

1.0 GENERAL

1.1 Related Sections

.1	Submittals	Section 01330
.2	Quality Control	Section 01450
.3	Trenching, Backfilling and Compaction for Utilities	Section 02315
.4	Site Excavation, Embankment and Compaction	Section 02335
.5	Perforated Subdrain Pipe	Section 02706
.6	Subgrade Construction	Section 02705
.7	Granular Base Course	Section 02721

1.2 Scope

- .1 Items of work covered by this specification are those pertaining to the supply and installation of nonwoven, woven geotextile, and multiaxial (biaxial or triaxial) geogrids for roadway applications.

1.3 References

- .1 ASTM D 4439 Geosynthetic Terminology
- .2 ASTM D 4354 Sampling of Geosynthetics
- .3 AASHTO M288-17 Standard Specification for Geosynthetic Specification for Highway Applications
- .4 AASHTO R 50-09 Geosynthetic Reinforcement of the Aggregate Base Course of Flexible Pavement Structures.
- .5 GMA White Paper II Geosynthetic Reinforcement of the Aggregate Base/Subbase Courses of Pavement Structures
- .6 FHWA Geosynthetic Design and Construction Guidelines, FHWA NHI-07-092 Chapter 5 Roadway Reinforcement

1.4 Definitions

- .1 Nonwoven Geotextile: A planar geosynthetic made of randomly orientated yarns produced by bonding fibres, or interlocking fibres, or both bonding and interlocking fibres by mechanical, chemical, or thermal means.
- .2 Slit-Tape / Slit-Film Woven Geotextile: A planar geosynthetic made from flat, tape-like yarns that are produced by slitting and extruded film. Unsuitable for

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subgrades in which high groundwater, moderate to high moisture contents, seasonal moisture fluctuations, or thaw weakening are present.

- .3 Enhanced Woven Geotextile: A planar woven geotextile made from high-tenacity long-chain synthetic polymers composed of at least 95 percent by weight of polyolefins. They shall form a stable network such that the filaments or yarns retain their dimensional stability relative to each other, including selvages.
- .4 Multiaxial Geogrid: A geosynthetic formed by a regular network of integrally connected polymer tensile elements with square, rectangular, or triangular apertures of sufficient size to allow strike-through of surrounding soil, rock or other geotechnical materials.
- .5 Minimum Average Roll Value (MARV): Property value calculated as typical minus two standard deviations. It shall yield a 97.7 percent degree of confidence that any sample taken during quality assurance testing will exceed value reported.
- .6 Separation: A geosynthetic function in which a geosynthetic is used to prevent intermixing of two dissimilar geotechnical materials to maintain their engineering properties such as a subgrade soil and an aggregate cover (base/subbase/select embankment).
- .7 Filtration: A geosynthetic function in which a geotextile is placed between two dissimilar soils to allow for long-term passage of water while preventing the uncontrolled passage of soil particles.
- .8 Reinforcement: A geosynthetic function in which a geosynthetic acts as a tensile member in the surface structure of a pavement.
- .9 Confinement: A geosynthetic function in which a geosynthetic prevents the lateral movement of aggregate.
- .10 Stabilization: The use of an enhanced woven geosynthetic on weak to very weak subgrade conditions ($\text{CBR} \leq 3.0\%$) to provide the coincident functions of separation, filtration, reinforcement, and confinement. Alternatively, a combination of geogrid and geotextile providing the same functions may also be utilized.

1.5 Measurement and Payment

- .1 Geosynthetic will be measured in square metres in place. Payment shall be full compensation for supply, placing, overlapping or sewing.

1.6 Sampling, Testing, and Acceptance

- .1 All geosynthetics may be subject to additional sampling and testing by the Engineer to verify conformance with this specification.

- .2 Sampling shall be in accordance with the most current ASTM D4354, using the section titled "Procedure for Sampling for Purchaser's Specification Conformance Testing".
- .3 Testing shall be performed in accordance with the methods referenced in this specification for the indicated application. The number of specimens to test per sample is specified by each test method. Geosynthetic product acceptance shall be based on ASTM D4759.

1.7 Materials Certification

- .1 The manufacturer is responsible for establishing and maintaining a quality control program to assure compliance with the requirements of the specification. Documentation describing the quality control program shall be made available upon request. The manufacturer shall have a quality control program that includes an on-site laboratory accredited by the Geosynthetic Accreditation Institute Laboratory Accreditation Program (GAI-LAP) to perform the required test methods.
- .2 The manufacturer's certificate shall state that the furnished geosynthetic meets MARV requirements, except as otherwise specified, of the specification as evaluated under the manufacturer's quality control program. A person having the legal authority to bind the manufacturer shall attest to the certificate.
- .3 The manufacturer must participate in the AASHTO National Transportation Product Evaluation Program's Audit Program for Geotextiles (GTX). Upon request, the manufacturer will provide:
 - .1 Public status data in NTPEP's DataMine website.
 - .2 Current publicly released NTPEP Reports on Laboratory Results of Evaluations showing the physical properties of the geosynthetic product or product line is in compliance with the specifications.
- .4 Products without proper identification or labelling, mislabeling, or misrepresentation of materials shall be reason to reject those geosynthetic materials. Identification includes an NTPEP stamp at every 5 meters along a length of a roll.

1.8 Submissions

- .1 The contractor shall provide the Engineer a Manufacturer's Certificate stating the name of the manufacturer, product name, style number, chemical composition of the filaments or yarns, and other pertinent information to fully describe the geotextile for review and approval before being used.
- .2 Certificates with distributor or private label letterhead will not be accepted. Technical or Material Data Sheets will not be accepted.

- .3 The contractor shall provide the Engineer the Manufacturer's valid GAI-LAP laboratory accreditation certificate.
- .4 Preliminary review of the material as represented by the test results shall not constitute general acceptance of all the material or source of supply.
- .5 Rejected material will not be paid for. The Engineer has the right to request roll test data or additional testing if there are any concerns with the proposed geosynthetic.

1.9 Delivery and Storage

- .1 Each geotextile roll shall be wrapped with a material that will protect the geosynthetic, including the ends of the roll from damage due to shipment, water, sunlight, and contaminants. The protective wrapping shall be maintained during periods of shipment and storage. Each geotextile roll shall include an inner core made from a different material that shall protect, ensure ease of handling, and prevent damage from forklifts or other equipment used to transfer or move the geosynthetic roll.
- .2 During delivery and storage, the geotextile shall be elevated off the ground and adequately covered to protect them from the following: site construction damage, precipitation, extended ultra violet radiation, chemicals that are strong acids or strong bases, flames and sparks, temperatures in excess of 71° Celsius, and any other environmental condition that may damage the physical property values of the product.

2.0 PRODUCTS

2.1 Separation and Filtration Applications

- .1 This specification is applicable to the use of a geotextile to prevent mixing of a subgrade soil and an aggregate cover material (subbase, base, select embankment). The secondary function is allowing moisture to travel through the plane of the geotextile while preventing the migration of fine soil particles.
- .2 The separation and filtration applications are appropriate for pavement structures constructed over soils with a California Bearing Ratio greater than or equal to 3 ($CBR \geq 3$) or a shear strength greater than 90 kPa. It is appropriate for unsaturated subgrade soils.
- .3 The geotextile shall be an AASHTO M288-17 Class 2 nonwoven meeting the requirements of the following table. All numerical values in the table except AOS represent MARV in the weakest principal direction. Values for AOS represent maximum average roll value.

Specifications and Physical Properties		
	ASTM Test Method	AASHTO Class 2 Nonwoven
Grab Strength	D 4632	700 N
Elongation	D 4632	≥50%
CBR Puncture Strength	D 6241	1375 N
Trapezoidal Tear	D 4533	250 N
Apparent Opening Size (AOS)	D 4751	0.22 mm
Permittivity	D 4491	1.5

- .4 The severity of installation conditions for the application generally dictate the required geotextile class. The Engineer shall specify Class 1 nonwoven geotextile properties for more severe or harsh installation conditions. See AASHTO M288-17 Table 4 for survivability guidance.

2.2 Stabilization Applications

- .1 This specification is applicable to the use of a geotextile for pavement structures constructed over soils with a California Bearing Ratio between 2% and 3% or a shear strength between 60 kPa and 90 kPa. It is appropriate for wet conditions to provide the coincident functions of separation, filtration, reinforcement, and confinement.
- .2 The stabilization application is appropriate for subgrade soils that are saturated due to a high groundwater table, soils susceptible to thaw-weakening, or due to prolonged periods of wet weather.
- .3 The geotextile shall meet the requirements of the following table. All numerical values in the table except AOS represent MARV in the weakest principal direction. Values for AOS represent maximum average roll value.

Enhanced Woven Geotextile Specifications and Physical Properties		
	ASTM Test Method	Class 3A MARV
Tensile Strength (at ultimate)	D 4595	35.9 kN/m
Tensile Strength (at 5% strain)	D 4595	18.6 kN/m
Flow Rate	D 4491	1630 l/min/m ²
Permittivity	D 4491	0.6 sec ⁻¹
Apparent Opening Size (AOS)	D 4751	0.6 mm

- .4 Alternatively, a separation/filtration nonwoven geotextile meeting section 2.1 combined with a multiaxial geogrid meeting the requirements of the following

table can be used. All numerical values in the table represent MARV in the weakest principal direction.

Geogrid Specifications and Physical Properties		
	ASTM Test Method	FHWA Class 1 Geogrid
Tensile Strength (at ultimate)	D 6637	18.0 kN/m
Tensile Strength (at 2% strain)	D 6637	6.0 kN/m
Tensile Strength (at 5% strain)	D 6637	11.0 kN/m
Junction Strength	D 7737	17.9 kN/m
UV Stability (after 500 hr)	D 4355	50%

2.3 Enhancement Applications

- .1 This specification is applicable to the use of a geotextile for pavement structures constructed over soils with a California Bearing Ratio below 2.0% or below a shear strength of 60 kPa. This specification is applicable to the use of a geotextile in wet, saturated conditions to provide the coincident functions of separation, filtration, reinforcement, and confinement.
- .2 The enhancement application is appropriate for subgrade soils that are saturated due to a high groundwater table, soils susceptible to thaw-weakening, or due to prolonged periods of wet weather.
- .3 The geotextile shall meet the requirements of the following table. All numerical values in the table except AOS represent MARV in the weakest principal direction. Values for AOS represent maximum average roll value.

Enhanced Woven Geotextile Specifications and Physical Properties		
	ASTM Test Method	Class 1A MARV (CBR < 2.0)
Tensile Strength (at ultimate)	D 4595	70 kN/m
Tensile Strength (at 5% strain)	D 4595	35 kN/m
Flow Rate	D 4491	1222 l/min/m ²
Permittivity	D 4491	0.5 sec ⁻¹
Apparent Opening Size (AOS)	D 4751	0.60 mm

2.4 Proprietary Geosynthetic Products

- .1 Proprietary geosynthetic products can be included in the roadway surface structure by the design engineer provided:

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- .1 The proposed roadway structure meets or exceeds the performance of the City of Prince Albert standard roadway pavement structure as laid out in Section 6.6 “Minimum Requirements for Roadway Pavement” of the City of Prince Albert Design standards.
- .2 The use of a proprietary geosynthetic product is in the best interest of the City of Prince Albert. Potential justifications may include reduced construction costs, improved life-cycle costs, reduced excavation requirements avoiding utility conflicts, reduced excavation requirements avoiding high water table, mitigation of special soil conditions such as frost heave or expansive clay soils.
- .3 The proprietary geosynthetic product is calibrated for the applicable design method (AASHTO 93, AASHTO ME, or Giroud-Han).
- .2 Alternate proprietary products may be submitted by bidders during the tender stage. Alternate products must:
 - .1 be submitted 10 days prior to tender close to allow for full evaluation.
 - .2 be stamped by a professional engineer registered in the Province of Saskatchewan.
 - .3 have full scale performance testing in accordance with AASHTO R50-09 and GMA White Paper II performed by an Independent testing agency.
 - .4 Documentation of benefit must be by the empirical means of constructing test sections with and without geosynthetic for the project conditions or similar conditions of interest.
 - .5 Documentation of benefit by analytical or modelling techniques will not be permitted.
 - .6 Have performance testing that demonstrates equal or greater performance to the specified proprietary product in similar geotechnical and vehicle loading conditions. The benefit must be quantified as a Base Course Reduction (BCR), Traffic Benefit Ratio (TBR), or Layer Coefficient Ratio (LCR) value when possible.
 - .7 Proprietary geosynthetic product submittals shall include information on five (5) similar projects in size and scope.
 - .8 Comparison or evaluation of proprietary products based on mechanical or physical properties is not permitted.
- .3 The Engineer shall specify the Proprietary Product by trade name and include contact information for local distributor(s).

3.0 EXECUTION

3.1 Geosynthetic Installation

- .1 These installation instructions are intended for use in conjunction with the material specification for geosynthetics. The specification details material properties for geosynthetics used in separation, subsurface drainage, permanent erosion control, and stabilization applications. The material properties are only one factor in a successful installation involving geosynthetics. Proper material handling, construction, and installation techniques are essential in order to ensure that the intended function of the geosynthetic is fulfilled.
- .2 Atmospheric exposure of the geosynthetics to the elements following laydown shall be a maximum of 14 days to minimize damage potential.
- .3 The installation site shall be prepared by clearing, grubbing, and excavating or filling the area to the design grade. This includes the removal of topsoil and vegetation.
- .4 Soft spots and unsuitable areas will be identified during site preparation or subsequent proof rolling. These areas shall be excavated and backfilled with select material and compacted using normal procedures.
- .5 The geosynthetic shall be laid smooth without wrinkles or folds on the prepared subgrade in the direction of construction traffic. Adjacent geosynthetic panels shall be overlapped or sewn as required in the plans. S

Geosynthetic Overlap Requirement	
CBR ≥ 3%	300 - 450 mm overlap
1% ≤ CBR < 3%	600 - 900 mm overlap
0.5% ≤ CBR < 1%	900 mm overlap or sewn
CBR < 0.5%	sewn

- .6 When using a multiaxial geogrid for subgrade stabilization, the separation/filtration nonwoven geotextile will be placed directly upon the subgrade and the multiaxial geogrid will be placed directly on top of the separation/filtration nonwoven geotextile.
- .7 New roadway construction will include geosynthetic installed throughout road cross-section from back of sidewalk to back of sidewalk unless directed otherwise by the Engineer.
- .8 Existing roadway reconstruction or repair work shall include geosynthetic installation from gutter to gutter or as directed by the Engineer.

- .9 On curves, the geotextile may be cut to conform to the curves. The overlap shall be in the direction of construction and held in place by piles of Granular Base Course or Granular Subbase Course.
- .10 Prior to covering, the geotextile shall be inspected to ensure that it has not been damaged during installation. The inspection shall be done by the engineer or the engineer's designated representative. Damaged geotextiles, as identified by the engineer, shall be repaired immediately. Cover the damaged area with a geotextile patch that extends an amount equal to the required overlap beyond the damaged area.
- .11 Place and compact soil layers in accordance with Section 02705 - Subgrade Construction, 02721 – Granular Base Course.
- .12 The subbase shall be placed by end dumping onto the geotextile from the edge of the geotextile or from previously placed subbase aggregate. Construction vehicles shall not be allowed directly on the geotextile. The subbase shall be placed such that at least the minimum specified lift thickness shall always be between the geotextile and equipment tires or tracks. Turning of vehicles shall not be permitted on the first lift above the geotextile.
- .13 On subgrades having a CBR value of less than 1.0%, the subbase aggregate should be spread in its full thickness as soon as possible after dumping to minimize potential of localized subgrade failure due to overloading of the subgrade.
- .14 Any ruts occurring during construction shall be filled with additional subbase material and compacted to the specified density.
- .15 In stabilization applications, the use of vibratory compaction equipment is not recommended with the initial lift of the subbase material. The use of static rollers is encouraged for the initial lift.

END OF SECTION