
MEMORANDUM

TO: All SD Dept. of Transportation Materials Manual Holders

FROM: Office of Materials and Surfacing

DATE: August 14, 2026

SUBJECT: Materials Manual Revisions dated September 1, 2026

Enclosed you will find a copy of the Revisions for your respective Manual along with a "Manual Accountability Form" which must be completed and returned in accordance with the instructions provided thereon. If this form is not completed and submitted to the South Dakota Department of Transportation, it will be assumed the recipient of this mailing is no longer interested in receiving updates or is no longer the manual holder. These manual holders will be removed from our mailing list and will not receive future updates and revisions.

Also enclosed is a tabulation of the changes to be made in the Manual. Remove and replace contents of your Manual in accordance with the instructions provided in the tabulation.

The subject revisions will apply to all projects let September 1, 2026, and thereafter. Projects currently under contract will need to fulfill the MSTR requirements which were in place when the project was let as identified on the DOT-14. It will be permissible to utilize these revised testing procedures and associated forms in Sections 100 to 500 of the Manual on projects let prior to the revisions as long as it does not adversely affect the contractor's ability to fulfill the contract requirements.

Sincerely,



Tanner G. Fitzke

Chief Materials & Surfacing Engineer



Kelly Hudecek

Program Administrator

CC: File

Enclosures



U.S. Department
of Transportation
**Federal Highway
Administration**

South Dakota Division

July 10, 2026

116 East Dakota Ave, Suite A
Pierre, SD 57501
(605) 224-8033
<https://www.fhwa.dot.gov/sddiv>

In Reply Refer To:

HDA-SD

Mr. Tanner Fitzke
Chief Materials & Surfacing Engineer
South Dakota Department of Transportation
Division of Planning/Engineering
Office of Materials and Surfacing
700 E. Broadway Avenue
Pierre, South Dakota 57501

Subject: 2026 SDDOT Materials Manual Revisions Approval

Dear Mr. Fitzke:

In accordance with Title 23, Part 637 of the Code of Federal Regulations, the 2026 South Dakota Department of Transportation's Materials Manual with its proposed revisions that were transmitted to me via Mr. Ben Brown's June 30, 2026 email are hereby approved by the Federal Highway Administration.

Sincerely,

Kirk Van Roekel, PE
Engineering and Operations Supervisor
FHWA - SD Division Office

June 30, 2026

Kirk Van Roekel
Division Administrator
Federal Highway Administration – SD Division
116 E. Dakota Avenue
Pierre, SD 57501-3110

Dear Kirk:

Enclosed for your review and approval are the proposed revisions to the Department's Materials Manual for this year.

The submittal includes a significant volume of paper but for the benefit of your review and ease of our user's to be able to discern where changes were made, we have provided a vertical line in the right margin of each sheet where a change was made. Please review the contents of the submittal and advise accordingly on approval status.

Your prompt review and response would be greatly appreciated, and if you have any questions or comments in regard to this submittal, please feel free to contact our office.

Sincerely,



Tanner G. Fitzke
Chief Materials & Surfacing Engineer Enclosures

CC: Joel Jundt
Craig Smith
Kelly Hudecek
Region Material Engineers

2026 – MATERIALS MANUAL REVISIONS

Make the following changes in your Manual:

RSTC SECTION

1. Remove RSTC Table of Contents in its entirety and replace with revised sheets.
2. Remove RSTC page 8 through 26 and replace with revised sheets.

MSTR SECTION

3. Remove MSTR Table of Contents in its entirety and replace with revised edition.
4. Remove MSTR in its entirety and replace with revised edition.

SECTION 100 – Soils

5. Remove Section 100 Table of Contents in its entirety and replace with revised edition.
6. SD 108 remove the section in its entirety and replace with the revised edition.

SECTION 200 – Aggregates

7. Remove Section 200 Table of Contents in its entirety and replace with revised edition.
8. SD 202 remove page 3 through 24 and replace with the revised sheets.
9. SD 207 remove page 1 through 6 and replace with the revised sheets.

SECTION 300 – Asphalt

10. Remove Section 300 Table of Contents in its entirety and replace with revised edition.
11. SD 320 remove page 3 and replace with the revised sheet.
12. SD 323 add the new procedure to this section.

SECTION 400 – Concrete

13. SD 402 remove the section in its entirety and replace with the revised edition.
14. SD 403 remove the section in its entirety and replace with the revised edition.
15. SD 405 remove page 3 through 6 and replace with the revised sheets.
16. SD 417 remove the section in its entirety and replace with the revised edition.

South Dakota Department of Transportation
Required Samples, Tests, and Certificates (RSTC)

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Materials not meeting specifications will not be incorporated into the project. If an acceptance test fails, the Contractor will correct the material. When an acceptance test fails and the process continues without shutting down (e.g., slump, air entrained tests) an acceptance test will be performed immediately after the contractor has had the opportunity to correct the subsequent material.

- F. Density test: When a dry density results in a value of 105% or greater of the maximum dry density, the Engineer will perform an additional density test as close as practical to the original location. If this additional density test also results in a value of 105% or greater than the maximum dry density, the Engineer will contact the Region Materials Engineer to investigate the compaction methods and testing equipment to determine the cause of the suspect result.
- G. Sharing refers to the use of an MS&T function that allows a test result or certification recorded for one project to be applied within that project or to another project. Sharing may be used only under the following conditions:
- (1) The material represented by the test or certification must meet the material requirements for the receiving application or project. These requirements include the material's type, specification, tolerances, grade or class, source, lot or batch, mix design, and producer, as applicable and governed by the MSTR.
 - (2) Sharing will not be allowed if it would result in the receiving application or project falling below its minimum required sampling or testing frequency.
 - (3) Shared results must represent the material actually used on the receiving application or project. A test may only be shared when the material on both applications originates from the same production period or batch, or when the Materials Manual permits annual or source based testing to represent multiple contracts.
 - (4) Results shared among two or more contracts will be reported separately for each contract in accordance with RSTC Section 4. Each project file must contain the applicable test report or certification and must clearly reference the originating project or source.
 - (5) Sharing will not be allowed when the receiving application or project has a stricter specification requirement, a modified special provision, or any project specific testing requirement that is not satisfied by the shared test.
 - (6) Sharing may only occur within an appropriate timeframe such that the test result remains valid for the production represented. When the Materials Manual specifies an annual, lot based, or batch based test validity period, sharing is limited to that period.

If any of the above conditions are not met, the test result or certification will not be shared, and a new acceptance sample or certification shall be obtained for the receiving project.

5.2 Quality Control and Quality Assurance.

Definition.

Quality Control and Quality Assurance samples and tests are used in association with Asphalt Concrete – Class Q.

Operational Procedure.

The contractor or his representative will perform all quality control “QC” tests. A representative of the Area Office will perform the quality assurance “QA” tests. Prior to production the QC and the QA testers will perform, correlation tests as a method of assuring equipment and personnel are performing tests in accordance with the Materials Manual.

Production testing procedures will be as specified in Section 322 of the Standard Specifications.

QC/QA Dispute Resolution System

If the differences between the QC and QA results are greater than the allowed tolerance in R.S.T.C. or SD 317, the Engineer will investigate the reason for the difference. The investigation may include review and observation of test procedures and equipment. The QA technician will test the next QC sample as soon as a difference between any QC and QA test result is found. The Engineer may require that a sample be tested jointly by the Contractor's QC technician, the Engineer's QA technician, and the Region Materials Engineer. The Region Materials Engineer test results or, if necessary, the Department's Central Laboratory test results will be the referee used for acceptance and will determine which sample test results will be incorporated into the pay factor calculations only when a dispute between the QA and QC sample cannot be resolved.

5.3 Corrective Action Samples and Tests.

Definition.

Corrective action samples and tests are used to determine the effectiveness of any action implemented to remedy a specification deficiency detected or confirmed by a failing acceptance test.

The corrective action test represents the same lot of material or unit of work as the failing acceptance test. The corrective action test becomes the acceptance test after the entire lot or unit has been satisfactorily corrected.

Operational Procedure.

When an acceptance test fails and appropriate action is taken to correct the entire lot represented by the test, a corrective action test shall be performed to check the

validity of the corrective action taken. This test shall be taken from the same location or in such a manner that it represents the same lot as the acceptance test. If the corrective action test confirms the non-specification condition has been corrected, this test becomes the basis of acceptance for the material or construction involved.

If the corrective action test determines the non-specification condition still exists, further corrective action and tests will be required until the condition has been satisfactorily corrected. Details of each corrective action shall be noted on the worksheet or report for the appropriate corrective action test.

5.4 Process Correction Samples and Tests.

Definition.

Process Correction Samples and Tests represent the effectiveness of action taken to correct a process. The material represented by the failing acceptance test has generally been mixed with other materials such as lime, asphalt, or Portland cement and placed on the project; therefore, it is impossible to correct the in-place material.

Operational Procedure.

When an acceptance test fails, and the process is shut down, the contractor shall perform a correction to the process. A process correction test shall be performed to determine effectiveness of the action taken. Before the process is allowed to continue, a passing process correction test must be performed. This process correction test does not represent any material and shall be recorded as a process correction test.

An acceptance test shall be taken shortly after the process resumes.

5.5 Failing Acceptance Samples and Tests.

Definition.

A failing acceptance sample or test is a test that is outside specifications.

Operational Procedure.

The following procedure is to be used when the work or material incorporated into the project does not meet specifications, corrective action is not feasible, and the Area Engineer has determined that the work or material can remain in place.

- A. The Area Engineer will prepare a DOT-18 form setting forth the details of the non-specification work or materials including quantity, location, and an explanation of action taken as a result of the specification deviation. The Area Engineer will submit the DOT-18 form to the Region Engineer. Copies of test results or test numbers and a full explanation of the situation will accompany the DOT-18.

Samples for acceptance testing will represent the following quantity of material: one-half of the material produced from the time the previous sample was taken to the time the current sample is obtained, plus one-half of the

material produced from the time the current sample is taken until the next sample is collected, except as noted below.

- (1) The first sample will represent material produced from the start of production, ahead to midpoint of when the next sample is taken.
- (2) The final sample will represent material produced back to midpoint with the previous sample and ahead to the end of production.
- (3) A failing sample will represent material produced back to the midpoint with the previous sample and ahead to when production is stopped and process correction measure taken; or production continues, and corrective measure is taken.
- (4) The second and subsequent, consecutive, failing tests represent all material produced from the previous process correction or corrective measure ahead to when production is again stopped and/or corrective measure is taken.
- (5) The next passing sample after a failure will represent material produced after production stopped and process correction measure taken; or production continues, and corrective measure is taken ahead to midpoint of when the next sample is taken.

Testing frequency is established independently of the quantity of material represented by each sample. Consequently, a non-compliant test result may apply to a greater quantity of material than is directly reflected by the prescribed testing frequency.

There are exceptions to this guidance. If a test is missed, the test results from a test adjacent to a missed test cannot represent more than the minimum testing frequency. Manufactured materials represented by batch, lot, etc., will represent the entire batch, lot, etc.

- B. The Region Office will determine the price adjustment for the non-specification material that has been allowed to remain in place and attach the letter to the DOT-18. The price adjustment letter will be submitted to the Contractor by the Region Office. Price adjustment will be administered according to the "Price Adjustment Guidelines" and/or other relative information and/or personal contacts with individuals who are resource experts.

Asphalt Test Reproducibility Tolerances

Test results which fall outside the specification limits for a particular test, but within the test reproducibility tolerance as set forth below, will be acceptable.

Cut-Back Asphalt	
Test	Tolerance*
Flash Point	
Tag Open Cup (Ave. of three test).....	4°F
Cleveland Open Cup	15°F

Viscosity	
Kinematic, 140°F (To 3000 CS)	1.5%
Kinematic, 140°F (Above 3000 CS)	4.5%
Saybolt-Furol	4.55

Distillation	
Distillate % by vol. (Up to 347°)	1.8% pts.
Distillate % by vol. (Above 347°)	1.0% pt.
Residue % by vol.	1.0% pt.

Test on Residue	
Penetration	8.0%
Solubility in CH ₃ CCl ₃	0.13% pt.

Emulsified Asphalt

<u>Test</u>	<u>Tolerance*</u>
Distillation	
Residue % by vol.	1.0% pt.
Test on Residue	
Penetration (100 or more)	15 pen. pts.
Penetration (Less than 100)	8 pen. pts.

Asphalt Cement

<u>Test</u>	<u>Tolerance*</u>
Penetration	
Penetration, 77°F (Less than 50)	2 pen. pts.
Penetration, 77°F (50 or above)	4%
Flash Point	
Cleveland Open Cup	15°F
Pensky-Marten's Closed Cup (Below 220°F)	3°F
Pensky-Marten's Closed Cup (Above 220°F)	13°F
Viscosity	
Kinematic, 275°F	4.4%
Absolute, 140°F	5.0%
Solubility in CH ₃ CCl ₃	0.13 pts.
Thin-film Test	
Loss on heating	20%
% of Original	4% pts.

*When tolerances are expressed in terms of percent, the allowable deviation is calculated as the indicated percentage of the upper or lower specification limit, whichever is applicable.

5.6 Independent Assurance Sample and Tests.

Definition.

Independent Assurance (IA) activities are an unbiased and independent evaluation of sampling and testing procedures used in the acceptance program. Sampling and testing will be performed by qualified personnel. They do not provide test results for acceptance.

Operational Procedure.

Independent Assurance sampling and testing, or other procedures will be performed by qualified sampling and testing personnel as per the requirements of the South Dakota Department of Transportation Materials Testing & Inspection Certification Program Manual. Independent Assurance sampling and testing must be performed by personnel other than those performing the acceptance testing. They must be performed by Region Materials or Central Testing Laboratory personnel.

All equipment will meet the requirements of the South Dakota Department of Transportation Materials Testing & Inspection Certification Program Manual. The testing of IA samples must be performed with equipment other than that used for testing acceptance samples. Separate equipment will not be required when both acceptance and IA samples of the same material are tested in the Central Testing Laboratory.

A small portion (not more than 10%) of samples obtained and tests performed in the field may be accomplished by observation if approved by the Region Materials Engineer and the sampling and testing is closely observed and found to be in accordance with specified procedures.

It will be the responsibility of the Region Materials Engineer to document a comparison between the results of each IA test and acceptance test by using the following table:

Acceptable Tolerances for Comparison of IA Test Results (not including QC/QA Asphalt Concrete and IA).

Sieves	
80 to 100% passing	± 5
50 to 79% passing	± 4
30 to 49% passing	± 3
10 to 29% passing	± 2
0 to 9% passing	± 1
Liquid Limit and Plastic Index	
L.L. 30 or Over	± 3
L.L. 18 to 29	± 2
L.L. below 18	± 3
P.I. 11 to 20	± 3
P.I. 5 to 10	± 2
P.I. 0 to 4	± 1

The tolerances shown above will apply only when there is a specification on them.

Flakiness Index	± 5
Flat & elongated particles	± 2
Fine aggregate angularity	± 1.0
Light weight particles if spec max is ≤ 1.0	± 0.5
Light weight particles if spec max is > 1.0	± 1.0
Sand Equivalent	± 7
Crushed particles	± 10
Air voids in asphalt concrete	± 1.2

Bulk specific gravity	± .020
Maximum specific gravity (Rice)	± .020
Unit weight of concrete	± 2.0 lbs./cu.ft.
Air content in fresh concrete	± 0.3
Slump Flow.....	± 1 in.
Temperature in fresh concrete.....	± 2°
In-place density, wet density.....	± 3.0 lbs.
Standard density, wet density	± 3.0 lbs.
In-place density, moisture content	± 2
1-Point Curve Plot	2 curves (Ohio) above or below

When the results of 2 tests being compared fall into different tolerance groups, apply the group which permits the largest tolerance.

Example:

Acceptance test results: 47% Passing #4 Sieve
 (Acceptable tolerance: Plus or Minus 3 – 30 to 49% Passing)

IA test results: 51% Passing #4 Sieve
 (Acceptable tolerance: Plus or minus 4 – 50 to 79% Passing)

The tolerance to be applied will be plus or minus 4.

Acceptable Tolerances for Comparison of Class Q Asphalt Concrete between QC, QA and IA

Sieve 3/8 inch and larger	± 5
Sieve #4 thru #50	± 3
Sieve #100 thru #200	± 1.5
Lightweight Particles.....	± 1.0
Sand Equivalent	± 7
Crushed Particles	± 10
Fine Aggregate Angularity	± 1.0
Air Voids	± 1.2
Bulk Specific Gravity of Asphalt Concrete	
(Gyratory) @ N _{design}	± 0.020
Mixture Densification @ N _{design}	± 1.2
Maximum Specific Gravity (Rice).....	± 0.020
Bulk Specific Gravity of In Place Density	
Cores.....	± 0.020

If the IA is out of tolerance with the QC and/or QA the Region Materials Engineer will:

- (1) When there are no, or only minor discrepancies, between the results of the comparison tests, note that fact on the report.
- (2) When the comparison indicates major or repeated differences, document on the report the type or the amount of each significant variation and the proposed remedial action.

- (3) Immediately following the remedial action, test to determine if the cause for variation found in the test results has been corrected. The remedial action IA ("R") test report will contain a brief summary of the problem's detection and correction.

5.7 Remedial Action Samples and Tests

Definition.

Remedial action is to determine the effectiveness of action employed to establish satisfactory alignment of the acceptance testing and IA testing (or QC and QA testing). Remedial action may consist of, but is not limited to:

- A. Mechanical adjustment, calibration, repair, or replacement of equipment.
- B. Changes in, review, or revisions of sampling or testing procedures.

Operational Procedure.

The IA testing organization making the remedial action test shall document on the report (DOT-17):

- A. The problem requiring remedial action.
- B. Remedial action taken.

5.8 Quality Samples and Tests.

Definition.

Quality tests are performed on aggregate samples and include L.A. abrasion, soundness, clay lumps, shrinkage, organic impurities, and color. Quality tests are generally performed on samples representing the material proposed for use, or samples from a material's production site prior to its use.

Operational Procedure.

It shall be the responsibility of the Area Engineer to ensure that the file for each project under his supervision contains the results of Quality tests required by the specifications. The record may consist of:

- A. The Central Testing Laboratory report of quality tests on mix design, acceptance, or IA samples.
- B. Copies of the results of quality tests performed on the material being used, that may be filed elsewhere, e.g., filed in the Region Materials or the Central Testing Laboratory.
- C. Copies of results of tests performed on the source of material being used, which has been sampled, tested, and reported for another project.

- (1) When copies of test results are used, care shall be exercised to secure compliance with requirements of the specifications and this manual. Clearly state cross references so determination of the origin is absolute.

D. The Region Materials Engineer shall:

- (1) Provide the Area Engineer, upon request, copies of results of preliminary quality tests previously made on material to be used in construction. This information in the project file enables the Area Engineer to make an early appraisal of the degree of surveillance necessary for proper job control.
- (2) Make a periodic routine inquiry or examination to determine the existence in the project file of current required quality test reports or copies of results.

5.9 Information Samples and Tests.

Definition.

Information samples and tests are taken to evaluate, identify, investigate, and determine the acceptability of new products or material sources for potential future use. Information samples for a particular project may also be used to determine the results of a test segment or to determine additional data, e.g., only percentage passing a specific individual sieve or a particular characteristic, such as soundness, wear, etc., to provide data to establish a production or construction guide or find the percent air and slump of fresh concrete when a truck arrives. The MSTR does not apply, and a DOT-18 will not be required.

Operational Procedure.

When an information sample or test is submitted to the Region Materials or Central Labs, the Sample Data Sheet (DOT-1) or new product evaluation request shall be completed for and submitted with each sample or test. When using the DOT-1 state the purpose of the sample or test clearly as remarks on the Sample Data Sheet; e.g., "Info #3, for P.I. only". Information test results for a particular project shall be reported and retained for additional project documentation.

5.10 Mix Design Samples and Tests.

Definition.

Mix design samples and tests are made on material produced and intended for use in combinations that are established by the Central Testing Laboratory. Mix production shall not be permitted until the design mix is obtained. Samples must be submitted to the Central Testing Laboratory in advance so tests and designs can be completed without delay to production or construction.

Operational Procedure.

To determine sampling and testing requirements for asphalt, lime, or Portland cement concrete materials for a mix design, consult the MSTR relating to the appropriate material or construction or contact the Region Materials Engineer.

The Sample Data Sheet and shipping envelope shall indicate what admixtures are to be used, if any, and material or project features that might be unusual.

5.11 Samples and Tests for other Agencies (Outside Testing).

The policy for performing sampling, testing, or related engineering work for outside agencies is as follows:

- A. The outside agency shall submit a written request explaining the nature, extent, and required completion dates of the work along with the address or addresses to which test results and billing of the work are to be sent.
- B. This written request shall be submitted to the Region Engineer when the requested work is to be performed by region personnel. The Region Office shall forward the request to the Chief Materials and Surfacing Engineer along with a statement as to capability to do the work without interfering with the normal work schedule or Engineers in private practice, locally established, to do the type of work requested.
- C. The written request shall be submitted directly to the Chief Materials and Surfacing Engineer when the requested work is to be performed by Central Testing Laboratory personnel.
- D. The Chief Materials and Surfacing Engineer or the Region Engineer, upon receipt of the request, shall review the circumstances and advise the requesting agency in writing of the decision reached. Copies will be sent to the Region, Region Materials, and Area Engineers when they are involved in the requested work. Copies will be sent to the appropriate Central Office personnel when the requested work is to be performed by Central Testing Laboratory personnel.
- E. The written approval for the work, from the Chief Materials and Surfacing Engineer, shall include the accounts receivable number to which costs will be charged. A copy of the written approval shall be forwarded to Transportation Finance.

Requests may be made and approved by telephone provided written confirmation follows. Outside agencies will not be granted open authorization for a specific period of time but will be given approval on a job basis.

6. Certification Process:

6.1 Tier.

Certain materials used in highway construction present higher risks if failure occurs, depending on how they are made. The Department, therefore, has ranked the materials listed in the MSTR based on how they are used in the project. The resulting "Tiering" structure categorizes the materials from critical to non-critical. Definitions of the tiers are as follows:

Tier 1: A material that is critical to safety or costly to replace is considered extremely crucial to the overall success of the project. The Department classifies these

crucial materials as “Tier 1” materials. The Department will only allow the Contractor to install a “Tier 1” material on the project when the Contractor satisfies both of the following conditions:

1. The Contractor furnishes the documents specified under the heading “Certification” in the MSTR of the Materials Manual.
2. The Certification Engineer approves that the certified material conforms to the specifications.

The Department will make payment according to the specifications for a “Tier 1” material only after the Contractor installs the approved material.

Tier 2: The Department will only allow the Contractor to install a “Tier 2” material on the project when the Contractor satisfies either of the following conditions:

1. The Contractor furnishes the documents specified under the heading “Certification” in the MSTR of the Materials Manual, or
2. The Contractor uses a material listed on the Approved Products List or furnished by a certified supplier.

The Department will make payment according to the specifications for a “Tier 2” material only after the Contractor installs the material.

Tier 3: The Department classifies a “Tier 3” material as those materials that require no documentation under the heading “Certification” in the MSTR of the Materials Manual. The Contractor may install a “Tier 3” material on the project at any time.

The Department will make payment according to the specifications for a Tier 3 material only after the Contractor installs the material.

6.2 Certification.

Definition.

Certification is the process by which a Contractor (Umbrella Certificate only), manufacturer, or supplier certifies or guarantees that certain products, materials, or items conform to the specifications. Certification may eliminate the need for acceptance testing although the Department reserves the right to sample, test, and make final acceptance of materials after delivery to the project. The Department accepts the following certifications:

- A. Certificates.
- B. Certified Suppliers.
- C. Items on the Approved Products List.
- D. Umbrella Certificates.

The types of acceptable certifications are further discussed in this section.

The Contractor shall provide the appropriate form of certification, as required by the MSTR.

Operational Procedure.

Certification may be in the form of a report of test results or a statement of specification compliance for a material. It shall be signed by an authorized representative of the company.

Each type of certification must show the designation of each product for which the material is intended; the specific identification for each item, such as a batch, truck, car, heat, or lot number; and adequate reference to exactly determine the item and quantity represented.

Certifications may be submitted separately, or the information may be stamped or printed on shipping orders or included as part of the standard Bill of Lading.

Each certification shall be checked as received to determine that it contains the required information relative to the specifications and supporting data, and that it applies to the material supplied to the project. If the certification meets the requirements, and visual inspection of the material or product indicates conformity, it shall be dated and submitted to the Certification Engineer.

Certifications received by the Area Engineer directly from the manufacturer, fabricator, or supplier shall be placed in the project file. A copy shall be forwarded without delay to the Certification Engineer and reviewed, approved or rejected. When the letter of transmittal containing the assigned certification, number is received by the Area Engineer, it should be treated the same as a numbered test report. The project file should contain a record of certifications received from the supplier and their approval or rejection by the Certification Engineer.

When certifications are submitted directly to the Certification Engineer by the manufacturer, fabricator, or supplier, the original certification shall be forwarded to the Area Engineer to be placed in the project file. Notice of approval or rejection will accompany the original copy.

6.3 Certificates.

Written documentation stating that the specified material is in conformity with the pertinent specification requirements of the contract.

Materials delivered without the required certificates shall not be used pending receipt of certification or satisfactory test results.

Certificates may come in different forms. Acceptable forms that may be submitted include the following:

- A. Certificate of Compliance / Manufacturer's Certificate – A signed document from a manufacturer or supplier certifying that materials indicated on the document are in compliance with the contract and specifications.

- B. Certified Test Report – A signed test report from a mill or plant that certifies that materials were tested in accordance with a specific industry standard or test method. The report shall indicate the procedures followed and results obtained.
- C. Certified Statement – Department furnished forms (DOT-57, DOT-77, and DOT-97) required by the MSTR. The supplier/producer shall complete the form, sign it, and return it to the Inspector.
- D. Buy America Certification - Iron and Steel, Manufactured (Composite) Products and Construction Materials will need to meet Standard Specification 6.9 Buy America. Certification requirements for Buy America are as follows:
 - (1) A statement will be included on the certification stating whether the product is of domestic or foreign origin.
 - (2) The Department will consider material required to meet Buy America that does not require separate certification as miscellaneous material. The Contractor will provide the Department a completed and signed Miscellaneous Materials Buy America Certificate stating the miscellaneous material required to be consumed in, permanently incorporated into, or affixed to the completed project complies with the Buy America requirements specified.

At a minimum, certificates shall include the information specified in paragraph 6.2, operational procedures and/or in paragraph “6.6, Definition”.

6.4 Certified Supplier.

Definition.

A certified supplier is a fabricator, mill, or plant that does not have to furnish certificates for individual heat numbers, loads, lots, or shipments to the project. To become a certified supplier, a fabricator, mill, or plant must submit a statement to the Chief Materials and Surfacing Engineer, certifying that the material produced and supplied to all projects will conform to the specifications. This statement must be submitted at least once a year, prior to the first shipment to a project. It is understood that materials furnished by a certified supplier may be subject to testing at any time.

Operational Procedure.

A list of the fabricators, mills or plants which have been certified by the Chief Materials and Surfacing Engineer shall be compiled, maintained and distributed by the Certification Engineer for use by the Area Engineer. The list may be distributed with, or as part of the Approved Products List. The certified status for the supplier will be effective through December 31st of the year in which it is issued, unless revoked earlier. It may be reinstated as directed by the Chief Materials and Surfacing Engineer.

A. Certified Producer of Cement.

- (1) A statement signed by an authorized representative of the company, that the cement supplied to all projects will meet the specifications,

with a request to be certified, will be submitted to the Chief Materials and Surfacing Engineer.

- (2) To be certified, the cement plant shall meet the requirements of SD 416.

B. Certified Fabricator of Reinforcing Steel.

- (1) A statement signed by an authorized representative of the company, that steel supplied to projects will meet specifications, shall be submitted to the Chief Materials and Surfacing Engineer. Certified copies of mill test results, representing the fabricator's steel stock on hand, shall be available in his file for review by the Chief Materials and Surfacing representative.
- (2) The certified fabricator's steel stock shall be randomly sampled by a representative of the Department of Transportation. The sample shall be obtained from steel represented by heat numbers or lots received since the previous sample was taken. The sample shall be submitted to the Central Testing Laboratory.
 - (a) When tests confirm non-specification material or product, the certified fabricator shall be notified of the deviation and may be removed from the certified list until the deviation and cause have been corrected to the satisfaction of the Chief Materials and Surfacing Engineer.
 - (b) Reinforcing steel supplied by a certified fabricator, which has not been subject to sampling at the Fabricator's plant, such as epoxy coated steel shipped directly to the project from the manufacturer and coater, shall be considered as supplied by a non-certified plant.
- (3) A certified fabricator shall forward to the Engineer for each shipment to the project, a record of the reinforcing steel lengths, shapes, and sizes. The information may be submitted as a copy of the bar list, shipping or packing list, or Bill of Lading.
- (4) A non-certified fabricator is required to forward to the Engineer, for each shipment of reinforcing steel to the project, a certified copy of the mill test report of chemical analysis and physical properties for each heat or lot number.

Deliveries to the project shall be identified by heat number and checked in the field against heat numbers appearing on certified analysis. Bars having heat numbers not covered by certified analysis shall not be placed in the work until certification is obtained.

C. Certified Lime Plant (Mill).

- (1) A statement signed by an authorized representative of the lime plant (Mill), that hydrated lime supplied to projects will meet specifications,

along with the certified analysis most recently made in the plant's laboratory, shall be submitted to the Chief Materials and Surfacing Engineer with the request to be certified.

- (2) During production, the certified plant shall provide the Central Testing Laboratory, weekly certified analysis of its product, reporting the following:
 - (a) Percent calcium and magnesium oxide.
 - (b) Percent free water or mechanical moisture.
 - (c) Accumulative percentage, by weight, of residue retained on the #6, #20, and #100 sieves.
- (3) A sample shall be obtained at the plant on a random schedule, during production, by a representative of the Department of Transportation. The sample, with copies of results of tests made by the plant since the Department of Transportation's last sampling, shall be submitted to the Central Testing Laboratories.
- (4) The Central Testing Laboratory report shall include, as remarks, comparison of its test results with those of the plant for corresponding material.

When tests confirm non-specification material or product, the certified plant shall be notified of the deviation and may be removed from the certified list until the deviation and cause have been corrected.

6.5 Items on the Approved Products List.

Definition.

The Approved Products List is a record prepared, revised, maintained, and distributed by the Central Testing Laboratory. Items or brand name products qualified for the list are those which have developed and maintained a history of satisfactory results from acceptance tests and plant inspections and tests, or for which the Department has verified specification compliance and field performance. Certificates of Compliance will not be required for named products from the Approved Products List, unless otherwise specified.

- A. The list, by brand name, may contain such items as: Accelerators, air entraining agents, castings, concrete pipe (Release dates), epoxies, liquid membrane cures, paint, retarders, water reducing agents, metal products, wood products, etc.
- B. This method provides several items that the Contractor may order without a delay in testing.
- C. Items on the Approved Products List shall be tested in accordance with MSTR.

- D. The Area Engineer should contact the Region Materials Engineer or the Certification Engineer if there are questions about the Approved Products List.
- E. When inspections or tests reveal failing material or products, the producer will be notified by the Chief Materials and Surfacing Engineer of the deviations. Failure to take satisfactory corrective action within a specified time limit will result in suspension and removal from the Approved Products List.

6.6 Umbrella Certificates.

Definition.

A single written document stating that the materials listed or the identified component materials of a system or assembly, including miscellaneous items, are in conformity with the pertinent specification requirements of the contract.

The certificate includes an entry for the following:

- A. Project number
- B. County.
- C. PCN number.
- D. Location.
- E. Contractor - Name and address.
- F. Subcontractor - Name and address. (If applicable)
- G. Component description.
- H. Certifying manufacturer of each component.
- I. Heat or lot number. (As applicable)
- J. Contractor signature, title, and date.
- K. Name, title, and date for individual preparing the document.

Operational Procedure.

Umbrella Certificates shall be submitted for items such as guardrail, lighting and traffic control, signing, chain-link systems and bridge drains as required by the MSTR. The information specified above shall be provided on Department furnished forms (DOT-99).

The Prime Contractor is responsible for completing the certificate. If a subcontractor is going to perform the work covered by the certificate, the subcontractor may fill in the information; however, the Prime Contractor must sign the certificate. Each component material that is to be included on the Umbrella Certificate will be identified as such on the DOT-14. The Prime Contractor will not be allowed to submit individual certification documents for the component materials in lieu of completing a DOT-99 form.

Materials certified by an Umbrella Certificate will be inspected to confirm that the proper materials are used and are installed according to the plans and specifications. The Contractor shall furnish the Engineer with an original copy of the completed DOT-99 when the work begins. The Engineer shall verify that all materials shown as requiring Umbrella Certification on the DOT-14 are included on the form. A copy of the DOT-99 shall be forwarded to the Certification Engineer.

If a construction change order (CCO) is issued that affects items covered by an already submitted Umbrella Certificate, the Project Engineer will verify that the Umbrella Certificate is still an accurate representation of the items or materials required. Based on the Project Engineer's determination, the Prime Contractor may be requested to submit a revised Umbrella Certificate to reflect the changes to the contract.

Payment for the materials or components will be made only after approval of the Umbrella Certificate by an appropriate Department representative and the materials have been installed on the project.

6.7 Verification Methods.

The methods by which the Department determines the acceptability of materials to be placed on the project include the following:

- A. Sampling and Testing – Some materials may require samples be taken and tests performed to determine that the material being certified is in conformity with the plans and specifications. Materials to be sampled and/or tested will be identified in the MSTR.
- B. Documented Inspection – Inspection will be performed as necessary to verify conformance with specifications. Inspection may include taking measurements, performing calculations, and verifying the condition of materials furnished to the site. Inspection may also consist of verifying that materials furnished to the site are representative of those materials identified by certification documents. Documentation of the inspection is to be included in the diary or on the CM&P system, or on forms provided for a particular material.
- C. Random Audit of Contractor's Records – Verification of Contractor's ability to produce the required certifications. The Prime Contractor must build and maintain a file of the identified certifications and retain them for not less than 5 years from Final Acceptance by the Department. Furnish or make available copies of these records and documents for inspection and verification by the Department and FHWA upon request. If any litigation, claim, negotiation, audit or other action involving the records has been started before the expiration of the 5-year period, the records must be retained until the completion of the action and resolution of all issues which arise from it, or until the end of the regular 5-year period, whichever is later.

The records shall be available for review upon request by the Department. Beginning on the date that the Department receives the completed DOT-99 form, random audits of certification records may be conducted by Department personnel. The purpose of the audits is to verify that the contractor is maintaining the proper paperwork.

- D. Annual Inspection of Suppliers – On an annual basis, the Department will randomly select projects and conduct audits of certified suppliers. Random visits of supplier plants or fabricator shops are intended to verify that the facilities meet Department standards.

7. Computations and Reports:

7.1 Report.

Each required field test shall be recorded in the Materials, Sampling, and Testing system (MS&T). If test report is not available in MS&T, the test shall be documented as determined by the Region Materials Engineer.

The Region and Central Testing Laboratories shall retain the original reports of tests performed in their respective laboratory.

The original copy of tests or worksheets made by the Area Engineer but not entered into MS&T system shall be retained in the project file. These tests will be made available to the Region Materials Engineer upon request.

The Contractor shall be advised immediately of all test failures (refer to RSTC 5 Identification).

Reports of test results shall be recorded only as the whole number or decimal required by the specification, e.g., for a specification requirement: "10-35% passing #40 sieve", the report need only show the percent (As a whole number) passing the #40 sieve.

7.2 Computations.

Computations shall be carried one place beyond the reporting figure, and all test results shall be reported to the whole number or decimal required by the specification.

Rounding from the computations to the reporting figure shall be the last step in calculating the test results.

When the requirement appears as a fraction, that fraction shall be interpreted as a decimal rounded to the nearest one hundredth (0.01) for computations.

Discrepancies may arrive between hand calculations and MS&T computations. In these instances, the results in MS&T shall govern.

Rounding.

If the first digit after the digit to be retained has a value of less than 5, the retained figure is not changed. If the first digit after the digit to be retained has a value of 5 or more, the digit to be retained is increased by one. No result, whether intermediate or final shall be rounded more than once.

Compliance will be based upon interpreting the reporting results as though they were rounded to the terms (whole numbers, decimals, or fractions reduced to decimals) of the specification. Thus, the minus #200 material reported as 8.4% shall be considered having no deviation from specifications that require 4–8% passing the #200 sieve. It would, however, be a deviation from specifications requiring 4.0–8.0% passing the #200 sieve.

8. Availability and Filing:

8.1 Acceptance Samples and Tests.

Original reports of acceptance sampling and testing not entered into the MS&T system, are to be retained in the Project Engineer's file and made available for examination by the FHWA Engineer. The reports shall show the source of the samples and where, when, and by whom the sampling and testing was done. These test reports shall remain part of the official project record. Results of acceptance tests need not be submitted to the FHWA, unless specifically requested.

8.2 Independent Assurance Samples and Tests.

Test reports of the IA sampling and testing are to be made available in the Region Laboratory and the project file for examination by the FHWA inspecting Engineer.

Results of IA tests made by Central Testing Laboratories shall be forwarded to the participating Region or Area Laboratory with copies filed in the appropriate Region Materials and Central Testing Laboratory offices.

Results of tests made by the Central Testing Laboratories on comparative samples submitted by AASHTO Resource and CCRL, and the reports of the test equipment and procedure inspections made by those organizations are to be filed in the Central Testing Laboratory Office.

Test reports of the IA sampling and testing need not be submitted to the FHWA Division Office, unless requested.

9. Electronic Reports and Filing:

In lieu of paper test reports, forms and worksheets, SDDOT reports can be completed electronically in the SDDOT Materials, Sampling, and Testing system (MS&T). Electronic tests, forms and reports which are created and available in the MS&T system are acceptable as filed electronically and do not need to be placed in the project file. Electronic copies stored on the MS&T system are acceptable as signed documents.

South Dakota Department of Transportation

Minimum Sample and Test Requirements (MSTR)

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Minimum Sample and Test Requirements (MSTR)

1. **Asphalt Construction:**

General Notes:

The Area Engineer must furnish representative samples of component mineral aggregate materials to the Bituminous Engineer to establish the design mix. The samples submitted will be tested for quality in the Central Laboratory. Mix production will not be permitted until the mix design has been obtained from the Bituminous Engineer. For mix designs, submit representative virgin mineral aggregate samples and recycled asphalt pavement (RAP) samples proportionate to the bin splits proposed for use during construction. The total aggregate submitted for mix designs will be from 400 to 500 pounds.

When quality tests are required by specifications, one sample per 50,000 ton of virgin mineral aggregate will be submitted to the Central Laboratory. The first required quality test will be performed on material submitted for mix design and additional quality tests will be performed on composite samples submitted to the Central Laboratory. Aggregate production for asphalt concrete, base course, and similar materials from the same source used on one or more projects simultaneously requires only the single minimum test frequency for quality; however, results must be reported separately for each material for each project file. For quarried ledge rock aggregate that has a satisfactory quality record and has been used in asphalt for five years or more, the quality test requirements may be reduced to once per year. Sample size: 120 lbs., 4 bags; plus, an additional 60 lbs., 2 bags, when soundness is required. (DOT-1)

Small Quantities:

Samples or tests on bituminous mixtures will not be specifically required for project quantities that do not exceed approximately 100 ton per day or approximately 500 ton per project, provided there are appropriate certificates and tests to ensure that the sources of supply have recently furnished satisfactory similar material and construction. Acceptance may be based on documented Visual Inspection for equipment, method of placement, compaction, temperature, etc., or mixture may be tested at the direction of the project engineer.

Asphalt Concrete Composite:

Written certification from the producer stating that the asphalt concrete composite conforms to the specifications (DOT-97) and a Certificate of Compliance from the supplier for the asphalt binder used in the mixture, asphalt for prime, asphalt for tack, and asphalt for flush seal will be furnished in duplicate to the Engineer. The Contractor will provide a job-mix formula (DOT-97) with supporting mix design to the Bituminous Engineer prior to production. The Engineer may accept the mixture based on the Certificate of Compliance, Visual Inspection for equipment, method of placement, compaction, temperature, etc.

Calibration and Process Correction Tests:

Prior to production of asphalt concrete, a cold feed calibration sample of virgin aggregate will be obtained to assure that all associated equipment and procedures provide acceptable results. Calibration test results will meet the requirements of the mix design report (and tolerances, if necessary). The calibration testing will continue until the results meet the

requirements of the mix design report (and tolerances, if necessary). The calibration testing will be performed on each mix type produced prior to production of that mix type.

Calibration and process correction ("PC") samples taken and tested when production is stopped are to verify the proper calibration of the plant and to determine the effectiveness of changes in bin splits or other action taken to change the gradation and quality of the aggregate. Satisfactory test results are the basis for allowing production to resume; however, since production is shut down and these samples do not represent material actually produced for use, they will not be used as acceptance samples.

If production is not shut down after a failing test and the next sample is taken and tested to confirm the effectiveness of the process correction, this test is also an acceptance test, as it actually represents material produced and placed on the project. The sample will be numbered as the next consecutive acceptance sample.

IA testing is not required on Contractor furnished and Contractor furnished & placed material.

QC Test Frequency Reduction

The Contractor may request to reduce the QC testing frequency when the QC samples and the QA samples indicate acceptable results within the specifications located in Section 322 of the Standard Specifications for Roads and Bridges and the tolerances from R.S.T.C for sand equivalent, lightweight particles, crushed particles, and fine aggregate angularity and the Engineer and the Contractor are both confident that future production will meet specifications. The reduction in test frequency will be authorized in writing by the Area Engineer.

The Area Engineer will notify the Contractor in writing of the reduction in testing frequency and a copy of this letter will be forwarded to the Region Materials Engineer and Certification Program Administrator. A reduction in testing frequency may be revoked by the Area Engineer at any time.

The frequency of tests performed may be reduced using the following procedure. The QC technician will complete all tests on the first five consecutive tests lot of material produced. A reduction in the frequency of testing will be allowed based upon the average test results obtained from five consecutive tests of material tested by the QC technician. This reduction in test frequency for any of the tests shown in the QC Test Frequency Reduction Guidelines will remain in effect as long as the test results remain within the range of the testing frequency currently being used.

The frequency of the QC testing for sand equivalent, lightweight particles, and crushed particles may be further reduced beyond what is shown in the QC Test Frequency Reduction Guidelines by the Area Engineer. The Area Engineer may reduce the frequency beyond what is shown in the QC Test Frequency Reduction Guidelines based on an evaluation of test results from the material source.

QC TEST FREQUENCY REDUCTION GUIDELINES

Sand Equivalent

10 or more above minimum
7 to 9 above minimum
4 to 6 above minimum

Reduce test frequency to 1 test per lot
Reduce test frequency to 2 tests per lot
Reduce test frequency to 3 tests per lot

Within 3 of minimum

No reduction in test frequency

+ #4 and - #4 Lightweight Particles (less than 1.95 Specific Gravity)

Results of 0.0% lightweight particles

Reduce test frequency to 1 test per lot

1.5% or more below maximum

Reduce test frequency to 1 test per lot

1.1 to 1.4% below maximum

Reduce test frequency to 2 tests per lot

0.6 to 1.0% below maximum

Reduce test frequency to 3 tests per lot

Within 0.5% of maximum

No reduction in test frequency

Crushed Particles

Results of 100% crushed faces

Reduce test frequency to 1 test per lot

25% or more above minimum

Reduce test frequency to 1 test per lot

16 to 24% above minimum

Reduce test frequency to 2 tests per lot

6 to 15% above minimum

Reduce test frequency to 3 tests per lot

Within 5% of minimum

No reduction in test frequency

Fine Aggregate Angularity

2.5% or more above minimum

Reduce test frequency to 1 test per lot

2.0 to 2.4% above minimum

Reduce test frequency to 2 tests per lot

1.5 to 1.9% above minimum

Reduce test frequency to 3 tests per lot

Within 1.4% of minimum

No reduction in test frequency

1.1 Asphalt Concrete, Hot Mix (Includes Base and Surfacing Courses).

A. Aggregate, Composite.

(1) Tier 3.

(2) Certification.
See "General Notes".

(3) Acceptance.
Class D, E, G, HR, S one sample per plant, per 1,000 ton of mix (1,000 ton of virgin aggregate for Class HR), tested for composite gradation, sand equivalent and fine aggregate angularity. Class S will not be tested for sand equivalent and fine aggregate angularity. (DOT-69)
Crushed and lightweight particle tests will be made:

- (a) On the first 5 samples and then for each 5,000 ton of mix thereafter.
- (b) Following a failing test or change in the mix proportions

If equipment and or operations indicate taking and testing separate bin samples is required or desired, test will be mathematically combined to produce the composite gradation.

Material used for samples will be from the bins used for gradation determinations. (DOT-68)

Lightweight particles, crushed particles, sand equivalent and fine aggregate angularity testing will not be required when 100% of the material used for the test (excluding mineral filler and additives) is ledge rock material (DOT-69).

Class Q one sample per plant, per 1,000 ton for QC of mix 5,000 ton for QA, tested for composite gradation, crushed particles, light weight particles, sand equivalent and fine aggregate angularity. (DOT-69).

(4) Independent Assurance.

Class D, E, G, HR, S one sample per plant, per 10,000 ton of mix. None required for contract quantities less than 500 ton.

Lightweight particles, crushed particles, sand equivalent and fine aggregate angularity testing will not be required when 100% of the material used for the test (excluding mineral filler and additives) is ledge rock material (DOT-69).

Class Q one sample per plant, per 15,000 ton of mix. None required for contract quantities less than 500 ton.

Blade Laid one sample per plant, per 1,000 ton for QC of mix 5,000 ton for QA, tested for composite gradation.

B. Asphalt Binder.

(1) Tier 2.

(2) Certification.

A Certificate of Compliance is required for each conveyance or load of asphalt delivered to a project. The original and one copy should be received with each load delivered to the project.

NOTE: The Department is a member of a Combined State Binder Group. The group includes surrounding state Department of Transportation and a variety of suppliers of asphalt binder materials who have become certified through the process outlined by the group's publication. The certification and testing requirements will be the same for materials received from these suppliers as with other suppliers.

(3) Acceptance.

One randomly selected sample per 250 ton, per type, grade, and source. Sample size: two 1 qt. samples. A certificate of compliance for each conveyance or load the sample represents must be submitted with each sample. (DOT-1)

The sample will be obtained from an in-line-sampling valve located between the storage unit and the mix plant. (SD 301)

Detailed analysis will be made on the 1st sample of each type or grade, from each source, then on a random basis for each 250 ton per type, grade, and source.

Identification tests may be made on all samples for which the detailed analysis is not made.

- (4) Independent Assurance.
One per project by observation of acceptance sample. (DOT-1)
None required for contract quantities less than 100 ton.

C. Asphalt Binder Content.

- (1) Tier not applicable.
- (2) Certification.
None required.
- (3) Acceptance.
Calculated daily using measured quantity of asphalt and tonnage of mix produced for each mix design. (DOT-89)

The asphalt binder content will be carried over and calculated with the next day of production if less than 500 ton of material is produced for the day. In case that there is no next day of production, an asphalt binder content will be measured and reported for the smaller than 500 ton day.

If asphalt concrete is being produced by a commercial source that is supplying two or more different types of mixes with different binder contents throughout the day, the binder content may be determined by using one of the following methods:

- a) Stick the tank before each change of making different types of mixes as shown above for determining the quantity of binder used and the daily binder content.
- b) Determine the binder content by using the ignition oven test method (AASHTO T 308) with at least one test per day for determining the quantity of binder used and the daily binder content.
- c) The quantity of asphalt binder may be determined using a certified or calibrated pump/flow meter. The pump/flow meter will be certified or calibrated annually.
 - i Certification must be done by a state scale inspector, a licensed private testing company or a qualified representative of the pump/flow meter manufacturer and a letter of certification be retained in the plant control shack.
 - ii Calibration will be performed by the Contractor and will be witnessed by the DOT. The Contractor will provide all equipment for initial and subsequent calibration checks; furnish the DOT with a copy of all calibration checks; use a calibration vessel with a volume of at least 1,000 gallons; ensure the weigh scales have been tested and certified and provide copies to the DOT; and furnish the DOT a copy of the test report showing the asphalt cement specific gravity. Spot check failure will require the Contractor to

perform a new calibration. The DOT may request additional calibrations throughout the construction season. Use the printout sheet from the plant which has the pump/flow meter readings showing the amount of binder added into the mix furnished to the project to determine the quantity of binder used and the daily binder content.

- (4) Independent Assurance.
None required.

D. RAP Content

- (1) Tier not applicable.
- (2) Certification.
None required.
- (3) Acceptance.
One per day. (DOT-93).
- (4) Independent Assurance.
None required.

E. RAP in Asphalt Concrete

- (1) Tier not applicable.
- (2) Certification.
None required.
- (3) Acceptance.
One sample per day, tested for sieve analysis and moisture.
(DOT-35) (DOT-3) (SD 305)
- (4) Independent Assurance.
None required.

F. Lime Content

- (1) Tier not applicable.
- (2) Certification.
None required.
- (3) Acceptance.
Calculated daily using weighed quantity of lime and tonnage of mix produced. (DOT-33Q)

Lime supplied by non-certified lime plants will require 1 acceptance sample per 750 tons.
- (4) Independent Assurance.
None required.

G. Density, In Place.

(1) Tier not applicable.

(2) Certification.
None required.

(3) Acceptance.
Class D, E, G, HR one per lot of mix or one day's production, whichever is less. A lot will consist of 1,000 ton. A new lot will begin at the start of work each day and each time the mix design or source of material is changed. The last lot of the day may represent up to 1,500 ton. (DOT-42)

If required by specifications, two randomly located cores per 1,000 ton lot will be taken for determination of in place density. The average of the two cores density results will be the value used for density. (DOT-42Q, DOT-86)

Class Q: One per 1,000 ton subplot will be taken for determination of in place density. The average of the two core density results will be the 1,000 ton subplot value used for density in the pay factor calculations. (DOT-42Q)

Class S: Three randomly located cores taken within the first 1,000 tons of hot mix placed. Send to the Central Lab for informational testing.

(4) Independent Assurance.
Class D, E, G, HR, one per 10,000 ton. None required for contract quantities less than 500 ton.
Class Q: One taken during the first 5,000 tons of hot mix tested and then at a minimum frequency of one core per 15,000 tons thereafter.

H. Theoretical Maximum Specific Gravity (Rice)

(1) Tier not applicable.

(2) Certification.
None required.

(3) Acceptance.
Class D, E, G, HR one per 1,000 ton. (DOT-42)

Class Q one per 1,000 ton for QC, one per 5,000 ton for QA. Sample to be obtained from the windrow in front of the laydown machine. (DOT-86) None required for Bladed Laid.

(4) Independent Assurance.
Class D, E, G, HR one per 10,000 ton. None required for contract quantities less than 500 ton.

To verify that the end product is representative of what was actually designed, area personnel will provide the Region Materials Laboratory with a sample (50 to 60 lbs.) of un-compacted mix from the first

regularly scheduled theoretical maximum specific gravity (Rice) test. The Region Materials Laboratory will perform theoretical maximum specific gravity (Rice) test for comparative purposes with the acceptance test and will perform tests to determine the bulk specific gravity (Gyratory) and the percent air voids. Report results to the Bituminous Engineer.

Class Q one per 15,000 ton. None required for contract quantities less than 500 ton or Blade Laid.

I. Bulk Specific Gravity.

(1) Tier not applicable.

(2) Certification.
None required.

(3) Acceptance.
Class D, E, G, HR None required.

Class Q one per 1,000 ton for QC, 5,000 ton for QA. Sample to be obtained from the windrow in front of the laydown machine. (DOT-86)
None required for Blade Laid.

(4) Independent Assurance.
Class D, E, G, HR one per 10,000 ton. None required for contract quantities less than 500 ton. (DOT-42)

Class Q One per 15,000 ton. None required for Blade Laid.

J. Mixture Densification, Voids in Mineral Aggregate and Dust to Binder Ratio.
(Class Q)

(1) Tier not applicable.

(2) Certification.
None required.

(3) Acceptance.
One per 1,000 ton for QC, 5,000 ton for QA. Sample to be obtained from the windrow in front of the laydown machine (DOT-86) None required for Blade Laid.

(4) Independent Assurance.
One per 15,000 ton.

K. Moisture Content of Mix (Class Q and HR)

(1) Tier not applicable.

(2) Certification.
None required.

- (3) Acceptance.
One per 10,000 ton. Sample to be obtained from the windrow in front of the laydown machine. (DOT-35) None required for Blade Laid.
- (4) Independent Assurance.
None required.

L Drain Down (Class S)

- (1) Tier not applicable
- (2) Certification
None required.
- (3) Acceptance
One per day (DOT-91)
- (4) Independent Assurance
None required.

M Stabilizing Additive (Class S)

- (1) Tier not applicable
- (2) Certification
None required.
- (3) Acceptance
One per day (DOT-94)
- (4) Independent Assurance
None required.

1.2 Cold In Place Recycling.

A. Aggregate.

- (1) Tier 3.
- (2) Certification.
None required.
- (3) Acceptance.
One sample per day. (DOT-3)
- (4) Independent Assurance.
None required.

B. Density, Standard.

- (1) Tier not applicable.
- (2) Certification.
None required.

- (3) Acceptance.
A minimum of one test strip will be completed to determine the target density. When there is significant change in mix proportions, weather conditions or other controlling factors, the Engineer may require completion of additional test strip(s) to check target density. (DOT-28)
- (4) Independent Assurance.
None required.

C. Density, In Place.

- (1) Tier not applicable.
- (2) Certification.
None required.
- (3) Acceptance.
One per mile, per lane surfaced. (DOT-41)
- (4) Independent Assurance.
None required.

D. Moisture Content (Prior to Compaction).

- (1) Tier not applicable.
- (2) Certification.
None required.
- (3) Acceptance
One per 1/2 mile, per lane processed. (DOT-35)

After the Contractor has informed the Engineer that the moisture specification has been met, the Engineer will perform the acceptance moisture tests. These moisture tests will be performed within the same areas as the density in place.

- (4) Independent Assurance.
None required.

E. Moisture Content (After Compaction).

- (1) Tier not applicable.
- (2) Certification.
None required.
- (3) Acceptance.
One per mile, per lane surfaced. (DOT-35)

After the Contractor has informed the Engineer that the moisture specification has been met, the Engineer will perform the acceptance moisture tests. These moisture tests will be performed within the same areas as the density in place.

- (4) Independent Assurance.
None required.

1.3 Asphalt Surface Treatment.

A. Cover Aggregate, Types 1 and 2.

- (1) Tier 3.
- (2) Certification.
None required.
- (3) Acceptance.
One sample per 500 ton, tested for gradation. One sample per 2,000 ton tested for P.I., and if required by specification flakiness index and crushed particles. (DOT-3 & DOT-61)

Crushed particles testing will not be required when 100% of the material is ledge rock material.
- (4) Independent Assurance.
One sample per project. None required on quantities less than 1,500 tons.

B. Cover Aggregate, Type 3.

- (1) Tier 3.
- (2) Certification.
None required.
- (3) Acceptance.
One sample per 1,500 ton, tested for gradation, P.I., crushed particles and flakiness index. (DOT-3 & DOT-61)
- (4) Independent Assurance.
One sample per project. None required on quantities less than 1,500 tons.

C. Mineral Aggregate for Microsurfacing

- (1) Tier 3.
- (2) Certification.
None required.
- (3) Acceptance.
One sample per 500 ton, tested for gradation. One sample per 2,000 ton tested for P.I., + #4 lightweights - #4 lightweights and if required by specification crushed particles. (DOT-3)
- (4) Independent Assurance.
One sample per project. None required on quantities less than 1,500 tons.

1.4 Asphalt Liquid.

A. Material.

(1) Tier 2.

(2) Certification.

A Certificate of Compliance is required for each conveyance or load of asphalt delivered to the project. The original and one copy should be received with each load delivered to the project.

(3) Acceptance.

One randomly selected sample per 200 ton, per type, grade, and source. Water added to dilute emulsified asphalt is not included in the 200 ton sampling frequency. Diluted emulsified asphalt will be sampled and tested. If water is added to dilute emulsified asphalt, note the dilution rate on the DOT-1. Sample sizes: Emulsions, two 1/2 gal. samples; all other asphalts, two 1 qt. samples. A Certificate of Compliance for each conveyance or load the sample represents must be submitted with each sample. (DOT-1)

Asphalt delivered in a transport and pup ("Trailer") will be considered as one conveyance if it is from the same source and of the same grade.

Detailed analysis will be made on the first sample of each type or grade, from each source. Then on a random basis for each 200 ton per type, grade, and source. Identification or detailed tests may be made on samples for which the detailed analysis is not required.

(4) Independent Assurance.

None required.

1.5 Crack Sealing of Asphalt Concrete.

A. Sealant.

(1) Tier 2.

(2) Certification.

Item used must be on the Approved Products List.

(3) Acceptance.

One 5 lb. sample representing each lot or batch will be taken from the application wand during the sealing process. The sample will be placed in a Teflon or silicone lined box having a minimum capacity of 5 lbs. None required for contract quantities of 200 lbs. or less. (DOT-1)

Visual Inspection will consist of measuring the width and depth of the routed vessel to ensure proper dimensions are obtained according to the plans.

(4) Independent Assurance.

None required.

- B. Backer Rod.
- (1) Tier 2.
 - (2) Certification.
APL: None required.
Non-APL: A Certificate of Compliance is required.
 - (3) Acceptance.
One 2 ft. length submitted with the sealant. (DOT-1)

None required if less than 200 lbs. of sealant is used.
 - (4) Independent Assurance.
None required.

1.6 Milling (Surface Texture)

- A. Cold Milling.
- (1) Tier not applicable.
 - (2) Certification.
None required.
 - (3) Acceptance.
One per day for mainline. A lot will consist of one day's production.
(DOT-55A)

None required for project quantities less than 2,000 square yards.
Acceptance will be based on documented Visual Inspection.
 - (4) Independent Assurance.
None required
- B. Micro-Milling.
- (1) Tier not applicable.
 - (2) Certification.
None required.
 - (3) Acceptance.
One per day. A lot will consist of one day's production. (DOT-55A)

None required for project quantities less than 2,000 square yards.
Acceptance will be based on documented Visual Inspection.
 - (4) Independent Assurance.
None required.

2. Subbase, Base Course, and Gravel Cushion Construction:

General Notes:

When quality tests are required by specifications, one sample per 50,000 ton per source will be submitted to the Central Laboratory for testing. Aggregate production for asphalt concrete, base course, subbase, gravel cushion, etc., from the same source used on one or more projects simultaneously requires only the single minimum test frequency for quality; however, results must be reported separately for each material for each project file. Sample size: 120 lbs., 4 bags.

Samples and tests on aggregates will not be required for quantities less than 500 ton, provided there are prevailing test results to indicate the source has furnished satisfactory similar material. The quantity and source of the material will be provided to the Region Materials Engineer and the Chief Materials and Surfacing Engineer for review and approval. If approval is granted, acceptance will be based on documented Visual Inspection for equipment, method of placement, etc. Method of compaction must be approved by the Region Materials Engineer and Chief Material & Surfacing Engineer.

Prior to the first in place density test, the Area Engineer will submit a 60 lb., 2 bag sample to the Region Materials Laboratory where a 4-point determination will be made for each source, combination or type of material produced, including the specified additive or treatment where required. When changes in gradation which may affect density results occur, contact the Region Materials Engineer to determine if an additional 4-point will be required.

When the material to be used on a project is from an established quarry on which a 4-point determination was previously made, it will be permissible to use that 4-point provided the 1-points fall within the range established by it. If the 1-points do not fall within the established range, contact the Region Materials Engineer to determine if an additional 4-point will be required.

2.1 Subbase and Base Course,

A. Aggregate, Composite.

(1) Tier 3.

(2) Certification.
None required.

(3) Acceptance.
One sample of composite mixture per 3,000 ton, tested for gradation, L.L., and P.I. Report the percentage and source of each component material used. (DOT-3)

If required by specifications, a crushed particles test will be performed each 6,000 ton. Crushed particle testing will not be required when material consists of 100% ledge rock material, 100% recycled Portland cement concrete pavement or 100% recycled asphalt pavement.

- (4) Independent Assurance.
One sample of composite mixture per 15,000 ton. None required for contract quantities less than 1,000 ton.

If required by specifications, a crushed particles test will be performed each 6,000 ton. Crushed particle testing will not be required when material consists of 100% ledge rock material, 100% recycled Portland cement concrete pavement or 100% recycled asphalt pavement.

B. Density, In Place

- (1) Tier not applicable.
- (2) Certification.
None required.
- (3) Acceptance.
One per mile, per lift, per roadbed surface or site just prior to application of prime or subsequent course. Compacted lifts may be combined, not to exceed 6 in. total thickness, for testing purposes. (DOT-41)
- (4) Independent Assurance.
One per 4 miles of roadbed surface. None required for contract quantities less than 1,000 ton.

C. Density, Standard

- (1) Tier not applicable.
- (2) Certification.
None required.
- (3) Acceptance.
One 1-point determination using material from or adjacent to the hole for each in place test. When the 1-point determination deviates more than 2 percentage points below or 1 percentage point above optimum moisture, another 1-point (nearer to optimum moisture) will be made. If the maximum density deviates outside the 4-point range, the Region Materials Engineer will be contacted. (DOT-41)
- (4) Independent Assurance.
One per 4 miles of roadbed surface. None required for contract quantities less than 1,000 ton.

2.2 Gravel Cushion,

A. Aggregate, Composite.

- (1) Tier 3.
- (2) Certification.
None required.

- (3) Acceptance.
One sample of composite mixture per 3,000 ton, tested for gradation, L.L., and P.I. Report the percentage and source of each component material used. (DOT-3)

If required by specifications, a crushed particles test will be performed each 6,000 ton. Crushed particles test is not required when material consists of 100% recycled portland cement concrete pavement or 100% recycled asphalt pavement.

- (4) Independent Assurance.
One sample of composite aggregate per 15,000 ton.
None required for contract quantities less than 1,000 ton.

3. Miscellaneous Granular Materials:

General Notes:

When quality tests are required by specifications, one sample per 50,000 ton per source will be submitted to the Central Laboratory for testing. Aggregate production for asphalt concrete, base course, subbase, gravel cushion, etc. from the same source used on one or more projects simultaneously requires only the single minimum test frequency for quality; however, results must be reported separately for each material for each project file. Sample size: 120 lbs., 4 bags. (DOT-1)

3.1 Gravel and Sand for Maintenance Stockpiles.

- A. Aggregate.
 - (1) Tier 3.
 - (2) Certification.
None required.
 - (3) Acceptance.
One sample per 3,000 ton. (DOT-3)
 - (4) Independent Assurance.
None required.

3.2 Gravel Surfacing.

- A. Aggregate.
 - (1) Tier 3.
 - (2) Certification.
None required.
 - (3) Acceptance.
One sample of composite mixture per 3,000 ton. (DOT-3)

None required for contract quantities less than 100 ton.
 - (4) Independent Assurance.
One sample of composite mixture per source. None required for contract quantities less than 1,000 ton.

3.3 Blotting Sand for Prime Coat and Sand for Flush Seal.

- A. Aggregate.
 - (1) Tier 3.
 - (2) Certification.
None required.
 - (3) Acceptance.
One sample per project. (DOT-3)

- (4) Independent Assurance.
None required.

3.4 Granular Bridge End Backfill.

- A. Aggregate.
 - (1) Tier 3.
 - (2) Certification.
None required.
 - (3) Acceptance.
One sample per 1,000 ton. (DOT-3)
 - (4) Independent Assurance.
None required.
- B. Density, In Place.
 - (1) Tier not applicable.
 - (2) Certification.
None required.
 - (3) Acceptance.
None required.
 - (4) Independent Assurance
None required.

3.5 Gabion Fill (Rock or Stone).

- A. Aggregate.
 - (1) Tier 3.
 - (2) Certification.
None required.
 - (3) Acceptance.
Documented Visual Inspection for size and source.
 - (4) Independent Assurance.
None required.

3.6 Porous Backfill.

- A. Aggregate.
 - (1) Tier 3.
 - (2) Certification.
None required.

- (3) Acceptance.
One sample per 250 ton. (DOT-3)

The Project Engineer may reduce the testing frequency to 1 per 2,000 ton after the first three passing tests provided the source remains the same and provided there is no apparent change in the properties of the material. If observations by the Project Engineer cause concern that specifications compliance is questionable, the testing frequency may return to the 1 per 250 ton.

- (4) Independent Assurance.
None required.

3.7 Riprap.

A. Aggregate.

- (1) Tier 3.

- (2) Certification.
None required.

- (3) Acceptance.
Documented Visual Inspection for size and source.

If requested by the Engineer, the Contractor will provide a sample of riprap weighing at least 5 ton meeting the gradation for the class specified.

The weight per cubic foot will be determined on this sample. The sample may be a part of the finished riprap covering. This sample will be used as a frequent reference for judging the gradation of the riprap supplied.

Any difference of opinion between the Engineer and the contractor will be resolved by dumping and checking the gradation of two random truckloads of riprap. The mechanical equipment, a sorting site, and labor to assist in checking gradation will be provided by the contractor at no additional cost to the State.

- (4) Independent Assurance.
None required.

3.8 Pit Run.

A. Aggregate.

- (1) Tier 3.

- (2) Certification.
None required.

(3) Acceptance.
Documented Visual Inspection for size and source, and as determined by the Engineer a sieve analysis may be performed to verify the plans specified gradation. (DOT-3)

(4) Independent Assurance.
None required.

B. Density, In Place.

(1) Tier not applicable.

(2) Certification.
None required.

(3) Acceptance.
One in place density per ½ mile, per site, per zone. The zones are defined in item 3 under the “Reduction of 1-point Determinations” in the “General Notes” for subgrade construction (Embankments). (DOT-41)

(4) Independent Assurance.
None required.

C. Density, Standard.

(1) Tier not applicable.

(2) Certification.
None required.

(3) Acceptance.
One 1-point determination using material from or adjacent to the hole for each in place test. (DOT-41)

(4) Independent Assurance.
None required.

3.9 Slope Protection Aggregate.

A. Aggregate.

(1) Tier 3.

(2) Certification.
None required.

(3) Acceptance.
One sample per source, per project. (DOT-3)

(4) Independent Assurance.
None required.

3.10 Salvaged and Full Depth Reclamation Materials.

A. Aggregate.

- (1) Tier 3.
- (2) Certification.
None required.
- (3) Acceptance.
One sample per day. (DOT-3)

None required on surface preparation.
- (4) Independent Assurance.
None required.

B. Density, In Place (when required by specification).

- (1) Tier not applicable.
- (2) Certification.
None required.
- (3) Acceptance.
One per mile, per lift, per roadbed surface. (DOT-41)

None required if less than 500'.
- (4) Independent Assurance.
None required.

C. Density, Standard (when required by specification).

- (1) Tier not applicable.
- (2) Certification.
None required.
- (3) Acceptance.
A minimum of one test strip per lift will be completed to determine the target density. When there is significant change in mix proportions, weather conditions or other controlling factors, the Engineer may require completion of additional test strip(s) to check target density. (DOT-28)

None required if less than 500'.
- (4) Independent Assurance.
None required.

3.11 Pipe and Box Culvert Undercut Backfill (Granular)

- A. Aggregate.
- (1) Tier 3.
 - (2) Certification.
None required.
 - (3) Acceptance.
One sample per source, per project. (DOT-3)
 - (4) Independent Assurance.
None required.
- B. Density, In Place.
- (1) Tier not applicable.
 - (2) Certification.
None required.
 - (3) Acceptance.
One per each 1 foot zone per installation. (DOT-41)
- The density in the top 1 foot zone will be taken in the top lift of the undercut backfill immediately prior to installation of the pipe or box culvert.
- Where insulating board is used, the density will be taken in the lift below it.
- (4) Independent Assurance.
None required.
- C. Density, Standard.
- (1) Tier not applicable.
 - (2) Certification.
None required.
 - (3) Acceptance.
One 1-point determination using material from or adjacent to the hole for the in place test. 1-point may be referred when undercut depth exceeds 1 foot and multiple in place densities are required for the installation.
 - (4) Independent Assurance.
None required.

3.12 Cold Milled Asphalt Concrete and Placing Cold Milled Material.

- A. Milled Material.
- (1) Tier 3.

- (2) Certification.
None required.
- (3) Acceptance.
One sample per mile. (DOT-3)
- (4) Independent Assurance.
None required.

3.13 MSE Backfill.

- A. Aggregate.
 - (1) Tier 3.
 - (2) Certification.
None required.
 - (3) Acceptance.
One sample per 5,000 yd³ / 7,000 ton. (DOT-3)
 - (4) Independent Assurance.
One sample per project.

3.14 Granular Material for Box Culvert and Pipe Bedding.

- A. Aggregate.
 - (1) Tier 3.
 - (2) Certification.
None required.
 - (3) Acceptance.
One sample per 10,000 ton. (DOT-3)
 - (4) Independent Assurance.
One sample per 50,000 ton.
None required on quantities of 3,000 ton or less.

3.15 Miscellaneous Granular Materials

- A. Aggregate.
 - (1) Tier 3.
 - (2) Certification.
None required.
 - (3) Acceptance.
One sample per project. (DOT-3)
 - (4) Independent Assurance.
None required.

B. Rock, Clay, Sand Filler and Miscellaneous Granular Materials.

- (1) Tier 3.
- (2) Certification.
None required.
- (3) Acceptance.
One sample prior to blending with aggregate per 750 ton.
- (4) Independent Assurance.
None required.

C. Density, In Place.

- (1) Tier not applicable.
- (2) Certification.
None required.
- (3) Acceptance.
One per project, or other specified frequency, if density requirements are required by plans.
- (4) Independent Assurance.
None required.

D. Density, Standard.

- (1) Tier not applicable.
- (2) Certification.
None required.
- (3) Acceptance.
One 1-point determination using material adjacent to the hole for each project. (DOT-41) 1-point may be referenced to similar material on the project.
- (4) Independent Assurance.
None required.

4. Subgrade Construction (Embankments):

General Notes:

Embankment, berms and pipe backfill will each require a separate set of numbers for density and moisture tests.

The Central Laboratory will make preliminary tests for soils representing the major excavation areas and soil types. The results will be recorded for reference on the soils profile.

During construction, at least one acceptance test for gradation, L.L., and P.I. will be made to verify A-3 or A-2-4(0) soil classifications per source, per project, per day. (DOT-3) An independent assurance test will be made per 200,000 yd³ on this material. This requirement is waived for the ordinary compaction method.

When material meeting specifications for fine aggregate as per Section 800.2.E. is hauled to the project from a commercial source to be used as pipe backfill, one acceptance sieve analysis will be required per source, per project, per 500 yd³. (DOT-3)

Visual observations will be made to detect possible changes in soil characteristics. When there is doubt about soil classification, contact the Region Materials Engineer.

Moisture and Density Testing:

Compaction testing of soils consists of determining the in-place density of the material and calculating the percent compaction based on a maximum dry density. The maximum dry density will be determined using the one-point proctor method (SD 104).

Soils not compatible with the "Ohio Family of Curves" or the "Lightweight Family of Curves" will require a 4-point (SD 104) to determine target optimum moisture and maximum dry density. In this case, a 1-point determination will not be used until a 4-point is performed to establish optimum moisture and maximum dry density. Contact the Region Materials Engineer when soil is not compatible with either family of curves. If a soil meets both family of curves, the Ohio Family of Curves will take precedence.

When the soil encountered contains + 3/4" materials, the 1-point or 4-point determinations will be made to determine optimum moisture on the - 3/4" material as per SD 104.

A target moisture and density will be determined prior to or at the same time the initial testing begins within each 1/2 mile segment.

When a density test is performed at the time the embankment is being placed and compacted, the moisture determination is acceptable as a moisture control test. (DOT- 35).

Reduction of 1-Point Determinations:

The requirements for 1-point determinations outlined in paragraph 4.1 G. (3) and 4.3 B. (3) may be reduced, if the following conditions are met:

1. One-point determinations will be made on the first three tests (moisture tests or density tests) performed within each 1/2 mile segment.

2. Maximum dry densities of these three 1-point determinations must be within a spread of 6 lbs/ft³.
3. When the above is satisfied, the minimum number of 1-point determinations (moisture tests or density tests) required per 1/2 mile segment, for each roadbed, will be as follows:

Zone:	Depth:	Minimum required:
1	0 to 1 ft.	2*
2	1 ft. to 3 ft.	1
3	3 ft. to 5 ft.	1
4	5 ft. to bottom	1 per 5 ft.

*In accordance with Section 120, the second density will be performed within the upper 6 inches while the grade is prepared for surfacing.

Additional 1-point determinations will be made as required by changes in soil types within the 1/2 mile segment.

A density or moisture test may refer to a 1-point determination within 2,000 ft. of the test location, including backfill for pipe or box culverts.

When a 1-point determination is not made for a test and the test results in a failing moisture, failing density, or unusually high moisture or density, a 1-point determination will be made using material from the test location to ensure that the proper curve data is being used to determine the target moisture or density. This 1-point determination may be used for subsequent re-testing at the same location.

4.1 Specified Density (In Place).

- A. Embankment (Includes Subgrade Topping, Ordinary and Heavy Roadway Shaping).
 - (1) Tier not applicable.
 - (2) Certification.
None required.
 - (3) Acceptance.
One per 1/2 mile, per roadbed, per zone. The zones are defined in item 3 under "Reduction of 1-Point Determinations" in the "General Notes" for this section. (DOT-41)
 - (4) Independent Assurance.
One per 200,000 yd³ of excavation.
None required for contract quantities less than 10,000 yd³.
- B. Berms.
 - (1) Tier not applicable.

- (2) Certification.
None required.
- (3) Acceptance.
One per berm, per structure, per zone. (DOT-41)

Zone:	Depth:	Minimum required:
1	0 to 1 ft.	2*
2	1 ft. to 3 ft.	1
3	3 ft. to 5 ft.	1
4	5 ft. to bottom	1 per 3 ft.

*In accordance with Section 120, the second density will be performed within the upper 6 inches while the grade is prepared for surfacing.

- (4) Independent Assurance.
A minimum of one per project.

C. Bridge End Embankment

- (1) Tier not applicable.
- (2) Certification.
None required.
- (3) Acceptance.
Prior to placing the bridge end embankment, one density test will be required for the scarified and recompacted approach berm. In addition, three density tests will be required for each abutment backwall less than 7 ft. tall. Four density tests will be required for backwalls 7 ft. tall or over. Zones for density test will be equally spaced. (DOT-41)
- (4) Independent Assurance.
A minimum of one per project.

D. Cross Pipe Pre-Installation Density (Does not include utility, storm sewer, gas, or water main).

- (1) Tier not applicable.
- (2) Certification.
None required.
- (3) Acceptance.
One below rural mainline cross pipe per installation prior to installing pipe. None required if pipe is undercut. (DOT-41)
- (4) Independent Assurance.
None required.

E. Pipe Undercut Backfill (Soil).

- (1) Tier not applicable.

- (2) Certification.
None required.
- (3) Acceptance.
One per each 1 foot zone per installation (DOT-41)

The density in the top 1 foot zone will be taken in the top lift of the undercut backfill immediately prior to installation of the pipe or box culvert. 1-point may be referred when undercut depth exceeds 1 foot and multiple in place densities are required for the installation.

- (4) Independent Assurance.
None required.

F. Pipe and Box Culvert Backfill

- (1) Tier not applicable.
- (2) Certification.
None required.
- (3) Acceptance.
 - (a) Cross pipe, storm sewer pipe, sanitary sewer pipe, water main pipe, and box culvert. (DOT-41)
 - 1. Minimum Requirements per Installation.
 - a. On round pipe 24 in. or less in diameter or arch pipe 30 in., or less, one test approximately halfway up and one test in the 2 ft. of backfill above the pipe.
 - b. On round pipe that is 30 in. up to 72 in. in diameter, arch pipe that is 36 in. up to 84 in., or box culverts up to 6 ft. in height, one test in the lower one-half, one test in the upper one-half and one test in the 2 ft. of backfill above the pipe or box culvert.
 - c. On round pipe greater than 72 in. in diameter, arch pipe 96 in. or greater, or box culverts greater than 6 ft. in height, one test in the bottom one-third, one test in the middle one-third, one test in the top one-third and one test in the 2 ft. of backfill above the pipe or box culvert. Testing locations within the zones will alternate from side to side of the pipe or box culvert. If a different source of backfill material or compaction procedure is used on either side, each zone will be tested on both sides.
 - 2. After the minimum requirements have been met, one test per installation, per 3 ft. of backfill beginning 2 ft. above the top of the pipe or box culvert will be taken up

to the elevation where normal grading operations commence over the pipe or box culvert.

- (b) Approach Pipe.
The same as "(a) cross pipe, storm sewer pipe, sanitary sewer pipe, water main pipe, and box culvert", except none required for farm and field approaches.
- (4) Independent Assurance.
 - (a) Longitudinal Pipe (Storm Sewer, Sanitary Sewer or Water Main).
One per 2,000 lineal feet. None required if total installation is less than 200 lineal feet.
 - (b) Cross pipe and box culvert.
One per 10 installations. None required if project has a single installation that totals less than 200 lineal feet.
 - (c) Approach pipe.
None required.

The definition of "Per installation" as shown for density tests will be:

Each pipe or box culvert placed its entire length at one time.

Two or more pipes at one site when backfill is placed uniformly around all pipes and compactive effort is uniform around each pipe.

Each segment laid at different times such as in one-half length installations.

Each 300 lineal foot segment of cross, storm sewer, sanitary sewer, and water main pipe or portion thereof.

G. Density, Standard (Target).

- (1) Tier not applicable.
- (2) Certification.
None required.
- (3) Acceptance.
One 1-point determination using material from or adjacent to the hole for each in place test. (DOT-41)
- (4) Independent Assurance.
One 1-point determination per in place density.

4.2 Ordinary Compaction Method.

A. Density.

- (1) Tier not applicable.

- (2) Certification.
None required.
- (3) Acceptance.
Obtained as per ordinary compaction methods (DOT-41)
- (4) Independent Assurance.
None required.

B. Density, Standard (Target).

- (1) Tier not applicable.
- (2) Certification.
None required.
- (3) Acceptance.
One 1-point determination using material from or adjacent to the hole for each in place test. (DOT-41)
- (4) Independent Assurance.
None required.

4.3 Moisture Content.

A. Embankment (Includes Select Subgrade Material, and Berms, Excludes Ordinary Compaction).

- (1) Tier not applicable.
- (2) Certification.
None required.
- (3) Acceptance.
As required to fix control, then one every 2 hours at each construction area. (DOT-35)

A representative sample is to be taken from soil being processed and compacted.

If the moisture content for an in place density test is not within the specified moisture limits for the project, the density will be considered as failing and will be corrected.
- (4) Independent Assurance.
None required.

B. Box Culvert, and Pipe Backfill.

- (1) Tier not applicable.
- (2) Certification.
None required.

- (3) Acceptance.
One per 2 hours per pipe/box location.

If moisture test taken independent of density test, moisture will be documented on DOT-35.

- (4) Independent Assurance.
None required.

C. Moisture, Standard (Target).

- (1) Tier not applicable.
- (2) Certification.
None required.
- (3) Acceptance.
One 1-point determination. Material will be taken concurrently with the material taken for the in place moisture test. (DOT-35)
- (4) Independent Assurance.
None required.

5. Portland Cement Concrete Paving (PCCP) Construction:

General Notes:

For Special Provision for Contractor Furnished Mix Designs for PCCP:

All job mix designs for Portland cement concrete paving will be formulated by an approved testing firm. The concrete paving mix design will be verified by the Central Laboratory.

The samples of all materials to be used by both the testing firm and the Central Laboratory will be taken at the same time and split proportionately.

The Project Engineer will be notified prior to sampling and submitting mix design aggregate to the Central Lab.

For all other PCCP:

All job mix designs for Portland cement concrete paving will be either approved or formulated by the Concrete Engineer and may be tested in the Central Laboratory.

Samples of the aggregates will be submitted to the Central Testing Laboratory at least 40 days prior to anticipated use on the project for Quality and/or Design Mix testing/verification.

Material from proposed aggregate sources must be submitted when a new or modified mix is required or desired. The following quantities are required to be submitted for each mix design in bags no larger than 80 lbs. or buckets no larger than 5 gallons:

Fine aggregate.....	750 lbs.
Coarse aggregate	1100 lbs.*
Cement**	210 lbs.
Fly Ash***	65 lbs.
Air Entraining Agent.....	8 oz.
Water Reducing Agent(s)	32 oz.

*A minimum of 350 lbs. for each size.

** A complete Certified Chemical Analysis and Physical Test Report are required for cement other than GCC Dacotah Rapid City.

*** A complete Certified Chemical Analysis and Physical Test Report are required for fly ash.

Quality tests and other special tests on aggregates that require equipment not available at the Region Materials Laboratory and field labs will be made in the Central Laboratories on samples representing each 31,500 yd³.

For ledge rock aggregate that has a satisfactory quality record and has been used in concrete for five years or more, the quality test requirements may be reduced to once per year.

The sample sizes for all fine and coarse quality tests require 60 lbs. of each material. (DOT-1)

For contract quantities less than 50 yd³ of concrete, certification and acceptance will be as per Section 7.1.A., except one air content determination, one slump test, and one set of cylinders per source. (DOT-23).

5.1 Materials.

A. Aggregate, Fine and Coarse.

- (1) Tier 3.
- (2) Certification.
None required.
- (3) Acceptance.
One sample per 1,000 yd³ of concrete for each size and source. Fine and coarse aggregate be sampled and tested simultaneously. (DOT-3 / DOT-68)

When flat and elongated is specified, one sample tested per the first 15,000 yd³ then one per 30,000 yd³ thereafter.

Resampling because of a deviation from specifications of one of the aggregates requires resampling and retesting of only that material which failed.

When 100% of the material used in the coarse aggregate is ledge rock material, lightweight particle testing for the coarse aggregate is not required.

When test results for lightweight particles in fine aggregate for five consecutive tests indicate passing results with an average of 0.4% or less and no individual test over 0.6%, the test frequency may be reduced to 1 test for lightweight particles in fine aggregate per 5,000 yd³. Normal testing frequency will resume for the remainder of the project if there are any failing tests. In addition, the lightweight particles in fine aggregate test will also be completed for all samples selected for independent assurance (IA) testing.

- (4) Independent Assurance.
One sample per 15,000 yd³ of concrete paving for each size. None required for contract quantities less than 500 yd³. Lightweight particle test will not be required for coarse aggregate. One flat & elongated sample per project if required.

B. Aggregate, Fine and Coarse, Moisture Content.

- (1) Tier not applicable.
- (2) Certification.
None required.
- (3) Acceptance.
One sample per 2 hours of paving operations for each size. (DOT-35)

Moisture testing may be reduced by the Engineer when automated concrete batching equipment with fine aggregate, or fine and coarse aggregate, moisture sensing capability is used. When only fine aggregate moisture sensors are used, the concrete plant will use a coarse aggregate moisture (DOT-98A) acceptable to the Engineer. Any moisture sensor will be accurate to 1.0% of the aggregate total moisture.

When the moisture testing is reduced, a moisture test for each size of aggregate will be made at the start of production and every 10,000 yd³ or one per month, whichever happens first.

- (4) Independent Assurance.
None required.

C. Cement.

- (1) Tier 2.

- (2) Certification.
From a certified supplier: None required.

From a non-certified supplier: A Certificate of Compliance is required for each acceptance sample obtained.

- (3) Acceptance.
One sample per 10,000 yd³ of paving. Two 4 lb. samples. (DOT-1)
None required for contract quantities less than 500 yd³.
- (4) Independent Assurance.
None required.

D. Water.

- (1) Tier 3.

- (2) Certification.
None required.

- (3) Acceptance.
One 8 oz. sample in a plastic container per source prior to use. Frequency of testing thereafter to be determined by any changes (Runoff, growth of algae, etc.) affecting the source. (DOT-1)

Testing is not required for water from municipal supplies except in the north part of the Rapid City Region (Contact the Region Materials Engineer regarding this area).

- (4) Independent Assurance.
None required.

E. Chemical Admixtures (Includes Air Entraining, Water Reducing, Accelerators, Retarders, etc.).

- (1) Tier 2.

- (2) Certification.
APL: None required.
Non-APL: A Certificate of Compliance is required.
- (3) Acceptance.
One 8 oz. sample in a plastic container per type, lot, and source. (DOT-1)

Material must be thoroughly stirred, air agitated, or otherwise properly mixed to disperse all settlement just prior to sampling.
- (4) Independent Assurance.
None required.

F. Fly Ash.

- (1) Tier 2.
- (2) Certification.
A Certificate of Compliance is required and must be submitted with each acceptance sample obtained.
- (3) Acceptance.
One sample per 10,000 yd³ of paving. The sample will be a 4 lb. sample taken from a randomly selected conveyance. (DOT-1).
- (4) Independent Assurance.
None required.

5.2 Strength Tests.

A. Compressive Strength.

- (1) Tier not applicable.
- (2) Certification.
None required.
- (3) Acceptance.
One set of cylinders for the first 250 yd³ (for 1st days production); thereafter, one set of cylinders per 1500 yd³ of concrete produced from each plant per day. (DOT-23)

No more than 2 sets per day will be required.

A set of cylinders will consist of a minimum of 4 cylinders. Two cylinders will be used for compressive strength at 28 days (One cylinder is tested at 28 days and the other is saved for the backup). The other two cylinders will be used for early breaks (normally at 7 and 14 days). If additional early breaks are desired or required, additional cylinders must be made.

If early break cylinders are not available (already tested, etc.), it is preferred that 4 in. diameter cores be used to determine the strength

of hardened concrete for purposes of opening to traffic. If cores cannot be obtained the impact test hammer may be used to determine the approximate strength of hardened concrete.

- (4) Independent Assurance.
None required.

5.3 Fresh (Plastic) Concrete Tests.

A. Air Content, Unit Weight, Slump, and Temperature.

- (1) Tier not applicable.
- (2) Certification.
None required.
- (3) Acceptance.
Air content, unit weight, slump, and temperature determinations will be made each time a cylinder for compressive strength determination is made. Additional determinations will be made to ensure proper control, and not less than one determination will be made for each 2 hours of mixing-pouring operations. (DOT-23)
- (4) Independent Assurance.
One air content, unit weight, slump, and temperature determination per 15,000 yd³ of paving. None required for contract quantities less than 500 yd³ of concrete. The slump tests may be by observation of acceptance tests.

5.4 Measurements.

A. Longitudinal Surface.

- (1) Tier not applicable.
- (2) Certification.
None required.
- (3) Acceptance.
When profilograph/profiler testing is not required, test in accordance with SD 417. (DOT-29)

On projects where profilograph/profiler tests are required, coordinate with the contractor. Operation of the profilograph/profiler is the responsibility of the contractor. Calibration of the profilograph/profiler must be made after 1/2 mile of paving is available and periodically, (At DOT discretion), from then on.

A spot check will be made on each project, with a 10' straight edge to verify the effectiveness of corrective action taken to satisfy the acceptance requirements.

- (4) Independent Assurance.
None required.

B. Texture.

- (1) Tier not applicable.
- (2) Certification.
None required.
- (3) Acceptance.
One per 10,000 yd² lot. (SD 418) (DOT-55)
- (4) Independent Assurance.
None required.

C. Thickness.

- (1) Tier not applicable.
- (2) Certification.
None required.
- (3) Acceptance.
Coordinate with the Concrete Engineer (Coring to check thickness is a responsibility of the Concrete Engineer unless quantity is less than 4,000 yd²).

For projects with contract quantities less than 4,000 yd², cores will not be taken, unless requested by the Area Engineer. A minimum of four depth checks will be made on the plastic concrete. (Miscellaneous Test Document)
- (4) Independent Assurance.
None required.

D. Width.

- (1) Tier not applicable.
- (2) Certification.
None required.
- (3) Acceptance.
Coordinate with the Concrete Engineer (Checking width for each coring unit is a responsibility of the Concrete Engineer unless quantity is less than 4,000 yd²).

For projects with contract quantities less than 4,000 yd², a width check will be made for each different paved width. (Miscellaneous Test Document)
- (4) Independent Assurance.
None required.

5.5 Curing Materials.

A. Liquid Membrane Curing Compound.

- (1) Tier 2.
- (2) Certification.
APL: None required.
Non-APL: A Certificate of Compliance is required.
- (3) Acceptance.
One 8 oz. sample in a plastic or glass container per type, lot, and source. Sampling will occur from the end of the spray nozzle. (DOT-1)
- (4) Independent Assurance.
None required.

B. Burlap and Cotton Mat.

- (1) Tier 3.
- (2) Certification.
None required.
- (3) Acceptance.
Documented Visual Inspection.
- (4) Independent Assurance.
None required

C. Polyethylene Sheeting.

- (1) Tier 3.
- (2) Certification.
None required.
- (3) Acceptance.
Documented Visual Inspection.
- (4) Independent Assurance.
None required.

5.6 Joint Materials.

A. Preformed Expansion Type (Includes Non-Extruding and Resilient Bituminous and Non-Bituminous Types).

- (1) Tier 3.
- (2) Certification.
None required.

- (3) Acceptance.
One sample at least 6 in. x 36 in. x full thickness. The sample must be packaged to prevent distortion or breakage in handling and shipment.

None required for contract quantities less than 25 ft²; acceptance will be based on Visual Inspection, for size and type.

- (4) Independent Assurance.
None required.

B. Hot Poured Elastic Type.

- (1) Tier 2.

- (2) Certification.
APL: None required.
Non-APL: A Certificate of Compliance is required.

- (3) Acceptance.
One 5 lb. sample representing each lot or batch will be taken from the application wand during the sealing process. The sample will be placed in a Teflon or silicone lined box having a minimum capacity of 5 lbs. (DOT-1)

None required for contract quantities of 200 lbs. or less.

- (4) Independent Assurance.
None required.

C. Backer Rod (Hot Pour).

- (1) Tier 2.

- (2) Certification.
APL: None required.
Non-APL: A Certificate of Compliance is required.

- (3) Acceptance.
One 2 ft. length submitted with the joint material. (DOT-1)

None required if less than 200 lbs. of sealant is used, acceptance will be based on Visual Inspection, for size and type.

- (4) Independent Assurance.
None required.

D. Silicone.

- (1) Tier 2.

- (2) Certification.
Item used must be on the Approved Products List.

- (3) Acceptance.
One component silicone: One 1 pt. sample (In paint sample can) per lot, per source. (DOT-1)

In Place: 1 random sample approximately 3 in. in length will be cut per 1/10 mile of roadbed from the in place material to check bonding, width, thickness, shape and non-adherence to backer rod. The results of these measurements will be documented. (DOT-10)

Test cannot fail bond check that is performed in less than 7 days.

Acceptance samples of silicone or in place tests are not required for projects that have 500 ft. or less of joints to be sealed, provided basis of acceptance is documented.

- (4) Independent Assurance.
None required.

E. Backer Rod (Silicone).

- (1) Tier 2.
- (2) Certification.
APL: None required.
Non-APL: A Certificate of Compliance is required.
- (3) Acceptance.
None required.
- (4) Independent Assurance.
None required.

5.7 Keyways.

A. Material.

- (1) Tier 3.
- (2) Certification.
None required.
- (3) Acceptance.
Documented Visual Inspection of dimension measurements.
- (4) Independent Assurance.
None required.

6. Portland Cement Concrete Structure Construction:

General Notes:

When specified, the Contractor will design and be responsible for the performance of all concrete mixes used for structural concrete. The mix design data and support information for each mix will be reported to the Concrete Engineer on a DOT-24.

Quality, acceptance and independent assurance (IA), sampling, testing, and certification of the aggregates, admixtures, etc. used in Contractor mix design concrete will be performed by DOT personnel in accordance with the provisions of this section as they are incorporated into the work.

The Department will continue to perform job mix designs for special Portland cement concrete structural construction. The designs will be formulated and tested in the Central Laboratory. The following material quantities for this testing will be submitted to the Central Laboratory in bags no larger than 80 lbs. or buckets no larger than 5 gallons

Fine aggregate.....	750 lbs.
Coarse aggregate	1,100 lbs.*
Cement**	210 lbs.
Fly Ash***	65 lbs.
Air Entraining Agent.....	8 oz.
Water Reducing Agent(s)	32 oz.

*A minimum of 300 lbs. for each size.

** A complete Certified Chemical Analysis and Physical Test Report are required for cement other than GCC Dacotah Rapid City.

*** A complete Certified Chemical Analysis and Physical Test Report are required for fly ash.

Samples of new aggregate sources or sources not tested within the last 5 years will be submitted to the Central Laboratory at least 40 days prior to use.

Quality tests and other special tests on aggregates that require equipment not available at the Region Materials Laboratory and field labs will be made in the Central Laboratories on samples representing each 31,500 yd³.

For quarried ledge rock aggregate that has a satisfactory quality record and has been used in concrete for five years or more, the quality test requirements may be reduced to once per year.

The sample sizes for Quality tests are as follows: Sand, 30 lbs.; limestone, quartzite, or granite, 60 lbs. (DOT-1)

For contract quantities less than 10 yd³ of concrete, certification and acceptance will be as per Section 7.1.A., except one air content determination, one slump test, and one set of cylinders per source. (DOT-23).

6.1 Materials.

A. Aggregate, Fine and Coarse.

(1) Tier 3.

(2) Certification.
None required.

(3) Acceptance.
One sample per 200 yd³ of concrete for each size and source. Fine and coarse aggregate will be sampled and tested simultaneously. (DOT-3)

Resampling because of a deviation from specifications of one of the aggregates requires resampling and retesting of only that material which failed.

When 100% of the material used in the coarse aggregate is ledge rock material, lightweight particle testing is not required.

(4) Independent Assurance.
One sample for each size. None required for contract quantities less than 100 yd³ of concrete. Lightweight particle test will not be required for coarse aggregate.

B. Aggregate, Fine and Coarse, Moisture Content.

(1) Tier not applicable.

(2) Certification.
None required.

(3) Acceptance.
One sample per day for each size, prior to beginning of production, and additional samples not to exceed 200 yd³. (DOT-35)

Not required on low slump deck overlays.

Moisture testing may be reduced by the Engineer when automated concrete batching equipment with fine aggregate, or fine and coarse aggregate, moisture sensing capability is used. When only fine aggregate moisture sensors are used, the concrete plant will use a coarse aggregate moisture (DOT-98A) acceptable to the Engineer. Any moisture sensor will be accurate to 1.0% of the aggregate total moisture.

When the moisture testing is reduced, a moisture test for each size of aggregate will be made at the start of production and every 10,000 yd³ or one per month, whichever happens first.

(4) Independent Assurance.
None required.

C. Cement.

(1) Tier 2.

(2) Certification.

From a certified supplier: None required.

From a non-certified supplier: A Certificate of Compliance is required for each acceptance sample obtained.

(3) Acceptance.

One sample per type for each contract. Two 4 lb. samples. (DOT-1)

None required for contract quantities less than 50 yd³.

(4) Independent Assurance.

None required.

D. Water.

(1) Tier 3.

(2) Certification.

None required.

(3) Acceptance.

One 8 oz. sample in a plastic container per source prior to use. Frequency of testing thereafter to be determined by any changes (Runoff, growth of algae, etc.) affecting the source. (DOT-1)

Testing is not required for water from municipal supplies except in the north part of the Rapid City Region (Contact the Region Materials Engineer regarding this area).

(4) Independent Assurance.

None required.

E. Chemical Admixtures (Includes Air Entraining, Water Reducer, Accelerators, Retarders, etc.).

(1) Tier 2.

(2) Certification.

APL: None required.

Non-APL: A Certificate of Compliance is required.

(3) Acceptance.

One 8 oz. sample in a plastic or glass container per type, lot, and source. (DOT-1)

Material must be thoroughly stirred, air agitated, or otherwise properly mixed to disperse all settlement just prior to sampling.

(4) Independent Assurance.

None required.

F. Fly Ash.

(1) Tier 2

(2) Certification.

A Certificate of Compliance is required for each acceptance sample obtained.

(3) Acceptance.

One randomly selected 4 lb. sample per contract. (DOT-1)

None required for contract quantities less than 50 yd³ of concrete. A certificate of compliance for each conveyance the sample represents must be submitted with each sample.

(4) Independent Assurance.

None required.

6.2 Strength Tests.

A. Compressive Strength.

(1) Tier not applicable.

(2) Certification.

None required.

(3) Acceptance.

One set of cylinders (Made from the same batch of concrete) per 200 yd³ of concrete, per day for each class of concrete from each plant.

Strength tests for bridge deck concrete will be 1 per 100 yd³ of concrete per day. (DOT-23)

A set of cylinders will consist of a minimum of 4 cylinders. Two cylinders will be used for compressive strength at 28 days (One cylinder is tested at 28 days and the other is saved for the backup). The other two cylinders will be used for early breaks (Normally at seven and 14 days). If additional early breaks are desired or required, additional cylinders must be made.

It is recommended that cylinders be used to determine the attained strength of the hardened concrete. The impact test hammer may be used to determine the attained strength of hardened concrete for permitting traffic use and for comparative or confirmation tests. (DOT-9) When possible, the impact hammer should be tested on a concrete cylinder prior to breaking and adjust the correction factor for the comparative or confirmation tests.

(4) Independent Assurance.

None required.

6.3 Fresh (Plastic) Concrete Tests.

A. Air Content, Unit Weight, Slump, and Temperature.

- (1) Tier not applicable.
- (2) Certification.
Drilled Shaft Construction Report (DOT-297).
- (3) Acceptance.
Air content, unit weight, slump, and temperature determinations will be made each time a cylinder for compressive strength determination is made. Additional determinations will be made to ensure proper control, and not less than one determination for each 2 hours of mixing-placing operations. (DOT-23)

Additional determinations for air content, unit weight, slump, and temperature will be made for each one hour of mixing-placing operations on bridge decks.

Drilled Shaft:

Fresh Concrete tests will be made on every load of concrete before it is placed. When a pour of 18 cu. yds. or less is made, all concrete will be on site and the concrete in each conveyance will be tested before any concrete is placed.

Self-Consolidating Concrete (SCC):

First Truckload: The following fresh (plastic) concrete tests will be performed on the concrete from the first truckload of any individual concrete placement.

Slump Flow and VSI, J-Ring, Temperature, Air Content, and Unit Weight.

Subsequent Truckloads: After the first truckload, fresh (plastic) concrete tests will be performed on the concrete from all subsequent truckloads at the following frequency:

Slump Flow and VSI: Slump flow spread will be tested at a rate of every other conveyance.

J-Ring: J-Ring will be tested at a rate of one out of every four conveyances.

The Slump Flow and the J-Ring tests will be performed on the same conveyance. The tests will be performed concurrently or subsequently with no more than six minutes elapsed time between the slump flow and J-ring tests.

Temperature: Temperature will be tested at a rate of one out of every four conveyances.

Air Content and Unit Weight: Air content and unit weight will be tested at a rate of one out of every four conveyances. Additional determinations will be made if more than 2 hours has passed from the previous test.

- (4) Independent Assurance.
One air content, unit weight, slump, and temperature determination per contract. None required for contract quantities less than 100 yd³ of concrete. (DOT-23) The slump tests may be by observation of acceptance tests.

Self-Consolidating Concrete (SCC) - Slump flow, visual stability index, and J-ring testing may be by observation of acceptance tests.

6.4 Curing Materials.

A. Liquid Membrane Curing Compound.

- (1) Tier 2.
- (2) Certification.
APL: None required.
Non-APL: A Certificate of Compliance is required.
- (3) Acceptance.
One 8 oz. sample in a plastic or glass container per type, lot, and source. Sampling will occur from the end of the spray nozzle. (DOT-1)
- (4) Independent Assurance.
None required.

B. Burlap.

- (1) Tier 3.
- (2) Certification.
None required.
- (3) Acceptance.
Documented Visual Inspection.
- (4) Independent Assurance.
None required.

C. Film (Sheet Materials Including Waterproof Paper, Polyethylene Sheeting, White Burlap-Polyethylene Sheeting, etc.).

- (1) Tier 3.
- (2) Certification.
None required.

- (3) Acceptance.
Documented Visual Inspection.
- (4) Independent Assurance.
None required.

6.5 Joint Materials.

- A. Strip Seal and Preformed Elastomeric Open Cell Compression Type with Lubricant/Adhesive.
 - (1) Tier 2.
 - (2) Certification.
APL: None required.
Non-APL: A Certificate of Compliance is required for both the joint seal and lubricant/adhesive.
 - (3) Acceptance.
Documented Visual Inspection for correct size, shape, etc.
 - (4) Independent Assurance.
None required.
- B. Preformed Expansion Type (Includes Non-Extruding and Resilient Bituminous and Non-Bituminous Types).
 - (1) Tier 3.
 - (2) Certification.
None required.
 - (3) Acceptance.
One sample at least 6 in. x 36 in. x full thickness. The sample must be packaged to prevent distortion or breakage in handling and shipment.

None required for contract quantities less than 25 ft²; acceptance will be based on Visual Inspection, for size and type.
 - (4) Independent Assurance.
None required.
- C. Hot Poured Elastic Type.
 - (1) Tier 2.
 - (2) Certification.
APL: None required.
Non-APL: A Certificate of Compliance is required.
 - (3) Acceptance.
One 5 lb. sample representing each lot or batch will be taken from the application wand during the sealing process. The sample will be placed in a Teflon or silicone lined box having a minimum capacity of 5 lbs. (DOT-1)

None required for contract quantities of 200 lbs. or less.

- (4) Independent Assurance.
None required.

D. Silicone.

- (1) Tier 2.
- (2) Certification.
Item used must be on the Approved Products List.
- (3) Acceptance.
Documented Visual Inspection to verify that the item used is on the Approved Products List and that installation is in accordance with plan details.
- (4) Independent Assurance.
None required.

E. Backer Rod.

- (1) Tier 2.
- (2) Certification.
APL: None required.
Non-APL: A Certificate of Compliance is required.
- (3) Acceptance.
Documented Visual Inspection to verify that the item used is on the Approved Products List and that installation is in accordance with plan details.
- (4) Independent Assurance.
None required.

6.6 Commercial Textured and Special Surface Finish.

A. Materials.

- (1) Tier 2.
- (2) Certification.
Item used must be on the Approved Products List.
- (3) Acceptance.
Documented Visual Inspection to verify that the item used is on the Approved Products List and that installation is in accordance with plan details.
- (4) Independent Assurance.
None required.

6.7 Abutment Backwall Coating.

A. Materials.

- (1) Tier 2.
- (2) Certification.
Item used must be on the Approved Products List.
- (3) Acceptance.
Documented Visual Inspection to verify that the item used is on the Approved Products List.
- (4) Independent Assurance.
None required.

6.8 Measurement of Texture.

A. Tined Surface.

- (1) Tier not applicable.
- (2) Certification.
None required.
- (3) Acceptance.
One per structure, per pour. (SD 418) (DOT-55)
- (4) Independent Assurance.
None required.

6.9 Measurement of Deck Roughness.

A. Surface.

- (1) Tier not applicable.
- (2) Certification.
None required.
- (3) Acceptance.
On projects where profilograph tests are required, coordinate with the contractor. Operation of the profilograph is the responsibility of the contractor. Calibration of the profilograph is required.

When profilograph testing is not required, test in accordance with SD 417. (DOT-29)
- (4) Independent Assurance.
None required.

7. **Portland Cement Concrete Miscellaneous Construction - Class M:**

7.1 **Materials and Plants.**

A. Requirements.

(1) Tier 2.

(2) Certification.

Prior to placement, each supplier of Portland cement concrete, "Class M", will furnish the Area Engineer with a signed statement certifying that the "Class M" concrete meets specification requirements (DOT-57).

None required if material is listed on "Concrete Pipe Release Dates" report.

(3) Acceptance.

One air content determination, one slump test, and one set of cylinders per source. (DOT-23)

Self-Consolidating Concrete: One air content, slump flow, visual stability index, J-ring, temperature of fresh concrete, and one set of cylinders per placement. Additional determinations may be made to ensure proper control of mixing-placing operations (DOT-23).

None required for contract quantities less than 50 yd³ of concrete.

Visual Inspection required if less than 50 yd³

None required if material is listed on "Concrete Pipe Release Dates" report

(4) Independent Assurance.

None required.

B. Preformed Expansion Type Joint Material (Includes Non-Extruding and Resilient Bituminous and Non-Bituminous Types).

(1) Tier 3.

(2) Certification.

None required.

(3) Acceptance.

One sample at least 6 in. x 36 in. x full thickness. The sample must be packaged to prevent distortion or breakage in handling and shipment. (DOT-1)

None required for contract quantities less than 25 ft²; acceptance will be based on Visual Inspection, for size and type.

(4) Independent Assurance.

None required.

8. Roadway Lighting and Traffic Control:

General Notes:

If the acceptability of any item is questionable, the Region Traffic Engineer will be notified. He may request a sample be submitted for approval, may make an inspection, or may approve the item by other means.

Where the specifications contain the "Or equal" clause, it is understood that other makes of equal size, quantity, quality, and performance may be accepted if approved by the Region Traffic Engineer prior to installation.

8.1 Materials.

A. Standard Items of Electrical Equipment.

Circuit breakers
Conduit, sleeves, couplings, and fittings
Dry type transformers, etc.
Electric cables (Conductor)
Fused Y connector kits
In-line fuse holder connectors
Weatherproof cases with multiple contactors and fuses

(1) Tier 3.

(2) Certification.
None required.

(3) Acceptance.
Documented Visual Inspection for stamps or markings indicating size, type, and approval by UL, IPCEA, NEMA, or other recognized agency. It will also be ascertained and documented that the items are the correct size and type for the intended use.

(4) Independent Assurance.
None required.

B. Miscellaneous Hardware Items.

Ground rods and clamps

(1) Tier 3.

(2) Certification.
None required.

(3) Acceptance.
Documented Visual Inspection to verify that the items are of adequate size and compatible type for the intended use.

(4) Independent Assurance.
None required.

C. Items that are on the Approved Products List.

Detector Loop Sealer.
Detector Unit
Electrical Junction Box
MASH Compliant Pedestal Signal Pole
MASH Compliant Pedestrian Push Button Pole
Pedestrian Push Buttons
Photoelectric Cells.
Traffic Signal Controller - TS2
Video Detection Systems

- (1) Tier 2.
- (2) Certification.
Item used must be on the Approved Products List.
- (3) Acceptance.
Documented Visual Inspection to verify that the item used is on the Approved Products List. If the identification is doubtful or the item is not on the list, the Region Traffic Engineer will be notified, and his approval of the item requested.
- (4) Independent Assurance.
None required.

D. Items Requiring Approval of Catalogue Cuts or Shop Drawings.

Anchor Bolts
Battery Backup System for Traffic Signal
Detector units (Not on APL)
Drop Arm Road Closure Gate
Electrical Junction Box
Emergency Preemption Unit
Fiber Optic Cable
Lowering Devices
Luminaires
Optical Detector
Pedestal Signal Poles (Not on APL)
Pedestrian Push Buttons (Not on APL)
Pedestrian Push Button Pole (Not on APL)
Pre-formed Detector Loops (When factory made and not fabricated by the Contractor in accordance with plan details)
Radar Detection Systems
Rectangular Rapid Flashing Beacon
*Signal and Luminaire poles
Signal heads and accessories
Solar Powered Flashing Beacon
Traffic Signal Controllers and accessories (Not on APL).
Transmitter and Receiver units and accessories.
Video Detection Systems (Not on APL)
Wireless In-pavement Detection Systems

*Signal and lighting poles (Listed here as a “Tier 1” material only to satisfy the requirement that Shop Drawings and Registered PE Certificate must be approved prior to fabrication. See following page for Umbrella Certification requirements for these materials).

- (1) Tier 1.
- (2) Certification.
Prior to installation, the Contractor will submit catalogue cuts or shop drawings (5 copies) to the Traffic Design Engineer for review. Approved catalogue cuts and shop drawings will be forwarded to the Area Engineer.
- (3) Acceptance.
Documented Visual Inspection to ensure that the items delivered for use on the project are the same as indicated by the catalogue cuts or shop drawings and that the items have not been damaged by shipping and handling.
- (4) Independent Assurance.
None required.

E. Items Requiring an Umbrella Certificate for the Material.

Fixed and breakaway bases.
Mast arms and luminaires extensions.
Signal and lighting poles.
Span wire and pole clamps.
Transformer bases.

- (1) Tier 2
- (2) Certification.
Umbrella Certificate. (DOT-99)

If records are audited, the Contractor must produce a Certified Copy of the Mill Test Report for castings, and structural and tubular sections showing both physical and chemical properties.
- (3) Acceptance.
Documented Visual Inspection for correct size, obvious defects in fabrication, shipping, and handling damage, etc.
- (4) Independent Assurance.
None required.

9. Erosion and Sediment Control

9.1 Materials.

A. Erosion Control Devices

- (1) Tier 3.
- (2) Certification.
APL: None required.
Non-APL: A Certificate of Compliance is required.
- (3) Acceptance.
Documented Visual Inspection.
- (4) Independent Assurance.
None required.

B. Fertilizer.

- (1) Tier 2.
- (2) Certification.
APL: None required.
Non-APL: A Certificate of Compliance is required
A Bill of Lading, bag label, tag, or other document is required to confirm name and address of manufacturer, brand, grade, and a guaranteed analysis showing minimum percentages of total nitrogen, available phosphoric acid, and water soluble potash.

None required for contract quantities less than 500 lbs.
- (3) Acceptance.
None required.
- (4) Independent Assurance.
None required.

C. Fiber Mulch.

- (1) Tier 2.
- (2) Certification.
APL: None required.
Non-APL: A Certificate of Compliance is required.
- (3) Acceptance.
Documented Visual Inspection to verify that the packages are marked by the manufacturer with air dry content.
- (4) Independent Assurance.
None required.

D. Seeds.

- (1) Tier 2.

- (2) Certification.
A Certificate of Seed Analysis or Certified Test Report for each lot of seed to be used on the project. Certification is not required on projects requiring 100 lbs. of seed or less.

- (3) Acceptance.
Field obtained seed samples for determination of South Dakota noxious weeds will be taken at the following frequency: (SD 512) (DOT-1)

0 to 500 lbs.	None required
500 to 1,000 lbs.	One sample
every 1,000 lbs. thereafter	One sample

Samples taken to satisfy the requirements shown above will be tested for South Dakota noxious weed content only. SDSU seed laboratory will randomly select a number of these samples per year and do a detailed analysis. The random selection will be influenced by possible irregularities noted while conducting the noxious weed checks.

Documented Visual Inspection to ensure that the seed bag tags are from the same lot covered by the Certification.

- (4) Independent Assurance.
None required.

E. Mulch.

- (1) Tier 3.
- (2) Certification.
None required.
- (3) Acceptance.
Visual Inspection.
- (4) Independent Assurance.
None required.

F. Mycorrhizal Inoculum.

- (1) Tier 2.
- (2) Certification.
APL: None required.
Non-APL: A Certificate of Compliance is required.
- (3) Acceptance.
None Required.
- (4) Independent Assurance.
None required.

10. Buildings and Rest Area Construction:

General Notes:

Minimum Sample and Test Requirements (MSTR), listed in other sections of this manual, will apply when the same material items are used for the construction in this section. This refers to material items such as Portland cement concrete, reinforcing steel, seeding, fencing, and any other items appearing elsewhere in this manual.

Where the specifications contain the "Or equal" clause, it is understood that other makes of equal size, quantity, quality, and performance may be accepted, if approved by the Area Engineer prior to use.

Shop drawings, brochures, and schedules, used as a basis for approval, must be submitted in accordance with specifications to the Central Office for review and approval. Items accepted based on certification, brochures, or shop drawings will be visually inspected in the field to verify compliance with requirements. Documentation of this inspection will be made in the diary. Documented inspection will also be made on items accepted based on labels, identification tags, or other means.

10.1 Materials.

A. Brick.

- (1) Tier 3.
- (2) Certification.
None required.
- (3) Acceptance.
Documented Visual Inspection to verify that units are sound and free from cracks and other defects.
- (4) Independent Assurance.
None required.

B. Insulation.

- (1) Tier 3.
- (2) Certification.
None required.
- (3) Acceptance.
Documented Visual Inspection.
- (4) Independent Assurance.
None required.

C. Building Block (Hollow or Solid).

- (1) Tier 3.
- (2) Certification.
None required.

- (3) Acceptance.
Documented Visual Inspection to verify that units are sound and free from cracks and other defects.
- (4) Independent Assurance.
None required.

D. Basin and Manhole Block.

- (1) Tier 3.
- (2) Certification.
None required.
- (3) Acceptance.
Documented Visual Inspection to verify that units are sound and free from cracks and other defects.
- (4) Independent Assurance.
None required.

E. Miscellaneous Hardware Items.

Faucets, copper pipe, and fittings.
Light fixtures and other electrical items.
Lock sets, hinges, and door closures.
Other plumbing items and fixtures, etc.

- (1) Tier 3.
- (2) Certification.
None required.
- (3) Acceptance.
Documented Visual Inspection for stamps or markings indicating size, type, and approval by UL, NEMA, or another industry recognized agency. It will also be ascertained and documented that the items are the correct size and type for the intended use.
- (4) Independent Assurance.
None required.

11. Miscellaneous Incidental and Manufactured or Fabricated Items:

11.1 Aluminum.

- A. Cast, Framing, Handrail, Hardware, and Sheet (Includes Extruded Types).
- (1) Tier 2.
 - (2) Certification.
A Certified Copy of the Mill Test Report showing the chemical and physical tests for each heat or lot number.
 - (3) Acceptance.
Documented Visual Inspection for measurements.
 - (4) Independent Assurance.
None required.

11.2 Bearing Pads.

- A. Bronze or Copper.
- (1) Tier 2.
 - (2) Certification.
A Certificate of Compliance is required for each type and source.
 - (3) Acceptance.
Documented Visual Inspection.
 - (4) Independent Assurance.
None required.
- B. Elastomeric.
- (1) Tier 2.
 - (2) Certification.
A Certificate of Compliance is required for each source.

When furnished by pre-stressed fabricator - Umbrella Certification.
(DOT-99)
 - (3) Acceptance.
Documented Visual Inspection.
 - (4) Independent Assurance.
None required.
- C. Preformed Fabric.
- (1) Tier 3.
 - (2) Certification.
A Certificate of Compliance is required.

- (3) Acceptance.
Documented Visual Inspection.
- (4) Independent Assurance.
None required.

11.3 Bolt Assemblies (Bolts, Nuts, Washers, and Direct Tension Indicators)

A. High-Strength Bolts

- (1) Tier.
 - (a) ASTM F3125 grades A325 and A490 high-strength bolt assemblies used on steel girder or truss bridges. Tier 1.
 - (b) All other bolt assemblies not covered by the provisions in (a) above. Tier 2.
- (2) Certification.
 - (a) Bolt assemblies.
A Certified Copy of the Mill Test Report.
 - (b) Bolt assemblies used in guardrail, signing and lighting
Umbrella Certificate. (DOT-99)

If records are audited, the Contractor must produce a Certified Copy of the Mill Test Report.

A307 bolts including guardrail bolts, eye bolts, ribbed, and unfinished used in non-critical applications may be accepted in the Certification Office by Certificate of Compliance.
- (3) Acceptance.
 - (a) Grade A325 high-strength bolt assemblies used on steel girder or truss bridges.
 - I. Rotational capacity.

One sample of three bolt assemblies (Excluding direct tension indicators - DTI) for each bolt diameter, length, and lot number, tested for rotational capacity in accordance with SD 507. (DOT-96)

A bolt assembly is defined as a bolt, nut and washer(s) that are from the same rotational capacity lot # as is to be used in the work and as tested by the Supplier.
 - II. Direct tension indicator (DTI).

One sample of three direct tension indicator bolt assemblies for each diameter, length and lot number of bolt and for each lot number of direct tension indicator, tested in accordance with SD 503. (DOT-96). For bolts defined as short bolts in SD 503,

an additional three direct tension indicator bolt assemblies with bolts meeting the minimum length requirements specified in the Short Bolts for DTI Testing table, will be furnished.

A direct tension indicator bolt assembly is defined as a bolt, nut, washer(s) and direct tension indicator that are from the same lot as is to be used in the work.

- (b) All other bolt assemblies Documented measurements and Visual Inspection for size markings and coating.
- (4) Independent Assurance.
None required.
- B. Anchor Bolts, Nuts and Washers.
 - (1) Tier 1.
 - (2) Certification
A Certified Copy of the Mill Test Report.
 - (3) Acceptance.
None required.
 - (4) Independent Assurance.
None required.
- C. Tie Bolts (Precast Box Culvert and Reinforced Concrete Pipe)
 - (1) Tier 2.
 - (2) Certification.
Umbrella Certificate. (DOT-99)

If records are audited, the Contractor must produce a Certified Copy of the Mill Test Report.
 - (3) Acceptance.
Documented measurements and Visual Inspection.
 - (4) Independent Assurance.
None required.

11.4 Bridge Deck Drains / Abutment Joint Drains.

- A. Material.
 - (1) Tier 2.
 - (2) Certification.
Umbrella Certificate. (DOT-99)

If records are audited, the Contractor must produce for each component either a Certified Copy of the Mill Test Report or a Certificate of Compliance.

- (3) Acceptance.
Documented Visual Inspection.
- (4) Independent Assurance.
None required.

11.5 Bridge Paint.

A. Bridge Paint and Primer.

- (1) Tier 2
- (2) Certification.
Item used must be on the Approved Products List unless otherwise specified.
- (3) Acceptance.
None.
- (4) Independent Assurance.
None required.

B. Bridge Field Painting – Surface Preparation.

- (1) Tier 3
- (2) Certification.
None required.
- (3) Acceptance.
Documented Visual Inspection when steel is abrasive blast cleaned.
- (4) Independent Assurance.
None required.

C. Bridge Field Painting – Paint Application.

- (1) Tier 3
- (2) Certification.
None required.
- (3) Acceptance.
Documented Visual Inspection of dry film thickness (DFT).
- (4) Independent Assurance.
None required.

11.6 Castings and Cast Iron.

A. Bridge Hardware.

- (1) Tier 2.
- (2) Certification.
A Certificate of Compliance is required for each source.

(3) Acceptance.
None required.

(4) Independent Assurance.
None required.

B. Drop Inlet Frames, Grates, Box Curb Assemblies, etc.

(1) Tier 2.

(2) Certification.
Item used must be from an Approved Products List manufacturer.

(3) Acceptance.
Documented Visual Inspection for manufacturer, size, and type.

(4) Independent Assurance.
None required.

C. Grid Floor.

(1) Tier 2.

(2) Certification.
A Certificate of Compliance is required for each source.

(3) Acceptance.
None required.

(4) Independent Assurance.
None required.

11.7 Cattle Guards.

A. Material.

(1) Tier 2.

(2) Certification.
A Certified Copy of the Mill Test Report

(3) Acceptance.
Documented Visual Inspection and measurements.

(4) Independent Assurance.
None required.

11.8 Chloride.

A. Calcium, Sodium, and Magnesium.

(1) Tier 2.

(2) Certification.
A Bill of Lading is required for each source per shipment.

- (3) Acceptance.
Granular formulation: One 3 lb. sample per shipment in a metal, plastic, or glass container. (DOT-1)

Liquid formulation: One 8 oz. sample per shipment in a plastic or glass, air-tight container. (DOT-1)

Randomly select three approximately equal portions to make the composite sample.
- (4) Independent Assurance.
None required.

11.9 Controlled Density Fill/Flowable Fill.

- A. Material.
 - (1) Tier 2.
 - (2) Certification.
Prior to furnishing, the supplier of controlled density fill will provide the Area Engineer with a signed statement certifying that the controlled density fill meets the specification requirements. (DOT-77)
 - (3) Acceptance.
Documented Visual Inspection.
 - (4) Independent Assurance.
None required.

11.10 Drainage Fabric.

- A. Material.
 - (1) Tier 2.
 - (2) Certification.
APL: None required.
Non-APL: A Certificate of Compliance is required.

When supplied by pre-cast fabricator - Umbrella Certification. (DOT-99)
 - (3) Acceptance.
Documented Visual Inspection.
 - (4) Independent Assurance.
None required.

11.11 Epoxy-Resin Adhesive.

- A. Material.
 - (1) Tier 2.

- (2) Certification.
A Certificate of Compliance is required for each type and source.
- (3) Acceptance.
None required.
- (4) Independent Assurance.
None required.

11.12 Fencing.

A. Barb and Smooth Wire.

- (1) Tier 2.
- (2) Certification.
A Certificate of Compliance including the statement "Melted and Manufactured in the United States".
- (3) Acceptance.
One sample per 50 spools. Sample length to be a minimum of 24 inches and must contain at least 6 barbs for barbed wire. (DOT-1)

None required if less than 500 lineal feet of a fence type is used on a contract. Acceptance will be based on documented Visual Inspection for wire gauge, barbs, and coating.
- (4) Independent Assurance.
None required.

B. Chain-Link System (Includes Fabric, Posts, Rails, Fittings, and Hardware).

- (1) Tier 2.
- (2) Certification.
Umbrella Certificate. (DOT-99)

If records are audited, the Contractor must produce a Certificate of Compliance for each source.
- (3) Acceptance.
For fabric, one sample per 50 rolls. Sample length will be full vertical section containing 6 vertical wires. (DOT-1)

None required if less than 500 lineal feet of a fence type is used on a contract. Acceptance will be based on documented Visual Inspection for gauge and coating.

For chain-link posts, rails, fittings, and hardware, acceptance will be based on documented Visual Inspection for size and coating.
- (4) Independent Assurance.
None required.

C. Woven Wire.

(1) Tier 2.

(2) Certification.

A Certificate of Compliance including the statement "Melted and Manufactured in the United States".

(3) Acceptance.

One sample per 50 rolls. Sample length will be 3 ft. containing 3 stay [vertical] wires. (DOT-1)

None required if less than 500 lineal feet of a fence type is used on a contract. Acceptance will be based on documented Visual Inspection for gage, spacing, and coating.

(4) Independent Assurance.

None required.

D. Brace Wire.

(1) Tier 2.

(2) Certification.

A Certified Copy of the Certificate of Compliance including the statement "Melted and Manufactured in the United States".

(3) Acceptance.

Documented Visual Inspection for gage and coating.

(4) Independent Assurance.

None required.

E. Miscellaneous Fasteners, Staples, Ties, etc.

(1) Tier 3.

(2) Certification.

None required.

(3) Acceptance.

Documented Visual Inspection for measurement, size, and coating.

(4) Independent Assurance.

None required.

F. Gates (Tubular Frame).

(1) Tier 3.

(2) Certification.

None required.

(3) Acceptance.

Documented Visual Inspection for size, gauge, and coating.

- (4) Independent Assurance.
None required.

G. Steel Posts.

- (1) Tier 2.
- (2) Certification.
A Certified Copy of the Certificate of Compliance stating, "Melted and Manufactured in the United States".
- (3) Acceptance.
One lot of 5 posts per 1,000 of each size, per source will be inspected in the field for length and weight and the results documented. (Miscellaneous Test Document)
- (4) Independent Assurance.
None required.

H. Wood Posts.

- (1) Tier 2.
- (2) Certification.
Job site accepted posts: A Certificate of Compliance covering posts, preservatives, and treatment is required.

Plant site accepted posts: None required.
- (3) Acceptance.
Job site accepted posts: One sample per charge or shipment. Sample size: A minimum of 20 cores taken approximately midpoint of the posts. No more than one core per post is permitted. The minimum core length will be a minimum of half the diameter of the posts. (DOT-1)

If contract quantities are less than 100 post acceptance will be based on documented Visual Inspection for size, soundness, and straightness

Plant site accepted posts: For bundled posts, the State Inspector must retrieve the tag and send it to the Certification Engineer with documentation of the date, tag number(s), number of posts, size of posts, and the name of the supplier. Each bundle that has a DOT numbered tag may be accepted without further testing. (DOT-1)
If contract quantities are less than 100 posts, bundle tags are not required; however, Visual Inspection for size and type will be documented to verify that the posts came from a certified supplier.

Bundles received that are not tagged must be sampled at the job site. Posts should not be used until satisfactory test results are received.
- (4) Independent Assurance.
None required.

11.13 Gabion Baskets.

A. Material.

(1) Tier 2.

(2) Certification.

APL: None required.

Non-APL: A Certificate of Compliance is required.

(3) Acceptance.

One sample per shipment and source when baskets are fabricated in the field. Sample size: One 2 ft. section of the wire basket material. (DOT-1)

Documented Visual Inspection of gabions for dimensions, gauge of wire mesh and tie wires, tie spacing, etc.

None required for prefabricated gabions.

(4) Independent Assurance.

None required.

11.14 Mailbox Assemblies.

A. Material.

(1) Tier 2.

(2) Certification.

None required.

(3) Acceptance.

Documented Visual Inspection.

Visual Inspection will document that the post support assembly used is 1) an approved product, 2) 4" x 4" square or 4" round wood post (As per standard plate), or 3) an alternate approved by the Engineer prior to installation. If an alternate support assembly is to be utilized, the Contractor will provide written certification that the alternate mailbox support assembly meets the test level 3 crash testing requirements of NCHRP 350 or MASH. Visual Inspection will also document that the post support assembly utilized was installed in accordance with the standard plate and/or the manufacturer's installation instructions.

(4) Independent Assurance.

None required.

11.15 MSE/Geotextile Fabric.

A. Material.

(1) Tier 2.

- (2) Certification.
APL: None required.
Non-APL: A Certificate of Compliance is required.

Material Certification obtained from supplier should be submitted with sample.

- (3) Acceptance.
Documented Visual Inspection.
- (4) Independent Assurance.
None required.

11.16 Pavement Markings

A. Traffic Marking Paint

- (1) Tier 2.
- (2) Certification.
A Certificate of Compliance is required per type, source and lot. (It may be in the form of a manufacturer's certified analysis from the label on the container.)
- (3) Acceptance.
One 1 pt. sample per type, source, and lot. (DOT-1)

None required for contract quantities less than 20 gal.

No sample required on epoxy paint.
- (4) Independent Assurance.
None required.

B. Permanent Plastic Pavement Markings.

- (1) Tier 2.
- (2) Certification.
APL: None required.
Non-APL: A Certificate of Compliance is required.
- (3) Acceptance.
Field inspection documenting that the materials and installation procedures are in accordance with manufacturer's recommendations.
- (4) Independent Assurance.
None required.

C. Reflective Media.

- (1) Tier 3.
- (2) Certification.
A Certificate of Compliance is required for each type of media.

- (3) Acceptance.
None required.
- (4) Independent Assurance.
None required.

11.17 Piling.

- A. Pre-Cast and Pre-Stressed Concrete.
The Minimum Sample and Test Requirements (MSTR) outlined in paragraph 11.21 will apply.
- B. Steel Beam or Sheet (Includes Corrugated Pipe).
 - (1) Tier 1.
 - (2) Certification.
A Certified Copy of the Mill Test Report for each heat or lot number.
Pile Reports (DOT-203 & DOT-204).
 - (3) Acceptance.
None required.
 - (4) Independent Assurance.
None required.
- C. Timber (Treated).
 - (1) Tier 1.
 - (2) Certification.
A Treatment Certificate from the treating plant showing analysis of treating agent, the retention, and depth of the penetration.

Prior to driving operations, the inspector will verify that the Treatment Certificate represents the actual piling shipped.

Each piling will be tagged or stamped with a number, such as a charge number. This number will also appear on the Treatment Certificate.

The Treatment Certificate will state where the stamps and tags are located on the piling.
 - (3) Acceptance.
None required.
 - (4) Independent Assurance.
None required.
- D. Piling Shoes.
 - (1) Tier 1.
 - (2) Certification.
A Certified Copy of the Mill Test Report for each heat or lot number.

(3) Acceptance.
Documented measurements and Visual Inspection.

(4) Independent Assurance.
None required.

E. Pile Tip Reinforcement.

(1) Tier 1.

(2) Certification.
A Certified Copy of the Mill Test Report for each heat or lot number.

(3) Acceptance.
Documented measurements and Visual Inspection.

(4) Independent Assurance.
None required.

11.18 Pipe.

A. Concrete.

(1) Tier 2.

(2) Certification.
None required.

(3) Acceptance.
The Central Testing Laboratory will periodically load test each size and type at the plant or perform compressive strength tests on cylinders made by the manufacturer. The type and quantity of testing is at the discretion of the Central Testing Laboratory. Results will be documented in the form of a Concrete Pipe Release Date report.

Prior to installation, a documented field inspection for valid release dates, defects, or damage will be made.

If the pipe is 84" or larger, it will be inspected and tested in accordance with 11.21 F

One sample for each size and source of fine and coarse aggregate will be sampled and tested for quality and sieve analysis annually. (DOT-1, DOT-3)

(4) Independent Assurance.
None required.

B. Corrugated Metal.

(1) Tier 2.

(2) Certification.
APL: None required.

Non-APL: Shipping list showing fabricator, size, gauge, heat numbers, quantity (Including end sections); and Certified Mill Test Reports for all metal used in fabrication of the culvert.

- (3) Acceptance.

APL: Documented Visual Inspection for size, gauge, and heat number.

Non-APL: One sample for each heat number and gauge. Sample size: three pieces, each at least 2 1/4 in. x 2 1/4 in. (DOT-1)

Documented Visual Inspection for size, gauge, and heat number.

- (4) Independent Assurance.
None required.

C. PVC.

- (1) Tier 2.

- (2) Certification.
Certificate of compliance is required.

- (3) Acceptance.
Documented Visual Inspection for manufacturer, size, and type.

- (4) Independent Assurance.
None required.

D. Polyethylene

- (1) Tier 2.

- (2) Certification.
APL: None required.
Non-APL: A Certificate of Compliance is required.

- (3) Acceptance.
Documented Visual Inspection for manufacturer, size, and type.

- (4) Independent Assurance.
None required.

E. High-Density Polyethylene.

- (1) Tier 2

- (2) Certification.
APL: None required.
Non-APL: A Certificate of Compliance is required.

- (3) Acceptance.
Documented Visual Inspection for manufacturer, size, and type.

- (4) Independent Assurance.
None required.

F. Steel Pipe

(1) Tier 2

(2) Certification.

A Certified Copy of the Mill Test report for each heat or lot number will be furnished.

A Certificate of Compliance for the coating.

(3) Acceptance.

Documented Visual Inspection for size, and type.

(4) Independence Assurance.

None required.

G. HDPE Slip Line Pipe

(1) Tier 2.

(2) Certification.

Certificate of Compliance is required.

(3) Acceptance.

Documented Visual Inspection for size, and type.

(4) Independent Assurance.

None required.

11.19 Polyethylene Sheeting.

A. Material.

(1) Tier 3.

(2) Certification.

None required.

(3) Acceptance.

Documented Visual Inspection.

(4) Independent Assurance.

None required.

11.20 Polymer Modified Asphalt Growth Joint and Asphalt Bridge Joint.

A. Joint System.

(1) Tier 2.

(2) Certification.

Item used must be on Approved Products List.

(3) Acceptance.

None required.

- (4) Independent Assurance.
None required.

B. Binder.

- (1) Tier 2.
- (2) Certification.
Certificate of Compliance.
- (3) Acceptance.
None required
- (4) Independent Assurance.
None required.

11.21 Pre-cast and Pre-stressed Concrete.

If the Contractor proposes to utilize an out of state supplier to fabricate pre-cast or pre-stressed concrete components, the Contractor will notify the Department and the components will be fabricated in accordance with the contract specifications. The Department may allow testing and certification quality control procedures to be performed in accordance with the other state Department's quality control procedures under a separate agreement between the two states.

A. Aggregate, Fine and Coarse.

- (1) Tier 3
- (2) Certification.
None required.
- (3) Acceptance.
One sample per project for each size. Fine and coarse aggregate will be sampled and tested simultaneously. (DOT-3)
The moisture testing requirements on fine and coarse aggregate are waived in this application.

Resampling because of a deviation from specifications of one of the aggregates requires resampling and retesting of only that material which failed.

When 100% of the material used in the coarse aggregate is ledge rock, lightweight particle testing is not required. If independent assurance (IA) fails, acceptance testing will resume.

- (4) Independent Assurance.
One sample per project for each size and source. None required if acceptance testing performed by Region Materials personnel. None required for contract quantities less than 100 yd³.

A quality sample will be submitted for each size annually. This test may be shared throughout the year.

- B. Cement.
- (1) Tier 2.
 - (2) Certification.
Umbrella Certification. (DOT-99)
 - (3) Acceptance.
One sample per type, per year, per plant. Annual sample from each plant may be shared throughout the year.
 - (4) Independent Assurance.
None required.
- C. Chemical Admixtures (Includes Air Entraining, Water Reducer, Accelerators, Retarders, etc.).
- (1) Tier 2.
 - (2) Certification.
Umbrella Certification. (DOT-99)
 - (3) Acceptance.
One sample per type, per year, per plant. Annual sample from each plant may be shared throughout the year.
 - (4) Independent Assurance.
None required.
- D. Fly Ash.
- (1) Tier 2.
 - (2) Certification.
A Certificate of Compliance is required for load sampled.
 - (3) Acceptance.
One sample per type, per year, per plant. Annual sample from each plant may be shared throughout the year.
 - (4) Independent Assurance.
None required.
- E. Water.
- (1) Tier 3.
 - (2) Certification.
None Required.
 - (3) Acceptance.
None required.
 - (4) Independent Assurance.
None required.

F. Concrete, Strength Tests.

(1) Tier not applicable.

(2) Certification.
None required.

(3) Acceptance.
Cylinders, to determine the release time for pre-stressing steel and that the minimum design compressive strength requirements are met, will be made by the fabricator, and witnessed by the Engineer or his representative (DOT-23, DOT-54).

The producer will ensure that the cylinders are cured under identical conditions for the same length of time as the precast units.

A group of test cylinders will be made for each line of precast units, for each pour, or for each curing chamber, whichever is less. In addition, one group of test cylinders will be made for each class of concrete for each day's production, not to exceed 150 cubic yards.

For beams a set of cylinders is to be made for each day's production, each set of cylinders is to represent a specific number of beams, but not to exceed 160 ft. of casting bed.

A group of test cylinders will consist of a minimum of four (4) cylinders to determine strength of concrete for prestress transfer and compressive strength of pre-cast items. Two will be used to determine design strength if contractor desires to deliver or obtain Acceptance prior to 28-day age and two for the 28-day tests (one back-up cylinder). When tests of the cylinders above indicate at least minimum design compressive strength, the pre-cast or pre-stressed concrete items may be delivered, and the 28-day cylinder tests waived.

(4) Independent Assurance.
None required.

G. Fresh (Plastic) Concrete Tests. (Air Content, Unit Weight, Slump, and Temperature).

(1) Tier not applicable.

(2) Certification.
None required.

(3) Acceptance.
Air content, unit weight, slump and temperature of fresh concrete will be determined as required to maintain control and when strength test specimens are made (DOT-23, DOT-54).

Self-Consolidating Concrete (SCC):

Air Content, unit weight, slump flow, visual stability index, J-ring, and temperature of fresh concrete will be made each time a cylinder for

compressive strength determination is made. Additional determinations will be made to ensure proper control, and not less than one determination for each 2 hours of mixing-placing operations (DOT-23).

- (4) Independent Assurance.
One per project.

H. Metal Components.

- (1) Tier 2.
- (2) Certification.
 - (a) Bars, plates, structural shapes, and anchorage assembly. A Certified Copy of the Mill Test Report for each heat number.
 - (b) Pre-stressing strands.
A Certified Copy of the Mill Test for each shipment.
 - (c) Reinforcing wire mesh.
A Certified Copy of the Mill Test for each shipment.
 - (d) Reinforcing bars.
Certification will be in accordance with paragraph 11.24 D.(2).

Umbrella Certification - (DOT-99) When pre-cast/pre-stressed components are fabricated within the State of South Dakota.
- (3) Acceptance.
 - (a) Bars, plates, structural shapes, and anchorage assembly.
None required.
 - (b) Pre-stressing strands.
One sample per shipment. Sample size: One 2 ft. section.
 - (c) Reinforcing wire mesh.
None required.
 - (d) Reinforcing bars.
Acceptance will be in accordance with paragraph 11.24 D.(3).
- (4) Independent Assurance.
None required.

11.22 Precast Concrete Products Miscellaneous.

This includes all Items listed on the DOT-54 form that are not class pipe or pipe ends. This also includes right-of-way monuments, drop inlets, manholes and other precast concrete products not covered under MSTR 11.17, 11.18, or 11.21.

A. Material.

(1) Tier 3.

(2) Certification.
None required.

(3) Acceptance.
Concrete
The Central Testing Laboratory will perform compressive strength tests on cylinders made by the manufacturer and document the results in the form of a Concrete Pipe Release Date report.

Prior to installation, a documented Visual Inspection for valid release dates, defects, or damage will be made. (DOT-214)

One sample for each size and source of fine and coarse aggregate will be sampled and tested for quality and sieve analysis annually. (DOT-1, DOT-3)

(4) Independent Assurance.
None required.

11.23 Signing Materials.

A. Aluminum (Sheet and Extruded).

(1) Tier 2.

(2) Certification.
Umbrella Certificate. (DOT-99)

If records are audited, the Contractor must produce a Certified Copy of the Mill Test Report.

(3) Acceptance.
Documented measurements and Visual Inspection.

(4) Independent Assurance.
None required.

B. Posts.

(1) Tier 2.

(2) Certification.
(a) Steel.
Umbrella Certificate. (DOT-99)

If records are audited, the Contractor must produce a Certified Copy of the Mill Test Report.

(b) Wood.
Umbrella Certificate. (DOT-99)

If records are audited, the Contractor must produce a Certificate of Compliance covering posts, preservative, and treatment for each type and source.

- (3) Acceptance.
 - (a) Steel.
Documented measurements and Visual Inspection, as applicable, for coating, weight per foot, hole spacing, etc.
 - (b) Wood.
Prior to use, documented inspection and Visual Inspection for size, soundness, and straightness.
- (4) Independent Assurance.
None required.

C. Reflective Sheeting.

- (1) Tier 2.
- (2) Certification.
Umbrella Certificate. (DOT-99)

If records are audited, the Contractor must produce a Certificate of Compliance.
- (3) Acceptance.
Documented Visual Inspection for type of sheeting.
- (4) Independent Assurance.
None required.

11.24 Steel.

A. Guardrail Cable.

- (1) Tier 2.
- (2) Certification.
Umbrella Certificate. (DOT-99)

If records are audited, the Contractor must produce a Certified Copy of the Mill Test Report.
- (3) Acceptance.
Documented Visual Inspection for size and coating.
- (4) Independent Assurance.
None required.

B. Smooth Dowel Bars (Includes Bars in Dowel Bar Assemblies).

- (1) Tier 2.

- (2) Certification.
A Certified Copy of the Mill Test Report for the steel, and when the bars are epoxy coated, a Certificate of Compliance stating that the coating material and coating process conforms to specifications.
- (3) Acceptance.
None required.
- (4) Independent Assurance.
None required.

C. Support Baskets for Dowel Bars and Tie Bars.

- (1) Tier 3.
- (2) Certification.
None required.
- (3) Acceptance.
Documented Visual Inspection.
- (4) Independent Assurance.
None required.

D. Reinforcing Bars, Deformed Dowel Bars, and Deformed Tie Bars.

- (1) Tier 2.
- (2) Certification.
From a certified supplier: None required.

From a non-certified supplier, all epoxy coated bars and stainless steel: A Certified Copy of the Mill Test Report showing the chemical analysis and physical properties for each heat or lot number will be furnished. Deliveries to the project will be identified by heat numbers, using metal or weather and wear resistant tags wired to the bundles.

A Certificate of Compliance stating that the epoxy coating, the coating process, and the quality/production report(s) conform to specifications.

- (3) Acceptance.
One sample, two 24 in. lengths, per source, per project from a randomly selected size, (do not submit bars larger than #8 for testing) representing not more than 3 sizes or 3 heat numbers to be tested for physical properties in the Central Laboratory for all bars (Excludes black steel listed on the Approved Products List). (DOT-1)

From a certified supplier and for uncoated bars: Documented Visual Inspection for rust scales, proper grade markings, and signs of mishandling.

From a non-certified supplier, all epoxy coated bars and stainless steel: Documented Visual Inspection on delivery to the project including heat number, size, length, shape, and condition of shipment.

On epoxy coated bars, check for voids, holes, cracks, and handling and shipping damage to epoxy coatings. Each bundle of steel will be marked with a metal or weather and wear resistant tag showing the heat number(s) represented. The tags will be secured to the appropriate bundles, so the heat numbers can be checked against the shipping papers and the Certified Mill Test Reports.

- (4) Independent Assurance.
None required.

E. Wire Ties and Spacers.

- (1) Tier 3.
- (2) Certification.
None required.
- (3) Acceptance.
Documented Visual Inspection.
- (4) Independent Assurance.
None required.

F. Reinforcing Wire Mesh.

- (1) Tier 3.
- (2) Certification.
A Certified Copy of the Mill Test Report showing the chemical analysis and physical properties for each heat or lot number will be furnished. Deliveries to the project will be identified by heat numbers, using metal or weather and wear resistant tags wired to the bundles.
- (3) Acceptance.
Documented Visual Inspection for gage, spacing and coating.
- (4) Independent Assurance.
None required.

G. Structural (Includes Steel Bridge Girders, Trusses, Arches, Main Supporting Members, Steel Bridge Rail, Steel Diaphragms, Sign Bridges, Splice Plates and Bearings).

- (1) Tier 1.
- (2) Certification.
A Certified Copy of the Mill Test Report for each heat or lot number. Also, shop fabrication inspector's report certifying that material used is represented by the mill test.
- (3) Acceptance.
Documented measurements and Visual Inspection for size and coating.

- (4) Independent Assurance.
None required.

H. Miscellaneous Steel (Includes all steel not addressed in 11.24 G).

- (1) Tier 2.
- (2) Certification.
A Certified Copy of the Mill Test Report for each heat or lot number.
Also, shop fabrication inspector's report (If applicable) certifying that material used is represented by the mill test.
- (3) Acceptance.
Documented measurements and Visual Inspection for size and coating.
- (4) Independent Assurance.
None required.

I. Guardrail and Steel Guardrail Posts.

- (1) Tier 2.
- (2) Certification.
Umbrella certificate. (DOT-99) Refer to 11.3.A for guardrail bolts.

If records are audited, the Contractor must produce a Certified Copy of the Mill Test Report.
- (3) Acceptance.
Documented measurements and visual inspection for size, type, and coating.
- (4) Independent Assurance.
None required.

J. W Beam Guardrail Flared End Terminal, and W Beam Guardrail Tangent End Terminal

- (1) Tier 2
- (2) Certification.
None required. Must be from APL.
- (3) Acceptance
Documented Visual Inspection for size, type, and coating.
- (4) Independent Assurance.
None required.

K. High Tension Cable Guardrail

- (1) Tier 2
- (2) Certification.
Certificate of Compliance.

(3) Acceptance
Documented Visual Inspection for size, type, and coating.

(4) Independent Assurance.
None required.

L. Insert Assemblies for Guardrail.

(1) Tier 2.

(2) Certification.
APL: None required.
Non-APL: A Certified Copy of the Mill Test Report.

(3) Acceptance.
Documented measurements and Visual Inspection for size, type, and coating.

(4) Independent Assurance.
None required.

M. Rebar Splice.

(1) Tier 2.

(2) Certification.
Certificate of Compliance.

(3) Acceptance.
Visual Inspection of epoxy coating when applicable.

(4) Independent Assurance.
None required.

N. Concrete Inserts.

(1) Tier 2.

(2) Certification.
Certificate of Compliance.

(3) Acceptance.
None required.

(4) Independent Assurance.
None required.

11.25 Timber.

A. Structural.

(1) Tier 2.

(2) Certification.
A Grade Certificate by a Certified Lumber Association inspector for each shipment.

A treatment certificate, if applicable, by the company applying the treating agent, for each shipment. The certificate will show analysis of treating agent, penetration, and retention. This certificate may be submitted as an "open file" so that subsequent shipments from the same treatment may be referred to the certificate on file by tagging or other means of identification.

A Certificate of Origin by the fabricator, jobber, or other supplier stating that the shipment of material furnished is that represented by the grade, or grade and treatment, certificate above.

- (3) Acceptance.
None required.
- (4) Independent Assurance.
None required.

B. Guardrail Posts.

- (1) Tier 2.

- (2) Certification.

Job site accepted posts: A Certificate of Compliance covering posts, preservatives, and treatment is required.

Plant site accepted posts: None required.

- (3) Acceptance.
Job site accepted posts: One sample per charge or shipment.

Sample size: A minimum of 20 cores taken approximately midpoint of the posts. No more than one core per post is permitted. The minimum core length will be 3 in. (DOT-1)
None required for contract quantities less than 20 posts.

Documented Visual Inspection for size, soundness, and straightness.

Plant site accepted posts: Bundled guardrail posts will have a round tag stamped "South Dakota Department of Transportation Inspected" and a number. In addition, each post will have "DOT" in 1/2 in. letters stamped on one end.

For bundled posts, the State inspector must retrieve the tag and send it to the Certification Engineer with documentation of the date, tag number(s), number of posts, size of posts, soundness, straightness and the name of the supplier. Each bundle that has a DOT numbered tag may be accepted without further preservative testing.

For loose posts that are stamped "DOT" on one end, documentation must show the number of posts, size of posts, date, supplier, and a statement that each post was stamped.

If contract quantities are less than 20 posts, bundle tags are not required, however, Visual Inspection will be documented to verify that posts came from a certified supplier.

Bundles received that are not tagged must be sampled at the job site. Posts should not be used until satisfactory test results are received.

- (4) Independent Assurance.
None required.

C. Plank, etc.

- (1) Tier 2.

- (2) Certification.
A Certificate of Compliance covering the item and, if applicable, treating agent and treatment is required.

- (3) Acceptance.
Documented Visual Inspection or size, straightness, etc..

- (4) Independent Assurance.
None required.

11.26 Concrete Patching Materials.

A. Material

- (1) Tier 2.

- (2) Certification
A Certificate of Compliance is required.

- (3) Acceptance
Visual Inspection.

- (4) Independent Assurance.
None required.

12. Pavement Restoration:

General Notes:

The Minimum Sample and Test Requirements (MSTR) outlined in paragraph 5.1 A. will apply to the aggregate, except that a minimum of one independent assurance (IA) test will be required per project. None required for contract quantities less than 100 yd³.

The Minimum Sample and Test Requirements (MSTR) outlined in paragraphs 6.1 B. through 6.5 E. will apply to the balance of the materials unless changed below.

Self-Consolidating Concrete: Air Content, unit weight, slump flow, visual stability index, J-ring, and temperature of fresh concrete will be made each time a cylinder for compressive strength determination is made. Additional determinations will be made to ensure proper control, and not less than one determination for each 2 hours of mixing-placing operations (DOT-23).

Samples or tests will not be specifically required for contract quantities of 25 yd³ or less. Documentation of visual inspection that materials, methods, and equipment are satisfactory, will be provided.

12.1 PCC Pavement Repair.

A. Silicone.

(1) Tier 2.

(2) Certification.

Item used must be on the Approved Products List.

(3) Acceptance.

One component silicone: One 1 pt. sample (In paint sample can) per lot, per source.

In Place: After the silicone has cured 7 days, 5 random samples approximately 3 in. in length will be cut per 1/2 mile of roadbed from the in place material to check bonding, width, thickness, shape and non-adherence to backer rod. The results of these measurements will be documented. (SD 421)

When only the joints within or adjacent to the repair areas are sealed, the lot of 5 samples will be selected per 7,500 yd² of area repaired.

Acceptance samples of silicone or in place tests are not required for projects that have 500 ft. or less of joints to be sealed provided, the basis of acceptance is documented.

(4) Independent Assurance.

None required.

B. Backer Rod.

(1) Tier 2.

- (2) Certification.
APL: None required.
Non-APL: A Certificate of Compliance is required.
- (3) Acceptance.
None required.
Perform test according to A (3) under silicone.
- (4) Independent Assurance.
None required.

C. Hot Poured Elastic Type.

- (1) Tier 2.
- (2) Certification.
APL: None required.

Non-APL: A Certificate of Compliance is required.
- (3) Acceptance.
One 5 lb. sample representing each lot or batch will be taken from the application wand during the sealing process. The sample will be placed in a Teflon or silicone lined box having a minimum capacity of 5 lbs.

None required for contract quantities of 200 lbs. or less.
- (4) Independent Assurance.
None required.

D. Backer Rod (Hot Pour).

- (1) Tier 2.
- (2) Certification.
APL: None required.
Non-APL: A Certificate of Compliance is required.
- (3) Acceptance.
One 2 ft. length submitted with the joint material. (DOT-1)

None required if less than 200 lbs. of sealant is used, provided basis of acceptance is documented.
- (4) Independent Assurance.
None required.

12.2 Joint and Spall Repair.

- A. Concrete from Ready-Mix Plants.
The minimum sample and test requirements outlined in paragraph 5.1 A. and paragraphs 6.1 B., 6.1 C., 6.1 D., and 6.1 E. will apply, except as follows.

Acceptance samples of cement from a non-certified supplier and each size aggregate will be taken when:

- (1) There has been a delay of three or more days' production of material used on the project.
- (2) The production of the ready-mix plant indicates that the material represented by the prior samples has been exhausted on other construction.

B. Commercial Pre-Packaged Mix.
Item is classified as a Tier 2 material.

C. Fly Ash.
The minimum sample and test requirements outlined in paragraph 6.1 F. will apply, except the acceptance samples will consist of one sample per source. Sample size: 4 lb. sample per 25 ton.

D. Silicone.

(1) Tier 2.

(2) Certification.
Item used must be on the Approved Products List.

(3) Acceptance.
One component silicone: One 1 pint. sample (in paint sample can) per lot, per source. (DOT-1)

In Place: After the silicone has cured 7 days, 5 random samples approximately 3 in. in length will be cut per 1/2 mile of roadbed from the in place material to check bonding, width, thickness, shape and non-adherence to backer rod. The results of these measurements will be documented. (SD 421)

When only the joints within or adjacent to the repair areas are sealed, the lot of 5 samples will be selected per 7,500 yd² of area repaired.

Acceptance samples of silicone, or in place tests are not required for projects that have 500 ft. or less of joints to be sealed, provided, the basis of acceptance is documented.

(4) Independent Assurance.
None required.

E. Backer Rod.

(1) Tier 2.

(2) Certification.
APL: None required.
Non-APL: A Certificate of Compliance is required.

(3) Acceptance.
None required.

(4) Independent Assurance.
None required.

F. Hot Poured Elastic Type.

(1) Tier 2.

(2) Certification.
APL: None required.
Non-APL: A Certificate of Compliance is required.

(3) Acceptance.
One 5 lb. sample representing each lot or batch will be taken from the application wand during the sealing process. The sample will be placed in a Teflon or silicone lined box having a minimum capacity of 5 lbs. (DOT-1)

None required for contract quantities of 200 lbs. or less.

(4) Independent Assurance.
None required.

G. Backer Rod (Hot Pour).

(1) Tier 2.

(2) Certification.
APL: None required.
Non-APL: A Certificate of Compliance is required.

(3) Acceptance.
One 2 ft. length submitted with the joint material. (DOT-1)

None required if less than 200 lbs. of sealant is used, provided basis of acceptance is documented.

(4) Independent Assurance.
None required.

H. Epoxy Resin

(1) Tier 2.

(2) Certification
A Certificate of Compliance is required.

(3) Acceptance
None.

(4) Independent Assurance.
None required.

12.3 Pavement Jacking and Undersealing.

- A. Portland Cement.
The minimum sample and test requirements outlined in paragraph 6.1 C. will apply, except the acceptance samples from a non-certified supplier will be one per 50 ton, per source.
- B. Fly Ash.
The Minimum Sample and Test Requirements (MSTR) outlined in paragraph 6.1 F. will apply, except the acceptance samples will consist of one sample per 5 conveyances. The sample will be a 4 lb. sample taken from a randomly selected conveyance.
- C. Water.
The Minimum Sample and Test Requirements (MSTR) outlined in paragraph 6.1 D. will apply.
- D. Strength Tests.
The Minimum Sample and Test Requirements (MSTR) outlined in paragraph 6.2 A. will apply, except strength tests for acceptance will be at the rate of one set of cylinders per day.

Watertight, one piece, plastic cylinder molds will be used for making cylinders.

- E. Flow Test.
 - (1) Tier not applicable.
 - (2) Certification.
None required.
 - (3) Acceptance.
One per day for the first three days, thereafter each time the mix is changed. (ASTM C 939)
 - (4) Independent Assurance.
None required.
- F. Jacking Foam.
 - (1) Tier 2.
 - (2) Certification.
Certificate of Compliance.
 - (3) Acceptance.
Visual Inspection.
 - (4) Independent Assurance.
None required.

13. Bridge Deck Restoration:

General Notes:

The Minimum Sample and Test Requirements (MSTR) outlined in paragraphs 6.1 through 6.5 and 6.9 will apply unless changed below.

Testing for moisture content in the fine & coarse aggregate will not be required for this material.

13.1 Density Tests, Low Slump Bridge Deck Concrete.

- A. Density, In Place.
 - (1) Tier not applicable.
 - (2) Certification.
None required.
 - (3) Acceptance.
One test per day, per structure, per 1,000 yd². (DOT-56)
 - (4) Independent Assurance.
One per project.
- B. Density, Standard.
 - (1) Tier not applicable.
 - (2) Certification.
None required.
 - (3) Acceptance.
Two unit weight determinations made on the first pour, then one unit weight determination per pour thereafter. (DOT-56)
 - (4) Independent Assurance.
None required.

13.2 Bridge Deck Polymer Chip Seals

- A. Polymer
 - (1) Tier 2.
 - (2) Certification
Item must be on the Approved Products List
 - (3) Acceptance
Pull off test performed by Contractor as specified in Section 491 of the Standard Specifications.
 - (4) Independent Assurance.
None required.

B. Concrete Patching Materials

- (1) Tier 2.
- (2) Certification
A Certificate of Compliance is required.
- (3) Acceptance
Visual Inspection.
- (4) Independent Assurance.
None required.

C. Aggregate

- (1) Tier 3.
- (2) Certification
Certified Analysis.
- (3) Acceptance
Moisture Content.
One per structure. (DOT-35)
- (4) Independent Assurance.
None required.

13.3 Measurement of Bridge Deck Texture.

A. Tined Surface.

- (1) Tier not applicable.
- (2) Certification.
None required.
- (3) Acceptance.
One per structure, per pour, per 1,000 yd². (SD 418) (DOT-55)
- (4) Independent Assurance.
None required.

13.4 Measurement of Bridge Deck Roughness.

A. Surface.

- (1) Tier not applicable.
- (2) Certification.
None required.
- (3) Acceptance.
When profilograph testing is not required, test in accordance with SD 417. (DOT-28)

On projects where profilograph tests are required, coordinate with the contractor. Operation of the profilograph is the responsibility of the Contractor. Calibration of the profilograph is required.

- (4) Independent Assurance.
None required.

Table of Contents

Soils Section

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SD 106	Density of Soils In-place by the Rubber Balloon Method	3
SD 107	Direct Shear Test of Soils Under Consolidated Drained Conditions.....	1
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SD 109	One-Dimensional Consolidation Properties of Soils.....	1
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SD 111	Method to Determine Durable Material Retained on $\frac{3}{4}$ " Material	2
SD 112	Blank	
SD 113	Blank	
SD 114	Determination of In-place Density of Soils and Aggregates by Nuclear Method	6
SD 115	Blank	
SD 116	Blank	

Procedure for Moisture Content Determination for Soils and Aggregate

1. Scope:

This test is for determining the moisture content of soils and aggregates by drying on a stove or hot plate, drying in a convection or microwave oven, and the nuclear method of in-place moisture tests.

2. Apparatus:

2.1 Stove top or hot plate method.

- A. Stove or hot plate.
- B. Steel plate(s), approximately 1/4" thick to place between the burner(s) and the sample pan.
- C. Pan of sufficient size to contain the material and allow room for stirring without loss of material.
- D. Spoon or trowel for stirring the material during the drying process.
- E. Scale or balance having the capacity to weigh any sample which may be tested utilizing this procedure and readable to the nearest 0.1 gram.
- F. Gloves.

2.2 Oven drying method.

- A. Drying oven – Thermostatically controlled, preferably of the convection forced-draft type, capable of being heated continuously at a uniform temperature of $230^{\circ} \pm 9^{\circ}\text{F}$ throughout the drying chamber.
- B. Scale or balance having the capacity to weigh any sample which may be tested utilizing this procedure and readable to the nearest 0.1 gram.
- C. Pan of sufficient size to contain the material and allow room for stirring without loss of material.
- D. Stirring spoon or trowel.
- E. Gloves.

2.3 Nuclear method – In-place moisture test.

- A. A nuclear moisture/density gauge capable of determining moisture/densities by the direct transmission method and conforming to the requirements of AASHTO T 310.

- B. A reference standard block for taking standard counts.
- C. A drill rod, extraction tool and combination guide-scraper plate for preparing the test site and punching the hole for the source rod.
- D. A manufacture's instruction manual for the nuclear gauge.
- E. A nuclear gauge Information book, transportation documents book, nuclear badge, and metal storage box.
- F. A hammer to drive the drill rod, and a shovel and other tools for site preparation.

2.4 Microwave oven method.

- A. Microwave oven with vented chamber, variable power controls and output power rating of 1000 watts is adequate.
- B. Scale or balance having the capacity to weigh any sample which may be tested utilizing this procedure and readable to the nearest 0.1 gram.
- C. Containers (Must be suitable for microwave ovens-i.e., nonmetallic and resistant to sudden and extreme temperature change; porcelain, or glass).
- D. Glove or holder for handling hot containers.
- E. Spatulas, putty knives and glass rods.

3. Procedure:

3.1 Stove top or hot plate method.

- A. Obtain a sample of wet material weighing a minimum of 100 grams for soils and a minimum of 500 grams for granular materials. See nominal size chart below for minimum sample size for concrete aggregates.

Nominal maximum size of particles	Minimum weight of sample, grams
#4	500
3/8"	1000
1/2"	2000
3/4"	2500
1"	3500
1 1/2" & above	5000

- B. Weigh the material to the nearest 0.1 gram and dry it to a constant weight. Constant weight is achieved when two successive periods of drying indicate no change in the weight of the material. Check the first

two samples tested on a project and an occasional sample thereafter for constant weight, to ensure that sufficient drying time is being allowed.

The sample usually has been dried to constant weight, when, using a cool metal spoon or spatula, the sample is briefly stirred and there is no evidence of moisture or material sticking to the metal of the stirring instrument.

- C. Place the steel plate on the burner of the stove or gas hot plate. Steel plates are not required on electric hot plates. Place the pan holding the material on the steel plate.
- D. Stir the material during drying to prevent the temperature of the sample from exceeding $230^{\circ} \pm 9^{\circ}\text{F}$.
- E. If it is found that samples dried in an oven and those dried on top of the stove do not give test results that compare satisfactorily, use the oven dried method.

Cool until the container can be handled comfortably with bare hands and the operation of balance or sieves on which sample is placed are not affected by heat convection from material/pan.

3.2 Oven drying method.

- A. Obtain a sample of wet material weighing a minimum of 100 grams for soils and a minimum of 500 grams for granular materials. See nominal size chart in 3.1.A for minimum sample size for concrete aggregates. Weigh wet material and record to the nearest 0.1 gram.
- B. Place in dry, clean pan and place in the oven maintained at $230^{\circ} \pm 9^{\circ}$. Stirring the sample periodically during drying accelerates the process.
- C. Dry the material to a constant weight and weigh to the nearest 0.1 gram. Constant weight is achieved when two successive periods of drying indicate no change in the weight of the material. Check the first two samples tested on a project and occasional sample thereafter for constant weight, to ensure that sufficient drying time is established for material being tested and apparatus being used.

Cool until the container can be handled comfortably with bare hands and the operation of balance or sieves on which sample is placed are not affected by heat convection from material/pan.

3.3 Nuclear method – In-place moisture test.

- A. Calibration and performing the standard count of the nuclear gauge shall be in accordance with SD 114, paragraph 3.1 and 3.2.

- B. Select a location for the test where the gauge will be at least 2' away from any vertical projection, at least 10' away from any vehicle and at least 30' away from another nuclear gauge.
- C. Remove material, as necessary, to reach the top of the compacted lift to be tested. Prepare a horizontal area, sufficient in size to accommodate the gauge, using the scraper plate supplied with the gauge, by planing to a smooth condition to obtain maximum contact between the gauge and the material being tested. Make sure the gauge sits solidly on the site without rocking.
- D. The maximum depressions beneath the gauge shall not exceed 1/8". Use native fines or fine sand to fill voids and level the excess with the scraper plate. The total areas thus filled with fines or sand should not exceed 10% of the bottom area of the gauge.
- E. Place the guide scraper plate on the prepared test site and drive the drill rod with the extraction tool attached through the guide to a depth at least 2" below the depth of material to be measured. Remove the drill rod by pulling straight up and twisting the extraction tool, in order to avoid disturbing the hole.
- F. Place the nuclear gauge over the test site and extend the source rod into the hole to the desired depth. Release the trigger at the desired depth and listen for the "Click" indicating that the source rod is properly locked into position on the index rod. Verify the depth shown on the display of the gauge agrees with the actual depth of the source rod. Slide the gauge so the surface of the source rod nearest the keypad is in contact with the edge of the hole.
- G. Take a one-minute reading to determine the % moisture and record this number. It is recommended that you take more than one reading and average the results. At the completion of the % moisture measurements, dig up the area beneath the gauge to collect the moisture specimen if a comparison is to be performed and visually check for large voids or inconsistent material which may give inaccurate results. If a large void or inconsistent material is encountered, disregard the test and move to a nearby location.
- H. Correction determination: At least five tests must be performed using the nuclear gauge on mechanically compacted material and compared against oven dry moisture tests to compute a moisture correction. Take the moisture sample from the top of the lift to the depth of the source rod directly below the nuclear gauge and immediately place in an airtight container for moisture testing using the oven dry method. Use the DOT-39 to calculate the moisture correction. If an individual comparison is determined which is not within 2.0 % of the correction (Running average) calculated from the previous five individual comparisons, the results

shall be considered suspect and additional checks should be run to determine if the material has changed.

- I. After the moisture correction is determined, it is applied to future tests performed with the nuclear gauge. Each type of material shall have a different correction. Embankment material shall have a correction determination separate from surfacing material. Corrections are not interchangeable between nuclear gauges and must be individually determined. If a change in project, change in material source, unusually high or low % moisture readings, considerable changes in sieve analysis, or visual change in material, additional checks should be completed and documented on a DOT-39.

The nuclear gauge moisture reading shall never be used for determination of in-place dry density.

- J. Additional comparison checks against the oven dry method shall be performed at a minimum of at least once per 20 moisture tests. Results shall be documented on the DOT-39 worksheet and the correction (Running average) reevaluated for the five most recent in place moisture comparison tests performed.
- K. If a discrepancy exists, contact the Region Materials Engineer.

3.4 Microwave oven moisture test method. (Excluding Concrete Coarse Aggregate)

- A. Determine the weight of a clean, dry container or dish, and record it on the applicable worksheet as "Wt. of container".
- B. Cut or break up the soil into small size aggregations to aid in obtaining quicker and more uniform drying of the specimen. Obtain a sample of wet material weighing a minimum of 100 grams for soils and a minimum of 500 grams for aggregates. Place the sample in the container, and immediately determine and record the weight to the nearest 0.1 gram.
- C. Place the sample and container in a microwave oven and turn the oven on for 3 minutes. If experience with a particular soil type and specimen size indicates shorter or longer initial drying times can be used without overheating, the initial and subsequent drying times may be adjusted.

The 3-minute initial setting is for a minimum sample size of 100 grams. Smaller samples are not recommended when using the microwave oven because drying may be too rapid for proper control. Large samples may need to be split into segments and dried separately.

Most ovens have a variable power setting. For most soils tested, a setting of "High" should be satisfactory; however, for some soils such a setting may be too severe. The proper setting can be determined only through the use of and experience with a particular oven for various soil

types and sample sizes. The energy output of microwave ovens may decrease with age and usage; therefore, power settings and drying times should be established for each oven.

- D. After the set time has elapsed, remove the container and soil from the oven, weigh the specimen as soon as the container may be handled safely to the nearest 0.1 gram and record the weight.
- E. With a small spatula, knife, or short length of glass rod, carefully mix the soil, taking special precaution not to lose any soil.
- F. Return the container and soil to the oven and reheat for 1 minute.
- G. Repeat (D) through (F), until a constant weight has been achieved as per SD 108.
- H. Use the final weight to calculate the moisture content. Obtain this value immediately after the heating cycle, as soon as the container may be handled safely.

Incremental heating, together with stirring, will minimize overheating and localized drying of the soil. The recommended time increments have been suitable for most specimens having particles smaller than a #4 sieve and with a sample of approximately 200 g; however, they may not be appropriate for all soils and ovens, and adjustment may be necessary.

Cool until the container can be handled comfortably with bare hands and the operation of balance or sieves on which sample is placed are not affected by heat convection from material/pan.

Moisture content specimens should be discarded after testing and not used in any other tests due to particle breakdown, chemical changes or losses, melting, or losses of organic constituents.

4. Report:

- 4.1 Calculations for stove top or hot plate, oven drying, and microwave oven methods.

Calculate the percent of moisture for the drying on a stove or hot plate, oven drying, and microwave oven methods as follows:

Moisture content =

$$\frac{\text{Weight wet material} - \text{weight dry material}}{\text{Weight dry material}} \times 100$$

4.2 Calculations for the nuclear method – In-place moisture test on DOT-39.

A = % moisture determined by oven dried method.

B = % moisture determined by the nuclear gauge.

$C = A - B$

D = Correction (Running average) of 5 most recent valid values of C in %

Moisture content = nuclear moisture + correction (Running average).

5. References:

AASHTO T 310
AASHTO T 265
SD 114
SD 311
DOT-35
DOT-39
DOT-41

Sample ID **2413622**
File No.

Moisture - Density Worksheet

DOT-35
3-19

County Minnehaha PCN/PROJECT 03RA IM 0293(106)76
Field Nbr E001-E006 Tested By: Tester, One Checked By: Tester, Two Test Date: 04/02/2024
Material Type Total Excavation

Test No.	E001	E002	E003	E004	E005	E006	
Sampled at Station	44+25	36+57	34+75	37+30	41+30	36+25	
Distance from CL	22' L	10' L	15' L	5' R	22' R	13' R	
Represents Sta. - Sta.	27+00	27+00	27+00	27+00	27+00	27+00	
Depth Below Grade or Top of Pipe	4.5'	6'	5.5'	5'	2'	4.5'	
	Below Grade	Below Grade	Below Grade	Below Grade	Below Grade	Below Grade	Below Grade
1-Point not made - Refer to Moisture or Density No.							
Correction							
Field Comparison							

Nuclear Test... ☐ ☐ ☐ ☒ ☒ ☒ ☐

Field Moisture

Time	7:35 am	9:30 am	11:30 am	1:30 pm	3:30 pm	5:30 pm	
Wt. of Can and Material / Meter No.	155.7	120.8	142.5	MQ 778	MQ 778	MQ 778	
Wt. of Can and Dry Material	133.7	99.6	119.6				
Wt. Loss (moisture) Speedy Reading	22.0	21.2	22.9	656.0	656.0	656.0	
Standard Moisture Count							
Wt. of Can/Wt. of Speedy Sample				21.6	20.8	20.6	
Pct Moisture From Meter							
Wt. of Dry Material	133.7	99.6	119.6				
Moisture Correction (+/-)							
Percent Moisture	16.5	21.3	19.1				

1-Point Determinations

A-2-4 or A-3 Soil or QC/QA Asphalt Concrete or Test Strip	☐	☐	☐	☐	☐	☐	☐
Wt. of Can and Wet Material	157.8	134.8	134.8	112.7	126.2	112.7	
Wt. of Can and Dry Material	135.8	115.0	115.0	93.6	105.7	93.6	
Wt. Loss	22.0	19.8	19.8	19.1	20.5	19.1	
Speedy Reading							
Wt. of Can							
Wt. of Dry Material							
Percent Moisture	16.2	17.2	17.2	20.4	19.4	20.4	
Wt. of Mold and Wet Specimen	13.32	13.37	13.37	13.40	13.37	13.40	
Wt. of Mold	9.23	9.23	9.23	9.23	9.23	9.23	9.23
Wt. of Wet Specimen	4.09	4.14	4.14	4.17	4.14	4.17	
Mold No.	P-1885	P-1885	P-1885	P-1885	P-1885	P-1885	P-1885
Factor of Mold	30.01	30.01	30.01	30.01	30.01	30.01	30.01
Wet Density Lbs/cuft (Kg/m)	122.7	124.2	124.2	125.1	124.2	125.1	
Dry Density Lbs/cuft (Kg/m)	105.6	106.0	106.0	103.9	104.1	103.9	
Curve Used / Curve Family	O O	o O	o O	P O	p O	P O	
Max Dry Dens. From Ohio Curve Lbs/cuft (Kg/m)	107.1	105.9	105.9	104.7	103.5	104.7	
Optimum Moisture from Ohio Curve	18.1	18.6	18.6	19.2	19.7	19.2	

Pass/Fail ☒ ☒ ☒ ☒ ☒ ☒

Figure 1

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Aggregate Section

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SD 205	Unit Weight and Voids in Aggregates	4
SD 206	Amount of Material Finer than #200 Sieve	2
SD 207	Liquid Limit, Plastic Limit, and Plasticity Index	8
SD 208	Percentage of Particles Less Than 1.95 Specific Gravity in Fine Aggregates	2
SD 209	Specific Gravity and Absorption in Fine Aggregate	3
SD 210	Specific Gravity and Absorption in Coarse Aggregate	4
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SD 217	Fine Aggregate Angularity	3
SD 218	Scratch Hardness for Coarse Aggregate	4
SD 219	Determining Target Dry Density & In-Place Density of Salvaged/Recycled Materials Using the Nuclear Gauge (Test Strip)	6
SD 220	Sodium Sulfate Soundness of Aggregates	1
SD 221	Sand Equivalent of Fine Aggregate	4

Sieve opening size (Inches)	Maximum amount of material that may be retained in grams			
	8" dia. sieve	12" dia. sieve	13.8" x 13.8" sieve (14"x14" nominal)	14.6" x 22.8" sieve (16"x24" nominal)
4"	N/A	N/A	30,600	53,900
3 1/2"	N/A	15,100	27,600	48,500
3"	N/A	12,600	23,000	40,500
2 1/2"	N/A	10,600	19,300	34,000
2"	3,600	8,400	15,300	27,000
1 1/2"	2,700	6,300	11,500	20,200
1"	1,800	4,200	7,700	13,500
3/4"	1,400	3,200	5,800	10,200
5/8"	1,100	2,700	4,900	8,600
1/2"	890	2,100	3,800	6,700
3/8"	670	1,600	2,900	5,100
1/4"	450	1,100	1,900	3,400
#4	330	800	1,500	2,600
#6 thru #200	200	470	900	1,500

Chart 1

If any sieve is overloaded, make a notation on the gradation sheet and sieve the material retained on that sieve by hand in split portions until the adequacy of sieving requirement is met. Prevent the occurrence of any further overloading of sieves by using one of the following: insert an additional sieve with an opening size in between the overloaded sieve size and the next larger size in the sieve set, start with a smaller sample size to prevent the sieve from being overloaded, split the sample into two or more portions to sieve separately, or use a set of sieves having a larger frame size and providing greater sieving area. Sieve a sufficient amount of time so that the adequacy of sieving is met for all sieve sizes. Try approximately 10 minutes if using a mechanical sieve shaker and increase the time if the adequacy of sieving is not met for all sieve sizes.

- 3.12 Calculate the percentage of material retained on each sieve to the nearest 0.1% by dividing the weight of the retained material by the "Original dry sample weight" determined in 3.6.
- 3.13 Determine the accumulative percent passing each sieve by subtracting the retained percentage for the top sieve from 100.0 and continue subtracting the retained percentage for each sieve from the previous sieves accumulative passing percentage.
- 3.14 If the sample being tested requires a result for percentage of crushed particles, perform the test in accordance with SD 211 using a portion of the aggregate retained on the #4 sieve and above.

If the material being tested requires a result for total - #200, the material from that test can be used to perform the percentage of crushed particles test.

- 3.15 If the sample being tested requires a result for percentage of particles less than 1.95 specific gravity for the + #4 sieve material, perform the test in accordance with SD 214 using a portion of the aggregate retained on the #4 sieve and above.
- 3.16 Using the material from the pan below the #4 sieve, split out samples in accordance with SD 213 to conduct the balance of the required testing. The number and size of samples to be split out will depend on the type of material being tested. Most surface course materials will require a sample to complete the fine portion of the sieve analysis (500 gram min) and one for liquid limit/plastic limit/plasticity index (approximate 500 gram sample). If you are testing uncoated mineral aggregate for asphalt concrete, a third sample will have to be split out for a particles less than 1.95 specific gravity test.
- 3.17 Weigh the sample to be used for the fine portion of the sieve analysis to the nearest 0.1 gram and record the weight on the "Weight before washing" line on the worksheet.
- 3.18 Place the sample in a pan and add enough water to cover it. Agitate the sample with sufficient vigor to result in complete separation of all particles finer than the #200 sieve from the coarser particles and bring the fine material into suspension. Pour the wash water containing the suspended and dissolved solids over a nest of 2 sieves. The lower sieve of the nest will be a #200 and the upper will be in a range of #8 to #16. Both of the sieves will conform to the requirements of ASTM E 11. Repeat the process of adding water, agitating the sample, and pouring the water over the nest of sieves until the wash water is clear.
- 3.19 Dry the washed aggregate to a constant weight in an oven at $230^{\circ} \pm 9^{\circ}\text{F}$, as per SD 108 and weigh to the nearest 0.1 gram. Record this weight on the "Weight after washing" line of the worksheet.
- Cool until the container can be handled comfortably with bare hands and the operation of balance or sieves on which sample is placed are not affected by heat convection from material/pan.
- Subtract the weight of the sample after washing, from the weight of the sample before washing and record the result on the "Loss from washing (- #200)" line and on the "Pan wash" line below the #200 sieve on the sieve analysis.
- 3.20 Assemble a series of sieves that will furnish the information required by the specifications covering the material being tested. Nest the sieves in order of decreasing size of opening from top to bottom and include a pan below the last sieve.
- 3.21 Pour the aggregate into the top sieve of the nest, place the nest of sieves on a mechanical shaker and shake for a sufficient period of time (A minimum of 10 minutes). Adequacy of sieving can be checked as outlined in 3.8 above. The quantity of material retained on any sieve at the completion of the sieving operation will not exceed 4 grams per in^2 of sieve surface area. This amounts to 200 grams for an 8" diameter sieve.

- 3.22 Weigh the material retained on each sieve and in the pan and record the weights on the worksheet to the nearest 0.1 gram. Add the retained weights including the "Pan dry" and "Pan wash" quantities below the #200 sieve. Record this weight on the "Total" line at the bottom of the worksheet. This weight must be within 0.3% of the weight of the sample before washing. If it is not, a new sample will be tested.

Correct brush to use when cleaning sieves.

3/8" to #16 - steel #20 to #50 - brass #80 to > - paint

- 3.23 Complete the calculations for the fine sieves, beginning by dividing the initial sample weight derived in 3.17 above into the retained weights for each sieve and record the results on the worksheet to the nearest 0.1%. Next, multiply these retained percentages times the accumulative percentage passing the #4 sieve determined in 3.13 above and record the results on the worksheet again to the nearest 0.1%. Finally, determine the accumulative percentage passing each of these sieves by subtracting the retained percentage from the previous sieves accumulative passing percentage.
- 3.24 The percentage of material passing each sieve in the coarse and fines portion of the analysis may now be rounded and reported on the worksheet to the nearest whole number except the #200 sieve will be reported to the nearest 0.1%.
- 3.25 Prepare the sample of material split out earlier as outlined in SD 207 for liquid limit/plastic limit/plasticity index. testing.
- 3.26 Perform the liquid limit and plastic limit in accordance with SD 207, calculate the plasticity index, and report the results on the sieve analysis worksheet.
- 3.27 If the sample being tested requires a result for percentage of particles less Than 1.95 specific gravity for the - #4 sieve material, perform the test on the 250 to 350 gram sample split out in 3.16 above in accordance with SD 208.

Process for determining total - #200 materials in asphalt concrete (excludes Blade Laid and Class S):

- 3.28 Following completion of the coarse sieve analysis combine all materials which were retained on #4 sieve and above and split out a sample for total - #200 testing in accordance with SD 213 which meets the requirements shown in the following table.

Nominal maximum size of particles	Minimum weight of sample, grams
#4	500
3/8"	500
1/2"	700
3/4"	1000
1"	1500

- 3.29 Weigh the sample to the nearest 0.1 g and record the weight as "Weight before washing" in the box labeled "(A)" below the coarse sieve area as shown on the enclosed example DOT-3 worksheet.

- 3.30 Place the sample in a pan and add enough water to cover it. Agitate the sample with sufficient vigor to result in complete separation of all particles finer than the #200 sieve from the coarser particles and bring the fine material into suspension. Pour the wash water containing the suspended and dissolved solids over a nest of 2 sieves. The lower sieve of the nest will be a #200 and the upper will be in a range of #8 to #16. Both of the sieves will conform to the requirements of ASTM E 11. Repeat the process of adding water, agitating the sample, and pouring the water over the nest of sieves until the wash water is clear.
- 3.31 Following drying to a constant weight, weigh sample to nearest 0.1 g and record the weight as "Weight after wash" in the box labeled "(B)" below the coarse sieve area as shown on the enclosed example DOT-3 worksheet.
- 3.32 Calculate the percent passing the #200 Sieve (D) for the coarse aggregate by subtracting the "Weight after wash" (B) from the "weight before wash" (A) and dividing that result (C) by the "Weight before wash" (A). Multiply this result times 100. This is the percent - #200 for the coarse aggregate which must be recorded in the two boxes labeled "(D)" on the DOT-3 worksheet.

6.3	1/4		354.6	7.0	67.9	68	
4.75	#4	*	345.4	6.8	(F) 61.1	61	57-67
Pan			3090.1	61.1	D		
TOTAL			5055.1	100.0	wt. before washing (0.1) (A) 1069.3		
+ #4 Gradation Check:					wt. after washing (0.1) (B) 1058.5		
					loss from washing (C) 10.8		
					% - #200 (D) 1.01		
within 0.3% of original dry wt.		0.1%					

- 3.33 To complete the calculations for the total - #200 material, four pieces of information are needed in the - #200 box at the lower left corner of the DOT-3 worksheet. You have already provided one of these in step 3.32 above, ((D) which is the percent passing the #200 sieve on the coarse aggregate sample wash). The other three are: (E) The percent passing the #200 sieve on the fine sieve analysis (This includes the washed and sieved portion), (F) The percentage of material that passed the #4 sieve during the sieve analysis and (G) The percentage of material that was retained on the #4 Sieve. The amount of material retained on the #4 sieve (G) can be determined by subtracting the percent passing the #4 sieve (F) from 100.
- 3.34 Complete the calculations by multiplying the percent - #200 on the coarse sieve aggregate (D) times the percent of material retained on the #4 sieve (G) and multiply the percent - #200 on the fine sieves (E) times the percent of material that passed the #4 sieve (F) and divide each by 100. The result obtained when adding these 2 values is the "Total - #200 material" for this sample.

Example:

The coarse sieve analysis had 61.1% passing the #4 sieve. 100.0% minus 61.1% passing = 38.9% retained on the #4 sieve.

1.01% passed the #200 sieve in the coarse aggregate sample that was washed (D) and 10.06% passed the #200 sieve on the fine sieve analysis (E).

PAN dry		2.5	52.5	6.2	wt. before washing (0.1g)	521.8
PAN wash		50.0	(E) 10.1		wt. after washing (0.1g)	471.8
TOTAL		521.5	loss from washing (- # 200)			50.0
Coarse (D) 1.01	x % Retain/Design (G)	38.9	=	0.39	- #4 Gradation check: within 0.3% of the wt. before washing	
Chip	x % Retain/Design		=			
Fine (E) 10.06	x % Pass/Design (F)	61.1	=	6.15		
Total/Combined - #200				6.5		

Calculations:

$$\text{Retained \#4 sieve (G) } 38.9\% \times \text{(D) } 1.01\% \text{ pass on coarse aggregate} = \frac{0.39}{100}$$

$$\text{Passing \#4 sieve (F) } 61.1\% \times \text{(E) } 10.06\% \text{ pass on fine sieve analysis} = \frac{6.15}{100}$$

$$0.39 + 6.15 = 6.54 \quad \text{or} \quad 6.5\% \text{ total minus \#200 for the sample.}$$

Coarse Aggregate for Concrete:

- 3.35 Obtain a sample in accordance with SD 201. The sample will be large enough to provide specimens for all required testing.
- 3.36 Reduce the sample to the size of the specimens needed for testing by splitting or quartering in accordance with SD 213. Two separate splits will be required; one split for sieve analysis and particles less than 1.95 specific gravity and one split to wash for material finer than #200 sieve.
- 3.37 For the minimum size of samples for the various tests required, see 3.3 above for the sieve analysis, SD 206 for material finer than #200 sieve, SD 214 for particles less than 1.95 specific gravity in coarse aggregate.

Coarse aggregate for lightweight concrete specimens will consist of 0.1 ft³ or more of the material.
- 3.38 Perform the sieve analysis following the procedure outlined in 3.4, 3.6, 3.7, 3.8, 3.9, 3.10, 3.11, 3.12, and 3.13 above. Coarse aggregate for concrete has a specification on the #8 sieve, so it will be necessary to add that sieve to the nest of sieves.
- 3.39 Using the samples split out in 3.36 above, perform the test for material finer than #200 sieve in accordance with SD 206, particles less than 1.95 specific gravity (frequency as per MSTR) in accordance with SD 214. Report the results of these tests on the worksheet in accordance with the guidelines provided by the applicable test procedure.

Fine Aggregate for Concrete:

- 3.40 Obtain a sample in accordance with SD 201. The sample will be large enough to provide specimens for all required testing.
- 3.41 Reduce the sample to the size of the specimens needed for testing by splitting or quartering in accordance with SD 213. The sample will require, a sieve analysis, inclusive of material finer than #200 sieve in accordance with SD 206, and particles less than 1.95 specific gravity in fine aggregate (frequency as per MSTR) in accordance with SD 208.

For other fine aggregates, the number of specimens needed will depend on the testing required for the sample as per specifications or plan notes.

The sample split out for the sieve analysis, inclusive of material finer than #200 sieve, must contain a minimum of 500 grams while the sample for the less than 1.95 specific gravity in fine aggregate test must contain between 250 and 350 grams.

The minimum sample specimen weight for the sieve analysis, inclusive of material finer than #200 sieve, for lightweight fine aggregate will be as shown below:

Wt. of aggregate (lbs./ft ³)	Min. weight of test specimen (grams)
5 to 15	50
15 to 25	100
25 to 35	150
35 to 45	200
45 to 55	250
55 to 65	300
65 to 75	350

- 3.42 Perform the sieve analysis, inclusive of material finer than #200 sieve, in accordance with procedure outlined in 3.17, 3.18, 3.19, 3.20, 3.21, and 3.22 above.

Fine aggregate for concrete has a specification on the 3/8" and #4 sieve, so it will be necessary to add these sieves to the nest of sieves.

- 3.43 Calculate the percentage of material retained on each sieve to the nearest 0.1% by dividing the weight of the retained material by the weight of the sample before washing. Material passing #200 should be calculated to 0.01% and rounded to 0.1%.
- 3.44 Determine the accumulative percent passing each sieve by subtracting the retained percentage for the top sieve from 100.0 and continue subtracting the retained percentage for each sieve from the previous sieves accumulative passing percentage.

- 3.45 The percentage of material passing each sieve may now be rounded and reported on the worksheet to the nearest whole number except the #200 sieve will be reported to the nearest 0.1%.

Process for determining Fineness Modulus (F.M.)

- 3.46 Samples of fine aggregate for concrete require a result for fineness modulus (F.M.). The sieves used for determination of F.M. are identified on the DOT-3 worksheet by an (*). Calculate the F.M. as follows:
- A. Subtract the percentage passing (before rounding) the sieves designated by the (*) from 100.0 and record the result in the column titled F.M. After this has been accomplished on each sieve designated, total the results and divide by 100.
 - B. Report the result to the nearest 0.01%.

Example:

Sieve Size	Percent Passing	100.0 Minus Percent Passing
#4	99.8	0.2
#8	91.5	8.5
#16	67.8	32.2
#30	49.9	50.1
#50	21.5	78.5
#100	3.9	96.1
	Total:	265.2

$$\text{Fineness modulus (F.M.)} = \frac{265.6}{100} = 2.656 \text{ or } 2.66$$

Process for Determining Combined Percentage of Material Passing the #200 sieve

- 3.47 The specifications for aggregates used in concrete require the combined mixture of fine and coarse aggregate be such that not more than a certain percent of the combined materials pass the #200 sieve.

To calculate this combined percentage of material passing the #200 sieve, multiply the percent passing the #200 sieve on the fine and coarse aggregate times the percentage of the sand and rock used in the mix according to the design mix, divide each of the results by 100 and then add them together.

Example:

1.65% passing #200 sieve on coarse aggregate.
 0.95% passing #200 sieve on fine aggregate.
 Coarse aggregate is 64.4% of total aggregate used in the mix.
 Fine aggregate is 35.6% of total aggregate used in the mix.

$$\text{Coarse aggregate } 1.65\% \times 64.4\% / 100 = 1.06\%$$

$$\begin{array}{rclclcl} \text{Fine aggregate} & 0.95\% & \times & 35.6\% & / & 100 & = & 0.34\% \\ \text{Combined - \#200 sieve} & & & & & & = & 1.40 \text{ or } 1.4\%. \end{array}$$

The final percentage will be recorded to the nearest 0.1%.

- 3.48 Perform the test for particles less than 1.95 specific gravity in fine aggregates in accordance with SD 208 and report the results on the worksheet.

Class S, Microsurfacing, Asphalt Surface Treatments and Miscellaneous Fine Aggregate:

- 3.49 Obtain a sample in accordance with SD 201. The sample will be large enough to provide specimens for all required testing.
- 3.50 Reduce the sample to the size of the specimens needed for testing by splitting or quartering in accordance with SD 213. The number of specimens needed will depend on the testing required for the sample as per specifications or plan notes.
- 3.51 The minimum sample size for sieve analysis will be as outlined in 3.3 above. The minimum sample size for other tests will be as per designated test procedures.
- 3.52 If the sample being tested requires a result for flakiness index, perform the test in accordance with SD 203 using a portion of the aggregate retained on the #4 sieve and above.
- 3.53 If the sample being tested requires a result for percentage of crushed particles, perform the test in accordance with SD 211 using a portion of the aggregate retained on the #4 sieve and above.
- 3.54 If liquid limit/plastic limit/plasticity index is required by specifications, a sample of - #4 will be obtained from a separate split. The sample split out for the liquid limit/plastic limit/plasticity index. must be of adequate size to produce at least 100 grams of - #40 sieve material.
- 3.55 The sample will be oven dried to a constant weight at a temperature of $230^{\circ} \pm 9^{\circ}\text{F}$ or in accordance with SD 108.
- 3.56 Weigh the sample and record the weight in the "Weight before washing" line in the fine aggregate portion of the worksheet to the nearest 0.1 gram.
- 3.57 Perform wash as outlined in 3.18 above.
- 3.58 Dry the washed aggregate to a constant weight in an oven at $230^{\circ} \pm 9^{\circ}\text{F}$ as per SD 108 and weight to the nearest 0.1 gram. Record this weight on the "Weight after washing" line in the fine aggregate portion of the worksheet to the nearest 0.1 gram.
- 3.59 Subtract the weight of the sample after washing, from the weight of the sample before washing and record the result on the "Loss from washing (- #200)" line and on the "Pan wash" line below the #200 sieve on the sieve analysis.

- 3.60 Assemble a series of sieves that will furnish the information required by the specifications covering the material being tested. The use of 12" diameter sieves is recommended to prevent sieve overloading.
- 3.61 Pour the aggregate into the top sieve of the nest, place the nest of sieves on a mechanical shaker and shake for a sufficient period of time (A minimum of 10 minutes). Adequacy of sieving can be checked as outlined in 3.8 above. The quantity of material retained on any sieve at the completion of the sieving operation will not exceed the amount listed in "Chart 1" of 3.11 above.
- 3.62 Weigh the material retained on each sieve and in the pan and record the weights on the worksheet to the nearest 0.1 gram. Add the retained weights including the "Pan Dry" and "Pan Wash" quantities below the #200 sieve. Record this weight on the "Total" line at the bottom of the worksheet. This weight must be within 0.3% of the weight of the sample before washing. If it is not, a new sample will be tested.
- 3.63 Calculate the percentage of material retained on each sieve to the nearest 0.1% by dividing the weight of the retained material by the weight of the sample before washing. Material passing #200 should be calculated to 0.01% and rounded to 0.1%.
- 3.64 Determine the accumulative percent passing each sieve by subtracting the retained percentage for the top sieve from 100.0 and continue subtracting the retained percentage for each sieve from the previous sieves accumulative passing percentage.
- 3.65 The percentage of material passing each sieve may now be rounded and reported on the DOT-3 to the nearest whole number except the #200 sieve will be reported to the nearest 0.1%.

Granular Backfill and other Miscellaneous Aggregate:

- 3.66 Obtain a sample in accordance with SD 201. The sample will be large enough to provide specimens for all required testing.
- 3.67 Reduce the sample to the size of the specimens needed for testing by splitting or quartering in accordance with SD 213. The number of specimens needed will depend on the testing required for the sample as per specifications or plan notes.
- 3.68 The minimum sample size for sieve analysis will be as outlined in 3.3 above. The minimum sample size for other tests will be as per designated test procedures.
- 3.69 Perform the sieve analysis following the procedure outlined in 3.4 thru 3.15 above.

Milled, Reclaimed, and Salvaged Material

- 3.70 Obtain a sample in accordance with SD 201.
- 3.71 Reduce the sample to the size of the specimen needed for testing by splitting or quartering in accordance with SD 213.

- 3.72 The minimum sample size for sieve analysis will be as outlined in 3.3 above.
- 3.73 Perform the sieve analysis following the procedure outlined in 3.7 & 3.8 above.

4. Report:

- 4.1 Test results will be reported on form DOT-3 or DOT-68 (These forms do not apply to the Central Lab). Use of the DOT-68 is limited to the following:

- A. Concrete where 2 or more aggregate piles are being weighed during batching to meet a single gradation specification.
- B. Asphalt for mineral aggregate samples on projects utilizing a batch type mixing plant.

- 4.2 Calculations for the DOT-68 are determined as follows:

- A. Enter the "lbs./cu.yd." of rock and chip from the Mix Design on lines (H) and (I).
- B. Divide the "lbs./cu.yd." of the rock and chip by the "Total" to obtain the "Total Agg. %" and multiply by 100 for lines (H) and (I).

Mix Batch Ticket, lbs./cu. yd.; Total Agg %		
1" rock	1374.00	77.6
Chip	396.0	22.4
		0
		0
Total	1770.0	100.0

(H)
(I)

- C. Split a separate sample of rock and chip for gradation and a separate sample of each for wash ensuring that you meet the minimum sample size as per 3.3 and SD 206.
- D. Perform the gradation for each and calculate as per 3.12 – 3.13.

1" rock				Chip			
Sample Wt. (0.1g) 10312.3				Sample Wt. (0.1g) 3098.8			
Sieve Size	Retained (0.1g)	% total ret.(0.1%)	% pass. (0.1%)	Sieve Size	Retained (0.1g)	% total ret.(0.1%)	% pass. (0.1%)
2				2			
1 1/2				1 1/2			
1 1/4				1 1/4			
1	0.0	0.0	100.0	1			
3/4	1431.6	13.9	86.1	3/4			
5/8	2964.8	28.8	57.3	5/8	0.0	0.0	100.0
1/2	1853.9	18.0	39.3	1/2	0.0	0.0	100.0
3/8	2095.4	20.3	19.0	3/8	104.8	3.4	96.6
1/4				1/4	1347.5	43.5	53.1
#4	1798.4	17.4	1.6	#4	935.3	30.2	22.9
#8	60.7	0.6	1.0	#8	616.2	19.9	3.0
Pan Dry	98.4			Pan Dry	90.5		
Pan Wash	0.0			Pan Wash	0.0		
TOTAL	10303.20			TOTAL	3094.30		

E. Calculate the "Gradation Check" as per 3.10.

Gradation Check==> 0.09

Gradation Check==> 0.15

F. Perform the wash as per SD-206 and calculate lines (K) and (M).

G. Multiply line (K) by "Total Agg %", line (H) divide by 100 and enter on line (L) for "Bin adj. -200".

H. Multiply line (M) by "Total Agg %" line (I) divide by 100 and enter on line (N) for "Bin adj. -200".

wt. before wash	3771.0
wt. after wash	<u>3728.2</u>
loss from wash	42.8
% - #200 ==>	1.13 (K)
Bin adj. - #200	0.877 (L)

wt. before wash	2752.8
wt. after wash	<u>2707.1</u>
loss from wash	45.7
% - #200 ==>	1.66 (M)
Bin adj. - #200	0.372 (N)

I. Add lines (L) and (N) and enter on line (O) for "Total Combined -200" for the Coarse Aggregate.

Composite Coarse Aggregate								
Sieve Size	1" rock	Chip			Retained Total	Cumulative % Passing	Spec. Gradation	Job Mix Formula
2					0.0	100.0	100	
1 1/2					0.0	100.0	100	100-100
1 1/4					0.0	100.0	100	
1	0.0				0.0	100.0	100	95-100
3/4	10.8				10.8	89.2	89	
5/8	22.4	0.0			22.4	66.9	67	
1/2	14.0	0.0			14.0	52.9	53	25-60
3/8	15.8	0.8			16.5	36.4	36	
1/4		9.7			9.7	26.6	27	
# 4	13.5	6.8			20.3	6.4	6	0-10
# 8	0.5	4.5			4.9	1.4	1	0-5
Pan	0.7	0.7			1.4	0.1	0	
Total	77.6	22.4	0.0	0.0	99.9			

Total Combined - 200 ==> 1.25 (O)

J. The value from line (O) will then be carried to line (P) to calculate the "Total/Combined -200" with the Fine Aggregate.

You must link the Fine Aggregate test with the Coarse Aggregate in MS&T for this calculation to occur.

K. You must enter the % of Fine Aggregate from the Mix Design on line (Q). Also enter the % of Coarse Aggregate from the Mix Design on line (P). The total of the column "% Retain/Design" must = 100.

L. Calculate the "Total/Combined - #200" as per 3.48

Coarse	1.25%	x % Retain/Design	58.00	=	0.73	(P)
Chip		x % Retain/Design		=		
Fine	1.45%	x % Pass/Design	42.00	=	0.61	(Q)
04 Referenced		Total/Combined - #200	1.3			

M. To calculate the Composite Coarse Aggregate "Retained Total" multiply the "% total ret." from the respective sieve by the "Total Aggregate %" on the Mix Batch Ticket.

Example: (See line (J)) For 3/8 1" Rock multiply 20.3 x 0.776 = 15.75, round to 15.8, and 3/8 Chip multiply 3.4 x 0.224 = 0.76 round to 0.8,

You will round these numbers to report on the form but keep them at two decimal places to add in the next step.

Now add $15.75 + .76 = 16.51$, round to 16.5, this is your "Retained Total" for 3/8.

N. Calculate the "Cumulative % Passing" as per 3.13.

O. If the sample being tested requires a result for percentage of particles less than 1.95 specific gravity for the + #4 sieve material, perform the test in accordance with SD 214 using a portion of the aggregate retained on the #4 sieve and above.

5. References:

AASHTO T 27
ASTM E 11
SD 108
SD 201
SD 204
SD 206
SD 207
SD 208
SD 211
SD 213
SD 214
DOT-3
DOT-68
DOT-69

SD 202 Page 16

Sample ID 2203565

Sieve Analysis and P.I. Worksheet

DOT-3

File No.

3-19

PROJECT PH 0066(00)15

COUNTY Aurora, Ziebach

PCN B015

Charge to (if not above project)

Field No. 01

Date Sampled 03/10/2019

Date Tested 03/10/2019

Sampled By Brown, Benjamin

Tested By Tester, One

Checked By Tester, Two

Material Type Base Course

Source

Lot No.

Sublot No.

Weight Ticket Number or Station

Lift

of

[Wet Sample Weight (0.1g) - Original Dry Sample Weight (0.1g) 7,318.0] / dry weight x 100 = % moisture

Sieve Size	Fineness Modulus	Retained (0.1g)	% total ret. (0.1g)	% passing (0.1g)	% passing (rounded)	Spec Req.
4 in.						
3 in.						
2 1/2 in.						
2 in.						
1 1/2 in.						
1 1/4 in.						
1 in.		0.0	0.0	100.0	100	100 - 100
3/4 in.		167.6	2.3	97.7	98	80 - 100
5/8 in.		240.6	3.3	94.4	94	
1/2 in.		351.7	4.8	89.6	90	68 - 91
3/8 in.	15.0	338.8	4.6	85.0	85	
1/4 in.		625.2	8.5	76.5	77	
#4	31.5	586.2	8.0	68.5	69	46 - 70
Pan		5008.1	68.4			
Total		7,318.2				

+ #4 Gradation Check
within 0.3% of original dry weight 0.00

Dust Check
wt. before washing (0.1g)
wt. after washing (0.1g)
loss from washing
% - #200

Liquid Limit & Plastic Limit

	Liquid Limit	Plastic Limit
A. Can number	45	19
B. Weight of can + wet soil (0.01g)	29.87	28.34
C. Weight of can + dry soil (0.01g)	28.14	27.11
D. Weight of water (B - C) (0.01g)	1.73	1.23
E. Weight of can (0.01g)	19.92	20.17
F. Weight of dry soil (C - E) (0.01g)	8.22	6.94
G. Liquid Limit (D / F x J x 100) (0.1g)	21.2	N.P. □
H. Plastic Limit (D / F x 100) (0.1g)		17.7
I. Plasticity Index (G - H) (0.1g)	3.5	Specification
Liquid Limit N.C. □ (G rounded)	21	0 - 25
Plasticity Index (I rounded)	4	0 - 6
J. Correction # Blows	26	

22=0.9846, 23=0.9899, 24=0.9952, 25=1.0000, 26=1.0050, 27=1.0100, 28=1.0138
weight - #40 181.4 / weight - #4 611.2 x % passing #4 = 20.3
(±3.0% VARIABLE of accumulative % passing (0.1%) on the #40)

Sieve Size	Fineness Modulus	Retained (.1g)	% total ret. (0.1g)	% total x % pass. #4	% passing (0.1g)	% passing (rounded)	Spec Req.
#6							
#8	46.3	136.5	21.6	14.8	53.7	54	34 - 58
#10		28.2	4.5	3.1	50.6	51	
#12							
#16	56.7	67.1	10.6	7.3	43.3	43	
#20		62.7	9.9	6.8	36.5	37	
#30	71.7	75.8	12.0	8.2	28.3	28	
#40		61.4	9.7	6.6	21.7	22	13 - 35
#50	84.3	55.6	8.8	6.0	15.7	16	
#80		34.4	5.4	3.7	12.0	12	
#100	88.5	4.8	0.8	0.5	11.5	12	
#200		10.6	1.7	1.2	10.3	10.3	3.0 - 12.0
Pan dry		1.7	95.1	10.3	wt before washing (0.1g)	631.9	
Pan wash		93.4	15.0		wt after washing (0.1g)	538.5	
Total	3.94	632.2			loss from washing(-#200)	93.4	

Coarse % x % Retain/Design =
Fine 15.05 % x % Passing/Design =
Total/Combined -#200

- #4 Gradation Check

within 0.3% of original dry weight 0.05

Crushed Particles Test

Weight of crushed particles	447.0
Weight of total + #4 sample	1,015.9
Percent of crushed pieces	44
Specification	1 or more FF, min. 30 - 100

- #4 % Particles less than 1.95 Specific Gravity

Specific gravity of solution (1.95 ± 0.01)	
Weight of lightweight particles	
Weight of - #4 material	
% lightweight particles	
Specification	

+ #4 % Particles less than 1.95 Specific Gravity

Specific gravity of solution (1.95 ± 0.01)	
Weight of lightweight particles (0.1g)	
Weight of + #4 material (0.1g)	
% lightweight particles	
Specification	

Filler	0.00	Cr. Fines	0.00	0.00
Cr. Rock	0.00	Ma. Sand	0.00	Natural Sand 0.00
Na. Rock	0.00	Natural Fines	0.00	Add Rock

Comments

Sample ID 2203587

Sieve Analysis and P.I. Worksheet

DOT-3

File No.

3-19

PROJECT PH 0066(00)15

COUNTY Aurora, Ziebach

PCN B015

Charge to (if not above project)

Field No. 06

Date Sampled 03/11/2019

Date Tested 03/11/2019

Sampled By Tester, One

Tested By Tester, One

Checked By Tester, Two

Material Type AGGREGATE COMPOSITE

Source Jones Pit

Class E, Type 1

Lot No. 2

Sublot No. 1

Weight Ticket Number or Station Ticket # 76421, Sta. 165+55 Lt

Lift 1.00 of 1.00

[Wet Sample Weight (0.1g) 5235.1 - Original Dry Sample Weight (0.1g) 5,058.2] / dry weight x 100 = 3.5 % moisture

Sieve Size	Fineness Modulus	Retained (0.1g)	% total ret. (0.1g)	% passing (0.1g)	% passing (rounded)	Spec Req.
4 in.						
3 in.						
2 1/2 in.						
2 in.						
1 1/2 in.						
1 1/4 in.						
1 in.		0.0	0.0	100.0	100	0 - 100
3/4 in.		30.3	0.6	99.4	99	97 - 100
5/8 in.		159.7	3.2	96.8	96	
1/2 in.		620.1	12.3	87.7	84	76 - 90
3/8 in.	* 25.1	454.9	9.0	74.9	75	
1/4 in.		354.6	7.0	67.9	68	
#4	* 38.9	345.4	6.8	61.1	61	57 - 67
Pan		3090.1	61.1			
Total		5,055.1				
+ #4 Gradation Check						
within 0.3% of original dry weight						
0.06						

Liquid Limit & Plastic Limit

	Liquid Limit	Plastic Limit
A. Can number		
B. Weight of can + wet soil (0.01g)		
C. Weight of can + dry soil (0.01g)		
D. Weight of water (B - C) (0.01g)		
E. Weight of can (0.01g)		
F. Weight of dry soil (C - E) (0.01g)		
G. Liquid Limit (D / F x J x 100) (0.1g)	N.C.	N.P.
H. Plastic Limit (D / F x 100) (0.1g)		N.P.
I. Plasticity Index (G - H) (0.1g)		Specification
Liquid Limit N.C. (G rounded)		0 - 25
Plasticity Index (I rounded)	N.C.	0 - 0
J. Correction # Blows		
22=0.9846, 23=0.9899, 24=0.9952, 25=1.0000, 26=1.0050, 27=1.0100, 28=1.0138		
weight - #40 111.50 / weight - #4 321.60 x % passing #4 = 21.2		
(±3.0% VARIABLE of accumulative % passing (0.1%) on the #40)		

Sieve Size	Fineness Modulus	Retained (.1g)	% total ret. (0.1g)	% total x % pass. #4	% passing (0.1g)	% passing (rounded)	Spec Req.
#6							
#8	* 51.1	104.1	20.0	12.2	48.9	49	42 - 52
#10							
#12							
#16	* 60.9	83.4	16.0	9.8	39.1	39	32 - 42
#20							
#30	* 74.2	113.3	21.7	13.3	25.8	26	
#40		33.2	6.4	3.9	21.9	22	14 - 24
#50							
#80		44.6	8.5	5.2	16.7	17	
#100							
#200		90.4	17.3	10.6	6.1	6.1	4.0 - 8.0
Pan dry		2.5	52.5	6.2	wt before washing (0.1g)	521.8	
Pan wash		50.0	10.1		wt after washing (0.1g)	471.8	
Total		521.5			loss from washing(-#200)	50.0	
Coarse 1.01 % x % Retain/Design 38.90 = 0.39							
Fine 10.06 % x % Passing/Design 61.10 = 6.15							
Total/Combined -#200 6.5							
- #4 Gradation Check							
within 0.3% of original dry weight							
0.06							

Crushed Particles Test

Weight of crushed particles	786.4
Weight of total + #4 sample	1,008.9
Percent of crushed pieces	78
Specification	2 or more FF, min. 70 - 100
- #4 % Particles less than 1.95 Specific Gravity	
Specific gravity of solution (1.95 ± 0.01)	1.96
Weight of lightweight particles	5.2
Weight of - #4 material	304.1
% lightweight particles	1.7
Specification	0.0 - 3.0
+ #4 % Particles less than 1.95 Specific Gravity	
Specific gravity of solution (1.95 ± 0.01)	1.96
Weight of lightweight particles (0.1g)	30.3
Weight of + #4 material (0.1g)	1921.4
% lightweight particles	1.6
Specification	0.0 - 3.0

Add Rock	15.00	Cr. Rock	0.00	Ma. Sand	0.00
Filler	0.00	Natural Fines	0.00	Na. Rock	17.00
Cr. Fines	23.00		0.00	Natural Sand	45.00

Comments

Sample ID 2203609
File No.

Gyratory Aggregate Worksheet

DOT-69
3-19

PROJECT PH 0066(00)15

COUNTY Aurora, Ziebach

PCN B015

Field No. QC04

Date Sampled 03/12/2019

Date Tested 03/12/2019

Sampled By Tester, One

Tested By Tester, One

Checked By Tester, Two

Material Type AGGREGATE COMPOSITE

Source Jones Pit

Class Q2

Lot No. 1

Sublot No. 4

Weight Ticket Number or Station # 50855, Sta. 625+15

Lift 1 of 1

% moist. = (wet wt. 8816.4 - dry wt.) / dry wt. x 100 = 3.9

Original Dry Sample Wt. (1g) 8,289.9

Sieve Size	Retained (0.1g)	%total ret.(0.1%)	%pass. (0.1%)	%pass. (rounded)	Spec Req.				
mm in									
100 4									
75 3						Sand Equiv. Test	Sand Rdg.	Clay Rdg.	S.E.
62.5 2 1/2						Reading #1	3.10	6.60	47
50 2						Reading #2	3.10	6.50	48
37.5 1 1/2									
31.5 1 1/4						Sand Equivalent Tests Results			48
25 1									42 - 100
19 3/4	0.0	0.0	100.0	100	100 - 100	Fine Aggregate Angularity Test Results			41.8
16 5/8	7.3	0.1	99.9	100					41.0 - 100.0
12.5 1/2	501.4	6.0	93.9	94	89 - 100	Flat and Elongated Particles Test Results			0.0
9.5 3/8	890.3	10.7	83.2	83	79 - 93				
6.25 1/4	990.4	11.9	71.3	71					
4.75 #4	787.3	9.5	61.8	62					
Pan	5116.7	61.7				wt. before washing(0.1g)			709.30
Total	8293.4					wt. after washing(0.1g)			707.10
+ #4 Graduation Check:						loss from washing			2.2
within 0.3% of orig dry wt.			0.04			% - #200			0.31

Sieve Size	Retained (0.1g)	%total ret.(0.1%)	%total x %pass. #4	%pass. (0.1%)	%pass. (rounded)	Spec Req.	
mm #							
3.35 6							+ #4 % Particles less than 1.95 SP. GR.
2.36 8	187.7	29.8	18.4	43.4	43	41 - 51	Specific gravity of solution (1.95 ± 0.01) 1.95
2.00 10							wt. of lightweight particles (0.1 g) 19.1
1.70 12							weight of + #4 material (0.1 g) 1824.9
1.18 16	137.2	21.8	13.5	29.9	30		% lightweight particles 1.0
0.850 20							SPECIFICATION 0.0 - 3.0
0.600 30	112.0	17.8	11.0	18.9	19		- #4 % Particles less than 1.95 SP. GR.
0.425 40	54.3	8.6	5.3	13.6	14		Specific gravity of solution (1.95 ± 0.01) 1.95
0.300 50	42.7	6.8	4.2	9.4	9		wt. of lightweight particles (0.1 g) 3.2
0.180 80							weight of - #4 material (0.1 g) 302.4
0.150 100	35.0	5.6	3.5	5.9	6		% lightweight particles 1.1
0.075 200	10.5	1.7	1.1	4.8	4.8	2.9 - 6.9	SPECIFICATION 0.0 - 3.0
Pan dry	4.8	49.2	4.8				
Pan wash	44.40	7.8					
Total	628.60						
							Crushed Particles Test
Coarse	0.31	% x % Retain/Design	38.20	=	0.12		weight of crushed particles 651.7
Fine	7.81	% x % Retain/Design	61.80	=	4.83		weight of total + #4 sample 729.3
							percent of crushed particles 89
							SPECIFICATION 2 or more FF, min 65 - 100
Natural Sand	0.00	Nat. Rock	31.00	Natural Fines	25.00		
Natural Sand	0.00	Natural Fines	0.00	Osck Nat Fines	16.00		
Cr.Fines	28.00						

Figure 3

Weight of measure and glass plate		327.1
Weight of measure, glass plate & water		426.8
M = net mass of water		99.7
Water Temperature / Density	77 F	997.03
V = volume of cylinder, mL		100.0

Dry - #4 bulk specific gravity (Gsb)	2.563	
Volume of cylinder, mL(V)	100.0	
Weight of cylinder, g (A)	183.0	
Wt of cylinder + aggregate, g (B)	332.5	332.2
Wt. aggregate, g (F=B-A)	149.5	149.2
Uncompacted voids, (nearest 0.1%) $U = ((V - (F/Gsb)) / V) \times 100$	41.7	41.8
	Average 41.8	

Sieve Size	Total Sample Weight on Sieve	Weight of Tested Portion	Weight of Flat/ Elongated Particles	Percent Flat/ Elongated Individual Sieve	Percent Flat/ Elongated Weighted Average
mm in					
50.0 2					
37.5 1 1/2					
25.0 1					
19.0 3/4					
12.5 1/2					
9.5 3/8					
4.75 #4					

Total sample wt. 0.0

Percent flat and elongated particles in the total sample (weighted average) rounded 0.0
0

Comments 12" sieves used

Figure 3A

Sample ID 2203613 Sieve Analysis and P.I. Worksheet DOT-3
File No. 3-19
PROJECT PH 0066(00)15 COUNTY Aurora, Ziebach PCN B015
Charge to (if not above project)
Field No. 03 Date Sampled 03/12/2019 Date Tested 03/12/2019
Sampled By Tester, One Tested By Tester, One Checked By Tester, Two
Material Type COARSE AGGREGATE Source Hills Materials, Rapid City Quarry
A-45, Bridge Lot No. Sublot No.
Weight Ticket Number or Station Lift of

[Wet Sample Weight (0.1g) - Original Dry Sample Weight (0.1g) 10,414.8] / dry weight x 100 =

Sieve Size	Retained (0.1g)	% total ret. (0.1g)	% passing (0.1g)	% passing (rounded)	Spec Req.
4 in.					
3 in.					
2 1/2 in.					
2 in.					
1 1/2 in.	0.0	0.0	100.0	100	100 - 100
1 1/4 in.					
1 in.	286.0	2.7	97.3	97	95 - 100
3/4 in.	1,720.7	16.5	80.8	81	
5/8 in.	1,098.7	10.5	70.3	70	
1/2 in.	1,407.0	13.5	56.8	57	25 - 60
3/8 in.	1,620.8	15.6	41.2	41	
1/4 in.	2,492.5	23.9	17.3	17	
#4	908.0	8.7	8.6	9	0 - 10
Pan					
Total					

+ #4 Gradation Check

within 0.3% of original dry weight 0.18

Dish Check

wt. before washing (0.1g)

wt. after washing (0.1g)

loss from washing

% - #200

Sieve Size	Total Sample Weight on Sieve	Weight of Tested Portion	Weight of Flat/ Elongated Particles	% Flat/ Elongated Individual Sieve	% Flat/ Elongated Weighted Average
2 in.					
1 1/2 in.					
1 in.					
3/4 in.					
1/2 in.					
3/8 in.					
#4					
Total	0.0				0.0
				(rounded)	0
				Specification	0.0 - 10.0

Sieve Size	Retained (0.1g)	% total ret. (0.1g)	% passing (0.1g)	% passing (rounded)	Spec Req.
#6			8.6	9	
#8	644.7	6.2	2.4	2	0 - 5
#10					
#12					
#16					
#20					
#30					
#40					
#50					
#80					
#100					
#200					
Pan dry	217.9	217.9			3627.3
Pan wash	0.0	2.1			3567.5
Total	10396.3				59.8

+ #4 Gradation Check

Coarse 1.65 % x % Retain/Design 64.40 = 1.06

Fine 0.95 % x % Passing/Design 35.60 = 0.34

03 Referenced Total/Combined -#200 1.4

within 0.3% of original dry weight

Crushed Particles Test

Weight of crushed particles

Weight of total + #4 sample

Percent of crushed pieces

Specification or more FF, min. -

- #4 % Particles less than 1.95 Specific Gravity

Specific gravity of solution (1.95 ± 0.01)

Weight of lightweight particles

Weight of - #4 material

% lightweight particles

Specification -

+ #4 % Particles less than 1.95 Specific Gravity

Specific gravity of solution (1.95 ± 0.01) 1.96

Weight of lightweight particles (0.1g) 0.1

Weight of + #4 material (0.1g) 1857.0

% lightweight particles 0.0

Specification 0.0 - 1.0

Comments 13.8" x 13.8" sieves were used. The 1/4 sieve was overloaded. 1/4 sieve was split in half and sieved by hand.

Sample ID 2203622 **Screen Analysis and P.I. Worksheet** DOT-3
 File No. 3-19
 PROJECT PH 0066(00)15 COUNTY Aurora, Ziebach PCN B015
 Charge to (if not above project) _____
 Field No. 03 Date Sampled 03/12/2019 Date Tested 03/12/2019
 Sampled By Tester, One Tested By Tester, One Checked By Tester, Two
 Material Type FINE AGGREGATE Source Birdsall S & G Wasta
 A-45 Bridge Lot No. Sublot No. _____
 Weight Ticket Number or Station Lift of _____

[Wet Sample Weight (0.1g) _____ - Original Dry Sample Weight (0.1g) _____] / dry weight x 100 = _____ % moisture

Sieve Size	Fineness Modulus	Retained (0.1g)	% total ret. (0.1g)	% passing (0.1g)	% passing (rounded)	Spec Req.
4 in.						
3 in.						
2 1/2 in.						
2 in.						
1 1/2 in.						
1 1/4 in.						
1 in.						
3/4 in.						
5/8 in.						
1/2 in.						
3/8 in.	* 0.0	0.0	0.0	100.0	100	100 - 100
1/4 in.						
#4	* 0.2	1.2	0.2	99.8	100	95 - 100
Pan						
Total						
+ #4 Gradation Check				Dust Check		
within 0.3% of original dry weight				wt. before washing (0.1g)		
				wt. after washing (0.1g)		
				loss from washing		
				% - #200		

Sieve Size	Fineness Modulus	Retained (.1g)	% total ret. (0.1g)	% total x % pass. #4	% passing (0.1g)	% passing (rounded)	Spec Req.
#6							
#8	* 8.5	52.3	8.3		91.5	92	
#10							
#12							
#16	* 32.2	149.0	23.7		67.8	68	45 - 85
#20							
#30	* 50.1	112.8	17.9		49.9	50	
#40		79.4	12.6		37.3	37	
#50	* 78.5	99.3	15.8		21.5	22	10 - 30
#80							
#100	* 98.1	110.6	17.6		3.9	4	2 - 10
#200		18.4	2.9		1.0	1.0	
Pan dry		0.9	6.0		wt before washing (0.1g)		629.4
Pan wash		5.1	1.0		wt after washing (0.1g)		624.3
Total	2.66	629.0			loss from washing(-#200)		5.1

Coarse	1.65	% x % Retain/Design	64.40	=	1.06	- #4 Gradation Check	
Fine	0.95	% x % Passing/Design	35.60	=	0.34		
03 Referenced		Total/Combined -#200	1.4				
						within 0.3% of original dry weight	0.1

Crushed Particles Test

Weight of crushed particles _____

Weight of total + #4 sample _____

Percent of crushed pieces _____

Specification _____ or more FF, min. -

- #4 % Particles less than 1.95 Specific Gravity

Specific gravity of solution (1.95 ± 0.01) 1.95

Weight of lightweight particles (0.1g) 1.6

Weight of - #4 material (0.1g) 274.3

% lightweight particles 0.6

Specification 0 - 1

+ #4 % Particles less than 1.95 Specific Gravity

Specific gravity of solution (1.95 ± 0.01) _____

Weight of lightweight particles (0.1g) _____

Weight of + #4 material (0.1g) _____

% lightweight particles _____

Specification -

Comments _____

Sample ID 2474487 **Sieve Analysis** DOT-68
Mineral Aggregate Stationary Plant Mix 3-19
 Test# Manual 01 File Number _____
 PCN B020 Project Statewide
 County Statewide
 Charge to (if not above project) _____
 Sample Represents 1155.0 Cu. Yd. Class and Type COARSE AGGREGATE
 Date Sampled _____ Sampled By Tester, One
 Date Tested 05/29/2019 Tested By Tester, One
 Checked By Tester, Two
 Contractor Roads, Inc.

Mix Batch Ticket	lbs./cu. yd.	Total Agg%
1" rock	1374.0	77.6
Chip	396.0	22.4
Total	1770.0	100.0

1" rock									
Sample Wt. (.1g)	10312.3	Sample Wt. (.1g)	3098.8	Sample Wt. (.1g)	3098.8	Sample Wt. (.1g)	3098.8	Sample Wt. (.1g)	3098.8
Sieve Size Retained (.1g)	% total ret(0.1%) (0.1%)	Sieve Size Retained (.1g)	% total ret(0.1%) (0.1%)	Sieve Size Retained (.1g)	% total ret(0.1%) (0.1%)	Sieve Size Retained (.1g)	% total ret(0.1%) (0.1%)	Sieve Size Retained (.1g)	% total ret(0.1%) (0.1%)
2		2		2		2		2	
1 1/2		1 1/2		1 1/2		1 1/2		1 1/2	
1 1/4		1 1/4		1 1/4		1 1/4		1 1/4	
1	0.0	1	100.0	1		1		1	
3/4	1431.6	3/4	86.1	3/4		3/4		3/4	
5/8	2964.8	5/8	57.3	5/8	0.0	5/8		5/8	
1/2	1853.9	1/2	39.3	1/2	0.0	1/2		1/2	
3/8	2095.4	3/8	19.0	3/8	104.8	3/8		3/8	
1/4		1/4		1/4	1347.5	1/4		1/4	
#4	1798.4	#4	1.6	#4	935.3	#4		#4	
#8	60.7	#8	1.0	#8	616.2	#8		#8	
Pan Dry	98.4	Pan Dry	1.0	Pan Dry	90.5	Pan Dry		Pan Dry	
TOTAL	10303.2	TOTAL	3094.3	TOTAL	3094.3	TOTAL		TOTAL	
Gradation Check ==>	0.09	Gradation Check ==>	0.15	Gradation Check ==>		Gradation Check ==>		Gradation Check ==>	
wt. before wash	3771.0	wt. before wash	2752.8	wt. before wash		wt. before wash		wt. before wash	
wt. after wash	3728.2	wt. after wash	2707.1	wt. after wash		wt. after wash		wt. after wash	
loss from wash	42.8	loss from wash	45.7	loss from wash		loss from wash		loss from wash	
% - #200==>	1.13	% - #200==>	1.66	% - #200==>		% - #200==>		% - #200==>	
Bin adj. - 200==>	0.877	Bin adj. - 200==>	0.372	Bin adj. - 200==>		Bin adj. - 200==>		Bin adj. - 200==>	

Figure 6

Composite Coarse Aggregate

Sieve Size	1" rock	Chip	Retained Total	Cumulative Passing	Specification Gradation	Job Mix Formula
2			0.0	100.0	100	
1 1/2			0.0	100.0	100	100 - 100
1 1/4			0.0	100.0	100	
1	0.0		0.0	100.0	100	95 - 100
3/4	10.8		10.8	89.2	89	
5/8	22.3	0.0	22.3	66.9	67	
1/2	14.0	0.0	14.0	52.9	53	25 - 60
3/8	15.8	0.8	16.6	36.3	36	
1/4		9.7	9.7	26.6	27	
#4	13.5	6.8	20.3	6.3	6	0 - 10
#8	0.5	4.5	5.0	1.3	1	0 - 5
Pan	0.8	0.6	1.4	0.0	0	
Total	77.7	22.4	100.1			

Total Combined - #200 ==> 1.25

Coarse	1.25	% x % Retain/Design	58.00	=	0.73
Fine		% x % Pass/Design	42.00	=	
Total/Combined - #200					

+ #4 % Particles less than 1.95 SP. GR.

Specific gravity of solution	(1.95 ± 0.01)	1" rock	Chip
wt. of lightweight particles	(0.1g)	1.95	1.95
weight of + #4 material	(0.1g)	15.0	11.0
% lightweight particles		1512.3	1503.7
Bin Adj. % lightweight particles		1.0	0.7
		0.8	0.2

Composite % lightweight particles

SPECIFICATION

1.0
0.0 - 1.0

Figure 6A

Sieve Size mm	Sieve Size inches	Total Sample Weight on Sieve	Weight of Tested Portion	Weight of Flat/Elongated Particles	Percent Flat/Elongated Individual Sieve	Percent Flat/Elongated Weighted Average
Rock Size	50.0	2				
1" rock	37.5	1 1/2				
% of Rock	25.0	1				
77.6	19.0	3/4	1431.6	0.9	0.1	
	12.5	1/2	809.3	6.7	0.8	0.4
	9.5	3/8	228.5	4.6	2.0	0.4
	4.75	#4	96.7	0.9	0.9	0.2
Total sample wt. 10,144.1						
Percent flat and elongated particles in:						
Percent flat and elongated particles in Total Rock:						1.0
						0.8

Sieve Size mm	Sieve Size inches	Total Sample Weight on Sieve	Weight of Tested Portion	Weight of Flat/Elongated Particles	Percent Flat/Elongated Individual Sieve	Percent Flat/Elongated Weighted Average
Rock Size	50.0	2				
Chip	37.5	1 1/2				
% of Rock	25.0	1				
22.4	19.0	3/4				
	12.5	1/2	0.0	0.0		
	9.5	3/8	104.8	0.0		
	4.75	#4	2,282.8	1.1	2.7	2.6
Total sample wt. 2,387.6						
Percent flat and elongated particles in:						
Percent flat and elongated particles in Total Rock:						2.6
						0.6

Sieve Size mm	Sieve Size inches	Total Sample Weight on Sieve	Weight of Tested Portion	Weight of Flat/Elongated Particles	Percent Flat/Elongated Individual Sieve	Percent Flat/Elongated Weighted Average
Rock Size	50.0	2				
	37.5	1 1/2				
% of Rock	25.0	1				
	19.0	3/4				
	12.5	1/2				
	9.5	3/8				
	4.75	#4				
Total sample wt.						
Percent flat and elongated particles in:						
Percent flat and elongated particles in Total Rock:						1.4
Combined Percent Flat and Elongated Particles for Total Rock:						1
Rounded:						0.0 - 0.0
Specifications:						

Figure 6B

Comments

Method of Test for Liquid Limit, Plastic Limit, and Plasticity Index

1. Scope:

This test is for determining the liquid limit, plastic limit, and the plasticity index of soils and granular materials. Referee tests will be performed in accordance with AASHTO T 89 and AASHTO T 90.

The liquid limit is the water content at which a soil passes from a plastic to a liquid state.

The plastic limit is the lowest water content at which a soil remains plastic.

The plasticity index is the numerical difference between the liquid limit and the plastic limit.

The word "Soil" in these tests shall mean the - #40 sieve material.

2. Apparatus:

- 2.1 Balance having a capacity of at least 100 grams sensitive and readable to .01 gram.
- 2.2 Containers. Containers, such as metal cans with lids, which will prevent loss of moisture prior to and during weighing.
- 2.3 Drying oven. Ovens, hot plates or other suitable devices for drying the samples at $230^{\circ}\text{F} \pm 9^{\circ}\text{F}$.
- 2.4 Evaporating dish. A porcelain dish used for mixing the soil and water.
- 2.5 Liquid limit device conforming to specifications as described in AASHTO T 89.
- 2.6 Grooving tool. A combined grooving tool and gauge as described in AASHTO T 89.
- 2.7 Gauge. 10mm x 25mm x 50mm (Optional).
- 2.8 Plastic wash bottle with jet opening for adding water to the soil.
- 2.9 Pulverizing apparatus shall be a mortar and rubber covered pestle or a mechanical device consisting of a mortar of suitable size and shape and a power-driven, rubber covered muller for breaking up soil particles without reducing individual grain size.
- 2.10 Splitter. Mechanical splitter capable of reducing the size of sample. (SD 213).
- 2.11 Sieves. Sieves shall conform to ASTM E11.

- 2.12 Spatula. A spatula having a flexible steel blade approximately 3" in length and 3/4" in width.
- 2.13 Spoon. An appropriate size spoon for mixing and transferring the dry soil.
- 2.14 Surface for rolling. A ground glass plate or a piece of smooth paper laying on a smooth, horizontal surface.

3. Procedure:

For Disturbed Soil Samples

- 3.1 Obtain a field sample in accordance with SD 201.

Obtain an approximate 500 gram dry sample of - #4 sieve material that is of adequate size to produce at least 100 grams of - #40 sieve material.

- 3.2 Sieve the material on a #40 sieve.
- 3.3 Pulverize the material retained on the #40 sieve using the mortar and rubber covered pestle or the power driven muller. If the sample contains brittle particles, the pulverizing operation shall be done carefully and with just enough pressure to free the finer material that adheres to the coarser particles.

For Aggregate Samples

- 3.4 Obtain an approximate 500 gram sample of -#4 material from SD 202.

Begin by weighing the sample to the nearest 0.1 gram and record it as "Wt. - #4" on the worksheet. Place the material on a #40 sieve with a pan below the sieve and agitate them for a period of time. (The use of a relief sieve, #20 or #30, is encouraged above the #40 to prevent overloading.) Place the material retained on the sieves into a pulverizing mechanism (Which shall consist of a mortar and rubber covered pestle or a power driven muller) and carefully pulverize the material.

Alternately sieve and pulverize the material until not more than 1% will pass the #40 sieve during 1 minute of sieving.

Weigh the material in the pan to the nearest 0.1 gram and record it as "Wt. - #40" on the worksheet. Calculate the percentage of the sample which passed through the sieve by dividing the "Wt. - #40" by the "Wt. - #4" and then multiplying this percentage by the percent passing the #4 sieve (0.1%) in the sieve analysis. Compare this percentage to the percentage of material that passed the #40 sieve (0.1%) in the sieve analysis. These should compare within ± 3.0 . If the difference is more than 3.0 above the sieve analysis percentage, a new sample should be prepared and sieved, if it is more than 3.0% below the percentage passing in the sieve analysis, more pulverizing and sieving is required and the results recalculated.

NOTE: The variation should not be more than 3.0.

3.5 Liquid Limit

Adjust the cup of the liquid limit device to a 10 mm drop. Place a piece of masking tape across the wear spot on the bottom of the cup parallel with the axis of the cup hanger pivot. The tape must bisect the center of the wear spot, leaving the front half of the wear spot (away from the cup hanger pivot) exposed. From the front of the liquid limit device, slide the gauge under the cup until it comes in contact with the tape. Check the adjustment by turning the crank at 2 revolutions per second while holding gauge in position against the tape and cup. The adjustment is correct if a ringing or clicking sound is heard without the cup rising from the gauge.

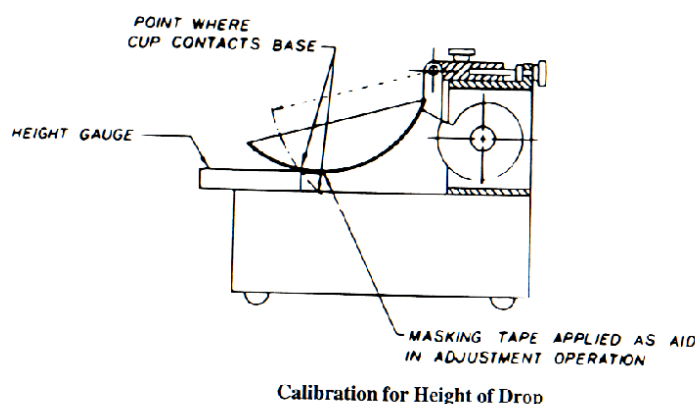


Figure 1

- 3.6 Mix the sample of - #40 material thoroughly and transfer approximately 50 to 100 grams to the evaporating dish. If not enough material is produced from steps 3.3 or 3.4, repeat steps 3.3 or 3.4 until enough material is produced. Add 15 to 20 mL of water by alternately and repeatedly stirring, kneading and chopping with a spatula, allowing time for moisture to soak into the soil. (Allow 5 to 10 minutes, with the longer time used for material slow to absorb water.) Make further additions of water in increments of 1 to 3 mL. Mix each increment of water thoroughly as previously described before adding another increment. Once testing has begun, no additional dry soil shall be added to the moistened soil. The cup of the liquid limit device shall not be used for mixing.

When sufficient water has been thoroughly mixed with the soil to form a uniform mass of stiff consistency, place an adequate quantity of this mixture in the cup above the spot where the cup rests on the base. Squeeze and spread this mixture with the spatula to level and at the same time trimmed to a depth of approximately 10 mm at the point of maximum thickness. Use as few strokes of the spatula as possible, taking care to prevent entrapment of air bubbles within the mass.

Divide the soil in the cup of the mechanical device with a firm stroke of the grooving tool, along the diameter through the centerline of the cam follower, forming a clean sharp groove of the proper dimensions (Figure 2). To avoid tearing the sides of the groove or slipping of the soil cake within the cup, up to 6 strokes (From front to back or back to front, counting as 1 stroke) shall be permitted.

NOTE: At this point, spilled portions of moistened soil shall be wiped from the edges of the cup and base of the machine to ensure a clean surface on which the cup will fall.

Lift and drop the cup containing the soil by turning the crank at a rate of two revolutions per second until the sides of the groove come in contact at the bottom of the groove for a distance of $\frac{1}{2}$ ", (Figure 3). Do not hold the base of the machine with the hand while turning the crank.

NOTE: Some soils tend to slide on the surface of the cup instead of flowing. If this occurs, remove the material from the cup, add more water, remix and repeat the test. If the soil continues to slide on the cup at a lesser number of blows than 25, the material shall be considered non-controllable (N.C.) and a note should be made that the liquid limit could not be determined.

Restrict the accepted number of blows for groove closure to between 22 and 28 blows. Record the number of blows for the accepted closure. Remove a slice of soil (8 grams minimum) approximately the width of the spatula, extending from edge to edge of the soil cake at right angles to and including that portion of the groove where the closure took place, and place it in a container. Promptly weigh and record to the nearest 0.01 g, the weight of the can and wet soil. Dry to a constant weight as per SD 108.

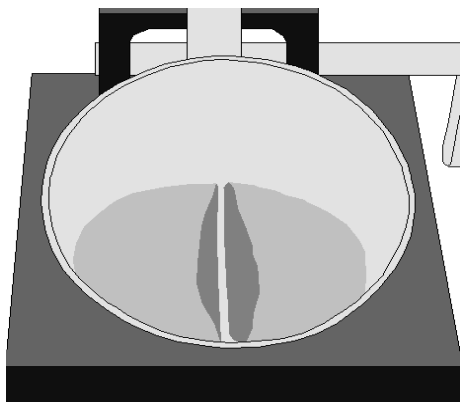


Figure 2
(Soil cake grooved for the test)

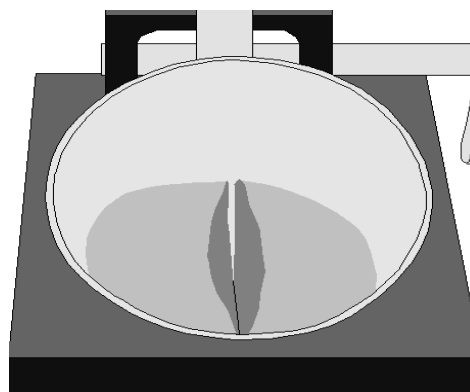


Figure 3
(Soil cake after normal test)

3.7 Plastic limit.

Take a sample weighing a minimum of 8 grams from the wet material in the evaporating dish used for the liquid limit test. Take the sample at any stage of the mixing process when the material becomes plastic enough to be shaped without excessively sticking to the fingers when squeezed. Set this sample aside until the liquid limit test has been completed.

Select a 1.5 to 2.0 gram portion from the 8 gram sample and squeeze and form this into an ellipsoidal-shaped mass. Roll this mass between the fingers and the ground-glass plate or a piece of smooth paper (do not use paper towels) laying on a smooth horizontal surface with just sufficient pressure to roll the mass into a uniform thread approximately 1/8" in diameter throughout its length (Figure 4). When the diameter of the thread reaches 1/8", break it into 6 or 8 pieces, squeeze the pieces together into a uniform mass roughly ellipsoidal in shape and re-roll. The rate of rolling shall be between 80 and 90 strokes per minute, counting a stroke as one complete motion of the hand forward and back to the starting position.

NOTE: If 1/8" cannot be attained after repeated roldown attempts, sample is considered non-plastic (NP).

Continue this alternate rolling to a thread, gathering together, kneading and re-rolling until the thread crumbles under the pressure required for rolling (Figure 5).

The crumbling may occur when the thread has a diameter greater than 1/8". This shall be a satisfactory end point, provided the soil has been previously rolled into a 1/8" diameter thread.

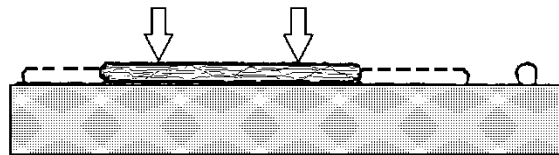


Figure 4



Figure 5

- 3.8 Gather all the crumbled soil together and place it in a tared container for weighing. This requires an additional sample to be taken and the steps in paragraph 3.7 followed again. Be sure the lid is on the container to prevent evaporation while the additional material is prepared.

Weigh and record the weight of the container and wet soil to the nearest 0.01 gram. Dry the sample to a constant weight as per SD 108.

4. Report:

4.1 Calculation of the liquid limit.

- A. Calculate the moisture content to the nearest 0.1% of the oven-dried weight as follows:

$$\% \text{ moisture} = \frac{\text{Weight of water}}{\text{Weight of oven-dried material}} \times 100$$

- B. Convert the percent of moisture to the Liquid Limit using the following conversion factors.

# of blows	x factor	# of blows	x factor
22 =	0.9846	26 =	1.0050
23 =	0.9899	27 =	1.0100
24 =	0.9952	28 =	1.0138
25 =	1.0000		

- C. Record the liquid limit to the nearest 0.1% on the worksheet.

4.2 Calculation of the plastic limit.

- A. Calculate the plastic limit as follows:

$$\text{Plastic limit} = \frac{\text{Weight of water}}{\text{Weight of oven-dried material}} \times 100$$

- B. Record the plastic limit to the nearest 0.1% on the worksheet.

4.3 Calculation of the plasticity index.

- A. Calculate the plasticity index as follows:

$$\text{Plasticity index} = \text{liquid limit} - \text{plastic limit}$$

- B. Record the plasticity index to the nearest 0.1% on the worksheet.

4.4 Report the liquid limit and plasticity index to the whole number or decimal required by the specifications.

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Sample ID 2242879

Surface Texture Measurements of Asphalt Concrete Surfaces

DOT - 55A

3-21

PROJECT PH 006(00)15 COUNTY Aurora, Ziebach PCN B015

Date Tested 03/23/2021 Tested by Tester, One Checked by Tester, Two

Test No. 01

Area Represented Station 512+45 to Station 568+70 Road Width 16.0

SITE NO.	1	2	3	4	5
STATION	523+00	534+95	540+20	551+45	561+70
Dist. to CL	5.5' LT	10.0' LT	7.7' LT	3.2' LT	6.9' LT
	Depth (X/32)	Depth (X/32)	Depth (X/32)	Depth (X/32)	Depth (X/32)
1	4	5	5	3	6
2	5	5	1	3	6
3	2	2	3	5	4
4	1	4	3	2	1
5	3	3	6	5	1
6	3	1	2	6	3
7	1	2	4	6	2
8	5	2	3	4	5
9	2	4	2	5	1
10	6	5	4	3	5
TOTAL	32	33	33	42	34
Avg. Depth	3/32	3/32	3/32	4/32	3/32
Is spacing Within Spec (Enter Y or N below)					
SPACING	Y	Y	Y	Y	Y
Lot Average: <u>3/32</u>					

Notes: The lot average shall be between 0" to 8/32" for cold milling.
The lot average shall be between 0" to 4/32" for micro-milling.

Asphalt Surface Treatment Design Procedure (Modified McLeod)

1. Scope:

This standard practice for asphalt surface treatment design uses the Modified McLeod Design Procedure (McLeod 1969, Janisch and Gaillard 1998) to ensure the proposed materials are of sufficient quality and have the desired properties to provide the expected performance. Proper design also ensures that proper application rates are being used. The aggregate application rate is designed to provide an asphalt surface treatment that contains a single layer of uniformly sized chips with minimal excess. The asphalt surface treatment is designed to achieve approximately 70% of the aggregate embedded in the residual asphalt.

Apparatus:

- 2.1 All related equipment and/or apparatus to perform parts or all of tests including SD 201, SD 202, SD 203, SD 204, SD 205, SD 209, SD 210, and SD 322.

3. Procedure:

3.1 Emulsion Properties.

A portion of an asphalt emulsion consists of water, which evaporates as the binder breaks. The amount of asphalt cement that remains after breaking is referred to as the residual asphalt content. It is important to consider the residual asphalt content because it represents the amount of material that is available for bonding to the cover aggregate. In general, the residual asphalt content is about 64 to 70% (i.e., 64 to 70% of an asphalt emulsion consists of asphalt cement).

As mentioned, the objective of this design procedure is to achieve 70% embedment of the average-sized aggregate. To accomplish this, the emulsion must be at the top of the average-sized aggregate before curing. If only 70% of the cover aggregate is covered initially, the asphalt height will be about 30% too low after curing.

3.2 Aggregate Properties.

Median Particle Size is the theoretical size through which 50% of the material passes. It is determined from the gradation chart using the following sieve sizes: 1-inch, $\frac{3}{4}$ -inch, $\frac{1}{2}$ -inch, $\frac{3}{8}$ -inch, $\frac{1}{4}$ -inch, #4, #8, #16, #50, and #200.

Flakiness Index (SD 203) is a measure of the percentage, by weight, of flat particles. It is determined by testing a sample of aggregate particles for their ability to fit through a slotted plate. The weight of the material passing the

slots is divided by the total weight of the aggregate sample to determine the percentage of flat particles or Flakiness Index.

Average Least Dimension represents a reduction of the median particle size after accounting for the number of flat particles. It represents the asphalt surface treatment thickness in the wheel path after traffic has reoriented the chip on their flattest side. It is determined from the median particle size and flakiness index using the following equation:

$$H = \frac{M}{1.139285 + 0.011506(FI)}$$

Where: H = Average Least Dimension (inches)
M = Median Particle Size (inches)
FI = Flakiness Index (%)

Loose Unit Weight (SD 205) is required to determine the voids in the aggregate in a loose condition. The voids represent the available space for the asphalt binder after placement and rolling. The Loose Unit Weight is a function of the gradation, shape, and specific gravity of the aggregate.

Bulk Specific Gravity (SD 209 and SD 210) represents the weight of aggregate as compared to the weight of water. Different aggregate types have different unit weights or specific gravities. This factor affects the application rate of the aggregate chips because a heavier aggregate will require more weight of chips (or a higher application rate) than a lighter aggregate to cover the same area. Bulk specific gravities for aggregates typically range from 2.400 to 3.000. Natural aggregates are generally about 2.400 and quartzite and limestone aggregates are generally around 2.600.

Voids in the Loose Aggregate (SD 205) represent the voids after the aggregate chips are placed on the pavement. It is based on the loose unit weight and can be determined using the following equation:

$$V = 1 - \left(\frac{W}{62.4 \times G} \right)$$

Where: V = Voids in the Loose Aggregate
W = Loose Unit Weight of the aggregate (lb/ft³)
G = Bulk Specific Gravity of the aggregate

For one-sized chips, this factor will typically be around 50%. Rolling will reduce the number of voids, typically to around 30%. Traffic will further reduce the number of voids to around 20%.

Aggregate Absorption (SD 209 and SD 210). Aggregates, especially porous aggregates, will absorb a portion of the asphalt emulsion. This will affect the amount of asphalt binder that is available for bonding with the aggregate chips.

To ensure that enough binder is remaining, this factor must be considered when designing the emulsion application rate. An absorption correction factor of 0.02 gallons per square yard is recommended for aggregates with absorption greater than 1.5%. Quartzite is generally not too absorptive and will not require a correction factor. However, some limestone and natural aggregates may require an adjustment to the emulsion application rate.

3.3 Other Design Properties.

Traffic Volume will influence the amount of asphalt binder that is required to provide sufficient embedment of the aggregate chips. All other factors equal, roadways with higher traffic volumes will require less residual asphalt. This may appear to be the opposite of what is typically expected. However, consider that traffic causes a reorientation of the chips until they eventually lie on their flattest side. More traffic results in a greater probability that the chips will be laying on their flattest side and will result in a thinner asphalt surface treatment. Less traffic will result in a thicker asphalt surface treatment and will require more asphalt binder to achieve sufficient embedment. The table below provides the recommended traffic correction factor to be used in determining the emulsion application rate. Failure to account for this factor will result in bleeding in the wheel paths.

Table 1 – Recommended Traffic Correction Factors

Traffic (ADT)	Traffic Factor
<100	0.85
100-500	0.75
500-1000	0.70
1000-2000	0.65
>2000	0.60

Traffic Whip-Off: a portion of the aggregate chips will get thrown off the roadway before final curing and embedment under traffic has occurred. This is accounted for in the procedure using a traffic whip-off factor. The factor is based on the traffic volume and traffic speed of the roadway. Low-volume, residential streets will have about a 5% loss, whereas the loss on high-volume, high-speed roadways will be around 10%. The factor can be computed using the following equation:

$$E = 1 + \left(\frac{P}{100} \right)$$

Where: E = Traffic whip-off factor
P = Expected loss of aggregate chips (%)

Therefore, an expected loss of 10% results in a traffic whip-off factor of 1.10.

Existing Pavement Condition. The surface condition of the existing pavement will greatly influence the amount of asphalt emulsion that is required. A dry, porous pavement will absorb a tremendous amount of asphalt binder and therefore affect the emulsion application rate. Conversely, a new pavement (or a pavement with bleeding on the surface) will absorb much less binder. The varying condition is accounted for in the design procedure by the surface correction factor. The recommended value, based on the pavement surface texture, is provided in Table 2.

The same application rate cannot be used for all roadways with varying conditions. Similarly, the surface condition should be monitored during placement, and the application rate adjusted as needed to address areas of differing condition.

Table 2 – Recommended Surface Correction Factors

Existing Pavement Surface Texture	Surface Correction Factor (gallons per square yard)
Black, flushed asphalt	-0.01 to - 0.06
Smooth, non-porous	0.00
Slightly porous and oxidized	+0.03
Slightly pocked, porous, and oxidized	+0.06
Badly pocked, porous, and oxidized	+0.09

3.4 Design Equations.

Once the inputs are determined, the application rates can be calculated using the McLeod design equations. The equations for aggregate and emulsion application rates are presented below.

Aggregate Application Rate

$$C = 46.8(1 - (0.4V)) \times H \times G \times E$$

Where: C = Chip application rate (lbs/yd²)
V = Voids in loose aggregate
H = Average least dimension (inches)
G = Bulk Specific Gravity
E = Traffic whip-off factor

Emulsion Application Rate

$$B = \frac{(2.244 \times H \times T \times V + S + A)}{R}$$

Where: B = Binder application rate (gal/yd²)
H = Average least dimension (inches)

T = Traffic correction factor
V = Voids in loose aggregate
S = Surface correction factor
A = Aggregate absorption factor (gal/yd²)
R = Residual asphalt content of binder

The emulsion application rate is recalculated using the median particle size instead of the average least dimension. This new emulsion rate provides the required rate if the chips are not reoriented and, therefore, is more representative of the rate required outside the wheel path. The average of the two rates is then used as the starting point in the field.

3.5 Example Design Problem.

A 150-pound sample of quartzite aggregate has been submitted for design. The roadway has traffic levels of 2,125 vehicles per day (ADT). The pavement surface is slightly pocked, porous, and oxidized. A CRS-2P emulsion with a residual asphalt content of 66.5% will be used as the binder. Determine the emulsion and aggregate application rates for this project.

Step 1: Determine the aggregate gradation, bulk specific gravity, and percent absorption.

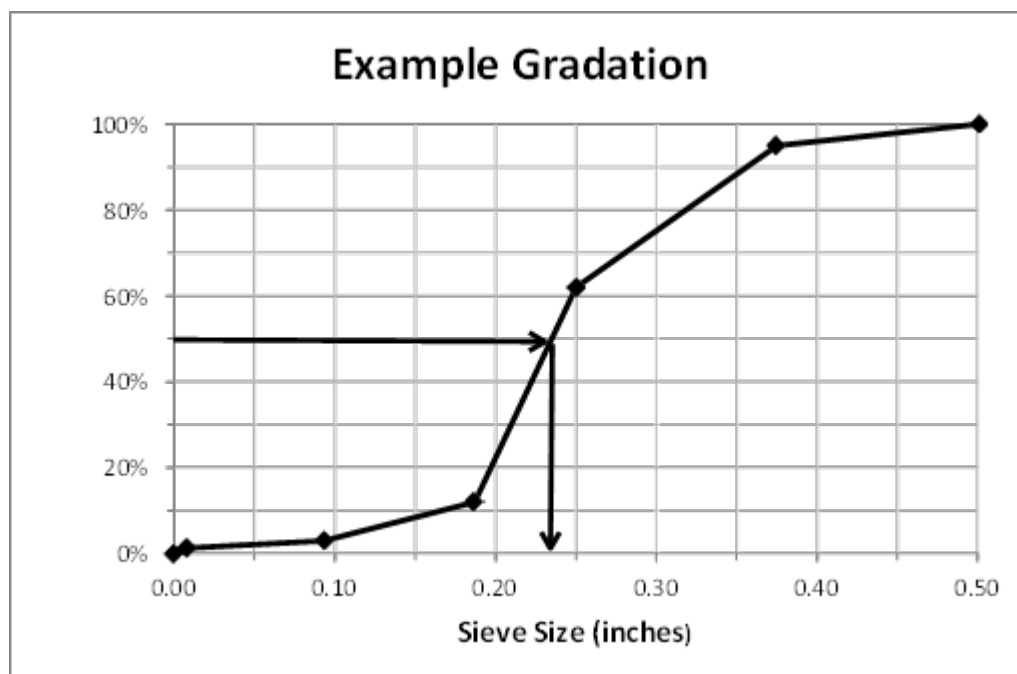
Laboratory testing of the aggregate revealed the gradation as shown in Table E1. Testing in accordance with SD 209 and SD 210 indicates a bulk specific gravity of the aggregate of 2.610. The aggregate absorption based on SD 209 and SD 210 is 0.55%, so no correction is needed.

Table E1 – Gradation Test Results for Example Design Problem

Sieve Size	Percent Passing
1/2 inch	100
3/8 inch	95
1/4 inch	62
#4	12
#8	3
#200	1.3

Step 2: Determine the mean particle size.

The median particle size (M) is determined by plotting the gradation results and reading off the sieve size at which 50% of the particles pass. The median particle size represents the theoretical size at which half the stones are larger, and half are smaller.



For the gradation shown above, the median particle size is determined to be 0.23 inches.

Step 3: Determine the Flakiness Index.

To determine the flakiness index, the aggregate particles are fitted through slots. The example results are shown in Table E2.

Table E2 – Flakiness Index Test Results for Example Design Problem

Size Fraction	Weight Retained on Slot (grams)	Weight Passing Slot (grams)
1/2 inch to 3/8 inch	54.2	12.3
3/8 inch to 1/4 inch	123.3	43.5
1/4 inch to #4	184.4	89.5
Total:	361.9	145.3

Using these results, the Flakiness Index (FI) is determined as follows:

$$FI = \frac{\text{Weight of Flat Chips}}{\text{Weight of Sample}} = \frac{145.3}{(361.9 + 145.3)} = 0.286 = 28.6\%$$

Step 4: Determine the average least dimension.

The average least dimension (H) is the expected thickness of the asphalt surface treatment after the chips have been reoriented on their flattest side from traffic. It is determined using the following equation:

$$H = \frac{M}{(1.139285 + 0.011506(FI))} = \frac{0.23}{(1.139285 + (0.011506 \times 28.6))} = 0.157 \text{ in}$$

Step 5: Determine the loose weight of the aggregate.

A metal cylinder with a volume of 0.50 cubic feet was loosely filled with aggregate and weighed. This process was repeated three times, the results of which are shown in Table E3.

Table E3 – Loose Unit Weight Test Results for Example Design Problem

Test Number	Weight of Aggregate (pounds)
1	45.25
2	45.32
3	45.29
Average	45.29

The loose unit weight (W) is then determined as follows:

$$W = \frac{\text{Weight of Aggregate}}{\text{Weight of Cylinder}} = \frac{45.29 \text{ lbs}}{0.50 \text{ ft}^3} = 90.58 \text{ lbs/ft}^3$$

Step 6: Determine the voids in the loose aggregate.

The voids in the loose aggregate (V) is determined using the following equation:

$$V = 1 - \left(\frac{W}{62.4G} \right) = 1 - \left(\frac{90.58}{62.4 \times 2.61} \right) = 0.44$$

Step 7: Determine the aggregate application rate.

With the inputs determined above, the aggregate application rate (C) is determined using the following equation:

$$C = 46.8(1 - (0.4V)) \times H \times G \times E$$

$$C = 46.8(1 - (0.4 \times 0.44)) \times 0.157 \times 2.61 \times 1.10 = 17.3 \text{ lbs/yd}^2$$

Step 8: Determine the emulsion application rate.

The calculation for the emulsion application rate is performed twice, once for the wheel-path areas (using the average least dimension) and again for the non-wheel path areas (using the median particle size). These calculations are shown below:

$$B_{wheelpath} = \frac{(2.244 \times H \times T \times V + S + A)}{R}$$

$$B_{wheelpath} = \frac{(2.244 \times 0.157 \times 0.60 \times 0.44 + 0.06 + 0.00)}{0.665} = 0.23 \text{ gal/yd}^2$$

$$B_{non-wheelpath} = \frac{(2.244 \times M \times T \times V + S + A)}{R}$$

$$B_{non-wheelpath} = \frac{(2.244 \times 0.23 \times 0.60 \times 0.44 + 0.06 + 0.00)}{0.665} = 0.30 \text{ gal/yd}^2$$

The average of the two results (0.27 gallons per square yard) is used as the starting point in the field.

4. Report:

4.1 The asphalt surface treatment design will include the following information:

- Cover aggregate source and gradation.
- Bulk specific gravity of the cover aggregate.
- Loose unit weight of the cover aggregate.
- Emulsified asphalt type and supplier.
- Emulsified asphalt rate of application.
- Cover aggregate rate of application.
- Compatibility results (SD 322).

The Contractor's material and data submitted must meet all specifications and requirements as shown in the plans and Standard Specifications for Roads and Bridges.

5. References

Listed in 2.1 above

"A General Method of Design for Chip Seals and Surface Treatments"

"Minnesota Seal Coat Handbook"

Method of Sampling Fresh Concrete

1. Scope:

This test covers the procedure for obtaining samples of fresh concrete.

2. Apparatus:

2.1 Shovel.

2.2 Wheelbarrow or other container.

3. Procedure

3.1 Obtain sample large enough to complete all necessary testing. Use the most appropriate procedure.

A. Stationary mixers and continuous mixers (volumetric mixers used for low slump overlays).

1. Obtain a sample by passing a receptacle completely through the discharge stream of the mixer or diverting the stream completely so that it discharges into a wheelbarrow or other container. Do not obtain sample from the very first or last part of the discharge.

B. Revolving truck mixers.

1. Wait to obtain the sample until after all the water and admixtures have been added to the mixer. Do not obtain the sample from the very first or last part of the discharge. Pass a receptacle through the entire discharge stream, or by diverting the stream completely to discharge into a wheelbarrow or other container. Regulate the discharge of the batch by the rate of revolution of the drum and not by the size of the opening.

NOTE: For concrete placements consisting of 4 yd³ or less, the sampling of the concrete will be at the beginning of the batch after 5 gallons $\pm$ of concrete have been discharged from the mixing drum.

Drilled Shafts:

The sampling of the concrete will be at the beginning of the batch after 5 gallons $\pm$ of concrete have been discharged from the mixing drum.

Self-consolidating Concrete:

Sampling of concrete will be at the beginning of the batch after 5 gallons have been discharged from the mixing drum.

2. Sampling may be in accordance with paragraph 3.1.C.

C. Dump trucks or open top truck mixers (agitators).

1. Discharge the contents of the truck and collect the sample from at least 5 different locations of the pile.

The sampling of the concrete for PCC paving train operations will be obtained from at least 5 different locations immediately ahead of the paver.

D. Pumps.

1. Take the sample from the discharge end of the pump. Collect the sample from at least 5 different locations of the pile. Discharge will not be directly into a sampling bucket. Sample will be taken at same location where discharge is being incorporated into the structures. Pump should not be shut off or angle of discharge changed.
2. When sampling from end of discharge hose is not possible (Drilled Shafts, Columns, Tremie, etc.), sample according to 3.1.B.1.

3.2 Testing the sample.

- A. Procedures for obtaining a composite sample will be completed within 15 minutes.
- B. The sample will be transported to the place where tests are to be made and will be remixed with a shovel to insure uniformity. Expediently obtain and use the sample and protect the sample from the sun, wind, and other sources of rapid evaporation, and from contamination
- C. Start tests for air content, temperature, unit weight, and slump within 5 minutes after obtaining the final portion of the composite sample. For SCC, slump flow, visual stability index, and J-ring will be performed in lieu of slump test. Start molding specimens for strength tests within 15 minutes after fabricating the composite sample.

NOTE: Volumetric mixer (used for low slump overlays); immediately after obtaining the sample, cover the wheelbarrow or container for five minutes. Following the elapsed time remix with a shovel, the sample will then be tested immediately.

4. Report:
None required.

5. References:
None.

Method of Test for Air Content of Freshly Mixed Concrete by the Pressure Method

1. Scope:

This test is for determining air content in fresh concrete by the pressure method.

2. Apparatus:

- 2.1 Air Meter conforming to AASHTO T 152. (Type B)
- 2.2 Tamping Rod - A round smooth straight 5/8 in. diameter steel rod with the tamping end or both ends rounded to a hemispherical tip of 5/8 in. diameter. The minimum length shall be 18 in.
- 2.3 Mallet - A mallet (with a rubber or rawhide head) having a mass of 1.25 ± 0.50 lb.
- 2.4 Strike-off Plate - A flat rectangular metal plate at least 1/4 in. thick or a glass or acrylic plate at least 1/2 in. thick with a length and width at least 2 in. greater than the diameter of the measure with which it is to be used. The edges of the plate shall be straight and smooth within a tolerance of 1/16 in.
- 2.5 Strike-off Bar - A flat straight bar of steel at least 1/8 in. thick and 3/4 in. wide by 12 in. long.
- 2.6 Scoop - A scoop of a size large enough so a representative amount of concrete is obtained and small enough that concrete is not spilled during placement in the measure.

3. Procedure:

3.1 Air Meter Calibration – Method A.

- A. Fill the measuring bowl with water.
- B. Screw the short piece of straight tubing into the threaded petcock hole on the underside of the cover. Clamp the cover assembly onto the measuring bowl with the tube extending down into the water.
- C. With both petcocks open, add water with a syringe through the petcock having the pipe extension below, until all the air is forced out the opposite petcock.
- D. Pump the pressure to a little beyond the initial calibration pressure. Use the initial pressure provided by the manufacturer or as marked on the gauge. Wait a few seconds for compressed air to cool to normal temperature and then stabilize the gauge needle at the initial calibration

pressure by pumping or bleeding off air as needed to get the exact initial pressure. Lightly tap the pressure gauge by hand to stabilize the needle.

- E. Close both petcocks and immediately press down on the thumb lever exhausting the air into the measuring bowl. Wait a few seconds until the hand is stabilized. Lightly tap the pressure gauge by hand to stabilize the needle. If all the air was eliminated and the initial calibration pressure was correctly selected, the gauge should read zero. If two or more tests show a consistent variation of $\pm 0.1\%$, change the initial calibration pressure to compensate for the variation. Use the newly established initial calibration pressure for subsequent tests. The initial calibration pressure should be marked on the gauge for reference on subsequent tests.
- F. Screw the curved tube into the outer end of the same petcock having the straight tubing below. By pressing on the thumb lever and controlling the flow with the petcock lever, fill the 5% calibration vessel level full of water from the meter. The 5% of water may also be determined by weight.
- G. Release the air at the free petcock. Open the other petcock and let the water in the curved pipe run back into the measuring bowl. There is now the equivalent of 5% air in the measuring bowl.
- H. With the petcocks open, pump up the air pressure in the same manner as outlined in paragraph D. Close the petcocks and immediately press the thumb lever. Wait a few seconds for exhaust air to warm to normal temperature, and for the needle to stabilize.

Lightly tap the pressure gauge by hand to aid in stabilizing the needle. The dial should read 5.0%.
- I. If two or more consecutive readings are more than 0.1% above or below 5%, remove the gauge glass and reset the needle to 5% by turning the re-calibration screw located on the needle assembly. If the re-calibration screw is adjusted, the initial pressure must be checked again. If the initial pressure changes, then the 5% reading should also be rechecked.
- J. The meter may be calibrated for higher air contents, if deemed necessary. This is accomplished by withdrawing additional water at 5% increments using the calibration vessel or at other values by weight and repeating the steps outlined in paragraphs G., H., and I. above.

3.2 Air Meter Calibration – Method B (Field Check Only)

- A. Fill the measuring bowl with water.
- B. Place the internal calibration cylinder at the bottom of the filled measuring bowl. (Keep the cylinder upright as you place it.)
- C. Clamp the cover assembly on the measuring bowl.
- D. With both petcocks open, add water with a syringe through one petcock until all air is forced out and water emerges from the opposite petcock.
- E. Pump the pressure to slightly beyond the initial calibration pressure that is marked on the gauge. Wait a few seconds for compressed air to cool to normal temperature and then stabilize the gauge needle at that initial pressure by pumping or bleeding off air as needed to get the exact initial pressure. Lightly tap the pressure gauge by hand to stabilize the needle.
- F. Close both petcocks and immediately press down on the thumb lever exhausting the air into the measuring bowl. Lightly tap the gauge by hand and wait a few seconds until the gauge needle is stabilized. If the gauge is calibrated correctly, the gauge should read 5.0%. If two or more tests show a consistent variation greater than $\pm 0.1\%$ in the result, the air meter should be calibrated as per Method A at the earliest convenience.
- G. Keep the small hole at the bottom of the internal calibration cylinder unobstructed. Usually, a very slight amount of water may be left in the cylinder after a test. Shake this water out before making another test or putting the internal calibration cylinder into storage. Use two internal calibration cylinders if you wish to calibrate at 10%.

3.3 Air test: Type B Meter.

- A. Obtain a sample of fresh concrete in accordance with SD 402.

NOTE: Samples of volumetric mixed low slump dense concrete will be placed in a covered container for 5 minutes prior to testing.
- B. Dampen the interior of the empty measuring bowl and remove any standing water from the bottom. Place the measuring bowl on a flat, level, and firm surface.
- C. Fill the measuring bowl with concrete in 3 approximately equal layers. Rod each layer 25 times. Distribute the strokes uniformly over the cross section of the layer being rodded.

Rod the lower layer throughout its depth, but the rod must not forcibly strike the bottom of the measuring bowl so as to cause excessive

vibration. Rod the second and third layers with the rod penetrating slightly (Approximately 1 inch) into the layer below.

Add concrete to the final layer in a manner to avoid excessive overfilling. Add additional concrete as required to keep the surface above the measuring bowl as it is rodded.

After each layer is rodded, tap the outside of the measuring bowl 10 to 15 times with the mallet. Tap with enough force to close any holes left by rodding and to release any large air bubbles that may have been trapped. For concrete with a slump of less than 2" the number of taps may be increased to achieve consolidation.

Self-Consolidating Concrete (SCC) – Slightly overfill the measure and fill in one continuous lift. Rodding, tapping the side of the measure, and vibrating of SCC is prohibited.

- D. Use a strike-off plate or strike-off bar to strike off the concrete flush with the top of the measuring bowl. Removal of 1/8" of material during strike off is optimum.

Strike-off plate will be used for strike-off on all unit weight determinations. Use the following procedure for striking off the measure. Press the strike-off plate on top of the measuring bowl to cover approximately 2/3 of the measuring bowl. Withdraw the strike-off plate with a sawing motion. Place the strike-off plate on the measuring bowl in the original position to cover the same 2/3 of the measuring bowl. Advance the strike-off plate with downward pressure and a sawing motion until it slides completely off the measuring bowl. Finish the surface with several strokes of the strike-off plate at an inclined angle.

When the strike-off bar is used, strike off the top surface of the measuring bowl with a sawing motion until the bowl is level full.

- E. Thoroughly clean the rim of the measuring bowl. The internal surface of the cover assembly and seal must be clean and should be wet prior to placing it on the measuring bowl. Clamp the cover assembly on securely and open both petcocks.
- F. Using the syringe supplied, inject water through one petcock until all of the air is displaced and expelled through the opposite petcock. Jar the meter gently with the hand to expel trapped air.
- G. Apply air pressure with the pump until the gauge reading equals the initial calibration pressure that is marked on the gauge.

- H. Wait a few seconds and stabilize the needle at the initial calibration pressure by pumping up or bleeding off with the air release valve. Lightly tap the pressure gauge by hand to stabilize the needle.

Confirm that the lid is sealed to the measuring bowl and that the air chambers is the initial calibration pressure, then close both petcocks.

With both petcocks closed, press and hold the thumb lever to release the pressurized air from the chamber into the sealed measuring bowl. While holding the thumb lever down smartly tap the measuring bowl with a mallet to relieve local restraints and then lightly tap the pressure gauge by hand to stabilize the needle.

- I. Read the percent of air in the concrete on the dial and then release the thumb lever.
- J. Release the pressure in the measuring bowl by opening the petcocks. At no point in the test should the thumb lever and petcocks be open at the same time. This action can damage the meter by allowing water or paste to enter the air chamber.
- K. Clean the measuring bowl and the cover assembly thoroughly with running water.

4. Report:

Report the percent of air to the nearest 0.1% on a DOT-23.

5. References:

AASHTO T 152
SD 402
DOT-23

- (2) If it is necessary to move the cylinders a short distance (carrying distance), do so immediately while the concrete is still in a plastic state. Prevent damage to the top of the concrete surface, the top of cylinders must be flat.
- (3) Store specimens where they are not subject to vibration or being moved for 24 ± 8 hours after molding. Schedule moving of the cylinders as close to the 24 hour time frame as possible.

To check for excess vibration, drive a 2" x 2" stake into the ground and place a glass of water on top. If ripples are visible in the glass of water, vibration is excessive.

- (4) Cylinders should never be exposed to the direct rays of the sun or be in direct contact with radiant heating or radiant cooling devices. Pavement surfaces act as a radiant heater or radiant cooler. Therefore, cover the cylinders use insulating material between the pavement and cylinders or choose a more acceptable location.
- (5) If extra cylinders are made, they can be field cured until tested to determine when to put concrete into service, protection/curing of the concrete, or form removal timing. The temperature and moisture of field cured cylinders will be kept as close as possible to the represented concrete. Leave the specimens in the molds until tested or forms or blankets are removed from the represented concrete whichever comes first. Where the cylinders can be stored under the blankets, field curing extra cylinders may be desirable for pavement repair or fast track concrete.
- (6) The temperature surrounding the cylinders (except for field curing) should be maintained as closely as practical between 60° and 80°F. If additional measures are needed for temperature control, the below hot or cold weather options will be used:

A. Hot weather concreting.

One of the following procedures will be used.

- Cover all cylinders with ample wet burlap and white plastic. Use weight (aggregate, rocks, etc.) to keep plastic against the surface and not blow off when windy.
- Move the plastic specimens a short distance (carrying distance) and place them in a temperature controlled job facility immediately after molding.

- Fill a 5-gal. bucket or comparable container to within 1/2" of the top of the cylinders with cool water. Cover container to reduce temperature changes and water evaporation. Consider drilling a hole in the bucket at the high water mark to prevent water from contacting the top of the cylinder until after initial set.
- Make a small pit in the ground or sand to accommodate the cylinders. After the cylinders are placed in the pit, cover the top of the pit area with wet burlap and white plastic or wet sand.

B. Cold weather concreting.

One of the following procedures will be used

- Move the plastic specimens a short distance (carrying distance) and place them in a temperature controlled job facility immediately after molding.
- Use a large cooler or other suitable insulated container and close the top to retain the heat from the cylinders.
- Place individually covered cylinders in a sunny area and cover with wet burlap and black plastic.
- Place specimens adjacent to the freshly placed concrete under blankets or other insulating material to utilize the heat from the freshly placed concrete in maintaining the temperature of the cylinders, provided the cylinders will not be subjected to vibration.

- (7) Transport the cylinders in the mold, within 24 ± 8 hours after casting, to a facility with lime (calcium hydroxide) water tank. Schedule moving of the cylinders as close to the 24 hour time frame as possible. Remove cylinders from the mold and place in lime water solution.

The lime water in the curing tank should have a concentration of 1 teaspoon of lime to 1 gallon of water and will be maintained at a temperature range of 70° to 77°F. Stir the lime water daily.

In lieu of a lime water curing tank, a moist room may be used. The moist room will maintain a temperature range of 70° to 77°F and a relative humidity of not less than 95%.

NOTE: Before placing the cylinders into the lime water solution, make sure the necessary identification data has been written on the top and side of each cylinder (Figure 2 and 3).

- (8) A single moist cylinder will be placed in a plastic cylinder bag and sealed for transportation. Cylinders must be protected from jarring or excessive bumps while in vehicle. Transporting may also be done by placing the specimen in a bed of sand. If a cylinder is dropped or mishandled in any way (curing problems, excessive heat or cold, dryness, etc.) make a note on the DOT-23.

Only one cylinder is to be sent to the Central Laboratory for the 28 day test. The 28 day cylinder will be sent in between 15 and 21 days. In the event that the 14 day cylinder fails to meet strength, the backup cylinder will be sent in with the original.

4. Report:

DOT-7 (Central Office)
DOT-23

5. References:

AASHTO M 205
SD 402
DOT-7
DOT-23

Sample ID 2225664

Concrete Worksheet

DOT-23

File No.

3 -19

PROJECT PH 0066(00)15

COUNTY Aurora, Ziebach

PCN B015

Charge to (if not above project)

Type of Concrete 11" Nonreinforced PCC Pavement

Contractor Roads, Inc

Conc. Class

Supplier Roads Inc

Subcontractor

Submitted By Tester, One

Send Results To

Project Engineer Koch, John

Fresh Concrete Tested By Tester, One

Fresh Concrete Test

Fresh Concrete Test Date	04/29/2019	
Field Cylinder/Beam No.	01	
Field No.	03(01)	
Truck No.	15	
Time		
Station / Location	Mainline - SBL	
Description	59+00	
Quantity Represented (Cu Yd)	132	Spec Limits
% Air Content (SD 403)	5.5	5.0 - 7.5
Slump. IN. (SD 404)	1.50	0.00 - 2.00
Concrete Temp. (Deg F) (SD 408)	72	50 - 90
Air Temp. (Deg F)	68	
Fresh Unit Weight Lb / Ft ³ (SD 411)	143.3	
W/C Ratio	0.400	
WRA (Y/N)	Y	

Compressive Strength Information

Lab Test No.						
Field Cylinder/Beam No.	01	01A	01B	01C		
Date Made	04/29/2019	04/29/2019	04/29/2019	04/29/2019	04/29/2019	04/29/2019
Age	28		14	7		
Date Broken	05/27/2019		05/13/2019	05/06/2019		
Diameter, IN.	6.00	6.00	6.00	6.00	6.00	6.00
Area, SQ. IN.	28.27	28.27	28.27	28.27	28.27	28.27
Max Load Lbs.						
Fracture Type	SHEAR	SHEAR	SHEAR	SHEAR	SHEAR	SHEAR
Compressive Str. PSI (SD 420)	5550		5020	4570		
Compressive Str. Corr. to 28-day						
Cylinder Lbs.	28.60		28.40	28.40		
Cylinder Unit Weight Lbs/ft ³	145.4		144.7	144.7		

Comments:

Figure 1

Method of Test for Determining Surface Deviations of PCC Pavement and Bridge Decks

1. Scope:

This test is for determining longitudinal and transverse surface deviations of PCC Pavement and bridge decks.

2. Apparatus:

2.1 10' straightedge

2.2 Steel shims of 1/16", 1/8", 3/16", and 1/4" with an allowable tolerance of ± 0.010 " in thickness. The shims will be a minimum size of approximately 1 1/4" wide and 3" long.

2.3 10' High-Low Detector

3. Procedure:

Determine if the High-Low Detector will be used or if only the straightedge will be used. If only the straightedge will be used, follow section 3.3.

The High-Low Detector is used to determine the general location of possible deficient areas (Bumps/dips) to be checked with a 10' straightedge. If the area to be checked is small the location of deficient areas may be determined with the straightedge without first identifying areas using the High-Low Detector.

3. 1 Verification of the High-Low Detector.

A Prior to use.

- (1) Place the High-Low Detector on a flat, straight surface. The surface should be checked with the 10' straightedge prior to verification.
- (2) Verify the High-Low Detector using shims of 1/16", 1/8", 3/16", and 1/4" or a combination of 1/16" and 1/8" shims. Place these shims longitudinally under the wheels.

The High-Low Detector should be verified through the entire range of 1/16", 1/8", 3/16", and 1/4" for both the high and low positions.

- (3) Mark the new height and depths accurately on the indicator plate of the detector. Narrow strips of colored adhesive tape are suggested for use in making the marks, as they can readily

be removed and replaced when further verification requires slight changes on the indicator plate.

3.2 Operation of the High-Low Detector.

- A. The High-Low Detector should be pushed in a longitudinal direction over the approximate center of the wheel paths in each travel lane. The detector should be kept in an upright position, approximately perpendicular to the pavement surface.
- B. A deviation of 1/8" exists when the needle of the High-Low Detector swings just past the 1/8" mark of the indicator plate on either the high or low side. Also, when the indicator needle is riding on the high side and swings to the low side (or vice versa) with a total movement indicating a change of 1/8" or more, within a longitudinal distance of less than 10', the questionable areas should be marked for checking with the 10' straightedge.

3.3 Straightedging.

The areas in question will be checked with a 10' straightedge positioned either parallel or perpendicular to the centerline of the roadway. Lay shim flat on the pavement surface approximately perpendicular to the straightedge.

During the checking operation, the straightedge will be at rest and supported by only its own weight on the narrow side.

A surface deviation is considered to exist when the shim resting on the surface of the concrete can be freely passed under the straightedge.

Determine if the 1/8" or 1/4" shim will be used to determine the permissible deviation. This is based on location and standard specifications.

A. Test locations.

- (1) Longitudinal surface tests will be completed on each wheel path on travel lanes and acceleration lanes. Tests will be completed at ramp entrances, shoulders, and other similar areas that visually indicate a deviation may exist.
- (2) Transverse surface tests will be completed at locations that visually indicate a transverse deviation may exist. Edge slump at the pavement edge is one example.

B. Determine the Maximum Depth of the deficient area.

- (1) The maximum depth of the deviation is determined by the largest shim or combination of shims that can pass freely under the straightedge, using examples in Figures 1a, 1b and 2.

Example: If the permissible deviation is 1/8" (2/16") and the

1/8" shim will freely slide under the straightedge, but 3/16" shim will not, then report as 1/8" (2/16") under "Depth of Deviation – Total".

C. Determining the Length of deviation in the deficient areas.

(1) Longitudinal surface test

The length of the deviation is determined using examples in Figures 1a, 1b and 2.

(2) Transverse surface test.

The length of the deviation is measured in the longitudinal direction.

D. Determine the Width of the deficient area.

(1) Longitudinal surface test

The width will be the total width of the travel lane (12 feet or less) or shoulder.

(2) Transverse surface test.

The width will be the total width of the travel lane or shoulder. This is regardless of the actual measured width of the deviation.

4. Report:

Document the Maximum Depth of Deviation at locations that exceed the permissible deviation. The Maximum Depth of Deviation reported will be to the nearest 1/16". The wheel path with the larger maximum depth of deviation will be used for determination.

4.1 Calculate the "Deficient Area" of longitudinal surface deviation.

The length used for computation of the area will be the length measured at the wheel path with the larger maximum depth of deviation.

$$\text{Deficient Area} = (L * W) / 9$$

L = Length of deviation (nearest 0.1')

W = Width (nearest 1')

Report only the deficient area of the wheel path with the larger deviation to the nearest 0.1 yd² on the DOT-29.

4.2 Calculate the "Deficient Area" of transverse surface deviation.

$$\text{Deficient Area} = (L * W) / 9$$

L = Length of deviation (nearest 0.1 ft.) W
= Width (nearest 1')

Report the deficient area to the nearest 0.1 yd² on the DOT-29.

5. References:
DOT-29

Sample ID 2412195

Longitudinal Surface Deviation

DOT-29

File No.

1-24

PROJECT NH-PS 0012(187)106

COUNTY Corson

PCN 04FL

Field Nbr 01R McIntosh

Date 12/21/2023

Tested By Armfield, Kelly

Location McIntosh Deck/Approache

Type Of Material	Class A45 Concrete, Bridge Deck
------------------	---------------------------------

[illegible]

Direction Tested = longitudinal (L) or transverse (T)

$$Sq\ Yd = (Length \times Width) / 9$$

Lane or Shoulder Width = affected width to nearest 0.5'

Length Deviation = nearest 0.1'

Depth of Deviation Total = max measured under straightedge to nearest 1/16"

$$\text{Depth of Deviated Permissible} = \text{specification}$$

Comments This DOT-29 Test is for the McIntosh Deck/Approaches - Right Side. This Tests in accordance with Per Standard Specific

LONGITUDINAL SURFACE DEVIATION

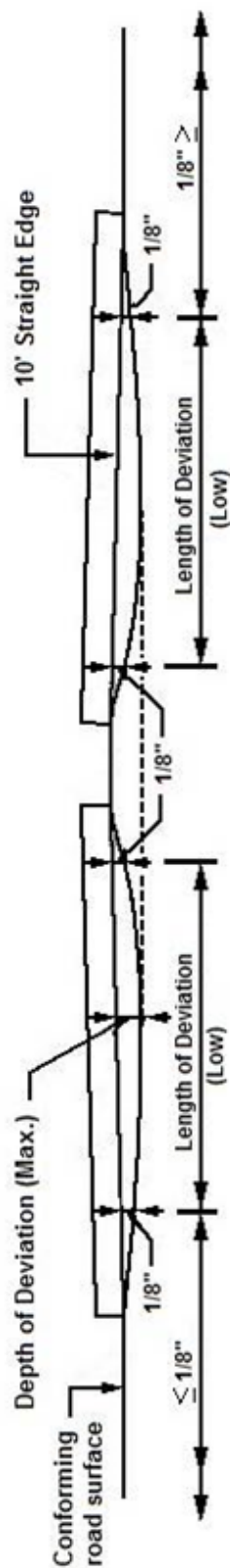


Figure 1A

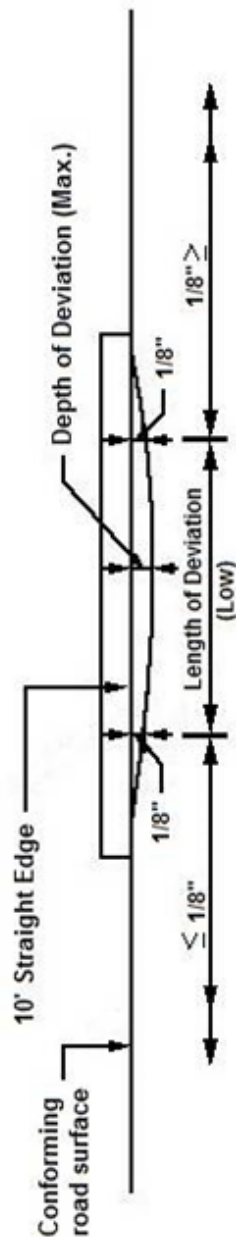


Figure 1B

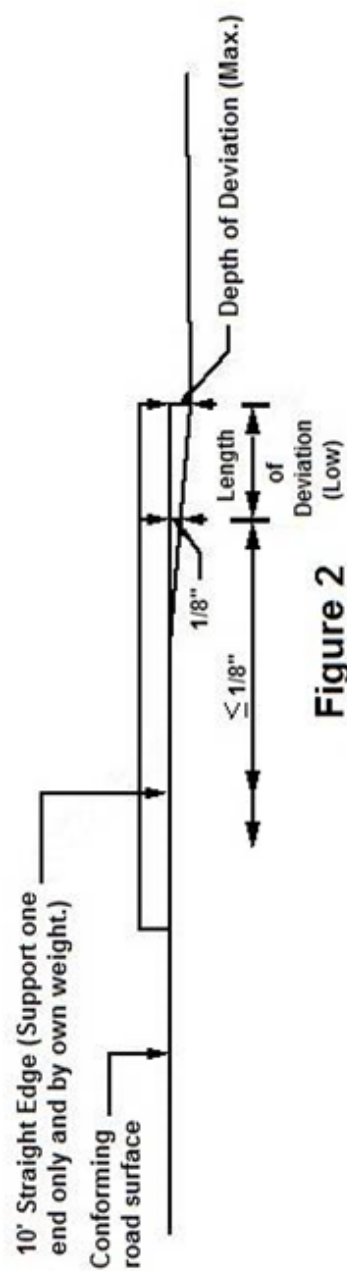


Figure 2