SD DEPARTMENT OF TRANSPORTATION

Department of Transportation
Division of Planning / Engineering
Office of Materials and Surfacing
700 E. Broadway Avenue
Pierre, SD 57501-2586
O: 605.773.3403 | F: 605.773.5867
dot.sd.gov

MEMORANDUM

TO: All SD Dept. of Transportation Materials Manual Holders

FROM: Office of Materials and Surfacing

DATE: August 14, 2025

SUBJECT: Materials Manual Revisions dated September 1, 2025

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, 2025, 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
116 East Dakota Avenue, Suite A
Pierre, SD 57501-3110
Phone: 605-776-1007
Fax: 605-224-8307

In Reply Refer to:
HAD-SD
(File)

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: 2025 SDDOT Materials Manual Revisions Approval

Dear Mr. Fitzke:

In accordance with Title 23, Part 637 of the Code of Federal Regulations, the 2025 revisions to the South Dakota Department of Transportation's Materials Manual that were transmitted to me via Mr. Ben Brown's June 30, 2025 email are hereby approved by the Federal Highway Administration.

Sincerely,

KIRK KOREY VAN ROEKEL

Digitally signed by KIRK KOREY VAN ROEKEL
Date: 2025.07.14 13:52:07 -05'00'

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

DEPARTMENT OF TRANSPORTATION

Department of Transportation
Division of Planning / Engineering
Office of Materials and Surfacing
700 E. Broadway Avenue
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dot.sd.gov

June 30, 2025

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 followed by "25" 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

2025 - SOUTH DAKOTA MATERIALS MANUAL ACCOUNTABILITY FORM – 2025

MATERIALS MANUAL **NUMBER (*)** _____

( ) has been revised in accordance with the instructions provided.

( ) has not been revised, because:

_____
Name of Company

_____
Holder Name **(please print)**

_____
Holder Signature

_____
Title

NOTE: In an effort to cut down on costs and unnecessary mailing of Materials Manual updates and revisions, it has been decided that 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. Therefore, the recipient will be removed from our mailing list, and will no longer receive future updates and revisions.

If you are no longer in possession of this Manual, check and/or complete below:

( ) it has been lost or destroyed,

( ) it has been transferred to: _____
Name **(please print)**

_____
Address **(please print)**

Remarks: _____

_____

DOT Field Personnel: Please complete this form and return it to your respective Region Materials Engineer **by December 1, 2025.**

All Other Manual Holders: Please complete this form and return it to Kelly Hudecek at the address shown below **by December 1, 2025.**

NOTE: If this document is not completed and returned, it will be assumed that you no longer have this manual and/or do not wish to receive future revisions.

Materials Manual updates and revisions can be found at the following website:
http://www.sddot.com/business/certification/forms/Default.aspx

Kelly Hudecek
South Dakota Department of Transportation
Office of Materials and Surfacing
700 East Broadway Avenue
Pierre, SD 57501

*** (This number is used by DOT Field Offices ONLY and is assigned by the Reg. Matl's. Engr.)**

The South Dakota Department of Transportation gives public notice of its policy to uphold and assure full compliance with the non-discrimination requirements of Title VI of the Civil Rights Act of 1964 and related Nondiscrimination authorities. Title VI and related Nondiscrimination authorities stipulate that no person in the United States of America shall on the grounds of race, color, national origin, religion, sex, age, disability, income level or Limited English Proficiency be excluded from the participation in, be denied the benefits of, or be otherwise subjected to discrimination under any program or activity receiving Federal financial assistance.

Any person who has questions concerning this policy or wishes to file a discrimination complaint should contact the Department's Civil Rights Office at 605-773-3540.

2025 – MATERIALS MANUAL REVISIONS

Make the following changes in your Manual:

PREFACE

1. PREFACE remove page 1 through 2 and replace with revised sheets.

ORGANIZATION & FUNCTIONS

2. ORGANIZATION & FUNCTIONS remove page 5 and replace with revised sheet.

RSTC SECTION

3. Remove RSTC Table of Contents in its entirety and replace with revised sheets.
4. Remove RSTC page 5 through 14 and replace with revised sheets.

MSTR SECTION

5. Remove MSTR Table of Contents in its entirety and replace with revised edition.
6. Remove MSTR in its entirety and replace with revised edition.

SETION 100 – Soils

7. Remove Section 100 Table of Contents in its entirety and replace with revised edition.
8. SD 105 remove page 1 through 2 and replace with the revised sheets.
9. SD 108 remove page 5 through 6 and replace with the revised sheets.
10. SD 111 remove in its entirety and replace with revised edition.
11. SD 114 remove in its entirety and replace with revised edition.

SECTION 200 – Aggregates

12. Remove Section 200 Table of Contents in its entirety and replace with revised edition.
13. SD 202 remove in its entirety and replace with revised edition.

SECTION 300 – Asphalt

14. SD 318 remove the section in its entirety and replace with the revised edition.
15. SD 319 remove the section in its entirety and replace with the revised edition.

SECTION 400 – Concrete

16. SD 413 remove the section in its entirety and replace with the revised edition.

Materials Manual, Sampling, and Testing Procedures

Preface

PURPOSE:

This Materials Manual has been prepared for the purpose of standardizing the Department's sampling and testing procedures and to provide assurance that the materials and workmanship incorporated in each construction project are in reasonably close conformity with the requirements of the plans and specifications.

The Chief Materials and Surfacing Engineer will be responsible for final interpretation of the contents of this manual and will be consulted if clarification is necessary.

The following sampling and testing procedures are used by the Department.

1. Tests that follow the national standard without modification.

2. Tests which have been modified by the Department laboratory which contain portions of a national standard.

3. Tests developed by the Department Laboratory without reference to a national standard.

The use & distribution of Materials & Surfacing Forms list, along with the most recent forms being used, is kept electronically by the office of Materials & Surfacing. The Approved Products List & certified plants list are maintained on the internet. A list for various approved concrete mix designs is kept electronically by the office of Materials & Surfacing. The mix design approved for a specific project is also kept in the project files. The asphalt mix designs are kept by the Bituminous Mix Design Office and in the project file. All of these lists are updated as changes occur.

LABORATORY INSPECTING PROGRAM:

The Department participates in a regular laboratory inspection and comparative sample testing program with the AASHTO Resources and CCRL. 25

Annual inspections and a comparative sample testing program have been established by the Central Laboratory with the Region Materials Laboratories.

A continuous inspection and comparative sample testing program are maintained between the Region Materials and the Area Engineer's project laboratories.

SAMPLING AND TESTING PROGRAM:

Minimum Sample and Test Requirements:

1. The schedules represent the minimum requirements for sampling and testing for each project. Good engineering practice may necessitate more frequent testing to assure adequate control. For example:

   (a) At the beginning of a project.

   (b) When a low volume of work is performed over a long period of time.

   (c) Whenever borderline or questionable material is encountered.

2. When project quantities are too small to justify sampling and testing costs, or when small quantities of material used will not have a significant influence on performance, strength or durability of major items on construction, or when large quantities of material of known satisfactory history are used, a request may be made to the Chief Materials and Surfacing Engineer, through the Region Materials Engineer, for permission to reduce or eliminate the Minimum Sample and Test Requirements (MSTR).

3. The sample and test requirements are stated in quantitative units and shall be followed by the words "Or a portion thereof".

4. Acceptance of some small quantities of miscellaneous materials may be made based on the manufacturer's material certification or by visual inspection as outlined in the schedule of Minimum Sample and Test Requirements (MSTR) or as directed by the Chief Materials and Surfacing Engineer.

LOCATION FOR OBTAINING SAMPLES AND TESTS:

Samples and tests for acceptance and independent assurance (IA) shall be taken from the completed work, if practicable; or from the point nearest the finished product, prior to or following blending, that representative specimens of the specified material can be obtained or as stated on the plans.

The use of the random numbers table shall be used, where applicable, for any random sampling and testing.

7. Region Materials.

Supervised by: Region Materials Engineer

Functions of the Region Materials Engineer:

Responsibilities on preliminary engineering work include scouting, locating, optioning, mapping, sampling, recording, and submitting samples and data for materials needed for construction projects.

With Region Engineer's approval, makes material recommendations to the Materials Engineer in Pierre. Advises project technicians in the use of correct sampling and testing procedures in accordance with the South Dakota Materials Manual, AASHTO, and ASTM.

Promotes and maintains accuracy and uniformity of sampling and testing by project personnel through a program of field laboratory and equipment inspection and a continuous comparative sampling and testing program.

Ensures that minimum requirements for independent assurance sampling and testing are met and that the comparisons with acceptance tests results are promptly made, documented and reported.

The Region Materials personnel shall not give oral or written orders to the Contractor, subcontractors or their employees.

Ensures the preparation of a materials certification based on sampling, testing and certification performed in connection with projects that are 100% State Funds for submittal to Region Engineer.

25

South Dakota Department of Transportation

Required Samples, Tests, and Certificates (RSTC)

Table of Contents

4.5 Failing Acceptance Samples and Tests.

Use the number as identified by the acceptance sample.

4.6 Independent Assurance Sample and Tests.

Use prefix “IA" and related test number and the related acceptance test number, e.g., IA01/01, IA02/05, IA03/10, etc.

4.7 Remedial Action Samples and Tests.

Use the suffix “R” and related test number of sample. For example, IA test number IA04/22 is outside the tolerances outlined in Section 5, remedial action test IA04R/22R is made to confirm remedial action to be successful. If remedial action is unsuccessful additional remedial action tests IA04RR/22RR, etc. will be made.

4.8 Quality Sample and Tests.

Use prefix “Q", e.g., Q01, Q02, Q03, etc.

4.9 Information Samples and Tests.

Use prefix “Info”, e.g., Info 01, Info 02, Info 03, etc. unless otherwise noted.

4.10 Mix Design Samples and Tests.

Use prefix “MD”, e.g., MD 01, MD 02, MD 03, etc.

4.11 Certificates.

Use numerical sequence for each type of material certified, e.g., 01, 02, 03, etc.

4.12 Certified Suppliers.

Any method approved by the Certification Office that will ensure identification.

4.13 Approved Products List.

Any method approved by the Certification Office that will ensure identification. The Approved Products List can be found at the SDDOT website.

4.14 Umbrella Certificates.

The “Certificate Group ID” number generated by the Materials Sampling and Testing (MS&T) system, or any method that will ensure identification.

4.15 Sample and Tests for other Agencies (Outside Testing).

Any method that will ensure identification.

4.16 Standby Samples.

Standby samples shall carry the number of the sample followed by an “A” or “B”. When it is necessary to test a standby specimen, the test will carry the same number followed by an “A” or “B”.

Where the Certificate of Compliance bears the number, the samples taken shall be numbered A and B. Example: Asphalt cement, the certificate is considered to be 1, the samples taken will be 01A and 01B.

5. Operational Procedures:

5.1 Acceptance Samples and Tests.

Scope.

This procedure outlines the requirements for acceptance sampling and testing by personnel under supervision of the Area Engineer to align such control to comply with FHWA requirements.

Definition.

Acceptance samples and tests include the samples and tests used for determining the acceptability of the materials and workmanship which have been or are being incorporated in the project. They are the principal basis for determining the acceptability of the projects' materials and construction.

Operational Procedure.

Acceptance sampling and testing at the construction site will normally be performed by qualified technicians from the Area Engineer's crew and under his direction in laboratory facilities provided for that purpose. Special tests required for acceptance or samples requiring special equipment not available on the project shall be submitted to the Region or Central Testing Laboratories.

When deemed necessary by the Region Engineer to expedite the testing program or assure dependable acceptance test results, he will direct the Region Materials Engineer to assign qualified technicians to the Area Engineer to make such tests. The Area Engineer will direct the activities of the assigned personnel. They will not be allowed to take IA samples or tests on that project material. Upon request by the Area Engineer, the Central Testing Laboratory will make tests on acceptance samples.

Sampling and testing should be supplemented by sufficient visual inspection of the materials as a whole, to ascertain whether the samples and tests are reasonably representative of the entire mass. In addition, there should be sufficient observation of the construction operations and processes to determine whether they can be expected to consistently produce uniform, satisfactory results.

The number of acceptance samples and the distribution of the locations from which they are to be taken are intended to be such as to adequately assure or verify that

the materials incorporated, and the construction produced are acceptable in accordance with the plans and specifications including approved changes.

The sampling and testing must be such that a decision regarding acceptance of materials and workmanship can generally be made as construction progresses.

Acceptance samples shall be:

A. Taken and tested at the construction site by project, Region, or Central Testing Laboratory personnel who are not associated with the taking of IA samples for that material and project.

B. Obtained at a production or processing plant, or other source away from the project and tested in the Region or Central Testing Laboratory. Even though previously sampled at some other point by project personnel, a reasonable number of acceptance samples for aggregates are to be taken at either:

   (1) The point they are to be incorporated in the work.

   (2) The point they are to be mixed with other materials.

C. Samples of manufactured products that are not easily contaminated or otherwise not normally susceptible to changes in characteristics that are tested by the manufacturer.

   For these products:

   (1) Numerical test results or certificates as to conformity with specification requirements are to be sent to the Area Engineer's Office when shipment is made.

      This consideration shall be immediately revoked if such certification is found to be unreliable.

   (2) Occasional sampling and testing shall be done by representatives of the State to provide assurance of the reliability of the results obtained by the manufacturer or supplier.

D. Previously accepted materials transferred from another project, when accompanied with a Letter of Transfer (DOT-70), may be accepted on the previous basis for acceptance.

E. When an acceptance test fails, and the process continues without shutting down (e.g., slump, entrained air tests) an acceptance test shall be performed immediately after the contractor has had the opportunity to correct the subsequent material.

   Samples taken and tested to confirm specification compliance of materials tested after a failing test <u>while production continues</u> are acceptance samples as they represent material produced and placed on the project; therefore, they shall be numbered as the next consecutive acceptance sample.

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. 25

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

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

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 tests will represent a quantity of material determined as follows: One-half of material produced from the time the previous sample was taken until the current sample is obtained plus one-half of the material produced between the time of sampling the current sample and the time the next sample is taken, 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.

The testing frequency is irrespective of the quantity represented. A failing sample may represent more material than 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

Test	Tolerance*
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

Test	Tolerance*
Penetration	
Penetration, 77ºF (Less than 50)	2 pen. pts.
Penetration, 77ºF (50 or above)	4%
Flash Point	
Cleveland Open Cup	15ºF
Pensky-Marten's Closed Cup (Below 220ºF)	3°F
Pensky-Marten's Closed Cup (Above 220ºF)	13°F
Viscosity	
Kinematic, 275ºF	4.4%
Absolute, 140ºF	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.

<u>Acceptable Tolerances for Comparison of Class Q Asphalt Concrete between QC, QA and IA</u>

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

The Region Materials Engineer will:

(1) When there are no, or only minor discrepancies, between the results of the two 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. 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. 25

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 a period of three years after the final payment is received on the project. If any litigation, claim, negotiation, audit or other action involving the records has been started before the expiration of the 3-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 3-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)

Table of Contents

Page

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 refinery for the asphalt binder used in the mixture 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, certified technicians will conduct comparison tests at the plant with a split companion cold feed calibration sample of virgin aggregate to

assure that all associated equipment and procedures provide comparable results. Comparison test results will meet the requirements of the mix design report and will conform to the tolerances in this manual. The split companion calibration testing will continue until the results meet the requirements of the mix design report and are within the listed tolerances. The split companion 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.

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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	Reduce test frequency to 1 test per lot
7 to 9 above minimum	Reduce test frequency to 2 tests per lot
4 to 6 above minimum	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

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 Materials & Surfacing 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.

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 (excluding mineral filler and additives) used in the composite 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 (excluding mineral filler and additives) used in the composite 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.

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. <u>RAP Content</u>

(1) Tier not applicable.

(2) Certification.
None required.

(3) Acceptance.
One per day. (DOT-93).

(4) Independent Assurance.
None required.

E. <u>RAP in Asphalt Concrete</u>

(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 sublot will be taken for determination of in place density. The average of the two core density results will be the 1,000 ton sublot 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)

(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.

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)

(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.

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)

(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)

(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 yd^3 / 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 yd^3 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 yd^3. (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/ft^3.

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. 25

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 yd^3 of excavation.
None required for contract quantities less than 10,000 yd^3.

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.
None required.

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) 25

(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 yd^3.

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 yd^3 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 yd^3 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 yd^3 then one per 30,000 yd^3 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 yd^3. 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 yd^3 of concrete paving for each size. None required for contract quantities less than 500 yd^3. 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 yd^3 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 yd^3 of paving. Two 4 lb. samples. (DOT-1)
None required for contract quantities less than 500 yd^3.

(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 yd^3 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 yd^3 (for 1st days production); thereafter, one set of cylinders per 1500 yd^3 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 yd^3 of paving. None required for contract quantities less than 500 yd^3 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. 25

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 yd^2 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 yd^2).

For projects with contract quantities less than 4,000 yd^2, 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 yd^2).

For projects with contract quantities less than 4,000 yd^2, 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 ft^2; 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 yd^3.

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 yd^3 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 yd^3 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 yd^3 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 yd^3. (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 yd^3 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 yd^3.

(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 yd^3 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 yd^3 of concrete, per day for each class of concrete from each plant.

Strength tests for bridge deck concrete will be 1 per 100 yd^3 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 yd^3 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 ft^2; 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 yd^3 of concrete.

Visual Inspection required if less than 50 yd^3

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 ft^2; 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.

Electrical junction boxes (not on APL).
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
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

25

*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.
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. 25

(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) 25

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. 25

(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. 25

(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. 25

(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. 25

(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 $yd^{3.}$

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. <u>Plank, etc.</u>

(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 yd^3.

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 yd^3 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 yd^2 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 yd^2 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 yd^2. (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 yd^2. (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

Density of Soils and/or Granular Material In-place by the Sand-Cone Method

1. Scope:

This test is for determining the in-place density of soils and/or granular materials.

2. Apparatus:

2.1 Density apparatus consisting of a 6 1/2" diameter sand cone and a one gallon jar conforming to the requirements of AASHTO T 191.

2.2 Base plate conforming to the requirements of AASHTO T 191.

2.3 Scale or balance having the capacity to weigh any sample which may be tested utilizing this procedure and readable to the nearest 0.01 lb. An additional scale or balance that is readable to the nearest 0.1 gram will be needed for determining the moisture.

2.4 Oven capable of maintaining a temperature of 230° ± 9°F or other equipment according to SD 108.

2.5 1/10th cubic foot standard measure.

2.6 Sand: Clean, dry and free flowing. It must not have a variation in bulk density greater than 1%. Sand retained between the #12 and #20, or #12 and #30 sieve sizes is most suitable. To prove suitability, several bulk density determinations must be made, using the same representative sample.

2.7 Sieves: 3/4", #4, #12, and #20 or #30 sieves conforming to ASTM E11.

2.8 Miscellaneous: Small pick, hammer, chisels, spoons, pans or other suitable containers for drying moisture samples, buckets, plastic bags and paint brush.

3. Procedure:

3.1 Calibration of Density Apparatus

A. Determine the weight of sand required to fill the cone and base plate.

Pour the standard sand into the density apparatus through the cone with the valve open until the jar is full. The density apparatus should be gently tapped several times (With palm of hand) during filling to ensure that the maximum amount of sand will be available for the next test. Weigh the full density apparatus and record the weight to the nearest 0.01 lb.

Place the base plate on a clean, level, plane surface such as the bottom of a 6" mold. Invert the density apparatus and seat the cone into the recess of the base plate. Open the valve to allow the

sand to fill the cone and base plate. Avoid jarring or vibrating the density apparatus while the sand is flowing.

Close the valve and weigh the density apparatus and remaining sand. Subtract this weight from the weight of the density apparatus full of sand. The difference is the weight of the sand to the nearest 0.01 lb. required to fill the cone and base plate. Use DOT–87 worksheet to record weights. An average of three such tests will be used to determine the weight of sand in the cone and base plate

B. Determine the Bulk Density of the Sand.

(1) Determine the weight of sand to fill the cone.

Pour the standard sand into the density apparatus through the cone with the valve open until the jar is full. The density apparatus should be gently tapped several times (With palm of hand) during filling to ensure that the maximum amount of sand will be available for the next test. Weigh the full density apparatus and record the weight to the nearest 0.01 lb.

Invert the density apparatus and place the cone on a clean, level, plane. Open the valve to allow the sand to fill the cone. Avoid jarring or vibrating the density apparatus while the sand is flowing.

Close the valve and weigh the density apparatus and remaining sand. Subtract this weight from the weight of the density apparatus full of sand. The difference is the weight of the sand to the nearest 0.01 lb. required to fill the cone. Use DOT–87 worksheet to record weights. An average of three such tests will be used to determine the weight of sand in the cone.

(2) Determine the weight of sand to fill the cone and standard measure. Weigh the full density apparatus and record the weight to the nearest 0.01 lb. Center the density apparatus with the cone down and resting on the rim of the standard measure. Open the valve to allow the sand to fill the measure and cone. Avoid jarring or vibrating the density apparatus while the sand is flowing.

Close the valve and weigh the density apparatus and remaining sand. Subtract this weight from the weight of the density apparatus full of sand. The difference is the weight of the sand to the nearest 0.01 lb. required to fill the cone and standard measure. Use DOT–87 worksheet to record weights. An average of three such tests will be used to determine the weight of the sand in the cone and standard measure.

NOTE: This step may be performed with the base plate sitting flush on the measure, in which case 3.1.B.(1) may be eliminated

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.

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:

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

25

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

1. Scope:

This procedure is for determining the percentage by weight of durable material passing an 8 inch opening and retained on a 3/4 inch sieve.

2. Apparatus:

2.1 3/4" sieve conforming to AASHTO M 92.

2.2 Scale having a capacity of at approximately least 30 lbs, sensitive and readable to 0.01 lb.

2.3 Miscellaneous: shovel, bucket.

3. Procedure:

3.1 Field Sieve Analysis

A. Obtain a sample of material weighing approximately 30 lbs.

B. Weigh the material, record to the nearest 0.1 lbs.

C. Sieve the sample over 3/4 inch sieve.

D. Weigh the material retained on the 3/4 inch sieve, record to the nearest 0.1 lbs.

3.2 Durability Check

A. Obtain a sample of material weighing approximately 30 lbs. (may use material from 3.1).

B. Wash the material retained on the ¾" sieve.

C. Dry the material retained on the ¾ inch sieve.

D. Weigh the material retained on the 3/4 inch sieve (Wi), record to the nearest 0.1 lbs.

E. Place the sample in a pan and completely cover the sample with water.

F. Allow the material to soak for 24 hours.

G. Remove the material and dry.

H. Sieve the sample over 3/4 inch sieve.

I. Weigh the material retained on the 3/4 inch sieve (Wf), record to the nearest 0.1 lbs.

Material is considered durable if it is 95% or more durable.

3.3 Moisture

A. Perform field moisture as per SD108 and 1-point determination as per SD104, Method 4.

4. Report:

4.1 Field Sieve Analysis

The percentage of materials retained on the ¾" sieve is calculated as follows:

$$\%\ +3/4\text{" material} = \frac{\text{wt. of material retained on ¾" sieve}}{\text{Total weight of material}} \times 100$$

Report the percentage to the nearest 0.1%. (DOT-41)

4.2 Durability Check

The Material will be considered durable if the percentage of materials retained on the ¾" sieve is 5% or less.

$$\text{Durability} = \frac{\text{(Weight Final}(W_f) - \text{Weight Initial}(W_i)}{\text{Weight}(W_f)} \times 100$$

Report the durability percentage to the nearest 0.1%. (Miscellaneous. Test Document).

5. References:

None.

Determination of In-place Density of Soils and Aggregates by Nuclear Method

1. Scope:

This test is for determining density of soil and aggregate, including lime treated material, by the nuclear method.

2. Apparatus:

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

2.2 A reference standard block for taking standard counts.

2.3 A drill rod, extraction tool, and combination guide-scraper plate for preparing the test site and punching the hole for the source rod.

2.4 A manufacturer's instruction manual for the nuclear gauge.

2.5 A nuclear gauge information book, transportation documents book, and nuclear badge.

2.6 A hammer to drive the drill rod, and a shovel and other tools for site preparation.

3. Procedure:

3.1 Calibration.

A. The Central Laboratory will calibrate nuclear gauges annually and each time repairs are made.

3.2 Standard counts.

A. Turn the gauge on and allow the gauge to warm up for at least 10 minutes.

B. Place the gauge on the reference standard block and take the standard count as recommended by the manufacturer.

C. Take at least one 4 minute standard count daily. This count should compare within 1% of the average of the 4 previous standard density counts and compare within 2% of the average of the 4 previous standard moisture counts for the gauge. If the standard count varies by more than these tolerances, do not accept the standard count. Check that all the manufacturer's guidelines have been followed and take another standard count.

If the second count also fails, follow the manufacturer's recommendation for the particular model gauge for taking and recording 4 additional standard counts.

D. Record the results of the standard count in the gauge's logbook and on form DOT-41.

3.3 Site preparation.

A. 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.

B. 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.

C. The maximum depressions beneath the gauge will 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.

3.4 Wet density determination.

A. 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 the material to be measured. Remove the drill rod by pulling it straight up and twisting the extraction tool, to avoid disturbing the hole.

B. 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.

Take a one-minute reading to determine the wet density in lbs./ft^3 and record this number on the DOT-41 worksheet. It is recommended that you take more than one reading and average the results. At the completion of wet density measurements, dig up the area beneath the gauge to collect the moisture specimen 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. The moisture content used to

determine the in place dry density must be collected from beneath the gauge.

3.5 Correction determination.

A. At least five tests must be performed using the nuclear gauge on mechanically compacted material and compared against SD 105 or SD 106 to compute a wet density correction (Figure 2) Use the DOT-39 to calculate the wet density correction. If an individual comparison is determined which is not within ±3.0 lbs./ft^3 of the Correction (Running average) calculated from the previous five individual comparisons, the results will be considered suspect and additional checks should be run to determine if the material has changed. 25

After the wet density correction is determined, it is applied to future tests performed with the nuclear gauge. Each type of material will have a different correction. Embankment material will 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 density 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 will never be used for determination of in-place dry density.

B. Additional comparison checks against SD 105 or SD 106. These tests will be performed at a minimum of at least once per 20 wet density tests. Results will be documented on the DOT-39 worksheet and the Correction (Running average) reevaluated for the five most recent wet density comparison tests performed. Results from Independent assurance tests may be used in determining the correction.

C. If a discrepancy exists, contact the Region Materials Engineer.

3.6 Standard density determination.

A. To determine standard density, take material from or adjacent to the test hole for SD 104, method 2 or method 4.

4. Report:

4.1 Calculations of wet density correction on DOT 39

A = Balloon or sand cone density in lb/ft^3.

B = Wet density in $lbs./ft^3$ determined by the nuclear gauge.

C = A – B

D = Correction (Running average) of 5 most recent values of C in lb/ft^3.

Wet Density = Nuclear wet density + correction

4.2 Report the percent of standard density to the nearest whole percentage point.

5. References:

AASHTO T 310
SD 105
SD 106
SD 108
DOT-39
DOT-41

Sample ID 2205215 **Density Report** DOT - 41
File No. 6-21

County: Aurora, Ziebach | PCN/PROJECT: B015 PH 0066(00)15
Station: 28+91 | Dist From CL: 17' R | Width (Gravel):
Depth: (from top of Subgrade or Pipe) | Field #: test
Tested By: Tester, One | Checked By: Tester, Two | Date: 06/21/2021

WORK AREA REPRESENTED (Circle what applies)

EMBANKMENT STA. TO STA. 26+00 to 52+00 (per half mile, for each roadbed)
Zone 1 (0-1 ft.) | Zone 2 (1-3 ft.) | Zone 3 (3-5 ft.) | Zone 4 (5 ft. to bottom) 1 per 5 ft.

BRIDGE END EMBANKMENT STA. TO STA.
1 per zone within plan limits | 3 equal zones when backwall is less than 7ft. | 4 equal zones when backwall is greater than 7ft.
Zone 1 | Zone 2 | Zone 3 | Zone 4 | Zone 5

BERM STA. TO STA. (100 ft. from Bridge End)
Zone 1 (0-1 ft.) | Zone 2 (1-3 ft.) | Zone 3 (3-5 ft.) | Zone 4 (5 ft. to bottom) 1 per 3 ft.

PIPE							
	CROSS	24" or smaller	undercut	(1/2 way up)	(0-2 ft. Above)		
	STORM	30" to 72"	undercut	(Lower 1/2)	(Upper 1/2)	(0-2 ft. Above)	
	INTERSECTION	72" or more	undercut	(Bottom 1/3)	(Middle 1/3)	(Top 1/3)	(0-2 ft. Above)

After Minimum for size pipe installation ☐ 1 per 3 ft of backfill beginning at 2' above top of pipe

SUBBASE STA. TO STA. LIFT

BASE COURSE STA. TO STA. LIFT

Standard Density

Curve Type	Curve Used		Maximum Density	Optimum Moisture		Granular Material 4-Point Range
Ohio	O	U.	107.1	18.1	%	-

SPECIFICATION 95%
% Obtained 100X(G/U) 98%

Balloon Method

B. Wt. Undried Matl. from Hole	
C. Volumeter Reading in Hole	
D. Initial Volumeter Reading	
E. Volume of Test Hole (C-D)	
F. Wet Density (B/E)	
G. Dry Density F/(100+M{Field}) x 100	

Sand Method

A. Std. Sand PCF		
B. Wt. Undried Matl. from Hole		
C. Initial Wt. Sand		
D. Final Wt. Sand Plus Cone Sand		
E. Volume of Test Hole (C-D)/A		
F. Wet Density (B/E)		
G. Dry Density F/(100+M{Field}) x 100		

Nuclear Method

Meter No. MQ 778
Test Mode 6" DIRECT TRANSMISSION
F. Wet Density from Gauge 120.80
+/-Corr. * 1.20 = 122.0
G. Dry Density F/(100+M{Field}) x 100 105.4

1-Point Density Determination

		1-Point	Field
O. Weight of Mold & Specimen	13.32		
P. Weight of Mold	9.23	130.7	109.1
Q. Wet Wt. of Molded Specimen (O-P)	4.09	112.5	94.3
R. Factor of Mold No. P-1885 Used in Test	30.01	18.2	14.8
S. Wet Density (QxR)	122.7	112.5	94.3
T. Dry Density S/(100+M [1-PT])x100	105.6	16.2	15.7

Moisture Determination

	1-Point	Field
H. Wt. of Wet Matl. and Container	130.7	109.1
I. Wt. of Dry Matl. and Container	112.5	94.3
J. Wt. of Moisture (H-I)	18.2	14.8
K. Wt. of Container		
L. Wt. of Dry Matl. (I-K)	112.5	94.3
M. Percent Moisture (Jx100)/L	16.2	15.7

Rock Determination

A. Total Sample Weight
B. Weight of Material Retained on 3/4" Sieve
C. Percent Retained On 3/4" Sieve (Bx100)/A

* Correction from DOT-39. If there is no correction or, if the correction has been applied to the meter show "NA".

Figure1

Sample ID: 2205230

Determination of Corrections for Moisture and Density by the Nuclear Gauge

DOT-39
3-19

PROJECT PH 0066(00)15 COUNTY Aurora, Ziebach PCN B015

Tested by Tester, One Checked by Tester, Two Test Date 04/28/2015

Nuclear Gauge No. MQ 778 Material Type Unclassified Excavation

Moisture (Percent)

Test No.	Date	Oven Dry	Nuclear Gauge	Individual Comparison Oven Dry - Nuclear	Correction (Running Avg.)
E001	06/03/2015	26.7	25.1	1.6	
E002	06/03/2015	23.9	22.1	1.8	
E003	06/03/2015	26.2	25.2	1.0	
E004	06/04/2015	12.4	10.9	1.5	
P002	06/04/2015	12.7	11.4	1.3	1.4
E025	06/08/2015	19.5	19.7	-0.2	1.1
E045	06/18/2015	18.3	16.8	1.5	1.0
E065	06/22/2015	18.7	17.5	1.2	1.1

Actual Moisture = Nuclear Moisture + Correction (Running Avg.)

Wet Density (Lbs/CuFt)

Test No.	Date	Sand or Balloon Test	Nuclear Gauge	Individual Comparison Sand/Balloon - Nuclear	Correction (Running Avg.)
E001	06/03/2015	123.2	122.7	0.5	
E002	06/03/2015	122.4	121.3	1.1	
E003	06/03/2015	122.8	121.8	1.0	
E004	06/04/2015	126.2	123.5	2.7	
P002	06/04/2015	127.8	127.6	0.2	1.1
E025	06/08/2015	124.5	122.2	2.3	1.5
E045	06/18/2015	127.1	126.3	0.8	1.4
E065	06/22/2015	126.1	126.2	-0.1	1.2

Actual Wet Density = Nuclear Density + Correction (Running Avg.)

Figure 2

Table of Contents

Aggregate Section

Method of Test for Sieve Analysis

1. Scope:

This test is for determining sieve analysis of subbase, base course, mineral aggregate (Surface course materials), concrete aggregates, fillers, and similar materials.

2. Apparatus:

2.1 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.

2.2 Sieves. Standard square opening, conforming to ASTM E 11.

2.3 Drying oven capable of maintaining a temperature of 230° ± 9°F.

2.4 Pans, scoops, brushes, etc., for handling materials.

2.5 Mechanical sieve shaker.

3. Procedure:

Surface Course Materials:

3.1 Obtain a sample in accordance with SD 201. The sample will be large enough to provide specimens for all required testing.

3.2 Reduce the sample to the size of the specimen needed for testing by splitting or quartering in accordance with SD 213.

3.3 Minimum sample size.

Nominal maximum size of particle is denoted by the smallest sieve opening listed below, through which 90% or more of the sample being tested will pass.

Nominal maximum size of particle	Minimum wt. of sample (Grams)
#4	500
3/8”	1000
1/2”	2500
3/4”	5000
1”	10000
1 1/2”	15000
2”	20000
2 1/2”	35000
3”	60000
3 1/2”	100000
4”	150000

3.4 The sample will be dried to a constant weight at a temperature of 230° ± 9°F or in accordance with SD 108. Frequent stirring will expedite the drying procedure.

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.

3.5 Determine loose weight, if required, in accordance with SD 205.

3.6 Weigh the sample and record the weight in the "Original dry sample weight" box of the DOT-3 worksheet to the nearest 0.1 gram.

3.7 Assemble a series of sieves that will furnish the information required by the specifications covering the material to be tested. Nest the sieves in order of decreasing size of opening from top to bottom and include a pan below the last sieve.

3.8 Pour the sample into the top sieve of the nest. Agitate the sieves by hand or on a mechanical shaker for a sufficient period of time, established by trial or checked by measurement on the actual test sample, to meet the criterion for adequacy of sieving.

The adequacy of sieving can be checked by the hand method. Hand sieving is done by using an individual sieve with a cover and pan while rotating and tapping the sieve approximately two times per second for one minute. The end point for sieving is when not more than 0.5% by weight will pass that sieve.

3.9 Remove any dirt adhering to the + #4 material. This can be accomplished by dumping the material from each individual sieve into a flat pan and rubbing it with a soft pine or rubber covered block. After the dirt has been removed, pour the contents of the pan back onto the sieves and complete the shaking.

An alternate method is to place the material retained on an individual sieve in a cement sample can. With the lid in place, agitate the aggregate using a circular motion. The material is then reintroduced to the sieve and sieved by hand.

3.10 Weigh the material retained on each sieve and the material in the pan to the nearest 0.1 gram and record the weights on the worksheet. Tabulate the total for these weights. The tabulated total should check within 0.3% of the "Original dry sample weight." If it does not, a backup sample will be tested.

3.11 In the coarse sieve series, the weight retained on a sieve in kg at the completion of sieving will not exceed the product of 2.5 times the sieve size opening in millimeters times the effective sieving area in m^2. In the fine sieve series (Openings smaller than #4) the weight retained on any sieve will not be greater than 4 $g/in.^2$ (See Chart 1 below).

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. (500 gram min) 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° ± 9°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): 25

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	Dust Chk	wt. before washing (0.1	(A)	1069.3
TOTAL			5055.1	100.0		wt. after washing (0.1%	(B)	1058.5
+ #4 Gradation Check:						loss from washing	(C)	10.8
within 0.3% of original dry wt.			0.1%			% - #200	(D)	1.01

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/Desig	(G) 38.9	= 0.39	- #4 Gradation check:		
Chip		x % Retain/Design		=	within 0.3% of the	0.1	
Fine	(E) 10.06	x %Pass/Design	(F) 61.1	= 6.15	wt. before washing		
		Total/Combined - #200		6.5			

Calculations:

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

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

0.39 + 6.15 = 6.54 or 6.5% 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 ft^3 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 265.6

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

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.

Coarse aggregate	1.65%	x	64.4%	/	100	=	1.06%
Fine aggregate	0.95%	x	35.6%	/	100	=	0.34%
Combined - #200 sieve						=	1.40 or 1.4%.

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° ± 9°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° ± 9°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 be 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.

25

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. 25

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	**(H)**
Chip	396.0	22.4	**(I)**
		0	
		0	
Total	1770.0	100.0	

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	
(J) 3/8	2095.4	20.3	19.0	3/8	104.8	3.4	96.6	**(J)**
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. before wash	2752.8		
wt. after wash	3728.2		wt. after wash	2707.1		
loss from wash	42.8		loss from wash	45.7		
% - #200 ==>	1.13	**(K)**	% - #200 ==>	1.66	**(M)**	
Bin adj. - #200	0.877	**(L)**	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
Chip		x % Retain/Design		=	
Fine	1.45%	x % Pass/Design	42.00	=	0.61
04 Referenced		Total/Combined - #200			1.3

(P)

(Q)

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

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	
Liquid Limit N.C. ☐	(G rounded)	21	
Plasticity Index	(I rounded)	4	
J. Correction # Blows	26		

Specification: Liquid Limit 0 - 25; Plasticity Index 0 - 6

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

Figure 1

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	96.2	96	
1/2 in.			620.1	12.3	83.9	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				

Dust Check: wt. before washing (0.1g) 1069.3; wt. after washing (0.1g) 1058.5; loss from washing 10.8; % - #200 1.01

+ #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)		
Liquid Limit N.C. ☑	(G rounded)		
Plasticity Index	(I rounded)	N.C.	

Specification
0 - 25
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

Figure 2

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. 8616.4 - dry wt.) / dry wt. x 100 = 3.9

Original Dry Sample Wt. (.1g) 8,289.9

Sieve Size mm	Sieve Size in	Retained (0.1g)	%total ret.(0.1%)	%pass. (0.1%)	%pass. (rounded)	Spec Req.
100	4					
75	3					
62.5	2 1/2					
50	2					
37.5	1 1/2					
31.5	1 1/4					
25	1					
19	3/4	0.0	0.0	100.0	100	100 - 100
16	5/8	7.3	0.1	99.9	100	
12.5	1/2	501.4	6.0	93.9	94	89 - 100
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			
Total		8293.4				

Dup		
	wt. before washing(0.1g)	709.30
	wt. after washing(0.1g)	707.10
	loss from washing	2.2
	% - #200	0.31

+ #4 Graduation Check:
within 0.3% of orig dry wt. 0.04

Sand Equiv. Test	Sand Rdg.	Clay Rdg.	S.E.
Reading #1	3.10	6.60	47
Reading #2	3.10	6.50	48

Sand Equivalent Tests Results 48 42 - 100

Fine Aggregate Angularity Test Results 41.8 41.0 - 100.0

Flat and Elongated Particles Test Results 0.0 -

Sieve Size mm	Sieve Size #	Retained (0.1g)	%total ret.(0.1%)	%total x %pass. #4	%pass. (0.1%)	%pass. (rounded)	Spec Req.
3.35	6						
2.36	8	187.7	29.8	18.4	43.4	43	41 - 51
2.00	10						
1.70	12						
1.18	16	137.2	21.8	13.5	29.9	30	
0.850	20						
0.600	30	112.0	17.8	11.0	18.9	19	
0.425	40	54.3	8.6	5.3	13.6	14	
0.300	50	42.7	6.8	4.2	9.4	9	
0.180	80						
0.150	100	35.0	5.6	3.5	5.9	6	
0.075	200	10.5	1.7	1.1	4.8	4.8	2.9 - 6.9
Pan dry		4.8	49.2	4.8	wt before washing (0.1g)		629.8
Pan wash		44.40	7.8		wt after washing (0.1g)		585.4
Total		628.60			**loss from washing(-#200)**		44.4

Coarse	0.31	% x % Retain/Design	38.20	=	0.12	
Fine	7.81	% x % Retain/Design	61.80	=	4.83	
		Total/Combined - #200			5.0	

- #4 Gradation check:
within 0.3% of the wt before washing 0.2

Natural Sand	0.00	Na. Rock	31.00	Natural Fines	25.00
Natural Sand	0.00	Natural Fines	0.00	Osch Nat Fines	16.00
Cr.Fines	28.00				

+ #4 % Particles less than 1.95 SP. GR.

Specific gravity of solution	(1.95 ± 0.01)	1.95
wt. of lightweight particles	(0.1 g)	19.1
weight of + #4 material	(0.1 g)	1824.9
% lightweight particles		1.0
SPECIFICATION		0.0 - 3.0

- #4 % Particles less than 1.95 SP. GR.

Specific gravity of solution	(1.95 ± 0.01)	1.95
wt. of lightweight particles	(0.1 g)	3.2
weight of - #4 material	(0.1 g)	302.4
% lightweight particles		1.1
SPECIFICATION		0.0 - 3.0

Crushed Particles Test

weight of crushed particles		651.7
weight of total + #4 sample		729.3
percent of crushed particles		89
SPECIFICATION	2 or more FF, min	65 - 100

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	Average
Uncompacted voids, (nearest 0.1%) U=((V-(F/Gsb))/V) x 100	41.7	41.8	41.8

Sieve Size mm	Sieve Size in	Total Sample Weight on Sieve	Weight of Tested Portion	Weight of Flat/ Elongated Particles	Percent Flat/ Elongated Individual Sieve	Percent Flat/ Elongated Weighted Average
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 enlongated particles in the total sample (weighted average) 0.0

rounded 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					

Dush Check

wt. before washing (0.1g)	
wt. after washing (0.1g)	
loss from washing	
% - #200	

+ #4 Gradation Check

within 0.3% of original dry weight: 0.18

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		wt before washing (0.1g)	3627.3
Pan wash	0.0	2.1		wt after washing (0.1g)	3567.5
Total	**10396.3**			loss from washing(-#200)	59.8

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

- #4 Gradation Check

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.

Figure 4

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

within 0.3% of original dry weight

Dust Check

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	*	96.1	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
Fine	0.95	% x % Passing/Design	35.60	=	0.34
03 Referenced		Total/Combined -#200			1.4

- #4 Gradation Check

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

Figure 5

Mix Batch Ticket	lbs./cu. yd.	Total Agg%
1" rock	1374.0	77.6
Chip	396.0	22.4
Total	1770.0	100.0

Sample ID 2203625 **Sieve Analysis** DOT-68

Mineral Aggregate **Stationary Plant Mix** 3-19

Test# 04 File Number

PCN B015 Project PH 0066(00)15

County Aurora, Ziebach

Charge to (if not above project)

Sample Represents 1155.0 Cu. Yd. Class and Type COARSE AGGREGATE

Date Sampled 03/13/2019 Sampled By Tester, One

Date Tested 03/13/2019 Tested By Tester, One

Checked By Tester, Two

Contractor Roads, Inc

1" rock

Sample Wt. (.1g) 10312.3

Sieve Size	Retained (.1g)	% total ret(0.1%)	% pass (0.1%)
2			
1 1/2			
1 1/4			
1	0.0	0.0	100.0
3/4	1431.6	13.9	86.1
5/8	2964.8	28.8	57.3
1/2	1853.9	18.0	39.3
3/8	2095.4	20.3	19.0
1/4			
#4	1798.4	17.4	1.6
#8	60.7	0.6	1.0
Pan Dry	98.4	1.0	

TOTAL 10303.2

Gradation Check ==> 0.09

wt. before wash 3771.0

wt. after wash 3728.2

loss from wash 42.8

% - #200==> 1.13

Bin adj. - 200==> 0.877

Chip

Sample Wt. (.1g) 3098.8

Sieve Size	Retained (.1g)	% total ret(0.1%)	% pass (0.1%)
2			
1 1/2			
1 1/4			
1			
3/4			
5/8	0.0	0.0	100.0
1/2	0.0	0.0	100.0
3/8	104.8	3.4	96.6
1/4	1347.5	43.5	53.1
#4	935.3	30.2	22.9
#8	616.2	19.9	3.0
Pan Dry	90.5	2.9	

TOTAL 3094.3

Gradation Check ==> 0.15

wt. before wash 2752.8

wt. after wash 2707.1

loss from wash 45.7

% - #200==> 1.66

Bin adj. - 200==> 0.372

Sample Wt. (.1g)

Sieve Size	Retained (.1g)	% total ret(0.1%)	% pass (0.1%)
2			
1 1/2			
1 1/4			
1			
3/4			
5/8			
1/2			
3/8			
1/4			
#4			
#8			
Pan Dry			

TOTAL

Gradation Check ==>

wt. before wash

wt. after wash

loss from wash

% - #200==>

Bin adj. - 200==>

Sample Wt. (.1g)

Sieve Size	Retained (.1g)	% total ret(0.1%)	% pass (0.1%)
2			
1 1/2			
1 1/4			
1			
3/4			
5/8			
1/2			
3/8			
1/4			
#4			
#8			
Pan Dry			

TOTAL

Gradation Check ==>

wt. before wash

wt. after wash

loss from wash

% - #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	% x % Retain/Design	58.00	=	
Fine	% x % Pass/Design	42.00	=	
04 Referenced	**Total/Combined - #200**			

+ #4 % Particles less than 1.95 SP. GR.		1" rock	Chip
Specific gravity of solution	(1.95 ± 0.01)	1.96	1.95
wt. of lightweight particles	(0.1g)	25.0	11.0
weight of + #4 material	(0.1g)	1500.0	1430.0
% lightweight particles		1.7	0.8
Bin Adj. % lightweight particles		1.3	0.2
Composite % lightweight particles		**1.5**	
SPECIFICATION		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	0.0				
77.6	19.0	3/4	1,431.6	1431.6	0.9	0.1	
	12.5	1/2	4,818.7	809.3	6.7	0.8	0.4
	9.5	3/8	2,095.4	228.5	4.6	2.0	0.4
	4.75	#4	1,798.4	96.7	0.9	0.9	0.2

Total sample wt. 10,144.1

Percent flat and enlongated particles in: 1.0

Percent flat and elongated particles in Total Rock: 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	0.0		
	9.5	3/8	104.8	75.0	0.0		
	4.75	#4	2,282.8	40.8	1.1	2.7	2.6

Total sample wt. 2,387.6

Percent flat and enlongated particles in: 2.6

Percent flat and elongated particles in Total Rock: 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 enlongated particles in:

Percent flat and elongated particles in Total Rock:

Combined Percent Flat and Elongated Particles for Total Rock: 1.4

Rounded: 1

Comments

Figure 6B

Sample ID 2203643 **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. 04 Date Sampled 03/16/2019 Date Tested 03/16/2019

Sampled By Tester, One Tested By Tester, One Checked By Tester, Two

Material Type FINE AGGREGATE Source Pete Lein & Sons, Wasta

1155.0 cuyd, RT. 2805.0 Lot No. Sublot No.

Weight Ticket Number or Station Belt 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	*	0.1	0.8	0.1	99.9	100	95 - 100
Pan							
Total							

+ #4 Gradation Check

within 0.3% of original dry weight

Dust Check

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	*	5.4	31.0	5.3		94.6	95	
#10								
#12								
#16	*	27.3	128.2	21.9		72.7	73	45 - 85
#20			96.5	16.5		56.2	56	
#30	*	62.0	106.7	18.2		38.0	38	
#40			89.1	15.2		22.8	23	
#50	*	87.2	58.7	10.0		12.8	13	10 - 30
#80			49.0	8.4		4.4	4	
#100	*	96.8	6.9	1.2		3.2	3	2 - 10
#200			10.6	1.8		1.4	1.4	
Pan dry			0.8	8.5		wt before washing (0.1g)		585.7
Pan wash			7.7	1.5		wt after washing (0.1g)		578.0
Total		2.79	**586.0**			loss from washing(-#200)		7.7

Coarse	1.36	% x % Retain/Design	58.00	=	0.79
Fine	1.45	% x % Passing/Design	42.00	=	0.61
04 Referenced		**Total/Combined -#200**			1.4

- #4 Gradation Check

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)	0.0
Weight of - #4 material	(0.1g)	298.4
% lightweight particles		0.0
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

Figure 7

Sample ID 2203623 **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 03/13/2019 Date Tested 03/13/2019

Sampled By Tester, One Tested By Tester, One Checked By Tester, Two

Material Type Type 2A Cover Aggregate Source Spencer Quarry

Taken @ 180.3 tons Lot No. Sublot No.

Weight Ticket Number or Station # 194, Sta 866+00 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.			235.5	19.2	80.8	81	
#4	*	47.6	349.1	28.4	52.4	52	0 - 70
Pan							
Total							

Dust Check

wt. before washing (0.1g)	
wt. after washing (0.1g)	
loss from washing	
% - #200	

+ #4 Gradation Check

within 0.3% of original dry weight

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.A.	N.P. ☐
H. Plastic Limit (D / F x 100)	(0.1g)		N.A.
I. Plasticity Index (G - H)	(0.1g)		
Liquid Limit N.C. ☐	(G rounded)		
Plasticity Index	(I rounded)	N.A.	

Specification
-
0 - 3

J. Correction # Blows

22=0.9646, 23=0.9899, 24=0.9952, 25=1.0000, 26=1.0050, 27=1.0100, 28=1.0138

weight - #40 / weight - #4 x % passing #4 =

(±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	*	89.8	518.3	42.2	22.1	10.2	10	0 - 28
#10			44.6	3.6	1.9	6.6	7	
#12								
#16	*							
#20								
#30	*							
#40			66.0	5.4	2.8	1.2	1	0 - 4
#50	*							
#80								
#100	*							
#200			12.2	1.0	0.5	0.2	0.2	0.0 - 3.0
Pan dry			1.1	4.7	0.2	wt before washing (0.1g)		1228.5
Pan wash			3.6	0.2		wt after washing (0.1g)		1224.9
Total			1230.4			loss from washing(-#200)		3.6

Crushed Particles Test

Weight of crushed particles		582.6
Weight of total + #4 sample		582.6
Percent of crushed pieces		100
Specification	2 or more FF, min.	50 - 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		

Coarse % x % Retain/Design =

Fine 0.38 % x % Passing/Design =

Total/Combined -#200

- #4 Gradation Check

within 0.3% of original dry weight 0.15

Natural Fines	0.00	Ma. Sand	0.00	Filler	0.00
Natural Sand	0.00	Add Rock	0.00	Na. Rock	0.00
	0.00	Cr. Rock	0.00	Cr. Fines	

Comments 12" sieves were used. The #8 was split in two and shaken by hand. As per foot note #2, plasticy index was wavied as not more than 4.0% of the material passed the #40 sieve.

Figure 8

Method of Test for Density and Air Voids of Asphalt Concrete by the Gyratory Method

1. Scope:

This test is to determine the density and air void level of asphalt concrete mix by using the gyratory compactor.

2. Apparatus:

2.1 Gyratory compactor conforming to the requirements of AASHTO T 312.

2.2 Gyratory molds & plates conforming to the requirements of AASHTO T 312.

2.3 Thermometers, dial type, armored glass, or digital with a range of 50° to 400°F with a sensitivity of 5°F.

2.4 Thermometer sensitive to 0.5°F and readable to 1°F.

2.5 Scale or balance having the capacity to weigh any sample which may be tested utilizing this procedure, accurate and readable to the nearest 0.1 gram. The scale or balance will be equipped with a suitable suspension apparatus and holder to permit weighing the sample while suspended from the center of the scale pan of the weighing device.

2.6 Mechanical convection oven with a minimum chamber volume of 5.0 cubic feet capable of heating to 350°F.

2.7 Flat bottom metal pan, flat bottom scoop, containers, large mixing spoon or small trowel, large spatula, gloves, paper disks, WD-40 lubricant, and grease.

2.8 Water Bath with an overflow outlet for maintaining a constant water level. An aquarium heater will suffice to control the temperature of the water bath at 77° ± 2°F. The water bath must be large enough to allow the suspension apparatus holder to be always covered with water. The sample and suspension apparatus must be completely covered with water during weighing. The wire suspension apparatus will be the smallest practical size to minimize any possible effect of a variable immersed length.

3. Procedure:

3.1 Sampling uncompacted mix.

A. Material for the gyratory testing will be obtained from the same sample as will be used for SD 312 but a larger sample must be obtained.

B. Take approximately 160 to 180 lbs. of hot mix for the laboratory density determination, 240 to 260 lbs. when IA testing is required.

C. Transport the sample in a pail or box that is insulated or protected to help retain heat.

D. Place the hot mix in a clean pan where there will be neither loss of material nor the addition of foreign matter. Place the pan and material in an oven maintained at or slightly above the required compaction temperature.

3.2 Gyratory machine preparation.

Before operating the gyratory, it's important to make sure that it's ready for operation. The steps below need to be completed prior to operating the Pine Brovold portable (AFGB1A) gyratory. Other gyratory compactors can be used and must be operated according to the manufacturer's recommendations.

A. Make sure the gyratory compactor has been calibrated to an internal angle of (1.16 ± 0.02°) or if using a Pine RAM calibration device, calibrated to a cold internal angle of (1.19 ± 0.03°) and the calibration records are available. SD DOT machines are calibrated by the SD DOT Central Lab.

B. Make sure that the gyratory is properly lubricated. There are several spots that require a regular application of grease, including:

a. The ring at the top of the cylinder which controls the angle of the gyration. This should be done prior to running a set of two gyratories.

b. The ram head on the top of the gyratory. Grease the outer portion of the ram head prior to running a set of three gyratories. This head causes the cylinder to gyrate.

c. The ram pressure head at the bottom of the cylinder. This is the head that pushes up the plate. This should get a coating of grease prior to running every gyratory, before the mold is put in place.

d. Once the material is loaded and leveled, put in the paper disk and top plate and grease the top of the plate. This is to be done on every gyratory.

e. The spherical bearing that contacts the bottom of the mold. The spherical bearing is located below the ram pressure plate. The best way to lubricate it is to use a brush with grease. This should be done once every two gyratories.

C. The gyratory mold needs to be cleaned inside and out with WD-40 at the end of each day to avoid HMA buildup. This is easiest when the molds are hot.

D. Turn the machine on and wait for it to run through the startup routine.

E. Make sure all the “Set Points” on the machine are correct. This is done by going into the “Setup” program on the machine. Most of these, like the dwell and the pressure, are constant and shouldn’t require adjustment. However, the number of gyrations will need to be changed when switching from the design gyration number to the maximum gyration number. This is done in the “Set Gyrations” category at the top of the “Setup” page. The gyrations are specified in the plans and shown on the mix design DOT-64 form. To change any of the settings, using the arrow keys scroll the cursor down to the desired attribute. Type in the number you want and press ↵ “Enter”.

F. Make sure that all pertinent points are lubricated (See gyratory machine preparation, step B)

3.3 Laboratory density determination.

A. Preheat molds, a flat bottom scoop and a trowel or spatula in an oven to the established mix compaction temperature recommended on the job mix formula (JMF) from the DOT-64 mix design form.

B. Obtain by quartering or by using a heated flat bottom scoop a representative sample from the pan of material used in SD 312 Section 3.3 B. The material placed in the mold will make a specimen 4.5 ± 0.2 inches high and 6 inches in diameter (Approximately 4500-4800 grams of material) and be compacted at established mix design compaction temperature on the JMF.

If the gyratory specimen doesn’t compact to a height of 115 mm ± 5 mm use the following equation to correct the amount of material to put in the mold.

A = Actual weight of the specimen (grams)

(115 X A) ÷ B

B = Actual height of the specimen

C. Heat the hot mix so that compaction takes place when the mix is at the established mix design compaction temperature recommended on the JMF. Thermometers will be calibrated and checked often to insure accurate temperature measurements.

D. Once the hot mix, tools, and mold have reached the correct temperature recommended on the JMF, prepare to make a specimen.

E. Apply grease to bottom ram head. Place a cylinder plate in the bottom of the mold with the beveled end toward the bottom that is heated to compaction temp prior to being placed in the gyratory machine. Put a paper disk in on top of the plate.

F. Place the mold into the gyratory compactor using the tongs, lowering it into the compactor until it reaches bottom, and then rotate the mold clockwise until it stops. Put the funnel on the top of the mold and load the mold with HMA mix in one lift (Usually about 4500-4700 grams of mix), which should only be loaded at the proper mix compaction temperature. Remove funnel, lightly level out the mix with spatula and put paper disk on top. Do not pack the mix. The temperature should be within ± 5° of the mix design compaction temperature shown on the DOT-64 JMF.

G. Place the plate on top of mix, with the beveled edge away from the mix, grease the top of the plate and swing the gyratory head on top of the cylinder and lower the head into place. Lock the gyratory head onto the machine using the three levers.

H. Press “Run” on the machine to get into the “Run Mode”, and then press “Start”, which will begin the process. As the gyratory is running, keep an eye on the gyrations, pressure, and angle. The gyrations are as specified in the Standard Specifications or plan notes. The pressure should be 600 ± 18 kPa. If the angle goes out (External angle range from calibration) make sure the molds are clean on the outside and the mold and material is at the correct compaction temperature. Call the Central Materials Lab on a SDDOT gyratory before making any adjustments to the machine angle.

I. Once the specified number of gyrations is complete and the ram head returned to its original position, then loosen the three levers on the side of the machine, lift the gyratory head and swing it out of the way.

J. Place the funnel on the top of the machine, press “Unload” twice, and as the gyratory breaks free of the mold, remove the funnel quickly to prevent injury to the gyratory specimen.

K. Once the specimen is completely extruded, remove the top paper disk and carefully remove the specimen from the machine, inverting it before you set it down to allow removal of the bottom paper disk. Set the specimen in front of a fan to cool on a smooth flat surface and cool to room temperature.

L. After the specimen has cooled to room temperature, measure the height at four locations. Record the average height of the specimen to the nearest 0.1 mm.

M. Weigh the specimen in air and record the weight to the nearest 0.1 gram.

N. Suspend the specimen in a water bath at 77° ± 2° F for 3 to 3.5 minutes. Record the immersed weight to the nearest 0.1 gram. Maintain a constant level of water in the water bath at the overflow outlet through the entire test procedure.

O. Immediately after weighing under water, blot the specimen dry with a damp terry cloth towel and record the saturated surface dry weight to the nearest 0.1 gram.

P. Press the “Main Menu” button, and then press “Result”. This will bring up a menu with “Select”, “Print”, and “Send”. Press “Print”, and the machine will ask you if you want to “Print Report” - “Yes”. Press “Enter” to print.

Q. Once the gyratory is unloaded and results printed, grease the machine as needed and ready it for the next test.

R. Make sure to label the gyratory correctly and label the printout sheet the same way.

S. Repeat steps for the other specimen.

* For more detailed instructions or to solve any problems that might arise, contact the Central Materials Lab (605-773-6994) if problem is not resolved.

4. Report:

Calculations to be completed on the DOT-86:

- G_{mm} - The maximum specific gravity will be determined according to SD 312 to the nearest 0.001.

- ***Put in the plant settings values for “% binder Pb” and “lime” until the actual cutoff values are obtained.

- % Binder P_b - Binder content calculation value determined on DOT-89 to the nearest 0.1 percent.

  For RAP (Recycled Asphalt Pavement) mixes, the Total binder estimate is calculated using the example on the DOT-64 mix design form (Just below the gradation chart).

  The calculated RAP binder content needs to be added to the virgin binder content that was determined on the DOT-89 form to account for the oil that is being added to the mix by the RAP and recorded to the nearest 0.1 percent.

- G_{sb} – Aggregate Composite G_{sb}, found on the DOT-64 mix design JMF reported to the nearest 0.001.

- Binder G_b – Designated on the oil tickets from the supplier reported to the nearest 0.001.

- Dust (- #200) – On the gradation DOT-69 form total / combined - #200 or from the (Acc % passing #200 sieve rounded) column if a + #4 sample was not washed reported to the nearest 0.1 percent.

- Lime – Lime content determination from the DOT-33Q reported to the nearest 0.01 percent.

- Add the dust (-#200) and the lime together and report to the nearest 0.1 percent.

- Obtain the number of gyrations needed for the type of mix design from the Standard Specifications or project plan notes (Field gyration values will be shown on the DOT-64 mix design form).

Complete the following calculations in order as follows:

1. Effective Specific Gravity of the Mineral Aggregate (Gse).

$$Gse = \left(\frac{100 - Pb}{\left(\frac{100}{Gmm} \right) - \left(\frac{Pb}{Gb} \right)} \right) \qquad [Report\ to\ nearest\ 0.001]$$

2. Percent Asphalt Absorption (Pba).

$$Pba = 100 \times \left(\frac{Gse - Gsb}{Gse \times Gsb} \right) \times Gb \qquad [Report\ to\ nearest\ 0.01\%]$$

3. Percent Aggregate Content of the Mixture (Ps).

$$Ps = 100 - Pb \qquad [Calculate\ to\ nearest\ 0.1\%]$$

25

4. Percent Effective Asphalt Content (Pbe).

$$Pbe = Pb - \left(\frac{Pba \times Ps}{100} \right) \qquad [Report\ to\ nearest\ 0.1\%]$$

5. Bulk Specific Gravity, measured (Gmb measured). *(Report to nearest 0.001)*

$$Gmb\ (measured) = \frac{Weight\ in\ Air}{SSD\ Weight - Weight\ in\ Water}$$

6. Bulk Specific Gravity, calculated (Gmb calculated). *(Report to nearest 0.001)*

$$Gmb\ (calculated) = \frac{Gmb\ (measured) \times Height\ (@\ N_{des})}{Height\ @\ N_{ini}}$$

7. Make sure that the Rice Specific Gravity (Gmm) testing is completed using SD 312. Average the two Gmm values and record to the nearest 0.001.

8. Calculate the Average Gmb for $N_{initial}$ and N_{design} to the nearest 0.001.

9. % Of Rice Specific Gravity (Gmm).

$$\%\ of\ Gmm = \left(\frac{Gmb}{Gmm}\right) \times 100 \qquad [Report\ to\ nearest\ 0.1\%]$$

10. % Air Voids (Va).

$$Va = \left(\frac{Gmm - Gmb}{Gmm}\right) \times 100 \qquad [Report\ to\ nearest\ 0.1\%]$$

11. % Voids in the Mineral Aggregate (VMA).

$$VMA = 100 - \left(\frac{Gmb \times Ps}{Gsb}\right) \qquad [Report\ to\ nearest\ 0.1\%]$$

12. % Voids Filled with Asphalt (VFA).

$$VFA = \left(\frac{VMA - Va}{VMA}\right) \times 100 \qquad [Report\ to\ nearest\ whole\ \%]$$

13. Dust to Binder Ratio. *(Report to nearest 0.1)*

$$Dust\ to\ Binder\ Ratio \quad = \quad \frac{\left(\%\ dust\ (-\#200) \quad + \quad (\%\ lime)\right)}{Pbe}$$

Do not forget to compare calculated values with the QC/QA specification requirements.

5. References

AASHTO R 35
AASHTO T 312
ANSI B46.1 (Note 2)
SD 312
DOT-33Q
DOT-64
DOT-69
DOT-86
DOT-89

Sample ID: 2224267

Gyratory Specific Gravity

DOT-86
3-19

PROJECT PH 0066(00)15 COUNTY Aurora, Ziebach PCN B015
Field No. QC01QA01 Date Sampled 08/05/2019 Date Tested 08/05/2019
Sampled by Tester, One Tested by Tester, One Checked by Tester, Two
Material Type Class Q2 Hot Mixed Asphalt Concrete Ticket No. 15729
Source Lift 1 of 1
Lot No. 1 Sublot No. 1

Mix Temp. 270 Offset 6 ESAL's Q2
Daily Ton 483.83 Total Ton 2,632.46 Oil Type PG 64-28

		No. of gyrations			
% binder Pb	5.1	N initial	6	Gse	2.681
Gsb	2.636	N design	50	Pba	0.66
binder Gb	1.032	N max	75	Pbe	4.5
dust (-#200)	4.9				
lime	0.49				
dust (-#200) + lime	5.4				

	Spec. A (Ndes)		Spec. B (Ndes)		Spec. M (Nmax)		
	@ N ini	@ N des	@ N ini	@ N des	@ N ini	@ N des	@ N max
a) Height, mm	123.60	113.40	123.90	113.90			
b) Weight in air		4,705.1		4,708.3			
c) Weight in water		2,729.6		2,729.0			
d) SSD weight		4,707.9		4,710.9			
e) Bulk SpGr meas b / (d - c)		2.378		2.376			
f) Bulk SpGr calc (Gmb)	2.182		2.184				
Waiver		☐		☐			☐

	Gmm #1	Gmm #2
Weight of sample in air	1,522.0	1,524.9
Weight of canister + water	1,376.4	1,376.4
Weight of canister + water + sample	2,284.1	2,286.2
Temperature of the water	77°F	77°F
Water correction factor	1.0000	1.0000
Rice SpGr (Gmm)	2.478	2.479

Average Maximum SpGr (Gmm) 2.479

	N initial	N design	N maximum
Average Gmb	2.183	2.377	
% of Rice SpGr (Gmm)	88.1	95.9	

% Air Voids (Va) 4.1 % VMA 14.4 % VFA 72 Dust to binder ratio 1.2

Figure 1

South Dakota Asphalt Concrete Gyratory Mix Design Procedure

1. Scope:

This standard practice for mix design evaluation uses aggregate and mixture properties to produce an asphalt concrete mix design formula that meets the specification requirements. This standard is for asphalt concrete hot mix that may or may not contain Reclaimed Asphalt Pavement (RAP).

2. Apparatus:

2.1 Gyratory compactor and support equipment (including height recording device, specimen molds, ram heads, and mold bottoms) meeting requirements of AASHTO T312.

2.2 All related equipment and/or apparatus to perform parts or all of tests including: SD 108, SD 201, SD 202, SD 204, SD 206, SD 208, SD 209, SD 210, SD 211, SD 212, SD 213, SD 214, SD 217, SD 220, SD 221, SD 301, SD 306, SD 309, SD 312, SD 313, SD 316, SD 318, SD 319, AASHTO T164, AASHTO T308, AASHTO T312, and ASTM D8159.

3. Procedure:

3.1 Preparation of aggregates.

The average gradation of each individual aggregate fraction will be used when combining to form an aggregate composite. This average will come from testing done on the individual fraction/stockpile prior to the asphalt concrete mix design being performed.

When RAP is allowed, it will not be included in meeting the total aggregate requirements set forth in the plans and/or Standard Specifications for Roads and Bridges.

A. The following are the minimum number of size fractions to use when recombining the gradation of each individual stockpile. The 3/4", 1/2", 3/8”, #4, #8, and all material passing the #8 are the minimum number of sizes required to be used when recombining the stockpiles.

B. Bulk specific gravity of the aggregate (G_{sb}) is determined by SD 209 and SD 210 for each fraction and combining to form a composite total G_{sb} and a - #4 Gsb. SDDOT Bituminous Office will determine both the total G_{sb} and the - #4 G_{sb} on the total composite and not on individual fractions.

When RAP is included in the plans, determine the asphalt binder content of the RAP by conducting at least two extractions (AASHTO T164 or ASTM D8159). Ignition oven tests (AASHTO T308) can only be used if a correction factor is known for the aggregate.

Determine the RAP aggregate gradation from the extractions or ignition oven tests and average the results on the mix design sheet.

Only the composite virgin mineral aggregate G_{sb} will be used on the Job Mix Formula and the - #4 G_{sb} will be used for the Fine Aggregate Angularity test procedure (SD 217).

C. Determine consensus virgin aggregate properties for the composite gradation including:

Crushed particles (SD 211), fine aggregate angularity (SD 217), flat and elongated particles (SD 212), and sand equivalent (SD 221).

Also, determine source virgin aggregate properties for lightweight particles (SD 208, SD 214), sodium sulfate soundness (SD 220) (*Optional*), and Los Angeles abrasion loss (SD 204) (*Optional*),

3.2 Determination of mixing and compacting temperatures.

A. Performance Graded binder (PG); mixing temperature will be 300° ± 10° F.

B. Performance Graded binder (); compaction temperature will be:

- 270° ± 5°F (PG 58-28, PG 58S-28).
- 275° ± 5°F (PG 58-34, PG 64-28, PG 58H-34).
- 280° ± 5°F (PG 64-34, PG 70-28, PG 58V-34, PG 58E-34).

3.3 Preparation of mixtures.

A. Adjust the laboratory sample gradations to meet the average stockpile gradations down to the #8 and recalculate the laboratory - #8 gradation to reflect the changes. Weigh into pans material from each fraction to form a composite. Heat aggregate composite samples in an oven overnight or for a minimum of four hours to a temperature not exceeding 50° F above the mixing temperature.

If RAP is allowed, heat the RAP in an individual oven for a period of no more than two hours at 230° ± 5° F and add soon after heating to the mixture of aggregate and binder. Also, when RAP is added, care must be taken to thoroughly mix all components.

B. Following mixing, immediately put the mixture in a covered container in an oven maintained at the compaction temperature for a period of

hours. At least three sets of specimens are to be made at 0.5% oil increments. This will include (2) G_{mb} samples at N_{des} using SD 318. Two G_{mm} (SD 312) samples are to be made at the center oil increment. The oil content will be based on the total weight of the bituminous mixture.

This total weight of mixture would include RAP, if it is allowed in the mixture, and should make a gyratory specimen to the required height of 115 ± 5 mm. An example of combining virgin aggregate, RAP, hydrated lime, and virgin binder is as follows:

If 5,000 grams is the target weight, 4.3% new asphalt binder, 20% is the RAP target, and the RAP contains 6.00% binder from the average of the two extraction tests:

- Hydrated Lime at 1.00% = $(5{,}000\ g \times 0.01) = 50\ grams$
- Added Virgin Binder = $(5{,}000\ g \times 0.043) = 215\ grams$
- $5{,}000\ g\ -\ 50\ g\ -\ 215\ g\ =\ 4{,}735\ grams\ of\ aggregate$
- Virgin Aggregate = $(4{,}735\ g \times 0.80) = 3{,}788\ grams$
- RAP Aggregate = $(4{,}735\ g \times 0.20) = 947\ grams$
- Hydrated Lime + Added Virgin Binder + Virgin Agg. + RAP = 5,000 grams

$$50\ g + 215\ g + 3{,}788\ g + 947\ g = 5{,}000\ grams$$

- Binder from RAP = $(947\ g \times 0.06) = 56.8\ grams$
- Total Binder % of mix = $\left(\frac{(215\ g\ +\ 56.8\ g)}{5000\ g}\right) \times 100 = 5.44\%$
- New Binder % of Total Binder = $\left(\frac{4.3}{5.44}\right) \times 100 = 79.0\%$
- Old Binder % Replacement = $\left(\frac{1.14}{5.44}\right) \times 100 = 21.0\%$

3.4 Compaction of specimens.

Combining elements of 3.1, 3.2, and 3.3 referenced from above, compact the specimens with a gyratory compactor at the gyration levels for N_{des} and calculate the N_{ini} using SD 318. The specified gyration levels are included in the plans and/or Standard Specifications for Roads and Bridges for a specific project. Determine the bulk specific gravity (G_{mb}) of each of the compacted specimens in accordance with SD 318.

3.5 Determine the Air Voids (V_a), Voids in the Mineral Aggregate (VMA), Voids Filled with Asphalt (VFA), and dust to effective binder for each binder percent

increment in accordance with SD 318. Also, include the percent of G_{mm} at N_{ini} for each binder increment.

4. Report:

4.1 Contractor and consultants can use and submit mix design data and calculations on their own forms and charts if all pertinent mix design data is included with the material sent to the SD DOT Mix Design Lab. Mix design submittals will include the following information:

- Aggregate stockpile gradation averages (including the legal pit descriptions for the materials)
- Virgin aggregate bin splits (and total bin splits, if RAP is allowed).
- + #4 and - #4 bulk specific gravity of each individual stockpile.
- Asphalt binder supplier and grade of binder to be used.
- Single percentage of binder recommended.
- Completed DOT-48 form for moisture sensitivity (SD 309). .
    - If not adding 1.00% hydrated lime.
- Recommended Job Mix Formula (JMF).
- Signed JMF including all required mix design test results.

The Contractor's material and data submitted to the SD DOT Mix Design Lab in Pierre must meet all specifications and requirements as shown in the plans and Standard Specifications for Roads and Bridges regarding Quality Control/Quality Assurance specifications that apply to the project.

4.2 The SD DOT Mix Design Lab will verify the mix design submitted by the Contractor/Area and conduct all necessary mix design quality tests required on the mineral aggregate, RAP, and asphalt concrete mixture. When the mix design verification is completed by the Department's Bituminous Mix Design Lab, an approved mix design report (DOT-64) will be provided to the Area Engineer and the Contractor prior to production.

5. References

Listed in 2.2 above

Procedure for Checking Contractor's Profilograph / Profiler

1. Scope:

This test covers the procedure for checking the Contractor's profilograph/profiler machine to the Department's profilograph/profiler to assure that the Contractor's machine is producing pavement smoothness results similar to the Department's machine.

2. Apparatus:

2.1 Profilograph / Profiler – SDDOT.

3. Procedure:

3.1 Assemble the profilograph/profiler machine as per manufacturer's recommendations.

3.2 Perform the vertical calibration a minimum of once per day or after each re-assembly. 25

3.3 Tire pressure shall be as per manufacturer's recommendations.

3.4 Perform the horizontal calibration annually, unless a discrepancy is noted. This shall be accomplished on a pre-measured test distance of 500 to 1000'. The tolerance should be at ± 0.2% of the measured distance.

3.5 Observe the Contractor's profilograph/profiler vertical calibration.

3.6 Operate the profilographs/profilers at the manufacturer's designated speed in one or more wheel paths for approximately one total lane mile with the Contractor. Compare the machine horizontal measurements with the Contractor's. The horizontal measurements should compare with ± 0.2%.

3.7 The average results of the contractor's machine should be within 1 inch/mile for a 0.2" blanking band and within 2 inches/mile for a 0 blanking band of the average results of the SDDOT machine.

3.8 Repeat the above steps until an acceptable comparison is obtained. The Contractor shall make whatever adjustments necessary to his machine to achieve an acceptable comparison.

4. Report:

4.1 The Central Office Materials Lab shall report the results of the comparison in a letter to the Area Engineer, Region Engineer, Concrete Engineer and the Project File.

5. References:

SDDOT Training Manual for concrete paving