6- 9-09
June 4, 2010
November 28, 2011
REVISED: February 25, 2014

Tennessee Department of Transportation
Division of Materials and Tests

Procedures for the Sampling and Testing, and Acceptance of Materials and Products (SOP 1-1)

Purpose: The purpose of this document is to establish the procedures and minimum requirements for the acceptance, verification, and certification of materials and products used on TDOT projects and projects under the oversight of TDOT (Local Projects, Grants, etc. that include Federal Funds).

Background: Acceptance of materials, or combination of materials, may be accomplished in several different ways. Federal requirements state that each State Highway Agency shall develop a Quality Assurance Program which assures all materials, on projects in which Federal monies are used, conform with the requirements of the approved plans and specifications. In addition, these procedures assure projects using state funds will also be constructed using the highest quality materials.

Policy: All materials used on TDOT projects must be accepted prior to use. Acceptance of materials is normally by:

1 - Testing during the production of a product (e.g. hot mix asphalt, portland cement concrete, base materials),
2 - By manufactures certifications, followed by random verification testing (e.g. reinforcing steel, cement, liquid asphalt) (refer to SOP 1-1, Part 4 using Random Numbers for Sampling and Testing)
3 - Pre-approval and testing of a product or its components prior to being used (e.g. aggregate quality, gray iron castings, reinforced concrete pipe, corrugated metal pipe)(usually TDOT stamped), or
4 - From the Qualified Products List (QPL) with certifications (e.g. sign sheeting, erosion control blankets, pavement marking materials).

The procedures set forth in the TDOT Materials and Testing Standard Operating Procedures Manual, the Sampling and Testing Schedule, the Sampling and Testing Guide, the Verification procedures, and the Independent Assurance Procedures, shall be used to document the minimum requirements for product acceptance.
NOTE: For those projects constructed under the oversight of TDOT (Local Projects, Grants, etc. that include Federal Funds) any reference in SOP 1-1 part 1 and SOP 1-1 part 2 that refers to TDOT Personnel being the sampled by party, is replaced by the Agency's CEI or Certified sampling and testing technician.

Types of Tests:

There are three basic types of sampling and tests routinely conducted: acceptance, verification, and assurance.

Acceptance Sampling and Testing: These tests are conducted to approve or accept a product, or construction method, by generally comparing the test results to specification requirements. Most products where TDOT conducts acceptance testing are based on a lot, or frequency, during the production and/or placement of that product, to assure specification compliance. For example, hot mix asphalt is accepted by gradation, asphalt content, and in place density, etc…, portland cement concrete is accepted by temperature, air content, slump, (and strength) at the time of placement, pavement base material is accepted based on gradation and density at the time of placement, etc…. Aggregate sources, however, are accepted for quality and gradations before the aggregate can be used in a particular application.

There are products that are sampled and tested, and then accepted at the manufactures facility and then delivered to TDOT projects for use. These products must have the TDOT Emblem stenciled on before being incorporated for use. These products would include: pre-cast drainage structures, pipes (reinforced concrete and corrugated metal), pre-stressed beams, and gray iron castings.

Verification Sampling and Testing: These tests are conducted at a much lower frequency than acceptance tests to verify/validate that products accepted by manufactures certifications are in compliance with the applicable Standards and Specifications. Verification sampling and testing are also completed to assure that contractors' quality control results are acceptable.

Independent Assurance Sampling and Testing: These are tests conducted to assure that acceptance sampling and testing procedures are done in accordance with the specified procedures and to compare testing equipment.

Quality Control of Samples: These tests are conducted by Contractors in an effort to maintain standards by testing samples against specifications.

Material Certifications:

All materials that are accepted on certification must have a DT-0044 (T-2) form, completed by the Contractor, showing contract number, project number, county, item number and quantity of material being accepted. Attach the DT-0044 (T-2) to the manufacturer's certification and forward to the Regional Materials and Tests supervisor. The Manufacturer's certification shall show or state TDOT requirements (specifications) and certified test results.

In many instances, the manufacturer's certification will not be project specific, i.e.; it will not have the contract or project number on the certification. When this

occurs, do not write the contract or project number on the certification. Instead, require the contractor or jobber to fill out a DT-0044 (T-2) form, have it notarized, and attach manufacturer's certification. Copies of certifications (including faxed copies) will be acceptable provided originals are kept on file by the contractor, supplier or manufacturer and available for inspection.

Any material that is on the department's Qualified Products List may be accepted by a certification from the manufacturer stating that the material furnished to the project is of the same formulation and has the same physical characteristics as the material evaluated for the Qualified Products List. The Contractor shall forward certification and a completed DT-0044 (T-2) to the Project Supervisor for review.

Most materials will arrive at the project site pre-tested. It is the project personnel's responsibility to provide the final inspection on all material and if for any reason the material is suspect, it should not be used until further evaluations are conducted.

The Regional Materials supervisor will be contacted to conduct these evaluations.

All manufacturers' certifications must be signed, except for sod and nursery materials from the Tennessee Department of Agriculture.

Miscellaneous materials used on special projects (such as rest areas) that are overseen by an architect or consulting engineer for the Architecture Department may be accepted by a blanket certification from them stating that the materials meet specification requirements.

At completion of project, the Project Supervisor must submit a signed Materials and Tests Certification (form DT-1696) to the Regional Construction and Materials and Tests Supervisors, and then forward to the Headquarters Materials and Tests Director.

Buy America Certifications:

All iron and steel products must meet Buy America requirements as set forth in TDOT Special Provision 106A, if included in the contract.

Table of Contents:

There are five parts to these procedures, each designed to assist the project personnel to carry out their responsibilities. Each part has its own specific purpose, and each must be checked for any material to be put in use.

Part 1- Sampling and Testing Guide

This is a field guide that lists some of the materials that are accepted on certification, by acceptance tests, or verification tests. It will assist the project personnel in assuring that acceptable material is utilized on projects.

Part 2 – Acceptance Sampling and Testing Schedule

This part lists construction materials by type of construction. It identifies the tests to be run, who is to take the samples, and how frequently the samples are to be taken and their location. It also states if certification or further testing (i.e. Verification Testing) is required.

Part 3 – Verification Sampling and Testing Schedule

This part is similar to part 2, but gives the details for Verification Test requirements. All verification samples must be submitted for testing within 2 weeks of the sample date.

Part 4 – Quality Control of Sampling and Testing Schedule

This part is also similar to part 2, but gives the details for quality control for contractors.

Part 5 –Using Random Numbers for Sampling and Testing

This part outlines the procedures that will help you to choose random and representative test locations using random number tables.

Tennessee Department of Transportation
Division of Materials and Tests

Part One: Sampling and Testing Guide

Products and Materials for Acceptance:

(1) AGGREGATES IN GENERAL:

Unless otherwise specified, gradation testing and quality samples will be taken at a point in production which insures that representative sampling, and testing occurs. Project personnel are responsible for requesting an aggregate report (DT-0275) from Materials and Tests personnel for each size or type of aggregate **before** material is shipped to job site.

Note: Rip-Rap Material from a Quarry - Materials and Tests Inspectors will issue test reports for quality and quantity only. The Project Inspector is responsible for size and placement.

Note: Rip-Rap from Job Site - The Project Inspector shall notify the Regional Materials and Tests Section so that a quality sample may be obtained. Materials and Tests will issue a quality report. The Project Inspector will be responsible for size, placement and pay quantities.

(2) AGRICULTURAL LIME:

The Materials and Tests Inspector will issue an aggregate report (DT-0275) for quality **prior** to material being shipped to job site when requested by project personnel.

Commercial Fertilizer - The Project Inspector must determine that fertilizer complies with Section 918.15, Standard Specification Book. No test report is required.

The Contractor will furnish project personnel invoices on both the agricultural lime and fertilizer.

(3) ALUMINUM RAILING SYSTEM (BRIDGE):

The Contractor shall furnish certifications covering each component of the system. These certifications along with a completed DT-0044 (T-2) form will be sent to the Project Supervisor.**

Pull out tests shall be performed and documented for drilled anchors.

(4) BOLT AND NUT ASSEMBLIES FOR HIGH STRENGTH STEEL STRUCTURES:

The Bolt/Nut/Washer/DTI Manufacturer shall submit three (3) bolts/nuts/washers assemblies from each heat number to the TDOT Headquarters Laboratory for verification testing **prior** to use. The manufacturer/distributor shall furnish, for each heat number and/or assembly, a mill

test report and/or a manufacturer/distributor certified test report in accordance with TDOT specification (§ 908.04). TDOT will issue a Lab report for each manufacturer/distributor submittal.

Shipments to the project shall be accompanied with a completed DT-0044 and a copy of the TDOT lab report identifying each heat number.

(5) BRICK:

Project Inspector shall check all shipments of brick for TDOT stencil mark or a lot number on side of bundles. If stenciled or has lot number, Materials and Tests Inspector will issue a test report. If not stenciled or contain a lot number, the Project Inspector will take a sample of five bricks and send to Headquarters Lab with completed DT-0044 (T-2) form. Brick is not to be used until you receive approval from lab.*

(6) BRIDGE BEARING DEVICES (ELASTOMERIC):

Materials and Tests personnel must test elastomeric bearing devices **before** installation. If elastomeric bearing devices are sent to the project for which the Project Supervisor does not have a test report, notify the Regional Materials and Tests Supervisor so that the bearing devices can be tested prior to placement.*

(7) BRIDGE BEARING DEVICES (LAMINATED):

Acceptance of laminated bearing devices will be from Certified Mill Test Reports for both steel and rubber components. The Contractor will complete a DT-0044 (T-2) indicating that the materials are to be accepted by certification and visual inspection. Forward these documents to the Project Supervisor. Approved shop drawings are required.**

(8) BRIDGE BEARING DEVICES (STEEL);

The Project Inspector will accept steel bridge bearing devices on certification and Mill Test Reports. The Contractor will complete a DT-0044 (T-2) form to be forwarded to the Regional Materials and Tests supervisor.

(9) BRIDGE DECK SEALS (MEMBRANES):

Must be selected from Qualified Products List 2.***

(10) BRIDGE EXPANSION DEVICES AND PREFORMED ELASTOMERIC COMPRESSIVE JOINT SEALS:

The Contractor or producer will furnish certifications on expansion devices. These certifications along with completed DT-0044 (T-2) form will be sent to Project Supervisor. Approved shop drawings are required.**

Note: Modular Joints - Must have certified letter from manufacturer's representative certifying that the joint was installed according to manufacturer's recommendations.
See also QPL 9 for elastomeric joints, 9B for expansion joint systems at bridge ends and QPL 7 for preformed elastomeric joint seals.

(11) BRIDGE PAINT:

Must be from Qualified Products List 3.***

(12) CALCIUM CHLORIDE:

The Project Inspector will take a one (1) quart sample (glass container only) per shipment, along with competed DT-0044 (T-2) form and send to Headquarters Lab.* Chloride shall not to be used until approved by lab.

(13) CEMENT, FLY ASH, AND GROUND GRANULATED BLAST FURNACE SLAG (GGBFS) FOR CONCRETE:

Must be from Qualified Products Lists 15 and 16.*** Verification sampling is required. See Sampling and Testing Schedule for verification requirements. Samples are to be forwarded to Headquarters Lab.* (Sample size shall be a minimum of 10 lbs. and contamination of sample shall be avoided)

(14) CONCRETE AGGREGATES:

The Materials and Tests Inspector, after being notified by the Project Inspector, shall run verification tests on both coarse and fine aggregates at the concrete plant **prior** to production. The Materials Inspector will issue an aggregate report (DT-0275) along with a verification report on each aggregate.

The Project Inspector will be responsible for checking the daily concrete reports that are filled out by the contractor's Certified Concrete Plant Quality Control Technician to determine that gradation and wash tests on all aggregates meet requirements and are performed in accordance with the approved process control plan. The Fineness Modulus shall be calculated and within the tolerances outlined in AASHTO M-6.

(15) CONCRETE CURING COMPOUNDS (WHITE OR CLEAR), CONCRETE PRESERVATIVE (LINSEED OIL MIXTURE):

Refer to the Qualified Products List Procedures documents for acceptance guidelines (effective April 1, 2014). The Contractor shall submit a completed DT-0044 (T-2) form with the manufacturer’s certification to the Project Supervisor. Where applied texture finish is specified, a Type 1-D, Class B, membrane which is compatible with the texture finish shall be used. Either Type 2 membrane or Type 1-D, Class B, membrane may be used on bridge decks when applied in combination with the water method of curing. Type 2 membrane shall be used in all other applications.

Note: Lot numbers or batch numbers on drums or pails must match numbers on certifications.

(16) CONCRETE IN GENERAL:

Cylinders made for Class CP concrete shall be 2 (6"x12") cylinders. Cylinders for all other classes of concrete including structural concrete shall be 3 (4"x8") cylinders.

(17) CONCRETE PIPE:

The Project Inspector shall check all concrete pipe for a "certified" stamp. Each shipment to a project site shall be accompanied with a producer certification in accordance with the TDOT Standard Operating Procedure (SOP 5-3). The Contractor will complete a DT-0044 (T-2) form with the producers' certification.

(18) APPLIED TEXTURE COATINGS FOR CONCRETE:

Must be from Qualified Products List 12.***
The QPL identifies the number of coats required to meet the specification rate of texture coat used.

(19) CORRUGATED METAL (C.M.) PIPE:

The Project Inspector may accept all C.M. Pipe that is stenciled TDOT and reported (DT-0280).

If from an out-of-state producer, samples of the CM shall be submitted with form DT-1368 for verification testing, **prior** to use, with a certified mill test report and galvanization report.

Materials and Tests Inspector will report all approved metal pipe (DT-0280).

(20) EARTH RETAINING STRUCTURES

All earth retaining structures shall be constructed in accordance with the TDOT Special Provision 624 and/or the approved shop drawings. The acceptance of materials used during construction shall be in accordance with the following, and shall be submitted with a completed form DT-0044:
- Cast-in-place concrete - All concrete, aggregate, reinforcing steel, etc… will be accepted at the frequencies and procedures established herein for the "Acceptance Samples and Tests for Portland cement concrete"
- Pre-cast Concrete- All pre-cast concrete items shall be manufactured in a facility that has been certified in accordance with the TDOT Standard Operating Procedure (SOP 5-3) on the "Manufacture and Acceptance of Precast Concrete Drainage Structures, Noise wall panels, and Retaining wall panels". TDOT will perform verification testing. If units are from an out of state producer, all raw materials must be approved before manufacturing and verification of completed units may be from the project site after shipment, but **before** units are placed.
- Backfill, select backfill, and aggregate- All backfill, select granular backfill, and aggregate material sources must be identified by the contractor and certified by test reports that it meets the

requirements in TDOT Special Provision 624 and/or approved shop drawings. Acceptance testing required by TDOT **prior** to use and at the established frequencies.
- Modular Blocks- All modular blocks shall be certified with test reports by the manufacturer that they meet the requirements in TDOT Special Provision 624. **Prior** to use, TDOT will conduct strength and absorption verification testing.
- Attachment devices, geosynthetic reinforcement and joint materials- All attachment devices, geosynthetic reinforcement material, and joint materials shall be made in accordance with TDOT Special Provision 624. All materials shall be certified by the manufacture.
- Steel items- All steel products (i.e. structural steel piles/soldier beams, reinforcing steel, structural steel, pre-stressing steel, etc.) used in the construction of anchor walls shall be accepted for use in accordance with the procedures established herein, or as required in TDOT Special Provision 624. All heat numbers shall match the mill test reports.
- Incidental items- Any other incidental materials shall be accepted in accordance TDOT Special Provision 624 and/or approved shop drawings. All items shall be certificated by the manufacturer.

(21) ELECTRICAL ITEMS/ ITS COMPONENTS/ LIGHTING:

Before work is to begin, the Contractor shall furnish a technical package including all materials, products, technical data, and installation requirements to TDOT and to the Maintaining Agency. Poles and other related structural items are to be submitted and approved by TDOT Structures. These items shall be submitted separately from the electrical submittals. At the completion of work, the Contractor shall issue a certificate of compliance and certifications stating that materials meet TDOT specifications with a completed DT-0044** with all final quantities. In addition, the Contractor shall also provide an approval letter from the owner/maintaining agency stating acceptance of the completed system.

(22) EROSION CONTROL BLANKET:

Must be from Qualified Products List 17.***

(23) FENCING MATERIALS:

The Project Inspector shall sample all fencing materials used at the site. The TDOT representative shall deliver the samples to the Materials and Tests Laboratory.

Manufacturing Requirements:

> Stock Fence –TDOT Specification 909.01 (a) fabric, 909.01 (b) steel posts and braces, 909.01 (d) barbed wire.
>
> Chain Link Fence –TDOT Specification 909.02 (A) fabric, 909.02 (B) line posts, 909.02 (C) end-posts, corner-posts, and braces, 909.02 (D) top rail, 909.02 (E) barbed wire, 909.02 (F) miscellaneous fittings and hardware, 909.02 (G) wire ties, 909.02 (H) tension wire, 909.02 (I) truss rods and turnbuckle, 909.02 (J) polyvinyl chloride chain link fence.

Required Paperwork:

Use a separate Form DT-0044 (T-2) for each item listed above so that the lab can report a pass/fail result as each item is tested. The contractor must fill out the notary section on the Form DT-0044 and have the form notarized if the material is properly certified but is not project identified.

Certifications shall reflect the appropriate information per TDOT Specifications and only applicable items need to be certified. All applicable ASTM or AASHTO Specifications shall be cited in the certifications if you choose to reference any ASTM or AASHTO requirements or simply certify everything by the appropriate TDOT Specification as indicated above.

Sample Requirements and Sampling Instruction:

Fence Fabric: (Farm/Chain link) Cut one (1) foot long by roll width section.

Fence Gates – Manufactured in accordance with TDOT Specification 909.03 for (A) stock fence gates, (B) chain link fence gates.

Barbed wired and tension wire: Cut 3’ sample from the roll.

Round Posts (corner, line, brace and top rail) Cut 2" off each end on each size post and discard. Then cut a 4" sample from each end. Sample should be cut as neatly and evenly as possible in order to accurately calculate the zinc coating surface area. Cut with a saw or pipe cutter only.

T Posts: Cut 6” sample from top end with a saw or pipe cutter only.

Hardware: (considered one item) One (1) each of the following miscellaneous items: truss rod, turnbuckle, fittings, hardware & wire ties.

(24) FIBER EXPANSION JOINT MATERIALS:

Must be from Qualified Products List 5.***

(25) FLEXIBLE SURFACE AND GROUND MOUNTED DELINEATOR POST:

Must be from Qualified Products List 1.***

(26) FLOWABLE FILL:

Prior to use, the supplier will submit a list of materials and batch weights to Headquarters Materials and Tests for approval. Proportions and tests shall meet the specified requirements in TDOT Specification Book (§ 204.06). If an Early Strength or Excavatable mixture is specified,

the producer must first demonstrate the properties specified in the TDOT Specification Book (§ 204.06) are met.

(27) GABION FABRIC (WIRE):

Acceptance same as for chain link fabric above.

(28) GEOTEXTILES:

All geotextiles shall be submitted with certified test results and a certification as required for the different types:

(A) Type I - The Project Inspector will accept material by certification stating that the materials meet requirements for AASHTO-M288, Subsurface Drainage, Tables 1 and 2 Class 2 with 15 % to 50% of in situ soil passing 0.075mm. Certifications and a completed DT-0044 (T-2) form, submitted by the Contractor to the Project Supervisor, will be forwarded to the Regional Materials and Tests Supervisor.

(B) Type II - The Project Inspector will accept silt fence geotextiles by certification stating that the materials meet requirements for AASHTO-M288, Sediment Control, Table 6, Unsupported Silt Fence with an elongation less that 50%. Certifications and a completed DT-0044 (T-2) form, submitted by the Contractor to the Project Supervisor, will be forwarded to the Regional Materials and Tests Supervisor.

(C) Type III - The Project Inspector will accept erosion control geotextiles by certification stating that the materials meet requirements for AASHTO-M288, Erosion Control, Tables 1 and 5 with an elongation less than 50% and 15% to 50% of in situ soil passing 0.075. Certifications and a completed DT-0044 (T-2) form, submitted by the Contractor to the Project Supervisor, will be forwarded to the Regional Materials and Tests Supervisor.

(D) Type IV - The Project Inspector shall furnish a completed DT-0044 (T-2) form with certification stating that the material meets AASHTO M 288 Stabilization, Tables 1 and 4, Class I with an elongation less than 50%. A sample of the geotextile material measuring 80 inches in length by the width of the roll shall be submitted to Headquarters Materials and Tests Laboratory. The sample shall contain at minimum one NTPEP manufacturing mark located on the roll edge of the product. Do not use until you receive a test report.*

(E) Type V - The material shall conform to requirements as specified by the plans or special provisions. Contact Regional Materials for correct reporting process.
The contractor shall furnish a certified laboratory test report from an approved testing laboratory with each shipment of materials. Laboratory test reports shall include the actual numerical test data obtained. Test results shall be submitted to the Engineer of Materials and Tests.

Each unique geotextile manufactured for AASHTO M288 qualification and NTPEP program participation shall be marked with a clearly legible print showing, as a minimum, the manufacturing plant (or manufacturing plant ID code numbers). This marking shall be located on the roll edge of the product in the selvedge at a frequency of once per 5 meters (16.4 ft). The marking shall be unique for each manufacturer and manufacturing plant facility.

(29) GRAY IRON CASTINGS:

The manufacturer/supplier of castings shall provide samples of material from each heat number to Headquarters Materials and Tests for verification testing, **prior** to use, in accordance with the standard specification (§908.07). Both the samples sent to HQ Materials and Tests and the castings to be incorporated into the work shall be accompanied with a certified mill test report that list the heat number or ID, description of the casting (including TDOT standard drawing number), the weight of each casting, and the number cast from each ID. The sample ID shall be traceable and correspond to the casting ID. All castings shall have an ID number cast into the product.

The manufacturer/supplier of castings shall provide a distribution point within Tennessee to provide a location for inspection, verification of heat numbers, and approval stenciling with a TDOT stencil. The manufacturer/supplier must provide a covered area with appropriate scales for weighing and dimension checks of the castings at the distribution point. The manufacturer/supplier shall notify a Region Materials and Test representative for the required inspection and issuance of test reports.

All castings shall be stenciled with a TDOT stencil mark before shipment to a project.
Castings received on a project without a TDOT stencil mark will not be acceptable for use. The Project Inspector shall check each casting for a TDOT stencil mark. A test report (DT-0317) will be issued by a Materials and Tests Inspector if the castings are stenciled.

(30) GROUT:

Unless otherwise specified, grout shall be in accordance with Standard Specifications 918.21.
Prior to use, the supplier will furnish a list of approved materials and batch weights to the Project Supervisor. This list will be sent to the Regional Materials and Tests Office for review. If the grout has a strength requirement, the design shall be submitted for approval to Headquarters Materials and Tests. The design shall be accompanied by trial batches proving that strength requirements are met. At the completion of the project, the Contractor will certify by letter that the materials were batched according to the proposed submittal and submit a completed DT-0044 (T-2) to the Project Supervisor.**

(31) GUARDRAIL:

The Tennessee Department of Transportation has a policy whereby certifications of guardrail to individual Tennessee DOT projects would not be required provided that you had furnished a Brand Registration and Guarantee in compliance with Paragraph 5.3.1 AASHTO Designation M-180 Specifications for Corrugated Sheet Beams for Highway Guardrail. This Guarantee must be

renewed annually during the month of September and will be valid for a period of 1 year expiring October 1st of the following year. If the Guarantee which you have on file with us has expired, no more guardrail or accessories will be accepted by Guarantee until the Guarantee has been renewed. This Brand Registration and Guarantee should be furnished to:

Mr. Brian K. Egan, Engineering Director
Division of Materials and Tests
Tennessee Department of Transportation
6601 Centennial Boulevard
Nashville, Tennessee 37243-0360

The Guardrail Brand Registration and Guarantee must state that the materials furnished shall conform to the requirements of AASHTO Designation M-180, ASTM A-36, ASTM A-123, AASHTO M-111 or ASTM A-153, whichever may apply; that all manufacturing processes including galvanizing have occurred in the USA, and must contain a clause which states that the materials will be replaced without cost to the Department when found not to be in conformity with the above specifications.

Items that may be included in the Brand Registration and Guarantee are: sheet beams, backup plates, buffer ends, end shoes, posts, bolts, nuts, washers and other accessories. All items furnished must be marked in accordance with AASHTO Designation M-180, Subsection Eleven (11), Paragraphs 11.1, 11.2, 11.3 and 11.4. All bolts shall be marked in compliance with ASTM A-307.

The Brand Registration and Guarantee shall be sworn to for the fabricator by a person having legal authority to bind the company with an acknowledgment by a Notary. The fabricator will be required to keep on file at the fabrication plant copies of all tests as outlined in AASHTO M-180, Paragraph 5.3.2.

In the event that the fabricator does not elect to furnish a Brand Registration and Guarantee, all material shipped to a Tennessee Department of Transportation project must be accompanied by a Certified Mill Test report and shall be sampled and tested prior to use.

Note: Notify the Regional Materials and Tests Office if any anchor bolts that require a pull test are used on the project. A Materials and Tests Inspector will perform a pull test.

Please see SOP 6-1 (Procedures and Qualifications for Guardrail Manufacturer and Supplier) for additional information.

(32) GUARDRAIL POSTS, BLOCKS, BOLTS, WASHERS, AND OTHER MISCELLANEOUS PARTS:

Miscellaneous parts may or may not be covered by a supplier's guarantee. If covered by a guarantee, the Contractor shall furnish a copy of the guarantee letter and a completed DT-0044 (T-2) to the Project Supervisor as a report. If not covered by a guarantee, the contractor shall follow the guidelines in **SOP 6-1** (**Procedures and Qualifications for Guardrail**

Manufacturer and Supplier) and submit samples and certifications along with a DT-0044 (T-2) showing types and quantities of the miscellaneous parts to the Headquarters Laboratory for testing. Do not permit the use of these materials until an approved test report is received from the laboratory.

(33) HIGHWAY SIGNING (PERMANENT) AND SIGN STRUCTURES / SIGN SUPPORTS:

Signs manufactured in state will be accepted at the job site by project personnel on certification from manufacturer. The manufacturer's identification markings must be on back of each sign. The Contractor shall complete a DT-0044 (T-2) form and attach certification to Regional Materials and Tests Supervisor.**

Signs manufactured out-of-state will be accepted at the job site by project personnel from manufacturer's certifications. Send Mill Test Reports on all materials plus a certification from manufacturer showing project information and quantity along with completed DT-0044 (T-2) form to the Project Supervisor.**

All sign supports shall have a certified mill test report and a galvanization report submitted with the DT-0044.

(34) IMPACT ATTENUATOR:

The Contractor shall send a completed DT-0044 (T-2) form, shop drawings, and certification, to the Project Supervisor for review prior to delivery.** Also, must be from Qualified Products List 34***.

(35) JOINT SEALANT (NON-FIBER):

Must be from Qualified Products List 5.***

(36) LANDSCAPING ITEMS:

(A) Sod – The Contractor shall furnish a copy of the Department of Agriculture authorization to the Project Supervisor prior to removing the sod. Nursery certificates do not indicate that sod is certified.

(B) Trees and Shrubs – Before performing any work, the Contractor shall furnish the Project Supervisor a nursery dealer’s certificate with each shipment of plants. The certificate shall indicate the number of plants of each species in the shipment and the project number for which the plants are intended. The certificate shall also include a certification that the plant materials conform to the requirements of the plans and specifications and that all local, state, and federal laws pertaining to the inspection, sales, and shipment of plant materials have been complied with. When the project is completed, the Contractor shall submit certifications along with a completed DT-0044 (T-2) and the pay quantities will be sent to Regional Materials and Tests Supervisor.

(C) Hay, straw, and/or other baled plant material shipped from an Imported Fire Ant (IFA) quarantine area in Tennessee must be accompanied by a permit from the state's Department of Agriculture or other appropriate regulatory agency; the permit must state that the material has been inspected and found to be free of IFA. A permit is not required when shipping these materials from a non-quarantine area. The Tennessee Department of Agriculture web site has county-by-county information of quarantine areas.

(http://www.tennessee.gov/agriculture/regulatory/plants.html)

(37) LIQUID ASPHALT, EMULSIONS, AND OTHER BITUMINOUS MATERIALS:

I. Each shipment of bituminous materials from the Asphalt Terminal arriving at the job site or Asphalt Plant will be accepted when accompanied by completed form DT-0293 indicating compliance with the specifications.

II. A. Verification sampling at the asphalt **terminal** for each type of bituminous material will be obtained by a terminal employee. Samples for liquid asphalt shall be a split sample of the manufacturers compliance testing. Samples for emulsions shall be randomly taken and witnessed by the Regional Materials Inspector (refer to SOP 1-1, Part 4 using Random Numbers for Sampling and Testing). Samples shall be obtained every two weeks from each tank from which material is being shipped.

B. The Project Inspector will witness the contractor's employees obtain verification samples from the storage tank at the asphalt **plant** for each Performance Grade Asphalt being used. Samples shall be taken at the startup of production, then randomly once per week thereafter. For out of state producers, without Regional Materials Inspection, samples shall be taken at the asphalt plant in the manner as stated above on the initial shipment and every third load thereafter.

C. Samples shall be secured by TDOT employees and submitted to Materials and Test Headquarters Laboratory with a completed DT-0044 and certification within 7 calendar days for testing. All samples shall be taken from the sampling valve on storage tanks. Before taking the verification sample, sufficient liquid asphalt (1 gallon minimum) shall be discarded to flush the sampling pipe of possible contaminants. The sample size shall be a minimum of 1 quart. All precautions must be taken to avoid contamination of samples.

III. If modified asphalt binders are used (i.e., PG 70-22, PG 76-22) a minimum of one rotational viscosity test per day is required at the asphalt **plant**. The sample shall be collected as specified above. If blending or modification occurs at the asphalt plant or terminal, contact the Regional Materials Supervisor for correct procedures of reporting and sampling of material.

(38) MINERAL AGGREGATE BASE AND SURFACE:

Materials and Tests personnel will issue an aggregate report (DT-0275) for all mineral aggregate bases shipped to the project. Project personnel will be responsible for gradation and daily test reports for Type "A" and "B" bases. Contact Regional Materials and Tests to ensure proctors and classifications have been performed.

(39) PAVEMENT – TRAFFIC MARKING TAPE:

Must be from Qualified Products List 1.***

(40) PAVEMENT MARKERS:

Must be from Qualified Products List 1.***

(41) PAVEMENT MARKING MATERIALS (PAINT, THERMOPLASTIC, & BEADS):

The Contractor is to fill out daily forms on the marking materials and beads used. The Project Inspector verifies quantities and signs daily forms. These daily forms will be kept in the Project Supervisor's office until the job is complete. At completion, the marking contractor will furnish the Project Supervisor a certified DT-0044 (T-2) listing quantities, colors batch numbers, and lab serial numbers used on the project. The Contractor's DT-0044 (T-2) shall show quantities of marking materials and beads used for each pay item. This along with the Contractor's notarized DT-0044 (T-2) shall be furnished to the Regional Materials and Tests Supervisor.**

Thermoplastic Alternates: Must be from Qualified Products List 1.***

Markers: Must be from Qualified Products List 1.***

Paint: Samples shall be submitted to Headquarters Materials and Tests by the manufacturer to obtain lab serial numbers.

Glass Beads: Samples from each lot representing 44,000 lbs. shall be submitted to Headquarters Materials and Tests by the manufacturer to obtain lab serial numbers.

Preformed Plastic Pavement Marking: Must be from Qualified Products List 1.***
Temporary Tape: Must be from QPL List 1***.

(42) PLASTIC PIPE:

The Contractor will furnish a notarized DT-0044 (T-2) and certifications of compliance from the producer or manufacturer of all plastic pipe and tubing to the Project Supervisor.**

(43) PRECAST CONCRETE ITEMS:

Precast concrete items shall have a "certified" stamp from the producer. Each shipment to a project site shall be accompanied with a producer certification in accordance with the TDOT Standard Operating Procedure (SOP 5-3). The Contractor will complete a DT-0044 (T-2) form with the producer's certification.

(44) SEED, GRASS:

The Project Supervisor will accept each shipment of grass seed at the project site on certification from producer. Each bag will be labeled in accordance with Section 43-10-106 of the Tennessee Seed Law of 1986, and include the following: labeler/seedsman, weight, date of tests, kind, variety, analysis/percentage of the blend, lot numbers (either of individual seeds or the blend), percentage of inert matter, percentage of all weed seeds, percentage of germination for each seed type, and percentage of hard seed. If the seed order does not have the original certification letter and tags, do not use until you have received approval from Regional Materials and Tests Supervisor. The certification (DT-0333) from the seed producer shall state that all seeds meet the minimum TDOA standards, the type of seed, and if blended, shall certify the percentages for the various TDOT types. The certification and a completed DT-0044 (T-2) from the Contractor shall be sent to the Project Supervisor.**.

(45) SMALL QUANTITIES (AS DETERMINED BY PART- 2 SAMPLING SCHEDULE):

The Contractor shall send a completed DT-0044 (T-2) form and certifications, etc. (if required) to Project Supervisor.** *Small quantities do not waiver specifications.*

(46) STEEL BAR REINFORCEMENT:

Black Bar - The Project Inspector may accept uncoated bar by certification. Certification shall consist of a certified Mill Test Report accompanied by a list showing location of use, size, quantity and heat number of the bars furnished. In lieu of the above certification, the supplier may furnish a chemical and physical test report along with a cover certification which contains bar sizes, quantities and heat numbers and which certifies that the bars shipped meet the requirements of Section 907.01 of the Tennessee Department of Transportation Specifications. The Contractor shall furnish a DT-0044 (T-2), showing quantities shipped, along with copies of the certifications and list from each shipment will be furnished to the Project Supervisor.** Verification sample taken at the steel fabricator is required.
Epoxy Coated Bar - Epoxy coated bar will have the same requirements as black bar plus a certificate of compliance for the coating along with a daily coating manufacturing worksheet.

When steel rebar arrives at the project site from an out of state supplier, the Project Supervisor will collect and submit verification samples to the Regional Materials and Tests Supervisor. A sample is two (2) two-foot lengths of each bar size shipped.

(47) STEEL STRUCTURES:

The Project Supervisor will accept all steel structure items (lump sum) on Structural Steel Shop Inspection Reports. The Structures Division must approve these reports. The item numbers on the Structural Steel Shop Inspection Reports must match the item numbers on the steel at project site. The Contractor shall forward a completed DT-0044 (T-2) to the Project Supervisor.**

(48) STEEL WIRE FABRIC (WELDED) (WIRE MESH):

If wire fabric arrives at the job site and does not have an inspection tag (from a Materials and Tests Inspector) the Contractor, in view of the Project Inspector, shall cut a two foot by two foot sample. The Contractor shall send this sample, along with a completed DT-0044 (T-2) form to Headquarters Materials and Tests Lab. This material cannot be used until approved test results are available.*

(49) STRUCTURAL STEEL:

Pipe Endwalls or Catch Basin Grates, Bridge Repair Items, etc. (Paid for by the pound). The Project Inspector will check these items when they are delivered to the project site, for TDOT stencil marks or inspection tags from Materials and Tests Inspectors. Test reports (DT-0286) will follow if these items are stenciled or tagged. If not stenciled, contact Regional Materials and Tests Supervisor.

(50) STRUCTURAL STEEL PILES:

Acceptance of steel piles and tips will be made by Certified Mill Test Reports. The heat numbers appearing on the steel piles must match the number on the Mill Test Reports. The Mill Test Reports along with a DT-0044 (T-2) showing the quantities of each heat number used at the project site, will be sent to the Regional Materials Office. The DT-0044 (T-2) will reflect the quantities of each heat number used during the current monthly estimate cycle. Each heat number will be verified to ensure sufficient quantities of each heat number is listed on the Mill Test Report and no duplication of that Mill Test Report has previously been submitted. If the Mill Test Report is not job specific, then some documentation showing the contractor or his sub-contractor has legitimately purchased the piling, shall be included with the above information. In this case, the contractor/sub-contractor must complete the portion of the DT-0044 (T-2) indicating the material is properly certified but is not project identified and a notarized signature is required.

(50A) STRUCTURAL STEEL PILE TIPS:

Acceptance of steel pile tips will be made by Certified Mill Test Reports. Only pile tips listed on the QPL can be accepted by certification. The heat numbers appearing on the steel pile tips must match the number on the Mill Test Reports. The manufacturer of the steel pile tip and specific type or trade name must be listed on the QPL or the steel pile tip should not be accepted for use on a project. If the pile tip is not shown on the QPL, the material supplier must supply samples

of the pile tips in advance on any project in sufficient time to allow testing or verification of new materials before incorporation into the project.

(51) TEMPORARY TRAFFIC CONTROL ITEMS:

All temporary traffic control items shall be accepted in accordance with section 712 of the TDOT Specifications and be on the Qualified Products List 1, 29, 30, 33 and/or 34 (when applicable).***

The contractor shall submit all certifications/acceptance letters stating all products used meet the TDOT specifications and comply with NCHRP 350 criteria along with a completed DT-0044 (T-2) to the Project Supervisor.** See below for certifications and acceptance letters guide.

Category 1 Work Zone Devices:

Light weight devices considered non-hazardous when involved in a collision.

Cones: Cones require certification from the Contractor/Supplier stating that the proposed devices will meet the evaluation criteria of the NCHRP Report 350 and comply with the Department's requirements.

Flexible Drums: Flexible Drums shall be selected from the Department's Qualified Products List. The Contractor/Supplier shall then certify that the Flexible Drums Furnished are identical to the product evaluated for the Qualified Products List.

Delineators: Flexible Surface and Ground Mounted Delineator Posts and Barrier Wall Delineators shall be selected from the Department's Qualified Products List. The Contractor/Supplier shall certify that the delineators furnished are identical to the product evaluated for the Qualified Products List.

Category 2 Work Zone Devices:

Lightweight devices considered hazardous when involved in a collision.

Barricades: The Contractor/Supplier shall certify that the device has been manufactured to replicate an NCHRP Report 350 or MASH (Manual for Accessing Safety Hardware) approved product, as documented
in an acceptance letter from FHWA.
Portable Sign Stands: Portable Sign Stands including the X-footprint shall be selected from the Department's Qualified Products List.
The Contractor/Supplier shall certify that the Portable Sign Stands furnished are identical to the product evaluated for the Qualified Products List.

Category 3 Work Zone Devices:

All devices to be used on the National Highway System and on state Routes with speeds equal to or greater than 45MPH are to be crash tested to meet the requirements of the NCHRP Report 350 for Test Level 3. For speeds on State Routes less than 45 MPH, devices shall be crash tested for Test Level 2.

Portable Barrier Rail:
The Contractor/Supplier shall certify that the Barrier Rail was manufactured in accordance with the plans and meets TDOT requirements. If Portable Barrier Rail is selected from the Departments Qualified Products List, the Contractor/Supplier shall certify that the Portable Barrier Rail furnished is identical to the product evaluated for the Qualified Products List. Rail meeting NCHRP Report 230 that is purchased or manufactured prior to 10-1-02 may continue to be utilized until such time that the rail is deemed nonserviceable by the Engineer. Different shapes, lengths or connections of rail shall not be used in the same continuous run.

Truck Mounted and Portable Impact Attenuators:
Truck Mounted and Portable Impact Attenuators shall be in accordance with the Plans and/or Specifications. Truck Mounted and Portable Attenuators require certification from the Contractor/Supplier stating that the proposed product replicates an NCHRP Report 350 approved device as documented in an acceptance letter from FHWA.

Longitudinal Channelizing Barriers and Barricades:
Longitudinal Channelizing Barriers is a longitudinal device that must meet NCHRP Report 350 criteria for a re-directive barrier. A Longitudinal Channelizing Barricade does not redirect a vehicle upon impact. The vehicle penetrates the barrier and should only be used where entry behind the line of devices is acceptable. For these devices to actually perform as a barrier, reinforcement must be used to minimize deflections.
These devices shall be selected from the Departments Qualified Products List. The Contractor/Supplier shall certify that the device furnished is identical to the product evaluated for the Qualified Products List.

Ground Mounted Sign Supports:
Stationary sign supports shall be steel posts meeting the requirements of Section 916. Wood posts may not be used for sign supports. Bolts used in splicing supports shall be 5/16 in. (8 mm) diameter galvanized ASTM A449 (SAE J429 Grade 5) or galvanized ASTM A 325. The Contractor/Supplier shall certify that the Sign Supports to be used comply with the Department's requirements.

Vertical Panels:
Vertical Panels, Ground Mounted or Mounted on Interconnected Portable Barrier Rail shall be in accordance with the plans. The vertical panels (aluminum or copolymer) shall be attached to a steel "U" post. The Contractor/Supplier shall certify that the Vertical Panels to be used comply with the Department's requirements.

Category 4 Work Zone Devices:
Crash testing is not currently required.

Trailer Mounted Devices including Changeable Message Signs, Flashing Arrow Boards, and Warning Lights. These devices are to be selected from the Qualified Products List. The Contractor/Supplier shall certify that the devices furnished are identical to the product evaluated for the Qualified Products List.

Non-Categorized Materials:

Signs:
The Contractor/Supplier shall certify that signs used for Temporary Traffic Control meets TDOT requirements.

Temporary Pavement Marking Material:
Where Removable Pavement Markings are specified, they shall be listed on the Department's Qualified Products List. Prior to use, the Contractor/Supplier shall certify to the Department that the removable tape is identical to that listed on the Department's Qualified Products List.

(52) TRAFFIC SIGNALS (PERMANENT):

Before work is to begin, the Contractor shall furnish a technical package including all materials, products, technical data, and installation requirements to TDOT and to the Maintaining Agency. Shop Drawings for Steel Strain Poles and other related structural items are to be submitted and approved by TDOT Structures. These items shall be submitted separately from the electrical submittals and shall include moment capacity and other design calculations. At the completion of work, the Contractor shall issue a certificate of compliance and certifications stating that materials meet TDOT specifications with a completed DT-0044** with all final quantities. In addition, the Contractor shall also provide an approval letter from the owner/maintaining agency stating acceptance of the completed system.

Structural steel for poles, arms, etc. shall be accepted with the proper documentation in accordance with section 730.04 of the TDOT Specifications.

(53) TRAFFIC SIGNAL SYSTEMS (TEMPORARY):

The Contractor shall furnish the Project Supervisor certifications stating that the materials furnished meet TDOT specifications. Certifications along with DT-0044 (T-2) will be forwarded to the Project Supervisor.*

(54) UNDERDRAINS:

(A) Aggregate - An aggregate report **prior** the initial shipment denoting approval of aggregate quality.

(B) Plastic or Polyethylene Corrugated Pipe or Tubing – Same as Item 41.

(C) Fabric - See Geotextiles Type I.

(55) WATER, SEWER, AND OTHER UTILITY ITEMS:

All utility items shall be accepted in accordance with the TDOT Construction Circular Letter 105.07-04, Utility Diaries and Inspection Procedures, or as required in other Contract documents. The utility representative shall complete the proper forms and submit to the Project Supervisor.

(56) WATER STOPS:

The Project Inspector shall check all shipments for inspection tags or stencil. If the material is not tagged or stenciled, the Contractor shall furnish the Project Supervisor a certified test report from an approved laboratory covering each lot or unit of water stop. These test reports shall contain the numerical laboratory test data for the required tests. The certified test reports along with completed DT-0044 (T-2) forms will be sent to Project Supervisor.**

(57) WOOD TIMBERS AND POSTS (TREATED):

The Contractor will furnish the Project Inspector treatment reports and inspection reports on all wood timber and post per the applicable specifications. Send these reports along with completed DT-0044 (T-2) forms to Project Supervisor.**

*A signed and approved DT-0044 (T-2) from Headquarters Materials and Tests will be your report.

**3 copies each – after review, the Project Supervisor shall forward the original and one copy to Regional Materials and Tests Supervisor. Project Supervisor shall maintain one copy for project file.

*** Any material that is on the department's Qualified Products List may be accepted by a certification from the manufacturer stating that the material furnished to the project is of the same formulation and has the same physical characteristics as the material evaluated for the Qualified Products List. The Contractor shall forward certification and a completed DT-0044 (T-2) to the Project Supervisor for review.

PART TWO: ACCEPTANCE SAMPLES AND TESTS

Type of Construction	Material	Test	Sampled By	Frequency	Location or Time of Sampling	Remarks
Portland Cement Concrete (Except Prestressed, Precast, Pavement and Base)	Cement, Fly Ash, and GGBFS	Acceptance from Qualified Products List (Verification Sampling Required)				Must be from approved source; if not, must have complete lab tests before being used on project.
	Curing Compound	Acceptance from Qualified Products List (Verification Sampling Required)				A compatible Type 1-D, Class B membrane shall be used when texture coating is specified.
	Chemical Admixtures	Acceptance from Qualified Products List				Admixture must be on approved list and have the brand shown on concrete design. Check dosage amounts for compliance with concrete design.
	Aggregate: Coarse and Fine	Acceptance from Producer's Supplier's List (Verification Sampling Required)				Must be approved material.
	Reinforcing Steel (Bars)	Acceptance by Certification (Verification Sampling Required)				See attached Verification Check Samples and Tests section.
	Completed Concrete Mix	Cylinders (28-day) Slump, Air, Mix Temp.	Project Inspector	A complete set of tests and set of cylinders for each 100 yd3 per critical unit of structure. For Class D, One complete set of tests for each of the first three loads. One set of cylinders shall be cast from one of the first three passing loads; add'l tests and sets of cyl to be made for each add'l 50 yd3.	Randomly selected during placement.	Determine Slump and Air Content from the same sample of concrete that cylinders are made from. For Class D, Bridge Deck Concrete per SOP 4-1; concrete placed by pumping shall be checked for air content at the discharge end of the truck chute immediately prior to pumping.
Portland Cement Concrete Non-Structural Concrete for **Small Quantities Not to exceed 25 yd3 (20 m3) per week or 500 yd3 (120 m3) per project for combined concrete items.**	Cement and Fly Ash GGBFS	Acceptance from Qualified Products List (Verification sampling required)				Must be from approved source; if not, must have complete lab tests before being used on project.
	Curing Compound	Acceptance from Qualified Products List (Verification sampling required)				A compatible Type 1-D, Class B membrane shall be used when texture coating is specified.
	Chemical Admixtures	Acceptance from Qualified Products List				Admixture must be on approved list and have the brand shown on concrete design. Check dosage amounts for compliance with concrete design.
	Aggregate: Coarse and Fine	Acceptance from Producer's Supplier's List (Verification Sampling Required)				Must be approved material.
	Reinforcing Steel (Bars)	Acceptance by Certification (Verification Sampling Required)				
	Completed Concrete Mix	Visual Inspection, Cylinders, (28 day) Slump and Air Content	Project Inspector	Complete set of tests and pair of cylinders for pours of 25 yd3 or less weekly. If over 25 yd3 per week or more than 500 yd3s per project are poured then follow procedures outlined in Portland Cement Concrete (Except Prestressed, Precast, Pavement and Base). Delivery tickets must accompany each load & contain batch weights, class of concrete & time of batching.	Randomly selected at placement site.	NOT TO BE USED IN MAJOR STRUCTURES OR STRUCTURALLY CRITICAL ITEMS. ONLY FOR: Sidewalks, Curbs & Gutter, Building Foundations, Slope Paving, Ditch Paving, Guardrail Anchorage, Small Culvert Headwalls (30" (750 mm) or less), Fence Posts, Catch Basins, Manhole Bases & Inlets, and Small Sign Bases.
	Pre-approved Pre-packaged Concrete Mixtures	Acceptance from Qualified Products List				To be limited to 2 yd^3 (2 m^3) per day for items as listed above.

PART TWO: ACCEPTANCE SAMPLES AND TESTS

Type of Construction	Material	Test	Sampled By	Frequency	Location or Time of Sampling	Remarks
Portland Cement Concrete - Pavement & Base	Cement, Fly Ash, and GGBFS	Acceptance from Qualified Products List (Verification sampling required)				Must be from approved source. If not, must have complete lab analysis and approved before being used.
	Curing Compound	Acceptance from Qualified Products List (Verification sampling required)				A compatible Type 1-D, Class B membrane shall be used when texture coating is specified.
	Chemical Admixtures	Acceptance from Qualified Products List				Admixture must be on approved list and have the brand shown on concrete design. Check dosage amounts for compliance with concrete design.
	Aggregate: Coarse and Fine	Acceptance from Producer's Supplier's List (Verification Sampling Required)				Must be approved material.
	Completed Concrete Mix	Compressive Strength (Cylinders) Slump, Air, Mix Temperature	Project Inspector	One pair each 400 yd3 (300 m3); In areas where class A is allowed, the frequency shall be the same as Portland Cement Concrete.	Placement site	Additional test specimens will be required if pavement is to be opened to traffic within 14 days after placement. Determine Slump and Air Content from same sample of mix used for cylinders. Make additional Slump and Air Content determinations as required for control. Class CP concrete use 6x12 cylinders.
		Depth Measurement	Contractor Monitored by Project Inspector	One core per 1,000 lin. ft. (300 m) of poured width, with a minimum of 1 core for each interchange ramp.	Completed pavement	When thickness of core from a unit is deficient more than 1/4" (6mm) and not more than 1" (25mm) from Plan thickness, take 2 additional cores at intervals of not less than 300' (90mm) within the unit. Use the average of the three cores to determine thickness.
	Dowel and Tie Bars	Acceptance by Certification (Verification sampling required)				Assembly to be approved by the Engineer.
	Sealant	Acceptance by Qualified Products List				
Prestressed Concrete	Cement, Fly Ash, and GGBFS	Acceptance from Qualified Products List (Verification sampling required)				Must be from approved source; if not, must have complete lab tests before being used on project.
	Curing Compound	Acceptance from Qualified Products List (Verification sampling required)				
	Chemical Admixtures	Acceptance by Qualified Products List				Admixture must be on approved list and have the brand shown on concrete design. Check dosage amounts for compliance with concrete design.
	Aggregate: Coarse and Fine	Acceptance from Producer's Supplier's List (Verification Sampling Required)				Must be approved material.
	Reinforcing Steel (Bars)	Acceptance by Certified Mill Test Report (Verification Sampling Required)				
	Prestressing Strands	Acceptance by Certified Mill Test Report (Verification Sampling Required)				
	Finished Product	Visual Inspection	Materials & Tests	After casting and before shipment	Prestress producer's plant	Each item to be inspected for straightness, cracks, honeycomb, size and appearance. Cosmetic Patching shall be cured prior to shipment.
	Completed Concrete Mix	Slump, Air and Mix Temperatures	Materials & Tests or Contractor monitored by TDOT personnel.	1 set of tests per beam	At the discretion of the Inspector.	Additional tests performed when apparent slump change is indicated.
		Cylinders	Materials & Tests or Contractor monitored by TDOT personnel.	At least 1 set per beam.	One set at beginning, and one set at the end for tension release of the bed.	1 set for 28 day strength, 1 set for back up.

PART TWO: ACCEPTANCE SAMPLES AND TESTS

Type of Construction	Material	Test	Sampled By	Frequency	Location or Time of Sampling	Remarks
Precast concrete noise wall panels, retaining wall panels, and precast drainage structures including pipes, headwalls, manholes, catchbasins, box culverts, and structural spans.	Finished Product	Acceptance by Certification in accordance with SOP 5-3 (Verification sampling required)				Each shipment must be accompanied by a completed certification form. Each item shall be inspected after delivery to the project for cracks, spalls and/or appearance by project personnel prior to incorporating product into the work.
Earth Retaining Structures	Backfill	Density	Project inspector	1 per every 500 tons or fraction there of.	Project site	
		Acceptance from Producer's Supplier's List (Verification Sampling Required)				Must be approved material.
	Select Granular Backfill	Quality Ph Shear	Materials & Tests	1 @ beginning of Project and then every 6 months	Aggregate plant	
		Density	Project inspector	1 per every 500 tons	Project site	
		Eletro-Chemical Analysis	Producer	1 per Source @ Beg of Project & every 2 years thereafter	Aggregate plant	Add'l Test required w/ appearance change
		Gradation	Materials & Tests	Beginning of project	Aggregate plant or Roadway	
			Project Inspector	One test every 1000 tons (Min. 1 per week)	Aggregate plant or Roadway	
	Finished Product	Precast concrete Products	Acceptance in accordance w/SOP 5-1 and Special Provision 624 (Verification testing required)			
		Modular block	Acceptance in accordance w/Special Provision 624 (Verification testing required)			Verification required before use
Prime, Tack and Sealer	Emulsions	Acceptance by Certification in accordance with SOP 3-2 (Verification Sampling Required)				Each shipment must be accompanied by TDOT form DT-0293E materials certification report.
Prime Tack and Sealers (small Quantities)	Emulsions	Visually inspect for contamination	Project Inspector	1 per project	Project Site	Not to exceed 3 tons tack and 3 tons prime per project. Supplier to furnish certification (may be non-project specific) and delivery tickets showing quantities.
Bituminous Plant Mix Pavements	Aggregate	Acceptance from Producer's Supplier's List (Verification Sampling Required)				Must be approved material.
		Fractured Face Count, Glassy particles by weight	Project Inspector	Min. of 1 per project	Coarse aggregate Stockpile	Plus #4 (4.75mm) Material
	Performance-Graded Asphalt Cement	Acceptance by Certification in accordance with SOP 3-1 (Verification Required in accordance with Part Three herein)			Governed by process See SOP 3-1.	Each shipment must be accompanied by TDOT form DT-0293PG materials certification report.
	All Plant Mix Asphalt	Mix temperature	On Roadway by Project Insp.	Every third load.	From truck prior to leaving plant and on roadway prior to deposit into paver or transfer device.	Temperatures to be recorded on the delivery ticket. Sampled at the plant by producer on the discretion of Materials & Tests Supervisor.
		Stripping-10 min. boil	Project Inspector	Once daily	Truck and Asphalt Plant	Plus #4 (4.75mm) Material on selected
	Plant Mix Asphalt Gradings A, B, BM, and BM2	Density	Project Inspector	5 tests. Maximum Lot Size 5000 yd^2 (4180 m^2)	As soon as practical after compaction, when nuclear method is used. When used, cores will be obtained in accordance with SP407DEN.	Each lot shall be divided into 5 equal-sized sublots, and one test should be performed per each sublot. Longitudinal test locations should be determined randomly. No single transverse test location shall be duplicated within any single lot.
	Plant Mix Asphalt Gradings C, CW, D, E, E Shoulder			5 tests. Maximum Lot Size 10000 yd^2 (8360 m^2)		

PART TWO: ACCEPTANCE SAMPLES AND TESTS

Type of Construction	Material	Test	Sampled By	Frequency	Location or Time of Sampling	Remarks
Bituminous Plant Mix Pavements	Plant Mix Asphalt Grading B, BM, BM2, C, CW, D, E, CS, TLD, & TL	Asphalt Content AASHTO T-164, Method E-II by extraction, or AASHTO T-308 by ignition oven	Project Inspector	1 test for every 1000 tons randomly.	Completed mix in truck or on roadway.	AASHTO T-164 Method E-II will be performed by pouring the extracted asphalt and solvent through nested No. 16 (1.18mm) and No. 200 (75 microns) mesh sieves. AASHTO T 164 Method A may be used for modified asphalt or when problems are encountered filtering according to Method E-II. May not be required on production days of less than 100 tons. Ignition oven may be utilized to determine AC content and gradation.
		Aggregate Gradation AASHTO T-30				
		Air Voids (T166, T209, T269)	Project Inspector or Materials and Tests	During Test Strip Construction or Mix Verification.	Completed mix in truck or on roadway.	Applies only to mixes requiring a design. Verification Sample required to be submitted to Regional Lab.
		LOI (Surface Mix only)	Project Inspector	One sample per day for Surface Mix only.	Completed mix in truck.	If daily sample fails, take 3 cores per lot placed that day to determine LOI. Penalty for failure to meet.
	Plant Mix Asphalt Grading A, A-S, A-CRL, & Asphalt Treated Permeable Base	Aggregate Gradation AASHTO T-27	Project Inspector	1 test for every 1000 tons randomly.	Bin sample for Batch Plant. Belt sample for Dryer-Drum Plant.	Normally, dry gradation through the No. 200(75 microns) sieve for control and acceptance. AASHTO T-27 for referee tests, including AASHTO T-11. May not be required on production days of less than 100 tons. No extraction required.
Bituminous Plant Mix Pavements for Small Quantities	Bituminous Mixture	Visual Inspection	Project Inspector	Occasionally. Delivery ticket must accompany each load & contain weight of mix.	Placement site	Not to exceed 1000 tons of each type mix per project. Supplier to furnish certification showing type of mix and compliance with TDOT specifications. TDOT reserves right to perform any testing deemed necessary. Mix shall be formulated from a previously approved Job Mix Formula.
Bituminous Surface: Surface Treatment, Microsurfacing, Slurry Sealing, and related similar processes	Aggregate	Gradation & Washing	Project Inspector or Materials & Tests	One each 500 tons (450 tonne) for each size aggregate.	At source or at project prior to incorporating into work.	Inspection required before material use.
		Fractured face count	Project Inspector or Materials & Tests	Minimum of 1 per project.	At project prior to incorporating into work.	Plus No. 4 (4.75mm) sieve material, gravel mixes only.
		Loss on Ignition (LOI)	Project Inspector or Materials & Tests	Minimum of 1 per week	From stockpiled materials. If blended aggregate, then after blending.	Accept/deduct in accordance with 411.10, pgf 6
		Glassy particles by weight	Project Inspector or Materials & Tests	Minimum of 1 per project.	At project prior to incorporating into work.	Plus No. 4 (4.75mm) sieve material, slag mixes only.
		Acceptance from Producer's Supplier's List (Verification Sampling Required)				Must be approved material.
	Emulsions	Acceptance by Certification in accordance with SOP 3-2. (Verification Sampling Required)				Each shipment must be accompanied by a notarized materials certification report. DT0293E See attached Verification/Check Samples & Tests section.
Treated Permeable Base	Asphalt Treated Permeable Base or Portland Cement Treated Permeable Base	Thickness	Contractor to obtain specimen at locations identified by Project Inspector	One core per unit or fraction of unit. A unit is equal to a paver mat width 1,000 ft (300 m) in length.	Prior to being overlaid.	When thickness of core from a unit is deficient more than 1/4" (6mm) and not more than 1" (25mm) from Plan thickness, take 2 additional cores at intervals of not less than 300' (90mm) within the unit. Use the averaged of the three cores to determine thickness.

PART TWO: ACCEPTANCE SAMPLES AND TESTS

Type of Construction	Material	Test	Sampled By	Frequency	Location or Time of Sampling	Remarks
Embankment	Soil	Proctor Density & Optimum Moisture	Materials & Tests	As required by material changes.	Cuts sampled prior to construction. Borrow pits sampled as required prior to placement.	
		Density, Moisture	Project Inspector	One test each 10" (250mm) of lift not to exceed 1500 ft (450m) roadway or 5000 yd^3 (3800m^3). Exception: Within 50 ft (15m) of a bridge end (deck or box) 1 test will be performed for each lift. The test will be performed alternately on the embankment and on the backfill material.	All tests will be performed at random locations. During construction, immediately after compaction.	Density tests will not be required for embankment containing more than 50% of plus 19 mm (No. 3/4) sieve material. See Standard Specs. 205 for correct formation of embankment.
Subgrade Preparation	Soil	Proctor Density & Optimum Moisture	Materials & Tests	As required by material changes.	May be sampled before grading construction or after grading prior to sub-grade preparation.	
		Density, Moisture	Project Inspector	5 tests per10,000 yd^2 (8400 m^2) lot for top 6 inches.	Immediately before placing pavement structure.	Average of 5 tests in lot used to determine pass-fail, with no individual test below 95% of Proctor. Average lot to be no less than 100%.
Subgrade Treatment: Lime	Soil-Lime Mixture	Proctor Density, Optimum Moisture	Project Inspector	Prior to beginning of construction.	At beginning of compaction.	Additional tests may be required to account for material changes. Prior to beginning of construction, samples of soil & lime will be submitted to Central Lab for Proctor Density lab tests.
		Density, Moisture	Project Inspector	5 tests per 10,000 yd^2 (8400 m^2) lot.	Immediately following compaction.	Average of 5 tests in lot to determine pass - fail.
		Pulverization	Project Inspector	1 test per 10,000 yd^2 (8400 m^2).	At the beginning of compaction.	Sieve test requirement See Standard Specs. 304.06
		Thickness	Project Inspector	5 tests per 10,000 yd^2 (8400 m^2).	Job site.	
Soil-Cement Base	Cement	Acceptance by Certification (Verification Sampling Required)				Cement must be from an approved source or be approved prior to use.
	Water	Visual Inspection	Project Inspector	At the beginning of work.	As source changes.	
	Soil-Cement Mixture	Pulverization	Project Inspector	1 test per 10,000 yd^2 (8400 m^2).	After mixing, before compaction.	See Standard Specs. 304.06
		Density, Moisture	Project Inspector	5 tests per 10,000 yd^2 (8400 m^2) lot.	Immediately following compaction.	Average of 5 tests in lot to determine pass - fail.
		Thickness	Project Inspector	5 tests per 10,000 yd^2 (8400 m^2) lot.	After final finish of base.	

PART TWO: ACCEPTANCE SAMPLES AND TESTS

Type of Construction	Material	Test	Sampled By	Frequency	Location or Time of Sampling	Remarks
Mineral Aggregate Base & Surface	Aggregate	Acceptance from Producer's Supplier's List (Verification Sampling Required)				Must be approved material.
		Proctor, Sp. Gravity, Optimum Moisture	Materials & Tests	Once per year for producers or as material changes.	Sampled at source.	Quality report required for each project.
		Gradation	Project Inspector	One each 2500 tons (2,250 tonne).	Sampled from plant or roadway.	A minimum of 1 sample per day for small quantities not to exceed 500 tons per week. Note: A minimum of 1 sample per week when aggregate is used for maintenance or incidental purposes.
		Moisture	Project Inspector	1 each 2500 tons (2,250 tonne) or 2 per day.	At time of weighing.	First sample should be taken at beginning of day.
		Density, Moisture	Project Inspector	5 tests per 10,000 yd^2 (8400 m^2) lot.	Immediately following Compaction.	Average of 5 test in lot used to determine pass - fail. (Check sp. gravity not always required. See Standard Specs. 303.09
		Thickness	Project Inspector or Survey Party	Five test holes per lot of approx. 10,000 yd^2 (8400 m^2) or profile check at each break point at 50 ft (20m) intervals.	After base completed.	On test holes - lot average considered one test.
	Calcium Chloride, Sodium Chloride	Quality	Project Inspector	One sample each shipment to project.	Sample from stock before use.	
Mineral Aggregate Base and Surface for Small Quantities	Mineral Aggregate	Visual Inspection	Project Inspector	As directed by Project Engineer.	Project site.	Not to exceed 500 tons (450 tonne) per project.
Aggregate for Underdrains	Mineral Aggregate	Density	Project inspector	One test every 1000 tons (Min. 1 per week)	Project site	Must be from an Approved Source
Aggregate-Cement Base Courses	Cement	Acceptance by Certification (Verification Sampling Required)				Cement must be from approved source or to be accepted prior to use.
	Aggregate	Gradation	Project Inspector	One each 2500 tons (2250 tonne) .	Sampled from plant stockpile.	In special cases, this test run by Materials & Tests.
		Acceptance from Producer's Supplier's List (Verification Sampling Required)				Must be approved material.
	Water	Quality	Project Inspector	At the beginning of construction and when source changes.	Source prior to start of work.	Water of potable quality may be used without testing.
	Aggregate-Cement Mixture	Density, Moisture	Project Inspector	5 tests per lot of approx. 10,000 yd^2 (8400 m^2).	Immediately following compaction.	Average of 5 tests in lot used to determine pass - fail. Not required for Cement Treated Permeable Base.
		Thickness	Contractor to obtain specimen at locations identified by project inspector	One core per unit or fraction of unit. A unit is equal to a paver mat width 1,000 ft (300 m) in length.	Prior to being overlaid.	When thickness of core from a unit is deficient more than 1/4" (6mm) and not more than 1" (25mm) from Plan thickness, take 2 additional cores at intervals of not less than 300' (90mm) within the unit. Use the averaged of the three cores to determine thickness.
		Moisture	Project Inspector	1 each 2500 tons (2,250 tonne) or 2 per day.	At time of weighing.	First sample should be taken at beginning of day.

PART TWO: ACCEPTANCE SAMPLES AND TESTS

Type of Construction	Material	Test	Sampled By	Frequency	Location or Time of Sampling	Remarks
Aggregate - Lime Fly Ash Base Course	Hydrated Lime	Acceptance by Certification (Verification Sampling Required)				Must be from approved source or tested and approved prior to use.
	Fly Ash	Acceptance from Qualified Products List (Verification Sampling Required)				Must be from approved source or tested and approved prior to use.
	Aggregate	Gradation	Project Inspector	One each 2500 tons (2250 tonne) .	Sampled from plant stockpile.	Must be from approved source. In special cases, this test is performed by Materials & Tests.
	Water	Quality	Project Inspector	At the beginning of construction and when source changes.	Source prior to start of work.	Water of potable quality may be used without testing.
	Aggregate-Lime-Fly Ash Mixture	Density, Moisture	Project Inspector	5 tests per lot of approx. 10,000 yd^2 (8400 m^2).	Immediately following compaction.	Average of 5 tests in lot used to determine pass - fail. Not required for Cement Treated Permeable Base.
		Thickness	Contractor to obtain specimen at locations identified by project inspector	One core per unit or fraction of unit. A unit is equal to a paver mat width 1,000 ft (300 m) in length.	Prior to being overlaid.	When thickness of core from a unit is deficient more than 1/4" (6mm) and not more than 1" (25mm) from Plan thickness, take 2 additional cores at intervals of not less than 300' (90mm) within the unit. Use the averaged of the three cores to determine thickness.
		Moisture	Project Inspector	1 each 2500 tons (2,250 tonne) or 2 per day.	At time of weighing.	First sample should be taken at beginning of day.
Conditioning Mineral Aggregate Base	Aggregate	Optimum Moisture	Materials & Tests	1 per project and as materials change.	Sampled from roadway prior to beginning the conditioning.	
		Proctor	Materials & Tests	1 per year for producers or as material changes.	Sampled from roadway prior to beginning the conditioning.	
		Density, Moisture	Project Inspector	5 tests per 10,000yd^2 (8400 yd^2) lot.	Immediately following compaction.	Average of 5 tests per lot used to determine pass - fail.
	Calcium Chloride, Sodium Chloride	Chemical Analysis	Project Inspector	1 sample each shipment to project.	Sampled from stock before use.	Submit sample to Headquarters Lab for testing.
Miscellaneous and Small Quantities For Non-Critical Items	Aggregate: For use other than in Portland Cement Concrete	Visually inspect for contamination	Project Inspector	Occasionally.	Placement site.	Must be from approved source. Not to exceed 100 tons (90 tonne) per day nor more than 500 tons (450 tonne) per project. For use in pipe bedding, underdrains, etc.
	Masonry Items including: Concrete Block, Brick, R/W Markers	Visual Inspection and Dimension Check	Project Inspector	Occasionally.	Placement site.	Supplier to furnish certification. Not to exceed: Concrete block - 100 Brick ---------- 1,000 R/W markers --- 20
	Fence Fabric or Wire, Fence Posts & Braces, etc.	Visual Inspection and Dimension Check	Project Inspector	Occasionally.	Placement site.	Not to exceed 1000 lin. Ft. (300 m) per project. Supplier to furnish certification.
	P.V.C. Pipe and Underdrain Pipe 300 mm (12") D	Visual Inspection and Dimension Check	Project Inspector	Occasionally.	Placement site.	Not to exceed 500 lin. Ft. (150 m) per project. Supplier to furnish certification.
	Delineators & Posts	Acceptance from Qualified Products List (No Verification Sampling Required)				Not to exceed 100 pieces of each per project. Supplier to furnish certification.

PART THREE: VERIFICATION/CHECK SAMPLES AND TESTS

Type of Construction	Material	Test	Sampled By	Frequency	Location or Time of Sampling	Remarks
Portland Cement Concrete - (All except precast, prestressed, pavement and base)	Cement, Fly Ash, GGBFS	Laboratory Analysis	Materials & Tests	One at beginning of project and 1 per year thereafter per producer plant	Concrete plant	Must be from approved source. If not, must be tested and approved prior to use.
	Chemical Admixtures	Visual	Project Inspector	Each Design	Mix Design	Must be on approved list and brand shown on Concrete Design. Admixture concentration should be checked.
	Aggregate: Coarse & Fine	Quality	Materials & Tests	One every 6 months or every 200,000 tons from permanent plants. One initially on new or temporary source.	Aggregate plant	Must be from approved source. Also as appearance changes or locations in quarry are changed. Additional samples to be obtained when production exceeds normal output.
		Gradation and Wash	Materials & Tests	Beginning of project and 1 per month thereafter per project. None required if less than 200 yd3 (150 m3) of concrete.	Concrete plant	
	Reinforcing Steel (Bars)	Laboratory Analysis	Materials & Tests	Verify monthly	In-state fabricator's plant.	Samples should be taken randomly from stock.
	Out of state Producer's		Project Inspector	Verify approximately 10% of heat Nos. per shipment.	Project site	Samples should be taken from every shipment.
Portland Cement Concrete Non-Structural Concrete for **Small Quantities**	Aggregate: Coarse & Fine	Quality	Materials & Tests	One every 6 months or every 200,000 tons from permanent plants. One initially on new or temporary source.	Aggregate plant	Must be from approved source. Also as appearance changes or locations in quarry are changed. Additional samples to be obtained when production exceeds normal output.
Portland Cement Concrete - Pavement and Base	Cement, Fly Ash, GGBFS	Laboratory Analysis	Materials & Tests	One at beginning of project and 1 per year thereafter per producer plant	Concrete plant	Must be from approved source. If not, must be tested and approved prior to use.
	Chemical Admixtures	Visual	Project Inspector	Each Design	Mix Design	Must be on approved list and brand shown on Concrete Design. Admixture concentration should be checked.
	Aggregate: Coarse & Fine	Quality	Materials & Tests	One every 6 months or every 200,000 tons from permanent plants. One initially on new or temporary source.	Aggregate plant	Must be from approved source. Also as appearance changes or locations in quarry are changed. Additional samples to be obtained when production exceeds normal output.
		Gradation and Wash	Materials & Tests	Beginning of project and 1 per month thereafter per project. None required if less than 200 yd3 (150 m3) of concrete.	Concrete plant	Must be from an approved source
Prestressed Concrete	Cement, Fly Ash, GGBFS	Laboratory Analysis	Materials & Tests	Verify 1 per month.	In-state fabricator's plant.	Must be from approved sources.
	Aggregate: Coarse & Fine	Quality	Materials & Tests	One every 6 months or every 200,000 tons from permanent plants. One initially on new or temporary source.	Aggregate plant	Must be from approved source. Also as appearance changes or locations in quarry are changed. Additional samples to be obtained when production exceeds normal output.
	Reinforcing Steel (Bars)	Laboratory Analysis	Materials & Tests	Verify approximately 10% of heat Nos. used.	Out-of-state fabricator's plant.	Two bars per sample, for each bar size on shipment.
				Each Shipment	Prestress producers plant	
	Prestressing Steel Strands	Laboratory Analysis	Materials & Tests			Each reel or pack to have identification tags showing size, grade, and reel number. Each shipment to have stress/strain curves and manufacturers certification.

PART THREE: VERIFICATION/CHECK SAMPLES AND TESTS

Type of Construction	Material	Test	Sampled By	Frequency	Location or Time of Sampling	Remarks
Precast concrete noise wall panels, retaining wall panels, and precast drainage structures including pipes, headwalls, manholes, catchbasins, box culverts, and structural spans.	Cement, Fly Ash, GGBFS	Laboratory Analysis	Materials & Tests	1 per month	Precast Concrete plant	Must be from approved source. If not, must be tested and approved prior to use.
	Chemical Admixtures	Visual	Materials & Tests	Each Design	Mix Design	Must be on approved list and brand shown on Concrete Design. Admixture concentration should be checked and compared against design.
	Aggregate - Coarse & Fine	Gradation and Wash	Materials & Tests	1 per month	Precast Concrete plant	
	Reinforcing Steel (Bars)	Laboratory Analysis	Materials & Tests	Verify every 2 weeks.	In-state fabricator's plant.	Samples should be taken from every shipment.
			Materials & Tests	Verify approximately 10% of heat Nos. used.	In-state/Out-of-state fabricator's plant.	
	Finished Product	Verification in accordance with SOP 5-3				Must be from approved plant The Frequency of Verification testing will vary at the discretion of the Regional Materials Supervisor. A min. of 1 wet cast and 1 dry cast product per week must be tested. **Records to be maintained for documentation.**
Earth Retaining Structures	Backfill	Quality	Materials & Tests	One every 6 months or every 200,000 tons from permanent plants. One initially on new or temporary source.	Aggregate plant	Must be from an approved source
		Gradation	Materials & Tests	1 @ beginning of Project and then monthly	Aggregate plant or Roadway	
		Proctor/Unit Weight	Materials & Tests	Prior to start or 1 per year		Producer to run gradation weekly as in Quality Control Plan.
	Precast concrete items	Verification in accordance with SOP 5-3				
	Modular Blocks	Strength Absorption	Materials & Tests	Per lot/production run	In-State Producer yard	Verification sampling required for every lot. (One lot consists of a production run) Results of verification test must comply prior to use.
					Out-of-State Project Site	
Sub-grade Treatment Lime	Hydrated Lime or quick lime	Laboratory Analysis	Project Inspector	One at beginning of project and 1 per month thereafter per project.	On project before incorporated into work	
Aggregate for Underdrains	Mineral Aggregate	Gradation	Materials & Tests	1 @ beginning of Project and then monthly	Aggregate plant or Roadway	
		Proctor/Unit Weight	Materials & Tests	Prior to start or 1 per year		Producer to run gradation weekly or as stated in Quality Control Plan.
Soil - Cement Base	Cement	Laboratory Analysis	Project Inspector	One at beginning of project and 1 per month thereafter per project.	Mixing Site	Must be from approved source or tested and approved prior to use.
Mineral Aggregate Base & Surface	Aggregate	Quality	Materials & Tests	Once every 6 months from permanent plants. One initially on new or temporary source.	Sampled at source.	Quality report required for each project.
Aggregate Cement Base Course	Aggregate	Quality	Materials & Tests	Once every 6 months from permanent plants. One initially on new or temporary source.	Sampled at source.	Permeable base only.
	Cement	Laboratory Analysis	Project Inspector	One at beginning of project and 1 per month thereafter per project.	Mixing Site	Must be from approved list and brand shown on concrete design. Add Mixture dose rate should be checked.

PART THREE: VERIFICATION/CHECK SAMPLES AND TESTS

Type of Construction	Material	Test	Sampled By	Frequency	Location or Time of Sampling	Remarks
Aggregate - Lime Fly Ash Base Course	Fly Ash	Laboratory Analysis	Project Inspector	One per project.	Mixing Site	Must be from approved source or tested and approved prior to use.
	Aggregate	Quality	Materials & Tests	Once every 6 months from permanent plants. One initially on new or temporary source.	Sampled at source.	Quality report required for each project.
	Hydrated Lime	Laboratory Analysis	Project Inspector	One at beginning of project and 1 per month thereafter per project.	Mixing Site	Must be from approved source or tested and approved prior to use.
Liquid Bituminous Material (All Types)	Performance Graded Asphalt Cement	Complete Analysis	Materials & Tests	1 sample every 2 weeks that material is being shipped	Asphalt Terminal	Test to be performed at TDOT Headquarters Laboratory. (Excludes all non-critical items for small quantities) Producer to perform compliance test on split sample.
			Project Inspector	Beginning of job and weekly thereafter	Contractor's Storage Tank	
Prime, Tack, Sealer Only	Emulsions	Laboratory Analysis	Project Inspector	At beginning of project, then once per week thereafter.	Contractor's Storage Tank	Field samples to meet specifications. Samples must be received at central lab less than two weeks after sampling.
			Materials & Tests	Once every two weeks	Asphalt Terminal	Terminal samples to verify certifications.
Bituminous Surface: Surface Treatment, Microsurfacing, Slurry sealing and related similar processes	Aggregate	Quality	Materials & Tests	1 initially from new or temporary plants and 1 every 6 months.	Aggregate plant	Also, test as the appearance changes or location in quarry changes. Additional samples to be obtained when production exceeds normal output. Reports must be issued with initial shipment to project.
	Emulsions	Laboratory Analysis	Project Inspector	One at beginning of project and once per week thereafter	Contactor storage tank	Field samples to meet specifications. Samples must be received at central lab less than two weeks after sampling.
			Materials & Tests	Once every two weeks	Asphalt Terminal	Terminal samples to verify certifications.
Bituminous Plant Mix Pavements	Plant Mix Asphalt Grading B, BM, BM2, C, CW, D, E, CS, TLD, and TL	Air Voids (T166, T209, T269)	Project Inspector	During Test Strip Construction or Mix Verification.	Completed mix in truck or on roadway.	Projects with less than 1000 tons of asphalt shall be exempt from verification testing.
	Aggregate	Quality	Materials & Tests	One every 6 months or every 200,000 tons from permanent plants. One initially on new or temporary source.	Aggregate plant	Also, test as appearance changes or locations in quarry are changed. Additional samples to be obtained when production exceeds normal output.

PART FOUR: QUALITY CONTROL OF SAMPLES

Type of Construction	Material	Test	Sampled By	Frequency	Location or Time of Sampling	Remarks
Bituminous Plant Mix Pavements	Aggregate	Stockpile Gradation	Contractor	At start of project and randomly thereafter	Asphalt plant	Also, test as appearance changes or locations in quarry are changed. Additional samples to be obtained when production exceeds normal output.
		Stockpile Moistures		Daily	Asphalt plant	
	Recycled Asphalt	Stockpile Gradation and Asphalt Cement content.	Contractor	At startup of project and at least one test for each 2000 tons of RAP used in the mix.	Asphalt plant	For tolerances see Spec. 307.03(b) and 411.03(c)
	Plant Mix Asphalt with RAP or Gravels	Moisture	Contractor	Daily	Behind Paver	See Spec. 307.03(b) and 411.03 (c). Maximum 0.1%
	Plant Mix Asphalt Grading B, BM, BM2, C, CW, D, E, CS, TLD, & TL	Air Voids (T166, T209, T269)	Contractor	Complete set of tests AM & PM	Completed mix in truck or on roadway.	QA/QC tests for mix verification Modified Mixes

Part Five: Using Random Numbers for Sampling and Testing

(With Examples and Random Number Tables)

Significance

The selection of test locations is critical in ensuring control of materials and construction work.

If the results from the test locations conform to specified tests, the rest of the work is assumed to conform as well.

Test sites, then, are samples of construction work under your inspection. Their locations should be random and representative of the entire lot of material.

The procedures outlined below will help you to choose random and representative test locations.

Random Number Tables

Randomness in transportation construction inspection indicates unpredictability in the time or location of sampling and testing of a material or procedure in a construction phase.

Random numbers occur in no pattern or sequence. When you review a series of random numbers, you do not know what number may come next; there is no particular order in which random numbers occur. A sample random-number table is shown below.

	A		B		C		D		E		
	0.814	0.759	0.651	0.947	0.965	0.994	0.581	0.877	0.500	0.208	
	0.105	0.015	0.323	0.630	0.223	0.616	0.070	0.469	0.672	0.931	
1	0.035	0.841	0.590	0.184	0.488	0.794	0.909	0.940	0.062	0.031	1
	0.741	0.336	0.346	0.926	0.237	0.967	0.385	0.657	0.521	0.921	
	0.278	0.697	0.423	0.365	0.010	0.210	0.264	0.745	0.378	0.337	
	0.834	0.355	0.952	0.924	0.591	0.003	0.280	0.363	0.175	0.254	
	0.204	0.159	0.006	0.006	0.764	0.020	0.768	0.209	0.959	0.147	
2	0.426	0.860	0.160	0.009	0.978	0.033	0.394	0.445	0.682	0.600	2
	0.990	0.330	0.581	0.946	0.129	0.047	0.384	0.363	0.038	0.275	
	0.837	0.658	0.140	0.344	0.189	0.047	0.675	0.923	0.101	0.122	
	0.537	0.505	0.909	0.794	0.249	0.339	0.850	0.326	0.510	0.961	
	0.286	0.447	0.286	0.975	0.458	0.484	0.992	0.078	0.947	0.756	
3	0.492	0.633	0.262	0.660	0.451	0.511	0.255	0.439	0.185	0.712	3
	0.428	0.126	0.884	0.203	0.199	0.222	0.638	0.492	0.062	0.967	
	0.443	0.927	0.626	0.542	0.746	0.683	0.822	0.242	0.481	0.077	
	0.343	0.529	0.955	0.122	0.692	0.721	0.393	0.774	0.986	0.485	
	0.070	0.948	0.408	0.338	0.921	0.355	0.252	0.916	0.255	0.456	
4	0.832	0.666	0.385	0.337	0.918	0.098	0.209	0.163	0.921	0.241	4
	0.858	0.470	0.756	0.923	0.799	0.250	0.101	0.615	0.891	0.120	
	0.153	0.773	0.722	0.819	0.626	0.393	0.340	0.202	0.120	0.793	
	0.142	0.636	0.217	0.005	0.597	0.628	0.994	0.150	0.375	0.969	
	0.882	0.905	0.272	0.637	0.201	0.768	0.002	0.568	0.176	0.702	
5	0.369	0.985	0.930	0.070	0.891	0.835	0.340	0.283	0.863	0.566	5
	0.423	0.658	0.311	0.795	0.174	0.419	0.909	0.600	0.885	0.145	
	0.461	0.878	0.363	0.644	0.890	0.278	0.219	0.312	0.585	0.923	
	A		B		C		D		E		

Lot sizes vary depending on the type of construction and the material. For example, a lot for earthwork construction is defined by the width and length of roadway, while concrete tests for bridge decks (slump, temperature, and air content) are determined by the volume of concrete delivered to the site.

Determine the lot size and the number of samples and tests required per lot from the Sampling and Testing (S&T) Guide and Schedule (SOP 1-1).

Knowing the type of construction and the material to be tested, use the S&T Schedule to determine the type of test and frequency of testing.

This SOP changes as construction materials, equipment, and practices change, so you must consult the current S&T Schedule.

Below are three examples using random numbers.

Example 1: Moisture and density must be measured on a lift of aggregate for subgrade preparation of a roadbed. The proposed roadway is 48-feet wide.

According to the Sampling and Testing Schedule (SOP 1-1, Part 2, shown below), five tests for moisture and density are required for every 10,000-square-yard lot of aggregate placed.

Subgrade Preparation	Soil	Proctor Density & Optimum Moisture	Materials & Tests	As required by material changes.	May be sampled before grading construction or after grading prior to sub-grade preparation.	
		Density, Moisture	Project Inspector	5 tests per10, 000 yd^2 (8400 m^2) lot for top 6 inches.	Immediately before placing pavement structure.	Average of 5 tests in lot used to determine pass-fail, with no individual test below 95% of Proctor. Average lot to be no less than 100%.

Since the project is 48 feet wide, the lot length will be, *at most*,

$$\frac{10000\,\text{yd}^2 \text{ area of aggregate} \times 9\frac{\text{ft}^2}{\text{yd}^2}}{48\,\text{feet wide}} = 1875\,\text{feet per lot}$$

We decide to use 1000 linear feet of roadway as our designated lot since this is shorter than the allowable lot length of 1875 feet.

Using the table of random numbers shown below, we randomly choose a block of numbers, say, block C2.

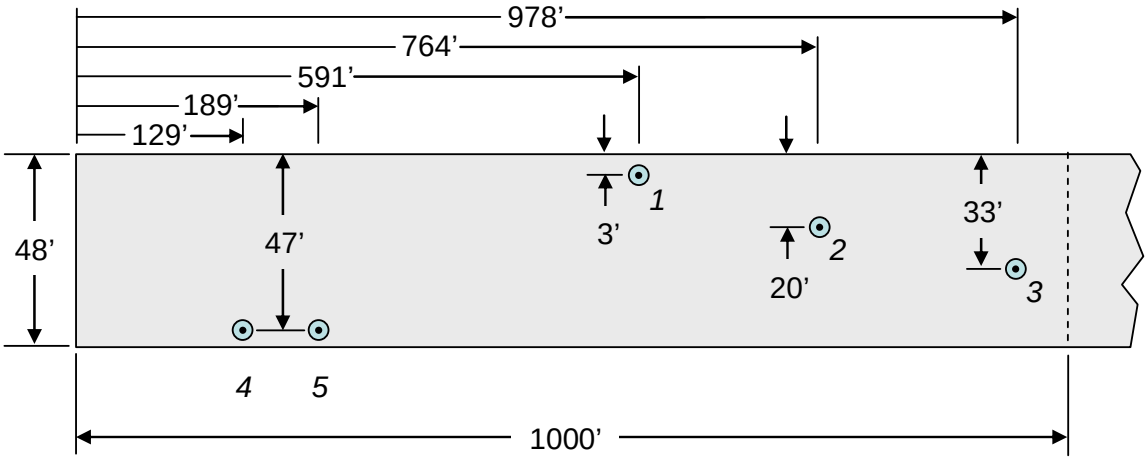
	A		B		C		D		E		
	0.271	0.584	0.674	0.883	0.379	0.976	0.555	0.083	0.967	0.812	
	0.185	0.905	0.686	0.491	0.424	0.566	0.724	0.582	0.393	0.176	
1	0.283	0.202	0.692	0.475	0.436	0.304	0.375	0.660	0.731	0.384	1
	0.567	0.800	0.642	0.205	0.827	0.129	0.598	0.216	0.124	0.787	
	0.703	0.621	0.893	0.063	0.755	0.194	0.133	0.110	0.795	0.824	
	0.103	0.338	0.620	0.594	0.591	0.069	0.639	0.203	0.313	0.733	
	0.536	0.826	0.362	0.321	0.764	0.408	0.487	0.515	0.591	0.676	
2	0.017	0.218	0.365	0.209	0.978	0.688	0.546	0.490	0.795	0.241	2
	0.840	0.594	0.341	0.006	0.129	0.986	0.350	0.437	0.927	0.782	
	0.161	0.720	0.366	0.219	0.189	0.985	0.899	0.501	0.793	0.889	
	0.251	0.496	0.741	0.314	0.014	0.839	0.124	0.209	0.292	0.099	
	0.380	0.901	0.262	0.180	0.459	0.843	0.640	0.720	0.131	0.132	
3	0.637	0.274	0.959	0.050	0.924	0.773	0.314	0.390	0.819	0.410	3
	0.310	0.324	0.111	0.760	0.706	0.165	0.930	0.515	0.639	0.116	
	0.568	0.379	0.600	0.362	0.697	0.006	0.080	0.680	0.028	0.206	
	0.378	0.392	0.910	0.202	0.512	0.156	0.336	0.465	0.813	0.471	
	0.805	0.641	0.118	0.878	0.932	0.196	0.018	0.094	0.419	0.211	
4	0.830	0.106	0.643	0.706	0.720	0.299	0.252	0.598	0.955	0.021	4
	0.367	0.538	0.050	0.448	0.896	0.669	0.968	0.984	0.890	0.117	
	0.274	0.509	0.848	0.645	0.890	0.998	0.389	0.611	0.586	0.137	
	0.566	0.802	0.283	0.151	0.399	0.316	0.559	0.684	0.318	0.516	
	0.078	0.505	0.541	0.962	0.868	0.007	0.192	0.610	0.255	0.081	
5	0.458	0.811	0.454	0.476	0.156	0.385	0.198	0.102	0.762	0.372	5
	0.486	0.345	0.786	0.759	0.465	0.222	0.487	0.355	0.935	0.223	
	0.783	0.432	0.275	0.218	0.942	0.054	0.641	0.278	0.957	0.778	
	A		B		C		D		E		

Using block C2, we have 10 random numbers that range between 0 and 1 carried to the thousandth decimal place. We will use these as multiplication factors to determine our test locations in the following table. The left-hand column of numbers in block C2 will be used to determine the longitudinal coordinates (length of the proposed roadway) by multiplying the lot length by the random number, then rounding to the nearest whole number. The right-hand column of numbers in block C2 will be used to determine the lateral coordinates (perpendicular to the proposed roadway) by multiplying the lot width by the random number, then rounding to the nearest whole number.

SAMPLE NO.	LENGTH	RANDOM NO.	LONGITUDINAL COORDINATE
1	1000	0.591	591
2	1000	0.764	764
3	1000	0.978	978
4	1000	0.129	129
5	1000	0.189	189

SAMPLE NO.	WIDTH	RANDOM NO.	LATERAL COORDINATE
1	48	0.069	3
2	48	0.408	20
3	48	0.688	33
4	48	0.986	47
5	48	0.985	47

Now, we simply match the first longitudinal coordinate with the first lateral coordinate to locate the first test location. Then, we match the remainder of the longitudinal and lateral coordinates to determine the remaining 4 test locations. The figure below shows the locations of the tests on the roadbed.



PLAN VIEW OF TEST AREA
(NOT TO SCALE)

Example 2: Nuclear gauge tests of density on a Grading 307-A mix of asphalt pavement that is 12 feet wide.

According to the Sampling and Testing Schedule (SOP 1-1, Part 2, shown below), five tests for density are required for every 5,000-square-yard lot of asphalt placed.

Bituminous Plant Mix Pavements	Plant Mix Asphalt Gradings A, B, BM, and BM2	Density	Project Inspector	5 tests. Maximum Lot Size 5000 yd^2 (4180 m^2)	As soon as practical after compaction, when nuclear method is used. When used, cores will be obtained in accordance with SP407DEN.	Each lot shall be divided into 5 equal-sized sublots, and one test should be performed per each sublot. Longitudinal test locations should be determined randomly. No single transverse test location shall be duplicated within any single lot.
	Plant Mix Asphalt Gradings C, CW, D, E, E Shoulder			5 tests. Maximum Lot Size 10000 yd^2 (8360 m^2)		

Since the project is 12 feet wide, the maximum lot length will be,

$$\frac{5000\,\text{yd}^2\ \text{area of aggregate} \times 9\dfrac{\text{ft}^2}{\text{yd}^2}}{12\,\text{feet wide}} = 3750\,\text{feet per lot}$$

Dividing this lot into five equal sub-lots, $3750\,\text{ft} \div 5 = 750\,\text{feet per sub-lot}$

For future reference:

LOT SIZE (yd^2)		LANE WIDTH (ft)			
		10	11	12	13
5,000	LOT LENGTH	4500	4091	3750	3462
	SUB-LOT LENGTH	900	818	750	692
10,000	LOT LENGTH	9000	8182	7500	6923
	SUB-LOT LENGTH	1800	1636	1500	1385

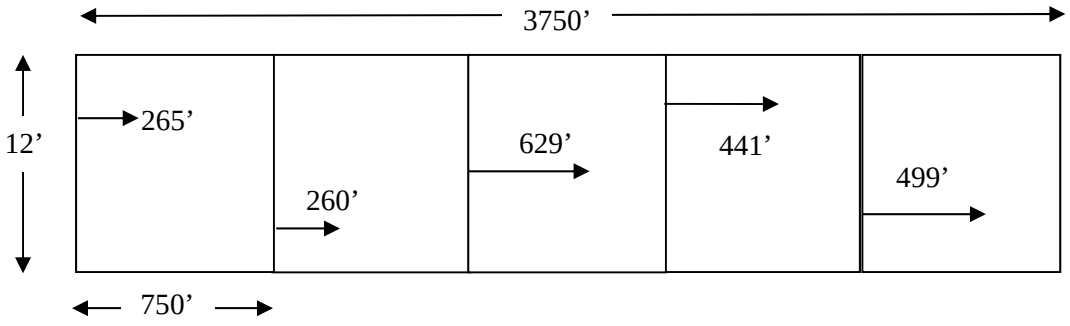
Using the table of random numbers shown below, we randomly choose a block of numbers, say, block D5.

	A		B		C		D		E		
	0.781	0.437	0.811	0.662	0.105	0.135	0.509	0.792	0.137	0.779	
	0.311	0.114	0.878	0.378	0.984	0.741	0.177	0.558	0.725	0.807	
1	0.746	0.926	0.294	0.674	0.952	0.597	0.559	0.685	0.891	0.909	1
	0.381	0.729	0.057	0.378	0.166	0.332	0.807	0.034	0.628	0.090	
	0.954	0.130	0.447	0.548	0.199	0.658	0.897	0.349	0.396	0.742	
	0.265	0.732	0.808	0.566	0.484	0.163	0.114	0.631	0.992	0.934	
	0.769	0.313	0.280	0.451	0.035	0.787	0.223	0.994	0.111	0.777	
2	0.729	0.963	0.946	0.178	0.198	0.252	0.085	0.630	0.677	0.055	2
	0.140	0.111	0.712	0.641	0.576	0.558	0.407	0.384	0.653	0.181	
	0.923	0.316	0.508	0.284	0.406	0.228	0.920	0.875	0.403	0.503	
	0.602	0.516	0.251	0.954	0.268	0.197	0.809	0.004	0.769	0.678	
	0.138	0.246	0.819	0.198	0.418	0.126	0.835	0.187	0.680	0.855	
3	0.178	0.399	0.550	0.565	0.071	0.916	0.560	0.219	0.537	0.856	3
	0.613	0.157	0.218	0.001	0.535	0.576	0.146	0.010	0.215	0.190	
	0.097	0.155	0.388	0.403	0.252	0.987	0.775	0.596	0.365	0.231	
	0.373	0.974	0.929	0.104	0.447	0.449	0.447	0.147	0.424	0.195	
	0.880	0.803	0.036	0.846	0.058	0.834	0.010	0.314	0.011	0.621	
4	0.749	0.231	0.217	0.206	0.869	0.810	0.804	0.426	0.157	0.881	4
	0.020	0.048	0.404	0.368	0.917	0.374	0.444	0.214	0.432	0.827	
	0.052	0.601	0.318	0.016	0.766	0.513	0.623	0.065	0.409	0.816	
	0.777	0.941	0.140	0.401	0.171	0.139	0.353	0.481	0.209	0.735	
	0.406	0.017	0.252	0.730	0.476	0.188	0.347	0.656	0.945	0.149	
5	0.044	0.413	0.782	0.032	0.459	0.856	0.838	0.594	0.322	0.654	5
	0.980	0.185	0.574	0.166	0.025	0.962	0.588	0.134	0.198	0.704	
	0.237	0.162	0.155	0.373	0.673	0.104	0.665	0.070	0.849	0.957	
	A		B		C		D		E		

Using block D5, we have 10 random numbers that range between 0 and 1 carried to the thousandth decimal place. We will use the multiplication factors in the left-hand column to determine our longitudinal test locations. Transverse locations are determined randomly with one test 12" off each edge, one test in each wheelpath, and one test in the center of the lane.

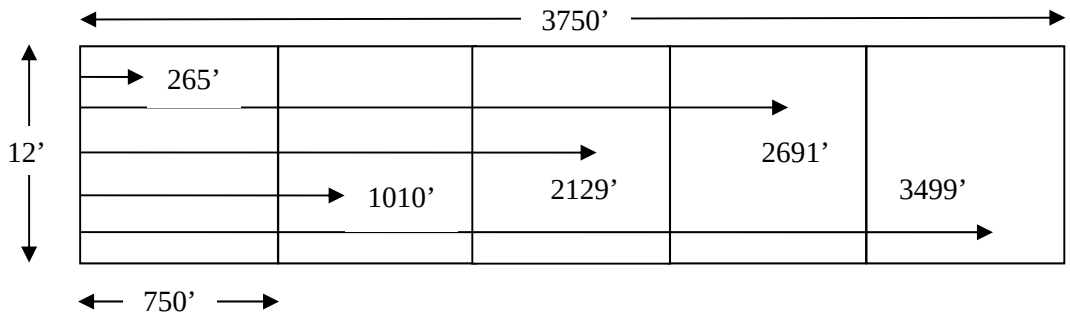
The distances into each sublot,

$$750\,\text{ft} * 0.353 = 265\,\text{ft}$$
$$750\,\text{ft} * 0.347 = 260\,\text{ft}$$
$$750\,\text{ft} * 0.838 = 629\,\text{ft}$$
$$750\,\text{ft} * 0.588 = 441\,\text{ft}$$
$$750\,\text{ft} * 0.665 = 499\,\text{ft}$$



If we wanted to know the total distance into the 3750' lot for each test:

$$\text{Test } 1 = 265\,\text{ft}$$
$$\text{Test } 2 = 750\,\text{ft} + 260\,\text{ft} = 1010\,\text{ft}$$
$$\text{Test } 3 = 750\,\text{ft} + 750\,\text{ft} + 629\,\text{ft} = 2129\,\text{ft}$$
$$\text{Test } 4 = 750\,\text{ft} + 750\,\text{ft} + 750\,\text{ft} + 441\,\text{ft} = 2691\,\text{ft}$$
$$\text{Test } 5 = 750\,\text{ft} + 750\,\text{ft} + 750\,\text{ft} + 750\,\text{ft} + 499\,\text{ft} = 3499\,\text{ft}$$



Example 3: Slump, temperature, and air content of concrete from mixing trucks delivering concrete to a bridge deck pour that is expected to use 1300 cubic yards of concrete.

According to the Sampling and Testing Schedule (SOP 1-1, Part 2, shown below), one complete set of tests for air content, slump, and temperature are required for the first three loads of concrete delivered. One set of cylinders must be cast from one of the three passing loads. For each additional 50 cubic yards of concrete, a set of cylinders must be made and tests for air content, slump, and temperature must be performed.

Portland Cement Concrete (Except Prestressed, Precast, Pavement and Base)	Completed Concrete Mix	Cylinders (28-day) Slump, Air, Mix Temp.	Project Inspector	A complete set of tests and set of cylinders for each 100 yd3 per critical unit of structure. For Class D, One complete set of tests for each of the first three loads. One set of cylinders shall be cast from one of the first three passing loads; add'l tests and sets of cyl to be made for each add'l 50 yd3.	Randomly selected during placement.	Determine Slump and Air Content from the same sample of concrete that cylinders are made from. For Class D, Bridge Deck Concrete per SOP 4-1; concrete placed by pumping shall be checked for air content at the discharge end of the truck chute immediately prior to pumping.

Now we'll use the random number tables in a different way. We must decide which loads of concrete to test. First, we'll assume each truck is hauling 10 cubic yards of concrete. Subsequent to the first 30 cubic yards, we'll test from truck loads by first choosing a random block of numbers from the following table. We'll choose block A3.

	A		B		C		D		E		
	0.818	0.696	0.758	0.117	0.827	0.567	0.974	0.487	0.874	0.665	
	0.565	0.826	0.141	0.229	0.996	0.003	0.783	0.079	0.145	0.827	
1	0.926	0.785	0.743	0.669	0.411	0.702	0.949	0.460	0.434	0.201	1
	0.776	0.529	0.397	0.450	0.851	0.569	0.157	0.571	0.097	0.556	
	0.333	0.996	0.810	0.562	0.053	0.975	0.122	0.055	0.702	0.609	
	0.626	0.783	0.145	0.210	0.591	0.003	0.493	0.136	0.036	0.223	
	0.291	0.607	0.048	0.788	0.764	0.020	0.991	0.719	0.948	0.727	
2	0.950	0.570	0.324	0.232	0.978	0.033	0.803	0.534	0.367	0.897	2
	0.521	0.642	0.912	0.464	0.129	0.047	0.359	0.497	0.382	0.993	
	0.235	0.611	0.262	0.783	0.189	0.047	0.241	0.252	0.706	0.886	
	0.537	0.505	0.557	0.919	0.939	0.579	0.351	0.525	0.304	0.092	
	0.286	0.447	0.366	0.025	0.454	0.643	0.647	0.958	0.887	0.702	
3	0.492	0.633	0.937	0.229	0.556	0.078	0.468	0.850	0.233	0.009	3
	0.428	0.126	0.767	0.250	0.740	0.976	0.835	0.280	0.808	0.401	
	0.443	0.465	0.666	0.947	0.372	0.412	0.408	0.589	0.170	0.211	
	0.970	0.183	0.800	0.534	0.702	0.508	0.295	0.397	0.391	0.421	
	0.198	0.464	0.847	0.596	0.228	0.450	0.671	0.787	0.169	0.648	
4	0.727	0.087	0.544	0.354	0.630	0.454	0.687	0.320	0.852	0.593	4
	0.272	0.647	0.553	0.886	0.761	0.396	0.059	0.207	0.014	0.331	
	0.284	0.210	0.344	0.355	0.060	0.158	0.536	0.940	0.365	0.546	
	0.027	0.134	0.910	0.121	0.186	0.452	0.081	0.231	0.400	0.598	
	0.818	0.052	0.867	0.848	0.497	0.386	0.485	0.976	0.283	0.388	
5	0.010	0.387	0.919	0.694	0.693	0.272	0.859	0.959	0.613	0.065	5
	0.112	0.245	0.158	0.294	0.690	0.704	0.273	0.389	0.075	0.676	
	0.949	0.172	0.810	0.381	0.307	0.129	0.552	0.162	0.016	0.047	
	A		B		C		D		E		

The table below shows one way to determine, using the random numbers above, the truck numbers from which samples will be taken.

SAMPLE NO.	DELIVERED CONCRETE (yd^3)	TOTAL AMOUNT OF CONCRETE (yd^3)	TOTAL LOADS OF CONCRETE (A)	RANDOM NO. (B)	LOAD NUMBER $[(A_n-A_{n-1})xB]+A_{n-1}$
1	10	10	1	NA	1
2	10	20	2	NA	2
3	10	30	3	NA	3
4	50	80	8	0.492	5
5	50	130	13	0.428	10
6	50	180	18	0.443	15
7	50	230	23	0.505	21
8	50	280	28	0.447	25
9	50	330	33	0.633	31
10	50	380	38	0.126	34

Example 4: Slump, temperature, and air content of concrete from mixing trucks delivering concrete to a structural footing that is expected to use 550 cubic yards of concrete.

According to the Sampling and Testing Schedule (SOP 1-1, Part 2, shown below), one complete set of tests for air content, slump, and temperature are required for the first load of concrete delivered. For each additional 100 cubic yards of concrete, a set of cylinders must be made and tests for air content, slump, and temperature must be performed.

Portland Cement Concrete (Except Prestressed, Precast, Pavement and Base)	Completed Concrete Mix	Cylinders (28-day) Slump, Air, Mix Temp.	Project Inspector	A complete set of tests and set of cylinders for each 100 yd3 per critical unit of structure. For Class D, One complete set of tests for each of the first three loads. One set of cylinders shall be cast from one of the first three passing loads; add'l tests and sets of cyl to be made for each add'l 50 yd3.	Randomly selected during placement.	Determine Slump and Air Content from the same sample of concrete that cylinders are made from. For Class D, Bridge Deck Concrete per SOP 4-1; concrete placed by pumping shall be checked for air content at the discharge end of the truck chute immediately prior to pumping.

Now we'll use the random number tables in a different way. We must decide which loads of concrete to test. First, we'll assume each truck is hauling 10 cubic yards of concrete. Subsequent to the first 10 cubic yards, we'll test from truck loads by first choosing a random block of numbers from the following table. We'll choose block C1.

	A		B		C		D		E		
	0.815	0.125	0.006	0.653	0.614	0.455	0.968	0.103	0.150	0.154	
	0.872	0.226	0.619	0.637	0.585	0.566	0.331	0.028	0.369	0.751	
1	0.685	0.964	0.937	0.948	0.969	0.454	0.194	0.425	0.852	0.500	1
	0.427	0.348	0.222	0.129	0.690	0.911	0.996	0.115	0.681	0.569	
	0.181	0.115	0.519	0.715	0.508	0.308	0.525	0.584	0.694	0.427	
	0.917	0.628	0.054	0.928	0.817	0.812	0.264	0.776	0.756	0.610	
	0.759	0.891	0.311	0.612	0.247	0.044	0.668	0.389	0.953	0.931	
2	0.510	0.632	0.371	0.037	0.667	0.681	0.730	0.638	0.965	0.925	2
	0.836	0.525	0.342	0.752	0.638	0.403	0.687	0.245	0.403	0.785	
	0.669	0.875	0.824	0.842	0.565	0.756	0.401	0.371	0.576	0.689	
	0.931	0.450	0.955	0.323	0.696	0.790	0.021	0.127	0.753	0.550	
	0.771	0.631	0.896	0.968	0.870	0.312	0.764	0.665	0.113	0.610	
3	0.855	0.525	0.056	0.255	0.921	0.282	0.301	0.401	0.775	0.246	3
	0.897	0.753	0.246	0.763	0.259	0.293	0.613	0.154	0.743	0.574	
	0.393	0.878	0.401	0.459	0.134	0.655	0.433	0.323	0.393	0.038	
	0.965	0.130	0.181	0.909	0.940	0.399	0.200	0.724	0.673	0.397	
	0.745	0.233	0.460	0.361	0.935	0.018	0.405	0.945	0.183	0.576	
4	0.204	0.623	0.771	0.120	0.859	0.314	0.880	0.447	0.680	0.938	4
	0.804	0.213	0.903	0.488	0.425	0.685	0.584	0.676	0.717	0.220	
	0.526	0.018	0.323	0.978	0.407	0.197	0.827	0.102	0.641	0.302	
	0.620	0.343	0.587	0.878	0.922	0.977	0.162	0.523	0.011	0.409	
	0.558	0.383	0.880	0.541	0.422	0.466	0.186	0.004	0.457	0.446	
5	0.128	0.893	0.685	0.864	0.349	0.413	0.273	0.971	0.970	0.311	5
	0.455	0.032	0.141	0.835	0.705	0.898	0.958	0.945	0.095	0.779	
	0.790	0.312	0.258	0.518	0.141	0.448	0.185	0.599	0.546	0.751	
	A		B		C		D		E		

The table below shows one way to determine, using the random numbers above, the truck numbers from which samples will be taken.

SAMPLE NO.	DELIVERED CONCRETE (yd^3)	TOTAL AMOUNT OF CONCRETE (yd^3)	TOTAL LOADS OF CONCRETE (A)	RANDOM NO. (B)	LOAD NUMBER $[(A_n-A_{n-1}) \times B]+A_{n-1}$
1	10	10	1	NA	1
2	100	110	11	0.614	7
3	100	210	21	0.585	17
4	100	310	31	0.969	31
5	100	410	41	0.690	38

	A		B		C		D		E		
	0.678	0.694	0.141	0.441	0.836	0.182	0.274	0.829	0.365	0.881	
	0.023	0.158	0.948	0.763	0.555	0.741	0.157	0.869	0.811	0.789	
1	0.504	0.635	0.730	0.899	0.719	0.357	0.284	0.140	0.644	0.082	**1**
	0.704	0.941	0.361	0.863	0.882	0.404	0.704	0.933	0.667	0.571	
	0.830	0.617	0.154	0.081	0.109	0.741	0.503	0.974	0.301	0.911	
	0.247	0.737	0.402	0.169	0.871	0.830	0.069	0.276	0.998	0.499	
	0.710	0.346	0.012	0.836	0.233	0.885	0.077	0.341	0.607	0.719	
2	0.205	0.290	0.040	0.804	0.638	0.987	0.353	0.539	0.208	0.676	**2**
	0.980	0.629	0.424	0.081	0.002	0.761	0.185	0.940	0.997	0.568	
	0.360	0.766	0.117	0.032	0.588	0.049	0.407	0.388	0.535	0.464	
	0.120	0.852	0.163	0.852	0.201	0.487	0.713	0.696	0.914	0.080	
	0.413	0.327	0.839	0.949	0.724	0.728	0.508	0.471	0.327	0.850	
3	0.955	0.924	0.285	0.028	0.299	0.064	0.953	0.791	0.437	0.745	**3**
	0.131	0.616	0.223	0.213	0.027	0.024	0.484	0.030	0.533	0.552	
	0.037	0.500	0.803	0.546	0.093	0.401	0.750	0.189	0.417	0.078	
	0.096	0.483	0.713	0.576	0.935	0.281	0.506	0.994	0.014	0.491	
	0.818	0.855	0.950	0.195	0.142	0.392	0.380	0.786	0.063	0.423	
4	0.689	0.685	0.742	0.863	0.906	0.966	0.617	0.375	0.908	0.685	**4**
	0.443	0.857	0.239	0.770	0.181	0.241	0.982	0.373	0.150	0.316	
	0.020	0.898	0.158	0.365	0.497	0.139	0.864	0.937	0.392	0.026	
	0.245	0.510	0.670	0.082	0.483	0.403	0.524	0.338	0.387	0.406	
	0.658	0.596	0.690	0.737	0.899	0.567	0.655	0.231	0.508	0.374	
5	0.107	0.682	0.077	0.763	0.593	0.877	0.094	0.929	0.268	0.973	**5**
	0.057	0.478	0.230	0.623	0.339	0.942	0.239	0.839	0.074	0.854	
	0.312	0.193	0.428	0.947	0.185	0.197	0.642	0.537	0.590	0.876	
	A		**B**		**C**		**D**		**E**		

	A		B		C		D		E		
	0.439	0.107	0.450	0.340	0.181	0.794	0.186	0.814	0.350	0.112	
	0.460	0.661	0.706	0.123	0.648	0.988	0.750	0.968	0.955	0.196	
1	0.631	0.799	0.355	0.746	0.842	0.268	0.445	0.942	0.430	0.324	**1**
	0.398	0.177	0.993	0.666	0.377	0.609	0.533	0.840	0.271	0.270	
	0.258	0.732	0.905	0.314	0.200	0.640	0.736	0.970	0.804	0.352	
	0.099	0.586	0.938	0.597	0.883	0.855	0.489	0.003	0.290	0.397	
	0.024	0.789	0.120	0.111	0.274	0.627	0.731	0.654	0.482	0.637	
2	0.536	0.280	0.146	0.968	0.044	0.326	0.097	0.326	0.228	0.370	**2**
	0.087	0.955	0.770	0.328	0.492	0.940	0.554	0.913	0.888	0.758	
	0.192	0.771	0.968	0.688	0.247	0.770	0.194	0.621	0.847	0.848	
	0.183	0.040	0.020	0.172	0.625	0.262	0.170	0.501	0.930	0.626	
	0.605	0.948	0.688	0.893	0.686	0.840	0.799	0.047	0.936	0.752	
3	0.924	0.795	0.113	0.148	0.316	0.956	0.536	0.701	0.440	0.702	**3**
	0.569	0.213	0.626	0.960	0.240	0.823	0.196	0.335	0.663	0.630	
	0.799	0.128	0.560	0.843	0.951	0.600	0.609	0.256	0.292	0.681	
	0.597	0.815	0.412	0.439	0.189	0.094	0.782	0.515	0.809	0.303	
	0.014	0.033	0.240	0.170	0.824	0.248	0.118	0.570	0.344	0.203	
4	0.916	0.958	0.802	0.089	0.958	0.677	0.515	0.843	0.127	0.868	**4**
	0.989	0.291	0.184	0.927	0.089	0.780	0.214	0.277	0.105	0.138	
	0.545	0.849	0.884	0.192	0.617	0.416	0.763	0.558	0.027	0.098	
	0.227	0.322	0.069	0.477	0.984	0.112	0.207	0.110	0.196	0.615	
	0.342	0.472	0.531	0.716	0.337	0.880	0.593	0.881	0.195	0.188	
5	0.059	0.058	0.688	0.504	0.418	0.197	0.894	0.298	0.843	0.959	**5**
	0.056	0.926	0.214	0.016	0.050	0.692	0.256	0.966	1.000	0.084	
	0.033	0.489	0.768	0.354	0.855	0.839	0.670	0.853	0.934	0.012	
	A		**B**		**C**		**D**		**E**		

	A		B		C		D		E		
	0.001	0.411	0.562	0.371	0.511	0.010	0.189	0.340	0.529	0.991	
	0.095	0.690	0.070	0.561	0.412	0.123	0.060	0.580	0.614	0.151	
1	0.742	0.355	0.526	0.217	0.848	0.774	0.923	0.542	0.653	0.385	**1**
	0.914	0.676	0.912	0.868	0.085	0.281	0.924	0.704	0.371	0.600	
	0.257	0.536	0.951	0.713	0.939	0.987	0.637	0.536	0.129	0.917	
	0.586	0.163	0.710	0.254	0.744	0.846	0.979	0.344	0.333	0.481	
	0.271	0.577	0.487	0.484	0.408	0.704	0.901	0.347	0.850	0.286	
2	0.480	0.538	0.017	0.074	0.427	0.225	0.452	0.049	0.233	0.846	**2**
	0.967	0.187	0.657	0.775	0.251	0.877	0.169	0.977	0.879	0.635	
	0.471	0.416	0.107	0.334	0.565	0.735	0.549	0.763	0.850	0.113	
	0.398	0.095	0.496	0.726	0.650	0.498	0.266	0.727	0.355	0.209	
	0.265	0.801	0.509	0.718	0.181	0.286	0.928	0.200	0.588	0.881	
3	0.937	0.348	0.446	0.688	0.955	0.834	0.796	0.045	0.292	0.019	**3**
	0.999	0.804	0.217	0.945	0.601	0.122	0.897	0.535	0.170	0.606	
	0.871	0.270	0.269	0.056	0.555	0.907	0.732	0.709	0.224	0.424	
	0.550	0.650	0.779	0.280	0.914	0.303	0.377	0.896	0.428	0.791	
	0.262	0.325	0.785	0.248	0.748	0.291	0.552	0.560	0.806	0.450	
4	0.194	0.754	0.700	0.244	0.521	0.673	0.196	0.495	0.227	0.995	**4**
	0.484	0.315	0.295	0.267	0.637	0.202	0.082	0.750	0.626	0.107	
	0.925	0.002	0.940	0.406	0.756	0.942	0.745	0.665	0.398	0.519	
	0.769	0.126	0.227	0.521	0.395	0.853	0.606	0.467	0.716	0.376	
	0.786	0.339	0.246	0.850	0.310	0.413	0.966	0.387	0.222	0.035	
5	0.121	0.278	0.807	0.006	0.872	0.081	0.317	0.163	0.942	0.763	**5**
	0.794	0.721	0.766	0.883	0.285	0.936	0.363	0.154	0.021	0.304	
	0.138	0.381	0.875	0.566	0.802	0.077	0.888	0.634	0.880	0.916	
	A		**B**		**C**		**D**		**E**		

	A		B		C		D		E		
	0.213	0.416	0.998	0.713	0.003	0.826	0.353	0.763	0.835	0.398	
	0.761	0.812	0.959	0.598	0.771	0.105	0.414	0.251	0.305	0.385	
1	0.071	0.848	0.185	0.978	0.881	0.329	0.822	0.690	0.779	0.126	**1**
	0.745	0.888	0.662	0.041	0.589	0.145	0.125	0.617	0.474	0.200	
	0.619	0.972	0.230	0.780	0.224	0.463	0.846	0.098	0.541	0.002	
	0.770	0.801	0.055	0.852	0.289	0.381	0.023	0.911	0.736	0.387	
	0.794	0.193	0.499	0.827	0.235	0.046	0.168	0.789	0.543	0.594	
2	0.768	0.053	0.915	0.063	0.541	0.687	0.848	0.742	0.891	0.091	**2**
	0.752	0.363	0.172	0.583	0.183	0.234	0.105	0.650	0.456	0.330	
	0.746	0.920	0.088	0.285	0.125	0.514	0.795	0.366	0.144	0.758	
	0.676	0.579	0.181	0.237	0.249	0.376	0.805	0.306	0.050	0.951	
	0.524	0.502	0.975	0.401	0.741	0.518	0.312	0.284	0.444	0.002	
3	0.408	0.575	0.505	0.360	0.774	0.546	0.635	0.758	0.440	0.299	**3**
	0.875	0.176	0.145	0.011	0.174	0.516	0.317	0.560	0.775	0.488	
	0.045	0.320	0.449	0.079	0.726	0.455	0.934	0.341	0.912	0.963	
	0.589	0.945	0.644	0.339	0.984	0.115	0.517	0.414	0.834	0.261	
	0.338	0.428	0.777	0.803	0.755	0.264	0.481	0.030	0.186	0.953	
4	0.034	0.715	0.499	0.896	0.934	0.827	0.601	0.527	0.282	0.758	**4**
	0.642	0.976	0.896	0.449	0.361	0.777	0.297	0.484	0.949	0.629	
	0.864	0.440	0.059	0.265	0.072	0.879	0.779	0.421	0.657	0.146	
	0.979	0.318	0.153	0.682	0.066	0.806	0.003	0.163	0.249	0.012	
	0.253	0.995	0.678	0.459	0.166	0.223	0.132	0.558	0.377	0.663	
5	0.922	0.764	0.313	0.247	0.330	0.167	0.098	0.416	0.378	0.585	**5**
	0.711	0.516	0.731	0.061	0.387	0.520	0.865	0.596	0.456	0.745	
	0.341	0.350	0.431	0.984	0.583	0.321	0.142	0.508	0.040	0.741	
	A		**B**		**C**		**D**		**E**		

	A		B		C		D		E		
	0.764	0.375	0.774	0.880	0.109	0.349	0.121	0.861	0.612	0.200	
	0.614	0.527	0.172	0.266	0.018	0.374	0.036	0.623	0.341	0.427	
1	0.017	0.694	0.456	0.638	0.812	0.271	0.423	0.329	0.644	0.041	**1**
	0.823	0.132	0.112	0.039	0.319	0.312	0.565	0.634	0.124	0.199	
	0.001	0.938	0.180	0.639	0.207	0.918	0.905	0.490	0.938	0.019	
	0.281	0.761	0.733	0.457	0.424	0.063	0.159	0.247	0.546	0.975	
	0.503	0.360	0.556	0.533	0.829	0.490	0.527	0.286	0.557	0.078	
2	0.689	0.948	0.589	0.816	0.370	0.794	0.913	0.324	0.529	0.041	**2**
	0.260	0.313	0.841	0.771	0.752	0.282	0.669	0.749	0.420	0.451	
	0.204	0.118	0.165	0.209	0.865	0.429	0.366	0.493	0.509	0.945	
	0.546	0.394	0.643	0.855	0.104	0.120	0.201	0.987	0.640	0.240	
	0.230	0.569	0.865	0.696	0.044	0.494	0.030	0.699	0.204	0.105	
3	0.808	0.107	0.645	0.308	0.094	0.288	0.391	0.885	0.069	0.994	**3**
	0.423	0.022	0.370	0.008	0.125	0.774	0.091	0.523	0.700	0.599	
	0.819	0.415	0.405	0.856	0.065	0.079	0.408	0.541	0.723	0.309	
	0.212	0.347	0.045	0.359	0.420	0.422	0.720	0.767	0.983	0.589	
	0.444	0.389	0.427	0.634	0.055	0.337	0.519	0.444	0.644	0.703	
4	0.224	0.571	0.271	0.859	0.636	0.175	0.255	0.080	0.027	0.877	**4**
	0.840	0.401	0.917	0.099	0.600	0.715	0.332	0.335	0.405	0.983	
	0.233	0.580	0.966	0.419	0.092	0.243	0.175	0.179	0.743	0.611	
	0.668	0.678	0.304	0.650	0.646	0.623	0.290	0.246	0.680	0.359	
	0.430	0.392	0.388	0.807	0.455	0.004	0.586	0.442	0.179	0.162	
5	0.309	0.373	0.239	0.392	0.490	0.549	0.773	0.695	0.917	0.797	**5**
	0.681	0.901	0.637	0.195	0.392	0.093	0.091	0.642	0.389	0.492	
	0.134	0.119	0.276	0.503	0.096	0.319	0.135	0.225	0.953	0.169	
	A		B		C		D		E		

	A		B		C		D		E		
	0.975	0.023	0.046	0.500	0.806	0.260	0.202	0.319	0.813	0.862	
	0.600	0.130	0.373	0.995	0.048	0.501	0.552	0.519	0.846	0.403	
1	0.536	0.018	0.935	0.372	0.090	0.931	0.311	0.579	0.466	0.979	**1**
	0.567	0.042	0.182	0.483	0.143	0.473	0.838	0.578	0.894	0.070	
	0.956	0.913	0.130	0.915	0.895	0.415	0.558	0.554	0.975	0.636	
	0.348	0.419	0.682	0.262	0.536	0.984	0.886	0.878	0.009	0.877	
	0.141	0.217	0.422	0.261	0.384	0.716	0.326	0.212	0.353	0.610	
2	0.625	0.370	0.164	0.966	0.722	0.236	0.548	0.137	0.851	0.053	**2**
	0.357	0.688	0.676	0.757	0.630	0.527	0.817	0.041	0.235	0.790	
	0.114	0.741	0.129	0.805	0.802	0.800	0.615	0.417	0.741	0.455	
	0.515	0.566	0.935	0.755	0.055	0.412	0.083	0.253	0.174	0.826	
	0.557	0.484	0.163	0.242	0.221	0.150	0.397	0.763	0.868	0.113	
3	0.787	0.758	0.735	0.302	0.391	0.540	0.043	0.991	0.537	0.459	**3**
	0.111	0.507	0.695	0.634	0.251	0.587	0.386	0.533	0.585	0.449	
	0.824	0.682	0.521	0.056	0.088	0.302	0.128	0.562	0.334	0.244	
	0.597	0.828	0.318	0.337	0.736	0.029	0.891	0.709	0.700	0.134	
	0.768	0.644	0.400	0.481	0.528	0.573	0.928	0.824	0.537	0.445	
4	0.778	0.664	0.687	0.607	0.493	0.515	0.269	0.363	0.662	0.947	**4**
	0.833	0.812	0.289	0.346	0.923	0.478	0.941	0.580	0.976	0.509	
	0.635	0.995	0.723	0.558	0.349	0.432	0.155	0.276	0.129	0.326	
	0.880	0.025	0.952	0.801	0.596	0.565	0.407	0.303	0.620	0.153	
	0.624	0.276	0.934	0.715	0.372	0.111	0.823	0.740	0.650	0.676	
5	0.084	0.459	0.616	0.230	0.955	0.787	0.486	0.817	0.420	0.599	**5**
	0.028	0.943	0.707	0.336	0.442	0.751	0.009	0.025	0.406	0.638	
	0.257	0.953	0.580	0.071	0.474	0.137	0.481	0.277	0.533	0.292	
	A		B		C		D		E		

	A		B		C		D		E		
	0.772	0.571	0.975	0.511	0.489	0.398	0.089	0.964	0.379	0.313	
	0.838	0.849	0.592	0.814	0.914	0.928	0.438	0.875	0.712	0.507	
1	0.447	0.478	0.176	0.084	0.317	0.169	0.755	0.741	0.821	0.134	**1**
	0.960	0.192	0.970	0.442	0.856	0.621	0.500	0.912	0.814	0.895	
	0.941	0.780	0.393	0.912	0.252	0.713	0.386	0.158	0.941	0.599	
	0.819	0.432	0.555	0.447	0.866	0.737	0.363	0.382	0.615	0.705	
	0.937	0.970	0.331	0.751	0.633	0.711	0.234	0.174	0.518	0.644	
2	0.408	0.983	0.714	0.499	0.782	0.417	0.849	0.013	0.325	0.064	**2**
	0.848	0.718	0.096	0.035	0.021	0.484	0.146	0.233	0.744	0.090	
	0.814	0.540	0.268	0.199	0.913	0.387	0.614	0.335	0.493	0.194	
	0.373	0.229	0.458	0.544	0.138	0.753	0.825	0.441	0.521	0.304	
	0.748	0.235	0.421	0.304	0.568	0.329	0.098	0.348	0.371	0.646	
3	0.365	0.098	0.826	0.053	0.931	0.166	0.835	0.384	0.716	0.951	**3**
	0.711	0.021	0.531	0.549	0.727	0.539	0.111	0.627	0.036	0.867	
	0.111	0.106	0.980	0.418	0.757	0.475	0.157	0.525	0.793	0.326	
	0.171	0.226	0.276	0.734	0.265	0.190	0.452	0.998	0.520	0.857	
	0.749	0.458	0.832	0.004	0.218	0.492	0.375	0.428	0.966	0.285	
4	0.074	0.807	0.868	0.560	0.526	0.077	0.236	0.430	0.861	0.112	**4**
	0.463	0.256	0.120	0.567	0.237	0.012	0.136	0.075	0.617	0.974	
	0.903	0.948	0.531	0.315	0.050	0.839	0.977	0.882	0.196	0.982	
	0.611	0.524	0.293	0.749	0.367	0.958	0.348	0.109	0.780	0.254	
	0.438	0.791	0.982	0.027	0.170	0.127	0.820	0.943	0.075	0.887	
5	0.973	0.410	0.313	0.035	0.949	0.848	0.720	0.672	0.530	0.799	**5**
	0.382	0.458	0.800	0.781	0.242	0.564	0.019	0.139	0.338	0.176	
	0.751	0.263	0.344	0.467	0.941	0.795	0.019	0.880	0.515	0.415	
	A		B		C		D		E		

	A		B		C		D		E		
	0.817	0.093	0.254	0.779	0.563	0.409	0.263	0.244	0.026	0.340	
	0.267	0.817	0.444	0.908	0.830	0.238	0.270	0.990	0.287	0.607	
1	0.287	0.574	0.016	0.879	0.159	0.232	0.440	0.553	0.799	0.461	**1**
	0.416	0.330	0.913	0.890	0.426	0.746	0.078	0.374	0.190	0.396	
	0.116	0.197	0.178	0.223	0.794	0.327	0.401	0.499	0.666	0.475	
	0.554	0.784	0.841	0.113	0.606	0.687	0.319	0.268	0.793	0.461	
	0.777	0.671	0.420	0.990	0.215	0.825	0.222	0.591	0.264	0.230	
2	0.215	0.696	0.455	0.127	0.976	0.774	0.761	0.437	0.664	0.164	**2**
	0.174	0.315	0.788	0.300	0.037	0.258	0.464	0.286	0.575	0.581	
	0.262	0.845	0.246	0.789	0.815	0.539	0.766	0.646	0.034	0.860	
	0.372	0.973	0.530	0.319	0.021	0.337	0.755	0.423	0.182	0.877	
	0.696	0.264	0.848	0.895	0.963	0.121	0.620	0.738	0.446	0.657	
3	0.551	0.612	0.469	0.596	0.767	0.900	0.050	0.859	0.210	0.652	**3**
	0.940	0.828	0.328	0.224	0.861	0.612	0.640	0.783	0.952	0.292	
	0.493	0.163	0.854	0.979	0.858	0.562	0.690	0.143	0.796	0.904	
	0.963	0.877	0.075	0.714	0.414	0.351	0.829	0.246	0.447	0.060	
	0.441	0.183	0.880	0.986	0.755	0.034	0.642	0.540	0.393	0.665	
4	0.558	0.228	0.709	0.238	0.572	0.599	0.504	0.971	0.698	0.744	**4**
	0.811	0.758	0.092	0.848	0.312	0.436	0.017	0.438	0.916	0.304	
	0.017	0.260	0.953	0.564	0.947	0.011	0.425	0.468	0.083	0.789	
	0.178	0.881	0.468	0.731	0.604	0.324	0.398	0.753	0.278	0.130	
	0.979	0.811	0.476	0.125	0.423	0.314	0.456	0.090	0.189	0.066	
5	0.057	0.136	0.483	0.100	0.712	0.204	0.372	0.385	0.918	0.405	**5**
	0.717	0.633	0.348	0.744	0.255	0.781	0.443	0.625	0.300	0.705	
	0.305	0.247	0.661	0.493	0.889	0.764	0.577	0.169	0.261	0.398	
	A		B		C		D		E		

	A		B		C		D		E		
	0.815	0.125	0.006	0.653	0.614	0.455	0.968	0.103	0.150	0.154	
	0.872	0.226	0.619	0.637	0.585	0.566	0.331	0.028	0.369	0.751	
1	0.685	0.964	0.937	0.948	0.969	0.454	0.194	0.425	0.852	0.500	**1**
	0.427	0.348	0.222	0.129	0.690	0.911	0.996	0.115	0.681	0.569	
	0.181	0.115	0.519	0.715	0.508	0.308	0.525	0.584	0.694	0.427	
	0.917	0.628	0.054	0.928	0.817	0.812	0.264	0.776	0.756	0.610	
	0.759	0.891	0.311	0.612	0.247	0.044	0.668	0.389	0.953	0.931	
2	0.510	0.632	0.371	0.037	0.667	0.681	0.730	0.638	0.965	0.925	**2**
	0.836	0.525	0.342	0.752	0.638	0.403	0.687	0.245	0.403	0.785	
	0.669	0.875	0.824	0.842	0.565	0.756	0.401	0.371	0.576	0.689	
	0.931	0.450	0.955	0.323	0.696	0.790	0.021	0.127	0.753	0.550	
	0.771	0.631	0.896	0.968	0.870	0.312	0.764	0.665	0.113	0.610	
3	0.855	0.525	0.056	0.255	0.921	0.282	0.301	0.401	0.775	0.246	**3**
	0.897	0.753	0.246	0.763	0.259	0.293	0.613	0.154	0.743	0.574	
	0.393	0.878	0.401	0.459	0.134	0.655	0.433	0.323	0.393	0.038	
	0.965	0.130	0.181	0.909	0.940	0.399	0.200	0.724	0.673	0.397	
	0.745	0.233	0.460	0.361	0.935	0.018	0.405	0.945	0.183	0.576	
4	0.204	0.623	0.771	0.120	0.859	0.314	0.880	0.447	0.680	0.938	**4**
	0.804	0.213	0.903	0.488	0.425	0.685	0.584	0.676	0.717	0.220	
	0.526	0.018	0.323	0.978	0.407	0.197	0.827	0.102	0.641	0.302	
	0.620	0.343	0.587	0.878	0.922	0.977	0.162	0.523	0.011	0.409	
	0.558	0.383	0.880	0.541	0.422	0.466	0.186	0.004	0.457	0.446	
5	0.128	0.893	0.685	0.864	0.349	0.413	0.273	0.971	0.970	0.311	**5**
	0.455	0.032	0.141	0.835	0.705	0.898	0.958	0.945	0.095	0.779	
	0.790	0.312	0.258	0.518	0.141	0.448	0.185	0.599	0.546	0.751	
	A		**B**		**C**		**D**		**E**		

	A		B		C		D		E		
	0.982	0.498	0.720	0.906	0.269	0.565	0.296	0.393	0.537	0.124	
	0.636	0.192	0.769	0.017	0.448	0.457	0.458	0.148	0.917	0.987	
1	0.499	0.185	0.016	0.919	0.847	0.967	0.794	0.258	0.641	0.288	**1**
	0.364	0.861	0.261	0.407	0.639	0.643	0.277	0.830	0.989	0.178	
	0.141	0.417	0.721	0.393	0.860	0.021	0.952	0.944	0.606	0.721	
	0.947	0.752	0.693	0.734	0.577	0.119	0.499	0.032	0.834	0.328	
	0.923	0.669	0.770	0.400	0.790	0.700	0.758	0.099	0.198	0.201	
2	0.885	0.025	0.563	0.815	0.063	0.269	0.244	0.711	0.418	0.517	**2**
	0.925	0.002	0.216	0.406	0.812	0.309	0.596	0.883	0.385	0.725	
	0.793	0.877	0.783	0.064	0.047	0.225	0.891	0.588	0.179	0.565	
	0.397	0.152	0.590	0.640	0.534	0.558	0.191	0.466	0.655	0.062	
	0.366	0.478	0.991	0.455	0.152	0.652	0.480	0.136	0.072	0.729	
3	0.537	0.039	0.970	0.382	0.927	0.865	0.663	0.873	0.119	0.835	**3**
	0.211	0.621	0.042	0.023	0.155	0.347	0.124	0.371	0.589	0.016	
	0.103	0.030	0.040	0.042	0.556	0.822	0.376	0.970	0.938	0.386	
	0.773	0.420	0.378	0.039	0.905	0.484	0.544	0.225	0.554	0.459	
	0.543	0.777	0.482	0.921	0.940	0.841	0.738	0.763	0.096	0.528	
4	0.996	0.200	0.554	0.421	0.334	0.556	0.359	0.592	0.237	0.736	**4**
	0.799	0.698	0.399	0.104	0.422	0.949	0.157	0.505	0.772	0.341	
	0.309	0.918	0.954	0.852	0.639	0.035	0.226	0.409	0.116	0.945	
	0.109	0.364	0.613	0.650	0.741	0.248	0.628	0.157	0.318	0.069	
	0.362	0.657	0.943	0.683	0.948	0.675	0.367	0.288	0.914	0.896	
5	0.651	0.328	0.501	0.552	0.218	0.951	0.936	0.198	0.531	0.307	**5**
	0.770	0.936	0.461	0.907	0.282	0.864	0.880	0.444	0.499	0.223	
	0.800	0.658	0.705	0.107	0.561	0.076	0.355	0.604	0.847	0.205	
	A		**B**		**C**		**D**		**E**		