Texas Department of Transportation

Texas A&M Transportation Institute

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TEXAS A&M TRANSPORTATION INSTITUTE

Sediment and Erosion Control Laboratory

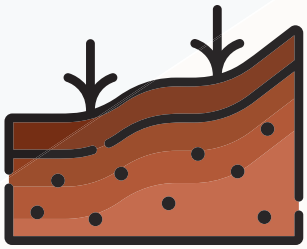
INTRODUCTION

Starting with the 1993 edition of the Texas Department of Transportation (TxDOT) *Standard Specifications for Construction of Highways, Streets and Bridges*, TxDOT shifted from a material-type specification into an "approved product"-type specification for two classifications of erosion control and revegetation products. These two product classifications included rolled and spray-on products promoted by industry for either slope protection or flexible channel liner applications, (termed "Slope Protection" and "Channel Protection" within TxDOT's Standard Specification Item 169), and standard hydraulic mulches (termed "Hydromulch for Seeding" within TxDOT's Standard Construction Item 164).

TxDOT's current approved products for slope protection, channel protection, and hydromulch for seeding; are listed on the interactive TxDOT Approved Products List (APL). Physical property tests, including ECTC and ASTM designated tests are performed to document material properties of tested products, however TxDOT has elected to base their official Approved Product List (APL) upon documented field performance of the products through a formal evaluation program conducted by the Planning and Environment Program of the Texas A&M Transportation Institute (TTI).

TxDOT has defined critical performance factors and has established minimum performance standards which must be met for any product seeking to be approved for use within any of TxDOT's construction or maintenance activities.

With respect to the rolled and spray on products being tested for approval, TxDOT adopted the following critical performance factors:



Sediment Retention

How well the product protected the seedbed of an embankment or a drainage channel from the loss of sediment during simulated rainfall or channel flow events.

Vegetation Cover

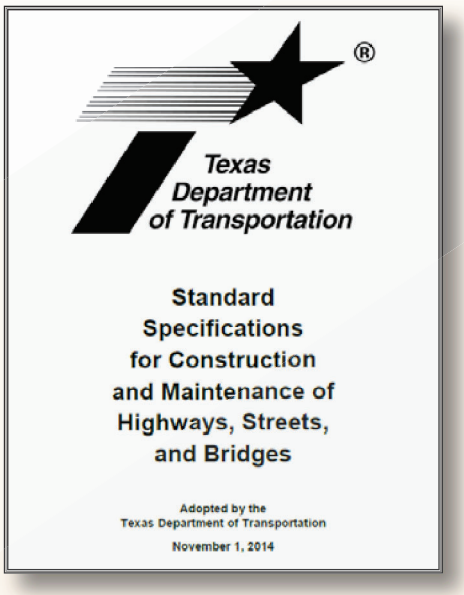
How well the product promoted the establishment of warm-season, perennial vegetation.

Furthermore, TxDOT recognized that the above rolled and spray-on products are promoted by industry within two general use classifications (TxDOT Standard Specification Item 169):

Slope Protection	Channel Protection
Products designed for overland flows associated with typical slope or embankment protection applications.	Products designed for concentrated water flows associated with typical highway drainage channels.

By statistically analyzing the performance data produced through controlled performance tests, TxDOT is able to maintain minimum performance standards for each classification of products evaluated at the TTI Sediment and Erosion Control (SEC) Laboratory. TxDOT reserves the right to revise the minimum performance standards as it deems necessary. For a product to be included on TxDOT's APL, the product must meet, or exceed; all adopted minimum sediment retention and vegetation cover performance standards for slope or channel protection applications. Failure to meet any of the adopted minimum performance standards will automatically reject the product from being placed on the APL.

In 2014, TxDOT decided to change the minimum performance standards on erosion control products to guarantee better performing products on construction and maintenance projects. With recent and potential upcoming changes in the regulatory environment, dealing with erosion and sediment control on construction and maintenance projects, TxDOT's Maintenance Division was and continues to be committed to maintaining the Approved Products List with the highest quality best management practices (BMPs) available. With increased environmental regulations, TxDOT must ensure the best products are being implemented on projects to minimize environmental concerns and reduce the risk for product failure. The new performance standards have been developed from years of product evaluation and ongoing changes to environmental regulations.



Effective February 2015, all slope protection products were required to meet (or exceed) the new performance thresholds to remain or be placed on the APL. Products previously approved, that failed to meet the new performance standards were removed from the APL. If a product was removed from the list, the product representative was provided the opportunity of retesting the identical product with the TTI SEC Lab. If a re-tested product met or exceeded the new 2015 minimum performance standards the product was added back to the list. All channel protection products continue to be required to meet all minimum performance standards adopted by TxDOT.

TXDOT Erosion Control Materials – Standard Specification Terminology

Item 164 – Seeding for Erosion Control	
Previous Terminology	**New Terminology (2021)**
Mulches 4:1 or flatter slopes – clay or tight soils	Hydromulch (For Seeding) - clay
Mulches 4:1 or flatter slopes – sandy or loose soils	Hydromulch (For Seeding) - sand
Item 169 – Soil Retention Blankets	
Previous Terminology	**New Terminology (2021)**
Class 1: Slope Protection	**Slope Protection**
Type A. Slopes 3:1 or flatter – clay soils	Moderate Clay
Type B. Slopes 3:1 or flatter – sandy soils	Moderate Sand
Type C. Slopes steeper than 3:1 – clay soils	Steep Clay
Type D. Slopes steeper than 3:1 – sandy soils	Steep Sand
Class 2: Flexible Channel Liners	**Channel Protection**
Type E. Biodegradable materials with shear stress less than 2.0 psf	Temporary 2 psf
Type F. Biodegradable materials with shear stress less than 4.0 psf	Temporary 4 psf
Type G. Nonbiodegradable materials with shear stress less than 6.0 psf	Permanent 6 psf
Type H. Nonbiodegradable materials with shear stress less than 8.0 psf	Permanent 8 psf

THE TESTING FACILITY – SEC LAB

Since 1990, the TTI SEC Lab provides the transportation industry with a research and performance evaluation program for roadside environmental management. The program includes storm water quality improvement, erosion and sediment control, and vegetation establishment and management.

TTI's Environment and Planning Program operates a 19-acre, full scale, indoor/outdoor facility. Demand for the facility has steadily grown since opening the lab in 1990, necessitating frequent expansion to meet industry needs. With funding from the TxDOT, TTI produces and maintains the TxDOT Approved Products List (APL) for all erosion control products used by TxDOT on Texas roadsides.

Click here to access the TxDOT's Interactive APL

Three major aspects of the lab are the indoor rain simulators, sediment control device facility, and variable slope channel flume. The TTI SEC Lab also houses a 2,800-square-foot climate-controlled greenhouse, index testing laboratory, bench-scale testing capabilities, 65-foot concrete flume, and a 1,000 linear ft x 25 ft tall soil embankment built with both a 2:1 and 3:1 side slope built per TxDOT standard construction specifications.

Slope protection product evaluations were first conducted outdoors utilizing test plots on the soil embankment. However, in 2002 an indoor rainfall simulator test facility was constructed which replaced the outdoor testing embankment. Due to high demand, in 2013 the indoor testing facility was expanded to accommodate additional bays and testing capabilities. The current facility includes two buildings with multiple beds and five available test bays. The facility is capable of testing erosion control products using multiple test protocols, including ASTM D6459, ASTM D8297 and custom R&D test methods, and has been in continual use since it was constructed.

Adjacent to the new rainfall simulator building is a 1,500-foot covered sediment bed preparation area. This area creates a dry workspace for storage of test beds during inclement weather. The expansion also included a 40-foot by 60-foot soil storage building that allows for test bed preparation during rain events without affecting antecedent soil moisture, a critical factor in the indoor testing procedure. The original rainfall building has also been modified to expedite testing. The building was originally designed for manual sediment collection however, it was retrofitted in 2013 to allow bulk handling and collection of sediment.

A variable slope flume is currently used to evaluate channel liner products. Prior to 2002, all channel products were tested using in-ground, at-grade channels located at the facility. In 2002, a metal flume with vertical plywood and plexiglass side walls was constructed to evaluate channel liner products and turf reinforcement mats. The flume was designed so that the test trays could be installed and evaluated by running concentrated flows of water at different flow rates, over the surface of the test trays. The flume utilizes a high-capacity pump capable of 42,000 gallons per minute, and can evaluate channel products based on categories that utilize increasing shear stress values of 2-12 pounds per square ft. In 2021, the flume pump was modified to allow easier access and a roof was built over the structure.

A greenhouse is located on site and is used to establish vegetation in trays and flumes before and during test cycles. The greenhouse allows vegetation to be grown and evaluated on a year-round basis.

INITIAL EVALUATION FEES

Evaluation fees are required of each product evaluated at the TTI SEC Lab. Current testing fees for evaluation of new products are as follows:

Class 1 “Slope Protection” Applications	$10,500 per evaluation
Class 2 “Flexible Channel Liner” Applications	$10,500 per evaluation
“Hydraulic Mulch” Applications	$10,500 per evaluation
Sediment Retention Device	$10,500 per evaluation

An “evaluation” is defined as one product and one complete test evaluation for each test category selected. An evaluation also includes physical properties tests for each material received. These tests are performed, and the data results are kept on file, so that the physical properties and characteristics of the product are measured and documented. The physical properties tests are not used to determine pass/failure of a product but are used to ensure that the physical characteristics and properties of a material are consistent. This data is also used when a product is recertified, to ensure that specific products approved for use; have not been significantly altered or changed. When recertifying a specific product, index physical properties tests are repeated and compared to the original physical properties test results. Common physical properties tests include mass per unit area, tensile strength, flexibility, water absorption capacity, swell, light penetration etc. TTI reserves the right to add or modify properties testing as needed.

Click here to download the “**Request for Testing Services**” form

EVALUATION WAITING LIST

Because of high demand for testing at the laboratory, it was necessary to implement a waiting-list procedure to provide the greatest degree of access to the facility to the greatest number of participants.

To be placed on the waiting list a completed “Request for Performance Evaluation” (RPE) must be received by TTI Lab Manager, and a 10% deposit of the overall testing fee must be received. Once both are received the product is immediately placed on the waiting list in the order received in preparation for testing. Personal memoranda, telephone calls, fax transmissions or individual letters to the Lab Manager will not be utilized to determine a product(s) position on the waiting list. Position on the waiting list is based upon the postmarked date on the completed RPE and the receipt of the testing deposit. In the event a participant fails to submit test material by the deadline established by TTI, the product will be rolled to the bottom of the waiting list.

Management reserves the right to limit the number of products any single company, manufacturer or distributor may evaluate during any given evaluation cycle, and will treat requests for different gradients, soil types and/or channel gradients as separate requests.

INSTALLATION & EVALUATION PROCEDURE

With respect to products being evaluated for “Slope Protection” applications, participants must select the steepness of slope on which their product is to be evaluated.

With respect to products being tested for “Channel Protection” applications, participants must select whether their product should be evaluated as a “temporary” or “permanent” channel liner. Products that break at a peak force less than 50 lbs. during tensile properties testing are considered “temporary” products and will be eligible for 2 & 4 lbs. per square ft. (psf) test categories but are not eligible for the higher flow 6 & 8 lbs. per square ft (psf) test categories. Products that break at a peak force of 50 lbs. or greater are considered “permanent” and are eligible for all test categories. Approved channel protection products will be required to meet all minimum performance standards adopted by TxDOT.

All products, whether submitted for “Slope Protection” or for “Channel Protection” applications, are installed in strict accordance with the manufacturer’s published installation literature, as determined by the Laboratory Manager. Particular attention will be paid to edge and junction overlaps, staple size, and staple pattern. Installation techniques which, in the Laboratory Manager’s opinion; are not supported by the product’s published installation literature will not be permitted.

SLOPE PROTECTION

The procedure for testing slope protection materials utilizes two slopes, steep (2:1) and moderate (3:1) and two soil types: sand, and clay. At the participants’ option, a material may be tested on 3:1, 2:1 or both. Selection of both slopes is allowed but is regarded as two separate evaluations and will require two separate applications and test fees per evaluation. Regardless of slope selected, the material is tested on both sand and clay soils. Materials are evaluated using three different identically installed test beds for each soil type and by using identical and repeatable rainfall rates, storm intensities and test durations as outlined in the test protocol. Slope protection products are tested without vegetation. Testing in an unvegetated condition provides a better measure of a materials ability to protect the soil surface prior to vegetation establishment.

Test Beds

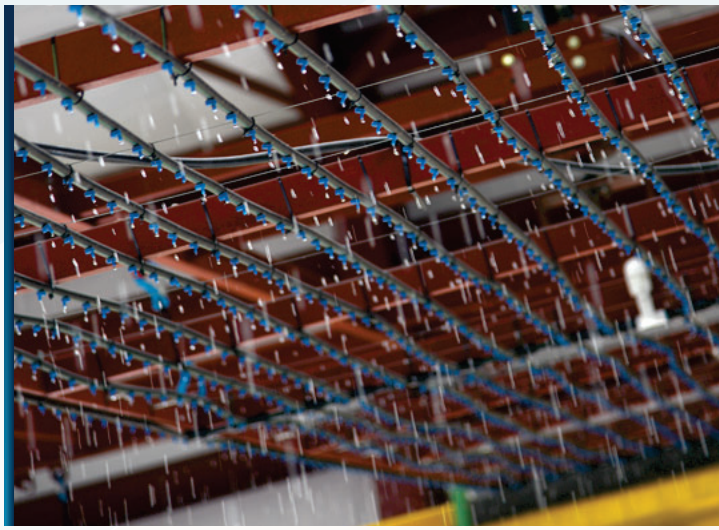
Test beds for slope testing are 30 ft.(l) x 6 ft.(w) x 9 in.(d) for ASTM D8297 testing and are 40 ft.(l) x 8 ft.(w) x 12 in.(d) for ASTM D6459 testing. Frames are steel and plywood with expanded metal bottoms. A layer of filter fabric is placed over the bottom grid to allow water to flow out of the bottom of the test bed once it has reached the bottom of the test soil layer.

Soils used in the tests are of two types: a loamy sand, and a high PI clay. The soils are collected from on-site and/or regional sources, graded for texture, composition, and organic content to ensure uniformity. Soil moisture and compaction is controlled for all tests.

Once the test beds have been prepared, test material is applied according to manufacturer’s published literature.

Rainfall Simulation

Rainfall is applied using drip emitters that closely model the more damaging precipitation drop sizes found in intense storms. Uniformity of the coverage and precipitation rate is carefully controlled. The rainfall simulators are mounted 14' above the surface of the test bed to achieve targeted 90% rainfall terminal velocity.



The ASTM D8297 test, required for TXDOT approval; includes 3 repetitions consisting of three distinct product Installations on three separate test beds for each soil type. For each of the test beds, three 30-minute storm events for three consecutive days at a rate of 3.5 in/hr are required. After each set of rainfall events, the test bed is completely rebuilt with new soil and new soil protection material prior to being used for additional testing.

Sediment Collection and Processing

All water and sediment are collected at the base of the sediment beds. The sediment is allowed to settle for a minimum of 12 hours. At that point the clear water is decanted. The remaining sediment and water are weighed. Weight is taken to the nearest 0.1 lb. Sediment is then agitated for two minutes, and 3 samples are taken. Agitation continues until all samples are taken. Samples are transferred to an oven and dried until all moisture is removed. Samples are then weighed on a scientific balance to the nearest 0.0004 lbs.

Sediment loss is calculated by determining the water (w) to sediment (s) ratio of the sediment samples by dividing the dry sample weight by the original sample weight (w/s). This ratio is applied to the full sediment sample to determine total sediment loss.

CHANNEL PROTECTION

The procedure for testing channel protection material utilizes 15 ft (l) x 1.5 ft (w) x 9 inches (d) trays which are placed in a variable slope flume prior to the simulated flow event. The temporary channel protection category products are evaluated at 2 and 4 psf. The permanent channel protection products are evaluated at 2, 4, 6, and 8 psf. Test flows start at 2 psf and continue until the material fails or survives a stress of 8 psf.

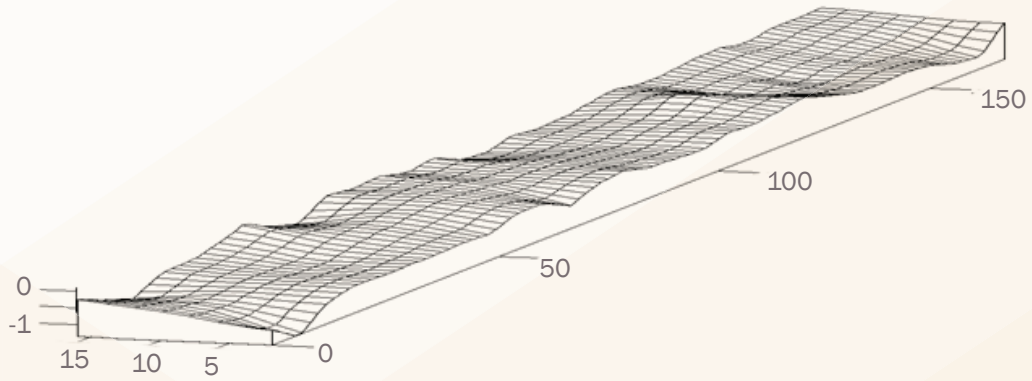
Product Installation

Three test trays are prepared for each material to be tested. Trays are lined with a filter fabric and then filled and compacted with sterile soil. Materials are installed in accordance with the manufacturer's published literature. Once prepared, the trays are placed in the flume. Testing in an unvegetated condition provides a better measure of a materials ability to protect the soil surface prior to vegetation establishment.

Sediment Data Collection

Before and after each test flow, 87 soil surface profiles are taken the length of the test tray. Two profiles 2 inches from each side of the flume and a third along the centerline on 6-inch increments are taken along the length of the flume. This is accomplished using an electronic soil profiler which measures the change in soil surface depth. The data is transferred and recorded in a computer.

Sediment loss is calculated using a standard and uniform mass per unit soil loss equation for each product.



HYDROMULCH FOR SEEDING

Hydromulch products are tested at a 4:1 slope and must pass the required minimum vegetation cover and sediment loss thresholds. This lower slope 4:1 category is used for evaluating basic paper and wood fiber hydraulic mulches and is not designed for BFMs and other high-end hydraulically applied products

Currently, all hydraulic mulches in the 4:1 slope category are applied at the following rates only:

- Sandy Soils - 2,500 lbs./acre (2.8 Mg/ha); or
- Clay Soils - 2,000 lbs./acre (2.3 Mg/ha).

Installation, evaluation and sediment collection and processing are the same as listed for slope protection. As with slope protection products, all hydromulch products will be installed based on manufacturers published literature but will only be installed at the rates listed above.

VEGETATION COVER

The Vegetation cover test is required for all slope protection, channel protection and hydromulch for seeding products being evaluated for placement on the APL. Each of these products are required to meet minimum vegetation cover standards as required by TxDOT in addition to sediment loss thresholds.

Vegetation cover is based on determining the average percent surface cover achieved in three standard nursery flats (12 in x 18 in) for each soil type, covered with the selected slope protection, channel protection, or hydromulch for seeding material. The same soil for the slope or channel protection tests or hydromulch for seeding test is used. Flats are seeded with a standard seeding mixture, fertilized at a uniform rate, and are allowed to grow for 30 days.

Vegetation cover is determined by taking video samples which are processed to determine the average surface percent cover of vegetation following a thirty-day growing period. Percent vegetation covered is determined using a digital camera and processed using current Vegetation Capture (V-CAP) technology.

SEDIMENT CONTROL DEVICES

The Sediment Control Device (SCD) testing facility is designed to measure the filtering and sediment retention characteristics of sediment control devices. The SCD test procedure is designed to effectively monitor & compare characteristics and performance of various sediment control devices. Suspended solid concentration (mg/L), mass loading (lbs.), and removal efficiency (%) are calculated.

A polypropylene tank with a capacity of 1600 gallons, an 18-foot X 15-foot concrete testing channel with a 4-foot natural soil installation zone, in-line turbidity sensors/controller, and bubble flow meters are used to complete this test.

Water combined with ground silica and ball clay is mixed in the polypropylene tank and sediment laden water is introduced into the system. Turbidity probes and bubbler tubes are connected to their appropriate locations at the sediment delivery system on the bottom of the mixing tank and the outlet tube of the collection zone. The flow meters and turbidity meters are then turned on and evaluated to ensure that the data is being collected and recorded correctly at each location. Overall performance of the SRD is measured by comparing the change in turbidity and change in flow rate when comparing the inflow and outflow data after all water has passed through the device.

Sediment control devices are not currently listed on the TxDOT APL, however TTI is currently developing an approval process for these products and at some point, in the future; sediment control devices that meet required performance standards will be included on the approved products list.

APPROVAL BY EXTENSION

For slope protection products, if the participant elects to evaluate a product on the steep (2:1) slope and the product successfully meets the current minimum performance standards established by TxDOT, the product will also be included as an approved product on the less steep - moderate (3:1) slope within the same soil texture group. For example, if a product is evaluated on the steep (2:1) clay slope, and successfully meets the adopted sediment and vegetation density standards, the product will also be listed as an approved product for the moderate (3:1) clay slope.

If a manufacturer elects to test at the moderate (3:1) slope, the product will not be added to the steep (2:1) slope as an approved product regardless of the performance of the material. If a product elects to be tested at both 3:1 and 2:1 slope, the product's individual performance, as documented within each application, shall determine placement upon TxDOT's Approved Product List (APL) and approval by extension shall not apply.

REVISION OF MINIMUM PERFORMANCE STANDARDS

Based upon statistical analysis of performance data as produced through the SEC Lab, TxDOT reserves the right to revise the minimum performance standards. If an individual product's performance data fails to meet any of the revised performance standards, the product will be removed from the APL. The product representative will be provided the opportunity of retesting the identical product within the next available evaluation cycle as determined by the Lab Manager. If the product's performance meets the newly adopted minimum performance standards, the product will remain on the APL.

CONTRACTOR'S OPTION

The APL will be maintained by TxDOT/TTI. It will be the Contractor's option of using any approved product included on the current APL. Installation of the rolled products will be in strict accordance with manufacturer's published installation guidelines. Hydraulically applied products will be installed at the application rates indicated on interactive APL.

PRODUCT BRAND NAME & REVISIONS

The manufacturer of all approved products shall notify TxDOT/TTI should any revisions to the trade or brand name for the product be made. The manufacturer must provide the revised trade or brand name(s) for the product and must provide written documentation that the product is the exact equivalent of the originally approved product and that no material properties were revised.At the time of initial product approval and during each subsequent recertification period, product name revisions or addition of trade names are allowed and are included in the recertification cost. Any other time a manufacturer chooses to change or add product names for approved products on the APL, the cost will be $500 for each product name revision.

RECERTIFICATION PROGRAM

The intent of the TxDOT recertification program is to ensure quality control of products listed on the TxDOT Approved Products List (APL). Once a product has completed large scale test requirements and has been approved and added to the APL, physical properties tests will be conducted every 3 years to ensure that no significant revisions have been made to the product's material characteristics, trade names, private label listing, official contact representative, etc. The following physical properties tests (index tests) will be conducted:

Rolled Products (RECPs)	
ASTM D 6475-17	Standard Test Method for Measuring Mass/Unit Area of Erosion Control Blankets
ASTM D 6566	Standard Test method for Measuring Mass per Unit Area of Turf Reinforcement Mats
ASTM D 6818	Standard Test Method for Tensile Properties of Rolled Erosion Control Products
ASTM D 6525	Standard Test Method for Measuring Nominal Thickness of RECP's
ASTM D 5199	Standard Test Method for Measuring the Nominal Thickness of Geosynthetics
ASTM D 6567	Standard Test Method for Measuring the Light Penetration of a RECP.

Spray-on Products (HECPs)	
ASTM D 7986	Standard Practice for Preparing Specimens of HECPs for Index Property Testing
ASTM D 6818	Standard Test Method for Tensile Properties of Rolled Erosion Control Products
ASTM D 7367	Standard Test Method for Determining Water Holding Capacity of Fiber Mulches
ASTM D 7560	Standard Test Method for Determination of Fiber Length Percentages in HECPs

Recertification Test Options & Fee Schedule

There are three options for completing the required recertification physical properties tests for each product.

Recertification Test Options	Slope Protection (Roll & Spray-on Products)	Channel Protection	Hydromulch
Option 1 Manufacturers may submit a physical sample of product to the **Texas A&M Transportation Institute** who will perform the appropriate physical property tests.	$1500	$1500	$1500
Option 2 Manufacturers may submit required physical properties test results from an **AASHTO or DOT accredited laboratory**. Tests results that have been performed at any time within the three-year period after initial approval and prior to the date the product is due for recertification will be accepted.	$500	$500	$500
Option 3 Manufacturers may submit the required physical properties test results from certified **in-house testing**. Tests results that have been performed in-house at any time within the three-year period after initial approval and prior to the date the product is due for recertification will be accepted.	$500	$500	$500

Product Requirements

Products submitted for recertification should be selected from standard manufactured lots and should accurately represent the same product marketed to the public. Product lot numbers and signed certification of product authenticity will be required each time a product is submitted for recertification at the Texas A&M Transportation Institute, or any time test results from an accredited lab are sent for recertification.

SEC lab personnel will contact manufacturers when products are due for recertification and will provide information regarding the amount of material needed and other pertinent information regarding recertification if product is to be recertified at TTI. TTI personnel will also contact manufacturers regarding the properties test result submittal process, if test results are being submitted from an AASHTO or DOT accredited laboratory.

Name Change or Addition of Trade Names

As mentioned previously, at the time of initial product approval and during each subsequent recertification period, product name revisions or addition of trade names are allowed and are included in the recertification cost. Any other time a manufacturer chooses to change or add product names for approved products on the APL, the cost will be $500 for each product name revision.

RESEARCH & DEVLOPMENT

R&D contracts and product development non applicable to the TXDOT approved products list is handled directly with product manufacturers and the Texas A&M Transportation Institute.R&D products tested at the TTI SEC Lab, will not be included on the TXDOT approved list until they have been evaluated according to ASTM D8297 standards and have met all minimum TXDOT performance criteria.

Contract testing for research and development, product evaluation using various standard test protocols (including ASTM D6459) and custom test evaluation of erosion and sediment control products is continually available at the TTI SEC lab. For inquires please contact TTI SEC lab personnel.

PROGRAM CONTACT PERSONNEL

To discuss or request information on TxDOT's overall evaluation program for erosion control products contact:

Travis Jez, Natural Resources Specialist IV

Texas Dept. of Transportation

Maintenance Division

Vegetation Management Section

(512) 913-7240

Travis.Jez@txdot.gov

To secure a "Application for Testing" packet, inquire about waiting list or evaluation schedules, or to arrange a visit to the evaluation facility, contact the following:

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Texas A&M Transportation Institute

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