accepted on the basis of

1. A material certification identifying:
    a. The geocell manufacturer's name,
    b. The geocell name,
    c. The test lot number,
    d. The minimum thickness,
    e. The cell seam peel strength,
    f. The ultraviolet stability, and
    g. The environmental stress crack resistance.
2. An evaluation that the information on the material certification meets the minimum requirements for the geogrids stated in Table 737-08 and the contract documents.