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December 1, 2022

To: All Holders of the Manual of Field Test Procedures

From: Justin G. Moderie, P.E., G.E.
State Construction and Materials Engineer

Subject: 2022 Revision of the Manual of Field Test Procedures

Enclosed is the 2022 revision to the Manual of Field Test Procedures. The revision package also includes a document providing a general list of the associated changes based on the layout of the Manual of Field Test Procedures. The revisions are based on comments from the Quality Assurance Steering Committee, Construction Training Coordinator, Quality Control Compliance Specialists and industry material testing technicians.

The change package effects contracts advertised after this change date, any contract advertised prior to this change package falls under the appropriate MFTP change for that advertisement date. AASHTO test procedures are to be followed according to the latest MFTP change or the appropriate AASHTO test version to date. ODOT and WAQTC test procedures are in effect for the date the contract is advertised and may be modified to the new update change package through a Contract Change Order established by the Project Manager.

The following pages identify the appropriate add and remove sequence necessary to update the 2021 version of the MFTP. If an earlier version is being updated, then the appropriate update package will need to be applied before utilizing the enclosed documents.

To place these pages in your book, start with the package of white pages and do the following.

FIRST

SECTION 1 TAB (Test Procedures)

REMOVE

INDEX (21) Pg. 1 & 2

ADD

INDEX (22) Pg. 1 & 2

COMMENTS

Updated for 2022 Procedures

ODOT TAB

REMOVE

AASHTO T 312 (19) Pg. T312-1~T312-13

ODOT TM 769 (21) Pg. 1~5

ODOT TM 772 (21) Pg. 1~5

AASHTO T 312 (22) Pg. T312-1~T312-13

ODOT TM 769 (22) Pg. 1~5

ODOT TM 772 (22) Pg. 1~5

Annex A of ODOT TM 326

See Change Sheet for Details

“ “ “ “ “

AASHTO TAB (Note: FOP Replacement is based on the procedure date, upper Rt. corner of document.

Official AASHTO designated procedures publish date is identified on the procedure cover page).

REMOVE

AASHTO T 19 (18) Pg. T 19-1~T 19-8

AASHTO T 22 (20) Pg. T 22-1~T 22-12

AASHTO T 27/11 (21) Pg. 12-1~12-40

AASHTO T 30 (21) Pg. 20-1~20-12

AASHTO T 84 (21) Pg. T84-1~T84-9

AASHTO T 85 (21) Pg. 16-1~16-6

AASHTO T 99/180 (21) Pg. 13-1~13-16

AASHTO T 119 (19) Pg. 11-1~11-2

AASHTO T 152 (20) Pg. 13-1~13-6

AASHTO T 166 (21) Pg. 18-1~18-8

AASHTO T 176 (21) Pg. 14-1~14-6

AASHTO T 196 (19) Pg. T196-1~T196-11

AASHTO T 209 (20) Pg. 15-1~15-10

AASHTO T 255/265 (21) Pg. 12-1~12-8

AASHTO T 272 (21) Pg. 15-1~15-8

AASHTO T 283 (21) Pg. T283-1~T283-10

AASHTO T 308 (20) Pg. 16-1~16-12

AASHTO T 309 (20) Pg. 10-1~10-2

AASHTO T 310 (20) Pg. 17-1~17-6

AASHTO T 324 (19) Pg. T324-1~T324-13

AASHTO T 329 (20) Pg. 15-1~15-4

AASHTO T 335 (21) Pg. 13-1~13-6

AASHTO R 76 (20) Pg. 10-1~10-6

AASHTO R 90 (18) Pg. 9-1~9-6

AASHTO R 100 (21) Pg. 14-1~14-6

ADD

AASHTO T 19 (22) Pg. T 19-1~T 19-9

AASHTO T 22 (22) Pg. T 22-1~T 22-13

AASHTO T 27/11 (22) Pg. 12-1~40

AASHTO T 30 (22) Pg. 20-1~20-12

AASHTO T 84 (21) Pg. T84-1~T84-10

AASHTO T 85 (22) Pg. 16-1~16-6

AASHTO T 99/180 (22) Pg. 8-1~8-16

AASHTO T 119 (19) Pg. 11-1~11-2

AASHTO T 152 (22) Pg. 13-1~13-8

AASHTO T 166 (22) Pg. 18-1~18-8

AASHTO T 176 (22) Pg. 14-1~14-6

AASHTO T 196 (22) Pg. T196-1~T196-11

AASHTO T 209 (22) Pg. 17-1~17-10

AASHTO T 255/265 (22) Pg. 7-1~7-8

AASHTO T 272 (21) Pg. 15-1~15-8

AASHTO T 283 (22) Pg. T283-1~T283-10

AASHTO T 308 (22) Pg. 16-1~16-12

AASHTO T 309 (22) Pg. 10-1~10-2

AASHTO T 310 (22) Pg. 17-1~17-6

AASHTO T 324 (22) Pg. T324-1~T324-14

AASHTO T 329 (22) Pg. 15-1~15-4

AASHTO T 335 (22) Pg. 13-1~13-6

AASHTO R 76 (20) Pg. 10-1~10-6

AASHTO R 90 (22) Pg. 9-1~9-6

AASHTO R 100 (22) Pg. 14-1~14-6

COMMENTS

See Change Sheet for Details

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REMOVE

SECTION 2 TAB (QA Program)

ADD

COMMENTS

Cover Sheet & Table of Contents (21)
QA Program (21) Pg. 1~27

Cover Sheet & Table of Contents (22)
QA Program (22) Pg. 1~27

See Change Sheet for Details
“ “ “ “ “

REMOVE

SECTION IA TAB

ADD

COMMENTS

QA Program (21) Pg. 28~56

QA Program (22) Pg. 28~56

See Change Sheet for Details

SECTION 3 TAB (Report Forms & Examples)

REMOVE

ADD

COMMENTS

734-1793 S (10-2021) & Examples
734-1793 B (10-2021) & Example
734-3573 (10-2012) & Example

734-1793 S (10-2022) & Examples
734-1793 B (10-2022) & Example
734-3573 (10-2022) & Example

See Change Sheet for Details
“ “ “ “ “
“ “ “ “ “

SECTION 4(B) TAB (Small Quantity Schedule)

REMOVE

ADD

COMMENTS

Small Quantity (17) Pg. 1~2

Small Quantity (22) Pg. 1~2

See Change Sheet for Details

SECTION 4(D) TAB (Acceptance Guide)

REMOVE

ADD

COMMENTS

Guide Pages 1~64 (November 2021)

Guide Pages 1~64 (November 2022)

See Change Sheet for Details

SECTION 5 “Green” TAB (Acceptance Guide)

REMOVE

ADD

COMMENTS

Guide Pages 1~64 (November 2021)

Guide Pages 1~64 (November 2022)

See Change Sheet for Details

SECOND

Take the yellow packet and place or remove the yellow sheets in front of the appropriate test method.

REMOVE

ADD

COMMENTS

AASHTO TAB

Yellow Sheet T 27/11 (07)	Yellow Sheet T 27/11 (22)	See Change Sheet for Details
Yellow Sheet T 166 (18)	Yellow Sheet T 166 (22)	“ “ “ “ “
Yellow Sheet T 176 (21)	Yellow Sheet T 176 (22)	“ “ “ “ “
Yellow Sheet T 217 (18)	Yellow Sheet T 217 (22)	“ “ “ “ “
Yellow Sheet T 272 (21)	Yellow Sheet T 272 (22)	“ “ “ “ “
Yellow Sheet R 100 (21)	Yellow Sheet R 100 (22)	“ “ “ “ “

The yellow sheet letters provide additional information for the test procedure or define which method in a test procedure to use for ODOT projects.

FORMS

The forms to use on ODOT construction projects are available in Microsoft Excel format. These forms can be copied from the forms included herein or accessed and downloaded from our website at: <http://www.oregon.gov/ODOT/Construction/Pages/Forms.aspx>

We in the ODOT Construction Section welcome your questions, comments, or suggestions concerning this Manual. We will consider your input for future modifications to the Manual.

MFTP 2022 Update

Summary of Changes

Introduction – No Changes

Section 1 – Test Procedures Index

This section was updated according to the test procedure date change, if applicable.

ODOT – Test Procedures

TM 769 (Certification of Inertial Profiler Equipment) – Only minor editorial and formatting issues were addressed. No content changes occurred.

TM 772 (Determining the International Roughness Index with an Inertial Laser Profiler)

- Under section 8, the Quality Assurance Check of project profiles will be at the discretion of the *Agency* and not the Project Manager.

Minor formatting and editorial items were also addressed.

T 312 (Preparing and Determining the Density of Asphalt Mixture Specimens by Means of the Superpave Gyrotory Compactor) – T 312 is in the Annex A of TM 326.

The following bullets identify additions, deletions, or modifications to the procedure:

- The cover sheet has been updated to reflect the new 2022 version of the procedure.
- Under Section 2.1, AASHTO Standards, added M 339 Thermometer reference procedure (Thermometers Used in the Testing of Construction Materials) to the list.
- Under Section 2.1, AASHTO Standards, changed the test procedure title name for R 30 to Laboratory Conditioning of Asphalt Mixtures.
- *Under Section 2.2 (ASTM Standards), added the following references:*
 - E1, Standard Specification for ASTM Liquid-in-Glass Thermometers
 - E230/E230M, Standard Specification for Temperature-Electromotive Force (emf) Tables for Standardized Thermocouples
 - E2877, Standard Guide for Digital Contact Thermometers
- *Under Section 2.3 (International Electrotechnical Commission Standards), added the following references:*
 - IEC 60584-1: 2013 Thermocouples - Part 1: EMF Specifications and Tolerances
- Under Apparatus, section 4.4 Thermometers, added the following thermometer information and note reference: Thermometers for measuring temperature of aggregates, binder, and asphalt mixtures shall meet the requirements of M 339M/M 339 with a temperature range of at least 10 to 230°C, and an accuracy of ±2.5°C (±4.5°F) (see Note 3).

Note 1—Thermometer types suitable for use include ASTM E1 mercury thermometers; ASTM E230/E230M thermocouple thermometer, Type J, any Class, or Type K, Class 1 or 2; IEC 60584 thermocouple thermometer, Type J, any Class, or Type K, Class 1 or 2; ASTM E2877 digital metal stem thermometer; or dial gauge metal stem (bi-metal) thermometer.

- Subsequent notes have been renumbered, due to the note 3 addition.
- Under Annex A, the following new reference has been added A2.5: Infrared Thermometer - For measuring the temperature of molds, end plates, and equipment, shall meet the requirements of M 339M/M 339 with a D:s ratio of 6:1.

AASHTO - Test Procedures

All the FOP's (WAQTC) for AASHTO test procedures have a revision date located in the upper right-hand corner and a publishing date at the lower right-hand corner of the document. The publishing date will change each year, but the test procedure date only changes with major content related modifications, not editorial corrections.

Other AASHTO test procedures in this section are from the AASHTO organization and won't have a WAQTC FOP reference and can be identified by the cover sheet with associated AASHTO official titles.

T 19 Bulk Density (“Unit Weight”) and Voids in Aggregate – The following subsections have been modified:

- The cover sheet has been updated to reflect the new 2022 version of the procedure.
- Under Section 2, Referenced Documents, added M 339 Thermometer reference procedure (Thermometers Used in the Testing of Construction Materials) to the list.
- Added the following ASTM Standards, section 2.2:
 - E1, Standard Specification for ASTM Liquid-in-Glass Thermometers
 - E230/E2230M, Standard Specification for Temperature-Electromotive Force (emf) Tables for Standardized thermocouples
 - E2877, Standard Guide for Digital Contact Thermometers
- Added a new reference section “International Electrotechnical Commission Standard:
 - IEC 60584-1: -2013, Thermocouples – Part 1: EMF Specifications and Tolerances
- Under Section 5, Apparatus, added 5.5.3, Thermometer shall meet the requirements of M339.
- Added a new note 4: “Thermometer types suitable for use include ASTM E230 thermocouple thermometer, Type – T, Special Class; or IEC 60584 thermocouple thermometer, type T, Class1”.
- Under section 7, Sample, added the following oven criteria: Oven(s) for heating and drying shall be capable of operation at the temperatures required, between 100 to 120°C (212 to 248°F), within ±5°C (±9°F), as corrected, if necessary, by standardization. More than one oven may be used, provided each is used within its proper operating temperature range. The thermometer for measuring the temperature shall meet the requirements of M 339M/M 339 with a temperature range of at least 90 to 130°C (194 to 266°F), and an accuracy of ±1.25°C (±2.25°F) (see Note 5).

- Added a new Note 5: “Thermometer types suitable for use include ASTM E1 mercury thermometers; ASTM E2877 digital metal stem thermometer; ASTM E230/E230M thermocouple thermometer, Type J or K, Special Class, Type T any Class; IEC 60584 thermocouple thermometer, Type J or K, Class 1, Type T any Class; or dial gauge metal stem (bi-metal) thermometer”.
- Renumbered existing notes based on the new additions.

T 22 (Compressive Strength of Cylindrical Concrete Specimens) – The following subsections have been modified:

- The cover sheet has been updated to reflect the new 2022 version of the procedure.
- Under Section 2, Referenced Documents added the following references:
 - E1, Standard Specification for ASTM Liquid-in-Glass Thermometers
 - E230/E230M, Standard Specification for Temperature-Electromotive Force (emf) Tables for Standardized Thermocouples
 - E2877, Standard Guide for Digital Contact Thermometers
- Added a new Reference section 2.3 - International Electrotechnical Commission Standard:
 - IEC 60584-1:2013 Thermocouples - Part 1: EMF Specifications and Tolerances
- A new terminology section has been added to the procedure as follows:

Definitions of Terms Specific to This Standard.

- *bearing block*—steel piece to distribute the load from the testing machine to the specimen.
- *lower bearing block*—steel piece placed under the specimen to distribute the load from the testing machine to the specimen.
- *Discussion*—The lower bearing block provides a readily machinable surface for maintaining the specified bearing surface. The lower bearing block may also be used to adapt the testing machine to various specimen heights. The lower bearing block is also referred to as *bottom block*, *plain block*, and *false platen*.
- *platen*—primary bearing surface of the testing machine.
- *Discussion*—The platen is also referred to as the testing machine *table*.
- *spacer*—steel piece used to elevate the lower bearing block to accommodate test specimens of various heights.
- *Discussion*—Spacers are not required to have hardened bearing faces because spacers are not in direct contact with the specimen or the retainers of unbonded caps.
- *upper bearing block*—steel assembly suspended above the specimen that is capable of tilting to bear uniformly on the top of the specimen.
- *Discussion*—The upper bearing block is also referred to as the *spherically seated block* and the *suspended block*.
- Under Section 6.1.1.1 the testing machine verification shall be “within 13 months of the last calibration”.
- Under Table 1, a new column has been added for the Max Dimensions of square Bearing Face in mm(in.).

- Under Section 7.4 added thermometer requirements according to the new temperature measuring specification M339. Also, added a new Note 11 in this section as follows: “Thermometer types suitable for use include ASTM E1 mercury thermometers; ASTM E2877 digital metal stem thermometer; ASTM E230/E230M thermocouple thermometer, Type T, Special: or IEC 60584 thermocouple thermometer, Type T, Class 1”.
- *Added a new section 8.3.1 Stating “Unless otherwise specified by the specifier of tests, for this method, the test age shall start at the beginning of casting specimens”. This has been a question in the past regarding the timelines associated in Table 2 and the permissible tolerance allowances.*
- Under Section 9.1, Calculation of compressive strength, added a statement indicating to use at least five digits for the value of π , that is, use 3.1416 or a more precise value.
- Under Section 10, Reporting, added the following subsections:
 - 10.1.1 Specimen identification
 - 10.1.2 Serial number of delivery ticket, if available.

T 27/11 (Sieve Analysis of Fine and Coarse Aggregates) – Under the Scope, updated the AASHTO reference year to 2022. The following bullets identify additions, deletions, or modifications to the procedure:

- Under all three procedure methods (A, B and C) the drying time to constant mass for initial mass and washed samples has been changed to $(110 \pm 5^\circ\text{C})$ ($230 \pm 9^\circ\text{F}$) throughout the procedure.
- Throughout all three procedure methods changed the wording for “Check Sum” from “to within” to “is not more than 0.3 percent”. This is a comparison of the mass of material put on the sieves and the mass of material that is recovered. This language now match’s AASHTO T 27.
- Under Method A, the existing step 1 is now broken into two steps and the numbering has been adjusted. Step 1 dry the sample and cool. Step 2 determine the mass.

Minor formatting and editorial items were also addressed.

❖ **T 27/11 (Yellow Sheet)** – The following bullets identify additions, deletions, or modifications to the procedure:

- Added the following bullet reference: Under procedures (A, B and C) Delete the $110 \pm 5^\circ\text{C}$ ($230 \pm 9^\circ\text{F}$) temperature reference for drying. Now the procedure will send the user to T 255/265 for drying of the material.

T 30 (Mechanical Analysis of Extracted Aggregates) – The following bullets identify additions, deletions, or modifications to the procedure:

- Under the Apparatus section, first bullet, added to the balance or scale requirements that the device must conform to AASHTO M 231.
- Under the Apparatus section, added wetting agent and defined as “any dispersing agent, such as dishwashing detergent, that will promote separation of the fine materials”.
- Under Procedure, step 4 and 9 removed detergent, dispersing agent and solution with wetting agent, based on new apparatus entry.

- Under Procedure, step 15 added the “check sum” language from T 27, which reads “is not more than 0.2 percent”. This change was made in several areas of the procedure.

Minor formatting and editorial items were also addressed.

T 84 (Specific Gravity and Absorption of Fine Aggregate) – Under the Scope, updated the AASHTO reference year to 2022. The following bullets identify additions, deletions, or modifications to the procedure:

- Under Section 2.1, Referenced Documents, added M 339 Thermometer reference procedure (Thermometers Used in the Testing of Construction Materials) to the list.
- Under Section 2.2 (ASTM Standards), added the following references:
 - E1, Standard Specification for ASTM Liquid-in-Glass Thermometers
 - E230/E230M, Standard Specification for Temperature-Electromotive Force (emf) Tables for Standardized Thermocouples
 - E2877, Standard Guide for Digital Contact Thermometers
- Added a new Reference section 2.3 - International Electrotechnical Commission Standard:
 - IEC 60584-1:2013 Thermocouples - Part 1: EMF Specifications and Tolerances.
- Added a new Reference section 2.4 – Other Document:
 - Kandhal, Prithvi S. and Dah-Yinn Lee. “An Evaluation of the Bulk Specific Gravity for Granular Materials” in *Highway Research Record No. 307: Synthetic Aggregates and Granular Materials*, 1970, p. 44. Available from <https://onlinepubs.trb.org/Onlinepubs/hrr/1970/307/307.pdf>
- Under Apparatus, section 5.5, added an oven requirement and a new note reference that meets the following conditions:
- **Oven**—An oven of appropriate size capable of maintaining a uniform temperature of 110 ± 5°C (230 ± 9°F). Oven(s) for heating and drying shall be capable of operation at the temperatures required, between 100 to 120°C (212 to 248°F), within ±5°C (±9°F), as corrected, if necessary, by standardization. More than one oven may be used, provided each is used within its proper operating temperature range. The thermometer for measuring the temperature, regardless of drying apparatus used, shall meet the requirements of M 339M/M 339 with a temperature range of at least 90 to 130°C (194 to 266°F), and an accuracy of ±1.25°C (±2.25°F) (see Note 1).
- **Note 2**—Thermometer types suitable for use include ASTM E1 mercury thermometers; ASTM E2877 digital metal stem thermometer; ASTM E230/E230M thermocouple thermometer, Type J or K, Special Class, Type T any Class; IEC 60584 thermocouple thermometer, Type J or K, Class 1, Type T any Class; or dial gauge metal stem (bi-metal) thermometer.
- Under Apparatus, section 5.6, added a thermometer requirement and a new note reference that meets the following conditions:

Thermometer—A thermometer for measuring the temperature of water and materials in solution shall meet the requirements of M 339M/M 339 with a temperature range of at least 16 to 27°C (60 to 80°F), with an accuracy of ±0.5°C (±0.9°F) (see Note 2).

- **Note 3**—Thermometer types suitable for use include ASTM E1 mercury thermometers; ASTM E2877 digital metal stem thermometer; ASTM E230/E230M thermocouple thermometer, Type T Special; or IEC 60584 thermocouple thermometer, Type T, Class 1.
- Existing note numbering has been adjusted for the new entries.

Minor formatting and editorial items were also addressed.

T 85 (Specific Gravity and Absorption of Coarse Aggregate) – Under the Scope, updated the AASHTO reference year to 2022.

Minor formatting, spelling and editorial items were also addressed.

T 99/180 (Moisture-Density Relations of Soils) – Under the Scope, updated the AASHTO reference year to 2022. The following bullets identify additions, deletions, or modifications to the procedure:

- Under the Apparatus section, Table 1 and 2, added the rammer drop tolerance. This was inadvertently left out during publication.
- Under Procedure, step 7, removed the “or better” phrase from the end of the sentence.
- Under Procedure, step 11, added the variable (w) after “moisture content” in the sentence. This variable is used in the calculation to convert “wet density” to “dry density”.
- In Annex A, under the Density Correction Equation, the rho variable and the percentage of the fines were emphasized using font configurations of Italic for the rho variable (ρ_d) and bold for the percentage of the fines (P_f). Technicians often confuse the two variables because they look similar.

Minor formatting and editorial items were also addressed.

T 119 (Slump of Hydraulic Cement Concrete) – minor editorials as follows:

- Under Procedure, step 3, removed the redundant phrase “in order” from the sentence.
- Under Procedure, step 4, removed the redundant phrase “by depth” from the end of the sentence.
- Under Procedure, step 6, removed the redundant phrase “by depth” from the end of the sentence.
- Under Procedure, step 9, 4th sentence, added the word “amount” after excess.
- Under Procedure, a new step 13 has been created and labeled “Immediately measure the slump:”. 3 new steps have been created a thru c, which states invert the cone, lay tamping rod across mold and measure distance to the displaced center. The existing steps 14, 15 and 16 have been removed, but the last step “discard the tested sample” has a new step 14 reference.

Minor formatting and editorial items were also addressed.

T 152 (Air Content of Freshly Mixed Concrete by the Pressure Method) –

The following bullets identify additions, deletions, or modifications to the procedure:

- Under the Apparatus, a new figure for the Type B meter has been added, which depicts all the component parts of the gauge.
- Under Procedure, Strike-Off and Air Content section, Modified step 5 and added the following sentence: “Jar the meter gently until all air is expelled from this same petcock”.
- Deleted the existing step 6 language and replaced with the following: “Verify that water is present in both petcocks”.
- Under Annex A, step 5, removed the last sentence, “Rock the meter slightly until all air is expelled through the petcock”.

Minor formatting and editorial items were also addressed.

T 166 (Bulk Specific Gravity of Compacted Asphalt Mixtures Using Saturated Surface-Dry Specimens) – Under Scope, updated the AASHTO reference year to 2022.

The following bullets identify additions, deletions, or modifications to the procedure:

- Under Apparatus, 5th bullet oven, deleted the existing temperature requirements and added the following: $52 \pm 3^{\circ}\text{C}$ ($126 \pm 5^{\circ}\text{F}$).
- Under Apparatus, 7th bullet thermometer, deleted the existing temperature range and added the following: 15 to 45°C (59 to 113°F).

Procedure – Method B (Volumeter)

- Under Apparatus, 2nd bullet water bath, added the following: “For immersing the specimen in water, capable of maintaining a uniform temperature at $25 \pm 1^{\circ}\text{C}$ ($77 \pm 2^{\circ}\text{F}$)”.
- Under Apparatus, bullet 3 Thermometer, removed the existing range language and replaced with the following: “15 to 45°C (59 to 113°F)”.
- Under Apparatus, 5th bullet oven, removed the existing temperature range and replaced with the following: “ $52 \pm 3^{\circ}\text{C}$ ($126 \pm 5^{\circ}\text{F}$)”.
- Under Procedure, step 3, added the following water bath temperature requirement: “ $25 \pm 1^{\circ}\text{C}$ ($77 \pm 2^{\circ}\text{F}$)”.
- Under Procedure, step 4, added the following phrase at the beginning of the first sentence “At the end of the ten-minute period....”).

Procedure – Method C (Rapid Test for Method A or B)

- Added an Apparatus section for the oven as follows: “Oven: Capable of maintaining a temperature of $110 \pm 5^{\circ}\text{C}$ ($230 \pm 9^{\circ}\text{F}$) for drying the specimens to a constant mass.”.
- Under Procedure, step 4 deleted the existing language and replaced with the following: “Place in an oven at $110 \pm 5^{\circ}\text{C}$ ($230 \pm 9^{\circ}\text{F}$)”.

Minor formatting and editorial items were also addressed.

❖ **T 166 (Yellow Sheet)** – The following bullets identify additions, deletions, or modifications to the procedure:

- Added the following bullet reference: Under Procedure – Method C (Rapid Test for Method A or B), delete step 4 and replace with the following: Place in the oven at a minimum of 105°C (221°F). Do not exceed the Job Mix Formula mixing temperature.

AASHTO removed the JMF language for drying under Method C section of the procedure, which would have caused a significant increase in drying time for a procedural step that requires the specimen to be broken apart and separated. If the temperature is at or below the JMF mixing temperature range the material shouldn't be impacted.

T 176 (Plastic Fines in Graded Aggregates and Soils by the use of the Sand Equivalent Test) – Under Scope, updated the AASHTO reference year to 2022.

The following bullets identify additions, deletions, or modifications to the procedure:

- Under Apparatus section, added the title “Manual shaker” in front of the manually operated shaker language.
- Under Apparatus section, added the No. 4 sieve to the list of required equipment. This has been inadvertently left out.

Minor formatting and editorial items were also addressed.

❖ **T 176 (Yellow Sheet)** – the following bullets identify additions, deletions, or modifications to the yellow sheet entries:

- Added a following bullet reference: Under Materials, 2nd bullet, the use of potable water for the working solution is allowed, but the Agency may require distilled or demineralized water, if test results are in question or tap water is found detrimental to the test.

The procedure requires the use of demineralized water, so this addition will allow the use of potable water, if test results aren't impacted.

T 196 (Air Content of Freshly Mixed Concrete by the Volumetric Method) – The cover sheet has been updated to reflect the new 2022 version of the procedure.

The following bullets identify additions, deletions, or modifications to the procedure:

- Under Section 2.1, AASHTO Standards, added M 339 Thermometer reference procedure (Thermometers Used in the Testing of Construction Materials) to the list.
- Under Section 2.2 (ASTM Standards), added the following references:
 - E1, Standard Specification for ASTM Liquid-in-Glass Thermometers
 - E230/E230M, Standard Specification for Temperature-Electromotive Force (emf) Tables for Standardized Thermocouples
 - E2877, Standard Guide for Digital Contact Thermometers
- Under Calibration, section 5.3 added a temperature tolerance to the water when determining the accuracy of the graduations on the neck of the top section. A temperature tolerance of $\pm 2.0^\circ$ ($\pm 3.6^\circ\text{F}$) is required.

- Also added the following thermometer requirements and note reference: The thermometer for measuring the temperature of the water shall meet the requirements of M 339M/M 339 with a temperature range of at least 19 to 23.5°C [66.4 to 74.6°F] and an accuracy of $\pm 0.5^\circ\text{C}$ [$\pm 0.9^\circ\text{F}$] (see Note 3).

Note 4—Thermometer types suitable for use include: ASTM E1 mercury thermometers that are submerged to their required immersion depths; ASTM E2877 digital metal stem thermometer; or ASTM E230/E230M thermocouple thermometer, Type T Special.

- All subsequent notes have been renumbered, due to the addition of note 3.

Minor formatting and editorial items were also addressed.

T 209 (Theoretical Maximum Specific Gravity (G_{mm}) and Density of Asphalt Mixtures) -

Under Scope, updated the AASHTO reference year to 2022.

The following bullets identify additions, deletions, or modifications to the procedure:

- Under the Apparatus section, 5th bullet “vacuum pump”, changed the residual pressure requirement from 4.0 kPa to 3.4.
- Under the Apparatus section, 9th bullet “Thermometers”, removed the 0.5°C (1°F) and replaced with the following: “Thermometric devices accurate to 0.25°C (0.5°F) and with a temperature range of at least 20 to 45°C (68 to 113°F).”.
- Under Test Sample Preparation, step 2, changed the allowance of two increment samples to have a specific gravity difference greater than 0.014 to 0.013.
- Under Test Sample Preparation, added a new step 3 as follows: “Plant-produced samples may be short-term conditioned according to AASHTO R 30 as specified by the agency.”.
- A new note 1 was added as follows: Short-term conditioning at the specified temperature is especially important when absorptive aggregates are used. This short-term conditioning will ensure the computation of realistic values for the amount of asphalt absorbed by the aggregate and void properties of the mix. Plant-produced asphalt mixtures should be evaluated to make sure short-term conditioning has taken place during production and delivery.
- Under Procedure General, step 9 deleted the existing 15 ± 2 minutes and replaced with 15 ± 1 .
- Under Annex A, Standardization of Bowl and Pycnometer or Volumetric Flask, the Bowl Check, step 7 has been added and reads as follows: “For labs that check the bowl standardization frequently (such as daily), calculate the moving average and range of the last three mass determinations. Designate the average of the last three masses as “B.””.
- Under Annex A, Bowl check, also added a step 8 that reads as follows: “If the moving range exceeds 0.3 g at any time, take corrective action and perform the standardization procedure again.”.

Minor formatting and editorial items were also addressed.

❖ **T 217 (Yellow Sheet)** – the following bullets identify additions, deletions, or modifications to the yellow sheet entries:

- The second bullet, Moisture Determination, the addendum step reference was corrected. During the 2018 procedure update, step references were changed, but the yellow sheet wasn't updated to reflect the changes.

T 255/265 (Total Evaporable Moisture Content of Aggregate by Drying and Laboratory Determination of Moisture Content of Soils) – Under Scope, updated the AASHTO reference year to 2022.

The following bullets identify additions, deletions, or modifications to the procedure:

- Under Apparatus, Heat source, added “thermostatically” in front of controlled and added the oven must be capable of maintaining $110 \pm 5^{\circ}\text{C}$ ($230 \pm 9^{\circ}\text{F}$).
- Under Apparatus, Heat source, uncontrolled, added the following statement: “for use when allowed by the agency, will not alter the material being dried, and close control of the temperature is not required.”.
- Under Sample Preparation, added a 2nd sentence indicating, if necessary, reduce the sample to moisture content sample size according to the FOP for AASHTO R 76.
- Table 1 changed the Nominal Maximum Size and corresponding Minimum Sample Mass from increasing to decreasing order.
- Table 2 changed the Maximum Particle Size and corresponding Minimum Sample Mass from increasing to decreasing order.
- Under Procedure, moved step 3 above the a. and b. references under step 2. Now step 2 reads “Place the wet sample in the container.” and step 3 has the a. and b. oven drying references.

Minor formatting and editorial items were also addressed.

T272 (One-Point Method for Determining Maximum Dry Density and Optimum Moisture) – Minor editorials as follows:

- Under Procedure, step 7, removed the term “or better” at the end of the sentence.
- Under Procedure, step 9, added the Rho variable (ρ_w) after the term “wet density”.
- Under Procedure, step 11, added the variable (w) after moisture content to line up with the calculations section.
- Under calculations section, added the Rho variable and defined as “Wet Density”.

Minor formatting and editorial items were also addressed.

T 272 (Yellow Sheet) – the following bullets identify additions, deletions, or modifications to the yellow sheet entries:

- Last Bullet, Changed page reference from “15-7” to “15-5”.

T 283 (Resistance of Compacted Asphalt Mixtures to Moisture-Induced Damage) – The cover sheet has been updated to reflect the new 2022 version of the procedure. There were significant changes to the procedure, due to the addition of new thermometer requirements (AASHTO M 339).

The following bullets identify additions, deletions, or modifications to the procedure:

- Under Section 2.1, AASHTO Standards, added M 339 Thermometer reference procedure (Thermometers Used in the Testing of Construction Materials) to the list.
- Under Section 2.1, AASHTO Standards, changed the test procedure title name for R 30 to Laboratory Conditioning of Asphalt Mixtures.
- *Under Section 2.2 (ASTM Standards), added the following references:*
 - E1, Standard Specification for ASTM Liquid-in-Glass Thermometers
 - E230/E230M, Standard Specification for Temperature-Electromotive Force (emf) Tables for Standardized Thermocouples
 - E879, Standard Specification for Thermistor Sensors for General Purpose and Laboratory Temperature Measurements
 - E1137/E1137M, Standard Specification for Industrial Platinum Resistance Thermometers
 - E2877, Standard Guide for Digital Contact Thermometers
- *Under Section 2.3 (International Electrotechnical Commission Standards), added the following references:*
 - IEC 60584-1: 2013 Thermocouples - Part 1: EMF Specifications and Tolerances
 - IEC 60751: 2008 Industrial Platinum Resistance Thermometers and Platinum Temperature Sensors

Apparatus Section

- Section 5.4 removed temperature reference and stated water baths shall be capable of maintaining a temperature as required.
- Added a new Section 5.4.1 and note reference as follows: Water bath of sufficient size, capable of maintaining a uniform temperature of $60 \pm 1^{\circ}\text{C}$ ($140 \pm 2^{\circ}\text{F}$). The thermometer for measuring the temperature of the water bath shall meet the requirements of M 339M/M 339 with a temperature range of at least 55 to 65°C (131 to 149°F) with an accuracy of $\pm 0.25^{\circ}\text{C}$ ($\pm 0.45^{\circ}\text{F}$) (see Note 1).

Note 5—Thermometer types suitable for use include ASTM E1 mercury thermometers; ASTM E879 thermistor thermometer; ASTM E1137/E1137M Pt-100 RTD platinum resistance thermometer, Class A; or IEC 60751: 2008 Pt-100 RTD platinum resistance thermometer, Class AA.

- Added a new Section 5.4.2 and note reference as follows: Water bath of sufficient size, capable of maintaining a uniform temperature of $25 \pm 0.5^{\circ}\text{C}$ ($77 \pm 0.9^{\circ}\text{F}$).

The thermometer for measuring the temperature of the water bath shall meet the requirements of M 339M/M 339 with a temperature range of at least 20 to 30°C (68 to 86°F) with an accuracy of $\pm 0.13^{\circ}\text{C}$ ($\pm 0.22^{\circ}\text{F}$) (see Note 2).

Note 6—Thermometer types suitable for use include ASTM E1 mercury thermometers; ASTM E879 thermistor thermometer; ASTM E1137/E1137M Pt-100 RTD platinum resistance thermometer, Special order; or IEC 60751: 2008 Pt-100 RTD platinum resistance thermometer, Special order.

- Modified section 5.5 and added the following requirements and note reference: The thermometer for measuring the temperature of the freezer shall meet the requirements of M 339M/M 339 with a temperature range of at least -25 to -10°C (-13 to 14°F) with an accuracy of $\pm 0.75^{\circ}\text{C}$ ($\pm 1.35^{\circ}\text{F}$) (see Note 3).

Note 7—Thermometer types suitable for use include ASTM E1 mercury thermometers; ASTM E2877 digital metal stem thermometer; ASTM E230/E230M thermocouple thermometer, Type T, Special Class; or IEC 60584 thermocouple thermometer, Type T, Class 1.

- Modified section 5.10 and added the following requirements and note reference: More than one oven may be used, provided each is used within its proper operating temperature range. Thermometer for measuring the temperature of materials shall meet the requirements of M 339M/M 339 with a temperature range of at least 25 to 185°C (77 to 365°F), and an accuracy of $\pm 0.75^\circ\text{C}$ (see Note 4).

Note 8—Thermometer types suitable for use include ASTM E1 mercury thermometers; ASTM E230/E230M thermocouple thermometer, Type T, Special Class; or IEC 60584 thermocouple thermometer, Type T, Class 1.

- Subsequent note references have been changed, due to the new notes added in the apparatus section.

Formatting and editorial items were also addressed.

T 308 (Determining the Asphalt Binder Content of Asphalt Mixtures by the Ignition Method) - Under Scope, updated the AASHTO reference year to 2022.

The following bullets identify additions, deletions, or modifications to the procedure:

- Under the Apparatus section, Ignition Furnace, 2nd sentence added the following: The convection-type furnace must be capable of maintaining the temperature between at least 530 and 545°C (986 and 1013°F) and have a temperature control accurate within $\pm 5^\circ\text{C}$ ($\pm 9^\circ\text{F}$). The existing temperature reference has been deleted. Also, removed the existing Note 2 reference and placed the language into the Ignition Furnace section.

Procedure – Method A (Internal Balance)

- Under step 5, removed the first sentence and created a new step 6 with the same language. Now step 5 states to determine and record the sample and assembly and step 6 states to calculate the initial mass of sample, subtract mass of the assembly from the sample and sample basket and record to nearest 0.1g.
- All subsequent steps have been renumbered, due to the new step addition.
- A new note 3 was added after step 10 and reads as follows: Differences greater than 5 g or failure of the furnace scale to stabilize may indicate that the specimen basket assembly is contacting the furnace wall.
- All subsequent notes have been renumbered, due to the new note addition.
- Modified step 14 to read as follows: Determine and record the mass of the sample and sample basket assembly after ignition to the nearest 0.1 g.
- Deleted the existing step 13 language, which is the new step 15 and added the following: Calculate the mass of the sample by subtracting the mass of the sample basket assembly from the mass of the sample and sample basket assembly and record to the nearest 0.1 g. Designate this mass as M_r .

Procedure – Method B (External Balance)

- Took the existing step 5 and create two steps (step 5 and step 6). Step 5 now reads “Determine and record the mass of the sample and sample basket assembly at room temperature to the nearest 0.1 g.
- Step 6 now reads as follows: Calculate the initial mass of the sample by subtracting the mass of the sample basket from the mass of the sample and sample basket assembly and record to the nearest 0.1 g. Designate this mass as (M_i).
- Modified the existing step 9, which is now step 11 to reads as follows: Calculate the sample mass by subtracting the mass of the sample basket assembly from the mass of the sample and sample basket assembly and record to the nearest 0.1 g.
- Modified the existing step 13, which is now step 16 to reads as follows: Calculate the mass of the sample by subtracting the mass of the sample basket assembly from the mass of the sample and sample basket assembly and record to the nearest 0.1 g.
- Modified the existing step 15, which is now step 19 to reads as follows: Calculate the final sample mass by subtracting the mass of the sample basket assembly and sample and sample basket assembly and record to the nearest 0.1 g. Designate this mass as M_f .
- Under the reporting section, added clarification for reporting of binder content. It now states to the nearest 0.01 percent or per agency.

Formatting and editorial items were also addressed.

T 309 (Temperature of Freshly Mixed Portland Cement Concrete) - Under Scope, updated the AASHTO reference year to 2022.

The following bullets identify additions, deletions, or modifications to the procedure:

- Under the Apparatus section, removed the existing language and replaced with the following: Thermometer: Capable of measuring the temperature of the concrete throughout the temperature range likely to be encountered, at least -18 to 50°C (0 to 120°F), and readable to $\pm 0.5^{\circ}\text{C}$ ($\pm 1^{\circ}\text{F}$) or smaller.
Also, added a new Note 1: Thermometer types suitable for use include ASTM E1 mercury thermometer or ASTM E2251 Low Hazard Precision Liquid-in-glass thermometer; ASTM E2877 digital metal stem thermometer; or thermocouple thermometer ASTM E230, Type T Special or IEC 60584 Type T, Class 1.
- Under the Apparatus section, removed the existing third bullet, which discussed “Reference Temperature measuring device”.
- The existing title “Calibration of Temperature Measuring Device” has been changed to “Standardization of Thermometer”.
- All “temperature measuring device” have been changed to “thermometer” throughout the test procedure. Also, changed “Calibration” to “Standardization”.

Formatting and editorial items were also addressed.

T 310 (In-Place Density and Moisture Content of Soil and Soil Aggregate by Nuclear Methods (Shallow Depth)) – Under Scope, updated the AASHTO reference year to 2022.

The following bullets identify additions, deletions, or modifications to the procedure:

- Under Procedure, step 1, added an extra step and new note 2 reference as follows: d. Correct for trench wall effect according to manufacturer's correction procedures if the test site is closer than 600mm (24 in.) to vertical projection. See Note 2.

Note 2: To perform moisture and density tests in a trench or against a large solid object, it is necessary to perform a trench offset correction to adjust the gauge, or it may read a falsely high moisture content. Moisture present in the walls can thermalize neutrons which return to the gauge and are read as moisture by the detector in the gauge.

- Under Percent Compaction, changed the WSDOT's TM 606 reference to WAQTC TM 15.

Minor formatting and editorial items were also addressed.

T 324 (Hamburg Wheel-Track Testing of Compacted Asphalt Mixtures) – The cover sheet has been updated to reflect the new 2022 version of the procedure. There were significant changes to the procedure, due to the addition of new thermometer requirements (AASHTO M 339).

The following bullets identify additions, deletions, or modifications to the procedure:

- Under Section 2.1, AASHTO Standards, added M 339 Thermometer reference procedure (Thermometers Used in the Testing of Construction Materials) to the list.
- Under Section 2.1, AASHTO Standards, changed the test procedure title name for R 30 to Laboratory Conditioning of Asphalt Mixtures.
- *Under Section 2.2 (ASTM Standards), added the following references:*
 - E1, Standard Specification for ASTM Liquid-in-Glass Thermometers
 - E230/E230M, Standard Specification for Temperature-Electromotive Force (emf) Tables for Standardized Thermocouples
 - E879, Standard Specification for Thermistor Sensors for General Purpose and Laboratory Temperature Measurements
 - E1137/E1137M, Standard Specification for Industrial Platinum Resistance Thermometers
 - E2877, Standard Guide for Digital Contact Thermometers
- *Under Section 2.3 (International Electrotechnical Commission Standards), added the following references:*
 - IEC 60584-1: 2013 Thermocouples - Part 1: EMF Specifications and Tolerances
 - IEC 60751: 2008 Industrial Platinum Resistance Thermometers and Platinum Temperature Sensors
- Under Apparatus, section 5.2, Temperature Control System, added the following thermometer requirements and a new Note 2 reference:

The thermometer for measuring the temperature of the water bath shall meet the requirements of M 339M/M 339 with a temperature range of at least 20 to 75°C (68 to 167°F), and an accuracy of $\pm 0.25^\circ\text{C}$ ($\pm 0.45^\circ\text{F}$) (see Note 2).

Note 9—Thermometer types suitable for use include ASTM E1 mercury thermometers; ASTM E879 thermistor thermometer; ASTM E1137/E1137M Pt-100 RTD platinum resistance thermometer, Class A; or IEC 60751: 2008 Pt-100 RTD platinum resistance thermometer, Class AA.

- Under Apparatus, section 5.8, Ovens, added the following oven requirements and a new Note 4 reference:

For heating aggregate and asphalt binders to their appropriate mixing temperature. Oven(s) for heating shall be properly standardized and capable of operation at the temperatures required, between 100 to 175°C (212 to 347°F), within ±5°C (±9°F), as corrected, if necessary, by calibration. More than one oven may be used, provided each is used within its proper operating temperature range. The thermometer for measuring the temperature of materials shall meet the requirements of M 339M/M 339 with a temperature range of at least 140 to 175°C (284 to 347°F), and an accuracy of ± 1.25°C (±2.25°F) (see Note 4).

Note 10—Thermometer types suitable for use include ASTM E1 mercury thermometers; ASTM E230/E230M thermocouple thermometer, Type T, Special Class; or IEC 60584 thermocouple thermometer, Type T, Class 1.

- All note references throughout the procedure have been renumbered, due to the new note references under the apparatus section.

Formatting and editorial items were also addressed.

T 329 (Moisture Content of Asphalt Mixtures by Oven Method) – Under Scope, updated the AASHTO reference year to 2022.

The following bullets identify additions, deletions, or modifications to the procedure:

- Under Apparatus, 4th bullet Thermometer, removed the existing thermometer temperature range and replaced with the following: 50 to 200°C (122 to 392°F) and readable to the nearest 2°C (4°F).

Minor formatting and editorial items were also addressed.

T 335 (Determining the Percentage of Fracture in Coarse Aggregate) – The following bullets identify additions, deletions, or modifications to the procedure:

- Under Terminology section a new term was introduced. Fractured criteria: Determined by the agency to define a fractured particle.

Minor formatting and editorial items were also addressed.

R 76 (Reducing Samples of Aggregate to Testing Size) - Under Scope, updated the AASHTO reference year to 2022.

The following bullets identify additions, deletions, or modifications to the procedure:

- Under Method B, Quartering, third bullet, added the term “Tarp” and provided a geometric configuration “square” to the definition.
- All references to “canvas, plastic sheet or sheet” have been changed to “Tarp”.

Minor formatting and editorial items were also addressed.

R 90 (Sampling of Aggregate Products) – The following bullets identify additions, deletions, or modifications to the procedure:

- For all steps in the procedure that required combining multiple increments the following phrase was added: “and mix thoroughly” after the term increments.

Minor formatting and editorial items were also addressed.

R 100 (Method of Making and Curing Concrete Test Specimens in the Field) – Under Scope, updated the AASHTO reference year to 2022.

The following bullets identify additions, deletions, or modifications to the procedure:

- Under the Apparatus section, Beam Molds, corrected the 4 in. x 4 in. beam mold nominal maximum aggregate size from 38 mm (1.5 in.) to 25 mm (1.0 in.).
- Under the Apparatus section, Vibrator, removed the following reference from the end of the sentence: “...for use with low slump concrete”.
- Under the Apparatus section, Thermometer, added the following statement to the end of the sentence: “...meeting the requirements for FOP AASHTO T 309.”.
- Under Final Curing, 3rd bullet, added the following ambient temperature requirement during the final 3 hours of curing: “...and ambient temperature is between 20 to 30°C (68 to 80°F).”.

Minor formatting and editorial items were also addressed.

❖ **R 100 (Yellow Sheet)** – the following bullets identify additions, deletions, or modifications to the yellow sheet entries:

- The second bullet, first sentence, was modified to indicate the high/low temperature-recording device is required to monitor the water medium and not the air remaining in the cooler.

WAQTC Test Procedures

No Changes

Section 2 QA Program

Section I, Overview –

- Under the Verification section, page 2, added the following requirement: “All aggregate samples will be obtained from the stockpile. Material transported to the source of incorporation (e.g., concrete plant, ACP facility, pug mill etc.), may be subject to further testing”.
- Under Quality Assurance Program Components, Third-Party Resolution, modified the first sentence to read as follows: “Third-party resolution is used when the Agency’s quality assurance test results conflict with ongoing quality control test results according to section VI (Product Specific QC/QA Testing Plan) and when the conflict cannot be resolved.

Section II, Roles and Responsibilities – No Changes

Section III, Lab Certification Program – Under Section III “Laboratory Certification Program”, Third-Party Laboratories, added the following requirement in the 2nd paragraph, 2nd sentence: “In this event, the third-party resolution duties will be performed by a certified laboratory meeting the requirements of CFR 0637.209 (a-4), accredited in the testing to be performed by the AASHTO Accreditation Program or a comparable laboratory accreditation program approved by FHWA.”.

The last sentence “The ODOT-CML shall certify third-party resolution laboratories, other than the ODOT-CML” has been deleted.

During ODOT’s last FHWA review, Federal Highway indicated a certification criterion was required for Third-Party Laboratories.

Section IV, Technician Certification Program –

Modified the certification duration table to show renewal of Cat-II and CCT is now good for a 5-year period.

Under Section IV “Technician Certification Program”, Complaint Process for Abuse, modified step 2 to indicate the technician and the individual filing the complaint “may” be invited to attend the meeting, instead of “will”.

Section V, Quality Assurance Laboratory Proficiency Sample Program – No Changes

Section VI, Product Specific QC/QA Testing Plan

Table 1 IA parameters – No Changes

Under the Concrete section, Mixture - added the following sentence under the Independent Assurance category: “The sample may be taken by QC or independent samples may be taken by both QC and QA. When independent samples are taken, acquire portions as close as possible to each other. Concrete with Nominal Aggregate size of 1 ½” will often require individual samples taken by QC and QA, due to sample size(s) and wet sieving requirements.”

Appendix A, ODOT Approved Aggregate Product Program – The third paragraph has been removed stating “The State QAE may allow minimum testing frequency to be altered after the supplier submits a written proposal to the regional SQAC. The written proposal shall detail the proposed sampling and testing frequencies and shall describe how uniformity of production will be assured.”

The program’s intent is QC will follow the acceptance guide frequency requirements under section 4D and only QA frequency of testing may be altered.

Minor formatting and editorial items were also addressed.

Appendix B, Contractor Quality Control Plan – No Changes

Appendix C, Troubleshooting Guide – Only minor editorial/grammatical changes.

Section 3 Report Forms and Examples

Forms Index and Introduction – No Changes

Forms Description of Worksheet and Calculation Explanations – No Changes

The following forms have been modified:

- **734-1793B (Nuclear Compaction Test Report for Base Materials)** – In the header section removed the field labeled “Control Strip No.”. Control Strip isn’t applicable to base aggregate placement.
- **734-1793S (Nuclear Compaction Test Report)** – Under the AASHTO T 99 area of the form extended the statement “Unscreened Combined In-Place Moisture “to cover the “Wet and Dry” areas under Speedy Moisture. If a companion moisture is utilized than it won’t be screened and the speedy moisture procedure can’t, be utilized.
- **734-3573 (Concrete Yield and W/C Ratio Worksheet)** – Added a field for “Time of Cast”. The new T 22 test procedure for “Compressive Strength of Cylinders” requires the cure time to start based on time of cylinder cast, instead of initial set.

Section 4A Product Compliance – No Changes

Section 4(B) Small Quantity Guidelines – Removed sections 00345, 00346, 00395 and 00642 from the table. These section references are no longer applicable and have been removed from the Standard Specifications.

Section 4(C) Laboratory Samples - No Changes

Field Tested Materials Guide - Section 4D

How to Use the Field-Tested Materials Acceptance Guide – No Changes

Types of Tests – No Changes

Acceptance Guide - *Note, throughout the acceptance guide most of the “Start of Production” references have been removed from the “Aggregate Production” category. Start of production testing for concrete and chip seal aggregates will remain in the document, e.g., Dry Rodded Unit Weight and Specific Gravity testing.*

“Start of Production” references have been removed because initial crusher setup falls under the responsibility of the contractor/supplier and isn’t applicable to statistical evaluation according to section 00165.

The following bullets identify additions, deletions, or modifications to the Specification sections of the guide:

- *The revision date has been updated to 2022 for the entire guide, due to multiple modifications in the document.*
- **Section 00405**, Pipe Zone Material, added “Flexible and Rigid Pipe” under the “Establishing Maximum Density” category. This was added to show both pipe configurations require a maximum density curve and density testing.

- **Section 00540**, Structural Concrete, added a reference for Lightweight Concrete as follows: “AASHTO T 196 required for lightweight concrete”.
- **Section 00559, Structural Concrete Overlays**, Portland Cement Concrete, added a reference for Lightweight Concrete as follows: “AASHTO T 196 required for lightweight concrete”.
- **Section 00745**, Asphalt Concrete Pavement – Statistical Acceptance, Smoothness, removed TM 770 (Determining Profile Index). TM 770 is no longer used under this specification.

Section 5 Type D & E Acceptance Guide – The same changes in section 4D will be made to this section, if applicable.



Sean P. Parker
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INSERT TAB

SECTION 1
Test Procedures

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* (TM) – Test Method.

** (T) – Test Method is a definitive procedure (such as identification, measurement or evaluation of properties) that produces a test result.

** (R) – Recommended Practices are a definitive set of instructions for performing specific operations (such as sampling, collection, or inspection) that do not produce a test result.

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ODOT

Preparing and Determining the Density of Asphalt Mixture Specimens by Means of the Superpave Gyratory Compactor

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ODOT TM 769-22

Method of Test for

Certification of Inertial Profiler Equipment

1. SIGNIFICANCE

- 1.1 This test method describes the procedure for measuring the vertical and horizontal accuracy of an Inertial Profiler for the purpose of certification under the Oregon Department of Transportation (ODOT) Quality Assurance Program. The profiler will be tested on a calibration course of known International Roughness Index (IRI) and distance for accuracy and repeatability.

2. SCOPE

- 2.1 This test method covers Inertial Profilers employing automated data collection of pavement profile for the purpose of determining IRI. Measurements are made using non-contact sensing systems from a moving platform meeting the requirements of Section 4, Equipment and AASHTO M 328.

3. REFERENCED DOCUMENTS

- 3.1 AASHTO M 328
- 3.2 AASHTO R56
- 3.3 AASHTO R 57
- 3.4 ProVAL User Manual

4. EQUIPMENT

- 4.1 An Inertial Profiler, triggering equipment, and calibration equipment meeting the requirements of AASHTO M 328 and AASHTO R 57.
- 4.2 The device must be capable of reporting elevations with a resolution of 0.001 inches or finer at a sampling interval of 2 inches or less within the operating speed of the profiler. The device must provide a means to field calibrate and measure the horizontal distance traveled. A device equipped with GPS must also have a Distance Measurement Instrument (DMI) that can be calibrated according to Section 8.2 to compensate when GPS coverage is unavailable.
- 4.3 The device must be equipped with software capable of generating, displaying, storing, and reporting IRI at 0.10-mile intervals. The profiler software will be capable of generating a PPF file that contains the data in PPF format.
- 4.4 The Inertial Profiler must be equipped with auto triggering equipment.
- 4.5 Lateral laser spacing of 69 to 71.5 inches is required.
- 4.6 Maintain the low pass filter at 0.000 feet and the High Pass filter at 200.000 feet for all calibration and certification testing.

5. OPERATOR REQUIREMENTS

- 5.1 The operator shall be proficient in the calibration and operation of the profiler per the manufacturers' recommended procedures. The certification of the profiling system is tied to the operator. All prospective operators must go through the certification procedure with the equipment, with acceptable results, to be certified. Certification documentation will show which operators are approved for each profiler.

6. CERTIFICATION REFERENCE SITE

- 6.1 The certification reference site(s) will be designated by the ODOT Pavement Services Unit. The reference site will include a Distance Measurement Instrument (DMI) verification section and a section for determining the accuracy and the repeatability of the profiler.

7. REFERENCE VALUE DETERMINATION

- 7.1 The profile of the reference site will be determined by the ODOT Pavement Services Unit using an accepted reference device. The IRI will be computed from the collected data.
- 7.2 The section for DMI Verification will be established by the ODOT Pavement Services Unit. The start and the end locations of the section will be marked.

8. EQUIPMENT CALIBRATION VERIFICATION

Submit documentation detailing the specifications of the equipment to be used and the manufacturer's recommended calibration and calibration check procedures.

- 8.1 *Distance Measurement Instrument (DMI) Verification:* The DMI of the profiler shall be set to report distance in feet. The operator will guide the profiler over the DMI section length as laid out by ODOT. The DMI must be triggered by the auto triggering equipment at the start and at the end of the DMI section, and the DMI readout recorded. The operator shall make two additional runs following the same procedure. Each run and distance readout will be observed by an ODOT representative. The average of the three absolute differences (between the DMI readout and actual length of section) must be less than 0.10% of the known distance.
- 8.2 If the profiler's DMI does not pass the above requirement, then the operator shall calibrate the DMI to the known distance specified by ODOT and repeat the three runs as stated above.

Note: The DMI reading is affected by the tire pressure. Hence, operators should make sure that the tire pressure is set to the manufacturers' recommended value and the tires are sufficiently warmed-up before calibrating the profiler and performing the required runs.

- 8.3 *Bounce test:* Perform according to the manufacturer's recommendations. If the profiler manufacturer does not have a procedure, then perform the following:

Position the vehicle on a flat and level surface. Place a smooth, flat, non-glossy material plate under each sensor (the base plate used for the block check can be used). Using the equipment's normal data collection software, initiate a data collection run using a simulated travel speed at the midpoint of the manufacturer's recommended data collection speed range.

(The only difference between a bounce test and a normal data collection run is that there is an artificial longitudinal travel signal supplied and the vehicle is not actually travelling along the road. The bounce test utilizes the same data collection software and routines used during normal data collection).

Allow the profiler to collect a minimum of 528 ft of static profile with the host vehicle as motionless as possible. Next, the sensor(s) should be moved vertically for a total displacement of approximately 1-2 in. (a yardstick may be helpful until the operator gets used to the procedure). This movement must continue until a minimum of 528 ft of simulated longitudinal distance has been covered. The typical method for full-size, high-speed host vehicles is to push the mounting system (bumper) down an inch or so and let the vehicle suspension rebound to create the total vertical travel of 1-2 in. The typical method for lightweight, slow-speed host vehicles is to stand toward the center of the vehicle platform and hop up and down such that all four corners of the vehicle suspension travel approximately 1-2 in. vertically. Stop the test after a minimum of 528 ft of bounce profile is collected.

The IRI during the static portion of the test must be less than 3 in/mile and the IRI during the bounce portion must be less than 10.0 in/mile or the manufacturer's recommended maximum, whichever is less. This requirement shall be met for each sensor. If the IRI value is greater than the stated values, provide documentation explaining why to the ODOT Pavement Services Unit. The Pavement Services Unit will determine either acceptance or failure of this test based on the documentation provided. An ODOT representative will observe and record the IRI value from the bounce test.

Note: Some profiling systems require a warm-up period before use. The system should be turned on for a minimum of fifteen minutes prior to calibration verification, or per the manufacturer's recommendations.

- 8.4 *Vertical height test:* The height sensor will be checked with blocks of a known thickness of 0.25-in, 0.50-in and 1.00-in. A smooth base plate will be placed under the height sensor height measurements will be taken, or the vertical height will be zeroed. A 0.25-in block will be placed on top of the base plate under the height sensor and height measurements will be taken. The 0.25-in block will be removed and replaced with the 0.50-in block on top of the base plate and height measurements will be taken. The 0.50-in block will be removed and replaced with the 1.00-in block on top of the base plate and height measurements will be taken.

The average height of the base plate will be calculated for those systems that cannot be zeroed. This height will be subtracted from the measured height readings for the 0.25-in block, the 0.50-in block and the 1.00-in block to calculate the measured thickness of each block. The error in calculated thickness will be determined from the average of the absolute values of the difference between the calculated thickness and the known thickness for the measurements. To pass the height test, the average of the absolute differences must be less than or equal to 0.01-in for each block.

An ODOT representative will observe the measured height values of the base plate and blocks.

- 8.5 *Calibration Verification Log:* Maintain a logbook which records the inertial profiler's history of all calibrations and equipment repairs or replacement. This log shall be made available to ODOT employees at any time on ODOT projects.

9. EQUIPMENT CERTIFICATION PROCEDURE

- 9.1 *Dynamic Test:* After meeting the requirements of Section 8, the Operator will use the Inertial Profiler to collect profile data on the designated certification reference track. The certification reference track will be a minimum of 528 feet in length.

The Operator will make a minimum series of five runs over the certification reference track. Set the horizontal measurement interval and the reporting interval on the Inertial Profiler to not greater than 2.00 inches. The data collection must be triggered by the automated triggering equipment. Terminate data collection at the end of the designated section. A minimum of five repeat runs of the profiler will be made on each section, and the IRI values computed for each run. The profiler will be operated at the speed that will be used for normal data collection, within the speed range recommended by the manufacturer of the profiler and typical of the data collection speed for contract smoothness measurement.

(Note: Make sure that the tires on the profiler are warmed up before doing the Dynamic test. If they are not warmed up, that can affect the DMI between runs and can significantly affect the Repeatability and Accuracy Scores that are computed in Section 9.3).

- 9.2 *Data Format:* Profile data will be collected, stored, and reported in a format recognized by the latest version of ProVAL (FHWA smoothness software available at www.roadprofile.com), and given to the ODOT representative for evaluation as described in Section 9.3.
- 9.3 *Repeatability and Accuracy:* The latest version of the ProVAL Profiler Certification Module will be used for cross correlation, to evaluate the five runs. For these computations, the following settings will be used in the In ProVAL Profiler Certification Module: (1) basis or comparison filter will be set to IRI without the 250 mm filter applied and (2) the comparison runs filter will be set to IRI with the 250 mm filter applied. A repeatability score of 90% and an accuracy score of 88% will be required for both wheel paths for certification.

10. EQUIPMENT REQUIREMENTS

10.1 All of the following conditions must be met for certification of the Inertial Profiler:

- Pass all Equipment calibration verifications -- Section 8.
- Meet repeatability requirement-- Section 9.3.
- Meet accuracy requirement-- Section 9.3.

11. CERTIFICATION OF OPERATORS AND EQUIPMENT

11.1 The ODOT Pavement Quality & Materials Engineer will make the final determination as to the acceptability of the Equipment for purposes of certification. The certification is good for 365 days, provided there are no software updates, equipment is not damaged or reconfigured and no significant changes are made to the profiling equipment or the host vehicle per the judgment of the Engineer.

Notice of Certification: Upon successful completion of this test method, written notice of certification will be issued by ODOT and include the following:

- Identification of the profiler certified (make, model, serial number, software version, and owner)
- Identification of the operator(s)
- Date of certification
- Low & High Pass filter settings at the time of the certification runs
- Repeatability results
- Verification of IRI using cross correlation results.

ODOT TM 772-22

Method of Test for

DETERMINING THE INTERNATIONAL ROUGHNESS INDEX WITH AN INERTIAL LASER PROFILER

1. SCOPE

- 1.1 This test method describes the procedure for operating a profiler, checking the calibration (horizontal and vertical accuracy) of the profiler, and determining the International Roughness Index (IRI) and areas of Localized Roughness from pavement profiles obtained by an inertial profiler. A procedure for Quality Control and Quality Assurance smoothness measurements on paving projects is also included.

2. REFERENCED DOCUMENTS

- 2.1 AASHTO M 328
- 2.2 AASHTO R 54
- 2.3 AASHTO R 56
- 2.4 AASHTO R 57
- 2.5 ProVAL User Manual

3. EQUIPMENT

3.1 Profilers

- 3.1.1 The profilers shall employ an accelerometer established inertial profiling reference and a laser height sensing instrument to produce a true profile of the pavement surface, as described in AASHTO M 328.
- 3.1.2 The device must be capable of reporting elevations with a resolution of 0.001 inches or finer at a sampling interval of 2 inches or less within the operating speed of the profiler. The device must provide a means to field calibrate and measure the horizontal distance traveled. A device equipped with GPS must also have a Distance Measurement Instrument (DMI) that can be calibrated according to Subsection 4.2.2 to compensate when GPS coverage is unavailable.
- 3.1.3 The device must be equipped with software capable of generating, displaying, storing, and reporting IRI at 0.10-mile intervals. The profiler software is required to generate .PPF files that contain the data in .PPF format. If GPS is used for horizontal distance measurement, the device must be capable of producing Keyhole Markup Language (.KML) and REFERENCE.KML files.
- 3.1.4 Maintain the low pass filter setting at 0.00 feet.
- 3.1.5 Maintain the high pass filter setting at 200.00 feet

4. CALIBRATION VERIFICATION

Submit the following to the Project Manager for approval at least 10 days before smoothness measurements are to begin:

- Documentation detailing equipment to be used and the manufacturer's recommended calibration and calibration check procedures.
- The ODOT Pavement Services Unit Certification documentation, showing certification of the operator and profiling equipment.

Perform all calibration verifications in the presence of the designated representative of the Project Manager.

4.1 Calibration Frequency

At a minimum, perform calibration once per calendar year per the manufacturer's recommendations and procedures.

4.2 Profiler Calibration Check

Perform horizontal and vertical calibration check at the frequency recommended by the manufacturer or at any time during testing if the test results are questionable. At a minimum, check vertical and horizontal calibration daily and at any time a configuration change is made to the profiler.

4.2.1 Vertical Calibration Check

Perform a vertical calibration check on each height sensor in the profiler according to the manufacturer's recommendations. At a minimum, (1) obtain a reading on a smooth base plate, then place a 0.25-in thick block on the base plate, and obtain a reading, and from these two readings compute the thickness of the block as measured by the profiling system, (2) obtain a reading on a smooth base plate, then place a 0.50-in thick block on the base plate and obtain a reading, and from these two readings compute the thickness of the block as measured by the profiling system, (3) obtain a reading on a smooth base plate, then place a 1.00-in thick block on the base plate and obtain a reading, and from these two readings compute the thickness of the block as measured by the profiling system. The thickness of the blocks used for this test shall meet the requirements of AASHTO R 57. The thickness of the blocks as determined by the profiling system should be within 0.01 inches of the actual thickness of the block.

4.2.2 Horizontal Calibration Check

This check is performed to verify the accuracy of the Distance Measurement Instrument (DMI). As a minimum, measure and mark off (to within 0.05%) a straight distance of 528 feet on a reasonably level, paved surface. Test the section 3 times.

The average of the three runs should be less than 1-foot absolute difference from the known 528 feet. If the profiler fails to meet this requirement, calibrate the DMI according to the manufacturer's recommendations and repeat the horizontal calibration and adjustments until the required average is achieved.

Note: Check the air pressure in the tires on the vehicle as necessary during horizontal calibration process to ensure the tire pressure is maintained. If the tire pressure changes, adjust the pressure or recalibrate the horizontal measurement until an acceptable and repeatable horizontal calibration check is accomplished. Tire pressure will influence the horizontal distance measured by the profiler.

4.3 Bounce Test

Perform the Bounce test according to the manufacturer's recommendations. As a minimum, place the profiler on a flat level smooth pavement with the electronics on and the vehicle stationary. The IRI corresponding to each sensor should be less than 3.0 inches/mile, for the time that it would take the profiler to travel 528 feet. Next, move the vehicle ("bounce") vertically with 2 inches minimum of vertical travel, for the time that it would take the profiler to travel 0.10 mile. The IRI corresponding to each sensor should be under 10.0 inch/mile or under the manufacturer's recommended maximum, whichever is less.

4.4 Calibration Verification

Before performing smoothness measurements on the project for each shift (day or night) of testing, verify the calibration of the Profiler by operating the machine twice over a 528-foot section of pavement with repeating test results. The calibration shall be considered acceptable when the difference in IRI between 2 consecutive test runs is 4.0 in/mile or less. If a single laser is used, then one wheel path will be tested. If two lasers are used (right and left) the average of the two IRI will be used. Provide documentation to the Project Manager verifying that the calibration and test runs have been successfully completed for each shift of testing.

A fog line or other straight line on a relatively smooth pavement surface is suggested for performing this check.

Maintain a log to be kept with the profiler, to provide a record of calibration history.

5. QUALITY CONTROL PROFILE TESTING AND REPORTING

- 5.1 Operate the profiling device to provide data for complete graphic profiles at all locations required by the contract specification.
- 5.2 Locate and mark all excluded areas by specification. Use white paint or other approved marking material on the shoulder adjacent to each lane to show where each auto trigger was placed (multiple marks on the shoulder may be required for multiple lane approaches and departures for skewed bridges and end panels). If surveyed locations were used for GPS auto trigger for start, stop and exclusion areas, provide those locations for each lane profiled in REFERENCE.KML format.

Do not evaluate, for IRI, excluded areas noted in the specifications. These areas are to be left out of the IRI analysis. Test excluded areas according to the applicable specification.

For auxiliary and slow lanes in passing sections, start the profile of the slow lane at the end of the taper where the lane becomes full width, and terminate the profile at the start of the taper from the full lane width (usually first skip stripe to last skip stripe). On bridges with skews, locate the start and end of the bridge exclusion where the 50 feet is the minimum distance from any point in the profiled lane from the bridge joint or end panel, as applicable (i.e. 50 feet from where the lane line first contacts the skew of the bridge when traveling towards the bridge).

- 5.3 Operate the profiling device in the direction of travel.
- 5.4 Set the reporting interval to 2.0 inches or less.
- 5.5 Operate the profiler to collect data along the specified wheel paths at a constant speed, which is within the operating speed range as recommended by the manufacturer (see Section 5.9 for the location of the wheel paths). Take care to keep the device as parallel as possible to centerline. Bring the profiler to the desired speed and alignment prior to the beginning of the test section. Maintain the profiler speed at as constant a rate as possible throughout the test section. Use the manufacturer's recommended lead-in and lead-out distances, or a minimum of 200 feet. Profiler speed will be maintained through the end of the test section.
- 5.6 Label profile reports and data files with the appropriate identification and project stationing, matching the project plans, for each profile. For example: northbound, fast lane could be identified as NB-A-Lane. Include project identification and project stations on the report that contains the table outlined in section 5.11.
- 5.7 Mark and identify the project stationing on the profiles. Initial and date the beginning and ending project stations of each day's test runs on the profile reports.
- 5.8 A horizontal distance tolerance of a maximum of 1.0% or 53 feet/mile is required. Reference the project stationing on the profile at a known project station at the beginning and ending of each run and excluded area. Write the project station on the chart or use event markers to reference the locations of verified project stationing. Check the project stationing every mile at a minimum.
- 5.9 Measure both the right and left wheel path. Measure the left wheel path at 3 feet from the lane divider (center line). Measure the right wheel path at 9 feet from the lane divider (center line). When using an inertial profiler that collects a single wheel path per pass, make sure that each wheel path starts and stops at the same longitudinal location.
- 5.10 Do not mix travel lanes in the same data file. Submit profile data (hard copies and data files – in .PPF, .KML, and manufacturer specific file formats) for all travel lanes and wheel paths for the entire project except for excluded areas, per specification (do not profile excluded areas).

- 5.11 Submit to the Project Manager a table that identifies the lanes, wheel paths, and distance locations (stations and/or mile posts) tested for each data file, representing all profiles on the project. (Most profile manufacturers have a reporting format that is acceptable.)
- 5.12 The Project Manager will evaluate the profile reports generated from manufacturer specific or .PPF raw data files through the most current version of the ProVAL software (available at www.roadprofile.com) for determination of the Smoothness Price Adjustment according to the applicable Specification. IRI values are evaluated to the nearest 0.1 inches/mile.

6. DETERMINATION OF THE INTERNATIONAL ROUGHNESS INDEX

Using ProVAL, or equivalent profiler manufacturer software, calculate the left wheel path IRI, right wheel path IRI, and the mean IRI (average of left and right wheel path IRI) for each 0.10 mile and partial section. The mean IRI will be used for incentive/disincentive determination according to 00745.96.

7. DETERMINATION OF LOCALIZED ROUGHNESS

Use the most current version of ProVAL, or equivalent profiler manufacturer software, to evaluate profiles for areas of Localized Roughness per the Specification minimum. Determine areas of Localized Roughness by computing the IRI over a continuous 25-ft length. Determine areas of Localized Roughness for each wheel path. Generate a report and submit it to the Project Manager for review. Stake or mark areas identified as exceeding the minimum specified Localized Roughness in a method acceptable to the Engineer for the ride test per Specification.

8. QUALITY ASSURANCE

At the discretion of the Agency, the Agency will perform Quality Assurance of profiles on projects according to the following:

The Agency profiler or a Third-Party profiler may run a verification of completed wearing course areas under the IRI specification for the contract or season of paving. The Contractor run profile will be considered acceptable if the mean IRI of both wheel paths averaged over all profiled lanes has a minimum of 90.0% of all measured 0.1-mile segments deviate by less than ± 6.0 in/mile IRI. The Project Manager will resolve any discrepancies; this could include re-certification of the profilers, or Third-Party testing of smoothness on the project.

INSERT TAB

AASHTO

Bulk Density (“Unit Weight”) and Voids in Aggregate

AASHTO Designation: T 19/T 19-22

ASTM Designation: C29/C 29M-07

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Compressive Strength of Cylindrical Concrete Specimens

AASHTO Designation: T 22-22

ASTM Designation: C39/C 39M-05

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**SIEVE ANALYSIS OF FINE AND COARSE AGGREGATES
FOP FOR AASHTO T 27
MATERIALS FINER THAN 75 µM (NO. 200) SIEVE IN MINERAL AGGREGATE
BY WASHING
FOP FOR AASHTO T 11**

Scope

A sieve analysis, or ‘gradation,’ measures distribution of aggregate particle sizes within a given sample.

Accurate determination of the amount of material smaller than 75 µm (No. 200) cannot be made using just AASHTO T 27. If quantifying this material is required, use AASHTO T 11 in conjunction with AASHTO T 27.

This FOP covers sieve analysis in accordance with AASHTO T 27-22 and materials finer than 75 µm (No. 200) in accordance with AASHTO T 11-22 performed in conjunction with AASHTO T 27. The procedure includes three methods: A, B, and C.

Apparatus

- Balance or scale: Capacity sufficient for the masses shown in Table 1, accurate to 0.1 percent of the sample mass or readable to 0.1 g, and meeting the requirements of AASHTO M 231
- Sieves: Meeting the requirements of ASTM E11
- Mechanical sieve shaker: Meeting the requirements of AASHTO T 27
- Suitable drying equipment (refer to FOP for AASHTO T 255)
- Containers and utensils: A pan or vessel of sufficient size to contain the sample covered with water and permit vigorous agitation without loss of material or water
- Optional
 - Mechanical washing device
 - Mallet: With a rubber or rawhide head having a mass of 0.57 ± 0.23 kg (1.25 ± 0.5 lb)

Sample Sieving

- In all procedures, the sample is shaken in nested sieves. Sieves are selected to furnish information required by specification. Intermediate sieves are added for additional information or to avoid overloading sieves, or both.
- The sieves are nested in order of increasing size from the bottom to the top, and the sample, or a portion of the sample, is placed on the top sieve.
- The loaded sieves are shaken in a mechanical shaker for approximately 10 minutes, refer to Annex A, *Time Evaluation*.

- Care must be taken so that sieves are not overloaded, refer to Annex B, *Overload Determination*. The sample may be sieved in increments and the mass retained for each sieve added together from each sample increment to avoid overloading sieves.

Sample Preparation

Obtain samples according to the FOP for AASHTO R 90 and reduce to sample size, shown in Table 1, according to the FOP for AASHTO R 76.

TABLE 1
Sample Sizes for Aggregate Gradation Test

Nominal Maximum Size* mm (in.)	Minimum Dry Mass g (lb)
125 (5)	300,000 (660)
100 (4)	150,000 (330)
90 (3 1/2)	100,000 (220)
75 (3)	60,000 (130)
63 (2 1/2)	35,000 (77)
50 (2)	20,000 (44)
37.5 (1 1/2)	15,000 (33)
25.0 (1)	10,000 (22)
19.0 (3/4)	5000 (11)
12.5 (1/2)	2000 (4)
9.5 (3/8)	1000 (2)
6.3 (1/4)	1000 (2)
4.75 (No. 4)	500 (1)

*Nominal maximum size: One sieve larger than the first sieve to retain more than 10 percent of the material using an agency specified set of sieves based on cumulative percent retained. Where large gaps between specification sieves exist, intermediate sieve(s) may be inserted to determine nominal maximum size.

Sample sizes in Table 1 are standard for aggregate sieve analysis, due to equipment restraints samples may need to be divided into several “subsamples.” For example, a gradation that requires 100 kg (220 lbs.) of material would not fit into a large tray shaker all at once.

Some agencies permit reduced sample sizes if it is proven that doing so is not detrimental to the test results. Some agencies require larger sample sizes. Check agency guidelines for required or permitted sample sizes.

Selection of Procedure

Agencies may specify which method to perform. If a method is not specified, perform Method A.

Overview**Method A**

- Determine original dry mass of the sample
- Wash over a 75 μ m (No. 200) sieve
- Determine dry mass of washed sample
- Sieve washed sample
- Calculate and report percent retained and passing each sieve

Method B

- Determine original dry mass of the sample
- Wash over a 75 μ m (No. 200) sieve
- Determine dry mass of washed sample
- Sieve sample through coarse sieves, 4.75 mm (No. 4) sieves and larger
- Determine mass of fine material, minus 4.75 mm (No. 4)
- Reduce fine material
- Determine mass of reduced portion
- Sieve reduced portion
- Calculate and report percent retained and passing each sieve

Method C

- Determine original dry mass of the sample
- Sieve sample through coarse sieves, 4.75 mm (No. 4) sieves and larger
- Determine mass of fine material, minus 4.75 mm (No. 4)
- Reduce fine material
- Determine mass of reduced portion
- Wash reduced portion over a 75 μ m (No. 200) sieve
- Determine dry mass of washed reduced portion
- Sieve washed reduced portion
- Calculate and report percent retained and passing each sieve

Procedure Method A

1. Dry the sample to constant mass $110 \pm 5^{\circ}\text{C}$ ($230 \pm 9^{\circ}\text{F}$) according to the FOP for AASHTO T 255. Cool to room temperature.
2. Determine and record the original dry mass of the sample to the nearest 0.1 percent or 0.1 g. Designate this mass as *M*.

When the specification does not require the amount of material finer than $75\ \mu\text{m}$ (No. 200) be determined by washing, skip to Step 11.

3. Nest a sieve, such as a 2.0 mm (No. 10), above the $75\ \mu\text{m}$ (No. 200) sieve.
4. Place the sample in a container and cover with water.

Note 1: A detergent, dispersing agent, or other wetting solution may be added to the water to assure a thorough separation of the material finer than the $75\ \mu\text{m}$ (No. 200) sieve from the coarser particles. There should be enough wetting agent to produce a small amount of suds when the sample is agitated. Excessive suds may overflow the sieves and carry material away with them.

5. Agitate vigorously to ensure complete separation of the material finer than $75\ \mu\text{m}$ (No. 200) from coarser particles and bring the fine material into suspension above the coarser material. Avoid degradation of the sample when using a mechanical washing device.

Note 2: Washing longer than 10 minutes in a mechanical washer has been shown to cause significant amounts of degradation depending upon aggregate type.

6. Immediately pour the wash water containing the suspended material over the nested sieves; be careful not to pour out the coarser particles or over fill the $75\ \mu\text{m}$ (No. 200) sieve.
7. Add water to cover material remaining in the container, agitate, and repeat Step 5. Continue until the wash water is reasonably clear.
8. Remove the upper sieve and return material retained to the washed sample.
9. Rinse the material retained on the $75\ \mu\text{m}$ (No. 200) sieve until water passing through the sieve is reasonably clear and detergent or dispersing agent is removed, if used.
10. Return all material retained on the $75\ \mu\text{m}$ (No. 200) sieve to the container by rinsing into the washed sample.

Note 3: Excess water may be carefully removed with a bulb syringe; the removed water must be discharged back over the $75\ \mu\text{m}$ (No. 200) sieve to prevent loss of fines.

11. Dry the washed sample to constant mass at $110 \pm 5^{\circ}\text{C}$ ($230 \pm 9^{\circ}\text{F}$) according to the FOP for AASHTO T 255. Cool to room temperature.
12. Determine and record the dry mass of the sample.
13. Select sieves required by the specification and those necessary to avoid overloading as described in Annex B. With a pan on bottom, nest the sieves increasing in size starting with the $75\ \mu\text{m}$ (No. 200).
14. Place the sample, or a portion of the sample, on the top sieve. Sieves may already be in the mechanical shaker, if not place sieves in mechanical shaker and shake for the

minimum time determined to provide complete separation for the sieve shaker being used (approximately 10 minutes, the time determined by Annex A).

Note 4: Excessive shaking (more than 10 minutes) may result in degradation of the sample.

15. Determine and record the individual or cumulative mass retained for each sieve and in the pan. Ensure that all material trapped in full openings of the sieve are removed and included in the mass retained.

Note 5: For sieves 4.75 mm (No. 4) and larger, check material trapped in less than a full opening by sieving over a full opening. Use coarse wire brushes to clean the 600 μm (No. 30) and larger sieves, and soft bristle brushes for smaller sieves.

Note 6: In the case of coarse / fine aggregate mixtures, distribute the minus 4.75 mm (No. 4) among two or more sets of sieves to prevent overloading of individual sieves.

16. Perform the *Check Sum* calculation – Verify the *total mass after sieving* compared to the *dry mass before sieving* is not more than 0.3 percent. The *dry mass before sieving* is the dry mass after wash or the original dry mass (M) if performing the sieve analysis without washing. Do not use test results for acceptance if the *Check Sum* result is more than 0.3 percent.

17. Calculate the total percentages passing, and the individual or cumulative percentages retained to the nearest 0.1 percent by dividing the individual sieve masses or cumulative sieve masses by the original dry mass (M) of the sample.

18. Report total percent passing to 1 percent except report the 75 μm (No. 200) sieve to 0.1 percent.

Method A Calculations

Check Sum

$$\text{Check Sum} = \frac{\text{dry mass before sieving} - \text{total mass after sieving}}{\text{dry mass before sieving}} \times 100$$

Percent Retained

$$\text{IPR} = \frac{\text{IMR}}{M} \times 100 \quad \text{or} \quad \text{CPR} = \frac{\text{CMR}}{M} \times 100$$

Where:

IPR	=	Individual Percent Retained
CPR	=	Cumulative Percent Retained
M	=	Original dry mass of the sample
IMR	=	Individual Mass Retained
CMR	=	Cumulative Mass Retained

Percent Passing (PP)

$$PP = PPP - IPR \quad \text{or} \quad PP = 100 - CPR$$

Where:

PP = Percent Passing

PPP = Previous Percent Passing

Method A Example Individual Mass Retained

Original dry mass of the sample (<i>M</i>):	5168.7 g
Dry mass of the sample after washing:	4911.3 g
Total mass after sieving equals	
Sum of Individual Masses Retained (IMR), including minus 75 μm (No. 200) in the pan:	4905.9 g
Amount of 75μm (No. 200) minus washed out (5168.7 g – 4911.3 g):	257.4 g

Check Sum

$$\text{Check Sum} = \frac{4911.3 \text{ g} - 4905.9 \text{ g}}{4911.3 \text{ g}} \times 100 = 0.1\%$$

The result is not more than 0.3 percent therefore the results can be used for acceptance purposes.

Individual Percent Retained (IPR) for 9.5 mm (3/8 in.) sieve:

$$IPR = \frac{619.2 \text{ g}}{5168.7 \text{ g}} \times 100 = 12.0\%$$

Percent Passing (PP) 9.5 mm (3/8 in.) sieve:

$$PP = 86.0\% - 12.0\% = 74.0\%$$

Reported Percent Passing = 74%

**Method A Individual
Gradation on All Sieves**

Sieve Size mm (in.)	Individual Mass Retained g (IMR)	Determine IPR by dividing IMR by <i>M</i> and multiplying by 100	Individual Percent Retained (IPR)	Determine PP by subtracting IPR from previous PP	Percent Passing (PP)	Reported Percent Passing*
19.0 (3/4)	0		0		100.0	100
12.5 (1/2)	724.7	$\frac{724.7}{5168.7} \times 100 =$	14.0	$100.0 - 14.0 =$	86.0	86
9.5 (3/8)	619.2	$\frac{619.2}{5168.7} \times 100 =$	12.0	$86.0 - 12.0 =$	74.0	74
4.75 (No. 4)	1189.8	$\frac{1189.8}{5168.7} \times 100 =$	23.0	$74.0 - 23.0 =$	51.0	51
2.36 (No. 8)	877.6	$\frac{877.6}{5168.7} \times 100 =$	17.0	$51.0 - 17.0 =$	34.0	34
1.18 (No. 16)	574.8	$\frac{574.8}{5168.7} \times 100 =$	11.1	$34.0 - 11.1 =$	22.9	23
0.600 (No. 30)	329.8	$\frac{329.8}{5168.7} \times 100 =$	6.4	$22.9 - 6.4 =$	16.5	17
0.300 (No. 50)	228.5	$\frac{228.5}{5168.7} \times 100 =$	4.4	$16.5 - 4.4 =$	12.1	12
0.150 (No. 100)	205.7	$\frac{205.7}{5168.7} \times 100 =$	4.0	$12.1 - 4.0 =$	8.1	8
0.075 (No. 200)	135.4	$\frac{135.7}{5168.7} \times 100 =$	2.6	$8.1 - 2.6 =$	5.5	5.5
minus 0.075 (No. 200) in the pan	20.4					
Total mass after sieving = sum of sieves + mass in the pan = 4905.9 g						
Original dry mass of the sample (<i>M</i>): 5168.7g						

* Report total percent passing to 1 percent except report the 75 μm (No. 200) sieve to 0.1 percent.

Method A Example Cumulative Mass Retained

Original dry mass of the sample (<i>M</i>):	5168.7 g
Dry mass of the sample after washing:	4911.3 g
Total mass after sieving equals Final Cumulative Mass Retained (FCMR) (includes minus 75 µm (No. 200) from the pan):	4905.9 g
Amount of 75µm (No. 200) minus washed out (5168.7 g – 4911.3 g):	257.4 g

Check Sum

$$\text{Check Sum} = \frac{4911.3 \text{ g} - 4905.9 \text{ g}}{4911.3 \text{ g}} \times 100 = 0.1\%$$

The result is not more than 0.3 percent therefore the results can be used for acceptance purposes.

Cumulative Percent Retained (CPR) for 9.5 mm (3/8 in.) sieve:

$$\text{CPR} = \frac{1343.9 \text{ g}}{5168.7 \text{ g}} \times 100 = 26.0\%$$

Percent Passing (PP) 9.5 mm (3/8 in.) sieve:

$$\text{PP} = 100.0\% - 26.0\% = 74.0\%$$

Reported Percent Passing = 74%

**Method A Cumulative
Gradation on All Sieves**

Sieve Size mm (in.)	Cumulative Mass Retained g (CMR)	Determine CPR by dividing CMR by M and multiplying by 100	Cumulative Percent Retained (CPR)	Determine PP by subtracting CPR from 100.0	Percent Passing (PP)	Reported Percent Passing*
19.0 (3/4)	0		0.0		100.0	100
12.5 (1/2)	724.7	$\frac{724.7}{5168.7} \times 100 =$	14.0	$100.0 - 14.0 =$	86.0	86
9.5 (3/8)	1343.9	$\frac{1343.9}{5168.7} \times 100 =$	26.0	$100.0 - 26.0 =$	74.0	74
4.75 (No. 4)	2533.7	$\frac{2533.7}{5168.7} \times 100 =$	49.0	$100.0 - 49.0 =$	51.0	51
2.36 (No. 8)	3411.3	$\frac{3411.3}{5168.7} \times 100 =$	66.0	$100.0 - 66.0 =$	34.0	34
1.18 (No. 16)	3986.1	$\frac{3986.1}{5168.7} \times 100 =$	77.1	$100.0 - 77.1 =$	22.9	23
0.600 (No. 30)	4315.9	$\frac{4315.9}{5168.7} \times 100 =$	83.5	$100.0 - 83.5 =$	16.5	17
0.300 (No. 50)	4544.4	$\frac{4544.4}{5168.7} \times 100 =$	87.9	$100.0 - 87.9 =$	12.1	12
0.150 (No. 100)	4750.1	$\frac{4750.1}{5168.7} \times 100 =$	91.9	$100.0 - 91.9 =$	8.1	8
0.075 (No. 200)	4885.5	$\frac{4885.5}{5168.7} \times 100 =$	94.5	$100.0 - 94.5 =$	5.5	5.5
FCMR	4905.9					
Total mass after sieving: 4905.9 g						
Original dry mass of the sample (M): 5168.7 g						

* Report total percent passing to 1 percent except report the 75 μ m (No. 200) sieve to 0.1 percent.

Procedure Method B

1. Dry the sample to constant mass at $110 \pm 5^{\circ}\text{C}$ ($230 \pm 9^{\circ}\text{F}$) according to the FOP for AASHTO T 255. Cool to room temperature.
2. Determine and record the original dry mass of the sample to the nearest 0.1 percent or 0.1 g. Designate this mass as *M*.

When the specification does not require the amount of material finer than $75\ \mu\text{m}$ (No. 200) be determined by washing, skip to Step 11.

3. Nest a protective sieve, such as a 2.0 mm (No. 10), above the $75\ \mu\text{m}$ (No. 200) sieve.
4. Place the sample in a container and cover with water.

Note 1: A detergent, dispersing agent, or other wetting solution may be added to the water to assure a thorough separation of the material finer than the $75\ \mu\text{m}$ (No. 200) sieve from the coarser particles. There should be enough wetting agent to produce a small amount of suds when the sample is agitated. Excessive suds may overflow the sieves and carry material away with them.

5. Agitate vigorously to ensure complete separation of the material finer than $75\ \mu\text{m}$ (No. 200) from coarser particles and bring the fine material into suspension above the coarser material. Avoid degradation of the sample when using a mechanical washing device.

Note 2: Washing longer than 10 minutes in a mechanical washer has been shown to cause significant amounts of degradation depending upon aggregate type.

6. Immediately pour the wash water containing the suspended material over the nested sieves; be careful not to pour out the coarser particles or over fill the $75\ \mu\text{m}$ (No. 200) sieve.
7. Add water to cover material remaining in the container, agitate, and repeat Step 5. Continue until the wash water is reasonably clear.
8. Remove the upper sieve and return material retained to the washed sample.
9. Rinse the material retained on the $75\ \mu\text{m}$ (No. 200) sieve until water passing through the sieve is reasonably clear and detergent or dispersing agent is removed, if used.
10. Return all material retained on the $75\ \mu\text{m}$ (No. 200) sieve to the container by rinsing into the washed sample.

Note 3: Excess water may be carefully removed with a bulb syringe; the removed water must be discharged back over the $75\ \mu\text{m}$ (No. 200) sieve to prevent loss of fines.

11. Dry the washed sample to constant mass at $110 \pm 5^{\circ}\text{C}$ ($230 \pm 9^{\circ}\text{F}$) according to the FOP for AASHTO T 255. Cool to room temperature.
12. Determine and record the dry mass after wash.
13. Select sieves required by the specification and those necessary to avoid overloading as described in Annex B. With a pan on bottom, nest the sieves increasing in size starting with the 4.75 mm (No. 4).
14. Place the sample, or a portion of the sample, on the top sieve. Sieves may already be in the mechanical shaker, if not place the sieves in the mechanical shaker and shake for the

minimum time determined to provide complete separation for the sieve shaker being used (approximately 10 minutes, the time determined by Annex A).

Note 4: Excessive shaking (more than 10 minutes) may result in degradation of the sample.

15. Determine and record the individual or cumulative mass retained for each sieve. Ensure that all particles trapped in full openings of the sieve are removed and included in the mass retained.

Note 5: For sieves 4.75 mm (No. 4) and larger, check material trapped in less than a full opening by sieving over a full opening. Use coarse wire brushes to clean the 600 μm (No. 30) and larger sieves, and soft hair bristle for smaller sieves.

16. Determine and record the mass of the minus 4.75 mm (No. 4) material in the pan. Designate this mass as M_1 .
17. Perform the *Coarse Check Sum* calculation – Verify the *total mass after coarse sieving* compared to the *dry mass before sieving* to not more than 0.3 percent. The *dry mass before sieving* is the dry mass after wash or the original dry mass (M) if performing the sieve analysis without washing. Do not use test results for acceptance if the *Check Sum* result is more than 0.3 percent.
18. Reduce the minus 4.75 mm (No. 4) according to the FOP for AASHTO R 76 to produce a sample with a minimum mass of 500 g. Determine and record the mass of the minus 4.75 mm (No. 4) split, designate this mass as M_2 .
19. Select sieves required by the specification and those necessary to avoid overloading as described in Annex B. With a pan on bottom, nest the sieves increasing in size starting with the 75 μm (No. 200) up to, but not including, the 4.75 mm (No. 4) sieve.
20. Place the sample portion on the top sieve and place the sieves in the mechanical shaker. Shake for the minimum time determined to provide complete separation for the sieve shaker being used (approximately 10 minutes, the time determined by Annex A).
21. Determine and record the individual or cumulative mass retained for each sieve and in the pan. Ensure that all particles trapped in full openings of the sieve are removed and included in the mass retained. (See Note 5.)
22. Perform the *Fine Check Sum* calculation – Verify the *total mass after sieving* compared to the *dry mass before sieving* (M_2) is not more than 0.3 percent. Do not use test results for acceptance if the *Check Sum* result is more than 0.3 percent.
23. Calculate to the nearest 0.1 percent, the Individual Mass Retained (IMR) or Cumulative Mass Retained (CMR) of the size increment of the reduced sample and the original sample.
24. Calculate the total percent passing.
25. Report total percent passing to 1 percent except report the 75 μm (No. 200) sieve to 0.1 percent.

Method B Calculations**Check Sum**

$$\text{Coarse Check Sum} = \frac{\text{dry mass before sieving} - \text{total mass after coarse sieving}}{\text{dry mass before sieving}} \times 100$$

$$\text{Fine Check Sum} = \frac{M_2 - \text{total mass after fine sieving}}{M_2} \times 100$$

Percent Retained for 4.75 mm (No. 4) and larger

$$IPR = \frac{IMR}{M} \times 100 \quad \text{or} \quad CPR = \frac{CMR}{M} \times 100$$

Where:

IPR	=	Individual Percent Retained
CPR	=	Cumulative Percent Retained
M	=	Original dry mass of the sample
IMR	=	Individual Mass Retained
CMR	=	Cumulative Mass Retained

Percent Passing (PP) for 4.75 mm (No. 4) and larger

$$PP = PPP - IPR \quad \text{or} \quad PP = 100 - CPR$$

Where:

PP	=	Percent Passing
PPP	=	Previous Percent Passing

Minus 4.75mm (No. 4) adjustment factor (R)

The mass of material retained for each sieve is multiplied by the adjustment factor, the total mass of the minus 4.75 mm (No. 4) from the pan, M_1 , divided by the mass of the reduced split of minus 4.75 mm (No. 4), M_2 . For consistency, this adjustment factor is carried to three decimal places.

$$R = \frac{M_1}{M_2}$$

where:

- R = minus 4.75 mm (No. 4) adjustment factor
- M_1 = total mass of minus 4.75 mm (No. 4) before reducing
- M_2 = mass of the reduced split of minus 4.75 mm (No. 4)

Total Individual Mass Retained (TIMR):

$$TIMR = R \times B$$

where:

- TIMR = Total Individual Mass Retained
- R = minus 4.75 mm (No. 4) adjustment factor
- B = individual mass of the size increment in the reduced portion sieved

Total Cumulative Mass Retained (TCMR)

$$TCMR = (R \times B) + D$$

where:

- TCMR = Total Cumulative Mass Retained
- R = minus 4.75 mm (No. 4) adjustment factor
- B = cumulative mass of the size increment in the reduced portion sieved
- D = cumulative mass of plus 4.75mm (No. 4) portion of sample

Method B Example Individual Mass Retained

Dry mass of total sample, before washing:	3214.0 g
Dry mass of sample after washing:	3085.1 g
Total mass after sieving	
Sum of Individual Masses Retained (IMR) plus the minus 4.75 mm (No. 4) from the pan:	3085.0 g
Amount of 75 µm (No. 200) minus washed out (3214.0 g – 3085.1 g):	128.9 g

Coarse Check Sum

$$\text{Coarse Check Sum} = \frac{3085.1 \text{ g} - 3085.0 \text{ g}}{3085.1 \text{ g}} \times 100 = 0.0\%$$

The result is not more than 0.3 percent therefore the results can be used for acceptance purposes.

Individual Percent Retained (IPR) for 9.5 mm (3/8 in.) sieve

$$\text{IPR} = \frac{481.4 \text{ g}}{3214.0 \text{ g}} \times 100 = 15.0\%$$

Percent Passing (PP) for 9.5 mm (3/8 in.) sieve:

$$\text{PP} = 95.0\% - 15.0\% = 80.0\%$$

Reported Percent Passing = 80%

**Method B Individual
Gradation on Coarse Sieves**

Sieve Size mm (in.)	Individual Mass Retained g (IMR)	Determine IPR by dividing IMR by M and multiplying by 100	Individual Percent Retained (IPR)	Determine PP by subtracting IPR from previous PP	Percent Passing (PP)
16.0 (5/8)	0		0		100
12.5 (1/2)	161.1	$\frac{161.1}{3214.0} \times 100 =$	5.0	$100.0 - 5.0 =$	95.0
9.50 (3/8)	481.4	$\frac{481.4}{3214.0} \times 100 =$	15.0	$95.0 - 15.0 =$	80.0
4.75 (No. 4)	475.8	$\frac{475.8}{3214.0} \times 100 =$	14.8	$80.0 - 14.8 =$	65.2
Minus 4.75 (No. 4) in the pan	1966.7 (M_1)				
Total mass after sieving: sum of sieves + mass in the pan = 3085.0 g					
Original dry mass of the sample (M): 3214.0 g					

Fine Sample

The minus 4.75 mm (No. 4) from the pan, M_1 (1966.7 g), was reduced according to the FOP for AASHTO R 76, to at least 500 g. In this case, the reduced mass was determined to be **512.8 g**. This is M_2 .

The reduced mass was sieved.

Total mass after sieving equals

Sum of Individual Masses Retained (IMR) including
minus 75 μ m (No. 200) in the pan 511.8 g

Fine Check Sum

$$\text{Fine Check Sum} = \frac{512.8 \text{ g} - 511.8 \text{ g}}{512.8 \text{ g}} \times 100 = 0.2\%$$

The result is not more than an 0.3 percent therefore the results can be used for acceptance purposes.

Adjustment Factor (*R*) for Total Individual Mass Retained (TIMR) on minus 4.75 (No. 4) sieves

The mass of material retained for each sieve is multiplied by the adjustment factor (*R*) carried to three decimal places.

$$R = \frac{M_1}{M_2} = \frac{1,966.7 \text{ g}}{512.8 \text{ g}} = 3.835$$

where:

- R = minus 4.75 mm (No. 4) adjustment factor
- M₁ = total mass of minus 4.75 mm (No. 4) from the pan
- M₂ = mass of the reduced split of minus 4.75 mm (No. 4)

Each “individual mass retained” on the fine sieves must be multiplied by *R* to obtain the *Total Individual Mass Retained (TIMR)*.

Total Individual Mass Retained (TIMR) for 2.00 mm (No. 10) sieve

$$\text{TIMR} = 3.835 \times 207.1 \text{ g} = 794.2 \text{ g}$$

Individual Percent Retained (IPR) for 2.00 mm (No. 10) sieve:

$$\text{IPR} = \frac{794.2 \text{ g}}{3214.0 \text{ g}} \times 100 = 24.7\%$$

Percent Passing (PP) 2 mm (No. 10) sieve:

$$PP = 65.2\% - 24.7\% = 40.5\%$$

Reported Percent Passing = 41%

**Method B Individual
Gradation on Fine Sieves**

Sieve Size mm (in.)	Individual Mass Retained g (IMR)	Determine TIMR by multiplying IMR by $R \left(\frac{M_1}{M_2} \right)$	Total Individual Mass Retained (TIMR)
2.00 (No. 10)	207.1	$207.1 \times 3.835 =$	794.2
0.425 (No. 40)	187.9	$187.9 \times 3.835 =$	720.6
0.210 (No. 80)	59.9	$59.9 \times 3.835 =$	229.7
0.075 (No. 200)	49.1	$49.1 \times 3.835 =$	188.3
minus 0.075 (No. 200) in the pan	7.8		
Total mass after sieving: sum of fine sieves + the mass in the pan = 511.8 g			

**Method B Individual
Final Gradation on All Sieves**

Sieve Size mm (in.)	Total Individual Mass Retained g (TIMR)	Determine IPR by dividing TIMR by M and multiplying by 100	Individual Percent Retained (IPR)	Determine PP by subtracting IPR from previous PP	Percent Passing (PP)	Reported Percent Passing*
16.0 (5/8)	0		0		100	100
12.5 (1/2)	161.1	$\frac{161.1}{3214.0} \times 100 =$	5.0	$100.0 - 5.0 =$	95.0	95
9.50 (3/8)	481.4	$\frac{481.4}{3214.0} \times 100 =$	15.0	$95.0 - 15.0 =$	80.0	80
4.75 (No. 4)	475.8	$\frac{475.8}{3214.0} \times 100 =$	14.8	$80.0 - 14.8 =$	65.2	65
2.00 (No. 10)	794.2	$\frac{794.2}{3214.0} \times 100 =$	24.7	$65.2 - 24.7 =$	40.5	41
0.425 (No. 40)	720.6	$\frac{720.6}{3214.0} \times 100 =$	22.4	$40.5 - 22.4 =$	18.1	18
0.210 (No. 80)	229.7	$\frac{229.7}{3214.0} \times 100 =$	7.1	$18.1 - 7.1 =$	11.0	11
0.075 (No. 200)	188.3	$\frac{188.3}{3214.0} \times 100 =$	5.9	$11.0 - 5.9 =$	5.1	5.1
minus 0.075 (No. 200) in the pan	29.9					
Original dry mass of the sample (M): 3214.0 g						

* Report total percent passing to 1 percent except report the 75 μ m (No. 200) sieve to 0.1 percent.

Method B Example Cumulative Mass Retained

Original dry mass of the sample (<i>M</i>):	3214.0 g
Dry mass of sample after washing:	3085.1 g
Total mass after sieving equals	
Cumulative Mass Retained (CMR) on the 4.75 (No. 4) plus the minus 4.75 mm (No. 4) in the pan:	3085.0 g
Amount of 75 μm (No. 200) minus washed out (3214.0 g – 3085.1 g):	128.9 g

Coarse Check Sum

$$\text{Coarse Check Sum} = \frac{3085.1 \text{ g} - 3085.0 \text{ g}}{3085.1 \text{ g}} \times 100 = 0.0\%$$

The result is not more than 0.3 percent therefore the results can be used for acceptance purposes.

Cumulative Percent Retained (CPR) for 9.5 mm (3/8 in.) sieve

$$\text{CPR} = \frac{642.5 \text{ g}}{3214.0 \text{ g}} \times 100 = 20.0\%$$

Percent Passing (PP) for 9.5 mm (3/8 in.) sieve

$$\text{PP} = 100.0\% - 20.0\% = 80.0\%$$

Reported Percent Passing = 80%

**Method B Cumulative
Gradation on Coarse Sieves**

Sieve Size mm (in.)	Cumulative Mass Retained g (CMR)	Determine CPR by dividing CMR by M and multiplying by 100	Cumulative Percent Retained (CPR)	Determine PP by subtracting CPR from 100.0	Percent Passing (PP)
16.0 (5/8)	0		0		100
12.5 (1/2)	161.1	$\frac{161.1}{3214.0} \times 100 =$	5.0	$100.0 - 5.0 =$	95.0
9.50 (3/8)	642.5	$\frac{642.5}{3214.0} \times 100 =$	20.0	$100.0 - 20.0 =$	80.0
4.75 (No. 4)	1118.3 (D)	$\frac{1118.3}{3214.0} \times 100 =$	34.8	$100.0 - 34.8 =$	65.2
Minus 4.75 (No. 4) in the pan	1966.7 (M _I)				
CMR: 1118.3 + 1966.7 = 3085.0					
Original dry mass of the sample (M): 3214.0 g					

Fine Sample

The mass of minus 4.75 mm (No. 4) material in the pan, M_I (1966.7 g), was reduced according to the FOP for AASHTO R 76, to at least 500 g. In this case, the reduced mass was determined to be **512.8 g**. This is M_2 .

The reduced mass was sieved.

Total mass after fine sieving equals

Final Cumulative Mass Retained (FCMR) (includes minus
75 μ m (No. 200) from the pan): 511.8 g

Fine Check Sum

$$\text{Fine Check Sum} = \frac{512.8 \text{ g} - 511.8 \text{ g}}{512.8 \text{ g}} \times 100 = 0.2\%$$

The result is not more than 0.3 percent therefore the results can be used for acceptance purposes.

The cumulative mass of material retained for each sieve is multiplied by the adjustment factor (R) carried to three decimal places to obtain the *Adjusted Cumulative Mass Retained (ACMR)* and added to the cumulative mass retained on the 4.75 mm (No. 4) sieve, D , to obtain the *Total Cumulative Mass Retained (TCMR)*.

Adjustment factor (R) for Adjusted Cumulative Mass Retained (ACMR) in minus 4.75 (No. 4) sieves.

$$R = \frac{M_1}{M_2} = \frac{1,966.7 \text{ g}}{512.8 \text{ g}} = 3.835$$

where:

- R = minus 4.75 mm (No. 4) adjustment factor
- M_1 = total mass of minus 4.75 mm (No. 4) from the pan
- M_2 = mass of the reduced split of minus 4.75 mm (No. 4)

Adjusted Cumulative Mass Retained (ACMR) for the 2.00 mm (No. 10) sieve

$$ACMR = 3.835 \times 207.1 \text{ g} = 794.2 \text{ g}$$

Total Cumulative Mass Retained (TCMR) for the 2.00 mm (No. 10) sieve

$$TCMR = 794.2 \text{ g} + 1118.3 \text{ g} = 1912.5 \text{ g}$$

Cumulative Percent Retained (CPR) for 2.00 mm (No. 10) sieve:

$$CPR = \frac{1912.5 \text{ g}}{3214.0 \text{ g}} \times 100 = 59.5\%$$

Percent Passing (PP) 2.00 mm (No. 10) sieve:

$$PP = 100.0\% - 59.5\% = 40.5\%$$

Reported Percent Passing = 41%

**Method B Cumulative
Gradation on Fine Sieves**

Sieve Size mm (in.)	Cumulative Mass Retained, g (CMR)	Determine TCMR by multiplying CMR by $R \left(\frac{M_1}{M_2} \right)$ and adding D	Total Cumulative Mass Retained (TCMR)
2.00 (No. 10)	207.1	$207.1 \times 3.835 + 1118.3 =$	1912.5
0.425 (No. 40)	395.0	$395.0 \times 3.835 + 1118.3 =$	2633.1
0.210 (No. 80)	454.9	$454.9 \times 3.835 + 1118.3 =$	2862.8
0.075 (No. 200)	504.0	$504.0 \times 3.835 + 1118.3 =$	3051.1
FCMR	511.8		
Total: sum of masses on fine sieves + minus 75 μm (No. 200) in the pan = 511.8			

**Method B Cumulative
Final Gradation on All Sieves**

Sieve Size mm (in.)	Total Cumulative Mass Retained g (TCMR)	Determine CPR by dividing CMR by M and multiplying by 100	Cumulative Percent Retained (CPR)	Determine PP by subtracting CPR from 100.0	Percent Passing (PP)	Reported Percent Passing*
16.0 (5/8)	0		0		100.0	100
12.5 (1/2)	161.1	$\frac{161.1}{3214.0} \times 100 =$	5.0	$100.0 - 5.0 =$	95.0	95
9.5 (3/8)	642.5	$\frac{642.5}{3214.0} \times 100 =$	20.0	$100.0 - 20.0 =$	80.0	80
4.75 (No. 4)	1118.3 (D)	$\frac{1118.3}{3214.0} \times 100 =$	34.8	$100.0 - 34.8 =$	65.2	65
2.00 (No. 10)	1912.5	$\frac{1912.5}{3214.0} \times 100 =$	59.5	$100.0 - 59.5 =$	40.5	41
0.425 (No. 40)	2633.1	$\frac{2633.1}{3214.0} \times 100 =$	81.9	$100.0 - 81.9 =$	18.1	18
0.210 (No. 80)	2862.8	$\frac{2862.8}{3214.0} \times 100 =$	89.1	$100.0 - 89.1 =$	10.9	11
0.075 (No. 200)	3051.1	$\frac{3051.1}{3214.0} \times 100 =$	94.9	$100.0 - 94.9 =$	5.1	5.1
FCMR	3081.1					
Original dry mass of the sample (M): 3214.0 g						

* Report total percent passing to 1 percent except report the 75 µm (No. 200) sieve to 0.1 percent.

Procedure Method C

1. Dry the sample to constant mass at $110 \pm 5^{\circ}\text{C}$ ($230 \pm 9^{\circ}\text{F}$) according to the FOP for AASHTO T 255. Cool to room temperature.
2. Determine and record the original dry mass of the sample to the nearest 0.1 percent or 0.1 g. Designate this mass as M .
3. Break up any aggregations or lumps of clay, silt, or adhering fines to pass the 4.75 mm (No. 4) sieve.
4. Select sieves required by the specification and those necessary to avoid overloading as described in Annex B. With a pan on bottom, nest the sieves increasing in size starting with the 4.75 mm (No. 4) sieve.
5. Place the sample, or a portion of the sample, on the top sieve. Sieves may already be in the mechanical shaker, if not place the sieves in the mechanical shaker and shake for the minimum time determined to provide complete separation for the sieve shaker being used (approximately 10 minutes, the time determined by Annex A).

Note 1: Excessive shaking (more than 10 minutes) may result in degradation of the sample.

6. Determine and record the cumulative mass retained for each sieve. Ensure that all material trapped in full openings of the sieve are removed and included in the mass retained.

Note 2: For sieves 4.75 mm (No. 4) and larger, check material trapped in less than a full opening sieving over a full opening. Use coarse wire brushes to clean the 600 μm (No. 30) and larger sieves, and soft bristle brush for smaller sieves.

7. Determine and record the mass of the minus 4.75 mm (No. 4) material in the pan. Designate this mass as M_1 .
8. Perform the *Coarse Check Sum* calculation –Verify the *total mass after coarse sieving* compared to the *original dry mass (M)* is not more than 0.3 percent.
9. Reduce the minus 4.75 mm (No. 4) according to the FOP for AASHTO R 76, to produce a sample with a minimum mass of 500 g.
10. Determine and record the mass of the minus 4.75 mm (No. 4) split, designate this mass as M_3 .
11. Nest a protective sieve, such as a 2.0 mm (No. 10), above the 75 μm (No. 200) sieve.
12. Place the sample in a container and cover with water.

Note 3: A detergent, dispersing agent, or other wetting solution may be added to the water to assure a thorough separation of the material finer than the 75 μm (No. 200) sieve from the coarser particles. There should be enough wetting agent to produce a small amount of suds when the sample is agitated. Excessive suds may overflow the sieves and carry material away with them.

13. Agitate vigorously to ensure complete separation of the material finer than 75 μm (No. 200) from coarser particles and bring the fine material into suspension above the coarser material. Avoid degradation of the sample when using a mechanical washing device.

Note 4: Washing longer than 10 minutes in a mechanical washer has been shown to cause significant amounts of degradation depending upon aggregate type.

14. Immediately pour the wash water containing the suspended material over the nested sieves; be careful not to pour out the coarser particles or over fill the 75 μm (No. 200) sieve.
 15. Add water to cover material remaining in the container, agitate, and repeat Step 12. Repeat until the wash water is reasonably clear.
 16. Remove the upper sieve and return material retained to the washed sample.
 17. Rinse the material retained on the 75 μm (No. 200) sieve until water passing through the sieve is reasonably clear and detergent or dispersing agent is removed, if used.
 18. Return all material retained on the 75 μm (No. 200) sieve to the container by flushing into the washed sample.
- Note 5:** Excess water may be carefully removed with a bulb syringe; the removed water must be discharged back over the 75 μm (No. 200) sieve to prevent loss of fines.
19. Dry the washed sample portion to constant mass at $110 \pm 5^\circ\text{C}$ ($230 \pm 9^\circ\text{F}$) according to the FOP for AASHTO T 255. Cool to room temperature. Determine and record the dry mass, designate this mass as *dry mass before sieving*.
 20. Select sieves required by the specification and those necessary to avoid overloading as described in Annex B. With a pan on bottom, nest the sieves increasing in size starting with the 75 μm (No. 200) sieve up to, but not including the 4.75 mm (No. 4) sieve.
 21. Place the sample portion on the top sieve. Place the sieves in the mechanical shaker and shake for the minimum time determined to provide complete separation for the sieve shaker being used (approximately 10 minutes, the time determined by Annex A).
- Note 6:** Excessive shaking (more than 10 minutes) may result in degradation of the sample.
22. Determine and record the cumulative mass retained for each sieve. Ensure that all material trapped in full openings of the sieve are removed and included in the mass retained.
- Note 7:** For sieves 4.75 mm (No. 4) and larger, check material trapped in less than a full opening by sieving over a full opening. Use coarse wire brushes to clean the 600 μm (No. 30) and larger sieves, and soft bristle brushes for smaller sieves.
23. Perform the *Fine Check Sum* calculation – Verify the *total mass after fine sieving* compared to the *dry mass before sieving* is not more than 0.3 percent. Do not use test results for acceptance if the *Check Sum* is more than 0.3 percent.
 24. Calculate the Cumulative Percent Retained (CPR) and Percent Passing (PP) for the 4.75 mm (No. 4) and larger.
 25. Calculate the Cumulative Percent Retained (CPR-#4) and the Percent Passing (PP-#4) for minus 4.75 mm (No. 4) split and Percent Passing (PP) for the minus 4.75 mm (No. 4).
 26. Report total percent passing to 1 percent except report the 75 μm (No. 200) sieve to 0.1 percent.

Method C Calculations

Check Sum

$$\text{Coarse check sum} = \frac{M - \text{total mass after coarse sieving}}{M} \times 100$$

$$\text{Fine check sum} = \frac{\text{dry mass before sieving} - \text{total mass after fine sieving}}{\text{dry mass before sieving}} \times 100$$

where:

M = Original dry mass of the sample

Cumulative Percent Retained (CPR) for 4.75 mm (No. 4) sieve and larger

$$CPR = \frac{CMR}{M} \times 100$$

where:

CPR = Cumulative Percent Retained of the size increment for the total sample

CMR = Cumulative Mass Retained of the size increment for the total sample

M = Total dry sample mass before washing

Percent Passing (PP) 4.75 mm (No. 4) sieve and larger

$$PP = 100 - CPR$$

where:

PP = Percent Passing of the size increment for the total sample

CPR = Cumulative Percent Retained of the size increment for the total sample

Or calculate PP for sieves larger than 4.75 mm (No. 4) sieve without calculating CPR

$$\frac{M - CMR}{M} \times 100$$

Cumulative Percent Retained (CPR_{#4}) for minus 4.75 mm (No. 4) split

$$CPR_{\#4} = \frac{CMR_{\#4}}{M_3} \times 100$$

where:

- CPR_{#4} = Cumulative Percent Retained for the sieve sizes of M₃
 CMR_{#4} = Cumulative Mass Retained for the sieve sizes of M₃
 M₃ = Total mass of the minus 4.75 mm (No. 4) split before washing

Percent Passing (PP_{#4}) for minus 4.75 mm (No. 4) split

$$PP_{\#4} = 100 - CPR_{\#4}$$

where:

- PP_{#4} = Percent Passing for the sieve sizes of M₃
 CPR_{#4} = Cumulative Percent Retained for the sieve sizes of M₃

Percent Passing (PP) for sieves smaller than 4.75 mm (No. 4) sieve

$$PP = \frac{(PP_{\#4} \times \#4 PP)}{100}$$

where:

- PP = Total Percent Passing
 PP_{#4} = Percent Passing for the sieve sizes of M₃
 #4 PP = Total Percent Passing the 4.75 mm (No. 4) sieve

Or calculate PP for sieves smaller than 4.75 mm (No. 4) sieve without calculating CPR_{#4} and PP_{#4}

$$PP = \frac{\#4 PP}{M_3} \times (M_3 - CMR_{\#4})$$

where:

- PP = Total Percent Passing
- #4 PP = Total Percent Passing the 4.75 mm (No. 4) sieve
- M₃ = Total mass of the minus 4.75 mm (No. 4) split before washing
- CMR_{#4} = Cumulative Mass Retained for the sieve sizes of M₃

Method C Example

Original dry mass of the sample (*M*): 3304.5 g

Total mass after sieving equals

Cumulative Mass Retained (CMR) on the 4.75 (No. 4) plus the minus 4.75 mm (No. 4) from the pan: 3085.0 g

Coarse Check Sum

$$Coarse Check Sum = \frac{3304.5 g - 3304.5 g}{3304.5 g} \times 100 = 0.0\%$$

The result is not more than 0.3 percent therefore the results can be used for acceptance purposes.

Cumulative Percent Retained (CPR) for the 9.5 mm (3/8 in.) sieve:

$$CPR = \frac{604.1 g}{3304.5 g} \times 100 = 18.3\%$$

Percent Passing (PP) for the 9.5 mm (3/8 in.) sieve:

$$PP = 100.0\% - 18.3\% = 81.7\%$$

Reported Percent Passing = 82%

Example for Alternate Percent Passing (PP) formula for the 9.5 mm (3/8 in.) sieve:

$$PP = \frac{3304.5 - 604.1}{3304.5} \times 100 = 81.7\%$$

Reported Percent Passing = 82%

**Method C Cumulative
Gradation on Coarse Sieves**

Sieve Size mm (in.)	Cumulative Mass Retained, g (CMR)	Determine CPR by dividing CMR by M and multiplying by 100	Cumulative Percent Retained (CPR)	Determine PP by subtracting CPR from 100.0	Percent Passing (PP)	Reported Percent Passing*
16.0 (5/8)	0		0.0		100.0	100
12.5 (1/2)	125.9	$\frac{125.9}{3304.5} \times 100 =$	3.8	$100.0 - 3.8 =$	96.2	96
9.50 (3/8)	604.1	$\frac{604.1}{3304.5} \times 100 =$	18.3	$100.0 - 18.3 =$	81.7	82
4.75 (No. 4)	1295.6	$\frac{1295.6}{3304.5} \times 100 =$	39.2	$100.0 - 39.2 =$	60.8 (#4 PP)	61
Mass in pan	2008.9					
CMR: 1295.6 + 2008.9 = 3304.5						
Original dry mass of the sample (M): 3304.5						

Fine Sample

The pan (2008.9 g) was reduced according to the FOP for AASHTO R 76, to at least 500 g. In this case, the reduced mass was determined to be **527.6 g**. This is M_3 .

Dry mass of minus 4.75mm (No. 4) reduced portion before wash (M_3): 527.6 g

Dry mass of minus 4.75mm (No. 4) reduced portion after wash: 495.3 g

Total mass after fine sieving equals

Final Cumulative Mass Retained (FCMR)
(includes minus 75 μm (No. 200) from the pan): 495.1 g

Fine Check Sum

$$\text{Fine Check Sum} = \frac{495.3 \text{ g} - 495.1 \text{ g}}{495.3 \text{ g}} \times 100 = 0.0\%$$

The result is not more than 0.3 percent therefore the results can be used for acceptance purposes.

Cumulative Percent Retained (CPR_{#4}) for minus 4.75 mm (No. 4) for the 2.0 mm (No. 10) sieve:

$$CPR_{\#4} = \frac{194.3 \text{ g}}{527.6 \text{ g}} \times 100 = 36.8\%$$

Percent Passing (PP_{#4}) for minus 4.75 mm (No. 4) for the 2.0 mm (No. 10) sieve:

$$PP_{\#4} = 100.0\% - 36.8\% = 63.2\%$$

**Method C Cumulative
Gradation on Fine Sieves**

Sieve Size mm (in.)	Cumulative Mass Retained g (CMR _{#4})	Determine CPR _{#4} by dividing CMR by M ₃ and multiplying by 100	Cumulative Percent Retained _{#4} (CPR _{#4})	Determine PP _{#4} by subtracting CPR _{#4} from 100.0	Percent Passing _{#4} (PP _{#4})
2.0 (No. 10)	194.3	$\frac{194.3}{527.6} \times 100 =$	36.8	$100.0 - 36.8 =$	63.2
0.425 (No. 40)	365.6	$\frac{365.6}{527.6} \times 100 =$	69.3	$100.0 - 69.3 =$	30.7
0.210 (No. 80)	430.8	$\frac{430.8}{527.6} \times 100 =$	81.7	$100.0 - 81.7 =$	18.3
0.075 (No. 200)	484.4	$\frac{484.4}{527.6} \times 100 =$	91.8	$100.0 - 91.8 =$	8.2
FCMR	495.1				
Dry mass of minus 4.75mm (No. 4) reduced portion before wash (M ₃): 527.6 g					
Dry mass after washing: 495.3 g					

Percent Passing (PP) for the 2.0 mm (No. 10) sieve for the entire sample:

#4 PP (Total Percent Passing the 4.75 mm (No. 4) sieve) = 60.8%

$$PP = \frac{63.2\% \times 60.8\%}{100} = 38.4\%$$

Reported Percent Passing = 38%

**Method C Cumulative
Final Gradation on All Sieves**

Sieve Size mm (in.)	Cumulative Mass Retained g (CMR)	Cumulative Percent Retained (CPR)	Percent Passing (PP -#4)	Determine PP by multiplying PP-#4 by #4 PP and dividing by 100	Percent Passing (PP)	Reported Percent Passing*
16.0 (5/8)	0	0.0			100.0	100
12.5 (1/2)	125.9	3.8			96.2	96
9.5 (3/8)	604.1	18.3			81.7	82
4.75 (No. 4)	1295.6	39.2			60.8 (#4 PP)	61
2.0 (No. 10)	194.3	36.8	63.2	$\frac{63.2 \times 60.8}{100} =$	38.4	38
0.425 (No. 40)	365.6	69.3	30.7	$\frac{30.7 \times 60.8}{100} =$	18.7	19
0.210 (No. 80)	430.8	81.7	18.3	$\frac{18.3 \times 60.8}{100} =$	11.1	11
0.075 (No. 200)	484.4	91.8	8.2	$\frac{8.2 \times 60.8}{100} =$	5.0	5.0
FCMR	495.1					

* Report total percent passing to 1 percent except report the 75 µm (No. 200) sieve to 0.1 percent.

Example for Alternate Percent Passing (PP) for the 4.75 mm (No. 4) sieve for the entire sample:

#4 PP (Total Percent Passing the 4.75 mm (No. 4) sieve) = 60.8%

$$PP = \frac{60.8\%}{527.6} \times (527.6 - 194.3) = 38.4\%$$

Reported Percent Passing = 38%

**Alternate Method C Cumulative
Gradation on Coarse Sieves**

Sieve Size mm (in.)	Cumulative Mass Retained, g (CMR)	Determine PP by subtracting CMR from M, and dividing the result by M then multiplying by 100	Percent Passing (PP)	Reported Percent Passing*
16.0 (5/8)	0.0		100.0	100
12.5 (1/2)	125.9	$\frac{3304.5 - 125.9}{3304.5} \times 100 =$	96.2	96
9.5 (3/8)	604.1	$\frac{3304.5 - 604.1}{3304.5} \times 100 =$	81.7	82
4.75 (No. 4)	1295.6	$\frac{3304.5 - 1295.6}{3304.5} \times 100 =$	60.8 (#4 PP)	61
Mass in Pan	2008.9			
Cumulative sieved mass: $1295.6 + 2008.9 = 3304.5$				
Original dry mass of the sample (M): 3304.5				

**Alternate Method C Cumulative
Gradation on Fine Sieves**

Sieve Size mm (in.)	Cumulative Mass Retained g (CMR _{#4})	Determine PP _{#4} by subtracting CMR _{#4} from M ₃ , dividing result by M ₃ and multiplying by 100	Percent Passing _{#4} (PP _{#4})
2.0 (No. 10)	194.3	$\frac{527.6 - 194.3}{527.6} \times 100 =$	63.2
0.425 (No. 40)	365.6	$\frac{527.6 - 365.6}{527.6} \times 100 =$	30.7
0.210 (No. 80)	430.8	$\frac{527.6 - 430.8}{527.6} \times 100 =$	18.3
0.075 (No. 200)	484.4	$\frac{527.6 - 484.4}{527.6} \times 100 =$	8.2
FCMR	495.1		
Dry mass of minus 4.75mm (No. 4) reduced portion before wash (M ₃): 527.6 g			
Dry mass after washing: 495.3 g			

**Alternate Method C Cumulative
Final Gradation on All Sieves**

Sieve Size mm (in.)	Percent Passing _{#4} (PP _{#4})	Determine PP by multiplying PP _{#4} by #4 PP and dividing by 100	Determined Percent Passing (PP)	Reported Percent Passing*
16.0 (5/8)			100.0	100
12.5 (1/2)			96.2	96
9.5 (3/8)			81.7	82
4.75 (No. 4)			60.8 (#4 PP)	61
2.0 (No. 10)	63.2	$\frac{63.2 \times 60.8}{100} =$	38.4	38
0.425 (No. 40)	30.7	$\frac{30.7 \times 60.8}{100} =$	18.7	19
0.210 (No. 80)	18.3	$\frac{18.3 \times 60.8}{100} =$	11.1	11
0.075 (No. 200)	8.2	$\frac{8.2 \times 60.8}{100} =$	5.0	5.0

* Report total percent passing to 1 percent except report the 75 µm (No. 200) sieve to 0.1 percent.

FINENESS MODULUS

Fineness Modulus (FM) is used in determining the degree of uniformity of the aggregate gradation in PCC mix designs. It is an empirical number relating to the fineness of the aggregate. The higher the FM the coarser the aggregate. Values of 2.40 to 3.00 are common for fine aggregate in PCC.

The sum of the cumulative percentages retained on specified sieves in the following table divided by 100 gives the FM.

Sample Calculation

	Example A				Example B		
	Percent				Percent		
		Retained				Retained	
Sieve Size mm (in)	Passing		On Spec'd Sieves*		Passing		On Spec'd Sieves*
75*(3)	100	0	0		100	0	0
37.5*(11/2)	100	0	0		100	0	0
19*(3/4)	15	85	85		100	0	0
9.5*(3/8)	0	100	100		100	0	0
4.75*(No.4)	0	100	100		100	0	0
2.36*(No.8)	0	100	100		87	13	13
1.18*(No.16)	0	100	100		69	31	31
0.60*(No.30)	0	100	100		44	56	56
0.30*(No.50)	0	100	100		18	82	82
0.15*(100)	0	100	100		4	96	96
			$\Sigma = 785$				$\Sigma = 278$
			FM = 7.85				FM = 2.78

In decreasing size order, each * sieve is one-half the size of the preceding * sieve.

Report

- On forms approved by the agency
- Sample ID
- Percent passing for each sieve
- Individual mass retained for each sieve
- Individual percent retained for each sieve
- or
- Cumulative mass retained for each sieve
- Cumulative percent retained for each sieve
- FM to the nearest 0.01

Report percentages to the nearest 1 percent except for the percent passing the 75 μm (No. 200) sieve, which shall be reported to the nearest 0.1 percent.

ANNEX A**Time Evaluation**

(Mandatory information)

The sieving time for each mechanical sieve shaker shall be checked at least annually to determine the time required for complete separation of the sample by the following method:

1. Shake the sample over nested sieves for approximately 10 minutes.
2. Provide a snug-fitting pan and cover for each sieve and hold in a slightly inclined position in one hand.
3. Hand shake each sieve by striking the side of the sieve sharply and with an upward motion against the heel of the other hand at the rate of about 150 times per minute, turning the sieve about one sixth of a revolution at intervals of about 25 strokes.

Note A1: A mallet may be used instead of the heel of the hand if comparable force is used.

If more than 0.5 percent by mass of the total sample before sieving passes any sieve after one minute of continuous hand shaking adjust shaker time and re-check.

In determining sieving time for sieve sizes larger than 4.75 mm (No. 4), limit the material on the sieve to a single layer of particles.

ANNEX B**Overload Determination**

(Mandatory information)

Additional sieves may be necessary to keep from overloading sieves or to provide other information, such as fineness modulus. The sample may also be sieved in increments to prevent overloading.

- For sieves with openings smaller than 4.75 mm (No. 4), the mass retained on any sieve shall not exceed 7 kg/m² (4 g/in²) of sieving surface.
- For sieves with openings 4.75 mm (No. 4) and larger, the mass, in grams shall not exceed the product of 2.5 × (sieve opening in mm) × (effective sieving area). See Table B1.

TABLE B1

Maximum Allowable Mass of Material Retained on a Sieve, g
Nominal Sieve Size, mm (in.)
Exact size is smaller (see AASHTO T 27)

Sieve Size		203 dia	305 dia	305 by 305	350 by 350	372 by 580
mm (in.)		(8)	(12)	(12 × 12)	(14 × 14)	(16 × 24)
		Sieving Area m ²				
		0.0285	0.0670	0.0929	0.1225	0.2158
90	(3 1/2)	*	15,100	20,900	27,600	48,500
75	(3)	*	12,600	17,400	23,000	40,500
63	(2 1/2)	*	10,600	14,600	19,300	34,000
50	(2)	3600	8400	11,600	15,300	27,000
37.5	(1 1/2)	2700	6300	8700	11,500	20,200
25.0	(1)	1800	4200	5800	7700	13,500
19.0	(3/4)	1400	3200	4400	5800	10,200
16.0	(5/8)	1100	2700	3700	4900	8600
12.5	(1/2)	890	2100	2900	3800	6700
9.5	(3/8)	670	1600	2200	2900	5100
6.3	(1/4)	440	1100	1500	1900	3400
4.75	(No. 4)	330	800	1100	1500	2600
-4.75	(-No. 4)	200	470	650	860	1510

MECHANICAL ANALYSIS OF EXTRACTED AGGREGATE FOP FOR AASHTO T 30

Scope

This procedure covers mechanical analysis of aggregate recovered from asphalt mix samples in accordance with AASHTO T 30-21. This FOP uses the aggregate recovered from the ignition furnace used in AASHTO T 308. AASHTO T 30 was developed for analysis of extracted aggregate and thus includes references to extracted bitumen and filter element, which do not apply in this FOP.

Sieve analyses determine the gradation or distribution of aggregate particles within a given sample to determine compliance with design and production standards.

Apparatus

- Balance or scale: Capacity sufficient for the sample mass, accurate to 0.1 percent of the sample mass or readable to 0.1 g and conforming to AASHTO M 231.
- Sieves, meeting the requirements of FOP for AASHTO T 27/T 11.
- Mechanical sieve shaker, meeting the requirements of FOP for AASHTO T 27/T 11.
- Mechanical Washing Apparatus (optional).
- Suitable drying equipment, meeting the requirements of the FOP for AASHTO T 255.
- Containers and utensils: A pan or vessel of a size sufficient to contain the sample covered with water and to permit vigorous agitation without loss of any part of the sample or water.
- Wetting Agent: Any dispersing agent, such as dishwashing detergent, that will promote separation of the fine materials.

Sample Sieving

- In this procedure, it is required to shake the sample over nested sieves. Sieves are selected to furnish information required by specification. Intermediate sieves are added for additional information or to avoid overloading sieves, or both.
- The sieves are nested in order of increasing size from the bottom to the top, and the test sample, or a portion of the test sample, is placed on the top sieve.
- The loaded sieves are shaken in a mechanical shaker for approximately 10 minutes, refer to Annex A; *Time Evaluation*.

Mass Verification

The aggregate sample mass, $M_{(T30)}$, determined in this method, shall agree with the mass of the aggregate remaining after ignition, M_f from the FOP for AASTHO T 308, within 0.10 percent. If the variation exceeds 0.10 percent, the results cannot be used for acceptance.

Procedure

1. Determine and record the mass of the sample that was removed from the basket in the FOP for AASHTO T 308 to 0.1 g. Designate this mass as $M_{(T30)}$.
 2. Verify the mass of the sample is within 0.10 percent by subtracting $M_{(T30)}$ from $M_{(T308)}$ dividing by $M_{(T308)}$ and multiply by 100 (see *Mass Verification Calculation* and example).

If the variation exceeds 0.10 percent, the sieve analysis results cannot be used for acceptance.
 3. Nest a sieve, such as a 2.0 mm (No. 10) or 1.18 mm (No. 16), above the 75 μ m (No. 200) sieve.
 4. Place the test sample in a container and cover with water. Add a wetting agent to the water to assure a thorough separation of the material finer than the 75 μ m (No. 200) sieve from the coarser particles. There should be enough wetting agent to produce a small amount of suds when the sample is agitated. Excessive suds may overflow the sieves and carry material away with them.
 5. Agitate vigorously to ensure complete separation of the material finer than 75 μ m (No. 200) from coarser particles and bring the fine material into suspension above the coarser material. Avoid degradation of the sample when using a mechanical washing device. Maximum agitation is 10 min.
- Note 1:* When mechanical washing equipment is used, the introduction of water, agitating, and decanting may be a continuous operation. Use care not to overflow or overload the 75 μ m (No. 200) sieve.
6. Immediately pour the wash water containing the suspended material over the nested sieves; be careful not to pour out the coarser particles or over fill the 75 μ m (No. 200) sieve.
 7. Add water to cover material remaining in the container, agitate, and repeat Step 6. Continue until the wash water is reasonably clear.
 8. Remove the upper sieve, return material retained to the washed sample.
 9. Rinse the material retained on the 75 μ m (No. 200) sieve until water passing through the sieve is reasonably clear and wetting agent is removed.
 10. Return all material retained on the 75 μ m (No. 200) sieve to the washed sample by rinsing into the washed sample.
 11. Dry the washed test sample to constant mass according to the FOP for AASHTO T 255. Cool to room temperature. Determine and record the “dry mass after washing.”
 12. Select sieves required by the specification and those necessary to avoid overloading. (See Annex B.) With a pan on bottom, nest the sieves increasing in size starting with the 75 μ m (No. 200).
 13. Place the test sample, or a portion of the test sample, on the top sieve. Place sieves in mechanical shaker and shake for the minimum time determined to provide complete separation for the sieve shaker being used (approximately 10 minutes, the time determined by Annex A).

Note 2: Excessive shaking (more than 10 minutes) may result in degradation of the sample.

14. Determine and record the individual or cumulative mass retained for each sieve including the pan. Ensure that all material trapped in full openings of the sieves are removed and included in the mass retained.

Note 3: For sieves 4.75 mm (No. 4) and larger, check material trapped in less than a full opening by sieving over a full opening. Use coarse wire brushes to clean the 600 µm (No. 30) and larger sieves, and soft bristle brushes for smaller sieves.

15. Perform the *Check Sum* calculation – Verify the *total mass after sieving* of material compared to the *dry mass after washing* is not more than 0.2 percent. Do not use test results for acceptance if the *Check Sum* result is more than 0.2 percent.

16. Calculate the total percentages passing, and the individual or cumulative percentages retained, to the nearest 0.1 percent by dividing the individual sieve masses or cumulative sieve masses by the total mass of the initial dry sample.

17. Apply the Aggregate Correction Factor (ACF) to the calculated percent passing, as required in the FOP for AASHTO T 308 “Correction Factor,” to obtain the reported percent passing.

18. Report total percent passing to 1 percent except report the 75 µm (No. 200) sieve to 0.1 percent.

Calculations

Mass verification

$$\text{Mass verification} = \frac{M_{f(T308)} - M_{(T30)}}{M_{f(T308)}} \times 100$$

Where:

$M_{f(T308)}$ = Mass of aggregate remaining after ignition from the FOP for AASHTO T 308

$M_{(T30)}$ = Mass of aggregate sample obtained from the FOP for AASHTO T 308

Check Sum

$$\text{check sum} = \frac{\text{dry mass after washing} - \text{total mass after sieving}}{\text{dry mass after washing}} \times 100$$

Percent Retained**Individual**

$$IPR = \frac{IMR}{M_{T30}} \times 100$$

Cumulative

$$CPR = \frac{CMR}{M_{T30}} \times 100$$

Where:

IPR	=	Individual Percent Retained
CPR	=	Cumulative Percent Retained
M_{T30}	=	Total dry sample mass before washing
IMR	=	Individual Mass Retained
CMR	=	Cumulative Mass Retained

Percent Passing**Individual**

$$PP = PCP - IPR$$

Cumulative

$$PP = 100 - CPR$$

Where:

PP	=	Calculated Percent Passing
PCP	=	Previous Calculated Percent Passing

Reported Percent Passing

$$RPP = PP + ACF$$

Where:

RPP = Reported Percent Passing

ACF = Aggregate Correction Factor (if applicable)

Example

Mass verification

$$Mass\ verification = \frac{2422.5\ g - 2422.3\ g}{2422.5\ g} \times 100 = 0.01\%$$

Given:

$$M_{R(T308)} = 2422.5\ g$$

$$M_{(T30)} = 2422.3\ g$$

Dry mass of total sample, before washing (M_{T30}):	2422.3 g
Dry mass of sample, after washing out the 75 μ m (No. 200) minus:	2296.2 g
Amount of 75 μ m (No. 200) minus washed out ($2422.3\ g - 2296.2\ g$):	126.1 g

Check sum

$$check\ sum = \frac{2296.2\ g - 2295.3\ g}{2296.2\ g} \times 100 = 0.0\%$$

This is not more than 0.2 percent therefore the results can be used for acceptance purposes.

Percent Retained for the 75 µm (No. 200) sieve

$$IPR = \frac{63.5 \text{ g}}{2422.3 \text{ g}} \times 100 = 2.6\%$$

or

$$CPR = \frac{2289.6 \text{ g}}{2422.3 \text{ g}} \times 100 = 94.5\%$$

Percent Passing using IPR and PCP for the 75 µm (No. 200) sieve

$$PP = 8.1\% - 2.6\% = 5.5\%$$

Percent Passing using CPR for the 75 µm (No. 200) sieve

$$PP = 100.0\% - 94.5\% = 5.5\%$$

Reported Percent Passing

$$RPP = 5.5\% + (-0.6\%) = 4.9\%$$

**Individual
Gradation on All Sieves**

Sieve Size mm (in.)	Individual Mass Retained g (IMR)	Determine IPR by dividing IMR by <i>M</i> and multiplying by 100	Individual Percent Retained (IPR)	Determine PP by subtracting IPR from Previous PP	Percent Passing (PP)	Agg. Corr. Factor from T 308 (ACF)	Reported Percent Passing*
19.0 (3/4)	0		0		100.0		100
12.5 (1/2)	346.9	$\frac{346.9}{2422.3} \times 100 =$	14.3	$100.0 - 14.3 =$	85.7		86
9.5 (3/8)	207.8	$\frac{207.8}{2422.3} \times 100 =$	8.6	$85.7 - 8.6 =$	77.1		77
4.75 (No. 4)	625.4	$\frac{625.4}{2422.3} \times 100 =$	25.8	$77.1 - 25.8 =$	51.3		51
2.36 (No. 8)	416.2	$\frac{416.2}{2422.3} \times 100 =$	17.2	$51.3 - 17.2 =$	34.1		34
1.18 (No. 16)	274.2	$\frac{274.2}{2422.3} \times 100 =$	11.3	$34.1 - 11.3 =$	22.8		23
0.600 (No. 30)	152.1	$\frac{152.1}{2422.3} \times 100 =$	6.3	$22.8 - 6.3 =$	16.5		17
0.300 (No. 50)	107.1	$\frac{107.1}{2422.3} \times 100 =$	4.4	$16.5 - 4.4 =$	12.1		12
0.150 (No. 100)	96.4	$\frac{96.4}{2422.3} \times 100 =$	4.0	$12.1 - 4.0 =$	8.1		8
0.075 (No. 200)	63.5	$\frac{63.5}{2422.3} \times 100 =$	2.6	$8.1 - 2.6 =$	5.5	-0.6 (5.5 - 0.6 =)	4.9
minus 75 µm (No. 200) in the pan	5.7						
Total mass after sieving = sum of sieves + mass in the pan = 2295.3 g							
Dry mass of total sample, before washing (M _{T30}): 2422.3g							

* Report total percent passing to 1 percent except report the 75 µm (No. 200) sieve to 0.1 percent.

**Cumulative
Gradation on All Sieves**

Sieve Size mm (in.)	Cumulative Mass Retained g (CMR)	Determine CPR by dividing CMR by M and multiplying by 100	Cumulative Percent Retained (CPR)	Determine PP by subtracting CPR from 100.0	Percent Passing (PP)	Agg. Corr. Factor from T 308 (ACF)	Reported Percent Passing*
19.0 (3/4)	0		0.0		100.0		100
12.5 (1/2)	346.9	$\frac{346.9}{2422.3} \times 100 =$	14.3	$100.0 - 14.3 =$	85.7		86
9.5 (3/8)	554.7	$\frac{554.7}{2422.3} \times 100 =$	22.9	$100.0 - 22.9 =$	77.1		77
4.75 (No. 4)	1180.1	$\frac{1180.1}{2422.3} \times 100 =$	48.7	$100.0 - 48.7 =$	51.3		51
2.36 (No. 8)	1596.3	$\frac{1596.3}{2422.3} \times 100 =$	65.9	$100.0 - 65.9 =$	34.1		34
1.18 (No. 16)	1870.5	$\frac{1870.5}{2422.3} \times 100 =$	77.2	$100.0 - 77.2 =$	22.8		23
0.600 (No. 30)	2022.6	$\frac{2022.6}{2422.3} \times 100 =$	83.5	$100.0 - 83.5 =$	16.5		17
0.300 (No. 50)	2129.7	$\frac{2129.7}{2422.3} \times 100 =$	87.9	$100.0 - 87.9 =$	12.1		12
0.150 (No. 100)	2226.1	$\frac{2226.1}{2422.3} \times 100 =$	91.9	$100.0 - 91.9 =$	8.1		8
0.075 (No. 200)	2289.6	$\frac{2289.6}{2422.3} \times 100 =$	94.5	$100.0 - 94.5 =$	5.5	-0.6 (5.5 - 0.6 =)	4.9
minus 75 µm (No. 200) in the pan	2295.3						
Total mass after sieving = 2295.3 g							
Dry mass of total sample, before washing (M _{T30}): 2422.3g							

* Report total percent passing to 1 percent except report the 75 µm (No. 200) sieve to 0.1 percent.

Report

- On forms approved by the agency
- Sample ID
- Depending on the agency, this may include:
 - Individual mass retained on each sieve
 - Individual percent retained on each sieve
 - Cumulative mass retained on each sieve
 - Cumulative percent retained on each sieve
 - Aggregate Correction Factor for each sieve from AASHTO T 308
 - Calculated percent passing each sieve to 0.1 percent
- Percent passing to the nearest 1 percent, except 75 μm (No. 200) sieve to the nearest 0.1 percent.

ANNEX A TIME EVALUATION

(Mandatory Information)

The minimum time requirement should be evaluated for each shaker at least annually by the following method:

1. Shake the sample over nested sieves for approximately 10 minutes.
2. Provide a snug-fitting pan and cover for each sieve and hold in a slightly inclined position in one hand.
3. Hand-shake each sieve by striking the side of the sieve sharply and with an upward motion against the heel of the other hand at the rate of about 150 times per minute, turning the sieve about one sixth of a revolution at intervals of about 25 strokes.

If more than 0.5 percent by mass of the total sample before sieving passes any sieve after one minute of continuous hand sieving adjust shaker time and re-check.

In determining sieving time for sieve sizes larger than 4.75 mm (No. 4), limit the material on the sieve to a single layer of particles.

ANNEX B OVERLOAD DETERMINATION

(Mandatory Information)

- For sieves with openings smaller than 4.75 mm (No. 4), the mass retained on any sieve shall not exceed 7 kg/m² (4 g/in²) of sieving surface.
- For sieves with openings 4.75 mm (No. 4) and larger, the mass (in kg) shall not exceed the product of 2.5 x (sieve opening in mm) x (effective sieving area). See Table B1.

Additional sieves may be necessary to keep from overloading the specified sieves. The sample may also be sieved in increments or sieves with a larger surface area.

TABLE B1
Maximum Allowable Mass of Material Retained on a Sieve, g
Nominal Sieve Size, mm (in.)
Exact size is smaller (see AASHTO T 27)

Sieve Size		203 mm	254 mm	305 mm
mm (in.)		(8 in.)	(10 in.)	(12 in.)
		dia.	dia.	dia.
		Sieving Area m ² (in ²)		
		0.0285	0.0457	0.0670
		(44.2)	(70.8)	(103.5)
50	(2)	3600	5700	8400
37.5	(1 1/2)	2700	4300	6300
25.0	(1)	1800	2900	4200
19.0	(3/4)	1400	2200	3200
16.0	(5/8)	1100	1800	2700
12.5	(1/2)	890	1400	2100
9.5	(3/8)	670	1100	1600
6.3	(1/4)	440	720	1100
4.75	(No. 4)	330	540	800
-4.75	(-No. 4)	200	320	470

Specific Gravity and Absorption of Fine Aggregate

AASHTO Designation: T 84-22

ASTM Designation: C 128-12

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SPECIFIC GRAVITY AND ABSORPTION OF COARSE AGGREGATE FOP FOR AASHTO T 85

Scope

This procedure covers the determination of specific gravity and absorption of coarse aggregate in accordance with AASHTO T 85-22. Specific gravity may be expressed as bulk specific gravity (G_{sb}), bulk specific gravity, saturated surface dry (G_{sb} SSD), or apparent specific gravity (G_{sa}). G_{sb} and absorption are based on aggregate after soaking in water. This procedure is not intended to be used with lightweight aggregates.

Terminology

Absorption – the increase in the mass of aggregate due to water being absorbed into the pores of the material, but not including water adhering to the outside surface of the particles, expressed as a percentage of the dry mass. The aggregate is considered “dry” when it has been maintained at a temperature of $110 \pm 5^{\circ}\text{C}$ ($230 \pm 9^{\circ}\text{F}$) for sufficient time to remove all uncombined water.

Saturated Surface Dry (SSD) – condition of an aggregate particle when the permeable voids are filled with water, but no water is present on exposed surfaces.

Specific Gravity – the ratio of the mass, in air, of a volume of a material to the mass of the same volume of gas-free distilled water at a stated temperature.

Apparent Specific Gravity (G_{sa})– the ratio of the mass, in air, of a volume of the impermeable portion of aggregate to the mass of an equal volume of gas-free distilled water at a stated temperature.

Bulk Specific Gravity (G_{sb})– the ratio of the mass, in air, of a volume of aggregate (including the permeable and impermeable voids in the particles, but not including the voids between particles) to the mass of an equal volume of gas-free distilled water at a stated temperature.

Bulk Specific Gravity (SSD) (G_{sb} SSD) – the ratio of the mass, in air, of a volume of aggregate, including the mass of water within the voids filled to the extent achieved by submerging in water for 15 to 19 hours (but not including the voids between particles), to the mass of an equal volume of gas-free distilled water at a stated temperature.

Apparatus

- Balance or scale: with a capacity of 5 kg, sensitive to 0.1 g. Meeting the requirements of AASHTO M 231.
- Sample container: a wire basket of 3.35 mm (No. 6) or smaller mesh, with a capacity of 4 to 7 L (1 to 2 gal) to contain aggregate with a nominal maximum size of 37.5 mm (1 1/2 in.) or smaller; or a larger basket for larger aggregates, or both.
- Water tank: watertight and large enough to completely immerse aggregate and basket, equipped with an overflow valve to keep water level constant.

- Suspension apparatus: wire used to suspend apparatus shall be of the smallest practical diameter.
- Sieves: 4.75 mm (No. 4) or other sizes as needed, meeting the requirements of FOP for AASHTO T 27/T 11.
- Large absorbent towel

Sample Preparation

1. Obtain the sample in accordance with the FOP for AASHTO R 90 (see Note 1).
2. Mix the sample thoroughly and reduce it to the approximate sample size required by Table 1 in accordance with the FOP for AASHTO R 76.
3. Reject all material passing the appropriate sieve by dry sieving.
4. Thoroughly wash sample to remove dust or other coatings from the surface.
5. Dry the test sample to constant mass according to the FOP for AASHTO T 255/T 265 at a temperature of 110 ±5°C (230 ±9°F) and cool in air at room temperature for 1 to 3 hours.

Note 1: Where the absorption and specific gravity values are to be used in proportioning concrete mixtures in which the aggregates will be in their naturally moist condition, the requirement for initial drying to constant mass may be eliminated, and, if the surfaces of the particles in the sample have been kept continuously wet until test, the 15-to-19-hour soaking may also be eliminated.

6. Re-screen the sample over the appropriate sieve. Reject all material passing that sieve.
7. The sample shall meet or exceed the minimum mass given in Table 1.

Note 2: If this procedure is used only to determine the G_{sb} of oversized material for the FOP for AASHTO T 99 / T 180, the material can be rejected over the appropriate sieve. For T 99 / T 180 Methods A and B, use the 4.75 mm (No. 4) sieve; T 99 / T 180 Methods C and D use the 19 mm (3/4 in).

Table 1

Nominal Maximum Size* mm (in.)	Minimum Mass of Test Sample, g (lb)
12.5 (1/2) or less	2000 (4.4)
19.0 (3/4)	3000 (6.6)
25.0 (1)	4000 (8.8)
37.5 (1 1/2)	5000 (11)
50 (2)	8000 (18)
63 (2 1/2)	12,000 (26)
75 (3)	18,000 (40)

* One sieve larger than the first sieve to retain more than 10 percent of the material using an agency specified set of sieves based on cumulative percent retained. Where large gaps in specification sieves exist, intermediate sieve(s) may be inserted to determine nominal maximum size.

Procedure

1. Immerse the aggregate in water at room temperature for a period of 15 to 19 hours.

Note 3: When testing coarse aggregate of large nominal maximum size requiring large test samples, it may be more convenient to perform the test on two or more subsamples, and then combine the values obtained.

2. Place the empty basket into the water bath and attach to the balance. Inspect the immersion tank to ensure the water level is at the overflow outlet height and basket is fully submerged. Tare the balance with the empty basket attached in the water bath.
3. Remove the test sample from the water and roll it in a large absorbent cloth until all visible films of water are removed. Wipe the larger particles individually. If the test sample dries past the SSD condition, immerse in water for 30 min, and then resume the process of surface-drying.

Note 4: A moving stream of air may be used to assist in the drying operation but take care to avoid evaporation of water from aggregate pores.

4. Determine the SSD mass of the sample, and record this and all subsequent masses to the nearest 0.1 g or 0.1 percent of the sample mass, whichever is greater. Designate this mass as "B."
5. Immediately place the SSD test sample in the sample container and weigh it in water maintained at $23.0 \pm 1.7^{\circ}\text{C}$ ($73.4 \pm 3^{\circ}\text{F}$). Shake the container to release entrapped air before recording the weight. Re-inspect the immersion tank to ensure the water level is at the overflow outlet height and basket is fully submerged. Designate this submerged weight as "C."

Note 5: The container should be immersed to a depth sufficient to cover it and the test sample during mass determination. Wire suspending the container should be of the smallest practical size to minimize any possible effects of a variable immersed length.

6. Remove the sample from the basket. Ensure all material has been removed. Place in a container of known mass.
7. Dry the test sample to constant mass according to the FOP for AASHTO T 255 / T 265 at $110 \pm 5^{\circ}\text{C}$ ($230 \pm 9^{\circ}\text{F}$) and cool in air at room temperature for 1 to 3 hours.
8. Determine and record the dry mass. Designate this mass as "A."

Calculations

Perform calculations and determine values using the appropriate formula below.

Bulk specific gravity (G_{sb})

$$G_{sb} = \frac{A}{B - C}$$

Bulk specific gravity, SSD ($G_{sb} SSD$)

$$G_{sb}SSD = \frac{B}{B - C}$$

Apparent specific gravity (G_{sa})

$$G_{sa} = \frac{A}{A - C}$$

Absorption

$$\text{Absorption} = \frac{B - A}{A} \times 100$$

Where:

- A = oven dry mass, g
- B = SSD mass, g
- C = weight in water, g

Sample Calculations

Sample	A	B	C	B - C	A - C	B - A
1	2030.9	2044.9	1304.3	740.6	726.6	14.0
2	1820.0	1832.5	1168.1	664.4	651.9	12.5
3	2035.2	2049.4	1303.9	745.5	731.3	14.2

Sample	G _{sb}	G _{sb} SSD	G _{sa}	Absorption
1	2.742	2.761	2.795	0.7
2	2.739	2.758	2.792	0.7
3	2.730	2.749	2.783	0.7

These calculations demonstrate the relationship between G_{sb}, G_{sb} SSD, and G_{sa}. G_{sb} is always lowest since the volume includes voids permeable to water. G_{sb} SSD is always intermediate. G_{sa} is always highest since the volume does not include voids permeable to water. When running this test, check to make sure the values calculated make sense in relation to one another.

Report

- On forms approved by the agency
- Sample ID
- Specific gravity values to the nearest 0.001
- Absorption to the nearest 0.1 percent

EMBANKMENT AND BASE
IN-PLACE DENSITY

WAQTC

FOP AASHTO T 85 (22)

**MOISTURE-DENSITY RELATIONS OF SOILS:
USING A 2.5 KG (5.5 LB) RAMMER AND A 305 MM (12 IN.) DROP**

FOP FOR AASHTO T 99

USING A 4.54 KG (10 LB) RAMMER AND A 457 MM (18 IN.) DROP

FOP FOR AASHTO T 180

Scope

This procedure covers the determination of the moisture-density relations of soils and soil-aggregate mixtures in accordance with two similar test methods:

- AASHTO T 99-22: Methods A, B, C, and D
- AASHTO T 180-22: Methods A, B, C, and D

This test method applies to soil mixtures having 40 percent or less retained on the 4.75 mm (No. 4) sieve for methods A or B, or 30 percent or less retained on the 19 mm ($\frac{3}{4}$ in.) sieve with methods C or D. The retained material is defined as oversize (coarse) material. If no minimum percentage is specified, 5 percent will be used. Samples that contain oversize (coarse) material that meet percent retained criteria should be corrected by using *Annex A, Correction of Maximum Dry Density and Optimum Moisture for Oversized Particles*. Samples of soil or soil-aggregate mixture are prepared at several moisture contents and compacted into molds of specified size, using manual or mechanical rammers that deliver a specified quantity of compactive energy. The moist masses of the compacted samples are multiplied by the appropriate factor to determine wet density values. Moisture contents of the compacted samples are determined and used to obtain the dry density values of the same samples. Maximum dry density and optimum moisture content for the soil or soil-aggregate mixture is determined by plotting the relationship between dry density and moisture content.

Apparatus

- Mold – Cylindrical mold made of metal with the dimensions shown in Table 1 or Table 2. If permitted by the agency, the mold may be of the “split” type, consisting of two half-round sections, which can be securely locked in place to form a cylinder. Determine the mold volume according to *Annex B, Standardization of the Mold*.
- Mold assembly – Mold, base plate, and a detachable collar.
- Rammer – Manually or mechanically operated rammers as detailed in Table 1 or Table 2. A manually operated rammer shall be equipped with a guide sleeve to control the path and height of drop. The guide sleeve shall have at least four vent holes no smaller than 9.5 mm ($\frac{3}{8}$ in.) in diameter, spaced approximately 90 degrees apart and approximately 19 mm ($\frac{3}{4}$ in.) from each end. A mechanically operated rammer will uniformly distribute blows over the sample and will be calibrated with several soil types, and be adjusted, if necessary, to give the same moisture-density results as with the manually operated rammer. For additional information concerning calibration, see AASHTO T 99 and T 180.

- Sample extruder – A jack, lever frame, or other device for extruding compacted specimens from the mold quickly and with little disturbance.
- Balance(s) or scale(s) of the capacity and sensitivity required for the procedure used by the agency.
 - A balance or scale with a capacity of 11.5 kg (25 lb) and a sensitivity of 1 g for obtaining the sample, meeting the requirements of AASHTO M 231, Class G 5.
 - A balance or scale with a capacity of 2 kg and a sensitivity of 0.1 g is used for moisture content determinations done under both procedures, meeting the requirements of AASHTO M 231, Class G 2.
- Drying apparatus – A thermostatically controlled drying oven, capable of maintaining a temperature of $110 \pm 5^{\circ}\text{C}$ ($230 \pm 9^{\circ}\text{F}$) for drying moisture content samples in accordance with the FOP for AASHTO T 255/T 265.
- Straightedge – A steel straightedge at least 250 mm (10 in.) long, with one beveled edge and at least one surface plane within 0.1 percent of its length, used for final trimming.
- Sieve(s) – 4.75 mm (No. 4) and/or 19.0 mm (3/4 in.), meeting the requirements of FOP for AASHTO T 27/T 11.
- Mixing tools – Miscellaneous tools such as a mixing pan, spoon, trowel, spatula, etc., or a suitable mechanical device, for mixing the sample with water.
- Containers with close-fitting lids to prevent gain or loss of moisture in the sample.

Table 1
Comparison of Apparatus, Sample, and Procedure – Metric

	T 99	T 180
Mold Volume, m ³	Methods A, C: 0.000943 ±0.000014	Methods A, C: 0.000943 ±0.000014
	Methods B, D: 0.002124 ±0.000025	Methods B, D: 0.002124 ±0.000025
Mold Diameter, mm	Methods A, C: 101.60 ±0.40	Methods A, C: 101.60 ±0.4
	Methods B, D: 152.40 ±0.70	Methods B, D: 152.40 ±0.70
Mold Height, mm	116.40 ±0.50	116.40 ±0.50
Detachable Collar Height, mm	50.80 ±0.64	50.80 ±0.64
Rammer Diameter, mm	50.80 ±0.25	50.80 ±0.25
Rammer Mass, kg	2.495 ±0.009	4.536 ±0.009
Rammer Drop, mm	305 ±2	457 ±2
Layers	3	5
Blows per Layer	Methods A, C: 25	Methods A, C: 25
	Methods B, D: 56	Methods B, D: 56
Material Size, mm	Methods A, B: 4.75 minus	Methods A, B: 4.75 minus
	Methods C, D: 19.0 minus	Methods C, D: 19.0 minus
Test Sample Size, kg	Method A: 3 Method C: 5 (1)	Method B: 7 Method D: 11(1)
Energy, kN-m/m ³	592	2,693

(1) This may not be a large enough sample depending on your nominal maximum size for moisture content samples.

Table 2
Comparison of Apparatus, Sample, and Procedure – English

	T 99	T 180
Mold Volume, ft ³	Methods A, C: 0.0333 ±0.0005	Methods A, C: 0.0333 ±0.0005
	Methods B, D: 0.07500 ±0.0009	Methods B, D: 0.07500 ±0.0009
Mold Diameter, in.	Methods A, C: 4.000 ±0.016	Methods A, C: 4.000 ±0.016
	Methods B, D: 6.000 ±0.026	Methods B, D: 6.000 ±0.026
Mold Height, in.	4.584 ±0.018	4.584 ±0.018
Detachable Collar Height, in.	2.000 ±0.025	2.000 ±0.025
Rammer Diameter, in.	2.000 ±0.025	2.000 ±0.025
Rammer Mass, lb	5.5 ±0.02	10 ±0.02
Rammer Drop, in.	12 ±0.06	18 ±0.06
Layers	3	5
Blows per Layer	Methods A, C: 25	Methods A, C: 25
	Methods B, D: 56	Methods B, D: 56
Material Size, in.	Methods A, B: No. 4 minus	Methods A, B: No.4 minus
	Methods C, D: 3/4 minus	Methods C, D: 3/4 minus
Test Sample Size, lb	Method A: 7 Method C: 12 ₍₁₎	Method B: 16 Method D: 25 ₍₁₎
Energy, lb-ft/ft ³	12,375	56,250

(1) This may not be a large enough sample depending on your nominal maximum size for moisture content samples.

Sample

If the sample is damp, dry it until it becomes friable under a trowel. Drying may be in air or by use of a drying apparatus maintained at a temperature not exceeding 60°C (140°F). Thoroughly break up aggregations in a manner that avoids reducing the natural size of individual particles.

Obtain a representative test sample of the mass required by the agency by passing the material through the sieve required by the agency. See Table 1 or Table 2 for test sample mass and material size requirements.

In instances where the material is prone to degradation, i.e., granular material, a compaction sample with differing moisture contents should be prepared for each point.

If the sample is plastic (clay types), it should stand for a minimum of 12 hours after the addition of water to allow the moisture to be absorbed. In this case, several samples at different moisture contents should be prepared, put in sealed containers, and tested the next day.

Note 1: Both T 99 and T 180 have four methods (A, B, C, D) that require different masses and employ different sieves.

Procedure

During compaction, rest the mold firmly on a dense, uniform, rigid, and stable foundation, or base. This base shall remain stationary during the compaction process.

1. Determine the mass of the clean, dry mold. Include the base plate but exclude the extension collar. Record the mass to the nearest 1 g (0.005 lb).
2. Thoroughly mix the selected representative sample with sufficient water to dampen it to approximately 4 to 8 percentage points below optimum moisture content. For many materials, this condition can be identified by forming a cast by hand.
 - a. Prepare individual samples of plastic or degradable material, increasing moisture contents 1 to 2 percent for each point.
 - b. Allow samples of plastic soil to stand for 12 hrs.
3. Form a specimen by compacting the prepared soil in the mold assembly in approximately equal layers. For each layer:
 - a. Spread the loose material uniformly in the mold.

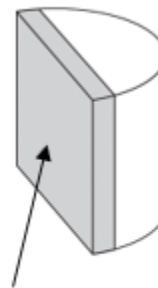
Note 2: It is recommended to cover the remaining material with a non-absorbent sheet or damp cloth to minimize loss of moisture.

- b. Lightly tamp the loose material with the manual rammer or other similar device, this establishes a firm surface.
 - c. Compact each layer with uniformly distributed blows from the rammer. See Table 1 for mold size, number of layers, number of blows, and rammer specification for the various test methods. Use the method specified by the agency.
 - d. Trim down material that has not been compacted and remains adjacent to the walls of the mold and extends above the compacted surface.

4. Remove the extension collar. Avoid shearing off the sample below the top of the mold. The material compacted in the mold should not be over 6 mm (¼ in.) above the top of the mold once the collar has been removed.
5. Trim the compacted soil even with the top of the mold with the beveled side of the straightedge.
6. Clean soil from exterior of the mold and base plate.
7. Determine and record the mass of the mold, base plate, and wet soil to the nearest 1 g (0.005 lb).
8. Determine and record the wet mass (M_w) of the sample by subtracting the mass in Step 1 from the mass in Step 7.
9. Calculate the wet density (ρ_w), in kg/m^3 (lb/ft^3), by dividing the wet mass by the measured volume (V_m).
10. Extrude the material from the mold. For soils and soil-aggregate mixtures, slice vertically through the center and remove one of the cut faces for a representative moisture content sample. For granular materials, a vertical face will not exist. Take a representative sample ensuring that all layers are represented. This sample must meet the sample size requirements of the test method used to determine moisture content.



Extruded material



**Representative moisture
content sample**

Note 3: When developing a curve for free-draining soils such as uniform sands and gravels, where seepage occurs at the bottom of the mold and base plate, taking a representative moisture content from the mixing bowl may be preferred in order to determine the amount of moisture available for compaction.

11. Determine and record the moisture content (w) of the sample in accordance with the FOP for AASHTO T 255 / T 265.
12. If the material is degradable or plastic, return to Step 3 using a prepared individual sample. If not, continue with Steps 13 through 15.
13. Thoroughly break up the remaining portion of the molded specimen until it will again pass through the sieve, as judged by eye, and add to the remaining portion of the sample being tested.
14. Add sufficient water to increase the moisture content of the remaining soil by 1 to 2 percentage points and repeat steps 3 through 11.

15. Continue determinations until there is either a decrease or no change in the wet mass.
There will be a minimum of three points on the dry side of the curve and two points on the wet side. For non-cohesive, drainable soils, one point on the wet side is sufficient.

Calculations

Wet Density

$$\rho_w = \frac{M_w}{V_m}$$

Where:

$$\begin{aligned} \rho_w &= \text{wet density, kg/m}^3 \text{ (lb/ft}^3\text{)} \\ M_w &= \text{wet mass} \\ V_m &= \text{volume of the mold, Annex B} \end{aligned}$$

Dry Density

$$\rho_d = \left(\frac{\rho_w}{w + 100} \right) \times 100 \quad \text{or} \quad \rho_d = \frac{\rho_w}{\left(\frac{w}{100} \right) + 1}$$

Where:

$$\begin{aligned} \rho_d &= \text{dry density, kg/m}^3 \text{ (lb/ft}^3\text{)} \\ w &= \text{moisture content, as a percentage} \end{aligned}$$

Example for 4-inch mold, Methods A or C

$$\begin{aligned} \text{Wet mass, } M_w &= 1.928 \text{ kg (4.25 lb)} \\ \text{Moisture content, } w &= 11.3\% \\ \text{Measured volume of the mold, } V_m &= 0.000946 \text{ m}^3 \text{ (0.0334 ft}^3\text{)} \end{aligned}$$

Wet Density

$$\rho_w = \frac{1.928 \text{ kg}}{0.000946 \text{ m}^3} = 2038 \text{ kg/m}^3 \quad \rho_w = \frac{4.25 \text{ lb}}{0.0334 \text{ ft}^3} = 127.2 \text{ lb/ft}^3$$

Dry Density

$$\rho_d = \left(\frac{2038 \text{ kg/m}^3}{11.3 + 100} \right) \times 100 = 1831 \text{ kg/m}^3 \quad \rho_d = \left(\frac{127.2 \text{ lb/ft}^3}{11.3 + 100} \right) \times 100 = 114.3 \text{ lb/ft}^3$$

Or

$$\rho_d = \left(\frac{2038 \text{ kg/m}^3}{\frac{11.3}{100} + 1} \right) = 1831 \text{ kg/m}^3 \quad \rho_d = \left(\frac{127.2 \text{ lb/ft}^3}{\frac{11.3}{100} + 1} \right) = 114.3 \text{ lb/ft}^3$$

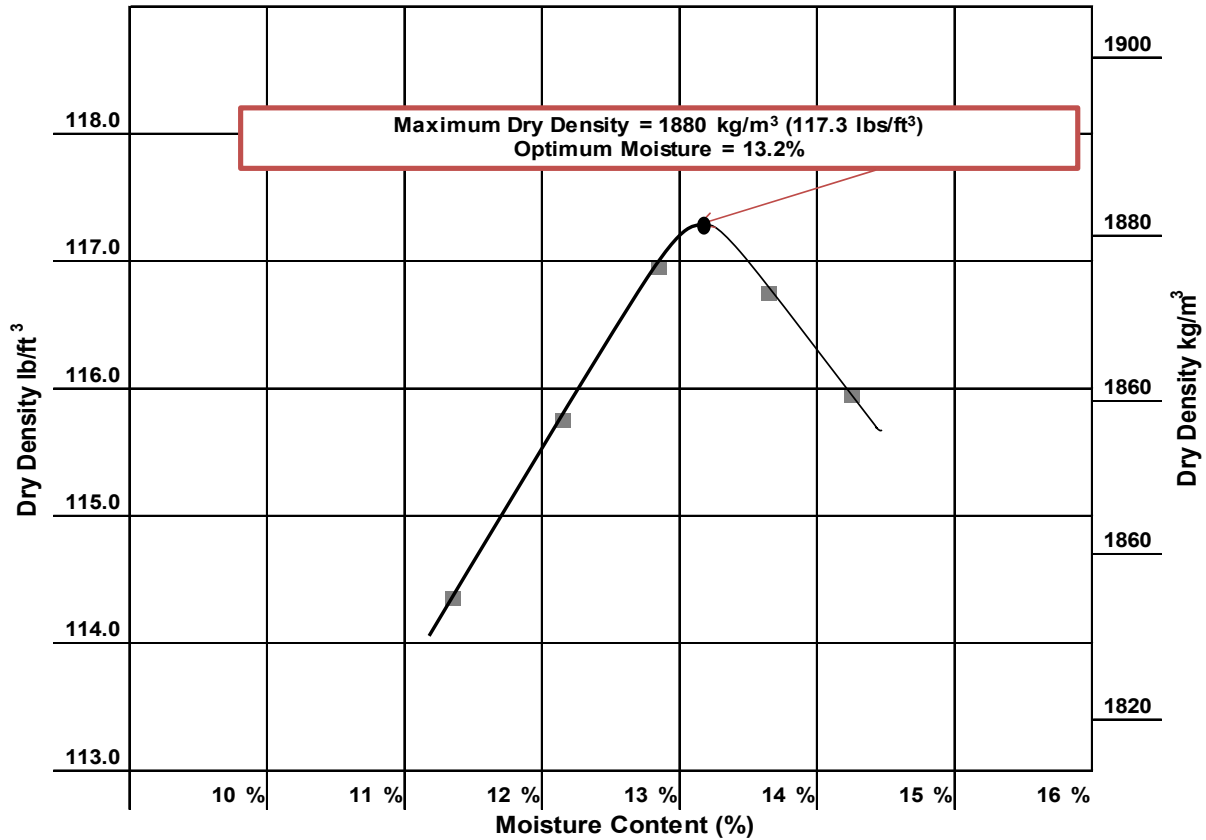
Moisture-Density Curve Development

When dry density is plotted on the vertical axis versus moisture content on the horizontal axis and the points are connected with a smooth line, a moisture-density curve is developed. The coordinates of the peak of the curve are the maximum dry density, or just “maximum density,” and the “optimum moisture content” of the soil.

Example

Given the following dry density and corresponding moisture content values develop a moisture-density relations curve and determine maximum dry density and optimum moisture content.

Dry Density		Moisture Content, %
kg/m ³	lb/ft ³	
1831	114.3	11.3
1853	115.7	12.1
1873	116.9	12.8
1869	116.7	13.6
1857	115.9	14.2



In this case, the curve has its peak at:

Maximum dry density = 1880 kg/m³ (117.3 lb/ft³)

Optimum moisture content = 13.2%

Note that both values are approximate since they are based on sketching the curve to fit the points.

Report

- Results on forms approved by the agency
- Sample ID
- Maximum dry density to the nearest 1 kg/m³ (0.1 lb/ft³)
- Optimum moisture content to the nearest 0.1 percent

ANNEX A

CORRECTION OF MAXIMUM DRY DENSITY AND OPTIMUM MOISTURE FOR OVERSIZED PARTICLES

(Mandatory Information)

This section corrects the maximum dry density and moisture content of the material retained on the 4.75 mm (No. 4) sieve, Methods A and B; or the material retained on the 19 mm (¾ in.) sieve, Methods C and D. The maximum dry density, corrected for oversized particles and total moisture content, are compared with the field-dry density and field moisture content.

This correction can be applied to the sample on which the maximum dry density is performed. A correction may not be practical for soils with only a small percentage of oversize material. The agency shall specify a minimum percentage below which the method is not needed. If not specified, this method applies when more than 5 percent by weight of oversize particles is present.

Bulk specific gravity (G_{sb}) of the oversized particles is required to determine the corrected maximum dry density. Use the bulk specific gravity as determined using the FOP for AASHTO T 85 in the calculations. For construction activities, an agency established value or specific gravity of 2.600 may be used.

This correction can also be applied to the sample obtained from the field while performing in-place density.

Procedure

1. Use the sample from this procedure or a sample obtained according to the FOP for AASHTO T 310.
2. Sieve the sample on the 4.75 mm (No. 4) sieve for Methods A and B or the 19 mm (¾ in.) sieve, Methods C and D.
3. Determine the dry mass of the oversized and fine fractions (M_{DC} and M_{DF}) by one of the following:
 - a. Dry the fractions, fine and oversized, in air or by use of a drying apparatus that is maintained at a temperature not exceeding 60°C (140°F).
 - b. Calculate the dry masses using the moisture samples.

To determine the dry mass of the fractions using moisture samples.

1. Determine the moist mass of both fractions, fine (M_{Mf}) and oversized (M_{Mc}):
2. Obtain moisture samples from the fine and oversized material.
3. Determine the moisture content of the fine particles (MC_f) and oversized particles (MC_c) of the material by FOP for AASHTO T 255/T 265 or agency approved method.
4. Calculate the dry mass of the oversize and fine particles.

$$M_D = \frac{M_m}{1 + MC}$$

Where:

M_D = mass of dry material (fine or oversize particles)

M_m = mass of moist material (fine or oversize particles)

MC = moisture content of respective fine or oversized, expressed as a decimal

5. Calculate the percentage of the fine (P_f) and oversized (P_c) particles by dry weight of the total sample as follows: See Note 2.

$$P_f = \frac{100 \times M_{DF}}{M_{DF} + M_{DC}} \quad \frac{100 \times 15.4 \text{ lb}}{15.4 \text{ lbs} + 5.7 \text{ lb}} = 73\% \quad \frac{100 \times 6.985 \text{ kg}}{6.985 \text{ kg} + 2.585 \text{ kg}} = 73\%$$

And

$$P_c = \frac{100 \times M_{DC}}{M_{DF} + M_{DC}} \quad \frac{100 \times 5.7 \text{ lb}}{15.4 \text{ lbs} + 5.7 \text{ lb}} = 27\% \quad \frac{100 \times 2.585 \text{ kg}}{6.985 \text{ kg} + 2.585 \text{ kg}} = 27\%$$

Or for P_c :

$$P_c = 100 - P_f$$

Where:

P_f = percent of fine particles, of sieve used, by weight

P_c = percent of oversize particles, of sieve used, by weight

M_{DF} = mass of dry fine particles

M_{DC} = mass of dry oversize particles

Optimum Moisture Correction Equation

1. Calculate the corrected moisture content as follows:

$$MC_T = \frac{(MC_F \times P_f) + (MC_C \times P_C)}{100} = \frac{(13.2\% \times 73.0\%) + (2.1\% \times 27.0\%)}{100} = 10.2\%$$

MC_T = corrected moisture content of combined fines and oversized particles, expressed as a % moisture

MC_F = moisture content of fine particles, as a % moisture

MC_C = moisture content of oversized particles, as a % moisture

Note 1: Moisture content of oversize material can be assumed to be two (2) percent for most construction applications.

Note 2: In some field applications agencies will allow the percentages of oversize and fine materials to be determined with the materials in the wet state.

Density Correction Equation

2. Calculate the corrected dry density (ρ_d) of the total sample (combined fine and oversized particles) as follows:

$$\rho_d = \frac{100\%}{\left[\left(\frac{P_f}{\rho_f} \right) + \left(\frac{P_c}{k} \right) \right]}$$

Where:

ρ_d = corrected total dry density (combined fine and oversized particles)
kg/m³ (lb/ft³)

ρ_f = dry density of the fine particles kg/m³ (lb/ft³), determined in the lab

P_c = percent of dry oversize particles, of sieve used, by weight.

P_f = percent of dry fine particles, of sieve used, by weight.

k = Metric: 1,000 * Bulk Specific Gravity (G_{sb}) (oven dry basis)
of coarse particles (kg/m³).

k = English: 62.4 * Bulk Specific Gravity (G_{sb}) (oven dry basis)
of coarse particles (lb/ft³)

Note 3: If the specific gravity is known, then this value will be used in the calculation. For most construction activities the specific gravity for aggregate may be assumed to be 2.600.

Calculation

Example

- Metric:

Maximum laboratory dry density (ρ_p):	1880 kg/m ³
Percent coarse particles (P_c):	27%
Percent fine particles (P_f):	73%
Mass per volume coarse particles (k):	(2.697) (1000) = 2697 kg/m ³

$$\rho_d = \frac{100\%}{\left[\left(\frac{P_f}{\rho_f}\right) + \left(\frac{P_c}{k}\right)\right]}$$

$$\rho_d = \frac{100\%}{\left[\left(\frac{73\%}{1880 \text{ kg/m}^3}\right) + \left(\frac{27\%}{2697 \text{ kg/m}^3}\right)\right]}$$

$$\rho_d = \frac{100\%}{[0.03883 \text{ kg/m}^3 + 0.01001 \text{ kg/m}^3]}$$

$$\rho_d = 2047.5 \text{ kg/m}^3 \text{ report } 2048 \text{ kg/m}^3$$

English:

Maximum laboratory dry density (ρ_f): 117.3 lb/ft³

Percent coarse particles (P_c): 27%

Percent fine particles (P_f): 73%

Mass per volume of coarse particles (k): (2.697) (62.4) = 168.3 lb/ft³

$$\rho_d = \frac{100\%}{\left[\left(\frac{P_f}{\rho_f}\right) + \left(\frac{P_c}{k}\right)\right]}$$

$$\rho_d = \frac{100\%}{\left[\left(\frac{73\%}{117.3 \text{ lb/ft}^3}\right) + \left(\frac{27\%}{168.3 \text{ lb/ft}^3}\right)\right]}$$

$$\rho_d = \frac{100\%}{[0.6223 \text{ lb/ft}^3 + 0.1604 \text{ lb/ft}^3]}$$

$$\rho_d = \frac{100\%}{0.7827 \text{ lb/ft}^3}$$

$$\rho_d = 127.76 \text{ lb/ft}^3 \quad \text{Report } 127.8 \text{ lb/ft}^3$$

Report

- On forms approved by the agency
- Sample ID
- Corrected maximum dry density to the nearest 1 kg/m³ (0.1 lb/ft³)
- Corrected optimum moisture to the nearest 0.1 percent

ANNEX B

STANDARDIZATION OF THE MOLD

(Mandatory Information)

Standardization is a critical step to ensure accurate test results when using this apparatus. Failure to perform the standardization procedure as described herein will produce inaccurate or unreliable test results.

Apparatus

- Mold and base plate
- Balance or scale – Accurate to within 45 g (0.1 lb) or 0.3 percent of the test load, whichever is greater, at any point within the range of use.
- Cover plate – A piece of plate glass, at least 6 mm (1/4 in.) thick and at least 25 mm (1 in.) larger than the diameter of the mold.
- Thermometers – Standardized liquid-in-glass, or electronic digital total immersion type, accurate to 0.5°C (1°F)

Procedure

1. Create a watertight seal between the mold and base plate.
2. Determine and record the mass of the dry sealed mold, base plate, and cover plate.
3. Fill the mold with water at a temperature between 16°C and 29°C (60°F and 85°F) and cover with the cover plate in such a way as to eliminate bubbles and excess water.
4. Wipe the outside of the mold, base plate, and cover plate dry, being careful not to lose any water from the mold.
5. Determine and record the mass of the filled mold, base plate, cover plate, and water.
6. Determine and record the mass of the water in the mold by subtracting the mass in Step 2 from the mass in Step 5.
7. Measure the temperature of the water and determine its density from Table B1, interpolating, as necessary.
8. Calculate the volume of the mold, V_m , by dividing the mass of the water in the mold by the density of the water at the measured temperature.

Calculations

$$V_m = \frac{M}{\rho_{water}}$$

Where:

V_m = volume of the mold

M = mass of water in the mold

ρ_{water} = density of water at the measured temperature

Example

Mass of water in mold = 0.94367 kg (2.0800 lb)

ρ_{water} at 23°C (73.4°F) = 997.54 kg/m³ (62.274 lb/ft³)

$$V_m = \frac{0.94367 \text{ kg}}{997.54 \text{ kg/m}^3} = 0.000946 \text{ m}^3 \quad V_m = \frac{2.0800 \text{ lb}}{62.274 \text{ lb/ft}^3} = 0.0334 \text{ ft}^3$$

Table B1
Unit Mass of Water
15°C to 30°C

°C	(°F)	kg/m ³	(lb/ft ³)	°C	(°F)	kg/m ³	(lb/ft ³)
15	(59.0)	999.10	(62.372)	23	(73.4)	997.54	(62.274)
15.6	(60.0)	999.01	(62.366)	23.9	(75.0)	997.32	(62.261)
16	(60.8)	998.94	(62.361)	24	(75.2)	997.29	(62.259)
17	(62.6)	998.77	(62.350)	25	(77.0)	997.03	(62.243)
18	(64.4)	998.60	(62.340)	26	(78.8)	996.77	(62.227)
18.3	(65.0)	998.54	(62.336)	26.7	(80.0)	996.59	(62.216)
19	(66.2)	998.40	(62.328)	27	(80.6)	996.50	(62.209)
20	(68.0)	998.20	(62.315)	28	(82.4)	996.23	(62.192)
21	(69.8)	997.99	(62.302)	29	(84.2)	995.95	(62.175)
21.1	(70.0)	997.97	(62.301)	29.4	(85.0)	995.83	(62.166)
22	(71.6)	997.77	(62.288)	30	(86.0)	995.65	(62.156)

Report

- Mold ID
- Date Standardized
- Temperature of the water
- Volume, V_m , of the mold to the nearest 0.000001 m^3 (0.0001 ft^3)

SLUMP OF HYDRAULIC CEMENT CONCRETE FOP FOR AASHTO T 119

Scope

This procedure provides instructions for determining the slump of hydraulic cement concrete in accordance with AASHTO T 119-18. It is not applicable to non-plastic and non-cohesive concrete.

Warning—Fresh Hydraulic cementitious mixtures are caustic and may cause chemical burns to skin and tissue upon prolonged exposure.

Apparatus

- Mold: conforming to AASHTO T 119
 - Metal: a metal frustum of a cone provided with foot pieces and handles. The mold must be constructed without a seam. The interior of the mold shall be relatively smooth and free from projections such as protruding rivets. The mold shall be free from dents. A mold that clamps to a rigid nonabsorbent base plate is acceptable provided the clamping arrangement is such that it can be fully released without movement of the mold.
 - Non-metal: see AASHTO T 119, Section 5.1.2.
- Tamping rod: 16 mm (5/8 in.) diameter and 400 mm (16 in.) to 600 mm (24 in.) long, having a hemispherical tip the same diameter as the rod. (Hemispherical means “half a sphere”; the tip is rounded like half of a ball.)
- Scoop: a receptacle of appropriate size so that each representative increment of the concrete sample can be placed in the container without spillage.
- Tape measure or ruler with at least 5 mm or 1/8 in. graduations
- Base: flat, rigid, non-absorbent moistened surface on which to set the slump mold

Procedure

1. Obtain the sample in accordance with the FOP for WAQTC TM 2. If the concrete mixture contains aggregate retained on the 37.5mm (1½ in.) sieve, the aggregate must be removed in accordance with the Wet Sieving portion of the FOP for WAQTC TM 2.

Begin testing within five minutes of obtaining the sample.

2. Dampen the inside of the mold and place it on a dampened, rigid, nonabsorbent surface that is level and firm.
3. Stand on both foot pieces to hold the mold firmly in place.
4. Use the scoop to fill the mold 1/3 full by volume, to a depth of approximately 67 mm (2 5/8 in.).

5. Consolidate the layer with 25 strokes of the tamping rod, using the rounded end. Distribute the strokes evenly over the entire cross section of the concrete.
For this bottom layer, incline the rod slightly and make approximately half the strokes near the perimeter, and then progress with vertical strokes, spiraling toward the center.
 6. Use the scoop to fill the mold 2/3 full by volume, to a depth of approximately 155 mm (6 1/8 in.).
 7. Consolidate this layer with 25 strokes of the tamping rod, penetrate approximately 25 mm (1 in.) into the bottom layer. Distribute the strokes evenly.
 8. Use the scoop to fill the mold to overflowing.
 9. Consolidate this layer with 25 strokes of the tamping rod, penetrate approximately 25 mm (1 in.) into the second layer. Distribute the strokes evenly. If the concrete falls below the top of the mold, stop, add more concrete, and continue rodding for a total of 25 strokes. Keep an excess amount of concrete above the top of the mold at all times. Distribute strokes evenly as before.
 10. Strike off the top surface of concrete with a screeding and rolling motion of the tamping rod.
 11. Clean overflow concrete away from the base of the mold.
 12. Remove the mold from the concrete by raising it carefully in a vertical direction. Raise the mold 300 mm (12 in.) in 5 ± 2 seconds by a steady upward lift with no lateral or torsional (twisting) motion being imparted to the concrete.
Complete the entire operation from the start of the filling through removal of the mold without interruption within an elapsed time of 2 1/2 minutes.
 13. Immediately measure the slump:
 - a. Invert the slump mold and set it next to the specimen.
 - b. Lay the tamping rod across the mold so that it is over the test specimen.
 - c. Measure the distance between the bottom of the rod and the displaced original center of the top of the specimen to the nearest 5 mm (1/4 in.).
- Note 1:* If a decided falling away or shearing off of concrete from one side or portion of the mass occurs, disregard the test and perform a new test on another portion of the sample. If two consecutive tests on a sample of concrete show a falling away or shearing off of a portion of the concrete from the mass of the specimen, the concrete probably lacks the plasticity and cohesiveness necessary for the slump test to be applicable.
14. Discard the tested sample.

Report

- Results on forms approved by the agency
- Sample ID
- Slump to the nearest 5 mm (1/4 in.).

AIR CONTENT OF FRESHLY MIXED CONCRETE BY THE PRESSURE METHOD FOP FOR AASHTO T 152

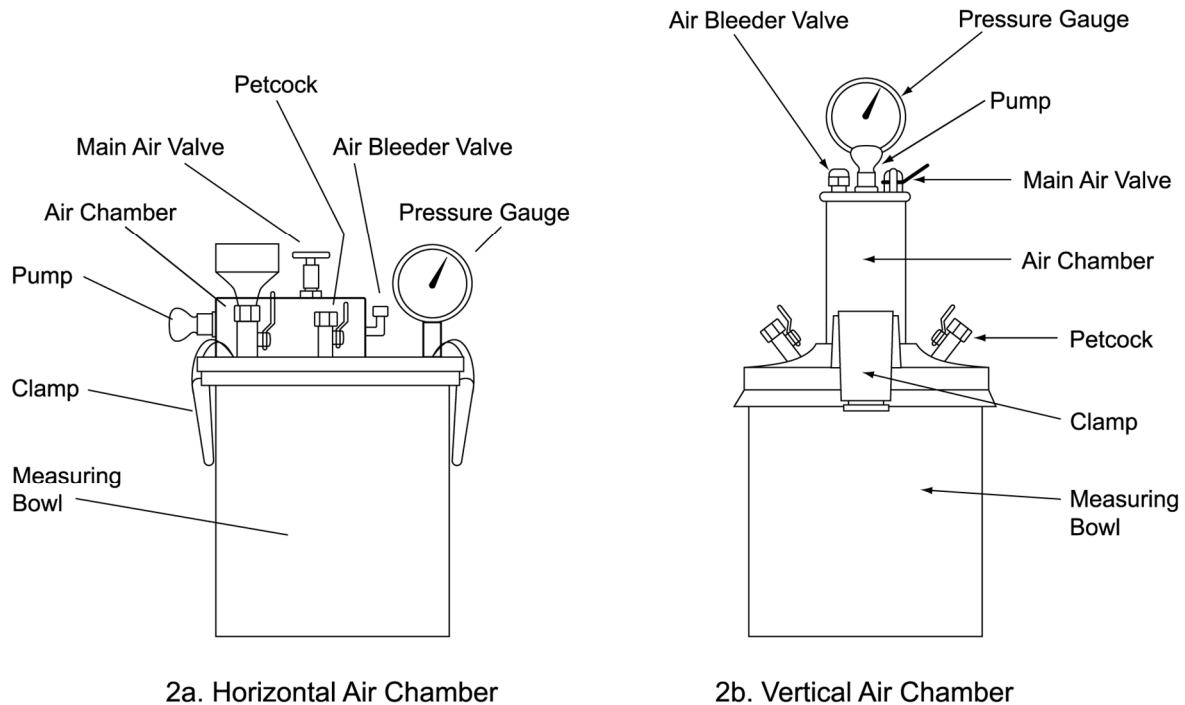
Scope

This procedure covers determination of the air content in freshly mixed Portland Cement Concrete containing dense aggregates in accordance with AASHTO T 152-19, Type B meter. It is not for use with lightweight or highly porous aggregates. This procedure includes standardization of the Type B air meter gauge, Annex A.

Warning—Fresh Hydraulic cementitious mixtures are caustic and may cause chemical burns to skin and tissue upon prolonged exposure.

Apparatus

- Air meter: Type B, as described in AASHTO T 152



Type B Meter

- Balance or scale: Accurate to 0.3 percent of the test load at any point within the range of use (for Method 1 standardization only)
- Tamping rod: 16 mm (5/8 in.) diameter and 400 mm (16 in.) to 600 mm (24 in.) long, having a hemispherical tip the same diameter as the rod. (Hemispherical means “half a sphere”; the tip is rounded like half of a ball.)

- Vibrator: frequency at least 9000 vibrations per minute (150 Hz), at least 19 to 38 mm (3/4 to 1 1/2 in.) in diameter but not greater than 38 mm (1 1/2 in.), and the length of the shaft shall be at least 75 mm (3 in.) than the depth of the section being vibrated.
 - Scoop: a receptacle of appropriate size so that each representative increment of the concrete sample can be placed in the container without spillage.
 - Container for water: rubber syringe (may also be a squeeze bottle)
 - Strike-off bar: Approximately 300 mm x 22 mm x 3 mm (12 in. x 3/4 in. x 1/8 in.)
 - Strike-off plate: A flat rectangular metal plate at least 6 mm (1/4 in.) thick or a glass or acrylic plate at least 12 mm (1/2 in.) thick, with a length and width at least 50 mm (2 in.) greater than the diameter of the measure with which it is to be used. The edges of the plate shall be straight and smooth within tolerance of 1.5 mm (1/16 in.).
- Note 1:* Use either the strike-off bar or strike-off plate; both are not required.
- Mallet: With a rubber or rawhide head having a mass of 0.57 ± 0.23 kg (1.25 ± 0.5 lb)

Procedure Selection

There are two methods of consolidating the concrete – rodding and vibration. If the slump is greater than 75 mm (3 in.), consolidation is by rodding. When the slump is 25 to 75 mm (1 to 3 in.), internal vibration or rodding can be used to consolidate the sample, but the method used must be that required by the agency in order to obtain consistent, comparable results. For concrete with slumps less than 25 mm (1 in.), consolidate the sample by internal vibration. Do not consolidate self-consolidating concrete (SCC).

Procedure

Sampling

1. Obtain the sample in accordance with the FOP for WAQTC TM 2. If the concrete mixture contains aggregate retained on the 37.5mm (1½ in.) sieve, the aggregate must be removed in accordance with the Wet Sieving portion of the FOP for WAQTC TM 2.

Testing shall begin within five minutes of obtaining the sample.

Rodding

1. Dampen the inside of the air meter measure and place on a firm level surface.
2. Use the scoop to fill the measure approximately 1/3 full with concrete. Evenly distribute the concrete in a circular motion around the inner perimeter of the measure.
3. Consolidate the layer with 25 strokes of the tamping rod, using the rounded end. Distribute the strokes evenly over the entire cross section of the concrete. Rod throughout its depth without hitting the bottom too hard.
4. Tap around the perimeter of the measure smartly 10 to 15 times with the mallet to close voids and release trapped air.

5. Add the second layer, filling the measure about 2/3 full. Evenly distribute the concrete in a circular motion around the inner perimeter of the measure.
6. Consolidate this layer with 25 strokes of the tamping rod, penetrating about 25 mm (1 in.) into the bottom layer.
7. Tap around the perimeter of the measure smartly 10 to 15 times with the mallet.
8. Add the final layer, slightly overfilling the measure. Evenly distribute the concrete in a circular motion around the inner perimeter of the measure.
9. Consolidate this layer with 25 strokes of the tamping rod, penetrating about 25 mm (1 in.) into the second layer.
10. Tap around the perimeter of the measure smartly 10 to 15 times with the mallet.
11. After consolidation, the measure should be slightly over full, about 3 mm (1/8 in.) above the rim. If there is a great excess of concrete, remove a portion with the trowel or scoop. If the measure is under full, add a small quantity. This adjustment may be done only after consolidating the final layer and before striking off the surface of the concrete.
12. Continue with 'Strike-off and Air Content.'

Internal Vibration

1. Dampen the inside of the air meter measure and place on a firm level surface.
2. Use the scoop to fill the measure approximately 1/2 full with concrete. Evenly distribute the concrete in a circular motion around the inner perimeter of the measure.
3. Insert the vibrator at three different points. Do not let the vibrator touch the bottom or side of the measure. Remove the vibrator slowly, so that no air pockets are left in the material. Continue vibration only long enough to achieve proper consolidation of the concrete. Over vibration may cause segregation and loss of appreciable quantities of intentionally entrained air.
4. Tap around the perimeter of the measure smartly 10 to 15 times with the mallet.
5. Use the scoop to fill the measure a bit over full. Evenly distribute the concrete in a circular motion around the inner perimeter of the measure.
6. Insert the vibrator at three different points, penetrating the first layer approximately 25 mm (1 in.). Do not let the vibrator touch the side of the measure. Remove the vibrator slowly, so that no air pockets are left in the material. Continue vibration only long enough to achieve proper consolidation of the concrete. Over vibration may cause segregation and loss of appreciable quantities of intentionally entrained air.
7. Tap around the perimeter of the measure smartly 10 to 15 times with the mallet.
8. Continue with 'Strike-off and Air Content.'

Self-Consolidating Concrete

1. Dampen the inside of the air meter measure and place on a firm level surface.
2. Use the scoop to slightly overfill the measure. Evenly distribute the concrete in a circular motion around the inner perimeter of the measure.
3. Continue with 'Strike-off and Air Content.'

Strike-Off and Air Content

1. Strike off the surface of the concrete and finish it smoothly with a sawing action of the strike-off bar or plate, using great care to leave the measure just full. The surface should be smooth and free of voids.
2. Clean the top flange of the measure to ensure a proper seal.
3. Moisten the inside of the cover and check to see that both petcocks are open, and the main air valve is closed.
4. Clamp the cover on the measure.
5. Inject water through a petcock on the cover until water emerges from the petcock on the opposite side. Jar the meter gently until all air is expelled from this same petcock.
6. Verify that water is present in both petcocks.
7. Close the air bleeder valve and pump air into the air chamber until the needle goes past the initial pressure determined for the gauge. Allow a few seconds for the compressed air to cool.
8. Tap the gauge gently with one hand while slowly opening the air bleeder valve until the needle rests on the initial pressure. Close the air bleeder valve.
9. Close both petcocks.
10. Open the main air valve.
11. Tap the side of the measure smartly with the mallet.
12. With the main air valve open, lightly tap the gauge to settle the needle, and then read the air content to the nearest 0.1 percent.
13. Release or close the main air valve.
14. Open both petcocks to release pressure, remove the concrete, and thoroughly clean the cover and measure with clean water.
15. Open the main air valve to relieve the pressure in the air chamber.

Report

- On forms approved by the agency
- Sample ID
- Percent of air to the nearest 0.1 percent.
- Some agencies require an aggregate correction factor in order to determine total percent of entrained air.

Total % entrained air = Gauge reading – aggregate correction factor from mix design
(See AASHTO T 152 for more information.)

ANNEX A STANDARDIZATION OF AIR METER GAUGE

(Mandatory Information)

Standardization is a critical step to ensure accurate test results when using this apparatus. Failure to perform the standardization procedures as described below will produce inaccurate or unreliable test results.

Standardization shall be performed at a minimum of once every three months. Record the date of the standardization, the standardization results, and the name of the technician performing the standardization in the logbook kept with each air meter.

There are two methods for standardizing the air meter, mass or volume, both are covered below.

1. Screw the short piece of straight tubing into the threaded petcock hole on the underside of the cover.
2. Determine and record the mass of the dry, empty air meter measure and cover assembly (mass method only).
3. Fill the measure nearly full with water.
4. Clamp the cover on the measure with the tube extending down into the water. Mark the petcock with the tube attached for future reference.
5. Add water through the petcock having the pipe extension below until all air is forced out the other petcock.
6. Wipe off the air meter measure and cover assembly; determine and record the mass of the filled unit (mass method only).
7. Pump up the air pressure to a little beyond the predetermined initial pressure indicated on the gauge. Wait a few seconds for the compressed air to cool, and then stabilize the gauge hand at the proper initial pressure by pumping up or relieving pressure, as needed.
8. Close both petcocks and immediately open the main air valve exhausting air into the measure. Wait a few seconds until the meter needle stabilizes. The gauge should now read 0 percent. If two or more tests show a consistent variation from 0 percent in the result, change the initial pressure line to compensate for the variation, and use the newly established initial pressure line for subsequent tests.
9. Determine which petcock has the straight tube attached to it. Attach the curved tube to external portion of the same petcock.
10. Pump air into the air chamber. Open the petcock with the curved tube attached to it. Open the main air valve for short periods of time until 5 percent of water by mass or volume has been removed from the air meter. Remember to open both petcocks to release the pressure in the measure and drain the water in the curved tube back into the measure. To determine the mass of the water to be removed, subtract the mass found in Step 2 from the mass found in Step 6. Multiply this value by 0.05. This is the mass of the water that must be removed. To remove 5 percent by volume, remove water until the external standardization vessel is level full.

Note A1: Many air meters are supplied with a standardization vessel(s) of known volume that are used for this purpose. Standardization vessel must be protected from crushing or denting. If an external standardization vessel is used, confirm what percentage volume it represents for the air meter being used. Vessels commonly represent 5 percent volume, but they are for specific size meters. This should be confirmed by mass.

11. Remove the curved tube. Pump up the air pressure to a little beyond the predetermined initial pressure indicated on the gauge. Wait a few seconds for the compressed air to cool, and then stabilize the gauge hand at the proper initial pressure by pumping up or relieving pressure, as needed.
12. Close both petcocks and immediately open the main air valve exhausting air into the measure. Wait a few seconds until the meter needle is stabilized. The gauge should now read 5.0 ± 0.1 percent. If the gauge is outside that range, the meter needs adjustment. The adjustment could involve adjusting the starting point so that the gauge reads 5.0 ± 0.1 percent when this standardization is run or could involve moving the gauge needle to read 5.0 percent. Any adjustment should comply with the manufacturer's recommendations.
13. When the gauge hand reads correctly at 5.0 percent, additional water may be withdrawn in the same manner to check the results at other values such as 10 percent or 15 percent.
14. If an internal standardization vessel is used, follow Steps 1 through 8 to set initial reading.
15. Release pressure from the measure and remove cover. Place the internal standardization vessel into the measure. This will displace 5 percent of the water in the measure. (See AASHTO T 152 for more information on internal standardization vessels.)
16. Place the cover back on the measure and add water through the petcock until all the air has been expelled.
17. Pump up the air pressure chamber to the initial pressure. Wait a few seconds for the compressed air to cool, and then stabilize the gauge hand at the proper initial pressure by pumping up or relieving pressure, as needed.
18. Close both petcocks and immediately open the main air valve exhausting air into the measure. Wait a few seconds until the meter needle stabilizes. The gauge should now read 5 percent.
19. Remove the extension tubing from threaded petcock hole in the underside of the cover before starting the test procedure.

Report

- Air meter ID
- Date standardized
- Initial pressure (IP)

BULK SPECIFIC GRAVITY (G_{mb}) OF COMPACTED ASPHALT MIXTURES USING SATURATED SURFACE-DRY SPECIMENS FOP FOR AASHTO T 166

Scope

This procedure covers the determination of bulk specific gravity (G_{mb}) of compacted asphalt mixtures using three methods – A, B, and C – in accordance with AASHTO T 166-22. This FOP is for use on specimens not having open or interconnecting voids or absorbing more than 2.00 percent water by volume, or both. When specimens have open or interconnecting voids or absorbing more than 2.00 percent water by volume, or both, AASHTO T 275 or AASHTO T 331 should be performed.

Overview

- Method A: Suspension
- Method B: Volumeter
- Method C: Rapid test for A or B

Test Specimens

Test specimens may be either laboratory-molded or sampled from asphalt mixture pavement. For specimens it is recommended that the diameter be equal to four times the maximum size of the aggregate and the thickness be at least one and one half times the maximum size.

Terminology

Constant Mass: The state at which a mass does not change more than a given percent, after additional drying for a defined time interval, at a required temperature.

Apparatus – Method A (Suspension)

- Balance or scale: 5 kg capacity, readable to 0.1 g, and fitted with a suitable suspension apparatus and holder to permit weighing the specimen while suspended in water, conforming to AASHTO M 231.
- Suspension apparatus: Wire of the smallest practical size and constructed to permit the container to be fully immersed.
- Water bath: For immersing the specimen in water while suspended under the balance or scale and equipped with an overflow outlet for maintaining a constant water level.
- Towel: Damp cloth towel used for surface drying specimens.
- Oven: Capable of maintaining a temperature of $52 \pm 3^{\circ}\text{C}$ ($126 \pm 5^{\circ}\text{F}$) for drying the specimens to a constant mass.

- Pan: Pan or other suitable container of known mass, large enough to hold a sample for drying in oven.
- Thermometer: Having a range of 15 to 45°C (59 to 113°F) and, graduated in 0.1°C (0.2°F) subdivisions.
- Vacuum device: refer to the FOP for AASHTO R 79 (optional)

Procedure – Method A (Suspension)

Recently molded laboratory samples that have not been exposed to moisture do not need drying.

1. Dry the specimen to constant mass, if required.
 - a. Oven method
 - i. Initially dry overnight at $52 \pm 3^{\circ}\text{C}$ ($125 \pm 5^{\circ}\text{F}$).
 - ii. Determine and record the mass of the specimen. Designate this mass as M_p .
 - iii. Return the specimen to the oven for at least 2 hours.
 - iv. Determine and record the mass of the specimen. Designate this mass as M_n .
 - v. Determine percent change by subtracting the new mass determination, M_n , from the previous mass determination, M_p , divide by the previous mass determination M_p , and multiply by 100.
 - vi. Continue drying until there is no more than 0.05 percent change in specimen mass after 2-hour drying intervals (constant mass).
 - vii. Constant mass has been achieved; sample is defined as dry.
 - b. Vacuum dry method according to the FOP for AASHTO R 79.
2. Cool the specimen in air to $25 \pm 5^{\circ}\text{C}$ ($77 \pm 9^{\circ}\text{F}$), and determine and record the dry mass to the nearest 0.1 g. Designate this mass as A.
3. Fill the water bath to overflow level with water at $25 \pm 1^{\circ}\text{C}$ ($77 \pm 2^{\circ}\text{F}$) and allow the water to stabilize.
4. Zero or tare the balance with the immersion apparatus attached, ensuring that the device is not touching the sides or the bottom of the water bath.
5. Immerse the specimen shaking to remove the air bubbles. Place the specimen on its side in the suspension apparatus. Leave it immersed for 4 ± 1 minutes.
6. Determine and record the submerged weight to the nearest 0.1 g. Designate this submerged weight as C.
7. Remove the sample from the water and quickly surface dry with a damp cloth towel within 5 seconds.

Note 1: To expedite the procedure, steps 1 and 2 may be performed last. To further expedite the process, see Method C.

8. Zero or tare the balance.
9. Immediately determine and record the mass of the saturated surface-dry (SSD) specimen to nearest 0.1 g. Designate this mass as B. Any water that seeps from the specimen during the mass determination is considered part of the saturated specimen. Do not exceed 15 seconds performing Steps 7 through 9.

Calculations – Method A (Suspension)

Constant Mass:

Calculate constant mass using the following formula:

$$\%Change = \frac{M_p - M_n}{M_p} \times 100$$

Where:

M_p = previous mass measurement, g

M_n = new mass measurement, g

Bulk specific gravity (G_{mb}) and percent water absorbed:

$$G_{mb} = \frac{A}{B - C}$$

$$Percent\ Water\ Absorbed\ (by\ volume) = \frac{B - A}{B - C} \times 100$$

Where:

- G_{mb} = Bulk specific gravity
- A = Mass of dry specimen in air, g
- B = Mass of SSD specimen in air, g
- C = Weight of specimen in water at $25 \pm 1^\circ C$ ($77 \pm 2^\circ F$), g

Example:

$$G_{mb} = \frac{4833.6 \text{ g}}{4842.4 \text{ g} - 2881.3 \text{ g}} = 2.465$$

$$\% \text{ Water Absorbed (by volume)} = \frac{4842.4 \text{ g} - 4833.6 \text{ g}}{4842.4 \text{ g} - 2881.3 \text{ g}} \times 100 = 0.45\%$$

Given:

A	=	4833.6 g
B	=	4842.4 g
C	=	2881.3 g

Apparatus – Method B (Volumeter)

- Balance or scale: 5 kg capacity, readable to 0.1 g and conforming to AASHTO M 231.
- Water bath: For immersing the specimen in water, capable of maintaining a uniform temperature at $25 \pm 1^\circ\text{C}$ ($77 \pm 2^\circ\text{F}$).
- Thermometer: Range of 15 to 45°C (59 to 113°F) and graduated in 0.1°C (0.2°F) subdivisions.
- Volumeter: Calibrated to 1200 mL or appropriate capacity for test sample and having a tapered lid with a capillary bore.
- Oven: Capable of maintaining a temperature of $52 \pm 3^\circ\text{C}$ ($126 \pm 5^\circ\text{F}$). for drying the specimens to a constant mass.
- Pan: Pan or other suitable container of known mass, large enough to hold a sample for drying in oven.
- Towel: Damp cloth towel used for surface drying specimens.
- Vacuum device: refer to the FOP for AASHTO R 79 (optional)

Procedure – Method B (Volumeter)

Recently molded laboratory samples that have not been exposed to moisture do not need drying.

1. Dry the specimen to constant mass, if required.
 - a. Oven method:
 - i. Initially dry overnight at $52 \pm 3^{\circ}\text{C}$ ($125 \pm 5^{\circ}\text{F}$).
 - ii. Determine and record the mass of the specimen. Designate this mass as M_p .
 - iii. Return the specimen to the oven for at least 2 hours.
 - iv. Determine and record the mass of the specimen. Designate this mass as M_n .
 - v. Determine percent change by subtracting the new mass determination, M_n , from the previous mass determination, M_p , divide by the previous mass determination, M_p , and multiply by 100.
 - vi. Continue drying until there is no more than 0.05 percent change in specimen mass after 2-hour drying intervals (constant mass).
 - vii. Constant mass has been achieved; sample is defined as dry.
 - b. Vacuum dry method according to the FOP for AASHTO R 79.
2. Cool the specimen in air to $25 \pm 5^{\circ}\text{C}$ ($77 \pm 9^{\circ}\text{F}$), and determine and record the dry mass to the nearest 0.1 g. Designate this mass as A.
3. Immerse the specimen in the temperature-controlled water bath at $25 \pm 1^{\circ}\text{C}$ ($77 \pm 2^{\circ}\text{F}$) for at least 10 minutes.
4. At the end of the ten-minute period, fill the volumeter with distilled water at $25 \pm 1^{\circ}\text{C}$ ($77 \pm 2^{\circ}\text{F}$) making sure some water escapes through the capillary bore of the tapered lid.
5. Wipe the volumeter dry. Determine the mass of the volumeter and water to the nearest 0.1 g. Designate this mass as D.
6. Remove the specimen from the water bath and quickly surface dry with a damp cloth towel within 5 seconds.
7. Immediately determine and record the mass of the SSD specimen to the nearest 0.1 g. Designate this mass as B. Any water that seeps from the specimen during the mass determination is considered part of the saturated specimen.
8. Place the specimen in the volumeter and let stand 60 seconds.
9. Bring the temperature of the water to $25 \pm 1^{\circ}\text{C}$ ($77 \pm 2^{\circ}\text{F}$) and cover the volumeter, making sure some water escapes through the capillary bore of the tapered lid.
10. Wipe the volumeter dry.
11. Determine and record the mass of the volumeter, water, and specimen to the nearest 0.1 g. Designate this mass as E.

Note 2: Method B is not acceptable for use with specimens that have more than 6 percent air voids.

Calculations – Method B (Volumeter)

Constant Mass:

Calculate constant mass using the following formula:

$$\%Change = \frac{M_p - M_n}{M_p} \times 100$$

Where:

M_p = previous mass measurement, g

M_n = new mass measurement, g

Bulk specific gravity (G_{mb}) and percent water absorbed:

$$G_{mb} = \frac{A}{B + D - E}$$

$$Percent\ Water\ Absorbed\ (by\ volume) = \frac{B - A}{B + D - E} \times 100$$

Where:

G_{mb} = Bulk specific gravity

A = Mass of dry specimen in air, g

B = Mass of SSD specimen in air, g

D = Mass of volumeter filled with water at $25 \pm 1^\circ C$ ($77 \pm 2^\circ F$), g

E = Mass of volumeter filled with specimen and water, g

Example:

$$G_{mb} = \frac{4833.6 \text{ g}}{4842.4 \text{ g} + 2924.4 \text{ g} - 5806.0 \text{ g}} = 2.465$$

$$\% \text{ Water Absorbed (by volume)} = \frac{4842.4 \text{ g} - 4833.6 \text{ g}}{4842.4 \text{ g} + 2924.4 \text{ g} - 5806.0 \text{ g}} \times 100 = 0.45\%$$

Given:

A	=	4833.6 g
B	=	4842.4 g
D	=	2924.4 g
E	=	5806.0 g

Apparatus – Method C (Rapid Test for Method A or B)

- Oven: Capable of maintaining a temperature of $110 \pm 5^\circ\text{C}$ ($230 \pm 9^\circ\text{F}$) for drying the specimens to a constant mass.

See Methods A or B.

Note 3: This procedure can be used for specimens that are not required to be saved and contain substantial amounts of moisture. Cores can be tested the same day as obtained by this method.

Procedure – Method C (Rapid Test for Method A or B)

1. Start on Step 3 of Method A or B, and complete that procedure, then determine dry mass, A, as follows.
2. Determine and record mass of a large, flat-bottom container.
3. Place the specimen in the container.
4. Place in an oven at $110 \pm 5 \text{ C}$ ($230 \pm 9 \text{ F}$).
5. Dry until the specimen can be easily separated into fine aggregate particles that are not larger than 6.3 mm ($\frac{1}{4}$ in.).
6. Determine and record the mass of the specimen. Designate this mass as M_p .
7. Return the specimen to the oven for at least 2 hours.
8. Determine and record the mass of the specimen. Designate this mass as M_n .

9. Determine percent change by subtracting the new mass determination, M_n , from the previous mass determination, M_p , divide by the previous mass determination, M_p , and multiply by 100.
10. Continue drying until there is no more than 0.05 percent change in specimen mass after 2-hour drying intervals (constant mass).
11. Constant mass has been achieved; sample is defined as dry.
12. Cool in air to $25 \pm 5^\circ\text{C}$ ($77 \pm 9^\circ\text{F}$).
13. Determine and record the mass of the container and dry specimen to the nearest 0.1 g.
14. Determine and record the mass of the dry specimen to the nearest 0.1 g by subtracting the mass of the container from the mass determined in Step 13. Designate this mass as A.

Calculations – Method C (Rapid Test for Method A or B)

Complete the calculations as outlined in Methods A or B, as appropriate.

Report

- On forms approved by the agency
- Sample ID
- G_{mb} to the nearest 0.001
- Absorption to the nearest 0.01 percent
- Method performed.

PLASTIC FINES IN GRADED AGGREGATES AND SOILS BY THE USE OF THE SAND EQUIVALENT TEST FOP FOR AASHTO T 176

Scope

This procedure covers the determination of plastic fines in accordance with AASHTO T 176-22. It serves as a rapid test to show the relative proportion of fine dust or clay-like materials in fine aggregates (FA) and soils.

Apparatus

See AASHTO T 176 for a detailed listing of sand equivalent apparatus. Note that the siphon tube and blow tube may be glass or stainless steel as well as copper.

- Graduated plastic cylinder.
- Rubber stopper.
- Irrigator tube.
- Weighted foot assembly: Having a mass of 1000 ± 5 g. There are two models of the weighted foot assembly. The older model has a guide cap that fits over the upper end of the graduated cylinder and centers the rod in the cylinder. It is read using a slot in the centering screws. The newer model has a sand-reading indicator 254 mm (10 in.) above this point and is preferred for testing clay-like materials.
- Bottle: clean, glass or plastic, of sufficient size to hold working solution
- Siphon assembly: The siphon assembly will be fitted to a 4 L (1 gal.) bottle of working calcium chloride solution placed on a shelf 915 ± 25 mm (36 ± 1 in.) above the work surface.
- Measuring can: With a capacity of 85 ± 5 mL (3 oz.).
- Balance or scale: Capacity sufficient for sample mass, accurate to 0.1 percent of the sample mass or readable to 0.1 g and meeting the requirements of AASHTO M 231.
- Funnel: With a wide mouth for transferring sample into the graduated cylinder.
- Quartering cloth: 600 mm (2 ft.) square nonabsorbent cloth, such as plastic or oilcloth.
- Mechanical splitter: See the FOP for AASHTO R 76.
- Strike-off bar: A straightedge or spatula.
- Clock or watch reading in minutes and seconds.
- Manual shaker: A manually operated sand equivalent shaker capable of producing an oscillating motion at a rate of 100 complete cycles in 45 ± 5 seconds, with a hand assisted half stroke length of 127 ± 5 mm (5 ± 0.2 in.). It may be held stable by hand during the shaking operation. It is recommended that this shaker be fastened securely to a firm and level mount, by bolts or clamps, if many determinations are to be made.

- Mechanical shaker: See AASHTO T 176 for equipment and procedure.
- Oven: Capable of maintaining a temperature of $110 \pm 5^{\circ}\text{C}$ ($230 \pm 9^{\circ}\text{F}$).
- Thermometer: Calibrated liquid-in-glass or electronic digital type designed for total immersion and accurate to 0.1°C (0.2°F).
- Sieve: 4.75-mm (No. 4) sieve meeting the requirements of the FOP for AASHTO T 27/T 11

Materials

- Stock calcium chloride solution: Obtain commercially prepared calcium chloride stock solution meeting AASHTO requirements.
- Working calcium chloride solution: Make 3.8 L (1 gal) of working solution. Fill the bottle with 2 L (1/2 gal) of distilled or demineralized water, add one 3 oz. measuring can (85 ± 5 mL) of stock calcium chloride solution. Agitate vigorously for 1 to 2 minutes. Add the remainder of the water, approximately 2 L (1/2 gal.) for a total of 3.8 L (1 gal) of working solution. Repeat the agitation process. Tap water may be used if it is proven to be non-detrimental to the test and if it is allowed by the agency. The shelf life of the working solution is approximately 30 days. Label working solution with the date mixed. Discard working solutions more than 30 days old.

Note 1: The graduated cylinder filled to 4.4 in. contains 88 mL and may be used to measure the stock solution.

Control

The temperature of the working solution should be maintained at $22 \pm 3^{\circ}\text{C}$ ($72 \pm 5^{\circ}\text{F}$) during the performance of the test. If field conditions preclude the maintenance of the temperature range, reference samples should be submitted to the Central/Regional Laboratory, as required by the agency, where proper temperature control is possible. Samples that meet the minimum sand equivalent requirement at a working solution temperature outside of the temperature range need not be subject to reference testing.

Sample Preparation

1. Obtain the sample in accordance with the FOP for AASHTO R 90 and reduce in accordance with the FOP for AASHTO R 76.
2. Sieve the sample over the 4.75 mm (No. 4) sieve. If the material is in clods, break it up and re-screen it over a 4.75 mm (No. 4) sieve. Clean all fines from particles retained on the 4.75 mm (No. 4) sieve and include with the material passing that sieve.
3. Split or quarter 1000 to 1500 g of material from the portion passing the 4.75 mm (No. 4) sieve. Use extreme care to obtain a truly representative portion of the original sample.

Note 2: Experiments show that, as the amount of material being reduced by splitting or quartering is decreased, the accuracy of providing representative portions is reduced. It is imperative that the sample be split or quartered carefully. When it appears necessary, dampen the material before splitting or quartering to avoid segregation or loss of fines.

Note 3: All tests, including reference tests, will be performed using Alternative Method No. 2 as described in AASHTO T 176, unless otherwise specified.

4. The sample must have the proper moisture content to achieve reliable results. This condition is determined by tightly squeezing a small portion of the thoroughly mixed sample in the palm of the hand. If the cast that is formed permits careful handling without breaking, the correct moisture content has been obtained.

Note 4: Clean sands having little 75 μm (No. 200), such as sand for Portland Cement Concrete (PCC), may not form a cast.

If the material is too dry, the cast will crumble, and it will be necessary to add water and remix and retest until the material forms a cast. When the moisture content is altered to provide the required cast, the altered sample should be placed in a pan, covered with a lid or with a damp cloth that does not touch the material, and allowed to stand for a minimum of 15 minutes. Samples that have been sieved without being air-dried and still retain enough natural moisture are exempted from this requirement.

If the material shows any free water, it is too wet to test and must be drained and air dried. Mix frequently to ensure uniformity. This drying process should continue until squeezing provides the required cast.

5. Place the sample on the quartering cloth and mix by alternately lifting each corner of the cloth and pulling it over the sample toward the diagonally opposite corner, being careful to keep the top of the cloth parallel to the bottom, thus causing the material to be rolled. When the material appears homogeneous, finish the mixing with the sample in a pile near the center of the cloth.
6. Fill the measuring can by pushing it through the base of the pile while exerting pressure with the hand against the pile on the side opposite the measuring can. As the can is moved through the pile, hold enough pressure with the hand to cause the material to fill the tin to overflowing. Press firmly with the palm of the hand, compacting the material and placing the maximum amount in the can. Strike off the can level with the straightedge or spatula.
7. When required, repeat steps 5 and 6 to obtain additional samples.

Procedure

1. Start the siphon by forcing air into the top of the solution bottle through the tube while the pinch clamp is open. Siphon 101.6 \pm 2.5 mm (4 \pm 0.1 in.) of working calcium chloride solution into the plastic cylinder.
2. Pour the prepared test sample from the measuring can into the plastic cylinder, using the funnel to avoid spilling.
3. Tap the bottom of the cylinder sharply on the heel of the hand several times to release air bubbles and to promote thorough wetting of the sample.
4. Allow the wetted sample to stand undisturbed for 10 \pm 1 minutes.
5. At the end of the 10-minute period, stopper the cylinder and loosen the material from the bottom by simultaneously partially inverting and shaking the cylinder.

6. After loosening the material from the bottom of the cylinder, shake the cylinder and contents by any one of the following methods:
 - a. Mechanical Method – Place the stoppered cylinder in the mechanical shaker, set the timer, and allow the machine to shake the cylinder and contents for 45 ± 1 seconds.

Caution: Agencies may require additional operator qualifications for the next two methods.

- b. Manual Method – Secure the stoppered cylinder in the three spring clamps on the carriage of the manually-operated sand equivalent shaker and set the stroke counter to zero. Stand directly in front of the shaker and force the pointer to the stroke limit marker painted on the backboard by applying an abrupt horizontal thrust to the upper portion of the right hand spring strap.

Remove the hand from the strap and allow the spring action of the straps to move the carriage and cylinder in the opposite direction without assistance or hindrance. Apply enough force to the right-hand spring steel strap during the thrust portion of each stroke to move the pointer to the stroke limit marker by pushing against the strap with the ends of the fingers to maintain a smooth oscillating motion. The center of the stroke limit marker is positioned to provide the proper stroke length and its width provides the maximum allowable limits of variation.

Proper shaking action is accomplished when the tip of the pointer reverses direction within the marker limits. Proper shaking action can best be maintained by using only the forearm and wrist action to propel the shaker. Continue shaking for 100 strokes.

- c. Hand Method – Hold the cylinder in a horizontal position and shake it vigorously in a horizontal linear motion from end to end. Shake the cylinder 90 cycles in approximately 30 seconds using a throw of $229 \text{ mm} \pm 25 \text{ mm}$ ($9 \pm 1 \text{ in.}$). A cycle is defined as a complete back and forth motion. To properly shake the cylinder at this speed, it will be necessary for the operator to shake with the forearms only, relaxing the body and shoulders.
7. Set the cylinder upright on the worktable and remove the stopper.
8. Insert the irrigator tube in the cylinder and rinse material from the cylinder walls as the irrigator is lowered. Force the irrigator through the material to the bottom of the cylinder by applying a gentle stabbing and twisting action while the working solution flows from the irrigator tip. Work the irrigator tube to the bottom of the cylinder as quickly as possible as it becomes more difficult to do this as the washing proceeds. This flushes the fine material into suspension above the coarser sand particles.

Continue to apply a stabbing and twisting action while flushing the fines upward until the cylinder is filled to the 381 mm (15 in.) mark. Then raise the irrigator slowly without shutting off the flow so that the liquid level is maintained at about 381 mm (15 in.) while the irrigator is being withdrawn. Regulate the flow just before the irrigator is entirely withdrawn and adjust the final level to 381 mm (15 in.).

Note 5: Occasionally the holes in the tip of the irrigator tube may become clogged by a particle of sand. If the obstruction cannot be freed by any other method, use a pin or other sharp object to force it out, using extreme care not to enlarge the size of the opening. Also, keep the tip sharp as an aid to penetrating the sample.

9. Allow the cylinder and contents to stand undisturbed for 20 minutes \pm 15 seconds. Start timing immediately after withdrawing the irrigator tube.

Note 6: Any vibration or movement of the cylinder during this time will interfere with the normal settling rate of the suspended clay and will cause an erroneous result.

10. Clay and sand readings:

- a. At the end of the 20-minute sedimentation period, read and record the level of the top of the clay suspension. This is referred to as the clay reading.
- b. If no clear line of demarcation has formed at the end of the 20-minute sedimentation period, allow the sample to stand undisturbed until a clay reading can be obtained, then immediately read and record the level of the top of the clay suspension and the total sedimentation time. If the total sedimentation time exceeds 30 minutes, rerun the test using three individual samples of the same material. Read and record the clay column height of the sample requiring the shortest sedimentation period only. Once a sedimentation time has been established, subsequent tests will be run using that time. The time will be recorded along with the test results on all reports.
- c. After the clay reading has been taken, place the weighted foot assembly over the cylinder and gently lower the assembly until it comes to rest on the sand. Do not allow the indicator to hit the mouth of the cylinder as the assembly is being lowered. Subtract 254 mm (10 in.) from the level indicated by the extreme top edge of the indicator and record this value as the sand reading.
- d. If clay or sand readings fall between 2.5 mm (0.1 in.) graduations, record the level of the higher graduation as the reading. For example, a clay reading that appears to be 7.95 would be recorded as 8.0; a sand reading that appears to be 3.22 would be recorded as 3.3.
- e. If two Sand Equivalent (SE) samples are run on the same material and the second varies by more than ± 4 , based on the first cylinder result, additional tests shall be run.
- f. If three or more Sand Equivalent (SE) samples are run on the same material, average the results. If an individual result varies by more than ± 4 , based on the average result, additional tests shall be run.

Calculations

Calculate the SE to the nearest 0.1 using the following formula:

$$SE = \frac{\text{Sand Reading}}{\text{Clay Reading}} \times 100$$

Example

$$SE = \frac{3.3}{8.0} \times 100 = 41.25 \text{ or } 41.3 \quad \text{Report 42}$$

Given:

Sand Reading = 3.3

Clay Reading = 8.0

Note 7: This example reflects the use of equipment made with English units. At this time, equipment made with metric units is not available.

Report the SE as the next higher whole number. In the example above, the 41.3 would be reported as 42. An SE of 41.0 would be reported as 41.

When averaging two or more samples, raise each calculated SE value to the next higher whole number (reported value) before averaging.

Example:

calculated value 1 = 41.3

calculated value 2 = 42.8

These values are reported as 42 and 43, respectively.

Average the two reported values:

$$\text{Average SE} = \frac{42 + 43}{2} = 42.5 \quad \text{Report 43}$$

If the average value is not a whole number, raise it to the next higher whole number.

Report

- On forms approved by the agency
- Sample ID
- Results to the next higher whole number
- Sedimentation time if over 20 minutes

**Air Content of Freshly Mixed Concrete
by the Volumetric Method**

AASHTO Designation: T 196-22

ASTM Designation: C 173-10

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THEORETICAL MAXIMUM SPECIFIC GRAVITY (G_{mm}) AND DENSITY OF ASPHALT MIXTURES FOP FOR AASHTO T 209

Scope

This procedure covers the determination of the maximum specific gravity (G_{mm}) of uncompacted asphalt mixtures in accordance with AASHTO T 209-22. Two methods using different containers – bowl and pycnometer / volumetric flask– are covered.

Specimens prepared in the laboratory shall be cured according to agency standards.

Apparatus

- Balance or scale: 10,000 g capacity, readable to 0.1 g, meeting AASHTO M 231, Class G2
- Container: A glass, metal, or plastic bowl, pycnometer or volumetric flask between 2000 and 10,000 mL as required by the minimum sample size requirements in Table 1 sample and capable of withstanding full vacuum applied
- Pycnometer / volumetric flask cover: A glass plate or a metal or plastic cover with a vented opening
- Vacuum lid: A transparent lid with a suitable vacuum connection, with a vacuum opening to be covered with a fine wire mesh
- Vacuum pump or water aspirator: Capable of evacuating air from the container to a residual pressure of 3.4 kPa (25 mm Hg)
- Vacuum measurement device: Residual pressure manometer or vacuum gauge, capable of measuring residual pressure down to 3.4 kPa (25 mm Hg) or less and accurate to 0.1 kPa (1 mm Hg)
- Manometer or vacuum gauge: Capable of measuring the vacuum being applied at the source of the vacuum
- Water bath: A constant-temperature water bath (optional for Pycnometer or Volumetric Flask Method)
- Thermometers: Thermometric devices accurate to 0.25°C (0.5°F) and with a temperature range of at least 20 to 45°C (68 to 113°F).
- Bleeder valve to adjust vacuum
- Automatic vacuum control unit (optional)
- Timer
- Towel

Standardization

Use a container that has been standardized according to Annex A. The container shall be standardized periodically in conformance with procedures established by the agency.

Test Sample Preparation

1. Obtain samples in accordance with the FOP for AASHTO R 97 and reduce according to the FOP for AASHTO R 47.
2. Test sample size shall conform to the requirements of Table 1. Samples larger than the capacity of the container may be tested in two or more increments. Results will be combined by calculating the weighted average ($G_{mm (avg)}$). If the increments have a specific gravity difference greater than 0.013, the test must be re-run.
3. Plant-produced samples may be short-term conditioned according to AASHTO R 30 as specified by the agency.

Note 1: Short-term conditioning at the specified temperature is especially important when absorptive aggregates are used. This short-term conditioning will ensure the computation of realistic values for the amount of asphalt absorbed by the aggregate and void properties of the mix. Plant-produced asphalt mixtures should be evaluated to make sure short-term conditioning has taken place during production and delivery.

Table 1
Test Sample Size for G_{mm}

Nominal Maximum* Aggregate Size mm (in.)	Minimum Mass g
37.5 or greater (1½)	4000
19 to 25 (¾ to 1)	2500
12.5 or smaller (½)	1500

*Nominal maximum size: One sieve larger than the first sieve to retain more than 10 percent of the material using an agency specified set of sieves based on cumulative percent retained.

Procedure – General

Two procedures – bowl and pycnometer / volumetric flask – are covered. The first 11 steps are the same for both.

1. Separate the particles of the sample, taking care not to fracture the mineral particles, so that the particles of the fine aggregate portion are not larger than 6.3 mm (¼ in.). If the mixture is not sufficiently soft to be separated manually, place it in a large flat pan and warm in an oven only until it is pliable enough for separation.
2. Cool the sample to room temperature.
3. Determine and record the mass of the dry container to the nearest 0.1 g.
4. Place the sample in the container.
5. Determine and record the mass of the dry container and sample to the nearest 0.1 g.

6. Determine and record the mass of the sample by subtracting the mass determined in Step 3 from the mass determined in Step 5. Designate this mass as “A.”
 7. Add sufficient water at approximately 25° C (77° F) to cover the sample by about 25 mm (1 in.).
- Note 1:* The release of entrapped air may be facilitated by the addition of a wetting agent. Check with the agency to see if this is permitted and, if it is, for a recommended agent.
8. Place the lid on the container and attach the vacuum line. To ensure a proper seal between the container and the lid, wet the O-ring or use a petroleum gel.
 9. Remove entrapped air by subjecting the sample to a partial vacuum of 3.7 ± 0.3 kPa (27.5 ± 2.5 mm Hg) residual pressure for 15 ± 1 minutes.
 10. Agitate the container and sample, either continuously by mechanical device or manually by vigorous shaking at 2-minute intervals. This agitation facilitates the removal of air.
 11. Release the vacuum. Increase the pressure to atmospheric pressure in 10 to 15 seconds if the vacuum release is not automated. Turn off the vacuum pump and remove the lid. When performing the pycnometer / volumetric flask method, complete steps 12B through 16B within 10 ± 1 minute.

Procedure – Bowl

- 12A. Fill the water bath to overflow level with water at $25 \pm 1^\circ\text{C}$ ($77 \pm 2^\circ\text{F}$) and allow the water to stabilize.
- 13A. Zero or tare the balance with the immersion apparatus attached, ensuring that the device is not touching the sides or the bottom of the water bath.
- 14A. Suspend and immerse the bowl and sample in water at $25 \pm 1^\circ\text{C}$ ($77 \pm 2^\circ\text{F}$) for 10 ± 1 minute. The holder shall be immersed sufficiently to cover both it and the bowl.
- 15A. Determine and record the submerged weight of the bowl and sample to the nearest 0.1 g. Designate as “C.”

Procedure – Pycnometer or Volumetric Flask

- 12B. Immediately fill the pycnometer / volumetric flask with water without reintroducing air.
- 13B. Stabilize the temperature of the pycnometer / volumetric flask and sample so that the final temperature is within $25 \pm 1^\circ\text{C}$ ($77 \pm 2^\circ\text{F}$).
- 14B. Finish filling the pycnometer / volumetric flask with water that is $25 \pm 1^\circ\text{C}$ ($77 \pm 2^\circ\text{F}$), place the cover or a glass plate on the pycnometer / volumetric flask, and eliminate all air.

Note 2: When using a metal pycnometer and cover, place the cover on the pycnometer and push down slowly, forcing excess water out of the hole in the center of the cover. Use care when filling the pycnometer to avoid reintroducing air into the water.

- 15B. Towel dry the outside of the pycnometer / volumetric flask and cover.

16B. Determine and record the mass of the pycnometer / volumetric flask, cover, de-aired water, and sample to the nearest 0.1 g. within 10 ±1 minute of completion of Step 11. Designate this mass as “E.”

Procedure – Mixtures Containing Uncoated Porous Aggregate

If the pores of the aggregates are not thoroughly sealed by a bituminous film, they may become saturated with water during the vacuuming procedure, resulting in an error in maximum density. To determine if this has occurred, complete the general procedure and then:

1. Carefully drain water from sample through a towel held over the top of the container to prevent loss of material.
2. Spread sample in a flat shallow pan and place before an electric fan to remove surface moisture.
3. Determine the mass of the sample when the surface moisture appears to be gone.
4. Continue drying and determine the mass of the sample at 15-minute intervals until less than a 0.5 g loss is found between determinations.
5. Record the mass as the saturated surface dry mass to the nearest 0.1 g. Designate this mass as “A_{SSD}.”
6. Calculate, as indicated below, G_{mm} using “A” and “A_{SSD},” and compare the two values.

Calculation

Calculate the G_{mm} to three decimal places as follows:

Bowl Procedure

$$G_{mm} = \frac{A}{A + B - C} \quad \text{or} \quad G_{mm} = \frac{A}{A_{SSD} + B - C}$$

(for mixes containing uncoated aggregate materials)

Where:

- A = mass of dry sample in air, g
- A_{SSD} = mass of saturated surface dry sample in air, g
- B = standardized submerged weight of the bowl, g (see Annex A)
- C = submerged weight of sample and bowl, g

Example:

$$G_{mm} = \frac{1432.7 \text{ g}}{1432.7 \text{ g} + 286.3 \text{ g} - 1134.9 \text{ g}} = 2.453 \quad \text{or}$$

$$G_{mm} = \frac{1432.7 \text{ g}}{1434.2 \text{ g} + 286.3 \text{ g} - 1134.9 \text{ g}} = 2.447$$

Given:

A = 1432.7 g

A_{SSD} = 1434.2 g

B = 286.3 g

C = 1134.9 g

Pycnometer / Volumetric Flask Procedure

$$G_{mm} = \frac{A}{A + D - E} \quad \text{or} \quad G_{mm} = \frac{A}{A_{SSD} + D - E}$$

(for mixtures containing uncoated materials)

Where:

A = mass of dry sample in air, g

A_{SSD} = mass of saturated surface-dry sample in air, g

D = standardized mass of pycnometer / volumetric flask filled with water at 25°C (77°F), g, (See Annex A)

E = mass of pycnometer / volumetric flask filled with water and the test sample at test temperature, g

Example (two increments of a large sample):

$$G_{mm_1} = \frac{2200.3 \text{ g}}{2200.3 \text{ g} + 7502.5 \text{ g} - 8812.0 \text{ g}} = 2.470$$

$$G_{mm_2} = \frac{1960.2 \text{ g}}{1960.2 \text{ g} + 7525.5 \text{ g} - 8690.8 \text{ g}} = 2.466$$

Given:

Increment 1	Increment 2
A ₁ = 2200.3 g	A ₂ = 1960.2 g
D ₁ = 7502.5 g	D ₂ = 7525.5 g
E ₁ = 8812.0 g	E ₂ = 8690.8 g

$$\text{Variation} = 2.470 - 2.466 = 0.004, \text{ which is } < 0.013$$

Allowable variation is: 0.013. The values may be used.

Weighted average

For large samples tested a portion at a time, calculate the $G_{mm(avg)}$ by multiplying the dry mass of each increment by its G_{mm} , add the results together (Σ) and divide by the sum (Σ) of the dry masses.

$$G_{mm(avg)} = \frac{\Sigma(A_x \times G_{mm_x})}{\Sigma A_x}$$

or

$$G_{mm(avg)} = \frac{(A_1 \times G_{mm_1}) + (A_2 \times G_{mm_2})}{A_1 + A_2} \text{ etc.}$$

Where:

- A_x = mass of dry sample increment in air, g
- G_{mmx} = theoretical maximum specific gravity of the increment

Example:

$$G_{mm(avg)} = \frac{(2200.3 \text{ g} \times 2.470) + (1960.2 \text{ g} \times 2.466)}{2200.3 \text{ g} + 1960.2 \text{ g}} = \frac{10,268.6}{4160.5 \text{ g}} = 2.468$$

Theoretical Maximum Density

To calculate the theoretical maximum density at 25°C (77°F) use one of the following formulas. The density of water at 25°C (77°F) is 997.1 kg/ m³ in Metric units or 62.245 lb/ft³ in English units.

$$\text{Theoretical maximum density kg/m}^3 = G_{mm} \times 997.1 \text{ kg/ m}^3$$

$$2.468 \times 997.1 \text{ kg/ m}^3 = 2461 \text{ kg/ m}^3$$

or

$$\text{Theoretical maximum density lb/ft}^3 = G_{mm} \times 62.245 \text{ lb/ft}^3$$

$$2.468 \times 62.245 \text{ lb/ft}^3 = 153.6 \text{ lb/ft}^3$$

Report

- On forms approved by the agency
- Sample ID
- G_{mm} to the nearest 0.001
- Theoretical maximum density to the nearest 1 kg/m³ (0.1 lb/ft³)

ANNEX A – STANDARDIZATION OF BOWL AND PYCNOMETER OR VOLUMETRIC FLASK

(Mandatory Information)

Bowl – Standardization

1. Fill the water bath to overflow level with $25 \pm 1^{\circ}\text{C}$ ($77 \pm 2^{\circ}\text{F}$) water and allow the water to stabilize.
2. Zero or tare the balance with the immersion apparatus attached, ensuring that the device is not touching the sides or the bottom of the water bath.
3. Suspend and completely immerse the bowl for 10 ± 1 minute.
4. Determine and record the submerged weight of the bowl to the nearest 0.1 g.
5. Refill the water bath to overflow level.
6. Perform Steps 2 through 5 two more times for a total of three determinations.
7. If the range of the three determinations is less than or equal to 0.3 g., average the determinations. Designate as “B.”
8. If the range of the three determinations is greater than 0.3 g., take corrective action and perform the standardization procedure again.

Bowl – Check

1. Fill the water bath to overflow level $25 \pm 1^{\circ}\text{C}$ ($77 \pm 2^{\circ}\text{F}$) water and allow the water to stabilize.
2. Zero or tare the balance with the immersion apparatus attached, ensuring that the device is not touching the sides or the bottom of the water bath.
3. Suspend and completely immerse the bowl for 10 ± 1 minute.
4. Determine and record the submerged weight of the bowl to the nearest 0.1 g.
5. If this determination is within 0.3 g of the standardized value, use the standardized value for “B.”
6. If it is not within 0.3 g, take corrective action and perform the standardization procedure again.
7. For labs that check the bowl standardization frequently (such as daily), calculate the moving average and range of the last three mass determinations. Designate the average of the last three masses as “B.”
8. If the moving range exceeds 0.3 g at any time, take corrective action and perform the standardization procedure again.

Pycnometer or Volumetric Flask – Standardization

1. Fill the pycnometer / volumetric flask with water at approximately 25°C (77°F).
2. Place the metal or plastic cover, or a glass plate on the pycnometer / volumetric flask and eliminate all air. (See Note 2.)
3. Stabilize the pycnometer / volumetric flask at $25 \pm 1^\circ\text{C}$ ($77 \pm 2^\circ\text{F}$) for 10 ± 1 min.
4. Towel dry the outside of the pycnometer / volumetric flask and cover.
5. Determine and record the mass of the pycnometer / volumetric flask, water, and lid to the nearest 0.1 g.
6. Perform Steps 2 through 5 two more times for a total of three determinations.
7. If the range of the three determinations is less than or equal to 0.3 g, average the three determinations. Designate as “D.”
8. If the range of the determinations is greater than 0.3 g., take corrective action and perform the “Pycnometer or Volumetric Flask – Standardization” again.

Pycnometer or Volumetric Flask – Check

1. Fill the pycnometer / volumetric flask with water at approximately 25°C (77°F).
2. Place the metal or plastic cover or a glass plate on the pycnometer / volumetric flask and eliminate all air. (See Note 2.)
3. Stabilize the pycnometer / volumetric flask at $25 \pm 1^\circ\text{C}$ ($77 \pm 2^\circ\text{F}$) for 10 ± 1 min.
4. Towel dry the outside of the pycnometer / volumetric flask and cover.
5. Determine and record the mass of the pycnometer / volumetric flask, water, and lid.
6. If this determination is within 0.3 g of the standardized value, use the standardized value for “D.”
7. If it is not within 0.3 g, perform the standardization procedure again.

**TOTAL EVAPORABLE MOISTURE CONTENT OF AGGREGATE BY DRYING
FOP FOR AASHTO T 255
LABORATORY DETERMINATION OF MOISTURE CONTENT OF SOILS
FOP FOR AASHTO T 265**

Scope

This procedure covers the determination of moisture content of aggregate and soil in accordance with AASHTO T 255-22 and AASHTO T 265-22. It may also be used for other construction materials.

Overview

Moisture content is determined by comparing the wet mass of a sample and the mass of the sample after drying to constant mass. The term constant mass is used to define when a sample is dry.

Constant mass – the state at which a mass does not change more than a given percent, after additional drying for a defined time interval, at a required temperature.

Apparatus

- Balance or scale: capacity sufficient for the principal sample mass, accurate to 0.1 percent of sample mass or readable to 0.1 g, and meeting the requirements of AASHTO M 231
- Containers, clean, dry, and capable of being sealed
- Suitable drying containers
- Microwave safe container with ventilated lid
- Heat source, thermostatically controlled, capable of maintaining $110 \pm 5^{\circ}\text{C}$ ($230 \pm 9^{\circ}\text{F}$).
 - Forced draft oven (preferred)
 - Ventilated oven
 - Convection oven
- Heat source, uncontrolled, for use when allowed by the agency, will not alter the material being dried, and close control of the temperature is not required:
 - Infrared heater/heat lamp, hot plate, fry pan, or any other device/method allowed by the agency .
 - Microwave oven (900 watts minimum)
- Utensils such as spoons
- Hot pads or gloves

Sample Preparation

Obtain a representative sample according to the FOP for AASHTO R 90 in its existing condition. If necessary, reduce the sample to moisture content sample size according to the FOP for AASHTO R 76.

For aggregate, the moisture content sample size is based on Table 1 or other information that may be specified by the agency.

TABLE 1
Sample Sizes for Moisture Content of Aggregate

Nominal Maximum Size* mm (in.)	Minimum Sample Mass g (lb)
150 (6)	50,000 (110)
100 (4)	25,000 (55)
90 (3 1/2)	16,000 (35)
75 (3)	13,000 (29)
63 (2 1/2)	10,000 (22)
50 (2)	8000 (18)
37.5 (1 1/2)	6000 (13)
25.0 (1)	4000 (9)
19.0 (3/4)	3000 (7)
12.5 (1/2)	2000 (4)
9.5 (3/8)	1500 (3.3)
4.75 (No. 4)	500 (1.1)

* One sieve larger than the first sieve to retain more than 10 percent of the material using an agency specified set of sieves based on cumulative percent retained. Where large gaps in specification sieves exist, intermediate sieve(s) may be inserted to determine nominal maximum.

For soils the moisture content sample size is based on Table 2 or other information that may be specified by the agency.

TABLE 2
Sample Sizes for Moisture Content of Soil

Maximum Particle Size mm (in.)	Minimum Sample Mass g
50 (2)	1000
25.0 (1)	500
12.5 (1/2)	300
4.75 (No. 4)	100
0.425 (No. 40)	10

Immediately seal or cover moisture content samples to prevent any change in moisture content or follow the steps in “Procedure.”

Procedure

Determine and record the sample mass as follows:

- For aggregate, determine and record all masses to the nearest 0.1 percent of the sample mass or to the nearest 0.1 g.
- For soil, determine and record all masses to the nearest 0.1 g.

When determining the mass of hot samples or containers or both, place and tare a buffer between the sample container and the balance. This will eliminate damage to or interference with the operation of the balance or scale.

1. Determine and record the mass of the container (and lid for microwave drying).
2. Place the wet sample in the container.
3. Determine and record the total mass of the container and wet sample.
 - a. For oven(s), hot plates, infrared heaters, etc.: Spread the sample in the container.
 - b. For microwave oven: Heap sample in the container; cover with ventilated lid.
4. Determine and record the wet mass of the sample (M_w) by subtracting the container mass determined in Step 1 from the mass of the container and sample determined in Step 3.
5. Place the sample in one of the following drying apparatuses:
 - a. For aggregate –
 - i. Controlled heat source (oven): at $110 \pm 5^\circ\text{C}$ ($230 \pm 9^\circ\text{F}$).
 - ii. Uncontrolled heat source (Hot plate, infrared heater, or other heat source as allowed by the agency): Stir frequently to avoid localized overheating.
 - b. For soil – controlled heat source (oven): at $110 \pm 5^\circ\text{C}$ ($230 \pm 9^\circ\text{F}$).

Note 1: Soils containing gypsum or significant amounts of organic material require special drying. For reliable moisture contents dry these soils at 60°C (140°F). For more information see AASHTO T 265, Note 2.

6. Dry until sample appears moisture free.
7. Determine mass of sample and container.
8. Determine and record the mass of the sample by subtracting the container mass determined in Step 1 from the mass of the container and sample determined in Step 7.
9. Return sample and container to the heat source for additional drying.
 - a. For aggregate –
 - i. Controlled heat source (oven): 30 minutes
 - ii. Uncontrolled heat source (Hot plate, infrared heater, or other heat source as allowed by the agency): 10 minutes
 - iii. Uncontrolled heat source (Microwave oven): 2 minutes

Caution: Some minerals in the sample may cause the aggregate to overheat, crack, and explode; altering the aggregate gradation.

- b. For soil – controlled heat source (oven): 1 hour
10. Determine mass of sample and container.
11. Determine and record the mass of the sample by subtracting the container mass determined in Step 1 from the mass of the container and sample determined in Step 10.
12. Determine percent change by subtracting the new mass determination (M_n) from the previous mass determination (M_p) divide by the previous mass determination (M_p) multiply by 100.
13. Continue drying, performing steps 9 through 12, until there is less than a 0.10 percent change after additional drying time.
14. Constant mass has been achieved; sample is defined as dry.
15. Allow the sample to cool. Immediately determine and record the total mass of the container and dry sample.
16. Determine and record the dry mass of the sample (M_D) by subtracting the mass of the container determined in Step 1 from the mass of the container and sample determined in Step 15.
17. Determine and record percent moisture (w) by subtracting the final dry mass determination (M_D) from the initial wet mass determination (M_w) divide by the final dry mass determination (M_D) multiply by 100.

Table 3
Methods of Drying

Aggregate		
Heat Source	Specific Instructions	Drying intervals to achieve constant mass (minutes)
Controlled:		
Forced draft (preferred), ventilated, or convection oven	110 ±5°C (230 ±9°F)	30
Uncontrolled:		
Hot plate, infrared heater, or any other device/method allowed by the agency	Stir frequently	10
Microwave	Heap sample and cover with ventilated lid	2
Soil		
Heat Source	Specific Instructions	Drying increments (minutes)
Controlled:		
Forced draft (preferred), ventilated, or convection oven	110 ±5°C (230 ±9°F)	1 hour

Calculation

Constant Mass

Calculate constant mass using the following formula:

$$\% \text{ Change} = \frac{M_p - M_n}{M_p} \times 100$$

Where:

M_p = previous mass measurement

M_n = new mass measurement

Example:

Mass of container: 1232.1 g

Mass of container and sample after first drying cycle: 2637.2 g

Mass, M_p , of possibly dry sample: 2637.2 g - 1232.1 g = 1405.1 g

Mass of container and sample after second drying cycle: 2634.1 g

Mass, M_n , of sample: 2634.1 g - 1232.1 g = 1402.0 g

$$\% \text{ Change} = \frac{1405.1 \text{ g} - 1402.0 \text{ g}}{1405.1 \text{ g}} \times 100 = 0.22\%$$

0.22 percent is not less than 0.10 percent, so continue drying.

Mass of container and sample after third drying cycle: 2633.0 g

Mass, M_n , of sample: 2633.0 g - 1232.1 g = 1400.9 g

$$\% \text{ Change} = \frac{1402.0 \text{ g} - 1400.9 \text{ g}}{1402.0 \text{ g}} \times 100 = 0.08\%$$

0.08 percent is less than 0.10 percent, so constant mass has been reached.

Moisture Content:

Calculate the moisture content, as a percent, using the following formula:

$$w = \frac{M_W - M_D}{M_D} \times 100$$

where:

w = moisture content, percent

M_w = wet mass

M_D = dry mass

Example:

Mass of container: 1232.1 g

Mass of container and wet sample: 2764.7 g

Mass, M_w, of wet sample: 2764.7 g - 1232.1 g = 1532.6 g

Mass of container and dry sample (COOLED): 2633.5 g

Mass, M_D, of dry sample: 2633.5 g - 1232.1 g = 1401.4 g

$$w = \frac{1532.6 \text{ g} - 1401.4 \text{ g}}{1401.4 \text{ g}} \times 100 = \frac{131.2 \text{ g}}{1401.4 \text{ g}} \times 100 = 9.36\% \text{ report } 9.4\%$$

Report

- On forms approved by the agency
- Sample ID
- M_w, wet mass
- M_D, dry mass
- w, moisture content to the nearest 0.1 percent

EMBANKMENT AND BASE
IN-PLACE DENSITY

WAQTC

FOP AASHTO T 255 / T 265 (22)

ONE-POINT METHOD FOR DETERMINING MAXIMUM DRY DENSITY AND OPTIMUM MOISTURE FOP FOR AASHTO T 272

Scope

This procedure provides for a rapid determination of the maximum dry density and optimum moisture content of a soil sample, using a one-point determination in accordance with AASHTO T 272-18. This procedure is related to the FOPs for AASHTO T 99/T 180 and R 75.

One-point determinations are made by compacting the soil in a mold of a given size with a specified rammer dropped from a specified height and then compared to an individual moisture/density curve (FOP for AASHTO T 99 or T 180) or a family of curves (FOP for AASHTO R 75). Four alternate methods – A, B, C, and D – are used and correspond to the methods described in the FOP for AASHTO T 99/T 180. The method used in AASHTO T 272 must match the method used for the reference curve or to establish the family of curves. For example, when moisture-density relationships as determined by T 99 - Method C are used to form the family of curves or an individual moisture density curve, then T 99 - Method C must be used to for the one-point determination.

Apparatus

See the FOP for AASHTO T 99/T 180.

Sample

Sample size determined according to the FOP for AASHTO T 310. In cases where the existing individual curve or family cannot be used a completely new curve will need to be developed and the sample size will be determined by the FOP for AASHTO T 99/T 180.

1. If the sample is damp, dry it until it becomes friable under a trowel. Drying may be in air or by use of a drying apparatus maintained at a temperature not exceeding 60°C (140°F).
2. Thoroughly break up aggregations in a manner that avoids reducing the natural size of individual particles.
3. Pass the material through the appropriate sieve.

Procedure

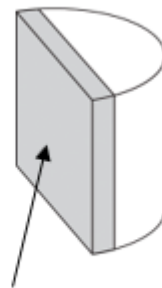
Use the method matching the individual curve or Family of Curves. Refer to Table 1 of the FOP for AASHTO T 99 / T 180 for corresponding mold size, number of layers, number of blows, sieve size, and rammer specification for the various test methods.

1. Determine the mass of the clean, dry mold. Include the base plate but exclude the extension collar. Record the mass to the nearest 1 g (0.005 lb).
2. Thoroughly mix the sample with sufficient water to adjust moisture content to 80 to 100 percent of the anticipated optimum moisture.

3. Form a specimen by compacting the prepared soil in the mold (with collar attached) in approximately equal layers. For each layer:
 - a. Spread the loose material uniformly in the mold.
- Note 1:* It is recommended to cover the remaining material with a non-absorbent sheet or damp cloth to minimize loss of moisture.
- b. Lightly tamp the loose material with the manual rammer or other similar device, this establishes a firm surface.
 - c. Compact each layer with uniformly distributed blows from the rammer.
 - d. Trim down material that has not been compacted and remains adjacent to the walls of the mold and extends above the compacted surface.
 4. Remove the extension collar. Avoid shearing off the sample below the top of the mold. The material compacted in the mold should not be over 6 mm (¼ in.) above the top of the mold once the collar has been removed.
 5. Trim the compacted soil even with the top of the mold with the beveled side of the straightedge.
 6. Clean soil from exterior of the mold and base plate.
 7. Determine the mass of the mold and wet soil to the nearest 1 g (0.005 lb).
 8. Determine the wet mass of the sample by subtracting the mass in Step 1 from the mass in Step 7.
 9. Calculate the wet density (ρ_w) as indicated below under “Calculations.”
 10. Extrude the material from the mold. For soils and soil-aggregate mixtures, slice vertically through the center and remove one of the cut faces for a representative moisture content sample. For granular materials, a vertical face will not exist. Take a representative sample ensuring that all layers are represented. This sample must meet the sample size requirements of the test method used to determine moisture content.



Extruded material



**Representative moisture
content sample**

11. Determine the moisture content (w) of the sample in accordance with the FOP for AASHTO T 255 / T 265.

Calculations

1. Calculate the wet density, in kg/m^3 (lb/ft^3), by dividing the wet mass by the measured volume of the mold (T 19).

Example – Methods A or C mold:

Wet mass = 2.0055 kg (4.42 lb)

Measured volume of the mold = 0.0009469 m^3 (0.0334 ft^3)

$$\rho_w = \frac{2.0055 \text{ kg}}{0.0009469 \text{ m}^3} = 2118 \text{ kg/m}^3$$

$$\rho_w = \frac{4.42 \text{ lb}}{0.0334 \text{ ft}^3} = 132.2 \text{ lb/ft}^3$$

Where:

$$\rho_w = \text{Wet density, kg/m}^3 \text{ (lb/ft}^3\text{)}$$

2. Calculate the dry density as follows.

$$\rho_d = \left(\frac{\rho_w}{w + 100} \right) \times 100 \quad \text{or} \quad \rho_d = \frac{\rho_w}{\left(\frac{w}{100} \right) + 1}$$

Where:

$$\rho_d = \text{Dry density, kg/m}^3 \text{ (lb/ft}^3\text{)}$$

w = Moisture content, as a percentage

Example:

$$\rho_w = 2118 \text{ kg/m}^3 \text{ (132.2 lb/ft}^3\text{)}$$

$$w = 13.5\%$$

$$\rho_d = \left(\frac{2118 \text{ kg/m}^3}{13.5 + 100} \right) \times 100 = 1866 \text{ kg/m}^3 \quad \rho_d = \left(\frac{132.2 \text{ lb/ft}^3}{13.5 + 100} \right) \times 100 = 116.5 \text{ lb/ft}^3$$

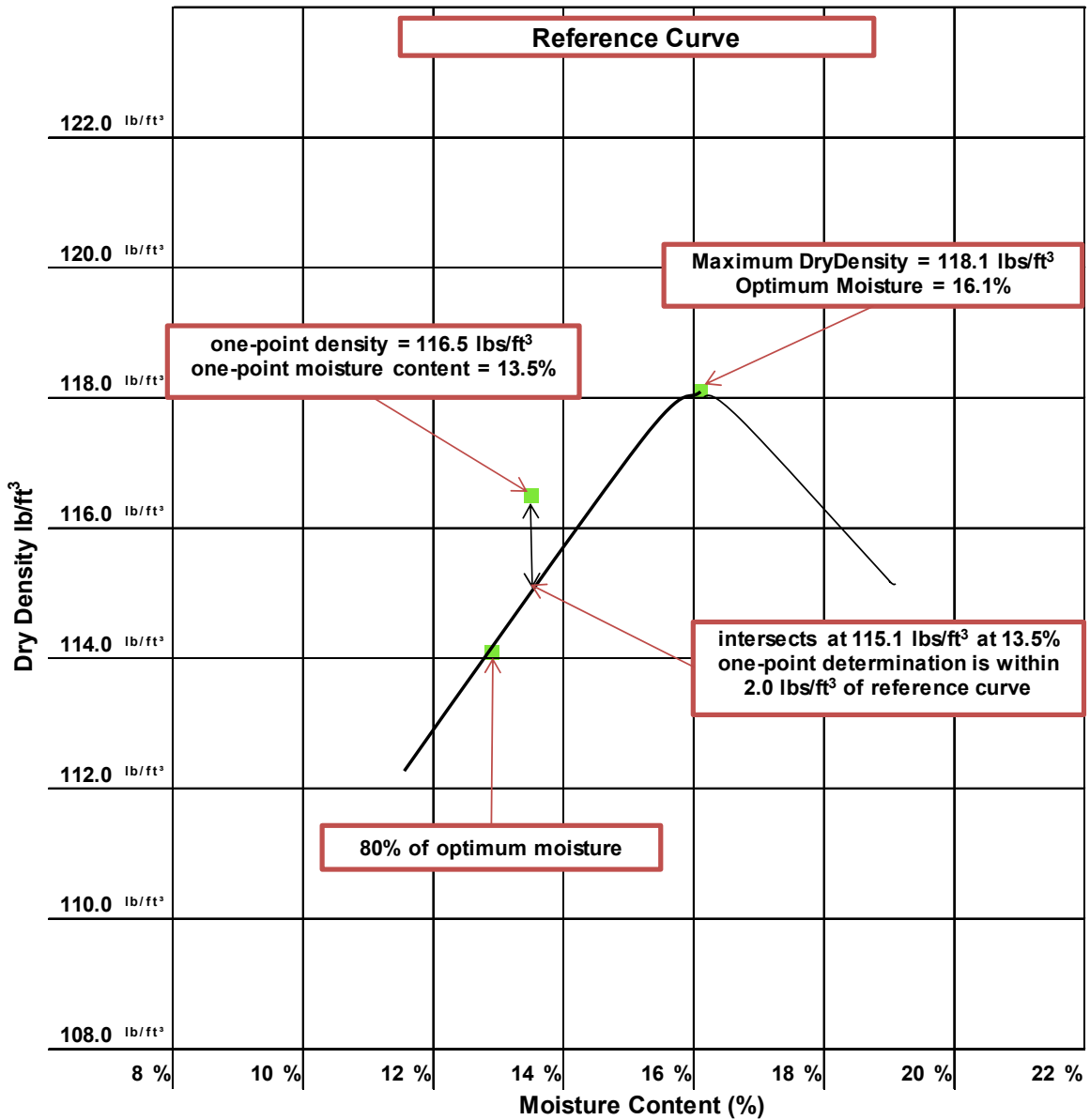
or

$$\rho_d = \left(\frac{2118 \text{ kg/m}^3}{\frac{13.5}{100} + 1} \right) = 1866 \text{ kg/m}^3 \quad \rho_d = \left(\frac{132.2 \text{ lb/ft}^3}{\frac{13.5}{100} + 1} \right) = 116.5 \text{ lb/ft}^3$$

Maximum Dry Density and Optimum Moisture Content Determination Using an Individual Moisture / Density Curve

1. The moisture content must be within 80 to 100 percent of optimum moisture of the reference curve. Compact another specimen, using the same material, at an adjusted moisture content if the one-point does not fall in the 80 to 100 percent of optimum moisture range.
2. Plot the one-point, dry density on the vertical axis and moisture content on the horizontal axis, on the reference curve graph.
3. If the one-point falls on the reference curve or within ± 2.0 lbs/ft³, use the maximum dry density and optimum moisture content determined by the curve.
4. Use the FOP for AASHTO T 99/T 180 Annex A to determine corrected maximum dry density and optimum moisture content if oversize particles have been removed.
5. Perform a full moisture-density relationship if the one-point does not fall on or within ± 2.0 lbs/ft³ of the reference curve at 80 to 100 percent optimum moisture.

Example



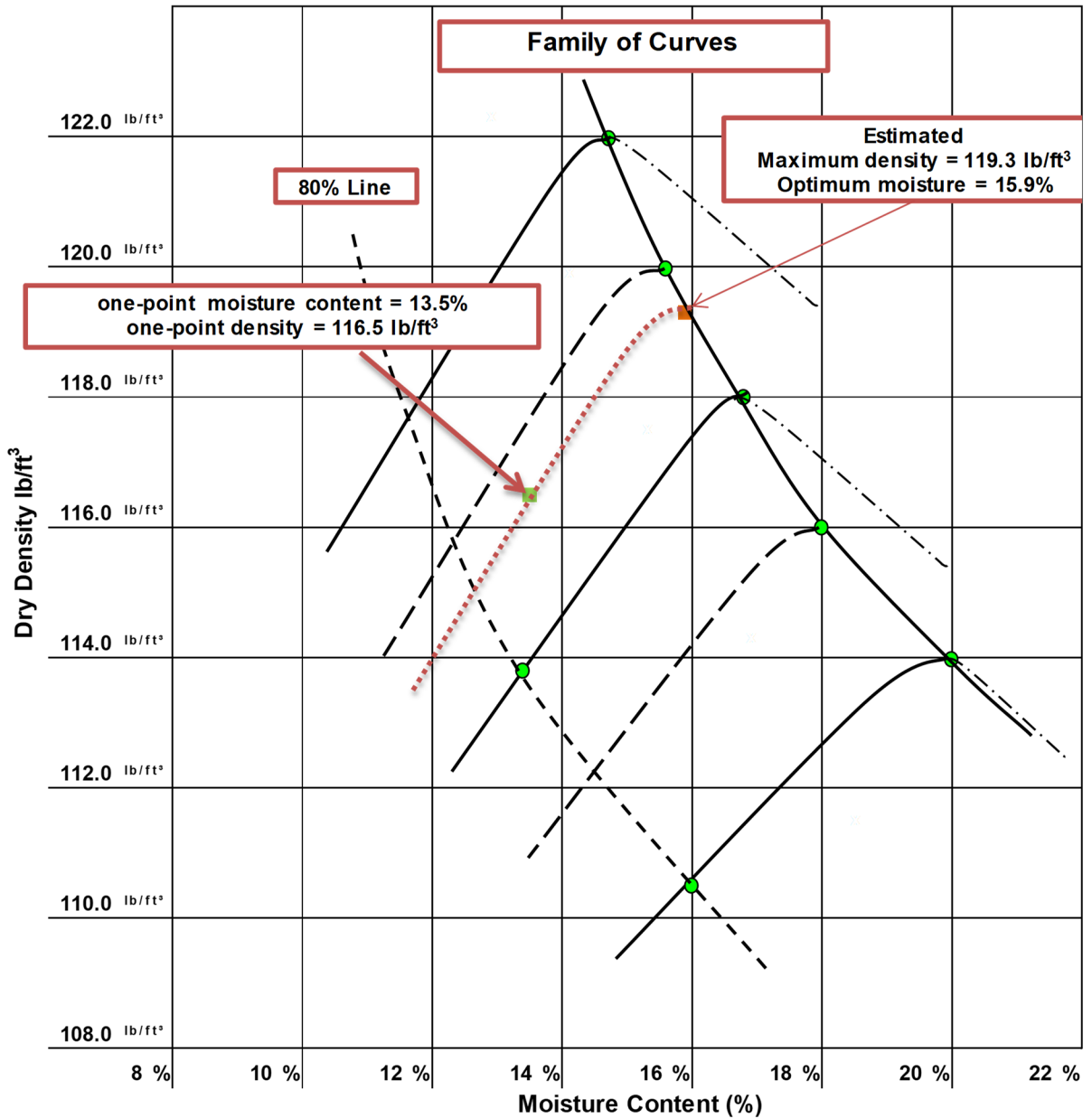
The results of a one-point determination were 116.5 lb/ft³ at 13.5 percent moisture. The point was plotted on the reference curve graph. The one-point determination is within 2.0 lb/ft³ of the point on the curve that corresponds with the moisture content.

Maximum Dry Density and Optimum Moisture Content Determination Using a Family of Curves

1. Plot the one-point, dry density on the vertical axis and moisture content on the horizontal axis, on the reference family of curves graph.
2. If the moisture-density one-point falls on one of the curves in the family of curves, use the maximum dry density and optimum moisture content defined by that curve.
3. If the moisture-density one-point falls within the family of curves but not on an existing curve, draw a new curve through the plotted single point, parallel and in character with the nearest existing curve in the family of curves. Use the maximum dry density and optimum moisture content as defined by the new curve.
 - a. The one-point must fall either between or on the highest or lowest curves in the family. If it does not, then a full curve must be developed.
 - b. If the one-point plotted within or on the family of curves does not fall in the 80 to 100 percent of optimum moisture content, compact another specimen, using the same material, at an adjusted moisture content that will place the one point within this range.
4. Use the FOP for AASHTO T 99/T 180 Annex A to determine corrected maximum dry density and optimum moisture content if oversize particles have been removed.
5. If the new curve through a one-point is not well defined or is in any way questionable, perform a full moisture-density relationship to correctly define the new curve and verify the applicability of the family of curves.

Note 2: New curves drawn through plotted single point determinations shall not become a permanent part of the family of curves until verified by a full moisture-density procedure following the FOP for AASHTO T 99/T 180.

Example



The results of a one-point determination were 116.5 lb/ft³ at 13.5 percent moisture. The point was plotted on the reference curve graph. The point was plotted on the appropriate family between two previously developed curves near and intermediate curve.

The “dotted” curve through the moisture-density one-point was sketched between the existing curves. A maximum dry density of 119.3 lb/ft³ and a corresponding optimum moisture content of 15.9 percent were estimated.

Report

- On forms approved by the agency
- Sample ID
- Maximum dry density to the nearest 1 kg/m^3 (0.1 lb/ft^3)
- Corrected maximum dry density (if applicable)
- Optimum moisture content to the nearest 0.1 percent
- Corrected optimum moisture content (if applicable)
- Reference curve or Family of Curves used

Resistance of Compacted Asphalt Mixtures to Moisture-Induced Damage

AASHTO Designation: T 283-22

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DETERMINING THE ASPHALT BINDER CONTENT OF ASPHALT MIXTURES BY THE IGNITION METHOD FOP FOR AASHTO T 308

Scope

This procedure covers the determination of asphalt binder content of asphalt mixtures by ignition of the binder in accordance with AASHTO T 308-22.

Overview

The sample is heated in a furnace at 538°C (1000°F) or less; samples may be heated by convection or direct infrared irradiation (IR). The aggregate remaining after burning can be used for sieve analysis using the FOP for AASHTO T 30.

Some agencies allow the use of recycled asphalt mixtures. When using recycled asphalt mixtures, check with the agency for specific correction procedures.

Asphalt binder in the asphalt mixture is ignited in a furnace. Asphalt binder content is calculated as the percentage difference between the initial mass of the asphalt mixture and the mass of the residual aggregate, with the asphalt binder correction factor, and moisture content subtracted. The asphalt binder content is expressed as percent of moisture-free mix mass.

Two methods, A and B, are presented.

Apparatus

Note 1: The apparatus must be calibrated for the specific mix design. See “Correction Factors” at the end of this FOP.

The apparatus for the Methods A and B is the same except that the furnace for Method A requires an internal balance.

- **Ignition Furnace:** A forced-air ignition furnace that heats the specimens by either the convection or direct IR irradiation method. The convection-type furnace must be capable of maintaining the temperature between at least 530 and 545°C (986 and 1013°F) and have a temperature control accurate within $\pm 5^{\circ}\text{C}$ ($\pm 9^{\circ}\text{F}$).

For Method A, the furnace will be equipped with an internal scale thermally isolated from the furnace chamber and accurate to 0.1 g. The scale shall be capable of determining the mass of a 3500 g sample in addition to the sample baskets. A data collection system will be included so that mass can be automatically determined and displayed during the test. The furnace shall have a built-in computer program to calculate the change in mass of the sample and provide for the input of a correction factor for aggregate loss. The furnace shall provide a printed ticket with the initial specimen mass, specimen mass loss, temperature compensation, correction factor, corrected asphalt binder content, test time, and test temperature. The furnace shall provide an audible alarm and indicator light when the sample mass loss does not exceed 0.01 percent of the total sample mass for three consecutive minutes. Perform lift test according to manufacturer’s instructions weekly during use, if applicable. The furnace shall be

designed to permit the operator to change the ending mass loss percentage from both 0.01 percent to 0.02 percent.

For both Method A and Method B, the furnace chamber dimensions shall be adequate to accommodate a 3500 g sample. The furnace door shall be equipped so that it cannot be opened during the ignition test. A method for reducing furnace emissions shall be provided and the furnace shall be vented so that no emissions escape into the laboratory. The furnace shall have a fan to pull air through the furnace to expedite the test and to eliminate the escape of smoke into the laboratory.

- **Sample Basket Assembly:** consisting of sample basket(s), catch pan, and basket guards. Sample basket(s) will be of appropriate size allowing samples to be thinly spread and allowing air to flow through and around the sample particles. Sets of two or more baskets shall be nested. A catch pan: of sufficient size to hold the sample basket(s) so that aggregate particles and melting asphalt binder falling through the screen mesh are caught. Basket guards will completely enclose the basket and be made of screen mesh, perforated stainless steel plate, or other suitable material.
- Thermometer, or other temperature measuring device, with a temperature range of 10 - 260°C (50-500°F).
- Oven capable of maintaining 110 ±5°C (230 ±9°F).
- Balance or scale: Capacity sufficient for the sample mass and conforming to the requirements of M 231, Class G2.
- **Safety equipment:** Safety glasses or face shield, high temperature gloves, long sleeved jacket, a heat resistant surface capable of withstanding 650°C (1202°F), a protective cage capable of surrounding the sample baskets during the cooling period, and a particle mask for use during removal of the sample from the basket assembly.
- **Miscellaneous equipment:** A container larger than the sample basket(s) for transferring sample after ignition, large flat pan, spatulas, bowls, and wire brushes.

Sampling

1. Obtain samples of asphalt mixture in accordance with the FOP for AASHTO R 97.
2. Reduce asphalt mixture samples in accordance with the FOP for AASHTO R 47.
3. If the mixture is not sufficiently soft to separate with a spatula or trowel, place it in a large flat pan in an oven at 110 ±5°C (230 ±9°F) until soft enough.
4. Test sample size shall conform to the mass requirement shown in Table 1.

Note 2: When the mass of the test specimen exceeds the capacity of the equipment used or for large samples of fine mixes, the test specimen may be divided into suitable increments, tested, and the results appropriately combined through a weighted average for calculation of the asphalt binder content.

Table 1

Nominal Maximum Aggregate Size* mm (in.)	Minimum Mass Specimen g	Maximum Mass Specimen g
37.5 (1 ½)	4000	4500
25.0 (1)	3000	3500
19.0 (¾)	2000	2500
12.5 (½)	1500	2000
9.5 (3/8)	1200	1700
4.75 (No. 4)	1200	1700

* One sieve larger than the first sieve to retain more than 10 percent of the material using an agency specified set of sieves based on cumulative percent retained. Where large gaps in specification sieves exist, intermediate sieve(s) may be inserted to determine nominal maximum size.

Procedure – Method A (Internal Balance)

1. For the convection-type furnace, preheat the ignition furnace to $538 \pm 5^{\circ}\text{C}$ ($1000 \pm 9^{\circ}\text{F}$) or to the temperature determined in the Correction Factors Annex of this method. Manually record the furnace temperature (set point) before the initiation of the test if the furnace does not record automatically. For the direct IR irradiation-type furnace, use the same burn profile as used during the correction factor determination.
2. Dry the sample to constant mass, according to the FOP for AASHTO T 329; or determine the moisture content of a companion sample in accordance with the FOP for AASHTO T 329.
3. Determine and record the mass of the sample basket assembly to the nearest 0.1 g.
4. Evenly distribute the sample in the sample basket assembly, taking care to keep the material away from the edges of the basket. Use a spatula or trowel to level the sample.
5. Determine and record the total mass of the sample and sample basket assembly at room temperature to the nearest 0.1 g.
6. Calculate the initial mass of the sample by subtracting the mass of the sample basket from the mass of the sample and sample basket assembly and record to the nearest 0.1 g. Designate this mass as (M_i).
7. Record the correction factor or input into the furnace controller for the specific asphalt mixture.
8. Input the initial mass of the sample (M_i) into the ignition furnace controller. Verify that the correct mass has been entered.
9. Verify the furnace scale is reading zero, if not, reset to zero.

CAUTION: Operator should wear safety equipment – high temperature gloves, face shield, fire-retardant shop coat – when opening the door to load or unload the sample.

10. Open the chamber door and gently set the sample basket assembly in the furnace. Carefully position the sample basket assembly so it is not in contact with the furnace wall. Close the chamber door and verify that the sample mass displayed on the furnace scale equals the total mass of the sample and sample basket assembly recorded in Step 5 within ± 5 g.

Note 3: Differences greater than 5 g or failure of the furnace scale to stabilize may indicate that the specimen basket assembly is contacting the furnace wall.

Note 4: Furnace temperature will drop below the set point when the door is opened but will recover when the door is closed, and ignition begins. Sample ignition typically increases the temperature well above the set point – relative to sample size and asphalt binder content.

11. Initiate the test by pressing the start button. This will lock the sample chamber and start the combustion blower.

Safety note: Do not attempt to open the furnace door until the asphalt binder has been completely burned off.

12. Allow the test to continue until the stable light and audible stable indicator indicate that the change in mass does not exceed 0.01 percent for three consecutive minutes. Press the stop button. This will unlock the sample chamber and cause the printer to print out the test results.

Note 5: An ending mass loss percentage of 0.02 may be used, if allowed by the agency, when aggregate that exhibits an excessive amount of loss during ignition testing is used.

13. Open the chamber door, remove the sample basket assembly, and place on the cooling plate or block. Place the protective cage over the sample basket assembly and allow it to cool to room temperature (approximately 30 minutes).
14. Determine and record the mass of the sample and sample basket assembly after ignition to the nearest 0.1 g.
15. Calculate the mass of the sample by subtracting the mass of the sample basket assembly from the mass of the sample and sample basket assembly and record to the nearest 0.1 g. Designate this mass as M_f .
16. Use the asphalt binder content percentage from the printed ticket. Subtract the moisture content and the correction factor if not entered into the furnace controller from the printed ticket asphalt binder content and report the difference as the corrected asphalt binder content.

Asphalt binder content percentage can also be calculated using the formula from “Method B” Step 16.

Calculation

Corrected asphalt binder content:

$$P_b = BC - MC - C_f^*$$

*If correction factor is not entered into the furnace controller

where:

P_b = the corrected asphalt binder content as a percent by mass of the asphalt mixture

BC = asphalt binder content shown on printed ticket

MC = moisture content of the companion asphalt mixture sample, percent, as determined by the FOP for AASHTO T 329 (if the specimen was oven-dried before initiating the procedure, MC=0)

C_f = correction factor as a percent by mass of the asphalt mixture sample

Procedure – Method B (External Balance)

1. Preheat the ignition furnace to $538 \pm 5^\circ\text{C}$ ($1000 \pm 9^\circ\text{F}$) or to the temperature determined in the Correction Factor Annex of this method. Manually record the furnace temperature (set point) before the initiation of the test if the furnace does not record automatically.
2. Dry the sample to constant mass, according to the FOP for AASHTO T 329; or determine the moisture content of a companion sample in accordance with the FOP for AASHTO T 329.
3. Determine and record the mass of the sample basket assembly to the nearest 0.1 g.
4. Place the sample basket(s) in the catch pan. Evenly distribute the sample in the sample basket(s), taking care to keep the material away from the edges of the basket. Use a spatula or trowel to level the sample.
5. Determine and record the mass of the sample and sample basket assembly at room temperature to the nearest 0.1 g.
6. Calculate the initial mass of the sample by subtracting the mass of the sample basket from the mass of the sample and sample basket assembly and record to the nearest 0.1 g. Designate this mass as (M_i).
7. Record the correction factor for the specific asphalt mixture.
8. Open the chamber door and gently set the sample basket assembly in the furnace. Carefully position the sample basket assembly so it is not in contact with the furnace wall. Burn the asphalt mixture sample in the furnace for 45 minutes or the length of time determined in the “Correction Factors” section.

9. Open the chamber door, remove the sample basket assembly, and place on the cooling plate or block. Place the protective cage over the sample and allow it to cool to room temperature (approximately 30 min).
10. Determine and record the mass of the sample and sample basket assembly to the nearest 0.1 g.
11. Calculate the sample mass by subtracting the mass of the sample basket assembly from the mass of the sample and sample basket assembly and record to the nearest 0.1 g.
12. Place the sample basket assembly back into the furnace.
13. Burn the sample for at least 15 minutes after the furnace reaches the set temperature.
14. Open the chamber door, remove the sample basket assembly, and place on the cooling plate or block. Place the protective cage over the sample basket assembly and allow it to cool to room temperature (approximately 30 min.).
15. Determine and record the mass of the sample and sample basket assembly to the nearest 0.1 g.
16. Calculate the mass of the sample by subtracting the mass of the sample basket assembly from the mass of the sample and sample basket assembly and record to the nearest 0.1 g.
17. Repeat Steps 10 through 13 until the change in measured mass of the sample after ignition does not exceed 0.01 percent of the previous sample mass.
Note 5: An ending mass loss percentage of 0.02 may be used, if allowed by the agency, when aggregate that exhibits an excessive amount of loss during ignition testing is used.
18. Determine and record the mass of the sample and sample basket assembly to the nearest 0.1 g.
19. Calculate the final sample mass by subtracting the mass of the sample basket assembly and sample and sample basket assembly and record to the nearest 0.1 g. Designate this mass as M_f .
20. Calculate the asphalt binder content of the sample.

Calculations

Calculate the asphalt binder content of the sample as follows:

$$P_b = \frac{M_i - M_f}{M_i} \times 100 - MC - C_f$$

where:

P_b = the corrected asphalt binder content as a percent by mass of the asphalt mixture sample

M_f = the final sample mass after ignition, g

M_i = the initial mass of the asphalt mixture sample before ignition, g

MC = moisture content of the companion asphalt mixture sample, percent, as determined by the FOP for AASHTO T 329 (if the specimen was oven-dried before initiating the procedure, MC = 0).

C_f = correction factor as a percent by mass of the asphalt mixture sample

Example

Correction Factor	= 0.42%
Moisture Content	= 0.04%
Initial Mass of Sample and Basket	= 5292.7 g
Mass of Basket Assembly	= 2931.5 g
M_i	= 2361.2 g
Total Mass after First ignition + basket	= 5154.4 g
Sample Mass after First ignition	= 2222.9 g
Sample Mass after additional 15 min ignition	= 2222.7 g

$$\%change = \frac{2222.9 \text{ g} - 2222.7 \text{ g}}{2222.9 \text{ g}} \times 100 = 0.009\%$$

%change is not greater than 0.01 percent, so $M_f = 2222.7 \text{ g}$

$$P_b = \frac{2361.2 \text{ g} - 2222.7 \text{ g}}{2361.2 \text{ g}} \times 100 - 0.42\% - 0.04\% = 5.41\%$$

$P_b = 5.41\%$

Gradation

1. Empty contents of the basket(s) into a container, being careful to capture all material. Use a small wire brush to ensure all residual fines are removed from the baskets.

Note 7: Particle masks are a recommended safety precaution.

2. Perform the gradation analysis in accordance with the FOP for AASHTO T 30.

Report

- On forms approved by the agency
- Sample ID
- Method of test (A or B)
- Corrected asphalt binder content, P_b , to the nearest 0.01 percent or per agency standard
- Correction factor, C_f , to the nearest 0.01 percent
- Temperature compensation factor (Method A only)
- Total percent loss
- Sample mass
- Moisture content to the nearest 0.01%
- Test temperature

Attach the original printed ticket with all intermediate values (continuous tape) to the report for furnaces with internal balances.

ANNEX – CORRECTION FACTORS

ASPHALT BINDER AND AGGREGATE

(Mandatory Information)

Asphalt binder content results may be affected by the type of aggregate in the mixture and by the ignition furnace. Asphalt binder and aggregate correction factors must, therefore, be established by testing a set of correction specimens for each Job Mix Formula (JMF) mix design. Each ignition furnace will have its own unique correction factor determined in the location where testing will be performed.

This procedure must be performed before any acceptance testing is completed, and repeated each time there is a change in the mix ingredients or design. Any changes greater than 5 percent in stockpiled aggregate proportions should require a new correction factor.

All correction samples will be prepared by a central / regional laboratory unless otherwise directed.

Asphalt binder correction factor: A correction factor must be established by testing a set of correction specimens for each Job Mix Formula (JMF). Certain aggregate types may result in unusually high correction factors (> 1.00 percent). Such mixes should be corrected and tested at a lower temperature as described below.

Aggregate correction factor: Due to potential aggregate breakdown during the ignition process, a correction factor will need to be determined for the following conditions:

- a. Aggregates that have a proven history of excessive breakdown
- b. Aggregate from an unknown source.

This correction factor will be used to adjust the acceptance gradation test results obtained according to the FOP for AASHTO T 30.

Procedure

1. Obtain samples of aggregate in accordance with the FOP for AASHTO R 90.
2. Obtain samples of asphalt binder in accordance with the FOP for AASHTO R 66.
Note 8: Include other additives that may be required by the JMF.
3. Prepare an initial, or “butter,” mix at the design asphalt binder content. Mix and discard the butter mix before mixing any of the correction specimens to ensure accurate asphalt content.
4. Prepare two correction specimens at the JMF design asphalt binder content. Aggregate used for correction specimens shall be sampled from material designated for use on the project. An agency approved method will be used to combine aggregate. An additional “blank” specimen shall be batched and tested for aggregate gradation in accordance with the FOP for AASHTO T 30. The gradation from the “blank” shall fall within the agency specified mix design tolerances.
5. Place the freshly mixed specimens directly into the sample basket assembly. If mixed specimens are allowed to cool before placement in the sample basket assembly, the

specimens must be dried to constant mass according to the FOP for AASHTO T 329. Do not preheat the sample basket assembly.

6. Test the specimens in accordance with Method A or Method B of the procedure.
7. Once both correction specimens have been burned, determine the asphalt binder content for each specimen by calculation or from the printed ignition furnace tickets, if available.
8. If the difference between the asphalt binder contents of the two specimens exceeds 0.15 percent, repeat with two more specimens and, from the four results, discard the high and low result. Determine the correction factor from the two original or remaining results, as appropriate. Calculate the difference between the actual and measured asphalt binder contents for each specimen to 0.01 percent. The asphalt binder correction factor, C_f , is the average of the differences expressed as a percent by mass of asphalt mixture.
9. If the asphalt binder correction factor exceeds 1.00 percent, the test temperature must be lowered to $482 \pm 5^\circ\text{C}$ ($900 \pm 9^\circ\text{F}$) and new samples must be burned. If the correction factor is the same or higher at the lower temperature, it is permissible to use the higher temperature. The temperature for determining the asphalt binder content of asphalt mixture samples by this procedure shall be the same temperature determined for the correction samples.
10. For the direct IR irradiation-type burn furnaces, the **default** burn profile should be used for most materials. The operator may select burn-profile Option 1 or Option 2 to optimize the burn cycle. The burn profile for testing asphalt mixture samples shall be the same burn profile selected for correction samples.
 - Option 1** is designed for aggregate that requires a large asphalt binder correction factor (greater than 1.00 percent) – typically very soft aggregate (such as dolomite).
 - Option 2** is designed for samples that may not burn completely using the **default** burn profile.
11. Perform a gradation analysis on the residual aggregate in accordance with the FOP for AASHTO T 30, if required. The results will be utilized in developing an “Aggregate Correction Factor” and should be calculated and reported to 0.1 percent.
12. From the gradation results subtract the percent passing for each sieve, for each sample, from the percent passing each sieve of the “Blank” specimen gradation results from Step 4.
13. Determine the average difference of the two values. If the difference for any single sieve exceeds the allowable difference of that sieve as listed in Table 2, then aggregate gradation correction factors (equal to the resultant average differences) for all sieves shall be applied to all acceptance gradation test results determined by the FOP for AASHTO T 30. If the 75 μm (No. 200) is the only sieve outside the limits in Table 2, apply the aggregate correction factor to only the 75 μm (No. 200) sieve.

**Table 2
Permitted Sieving Difference**

Sieve	Allowable Difference
Sizes larger than or equal to 2.36 mm (No.8)	± 5.0%
Sizes larger than to 75 µm (No.200) and smaller than 2.36 mm (No.8)	± 3.0%
Sizes 75 µm (No.200) and smaller	± 0.5%

Examples:

Sieve Size mm (in.)	Correction Factor Blank Sample % Passing	Correction Factor Sample #1 % Passing	Correction Factor Sample #2 % Passing	Difference 1 / 2	Avg. Diff.	Sieves to adjust
19.0 (3/4)	100	100	100	0/0	0.0	
12.5 (1/2)	86.3	87.4	86.4	-1.1/-0.1	-0.6	
9.5 (3/8)	77.4	76.5	78.8	+0.9/-1.4	-0.3	
4.75 (No. 4)	51.5	53.6	55.9	-2.1/-4.4	-3.3	
2.36 (No. 8)	34.7	36.1	37.2	-1.4/-2.5	-2.0	
01.18 (No. 16)	23.3	25.0	23.9	-1.7/-0.6	-1.2	
0.600 (No. 30)	16.4	19.2	18.1	-2.8/-1.7	-2.3	
0.300 (No. 50)	12.0	11.1	12.7	+0.9/-0.7	+0.1	
0.150 (No. 100)	8.1	9.9	6.3	-1.8/+1.8	0.0	
75 µm (No. 200)	5.5	5.9	6.2	-0.4/-0.7	-0.6	- 0.6

In this example, all gradation test results performed on the residual aggregate (FOP for AASHTO T 30) would have an aggregate correction factor applied to the percent passing the 75 µm (No. 200) sieve. The correction factor must be applied because the average difference on the 75 µm (No. 200) sieve is outside the tolerance from Table 2.

In the following example, aggregate correction factors would be applied to each sieve because the average difference on the 4.75 mm (No. 4) is outside the tolerance from Table 2.

Sieve Size mm (in.)	Correction Factor Blank Sample % Passing	Correction Factor Sample #1 % Passing	Correction Factor Sample #2 % Passing	Difference 1 / 2	Avg. Diff.	Sieves to adjust
19.0 (3/4)	100	100	100	0/0	0.0	0.0
12.5 (1/2)	86.3	87.4	86.4	-1.1/-0.1	-0.6	-0.6
9.5 (3/8)	77.4	76.5	78.8	+0.9/-1.4	-0.3	-0.3
4.75 (No. 4)	51.5	55.6	57.9	-4.1/-6.4	-5.3	-5.3
2.36 (No. 8)	34.7	36.1	37.2	-1.4/-2.5	-2.0	-2.0
01.18 (No. 16)	23.3	25.0	23.9	-1.7/-0.6	-1.2	-1.2
0.600 (No. 30)	16.4	19.2	18.1	-2.8/-1.7	-2.3	-2.3
0.300 (No. 50)	12.0	11.1	12.7	+0.9/-0.7	+0.1	+0.1
0.150 (No. 100)	8.1	9.9	6.3	-1.8/+1.8	0.0	0.0
75 μm (No. 200)	5.5	5.9	6.2	-0.4/-0.7	-0.6	-0.6

TEMPERATURE OF FRESHLY MIXED PORTLAND CEMENT CONCRETE FOP FOR AASHTO T 309

Scope

This procedure covers the determination of the temperature of freshly mixed Portland Cement Concrete in accordance with AASHTO T 309-22.

Warning—Fresh Hydraulic cementitious mixtures are caustic and may cause chemical burns to skin and tissue upon prolonged exposure.

Apparatus

- Container: Made of non-absorptive material and large enough to cover the sensor with concrete at least 75 mm (3 in.) in all directions; concrete cover must also be a least three times the nominal maximum size of the coarse aggregate.
- Thermometer: Capable of measuring the temperature of the concrete throughout the temperature range likely to be encountered, at least -18 to 50°C (0 to 120°F), and readable to $\pm 0.5^{\circ}\text{C}$ ($\pm 1^{\circ}\text{F}$) or smaller.

Note 1: Thermometer types suitable for use include ASTM E1 mercury thermometer or ASTM E2251 Low Hazard Precision Liquid-in-glass thermometer; ASTM E2877 digital metal stem thermometer; or thermocouple thermometer ASTM E230, Type T Special or IEC 60584 Type T, Class 1.

Standardization of Thermometer

Each thermometer shall be verified for accuracy annually and whenever there is a question of accuracy. Standardization shall be performed by comparing readings on the thermometer with another calibrated thermometer at two temperatures at least 15°C or 27°F apart.

Sample Locations and Times

The temperature of freshly mixed concrete may be measured in the transporting equipment, in forms, or in sample containers, provided the sensor of the thermometer has at least 75 mm (3 in.) of concrete cover in all direction around it.

Complete the temperature measurement of the freshly mixed concrete within 5 minutes of obtaining the sample.

Procedure

1. Dampen the sample container.
2. Obtain the sample in accordance with the FOP for WAQTC TM 2.
3. Place sensor of the thermometer in the freshly mixed concrete so that it has at least 75 mm (3 in.) of concrete cover in all directions around it.
4. Gently press the concrete in around the sensor of the thermometer at the surface of the concrete so that air cannot reach the sensor.
5. Leave the sensor of the thermometer in the freshly mixed concrete for a minimum of two minutes, or until the temperature reading stabilizes.
6. Complete the temperature measurement of the freshly mixed concrete within 5 minutes of obtaining the sample.
7. Read and record the temperature to the nearest 0.5°C (1°F).

Report

- Results on forms approved by the agency
- Sample ID
- Measured temperature of the freshly mixed concrete to the nearest 0.5°C (1°F)

IN-PLACE DENSITY AND MOISTURE CONTENT OF SOIL AND SOIL- AGGREGATE BY NUCLEAR METHODS (SHALLOW DEPTH) FOP FOR AASHTO T 310

Scope

This procedure covers the determination of density, moisture content, and relative compaction of soil, aggregate, and soil-aggregate mixes in accordance with AASHTO T 310-22. This procedure provides a rapid, nondestructive technique for determining the in-place wet density and moisture content of soil, aggregate, and soil-aggregate mixes. This field operating procedure is derived from AASHTO T 310. The nuclear moisture-density gauge is used in the direct transmission mode.

Apparatus

- Nuclear density gauge with the factory matched standard reference block.
- Drive pin, guide/scrapper plate, and hammer for testing in direct transmission mode.
- Transport case for properly shipping and housing the gauge and tools.
- Instruction manual for the specific make and model of gauge.
- Radioactive materials information and calibration packet containing:
 - Daily Standard Count Log.
 - Factory and Laboratory Calibration Data Sheet.
 - Leak Test Certificate.
 - Shippers Declaration for Dangerous Goods.
 - Procedure Memo for Storing, Transporting and Handling Nuclear Testing Equipment.
 - Other radioactive materials documentation as required by local regulatory requirements.
- Sealable containers and utensils for moisture content determinations.

Radiation Safety

This method does not purport to address all of the safety problems associated with its use. This test method involves potentially hazardous materials. The gauge utilizes radioactive materials that may be hazardous to the health of the user unless proper precautions are taken. Users of this gauge must become familiar with the applicable safety procedures and governmental regulations. All operators will be trained in radiation safety prior to operating nuclear density gauges. Some agencies require the use of personal monitoring devices such as a thermoluminescent dosimeter or film badge. Effective instructions together with routine safety procedures such as source leak tests, recording and evaluation of personal monitoring device data, etc., are a recommended part of the operation and storage of this gauge.

Calibration

Calibrate the nuclear gauge as required by the agency. This calibration may be performed by the agency using manufacturer's recommended procedures or by other facilities approved by the agency. Verify or re-establish calibration curves, tables, or equivalent coefficients every 12 months.

Standardization

1. Turn the gauge on and allow it to stabilize (approximately 10 to 20 minutes) prior to standardization. Leave the power on during the day's testing.
2. Standardize the nuclear gauge at the construction site at the start of each day's work and as often as deemed necessary by the operator or agency. Daily variations in standard count shall not exceed the daily variations established by the manufacturer of the gauge. If the daily variations are exceeded after repeating the standardization procedure, the gauge should be repaired and/or recalibrated.
3. Record the standard count for both density and moisture in the Daily Standard Count Log. The exact procedure for standard count is listed in the manufacturer's Operator's Manual.

Note 1: New standard counts may be necessary more than once a day. See agency requirements.

Overview

There are two methods for determining in-place density of soil / soil aggregate mixtures. See agency requirements for method selection.

- Method A Single Direction
- Method B Two Direction

Procedure

1. Select a test location(s) randomly and in accordance with agency requirements. Test sites should be relatively smooth and flat and meet the following conditions:
 - a. At least 10 m (30 ft) away from other sources of radioactivity
 - b. At least 3 m (10 ft) away from large objects
 - c. The test site should be at least 150 mm (6 in.) away from any vertical projection.
 - d. Correct for trench wall effect according to manufacturer's correction procedures if the test site is closer than 600 mm (24 in.) to vertical projection. See Note 2.

Note 2: To perform moisture and density tests in a trench or against a large solid object, it is necessary to perform a trench offset correction to adjust the gauge, or it may read a falsely high moisture content. Moisture present in the walls can thermalize neutrons which return to the gauge and are read as moisture by the detector in the gauge.

2. Remove all loose and disturbed material and remove additional material as necessary to expose the top of the material to be tested.
3. Prepare a flat area sufficient in size to accommodate the gauge. Plane the area to a smooth condition so as to obtain maximum contact between the gauge and the

material being tested. For Method B, the flat area must be sufficient to permit rotating the gauge 90 or 180 degrees about the source rod.

4. Fill in surface voids beneath the gauge with fines of the material being tested passing the 4.75 mm (No. 4) sieve or finer. Smooth the surface with the guide plate or other suitable tool. The depth of the filler should not exceed approximately 3 mm (1/8 in.).
5. Make a hole perpendicular to the prepared surface using the guide plate and drive pin. The hole shall be at least 50 mm (2 in.) deeper than the desired source rod depth and shall be aligned such that insertion of the source rod will not cause the gauge to tilt from the plane of the prepared area. Remove the drive pin by pulling straight up and twisting the extraction tool.
6. Place the gauge on the prepared surface so the source rod can enter the hole without disturbing loose material.
7. Lower the source rod into the hole to the desired test depth using the handle and trigger mechanism.
8. Seat the gauge firmly by partially rotating it back and forth about the source rod. Ensure the gauge is seated flush against the surface by pressing down on the gauge corners and making sure that the gauge does not rock.
9. Pull gently on the gauge to bring the side of the source rod nearest to the scaler / detector firmly against the side of the hole.
10. Perform one of the following methods, per agency requirements:
 - a. Method A Single Direction: Take a test consisting of the average of two, one-minute readings, and record both density and moisture data. The two wet density readings should be within 32 kg/m^3 (2.0 lb/ft^3) of each other. The average of the two wet densities and moisture contents will be used to compute dry density.
 - b. Method B Two Direction: Take a one-minute reading and record both density and moisture data. Rotate the gauge 90 or 180 degrees, pivoting it around the source rod. Reseat the gauge by pulling gently on the gauge to bring the side of the source rod nearest to the scaler/detector firmly against the side of the hole and take a one-minute reading. (In trench locations, rotate the gauge 180 degrees for the second test.) Some agencies require multiple one-minute readings in both directions. Analyze the density and moisture data. A valid test consists of wet density readings in both gauge positions that are within 50 kg/m^3 (3.0 lb/ft^3). If the tests do not agree within this limit, move to a new location. The average of the wet density and moisture contents will be used to compute dry density.
11. If required by the agency, obtain a representative sample of the material, 4 kg (9 lb) minimum, from directly beneath the gauge full depth of material tested. This sample will be used to verify moisture content and / or identify the correct density standard. Immediately seal the material to prevent loss of moisture.

The material tested by direct transmission can be approximated by a cylinder of soil approximately 300 mm (12 in.) in diameter directly beneath the centerline of the

radioactive source and detector. The height of the cylinder will be approximately the depth of measurement. When organic material or large aggregate is removed during this operation, disregard the test information, and move to a new test site.

12. To verify the moisture content from the nuclear gauge, determine the moisture content with a representative portion of the material using the FOP for AASHTO T 255/T 265 or other agency approved methods. If the moisture content from the nuclear gauge is within ± 1 percent, the nuclear gauge readings can be accepted. Moisture content verification is gauge and material specific. Retain the remainder of the sample at its original moisture content for a one-point compaction test under the FOP for AASHTO T 272, or for gradation, if required.

Note 2: Example: A gauge reading of 16.8 percent moisture and an oven dry of 17.7 percent are within the ± 1 percent requirement. Moisture correlation curves will be developed according to agency guidelines. These curves should be reviewed and possibly redeveloped every 90 days.

13. Determine the dry density by one of the following.
 - a. From nuclear gauge readings, compute by subtracting the mass (weight) of the water (kg/m^3 or lb/ft^3) from the wet density (kg/m^3 or lb/ft^3) or compute using the percent moisture by dividing wet density from the nuclear gauge by 1 plus the moisture content expressed as a decimal.
 - b. When verification is required and the nuclear gauge readings cannot be accepted, the moisture content is determined by the FOP for AASHTO T 255/T 265 or other agency approved methods. Compute dry density by dividing wet density from the nuclear gauge by 1 plus the moisture content expressed as a decimal.

Percent Compaction

- Percent compaction is determined by comparing the in-place dry density as determined by this procedure to the appropriate agency density standard. For soil or soil-aggregate mixes, these are moisture-density curves developed using the FOP for AASHTO T 99/T 180. When using maximum dry densities from the FOP for AASHTO T 99/T 180 or FOP for AASHTO T 272, it may be necessary to use the Annex in the FOP for T 99/T 180 to determine corrected maximum dry density and optimum moisture content.

For coarse granular materials, the density standard may be density-gradation curves developed using a vibratory method such as AKDOT&PF's ATM 212, ITD's T 74, WAQTC TM 15, or WFLHD's Humphres.

See appropriate agency policies for use of density standards.

Calculation

Calculate the dry density as follows:

$$\rho_d = \left(\frac{\rho_w}{w + 100} \right) \times 100 \quad \text{or} \quad \rho_d = \frac{\rho_w}{\frac{w}{100} + 1}$$

Where:

ρ_d = Dry density, kg/m³ (lb/ft³)

ρ_w = Wet density, kg/m³ (lb/ft³)

w = Moisture content from the FOP's for AASHTO T 255 / T 265, as a percentage

Calculate percent compaction as follows:

$$\% \text{ Compaction} = \frac{\rho_d}{\text{Agency density standard}} \times 100$$

Where:

ρ_d = Dry density, kg/m³ (lb/ft³)

Agency density standard = Corrected maximum dry density
from the FOP from T 99/T 180 Annex

Example:

Wet density readings from gauge: 1948 kg/m³ (121.6 lb/ft³)

1977 kg/m³ (123.4 lb/ft³)

Avg: 1963 kg/m³ (122.5 lb/ft³)

Moisture readings from gauge: 14.2% and 15.4% = Avg 14.8%

Moisture content from the FOP's for AASHTO T 255/ T 265: 15.9%

Moisture content is greater than 1 percent different so the gauge moisture cannot be used.

Calculate the dry density as follows:

$$\rho_d = \left(\frac{1963 \text{ kg/m}^3 \text{ or } 122.5 \text{ lb/ft}^3}{15.9 + 100} \right) \times 100 \text{ or } \rho_d = \frac{1963 \text{ kg/m}^3 \text{ or } 122.5 \text{ lb/ft}^3}{\frac{15.9}{100} + 1}$$
$$= 1694 \text{ kg/m}^3 \text{ or } 105.7 \text{ lb/ft}^3$$

Given:

$$\rho_w = 1963 \text{ kg/m}^3 \text{ or } 122.5 \text{ lb/ft}^3$$

$$w = 15.9\%$$

Calculate percent compaction as follows:

$$\% \text{ Compaction} = \frac{105.7 \text{ lb/ft}^3}{111.3 \text{ lb/ft}^3} \times 100 = 95\%$$

Given:

$$\text{Agency density standard} = 111.3 \text{ lb/ft}^3$$

Report

- On forms approved by the agency
- Sample ID
- Location of test, elevation of surface, and thickness of layer tested
- Visual description of material tested
- Make, model and serial number of the nuclear moisture-density gauge
- Wet density to the nearest 0.1 lb/ft³
- Moisture content as a percent, by mass, of dry soil mass to the nearest 0.1 percent
- Dry density to the nearest 0.1 lb/ft³
- Density standard to the nearest 0.1 lb/ft³
- Percent compaction the nearest 1 percent
- Name and signature of operator

Hamburg Wheel-Track Testing of Compacted Asphalt Mixtures

AASHTO Designation: T 324-22

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MOISTURE CONTENT OF ASPHALT MIXTURES BY OVEN METHOD FOP FOR AASHTO T 329

Scope

This procedure covers the determination of moisture content of asphalt mixtures in accordance with AASHTO T 329-22.

Overview

Moisture content is determined by comparing the wet mass of a sample and the mass of the sample after drying to constant mass. The term constant mass is used to define when a sample is dry.

Constant mass – the state at which a mass does not change more than a given percent, after additional drying for a defined time interval, at a required temperature.

Apparatus

- Balance or scale: 2 kg capacity, readable to 0.1 g and conforming to AASHTO M 231.
- Forced draft, ventilated, or convection oven: Capable of maintaining the temperature surrounding the sample at $163 \pm 14^{\circ}\text{C}$ ($325 \pm 25^{\circ}\text{F}$).
- Sample Container: Clean, dry, not affected by heat and of sufficient size to contain a test sample without danger of spilling.
- Thermometer or other suitable device with a temperature range of 50 to 200°C (122 to 392°F) and readable to the nearest 2°C (4°F).

Sample

The test sample shall be obtained in accordance with the FOP for AASHTO R 97 and reduced in accordance with the FOP for AASHTO R 47. The size of the test sample shall be a minimum of 1000 g.

Procedure

1. Preheat the oven to the Job Mix Formula (JMF) mixing temperature range. If the mixing temperature is not supplied, a temperature of $163 \pm 14^{\circ}\text{C}$ ($325 \pm 25^{\circ}\text{F}$) is to be used.
2. Determine and record the mass of the sample container, including release media, to the nearest 0.1 g.
Note 1: When using paper or other absorptive material to line the sample container ensure it is dry before determining initial mass of sample container.
3. Place the test sample in the sample container.
4. Determine and record the temperature of the test sample.
5. Determine and record the total mass of the sample container and test sample to the nearest 0.1 g.

6. Calculate the initial, moist mass (M_i) of the test sample by subtracting the mass of the sample container as determined in Step 2 from the total mass of the sample container and the test sample as determined in Step 5.
7. The test sample shall be initially dried for 90 ± 5 minutes, and its mass determined. Then it shall be dried at 30 ± 5 minute intervals until further drying does not alter the mass by more than 0.05 percent.
8. Cool the sample container and test sample to $\pm 9^\circ\text{C}$ ($\pm 15^\circ\text{F}$) of the temperature determined in Step 4.
9. Determine and record the total mass of the sample container and test sample to the nearest 0.1 g.
10. Calculate the final, dry mass (M_f) of the test sample by subtracting the mass of the sample container as determined in Step 2 from the total mass of the sample container and the test sample as determined in Step 9.

Note 2: Moisture content and the number of samples in the oven will affect the rate of drying at any given time. Placing wet samples in the oven with nearly dry samples could affect the drying process.

Calculations

Constant Mass:

Calculate constant mass using the following formula:

$$\% \text{ Change} = \frac{M_p - M_n}{M_p} \times 100$$

Where:

M_p = previous mass measurement

M_n = new mass measurement

Example:

Mass of container:	232.6 g
Mass of container and sample after first drying cycle:	1361.8 g
Mass, M_p , of possibly dry sample:	$1361.8 \text{ g} - 232.6 \text{ g} = 1129.2 \text{ g}$
Mass of container and possibly dry sample after second drying cycle:	1360.4 g
Mass, M_n , of possibly dry sample:	$1360.4 \text{ g} - 232.6 \text{ g} = 1127.8 \text{ g}$

$$\% \text{ Change} = \frac{1129.2 \text{ g} - 1127.8 \text{ g}}{1129.2 \text{ g}} \times 100 = 0.12\%$$

0.12 percent is not less than 0.05 percent, so continue drying the sample.

Mass of container and possibly dry sample after third drying cycle:	1359.9 g
Mass, M_n , of dry sample:	$1359.9 \text{ g} - 232.6 \text{ g} = 1127.3 \text{ g}$

$$\% \text{ Change} = \frac{1127.8 \text{ g} - 1127.3 \text{ g}}{1127.8 \text{ g}} \times 100 = 0.04\%$$

0.04 percent is less than 0.05 percent, so constant mass has been reached.

Moisture Content:

Calculate the moisture content, as a percent, using the following formula.

$$\text{Moisture Content} = \frac{M_i - M_f}{M_f} \times 100$$

Where:

M_i = initial, moist mass

M_f = final, dry mass

Example:

$$M_i = 1134.9 \text{ g}$$

$$M_f = 1127.3 \text{ g}$$

$$\text{Moisture Content} = \frac{1134.9 \text{ g} - 1127.3 \text{ g}}{1127.3 \text{ g}} \times 100 = 0.674, \text{ say } 0.67\%$$

Report

- On forms approved by the agency
- Sample ID
- Moisture content to the nearest 0.01 percent

DETERMINING THE PERCENTAGE OF FRACTURE IN COARSE AGGREGATE FOP FOR AASHTO T 335

Scope

This procedure covers the determination of the percentage, by mass, of a coarse aggregate (CA) sample that consists of fractured particles meeting specified requirements in accordance with AASHTO T 335-09.

In this FOP, a sample of aggregate is screened on the sieve separating CA and fine aggregate (FA). This sieve will be identified in the agency's specifications but might be the 4.75 mm (No. 4) sieve. CA particles are visually evaluated to determine conformance to the specified fractured criteria. The percentage of conforming particles, by mass, is calculated for comparison to the specifications.

Apparatus

- Balance or scale: Capacity sufficient for the principal sample mass, accurate to 0.1 percent of the sample mass or readable to 0.1 g and meeting the requirements of AASHTO M 231.
- Sieves: Meeting requirements of the FOP for AASHTO T 27/T 11.
- Splitter: Meeting the requirements of FOP for AASHTO R 76.

Terminology

1. Fractured criteria: Determined by the agency to define a fractured particle.
2. Fractured face: An angular, rough, or broken surface of an aggregate particle created by crushing or by other means. A face is considered a "fractured face" whenever one-half or more of the projected area, when viewed normal to that face, is fractured with sharp and well-defined edges. This excludes small nicks.
3. Fractured particle: A particle of aggregate having at least the minimum number of fractured faces specified. (This is usually one or two.)

Sampling and Sample Preparation

1. Sample and reduce the aggregate in accordance with the FOPs for AASHTO R 90 and R 76.
2. When the specifications list only a total fracture percentage, the sample shall be prepared in accordance with Method 1. When the specifications require that the fracture be counted and reported on each sieve, the sample shall be prepared in accordance with Method 2.
3. Method 1 - Combined Fracture Determination
 - a. Dry the sample sufficiently to obtain a clean separation of FA and CA material in the sieving operation.

- b. Sieve the sample in accordance with the FOP for AASHTO T 27/ T 11 over the 4.75 mm (No. 4) sieve, or the appropriate sieve listed in the agency’s specifications for this material.

Note 1: Where necessary, wash the sample over the sieve designated for the determination of fractured particles to remove any remaining fine material, and dry to a constant mass in accordance with the FOP for AASHTO T 255.

- c. Reduce the sample using Method A – Mechanical Splitter, in accordance with the FOP for AASHTO R 76, to the appropriate test size. This test size should be slightly larger than shown in Table 1, to account for loss of fines through washing if necessary.

TABLE 1
Sample Size
Method 1 (Combined Sieve Fracture)

Nominal Maximum Size* mm (in.)	Minimum Cumulative Sample Mass Retained on 4.75 mm (No. 4) Sieve g (lb)
37.5 (1 1/2)	2500 (6)
25.0 (1)	1500 (3.5)
19.0 (3/4)	1000 (2.5)
12.5 (1/2)	700 (1.5)
9.5 (3/8)	400 (0.9)
4.75 (No. 4)	200 (0.4)

* One sieve larger than the first sieve to retain more than 10 percent of the material using an agency specified set of sieves based on cumulative percent retained. Where large gaps in specification sieves exist, intermediate sieve(s) may be inserted to determine nominal maximum size.

4. Method 2 – Individual Sieve Fracture Determination

- a. Dry the sample sufficiently to obtain a clean separation of FA and CA material in the sieving operation. A washed sample from the gradation determination (the FOP for T 27/T 11) may be used.
- b. If not, sieve the sample in accordance with the FOP for AASHTO T 27 over the sieves listed in the specifications for this material.

Note 2: If overload (buffer) sieves are used the material from that sieve must be added to the next specification sieve.

- c. The size of test sample for each sieve shall meet the minimum size shown in Table 2. Utilize the total retained sieve mass or select a representative portion from each sieve mass by splitting or quartering in accordance with the FOP for AASHTO R 76.

Note 3: Where necessary, wash the sample over the sieves designated for the determination of fractured particles to remove any remaining fine material, and dry to a constant mass in accordance with the FOP for AASHTO T 255.

TABLE 2
Sample Size
Method 2 (Individual Sieve Fracture)

Sieve Size mm (in.)	Minimum Sample Mass g (lb)
31.5 (1 1/4)	1500 (3.5)
25.0 (1)	1000 (2.2)
19.0 (3/4)	700 (1.5)
16.0 (5/8)	500 (1.0)
12.5 (1/2)	300 (0.7)
9.5 (3/8)	200 (0.5)
6.3 (1/4)	100 (0.2)
4.75 (No. 4)	100 (0.2)
2.36 (No. 8)	25 (0.1)
2.00 (No. 10)	25 (0.1)

Note 4: If fracture is determined on a sample obtained for gradation, use the mass retained on the individual sieves, even if it is less than the minimum listed in Table 2. If less than 5 percent of the total mass is retained on a single specification sieve, include that material on the next smaller specification sieve. If a smaller specification sieve does not exist, this material shall not be included in the fracture determination.

Procedure

1. After cooling, spread the dried sample on a clean, flat surface.
2. Examine each particle face and determine if the particle meets the fractured criteria.
3. Separate the sample into three categories:
 - Fractured particles meeting the criteria
 - Particles not meeting the criteria
 - Questionable or borderline particles
4. Determine the dry mass of particles in each category to the nearest 0.1 g.
5. Calculate the percent questionable particles to the nearest 1 percent.
6. Re-sort the questionable particles when more than 15 percent is present. Continue sorting until there is no more than 15 percent in the questionable category.
7. Calculate the percent fractured particles meeting criteria to nearest 0.1 percent. Report to 1 percent.

Calculation

Calculate the percent questionable particles to the nearest 1 percent using the following formula:

$$\%Q = \frac{Q}{F + Q + N} \times 100$$

Where:

- %Q = Percent of questionable particles
- F = Mass of fractured particles
- Q = Mass of questionable or borderline particles
- N = Mass of unfractured particles

Example:

$$\%Q = \frac{97.6 \text{ g}}{632.6 \text{ g} + 97.6 \text{ g} + 352.6 \text{ g}} \times 100 = 9\%$$

Given:

- F = 632.6 g
- Q = 97.6 g
- N = 352.6 g

Calculate the percent fractured particles to the nearest 0.1 percent using the following formula:

$$P = \frac{\frac{Q}{2} + F}{F + Q + N} \times 100$$

Where:

- P = Percent of fractured particles
- F = Mass of fractured particles
- Q = Mass of questionable particles
- N = Mass of unfractured particles

Example:

$$P = \frac{\frac{97.6 \text{ g}}{2} + 632.6 \text{ g}}{632.6 \text{ g} + 97.6 \text{ g} + 352.6 \text{ g}} \times 100 = 62.9\% \quad \text{Report 63\%}$$

Given:

$$F = 632.6 \text{ g}$$

$$Q = 97.6 \text{ g}$$

$$N = 352.6 \text{ g}$$

Report

- On forms approved by the agency
- Sample ID
- Fractured particles to the nearest 1 percent.

REDUCING SAMPLES OF AGGREGATE TO TESTING SIZE FOP FOR AASHTO R 76

Scope

This procedure covers the reduction of samples to the appropriate size for testing in accordance with AASHTO R 76-16. Techniques are used that minimize variations in characteristics between test samples and field samples. Method A (Mechanical Splitter) and Method B (Quartering) are covered.

This FOP applies to fine aggregate (FA), coarse aggregate (CA), and mixes of the two (FA / CA) and may also be used on soils.

Apparatus

Method A – Mechanical Splitter

Splitter chutes:

- Even number of equal width chutes
- Discharge alternately to each side
- Minimum of 8 chutes total for CA and FA / CA, 12 chutes total for FA
- Width:
 - Minimum 50 percent larger than largest particle
 - Maximum chute width of 19 mm (3/4 in.) for fine aggregate passing the 9.5 mm (3/8 in.) sieve

Feed control:

- Hopper or straightedge pan with a width equal to or slightly less than the overall width of the assembly of chutes
- Capable of feeding the splitter at a controlled rate

Splitter receptacles / pans:

- Capable of holding two halves of the sample following splitting

The splitter and accessory equipment shall be so designed that the sample will flow smoothly without restriction or loss of material.

Method B – Quartering

- Straightedge scoop, shovel, or trowel
- Broom or brush
- Tarp: A square canvas or plastic sheet, appropriate for the amount and size of the material being reduced

Method Selection

Samples of CA may be reduced by either Method A or Method B.

Samples of FA which are drier than the saturated surface dry (SSD) condition, as described in AASHTO T 84, shall be reduced by a mechanical splitter according to Method A. As a quick approximation, if the fine aggregate will retain its shape when molded with the hand, it is wetter than SSD.

Samples of FA / CA which are drier than SSD may be reduced by Method A or Method B.

Samples of FA and FA / CA that are at SSD or wetter than SSD shall be reduced by Method B, or the entire sample may be dried – using temperatures that do not exceed those specified for any of the tests contemplated – and then reduced to test sample size using Method A.

Table 1

	Drier than SSD	Wetter than SSD
Fine Aggregate (FA)	Method A (Mechanical)	Method B (Quartering)
Mixture of FA/CA	Either Method	Method B (Quartering)
Coarse Aggregate (CA)	Either Method	Either Method

Procedure

Method A – Mechanical Splitter

1. Place two clean empty receptacles under the splitter.
2. Empty the sample into the hopper or pan without loss of material.
3. Uniformly distribute the material in the hopper or pan from edge to edge so that approximately equal amounts flow through each chute.
4. Discharge the material at a uniform rate, allowing it to flow freely through the chutes.
5. Remove any material retained on the surface of the splitter and place into the appropriate receptacle.
6. Using one of the two receptacles containing material, repeat Steps 1 through 6 until the material in one of the two receptacles is the appropriate sample size for the required test.
7. Retain and properly identify the remaining unused sample for further testing if required.

Mechanical Splitter Check

- Determine the mass of each reduced portion. If the percent difference of the two masses is greater than 5 percent, corrective action must be taken.

Calculation

$$\frac{\text{Smaller Mass}}{\text{Larger Mass}} = \text{Ratio} \quad (1 - \text{ratio}) \times 100 = \% \text{ Difference}$$

Splitter check: 5127 g total sample mass

Splitter pan #1: 2583 g

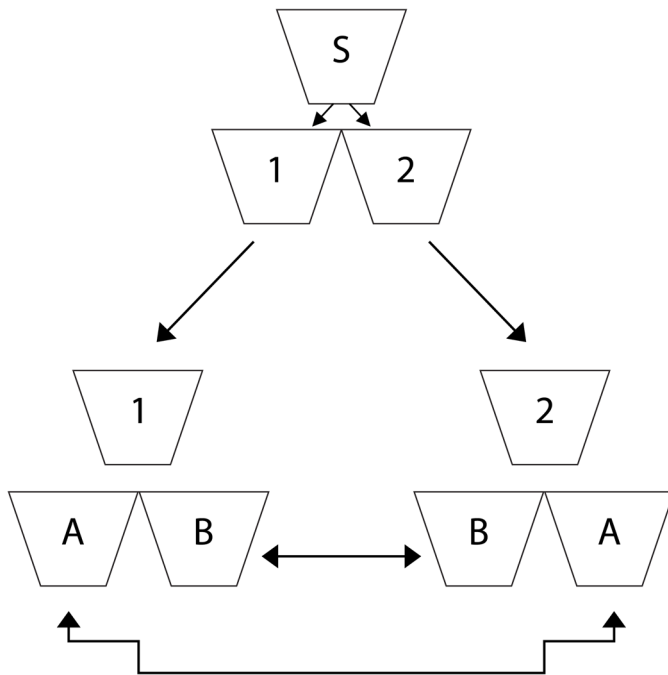
Splitter pan #2: 2544 g

$$\frac{2544 \text{ g}}{2583 \text{ g}} = 0.985 \quad (1 - 0.985) \times 100 = 1.5\%$$

Alternative to Mechanical Splitter Check

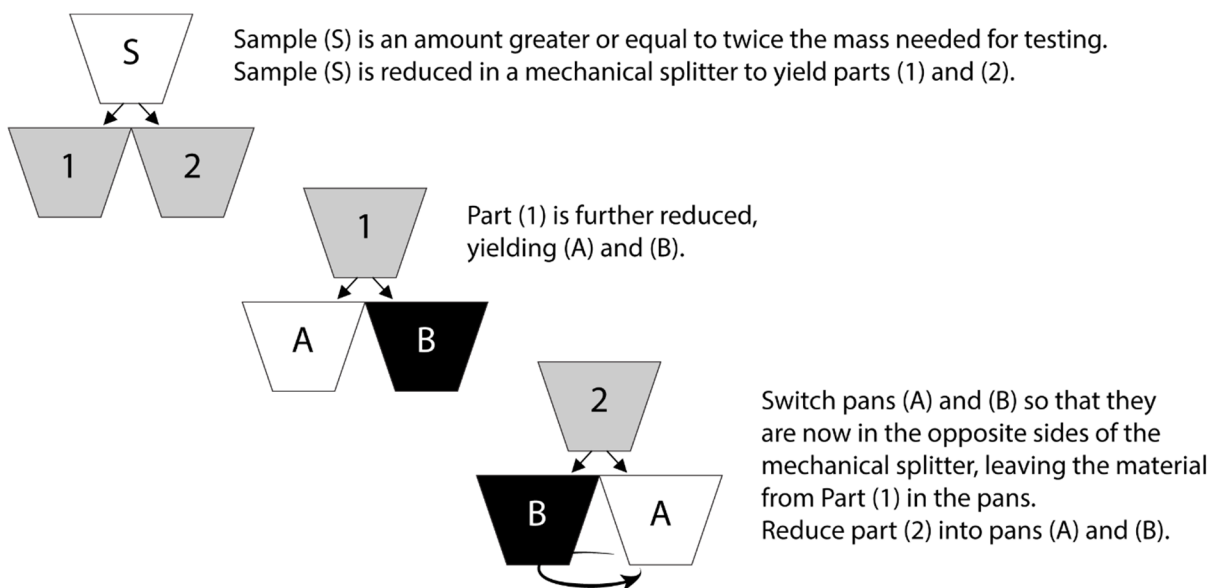
- In lieu of determining the mass of each reduced portion, use the method illustrated in Figure 1 or 2 during reduction.

Figure 1



- Sample (S) is an amount greater than or equal to twice the mass needed for testing. Sample (S) is reduced in a mechanical splitter to yield parts (1) and (2).
- Part (1) is further reduced yielding (A) and (B) while part (2) is reduced to yield (B) and (A).
- Final testing sample is produced by combining alternate pans, i.e. A/A or B/B only.

Figure 2



Method B – Quartering

Use either of the following two procedures or a combination of both.

Procedure 1: Quartering on a clean, hard, level surface:

1. Place the sample on a hard, clean, level surface where there will be neither loss of material nor the accidental addition of foreign material.
2. Mix the material thoroughly by turning the entire sample over a minimum of four times. With the last turning, shovel the entire sample into a conical pile by depositing each shovelful on top of the preceding one.
3. Flatten the conical pile to a uniform thickness and diameter by pressing down with a shovel. The diameter should be four to eight times the thickness.
4. Divide the flattened pile into four approximately equal quarters with a shovel or trowel.
5. Remove two diagonally opposite quarters, including all fine material, and brush the cleared spaces clean.
6. Successively mix and quarter the remaining material until the sample is reduced to the desired size.
7. The final test sample consists of two diagonally opposite quarters.

Procedure 2: Quartering on a tarp:

1. Place the sample on the tarp.
2. Mix the material thoroughly a minimum of four times by pulling each corner of the tarp horizontally over the sample toward the opposite corner. After the last turn, form a conical pile.
3. Flatten the conical pile to a uniform thickness and diameter by pressing down with a shovel. The diameter should be four to eight times the thickness.
4. Divide the flattened pile into four approximately equal quarters with a shovel or trowel or insert a stick or pipe beneath the tarp and under the center of the pile, then lift both ends of the stick, dividing the sample into two roughly equal parts. Remove the stick leaving a fold of the tarp between the divided portions. Insert the stick under the center of the pile at right angles to the first division and again lift both ends of the stick, dividing the sample into four roughly equal quarters.
5. Remove two diagonally opposite quarters, being careful to clean the fines from the tarp.

6. Successively mix and quarter the remaining material until the sample size is reduced to the desired size.
7. The final test sample consists of two diagonally opposite quarters.

SAMPLING AGGREGATE PRODUCTS FOP FOR AASHTO R 90

Scope

This procedure covers sampling of coarse, fine, or a combination of coarse and fine aggregates (CA and FA) in accordance with AASHTO R 90-18. Sampling from conveyor belts, transport units, roadways, and stockpiles is covered.

Apparatus

- Shovels or scoops, or both
- Brooms, brushes, and scraping tools
- Sampling tubes of acceptable dimensions
- Mechanical sampling systems: normally a permanently attached device that allows a sample container to pass perpendicularly through the entire stream of material or diverts the entire stream of material into the container by manual, hydraulic, or pneumatic operation
- Belt template
- Sampling containers

Procedure – General

Sampling is as important as testing. The technician shall use every precaution to obtain samples that are representative of the material. Determine the time or location for sampling in a random manner.

1. Wherever samples are taken, obtain multiple increments of approximately equal size.
2. Mix the increments thoroughly to form a field sample that meets or exceeds the minimum mass recommended in Table 1.

TABLE 1
Recommended Sample Sizes

Nominal Maximum Size*		Minimum Mass	
mm (in.)		g (lb)	
90	(3 1/2)	175,000	(385)
75	(3)	150,000	(330)
63	(2 1/2)	125,000	(275)
50	(2)	100,000	(220)
37.5	(1 1/2)	75,000	(165)
25.0	(1)	50,000	(110)
19.0	(3/4)	25,000	(55)
12.5	(1/2)	15,000	(35)
9.5	(3/8)	10,000	(25)
4.75	(No. 4)	10,000	(25)
2.36	(No. 8)	10,000	(25)

* One sieve larger than the first sieve to retain more than 10 percent of the material using an agency specified set of sieves based on cumulative percent retained. Where large gaps in specification sieves exist, intermediate sieve(s) may be inserted to determine nominal maximum size. Maximum size is one size larger than nominal maximum size.

Note 1: Sample size is based upon the test(s) required. As a general rule, the field sample size should be such that, when split twice will provide a testing sample of proper size. For example, the sample size may be four times that shown in Table 1 of the FOP for AASHTO T 27/T 11, if that mass is more appropriate.

Procedure – Specific Situations

Conveyor Belts

Avoid sampling at the beginning or end of the aggregate run due to the potential for segregation. Be careful when sampling in the rain. Make sure to capture fines that may stick to the belt or that the rain tends to wash away.

Method A (From the Belt)

1. Stop the belt.
2. Set the sampling template in place on the belt, avoiding intrusion by adjacent material.
3. Remove the material from inside the template, including all fines.
4. Obtain at least three approximately equal increments.
5. Combine the increments and mix thoroughly to form a single sample.

Method B (From the Belt Discharge)

1. Pass a sampling device through the full stream of the material as it runs off the end of the conveyor belt. The sampling device may be manually, semi-automatic or automatically powered.
2. The sampling device shall pass through the stream at least twice, once in each direction, without overfilling while maintaining a constant speed during the sampling process.
3. When emptying the sampling device into the container, include all fines.
4. Combine the increments and mix thoroughly to form a single sample.

Transport Units

1. Visually divide the unit into four quadrants.
2. Identify one sampling location in each quadrant.
3. Dig down and remove approximately 0.3 m (1 ft.) of material to avoid surface segregation. Obtain each increment from below this level.
4. Combine the increments and mix thoroughly to form a single sample.

Roadways**Method A (Berm or Windrow)**

1. Obtain sample before spreading.
2. Take the increments from at least three random locations along the fully formed windrow or berm. Do not take the increments from the beginning or the end of the windrow or berm.
3. Obtain full cross-section samples of approximately equal size at each location. Take care to exclude the underlying material.
4. Combine the increments and mix thoroughly to form a single sample.

Note 2: Obtaining samples from berms or windrows may yield extra-large samples and may not be the preferred sampling location.

Method B (In-Place)

1. Obtain sample after spreading and before compaction.
2. Take the increments from at least three random locations.
3. Obtain full-depth increments of approximately equal size from each location. Take care to exclude the underlying material.
4. Combine the increments and mix thoroughly to form a single sample.

Stockpiles

Method A – Loader Sampling

1. Direct the loader operator to enter the stockpile with the bucket at least 150 mm (6 in.) above ground level without contaminating the stockpile.
2. Discard the first bucketful.
3. Have the loader re-enter the stockpile and obtain a full loader bucket of the material, tilt the bucket back and up.
4. Form a small sampling pile at the base of the stockpile by gently rolling the material out of the bucket with the bucket just high enough to permit free flow of the material. (Repeat as necessary.)
5. Create a flat surface by having the loader back drag the small pile.
6. Visually divide the flat surface into four quadrants.
7. Collect an increment from each quadrant by fully inserting the shovel into the flat pile as vertically as possible, take care to exclude the underlying material, roll back the shovel and lift the material slowly out of the pile to avoid material rolling off the shovel.
8. Combine the increments and mix thoroughly to form a single sample.

Method B – Stockpile Face Sampling

1. Create horizontal surfaces with vertical faces in the top, middle, and bottom third of the stockpile with a shovel or loader.
2. Prevent continued sloughing by shoving a flat board against the vertical face. Sloughed material will be discarded to create the horizontal surface.
3. Obtain sample from the horizontal surface as close to the intersection as possible of the horizontal and vertical faces.
4. Obtain at least one increment of equal size from each of the top, middle, and bottom thirds of the pile.
5. Combine the increments to and mix thoroughly form a single sample.

Method C – Alternate Tube Method (Fine Aggregate)

1. Remove the outer layer that may have become segregated.
2. Using a sampling tube, obtain one increment of equal size from a minimum of five random locations on the pile.
3. Combine the increments to and mix thoroughly form a single sample.

Identification and Shipping

- Identify samples according to agency standards.
- Include sample report (below).
- Ship samples in containers that will prevent loss, contamination, or damage of material.

Report

- On forms approved by the agency
- Date
- Time
- Sample ID
- Sampling method
- Location
- Quantity represented
- Material type
- Supplier

METHOD OF MAKING AND CURING CONCRETE TEST SPECIMENS IN THE FIELD FOP FOR AASHTO R 100

Scope

This practice covers the method for making, initially curing, and transporting concrete test specimens in the field in accordance with AASHTO R 100-22.

Warning—Fresh Hydraulic cementitious mixtures are caustic and may cause chemical burns to skin and tissue upon prolonged exposure.

Apparatus

- Concrete cylinder molds: Conforming to AASHTO M 205 with a length equal to twice the diameter. Standard specimens shall be 150 mm (6 in.) by 300 mm (12 in.) cylinders. Mold diameter must be at least three times the maximum aggregate size unless wet sieving is conducted according to the FOP for WAQTC TM 2. Agency specifications may allow cylinder molds of 100 mm (4 in.) by 200 mm (8 in.) when the nominal maximum aggregate size does not exceed 25 mm (1 in.).
- Beam molds: Rectangular in shape with ends and sides at right angles to each other. Must be sufficiently rigid to resist warpage. Surfaces must be smooth. Molds shall produce length no more than 1.6 mm (1/16 in.) shorter than that required (greater length is allowed). Maximum variation from nominal cross section shall not exceed 3.2 mm (1/8 in.). Ratio of width to depth may not exceed 1:5; the smaller dimension must be at least 3 times the maximum aggregate size. Standard beam molds shall result in specimens having width and depth of not less than 150 mm (6 in.). Agency specifications may allow beam molds of 100 mm (4 in.) by 100 mm (4 in.) when the nominal maximum aggregate size does not exceed 25 mm (1 in.). Specimens shall be cast and hardened with the long axes horizontal.
- Standard tamping rod: 16 mm (5/8 in.) in diameter and 400 mm (16 in.) to 600 mm (24 in.) long, having a hemispherical tip of the same diameter as the rod for preparing 150 mm (6 in.) x 300 mm (12 in.) cylinders.
- Small tamping rod: 10 mm (3/8 in.) diameter and 305 mm (12 in.) to 600 mm (24 in.) long, having a hemispherical tip of the same diameter as the rod for preparing 100 mm (4 in.) x 200 mm (8 in.) cylinders.
- Vibrator: At least 9000 vibrations per minute, with a diameter no more than 1/4 the diameter or width of the mold and at least 75 mm (3 in.) longer than the section being vibrated.
- Scoop: a receptacle of appropriate size so that each representative increment of the concrete sample can be placed in the container without spillage.
- Trowel or float

- Mallet: With a rubber or rawhide head having a mass of 0.57 ± 0.23 kg (1.25 ± 0.5 lb.).
- Rigid base plates and cover plates: may be metal, glass, or plywood.
- Initial curing facilities: Temperature-controlled curing box or enclosure capable of maintaining the required range of 16 to 27°C (60 to 80°F) during the entire initial curing period (for concrete with compressive strength of 40 Mpa (6000 psi) or more, the temperature shall be 20 to 26°C (68 to 78°F). As an alternative, sand or earth for initial cylinder protection may be used provided that the required temperature range is maintained, and the specimens are not damaged.
- Thermometer: Capable of registering both maximum and minimum temperatures during the initial cure meeting the requirements for FOP for AASHTO T 309.

Procedure – Making Specimens – General

1. Obtain the sample according to the FOP for WAQTC TM 2.
2. Wet Sieving per the FOP for WAQTC TM 2 is required for 150 mm (6 in.) diameter specimens containing aggregate with a nominal maximum size greater than 50 mm (2 in.); screen the sample over the 50 mm (2 in.) sieve.
3. Remix the sample after transporting to testing location.
4. Begin making specimens within 15 minutes of obtaining the sample.
5. Set molds upright on a level, rigid base in a location free from vibration and relatively close to where they will be stored.
6. Fill molds in the required number of layers, attempting to slightly overfill the mold on the final layer. Add or remove concrete before completion of consolidation to avoid a deficiency or excess of concrete.
7. There are two methods of consolidating the concrete – rodding and internal vibration. If the slump is greater than 25 mm (1 in.), consolidation may be by rodding or vibration. When the slump is 25 mm (1 in.) or less, consolidate the sample by internal vibration. Agency specifications may dictate when rodding or vibration will be used.

Procedure – Making Cylinders –Self-Consolidating Concrete

1. Use the scoop to slightly overfill the mold. Evenly distribute the concrete in a circular motion around the inner perimeter of the mold.
2. Strike off the surface of the molds with tamping rod, straightedge, float, or trowel.
3. Immediately begin initial curing.

Procedure – Making Cylinders – Rodding

1. For the standard 150 mm (6 in.) by 300 mm (12 in.) specimen, fill each mold in three approximately equal layers, moving the scoop or trowel around the perimeter of the mold to evenly distribute the concrete. For the 100 mm (4 in.) by 200 mm (8 in.) specimen, fill the mold in two layers. When filling the final layer, slightly overfill the mold.
2. Consolidate each layer with 25 strokes of the appropriate tamping rod, using the rounded end. Distribute strokes evenly over the cross section of the concrete. Rod the first layer throughout its depth without forcibly hitting the bottom. For subsequent layers, rod the layer throughout its depth penetrating approximately 25 mm (1 in.) into the underlying layer.
3. After rodding each layer, tap the sides of each mold 10 to 15 times with the mallet (reusable steel molds) or lightly with the open hand (single-use light-gauge molds).
4. Strike off the surface of the molds with tamping rod, straightedge, float, or trowel.
5. Immediately begin initial curing.

Procedure – Making Cylinders – Internal Vibration

1. Fill the mold in two layers.
 2. Insert the vibrator at the required number of different points for each layer (two points for 150 mm (6 in.) diameter cylinders; one point for 100 mm (4 in.) diameter cylinders). When vibrating the bottom layer, do not let the vibrator touch the bottom or sides of the mold. When vibrating the top layer, the vibrator shall penetrate into the underlying layer approximately 25 mm (1 in.)
 3. Remove the vibrator slowly, so that no large air pockets are left in the material.
- Note 1:* Continue vibration only long enough to achieve proper consolidation of the concrete. Over vibration may cause segregation and loss of appreciable quantities of intentionally entrained air.
4. After vibrating each layer, tap the sides of each mold 10 to 15 times with the mallet (reusable steel molds) or lightly with the open hand (single-use light-gauge molds).
 5. Strike off the surface of the molds with tamping rod, straightedge, float, or trowel.
 6. Immediately begin initial curing.

Procedure – Making Flexural Beams – Rodding

1. Fill the mold in two approximately equal layers with the second layer slightly overfilling the mold.
2. Consolidate each layer with the tamping rod once for every 1300 mm² (2 in²) using the rounded end. Rod each layer throughout its depth, taking care to not forcibly strike the bottom of the mold when compacting the first layer. Rod the second layer throughout its depth, penetrating approximately 25 mm (1 in.) into the lower layer.

3. After rodding each layer, strike the mold 10 to 15 times with the mallet and spade along the sides and end using a trowel.
4. Strike off the surface of the molds with tamping rod, straightedge, float, or trowel.
5. Immediately begin initial curing.

Procedure – Making Flexural Beams – Vibration

1. Fill the mold to overflowing in one layer.
2. Consolidate the concrete by inserting the vibrator vertically along the centerline at intervals not exceeding 150 mm (6 in.). Take care to not over-vibrate and withdraw the vibrator slowly to avoid large voids. Do not contact the bottom or sides of the mold with the vibrator.
3. After vibrating, strike the mold 10 to 15 times with the mallet.
4. Strike off the surface of the molds with tamping rod, straightedge, float, or trowel.
5. Immediately begin initial curing.

Procedure – Initial Curing

- When moving cylinder specimens made with single use molds support the bottom of the mold with trowel, hand, or other device.
- For initial curing of cylinders, there are two methods, use of which depends on the agency. In both methods, the curing place must be firm, within ¼ in. of a level surface, and free from vibrations or other disturbances.
- Maintain initial curing temperature:
 - 16 to 27°C (60 to 80°F) for concrete with design strength up to 40 Mpa (6000 psi).
 - 20 to 26°C (68 to 78°F) for concrete with design strength of 40 Mpa (6000 psi) or more.
- Prevent loss of moisture.

Method 1 – Initial cure in a temperature-controlled chest-type curing box

1. Finish the cylinder using the tamping rod, straightedge, float, or trowel. The finished surface shall be flat with no projections or depressions greater than 3.2 mm (1/8 in.).
2. Place the mold in the curing box. When lifting light-gauge molds be careful to avoid distortion (support the bottom, avoid squeezing the sides).
3. Place the lid on the mold to prevent moisture loss.
4. Mark the necessary identification data on the cylinder mold and lid.

Method 2 – Initial cure by burying in earth or by using a curing box over the cylinder

Note 2: This procedure may not be the preferred method of initial curing due to problems in maintaining the required range of temperature.

1. Move the cylinder with excess concrete to the initial curing location.
2. Mark the necessary identification data on the cylinder mold and lid.
3. Place the cylinder on level sand or earth, or on a board, and pile sand or earth around the cylinder to within 50 mm (2 in.) of the top.
4. Finish the cylinder using the tamping rod, straightedge, float, or trowel. Use a sawing motion across the top of the mold. The finished surface shall be flat with no projections or depressions greater than 3.2 mm (1/8 in.).
5. If required by the agency, place a cover plate on top of the cylinder and leave it in place for the duration of the curing period, or place the lid on the mold to prevent moisture loss.

Procedure – Transporting Specimens

- Initially cure the specimens for 24 to 48 hours. Transport specimens to the laboratory for final cure. Specimen identity will be noted along with the date and time the specimen was made and the maximum and minimum temperatures registered during the initial cure.
- Protect specimens from jarring, extreme changes in temperature, freezing, or moisture loss during transport.
- Secure cylinders so that the axis is vertical.
- Do not exceed 4 hours transportation time.

Final Curing

- Upon receiving cylinders at the laboratory, remove the cylinder from the mold and apply the appropriate identification.
- For all specimens (cylinders or beams), final curing must be started within 30 minutes of mold removal. Temperature shall be maintained at $23^{\circ} \pm 2^{\circ}\text{C}$ ($73 \pm 3^{\circ}\text{F}$). Free moisture must be present on the surfaces of the specimens during the entire curing period. Curing may be accomplished in a moist room or water tank conforming to AASHTO M 201.
- For cylinders, during the final 3 hours before testing the temperature requirement may be waived, but free moisture must be maintained on specimen surfaces at all times until tested and ambient temperature is between 20 to 30°C (68 to 80°F).
- Final curing of beams must include immersion in lime-saturated water for at least 20 hours before testing.

Report

- On forms approved by the agency
- Pertinent placement information for identification of project, element(s) represented, etc.
- Sample ID
- Date and time molded.
- Test ages.
- Slump, air content, and density.
- Temperature (concrete, initial cure max. and min., and ambient).
- Method of initial curing.
- Other information as required by agency, such as: concrete supplier, truck number, invoice number, water added, etc.

INSERT TAB

SECTION 2
Quality Assurance
Program



QUALITY ASSURANCE PROGRAM

(Revised December, 2022)

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**OREGON DEPARTMENT OF TRANSPORTATION
QUALITY ASSURANCE PROGRAM**

I. OVERVIEW

The Oregon Department of Transportation (ODOT) has implemented a Quality Assurance (QA) Program approach that complies with the FHWA Guidelines for a QA program for construction projects on the National Highway System. This program defines the responsibilities of the Contractor and ODOT in order to satisfy the needs of the program. This program is currently used for all construction projects administered by ODOT or its consultants.

ODOT recognizes that there are other benefits of developing and implementing quality assurance specifications into its construction program. These benefits include:

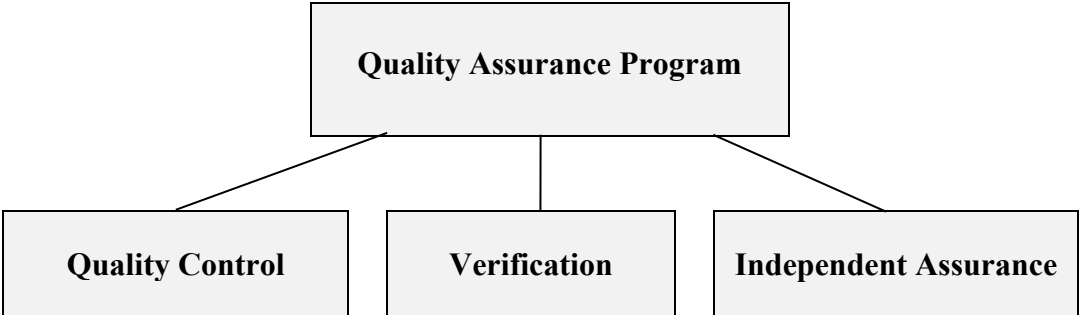
- To improve the overall quality of highway and bridge construction; and
- To place responsibility on the contractor for quality control in contracted work.

The success of the Agency’s Quality Assurance Program is dependent on three primary features. The first is the Laboratory Certification Program, which is discussed in Section III of this document. The second is the Technician Certification Program, which is discussed in Section IV and the final feature is the specific product QC/QA testing plan detailed in Section VI of this document.

Quality Assurance (QA)

Quality assurance is defined as: *All those planned and systematic actions necessary to provide confidence that a product or service will satisfy given requirements for quality.*

ODOT has developed its QA Program, which includes three separate and distinct sub-programs as illustrated below:



Quality Control (QC)

Quality control is defined as: *All Contractor/vendor operational techniques and activities that are performed or conducted to fulfill the contract requirements.*

The Contractor is responsible for providing quality control sampling and testing, furnishing material of the quality specified, and furnishing QL levels during aggregate production, when required. The Contractor's quality control technician must perform or observe the sampling operations. Testing operations shall be performed by technicians certified to run the respective tests. The certified technician, who performs the sampling and testing procedures, must sign the testing documentation.

Contractor quality control tests will be used for acceptance only if verified by tests performed by an independent group (region QA).

Small quantities of some materials may be accepted when requested by the Contractor and approved by the Project Manager (see Section 4(B) of MFTP).

ODOT will perform testing for all source/compliance tests and those non-field tested items associated with construction products (e.g. asphalts, emulsions, tack, etc.).

Verification

Verification is defined as: *Sampling and testing performed to validate the quality of the product.*

Verification samples are taken randomly (minimum ten-percent frequency of subplot quantity identified in Section 4(D) of the MFTP) and tested by an independent group (region QA) to verify that products meet required specification(s). All aggregate samples will be obtained from the stockpile. Material transported to the source of incorporation (e.g., concrete plant, ACP facility, pug mill etc.), may be subject to further testing. Quality control samples shall not be used for verification.

Independent Assurance (IA)

Independent assurance is defined as: *Activities that are an unbiased and independent evaluation of all the sampling and testing procedures used in the acceptance program.*

ODOT's Independent Assurance (IA) Program uses a combination approach requiring laboratory certification, technician certification, proficiency samples, and where possible, split samples of verification or QC tests. The Construction Section certifies quality control and quality assurance testing laboratories and technicians. Contractor's test results of split IA samples are compared to region QA test results for compliance using ODOT IA Parameters. The PM performs random inspections of QC laboratories and technicians for compliance. The quality of region QA test results are constantly monitored through the Quality Assurance Laboratory Proficiency Sample Program which is outlined in Section V.

Quality assurance testing (both verification and independent assurance) will be performed by a quality assurance laboratory designated by the Agency in compliance with 23 CFR 637.

Quality Assurance Program Components

Third-Party Resolution

Third-party resolution is used when the Agency's quality assurance test results conflict with ongoing quality control test results according to section VI (Product Specific QC/QA Testing Plan) and when the conflict cannot be resolved. Third-party resolution can be requested by either the Contractor or the Project Manager.

Third-party resolution testing shall be performed by a third-party resolution laboratory. The ODOT Construction Section's Central Materials Laboratory (ODOT-CML) performs third-party resolutions. This is normally done by testing quality control production backup samples, but may include other resolution techniques or procedures as determined by the Agency's technical expert for the corresponding specification section.

The test result(s) of the third-party resolution laboratory performing third-party resolution materials testing for any or all disputed test results will be considered the actual test results and will therefore be used for acceptance of the material.

Certification Advisory Committee (CAC)

The certification programs (both Technician and Laboratory Certifications) for ODOT's Quality Assurance Program will be overseen by a Certification Advisory Committee (CAC). The purpose of this committee is to review and provide general oversight to the certification programs. The committee will be responsible for establishing policy as related to the certification programs and will also be responsible for reviewing allegations concerning abuse by technicians. The CAC will perform other duties as required to successfully implement and continue the certification programs. A meeting of the CAC may be called at any time by the Chair of the Certification Advisory Committee or by written request of at least two members of the CAC. A majority of the members of the CAC shall be present for transaction of official business.

Membership

Membership of the Certification Advisory Committee will include the following:

- ODOT Construction and Materials Engineer (Chair)
- ODOT Pavements Services Engineer
- ODOT State Quality Assurance Engineer
- ODOT Structural Services Engineer
- ODOT Laboratory Services Manager
- APAO Executive Director or Representative
- OCAPA Executive Director or Representative

AGC Heavy Highway Representative
Industry “At Large” Representative (appointed by CAC)

Random Samples

The Quality Assurance Program is based on theoretical conditions and the application of statistical acceptance procedures. Sampling shall be by simple random, stratified random or systematic means as specified.

To obtain a representative sample, a reliable system of random sampling shall be employed. Some work, like process control, lends itself quite well to the use of the Random Units Table and the Random Sample Location forms that ODOT has developed. ODOT TM 400, Determining Random Sampling and Testing Locations, is available to assist with random number determinations and test site locations. Random sampling is the preferred method to assure that the samples are representative and to eliminate sampling bias. In other work, like verification or independent assurance, it may be difficult to apply random numbers to sample selection. In this case, it is imperative that the samples are taken at locations or times, which do not have an identifiable pattern and are completely random, without bias.

ODOT Approved Aggregate Product Program (OAAPP)

The ODOT Quality Assurance Program allows some freedom for aggregate sources to establish their own quality control plan that is tailored to the operation of the specific source. The supplier is required to submit a written quality control plan to the appropriate region Senior Quality Assurance Coordinator (SQAC) for approval. All testing for the approved quality control plan is required to be performed by a certified technician in an ODOT certified laboratory. Specific details on the ODOT Approved Aggregate Product Program may be found in Appendix A.

II. ROLES AND RESPONSIBILITIES

Contractor

The Contractor's responsibilities are to:

- Furnish a written quality control plan (See Appendix B for minimum requirements);
- Furnish and incorporate materials/products which are of the quality specified;
- Provide ODOT certified technicians and laboratories;
- Perform quality control of all materials/products used on ODOT construction projects;
- Sample and test materials using appropriate devices and procedures;
- Furnish QCs when required;
- Sample and provide splits to ODOT upon request, witnessed by an Agency representative;
- Perform required tests on Contractor's split of IA samples;
- Properly document, sign and deliver test results as required, on ODOT forms according to Section 3 criteria; and
- Retain splits of all QC samples until the Project Manager (PM) determines that the split samples may be discarded.
- Retain all split portions of IA samples until notified in writing by the PM to discard.

Project Manager (PM)

The Project Manager has the authority and responsibility to enforce the provisions of the contract. The PM's Quality Control Compliance Specialist (QCCS) supports the project QA activities and is experienced and certified in all areas of field testing and documentation. The QCCS is required to maintain certification in CAgT, CEBT, CAT 1, CDT and QCT. Certification in CAT II, CCT and CMDT is recommended.

The Project Manager is responsible to ensure that:

- The project meets the requirements specified in the plans and specifications.
- All required tests are performed, documented, and submitted. The PM is also responsible for informing the SQAC of project schedules, current quantities, and anticipated sampling requirements, so verification testing can be accomplished.
- The Contractor's QC program meets required standards. This is accomplished by performing inspections of the Contractor's personnel, testing procedures and testing equipment.
- The Contractor and region quality assurance laboratory is notified in writing within 5 working days of an IA/Verification sample's completion, regarding which backup samples may be discarded or that an investigation is in progress. Upon the completion of an investigation inform the Contractor, in writing, as to which backup samples may be discarded. Written notification will identify the lot/sublots represented by the IA/verification sample, include the IA test results and, if required, the resolution of an IA investigation.

Region Quality Assurance Team

The region quality assurance team consists of a Senior Quality Assurance Coordinator (SQAC), Quality Assurance Coordinator (QAC) and quality assurance technicians (QATs). They are resources for the PMs, inspectors, technicians, other agencies and contractors. They are also experienced in construction and design and certified in testing of construction materials.

Specific duties include, but are not limited to, the following:

- Maintain uniformity in construction and testing activities;
- Witness quality control technician sampling for IA and verification testing;
- Perform all required IA and verification testing;
- Properly document on ODOT forms according to Section 3 criteria;
- Calibrate or verify calibration of all nuclear moisture density gauges for ODOT, industry, and other agencies;
- Administer the region's radiation safety program;
- Troubleshoot construction problems related to materials;
- Recommend changes to mix designs;
- Assist in the technician certification program;
- Oversee region testing facilities;
- Inspect Contractor facilities and/or technicians; and
- Assist in QC laboratory certification.
- Retain IA/verification splits until notified by the PM.
- Administer the ODOT Approved Aggregate Product Program

Construction Section

The Construction Section's duties include:

- Support of the QA Program by coordinating training and certification for technicians and by certifying all testing labs associated with ODOT construction projects;
- Administer the proficiency sample program;
- Provide third-party resolution, according to the QA Program.
- Utilize the QA Steering Committee to establish and ensure statewide consistency in the QA Program.

III. LABORATORY CERTIFICATION PROGRAM

OVERVIEW

The Construction Section (CS) developed the Laboratory Certification Program to support the Oregon Department of Transportation's Quality Assurance Program for construction materials. The Laboratory Certification Program recognizes three categories of laboratories: quality control, quality assurance, and third-party resolution. To help ensure that laboratories provide consistent and accurate test results, laboratories that produce test results under the ODOT QA Program shall be certified according to this Laboratory Certification Program, as part of the Independent Assurance Program.

This laboratory certification process is designed to provide not only a "snapshot" of the quality of a laboratory, but also an evaluation of the laboratory's performance in maintaining quality and consistency. The ODOT Construction Section's Central Materials Laboratory (ODOT-CML), or its authorized representative, will examine the laboratory's conditions and testing equipment for accuracy and conformance to test procedure apparatus standards. If the laboratory's equipment is properly calibrated per the standards and the laboratory meets the specified conditions of the Laboratory Certification Program, ODOT will certify the laboratory.

Laboratory certifications are valid for one year, unless decertified by the Certification Advisory Committee or found to be deficient per the "Follow-Up On-site Inspection" criteria. If a laboratory's certification expires and the laboratory has a continued need to test materials for ODOT construction projects, the laboratory shall apply for and obtain recertification, prior to performing continued testing under the QA Program. An outline of the on-site inspection process and laboratory certification criteria is found under "On-Site Laboratory Inspection" below.

PROGRAM DESCRIPTION

Quality Control (QC) Laboratories

Quality control of construction materials is the responsibility of the Contractor. Laboratories performing quality control testing may be the Contractor's own, the material supplier's or an independent testing laboratory.

The ODOT-CML will certify all quality control laboratories for those test procedures and methods necessary to perform quality control tests of construction materials for ODOT construction projects. The QC laboratory is required to schedule laboratory inspection with the ODOT-CML to ensure certification prior to the performance of any tests under the ODOT QA Program.

Quality Assurance Laboratories

Quality assurance is the responsibility of ODOT. During the production of materials for ODOT contracts, quality assurance laboratories perform independent assurance (IA) tests in coordination with quality control laboratories and verification tests which may, or may not, be done in coordination with IA testing. These tests provide ODOT with an independent analysis of the quality control test results to help ensure that the results of quality control tests are valid.

Quality assurance laboratories will usually be ODOT region QA laboratories, but may also be the ODOT Central Materials Laboratory or an ODOT contracted independent testing laboratory.

The ODOT-CML requires the certification of all quality assurance laboratories for those test methods necessary to perform quality assurance IA and verification testing. Region quality assurance laboratories are required to participate in the Quality Assurance Laboratory Proficiency Sample Program (see Section V). The ODOT-CML and/or ODOT contracted independent testing laboratories performing IA or verification testing will participate in the proficiency program, or other acceptable laboratory certification program (e.g. AMRL certification).

Third-Party Resolution Laboratories

When quality control and quality assurance test results conflict and the conflict cannot be resolved; a neutral third-party resolution laboratory will test the material in question. The test results of the third-party resolution laboratory will decide the dispute.

The ODOT-CML will perform all third-party resolutions unless a potential for conflict of interest exists. Any laboratory which has performed independent assurance, verification or quality control testing on the material under dispute is considered to have a conflict of interest and shall not perform third-party resolution testing. In this event, the third-party resolution duties will be performed by a certified laboratory meeting the requirements of CFR 0637.209 (a-4), accredited in the testing to be performed by the AASHTO Accreditation Program or a comparable laboratory accreditation program approved by FHWA.

ON-SITE LABORATORY INSPECTION CRITERIA FOR QUALITY CONTROL AND QUALITY ASSURANCE LABORATORIES

A laboratory needing information and/or an application package for ODOT laboratory certification may contact the ODOT Central Materials Laboratory at the following address:

Oregon Department of Transportation
Construction Section, Materials Laboratory
Attn: Lab Certification Coordinator
800 Airport Road SE
Salem, OR 97301-4798
Telephone: (503) 986-3087

Laboratories requesting ODOT certification shall make arrangements to receive an on-site inspection. Forms will be included in the application package to facilitate the laboratory's response to this requirement. These forms are available electronically at the following URL address:

<https://www.oregon.gov/ODOT/Construction/Pages/Lab-Services.aspx>

On-Site Inspection

The lab certification inspector will visit each laboratory whose application for certification has been accepted. The laboratory inspector will evaluate the laboratory using criteria A through G listed below. It is the responsibility of the requesting laboratory to have their lab clean, organized and in complete operating order at the time of inspection. All equipment must be readily available and accessible. The ODOT laboratory certification team does not search for stowed equipment. In addition, an authorized representative must be present at the time of inspection to answer questions and to identify and present equipment. Failure to meet these criteria may result in a canceled inspection.

- A. The laboratory (fixed or mobile) shall maintain proper environmental controls. This criterion is used to evaluate the laboratory's physical ability to provide an appropriate environment in which to test materials. General requirements include: adequate power, water, lighting, floor space, temperature control, et cetera; and the capability of maintaining the proper environmental conditions that are specified in the test methods for which the laboratory is seeking certification.
- B. The laboratory shall maintain facilities for proper storage, identification, handling, retaining, and conditioning of test specimens and samples. This criterion is used to evaluate a laboratory's physical ability, internal policies and procedures to store samples and keep them organized. The laboratory shall maintain separate areas on its premises to store samples and splits of samples in an organized manner so that samples are not lost or discarded and may be found at a future date. In addition, the laboratory shall have facilities for the conditioning of samples as required by any test method for which the laboratory seeks certification.
- C. The laboratory shall use accredited calibration service providers. Calibration certificates held by laboratories shall meet the requirements of ISO/IEC 17025 and shall include appropriate statements of uncertainty. The laboratory shall maintain necessary calibration equipment and reference standards. A laboratory shall have on hand calibration and verification equipment necessary to ensure the accuracy of its equipment. Such equipment might include calibration weights for scales or balances, manometers for the verification of vacuum pumps, thermometers, etc.
- D. The laboratory shall maintain equipment conforming to specification requirements necessary for the testing performed. This criterion is used to ensure that the laboratory's testing equipment conforms to the specifications listed in the test methods for which the laboratory is seeking certification.
- E. The laboratory shall demonstrate adequate care when recording and processing data and test results. This criterion is used to evaluate the laboratory's ability to produce accurate test reports. The laboratory shall have procedures in place that facilitate the timely and accurate recording and submittal of data and the ultimate accuracy of its test reports.

- F. The laboratory shall include the laboratory's name and address and the name(s) of the technician(s) performing the test(s) on their test reports. This criterion is used to ensure that the above information appears on the laboratory's test reports that are submitted to ODOT. In addition to the above, the technician(s) certification number shall be entered on all ODOT test reports.
- G. The laboratory shall have on-site, at the time of inspection and during production operations, a copy of the current MFTP and all equipment, except items listed as mobile equipment, necessary to perform the test methods for which they have requested certification. The ODOT laboratory certification inspection team has a color coded tagging system, which identifies lab equipment that has met the certification criterion. The unique colored tag is valid for a 1 year period and starts from the date of the final report. Not all testing equipment is tagged; reference the appropriate test procedure to identify required equipment.

Mobile equipment for additional test procedures may be added at a later date provided the following conditions are met:

- The laboratory shall demonstrate adequate workspace and electrical system to operate required equipment.
- If equipment is new, provide copies of invoices that include the make, model and serial number of the equipment.
- If the equipment is rented or borrowed, it must come from another ODOT certified laboratory and provide the make, model and serial number as well as the number and color of the ODOT inspection tag.

Mobile Equipment

1. Ignition Oven
2. Gyrotory Compactor
3. Field concrete equipment

Preliminary Report

The ODOT lab certification inspector will prepare a preliminary report of findings and present it to the laboratory manager at the conclusion of the on-site inspection. The preliminary inspection report will list all discrepancies for each test method in which the laboratory has requested certification. The inspector will discuss each discrepancy found in the preliminary report with the laboratory manager in sufficient detail so that the laboratory manager understands the scope of the problem(s) and what corrective action is required in order to obtain certification for the test method(s) in question. When the inspector and the laboratory manager have covered all of the deficiencies, both parties will sign the preliminary report. These signatures indicate that both parties have read the report and understand its contents.

Within one business day, the ODOT lab certification inspector will deliver a copy of the report to the laboratory manager, or owner.

Laboratories are expected to correct all deficiencies within thirty days, so that a certification may be issued. If a laboratory needs more than thirty days to correct deficiencies, the laboratory shall notify the ODOT laboratory certification inspector, in writing, explaining why additional time is needed. The laboratory will not be certified until all deficiencies are corrected.

If no response to the preliminary report is received by the ODOT lab certification inspector within the thirty days allowed, the laboratory will immediately be decertified until the deficiencies are corrected, or a written response has been received.

Final Report

Once all of the deficiencies have been corrected, the ODOT lab certification inspector will prepare a final report of findings and send it to the laboratory.

Certificate of Laboratory Certification

The ODOT Central Materials Laboratory will prepare a certificate of laboratory certification for a laboratory when the laboratory has met the requirements listed in “On-Site Laboratory Inspection Criteria” and has corrected all deficiencies noted by the inspector. The certificate will be sent to the laboratory with the final report. The certificate will include the type of certification, laboratory name, test methods the laboratory has been certified to perform, color of the inspection tag and the Construction Section Manager’s signature. Laboratory certifications are valid for one year from the date of the inspection. This certificate is proof of a laboratory’s ODOT certification for the listed test methods and may be presented as such to any ODOT project manager.

Follow-Up On-Site Inspections

At any time during a laboratory’s term of certification, if the Project Manager or QA personnel suspect that any of the certified laboratory’s equipment, conditions outlined under Requirement G or the laboratory building itself are outside of specification, the Project Manager or QA personnel may request an additional on-site inspection. The Project Manager or QA personnel will contact the lab certification inspector and schedule the Follow-Up On-Site Inspection.

If the Follow-Up On-Site Inspection reveals that the laboratory is deficient in one or more areas, the laboratory inspector will immediately decertify the laboratory for those test methods affected by the deficient equipment or facilities. The laboratory inspector will recertify the laboratory following correction of all deficiencies. A laboratory shall not perform material tests using test methods for which it has been decertified.

Laboratory Decertification

A quality control or quality assurance laboratory may have its entire certification or its certification for specific test methods revoked by ODOT, if it is found to not conform to the specifications and standards of its ODOT certification. A laboratory that has had its certification revoked for a specific test method(s) shall not test materials that require the use of such revoked test method certification(s).

A laboratory that has had its entire certification revoked shall promptly cease testing materials for ODOT construction projects. A laboratory that has had its certification partially or entirely revoked may seek reinstatement by demonstrating conformance to the ODOT laboratory inspection requirements.

Any laboratory/company intentionally misrepresenting the status of their certification or falsifying test results will be subject to disciplinary action up to a one year suspension of their certification. Any allegation regarding the practices of a certified laboratory will be made in writing to the Certification Advisory Committee (CAC). The CAC will investigate the complaint and take appropriate disciplinary action. In all cases, the parties involved in the complaint will be provided an opportunity to appear before the CAC.

IV. TECHNICIAN CERTIFICATION PROGRAM

INTRODUCTION / BACKGROUND

The Oregon Department of Transportation's Quality Assurance Program requires all personnel and laboratories performing testing on ODOT projects to be certified. The level of certification is dependent on the specific type of testing to be performed. The Certification Advisory Committee (CAC), described in Section I of the QA Program, will provide approval and general oversight for the certification programs. Specific direction and administration of the individual certifications will be provided by ODOT unless other groups are specifically referenced in the description of the individual certifications.

The Oregon Department of Transportation is a member of the Western Alliance for Quality Transportation Construction (WAQTC), which consists of the Western and Central Federal Lands Highway Divisions and 9 western states that are committed to the quality of our transportation systems. WAQTC has developed a technician training program, which is comprised of instructional and student modules used to assist in the training process of material field-tested procedures. ODOT has adopted the training packages for all certifications except for ODOT specific certifications and those controlled by entities other than WAQTC, such as QCT, CCT, CMDT and CAT II.

The purpose of the Technician Certification Program is to ensure technicians performing testing have a minimum level of knowledge in the area of certification.

Technician Certifications

Following is a summary of the approved technician certifications and the associated certification durations:

Certification Discipline	Initial Certification	Renewal of Certification
CSTT	5 years	5 years
CCT	3 years	5 years
CMDT	3 years	*3 years
CAT-II	3 years	5 years
CAgT	3 years	5 years
CEBT	3 years	5 years
CDT	3 years	5 years
CAT I	3 years	5 years
ACI Grade 1	5 years	5 years
QCT	Concurrent with ACI Grade 1	

*To be eligible for CMDT recertification by taking only the recertification exam, the technician must have:

- Submitted a minimum of one dense ACP mix design meeting the requirements of the Contractor Mix Design Guidelines and ODOT TM 330, for each year of certification and
- Participated in the CMDT Proficiency program for each year following the initial certification year.

Certified Aggregate Technician (CAgT):

A CAgT performs a variety of tests on soils and aggregates, including: sieve analysis, fracture, sand equivalency and other tests. A CAgT also performs other duties as required by current specifications for soils and aggregate materials.

Certified Embankment and Base Technician (CEBT):

The CEBT performs testing of soils and aggregates for establishing the relative maximum density and optimum moisture for use in compaction testing of subgrade soils and aggregate bases. A CEBT also determines the specific gravities of aggregate.

Certified Density Technician (CDT):

A CDT performs in-place density testing of soils, aggregates, and asphalt mixtures using the nuclear density gauge. In addition to certification, a CDT must be in compliance with state and federal training regulations, and state and federal regulations concerning radioactive materials as administered by their company's Radiation Safety Officer (RSO). For soil, soil aggregate mixtures, and aggregates, a CDT determines: percentages of coarse and fine material, performs one-point testing and related calculations.

Certified Asphalt Technician I (CAT I):

A CAT I performs sampling and testing for ACP and EAC mixtures, including: AC content, maximum specific gravity, sieve analysis, void measurements and other tests and duties as required by current specifications.

Certified Asphalt Technician II (CAT II):

A CAT II is responsible for managing the volumetric properties of asphalt mixes by controlling plant operations, for troubleshooting ACP sampling and testing processes, and for making appropriate adjustments to ACP production and lay down procedures. **Certification at the CAT II level is contingent on having successfully attained CAT I certification at least once.**

Certified Mix Design Technician (CMDT):

A CMDT is responsible for preparing ACP, PAC and EAC mix designs, including all material testing and data analysis necessary to properly complete a design. A CMDT prepares designs for both dense and open graded mixtures.

Quality Control Technician (QCT):

A QCT performs testing of fresh Portland cement concrete including: sampling, concrete temperature, slump, unit weight, air content, and fabrication of specimens for strength testing and performs other duties including calculating cement content and water-cement ratio as required by specifications. QCT certification is obtained through the ACI Concrete Field Testing Technician - Grade 1 certification program, with the Oregon written Supplemental test, conducted by the Oregon Concrete and Aggregate Producers Association (OCAPA). QCT is only valid while the ACI Concrete Field Testing Technician – Grade Level 1 is valid.

Concrete Control Technician (CCT):

A CCT is responsible for preparing concrete mix designs, proportioning concrete mixtures to meet job requirements and for making adjustments to the mix design, as necessary, to provide a concrete mixture of the quality required by specifications. A CCT certification is obtained through a training program conducted by OCAPA.

Concrete Strength Testing Technician (CSTT):

A CSTT is responsible for testing the compressive or flexural strength of hardened concrete cylinders or beams. The duties of a CSTT include proper capping of specimens (bonded and un-bonded), correct operation of breaking device and visual evaluation of broken specimens. Also, the CSTT is responsible to insure the proper handling, mold removal, logging and curing of field fabricated samples, upon arrival at the laboratory. A CSTT certification may be obtained through a program conducted by Oregon Chapter of the American Concrete Institute.

Who Must Be Certified?

For all projects for which the Quality Assurance Program applies, all personnel responsible for performing sampling and testing must be certified. All personnel performing the Quality Control Compliance Specialist duties of reviewing test reports whether working for ODOT, a contractor, a consultant or for local agencies, must be certified.

Certification Requirements

To obtain any of the above certifications, the technician will be required to pass a written and/or a practical test demonstrating a knowledge and understanding of how to perform the specific tests and the specifications that apply to the material being tested. All tests shall be administered and evaluated only by evaluators approved by the Certification Advisory Committee Chair or their designated representative.

To apply for the certification, the applicant will register either for one of the approved training classes, where the exam will be administered as part of the class, or submit an application to challenge the exam. The challenge applications will be submitted through the approved training program to facilitate scheduling. Appropriate fees will be charged for the challenge exams to cover scheduling, overhead and facility use. Applicants will be scheduled for examination through a cooperative effort between ODOT and the appropriate training program service provider.

All certifications shall be contingent upon the technicians signing a rights and responsibilities agreement. This agreement outlines the technician's rights and responsibilities along with the possible consequences of the abuse and/or neglect of these responsibilities. The technician will submit a signed agreement at the time they take the certification examination.

Examination Process

The Asphalt Paving Association of Oregon (APAO) and Oregon Concrete Aggregate Producers Association (OCAPA) currently perform the instructional phase, while ODOT maintains the certification and administration of the written and practical exam processes. The certification system is made up of three phases. Phase one - WAQTC written exam, phase two - ODOT written exam and phase three - combined ODOT and WAQTC performance exam.

During the exam process, only hand calculators are allowed, the use of computers is not permitted during any exam phase.

Challenge Process

A person may challenge the exam process if they feel that they have the knowledge and skills to be able to pass without attending formal training. If the person does not currently possess a certification for that specific discipline and fails any of the following mentioned examination events, then that person must attend the formal training for that certification. If the person currently possesses a certification for that specific discipline and fails any of the following mentioned examination events, then that person may challenge the failed examination event for that certification a second time. If the person fails the challenged event a second time, then the person must attend formal training for that specific discipline.

WAQTC Written Examination

- a. Closed Book
- b. Consists of multiple modules, depending on the needed certification.
- c. Each module consists of 5 questions with multiple choice, true or false and required calculations.
- d. Written exam time lines vary depending on the needed certification. 1 to 1 ½ hours is given to complete the exam.

ODOT Written Examination:

- a. Open Book
- b. Consists of multiple choice, true or false, and essay questions related to test procedures as well as specifications and completion of various ODOT forms.
- c. Written exam time lines vary depending on the needed certification. 3 to 3 ½ hours is given to complete the exam.
- d. For CMTD certification, the written exam covers dense ACP and EAC & PAC open graded mix design, as well as aggregate treatment applications (i.e. lime and latex) for mix design. 4 hours is given to complete the exam.

ODOT /WAQTC Combined Performance Examination

- a. Each participant will demonstrate proficiency in the designated test methods with prepared samples and will demonstrate the ability to apply specifications and ODOT specific requirements to the needed test and identify the quality of the material being tested.
- b. The exam is open book but the technician may not use the performance exam checklist.
- c. The performance examination for ODOT is performed in conjunction with the WAQTC performance exam. 4 ½ hours is given to complete the performance exam process with 4 hours actual lab time and ½ hour given to complete calculations. The performance exam answers are graded based on completion of the required tests, accuracy of computations, application of the correct specifications and the results of computations meeting the parameters set forth in the Independent Assurance Parameters section of the Quality Assurance Program.
- d. During the performance exam the examinee may be asked to explain various steps of a procedure to reduce the full test time.
- e. The performance exam checklist consists of yes and no blocks. In order to complete the checklist successfully, all of the yes blocks must be filled out.

In the event, a participant fails the first attempt; a second attempt is given, if time permits and after the exam proctor explains the correct procedure. Anyone failing a test method on the performance exam may repeat that trial during the day of the performance exam, depending on the timelines and the type of test. Repeat trials will be allowed in not more than 50% of the total test methods in that performance exam. If the participant fails on the second attempt the performance exam will stop and the participant will have to re-take the exam at the scheduling convenience of the Agency.

Passing Score – Written

- a. Initial exam (first attempt) WAQTC: An overall score of 70% with a minimum of 60% on any one-test method.
- b. Re-exam (second attempt) WAQTC: An initial exam overall score below 70% will require a re-exam on all test methods. An initial exam score above 70% overall, but below 60% on one or more test methods, will require a re-exam on only those test methods. In the case of one test method comprising the re-exam, the examinee must receive a score of 70%. In the case of more than one test method comprising the re-exam, the examinee must receive an overall score of 70% with a minimum of 60% on any one-test method.
- c. Initial exam (first attempt and second attempt) ODOT: An overall score of 70% is required to successfully complete the exam requirement.
- d. Initial exam (first attempt) ODOT exam of:
 - QCT supplemental an overall score of 80% is required to successfully complete the exam requirement.
 - For the CCT and CMDT certification exams, an overall score of 75% is required to successfully complete the exam requirement.
 - Re-exam (second attempt) for the ODOT QCT, CMDT and CCT exam the participant must meet the same criteria as the initial exam first attempt.

Passing Score – Performance

- a. All performance checklists must have 100% yes blanks checked and each test method must be performed within the designated time limit. Each examinee is allowed two attempts to complete procedures if time allows.
- b. First attempt: Performing all the required tests, application of correct specifications and meeting the Independent Assurance Parameters is required to receive a pass rating. The grading is based on pass/fail of all associated tests performed under the desired certification.
- c. Second attempt: The same criteria as the Initial exam must be met.
- d. For CMDT, an acceptable Level 2, 3 or 4 ACP design must be submitted along with verification materials, as described in Section 6 of the most recent edition of the “Contractor Mix Design Guidelines for Asphalt Concrete”. A six-month period will be allowed for the mix design submittal from the date of the written exam.

Re-examination Policy – Written/Performance

Failure of any exam phase on a second attempt shall require attendance of the course for that qualification and passing the exam element failed on the second attempt if certification is still desired. In addition, on the date the certification exam was first taken a technician will have 120 days to complete the exam requirements for the desired certification. If the exam requirements are not met within the 120-day period and certification is still desired the technician will be required to perform the entire exam process again.

Applicants with Disabilities or Special Needs

Applicants with a disability or those having special needs should notify the Certification Advisory Committee Chair, or their designee, at the time application is made. This will allow time to plan for implementing necessary accommodations prior to the administration of the training and/or testing.

Disclaimer

Certification of an individual by the ODOT Technician Certification Program indicates only that the individual has demonstrated a certain level of competence on a written and/or practical examination in a selected field of activity. ODOT may require this certification of individuals performing activities specified in work contracts or other activities. ODOT and the Certification Advisory Committee make no claims regarding the abilities or competence of certified individuals. Each individual or organization utilizing certified individuals must make its own independent judgment of the competence of certified individuals. ODOT specifically disclaims any responsibility for the actions, or the failure to act, of individuals who have been certified through the ODOT Technician Certification Program.

To obtain certification may involve hazardous materials, operations and equipment. This program does not purport to address all safety or regulation concerns associated with the use of the procedures used. It is the responsibility of the users to use and establish appropriate safety and health practices and determine the applicability of regulatory limitations.

Documentation of Certification

Upon the successful completion of the examination(s), the participant's name, home address and/or company affiliation is registered in the official registry of certified technicians for the appropriate certification. ODOT Construction Section maintains the official registry. It is accessible on the internet at the following address:

<http://highway.odot.state.or.us/cf/techcertdynamic/>

It is anticipated that many technicians will hold multiple certifications. An official letter(s), indicating certification(s) held, will be provided after successful completion of the certification process.

Recertification

To remain current, a certified technician must obtain recertification before the expiration date of the certification. Recertification may only be obtained by passing the written and/or practical test required for that particular certification. A certified technician must apply for the individual certification for which they want to remain certified. The certified technician is responsible for scheduling his/her own written and/or practical comprehensive examination.

It should be noted that should a technician fail to successfully complete a certification renewal in a specialty area, the technician will be considered disqualified in that area only until the requirements for certification renewal have been successfully met, subject to the limitations set forth in this document.

Note: A certification extension may be provided upon written request to the SQAE. The request should contain the reason for the extension, desired certification and proof of future class attendance or challenge process through a registration of the training provider.

The length and conditions of any extension will vary and are at the discretion of ODOT.

Revocation or Suspension of Certification

The Certification Advisory Committee Chair, for just cause, may revoke technician Certifications at any time. Proposed revocations are sent to the individual in writing along with the individual's right to appeal the proposed revocation. A proposed revocation is effective upon receipt by the technician and will be affirmed, modified, or vacated following any appeal.

The reasons that certified technicians will be subject to revocation or suspension of their certifications are *negligence* or *abuse* of their responsibilities. The Certification Advisory Committee (CAC) may disqualify certified technicians for other reasons of just cause, which may or may not be specifically defined herein following the due process procedures outlined herein.

Negligence is unintentional deviations from approved procedures that may or may not cause erroneous results. The following penalties are guidelines for findings of *negligence*: The first finding of *negligence* will result in a letter of reprimand being sent to both the employee and the employer. Depending on the nature of the incident, the CAC could impose up to a 30 day suspension. The second significant incident during the certification period will result in the State Quality Assurance Engineer (SQAE) discussing the issue with the individual and their employer to establish a corrective action plan. Depending on the nature of the incident, the CAC could impose up to a 180 day suspension. The SQAE will also notify the entire ODOT Quality Assurance staff of the issue. A third instance of neglect may result in permanent revocation of the certification.

Abuse is knowingly deviating from approved procedures or when the technician should have known they were deviating from approved procedures. There are two levels of severity for *abuse*.

For level 1 *abuse*: The first finding may result in up to a 180-day suspension all of the certifications of the individual. A second instance (within the certification period) would result in a minimum of 180-day suspension of all certifications.

For level 2 *abuse*: the first finding will result in a 1-year suspension of all certifications of that individual. A second finding will result in permanent revocation of all certifications.

Revocations or suspensions for *abuse* or *negligence* in one certification area are considered revocations or suspensions in *all certifications* held by the technician.

Allegations of *negligence* or *abuse* are made to the State Quality Assurance Engineer (SQAE) in writing. The allegations will contain the name, address and signature of the individual(s) making the allegation. The SQAE will investigate all allegations. The SQAE will decide if the incident is significant to warrant review by the Certification Advisory Committee (CAC). If the incident is given to the CAC for review, then the accused and the individual(s) making the allegation are given the opportunity to appear before the CAC to present any appropriate information. Within a 60 day period, all involved parties will receive a report of the findings in writing. Any warranted penalties will be imposed in accordance with guidance contained herein and according to the guidelines outlined under the Technician Compliant Process. Decisions regarding allegations of *negligence* or *abuse* may be appealed in writing to the CAC Chair. The CAC Chair will independently consider such written appeals but may rely on the advice and counsel of the CAC.

In all cases, the CAC will conduct the investigation into the allegations and make a recommendation to the ODOT State Construction & Materials Engineer as to appropriate sanctions against the technician. All final decisions regarding suspension of certifications will be up to the ODOT Construction & Materials Engineer.

Since ODOT is a member of the Western Alliance for Quality Transportation Construction, the certifications are honored by other member states. The Certification Advisory Committee will notify the other members of the WAQTC, or other participants in the Transportation Technician Qualification Program (TTQP), of anyone having a certification revoked or suspended.

TECHNICIAN COMPLAINT PROCESS

The Oregon Department of Transportation's Technician Certification Program is intended to assure qualified personnel are performing all materials testing for ODOT construction projects. In addition to certified technicians, the department needs a means to address concerns that are raised regarding those technicians not following approved procedures. The Technician Complaint Process will provide guidance on how to deal with these concerns.

It should be understood that the intent of the process is to resolve differences of opinion on appropriate procedures at the lowest possible level. Technicians are encouraged to work together to resolve any differences they might have. Only when those issues cannot be resolved at the project level should they be raised to the level of filing an official complaint. It should be understood that in no way is the formal complaint process intended to remove any authority the Project Manager may have under an existing contract.

Any individual may file a complaint regarding testing procedures or practices. The first step when filing a complaint is to decide whether the issue is a case of "neglect" or "abuse". "Neglect" is unintentional deviations from approved procedures. "Abuse" is knowingly deviating from approved procedures or when the technician should have known they were deviating from approved procedures. The appropriate process for dealing with the issue is followed after a decision is made on the type of offence. The following pages outline the process for dealing with both neglect and abuse:

Complaint Process for Neglect

Again, neglect is much less severe than abuse and individuals are encouraged to resolve their differences at the project level so the project can continue forward in a positive fashion. The complaint process for neglect is intended primarily to allow a means of tracking the types of problems being encountered and also to look out for technicians who seem to have repeated instances of neglect.

Step 1: When an individual discovers a significant problem with a technician's procedures or testing process, that individual will personally point out the concern to the technician. The two individuals will work together to try to resolve the issue. They may need to refer to the Manual of Field Test Procedures or other contract documents to verify proper procedures.

If the two can agree on corrective action, the issue can be resolved at their level. If not, the region SQAC should be contacted for clarification. If discrepancies on correct procedures still exist, the issue will be brought to the ODOT State Quality Assurance Engineer (SQAE) for resolution.

Step 2: Once the problem is resolved, the individual who discovered the problem will send a short memo to the SQAE describing the issue and the resolution.

Depending on the severity of the issue, the SQAE may send a letter of reprimand to the technician and their employer and the CAC could impose up to a 30 day suspension.

Step 3: If a second significant incident is reported within the certification period for a specific technician, the SQAE will discuss the issues with the technician and their employer and establish a corrective action plan to help the technician avoid further complaints. Depending on the nature of the incident, the CAC could impose up to a 180 day suspension. In addition, the CAC could require the technician to attend additional training and retake the particular certification exam before reinstatement as a certified technician. The SQAE will also send out notice to all ODOT quality assurance staff of the issue. This notification is intended to help put ODOT staff on notice of particular problems being encountered.

Step 4: If a third instance of neglect is reported within the certification period, the specific technician and his/her employer must meet with representatives from the Certification Advisory Committee (CAC) to discuss the issues.

The technician will be responsible for providing a plan of how they will correct their deficiencies and assure no further instances will occur. The CAC may gather further information to substantiate the claims. The CAC will review the information and could impose up to permanent revocation of the certification in question.

It should be noted that because of the potential for repeated offences of neglect, the CAC could at any point in the process make a determination that the successive instances no longer qualify as neglect, but because of the repeated nature of an offense, may become an instance of abuse. If this occurs, the issue would be dealt with through the complaint process for abuse.

Complaint Process for Abuse

Because abuse is defined as intentional, the process for dealing with instances of abuse will be more formal and penalties more severe than for instances of neglect.

Step 1: If abuse is suspected, the issue shall be raised immediately to the ODOT State Quality Assurance Engineer (SQAE). The SQAE will investigate the issue and make a preliminary determination on whether it actually is abuse or neglect. If the issue is determined to be abuse, move to step 2 below. If it is determined to actually be a case of neglect, move to step 1 of the process for dealing with neglect.

Step 2: The SQAE will gather information regarding the incident from both the technician involved as well as the individual filing the complaint. The SQAE will review the information and determine whether the incident is significant to warrant review by the Certification Advisory Committee (CAC). This review will be completed within 60 day of receipt of the complaint. If the incident is determined to be “significant” the issue will be put on the agenda for the next CAC meeting.

Both the technician and the individual filing the complaint may be invited to attend the meeting to present any appropriate information. Insignificant issues will be handled directly by the SQAE and a summary of the incident will be submitted to the CAC for their review.

Step 3: The CAC will determine the merits of the complaint and also the severity level of the abuse. Abuse will be identified as one of two different levels of severity.

Level 1 being identified as the least severe form of abuse. This level is identified as knowingly deviating from approved procedures or when the technician should have known they were deviating from approved procedures. The key component for Level 1 Abuse is there is no misrepresentation the quality of material being incorporated in the project. This level of abuse could result in up to a 180 day suspension of all certifications held by the technician. The exact duration of the suspension will be set by the CAC depending on the circumstances encountered. A second instance (within the certification period) of Level 1 abuse would result in a minimum 180 day suspension of all certifications.

Level 2 abuse is much more severe. The distinguishing component of Level 2 abuse is misrepresentation of the quality of material being tested. This level of abuse will be dealt with by a 1-year suspension of all certifications for the technician. A second instance of level 2 abuse will result in permanent revocation of all certifications.

Record Retention

Investigations, supporting exhibits, letters of expectation, CAC recommendations and other investigative correspondence will be kept on file according to the following guidelines:

- Negligence – records will be kept for a 5 year period starting on the date of the investigation.
- Abuse – records will be kept permanently.

At any time retained records may be used to support further allegations of negligence or abuse.

V. QUALITY ASSURANCE LABORATORY PROFICIENCY SAMPLE PROGRAM

OREGON DEPARTMENT OF TRANSPORTATION CONSTRUCTION SECTION

Proficiency sample testing is an additional factor used to evaluate the performance of a quality assurance (QA) laboratory and the quality assurance (QA) laboratory technicians. It provides information not otherwise available from the On-Site Laboratory Inspection (see Section III) and a means of continued monitoring of testing personnel and testing equipment. The ODOT Construction Section requires QA laboratories and QA laboratory technicians to participate in this QA Proficiency Sample Program. Participation includes testing all applicable samples, which are to be distributed and completed within the specified time frame. The resulting data is analyzed by the ODOT State Quality Assurance Engineer.

Proficiency samples are distributed by the Construction Section at annual intervals as outlined in the Proficiency Sample Testing Plan in Table 1 of this section. The Construction Section will distribute a minimum of one set of samples from each material test method listed in Table 1 for each of the QA laboratory technicians. The ODOT Central Materials Laboratory (ODOT-CML) and the QA laboratory technicians will perform the required testing listed in Table 1 on each set of samples. The distribution of proficiency samples is not intended to coincide with the on-site laboratory inspection. Proficiency Sample test results will be submitted to the State Quality Assurance Engineer within thirty days of receipt of the sample. The State QAE will tabulate all of the testing results from the ODOT-CML and the QA laboratory technicians and statistically evaluate if any of the technician results are more than two standard deviations beyond the grand mean for each test method.

When a QA laboratory technician's results are beyond two standard deviations of the grand means, the Senior Quality Assurance Coordinator (SQAC) will investigate the reason for the discrepancies and report the findings and actions taken to the State Quality Assurance Engineer (SQAE) within thirty days of issuance of a final report. The SQAE will determine whether or not the findings warrant further action to address the testing deviations and identify steps that need to be taken to ensure that the technician is correctly performing the test. The SQAE will be responsible for monitoring the technician testing results until there is confidence that the technician is following approved procedures.

When an ODOT-CML technician's results are beyond two standard deviations of the grand means, the ODOT Laboratory Services Manager shall investigate the reason for the discrepancies and report the findings and actions taken to the State Quality Assurance Engineer (SQAE) within thirty days of issuance of a final report. The SQAE will address the testing deviations, identify steps to be taken and be responsible for monitoring results in the same manner as for a QA laboratory technician.

If a QA laboratory technician or ODOT-CML technician exceeds the two standard deviation limit on the next year’s proficiency samples for the same material test method and is not able to provide the SQAE with a satisfactory explanation for exceeding the limits; the technician will immediately perform a backup proficiency sample witnessed by the SQAE or designated representative. The SQAE will review the process that was followed from the previous year’s investigation findings and make a determination if the technician is not following approved procedures. If the SQAE finds that the technician is not following approved procedures, the SQAE will immediately suspend the technician from performing any QA project work or third-party resolution work involving the test method that has been identified. The SQAE will identify what steps are necessary to allow the technician to resume testing for the failing test method.

TABLE 1 – PROFICIENCY SAMPLE TESTING PLAN

January Distribution

TEST METHOD
SOIL & Aggregate Sample
Bulk Specific Gravity – AASHTO T 85
Coarse Particle Correction – AASHTO T 99
Max. Density – AASHTO T 99 Aggregate Base
Max. Density – AASHTO T 99 Soil
Sieve Analysis – AASHTO T 27/11
Sand Equivalent – AASHTO T 176
Fracture – AASHTO T 335
Wood Particles – ODOT TM 225
Elongated Pieces – ODOT TM 229
ACP Mixture Sample
Bulk Specific Gravity – AASHTO T 166, Method A
Max. Specific Gravity – AASHTO T 209
AC Content by Incinerator – AASHTO T 308
Mechanical Analysis of Extracted Aggregate- AASHTO T 30
Fabrication of Gyratory Specimen – ODOT TM 326

A laboratory may obtain additional information on the Construction Section’s Quality Assurance Laboratory Proficiency Sample Program by contacting the Construction Section at the following address:

Oregon Department of Transportation
 Construction Section, Materials Laboratory
 Attn: State Quality Assurance Engineer
 800 Airport Road S.E.
 Salem, OR 97301
 Telephone (503) 986-3061

VI. PRODUCT SPECIFIC QC/QA TESTING PLAN

The Quality Assurance Program consists of three distinct sub-programs. The Quality Control Program, the Verification Program and the Independent Assurance Program. This section provides specific details on how these programs work together to assure specification materials are incorporated into ODOT projects. It also provides details on specific requirements of each of the programs for each of the materials, which are utilized on ODOT projects.

In general, the Contractor's quality control tests are obtained at the highest frequency. Agency verification tests are usually run on a minimum frequency of 10% of subplot quantities identified in section 4(D) of the MFTP. While the Independent Assurance program takes steps to assure the quality of both the QC and the verification test results.

ODOT will accept materials based on the contractors QC test results only if verified by the Agency verification testing. Verification of QC test results will require all of the following conditions to be met:

1. The Department's testing results show that the material meets the specified quality.
2. The split samples meet Independent Assurance Parameters.
3. The Department's verification test results compare reasonably to the ongoing quality control data.

If any of the above conditions are not met, an investigation will be conducted by the Project Manager to determine whether to reject the material or if the material is suitable for the intended purpose according to section 00150.25 and also what price adjustment may be applied. See Investigation Criteria for details and requirements.

Step 2 in the above conditions compares the Contractor's test results on the split IA sample to the Agency results. The Independent Assurance Parameters to be used for the comparison are listed in Table 1 of this section.

The following pages detail the Investigation Criteria, quality control, verification and independent assurance requirements for each of the specific materials used on ODOT projects.

Investigation Criteria

The intent of the investigation is to determine reasonable cause for the discrepancy and provide supporting documentation of materials failing to meet the conditions outlined for verification, independent assurance and prior quality control testing. An investigation is required for all materials failing to meet these conditions because of the potential impact on the quality of the material produced or incorporated into the project.

Several resources are available to assist with the troubleshooting process and data collection. Appendix C (Troubleshooting Guide) provides some guidance through the evaluation phase based on material discipline and the associated tests. The guide is an evaluation tool and is not necessarily a complete listing of all potential areas to be investigated and the assistance of the region Sr. QAC, State QAE, Sr. QAE or other technical resources is encouraged.

The investigation and the resolution of the discrepancy shall be documented on form (734-4040) and at a minimum will contain the following information:

- Clearly explain the issue under investigation. Provide the bid item number, material description, test procedure or process in question, associated quality assurance testing reference's and date or timelines of the testing issue.
- Describe the steps taken to resolve the discrepancy and the associated information or test results gathered to support the findings.
- Provide a conclusion based on the findings.
- Describe recommendations or actions to be taken.
- Provide written notification to the region Sr. QAC and quality control entity upon completion of the investigation. Ensure a copy of the investigation is maintained in the project files.

INSERT TAB

**SECTION IA
Parameters**

TABLE 1
Independent Assurance Parameters
Maximum Allowable Differences

Gradation Sieve Sizes with Assigned Tolerances T 27, T 27/11 & T 30	
Larger than No. 8	5%
No. 8	4%
No.10	4%
Larger than No. 200 and smaller than No. 10	2%
No. 200 with targets 10.0% or less	1.0%
No. 200 with targets greater than 10.0%	1.5%
Asphalt Content – T 308	0.40%
Fracture - T 335	5%
Wood Particles - TM 225	0.05%
Elongated Pieces – TM 229	
5:1 Ratio	2.0%
3:1 Ratio	4.0%
Sand Equivalent – T 176	8 points
Soil Curves – T 99/180 (ρ_f)	
<i>Maximum Density</i>	3.0 lbs. per ft ³
<i>Moisture</i>	3.0%
Aggregate Base – T 99/180 (ρ_f)	
<i>Maximum Density</i>	3.0 lbs. per ft ³
<i>Moisture</i>	2.0%
<i>Plant Mixed Moisture Content</i>	1%
Maximum Specific Gravity – Rice - T 209	
<i>Standard G_{mm}</i>	0.020
<i>Dryback G_{SSD} (If required)</i>	0.020
Bulk Specific Gravity of Lab fabricated specimens - T 166	0.032
Maximum Specific Gravity (G_{sb}) - T 85	0.032
Air Content of Concrete - T 152	0.5%
Slump of Concrete - T 119	1"
Temperature of Concrete - T 309	3°F
Unit Weight of Concrete - T 121	3.0 lbs. per ft³

AGGREGATE PRODUCTION

<i>Quality Control</i>	<i>Verification</i>	<i>Independent Assurance</i>
Required	Required	Required

Quality Control

The ODOT Central Materials Laboratory (ODOT-CML) will retain quality control of source/product compliance as stated in Section 4(A). The Contractor's QC technician shall sample the aggregates, place the sample in a proper container and label as specified in Section 4(C), complete the *ODOT Sample Data Sheet* (Form 734-4000), and deliver to the PM.

The Contractor's QC technician shall establish a random sampling and testing program and submit it to the PM prior to the start of production.

The Contractor's QC technician shall perform quality control sampling and testing required to ensure a quality product at the frequencies indicated in Section 4(D) of the MFTP. The Contractor shall deliver the test results to the PM by the middle of the following work shift.

Pre-produced aggregates shall be tested at the frequency applicable for the material and use as determined by the appropriate specifications(s) and Section 4(D) of the MFTP (i.e. a 20,000 ton stockpile of aggregate base will require 10 QC tests and 1 QA test).

The Contractor is responsible for furnishing quality levels during aggregate production when specified. The Contractor's QC technician shall reject material that does not meet the specified quality and notify the PM of the disposition and quantities of those materials. All required tests, except for gradation, are considered pass/fail. *Gradation is subject to statistical analysis as described in specifications Section 00165.*

Backup samples for aggregates shall be a minimum of 1/2 the minimum mass shown in Table 1 of AASHTO R 90 for the appropriate nominal maximum size aggregate.

Verification

QA performs verification tests, taken randomly, according to the Manual of Field Test Procedures Acceptance Guide (Section 4(D)). A split of the sample taken by QC will be given to QA for testing.

If verification testing fails to meet the specifications, other than gradation, QA will immediately notify the PM. The PM will evaluate the results and resolve the discrepancy.

If verification test results indicate that a material is out of specification for gradation, QA will notify the PM, who will determine if the stockpile QL meets the specifications. The PM will determine if the stockpile is acceptable.

Independent Assurance

All parties that test materials shall employ ODOT certified technicians and use ODOT certified laboratories.

The Contractor's QC technician shall test the Contractor's split of IA samples and provide the results to the PM the next workday. The PM will verify that the Contractor's test results and QA's test results are within IA parameters.

If the Contractor's test results and QA's test results for IA samples are not within IA parameters, the PM will evaluate the results and resolve the discrepancy. See Investigation Criteria.

EARTHWORK

(Section 00330)

ESTABLISHING MAXIMUM DENSITIES

<i>Quality Control</i>	<i>Verification</i>	<i>Independent Assurance</i>
Required	Not Required	Required

Quality Control

The Contractor's QC technician is responsible for establishing maximum densities and optimum moisture content for each unique soil type and soil/aggregate mixture incorporated into the project. *Backup samples shall be a minimum mass of (45 lbs) and retained until notified by the PM to discard.*

Verification

None Required

Independent Assurance

All parties involved in the testing process shall employ ODOT certified technicians and use ODOT certified laboratories.

QA will test the Contractor's split of the soil sample and provide the results to the PM within a 48 hr. period, based on the time the sample was split. The PM will verify that the Contractor's test results and QA's test results are within IA parameters.

If the Contractor's test results and QA's test results are not within IA parameters, the PM will perform an investigation (see Investigation Criteria) evaluate the results and resolve the discrepancy.

COMPACTION

<i>Quality Control</i>	<i>Verification</i>	<i>Independent Assurance</i>
Required	Required	Required

Quality Control

The Contractor's QC technician shall establish a random sampling and testing program.

The Contractor’s QC technician shall be on the project during performance of earthwork operations, as needed, to ensure that materials/products are in conformance with the specifications. The QC technician’s duties include, but are not limited to: visual observation, sampling and testing. The Contractor shall rework all areas showing visual deflection. Sampling and testing procedures shall be performed at the frequencies indicated in Section 4(D) of the MFTP. The Contractor shall deliver the test results to the PM by the end of the work shift for T-99 Method A applications and within a 24 hr. period for T-99 Method D applications, based on the time the test information was collected in the field.

The Contractor's QC technician shall use the "one-point" method to establish the correct soil curve for each density test performed. If the soil does not match an established family of curves or a single curve, the Contractor shall establish a new curve for the soil, within a 48 hr. period, based on the time the sample was acquired. If use of the new maximum density curve results in a failing test, the Contractor shall take corrective action and retest until compaction is determined to meet the specifications, **prior to construction of a new lift.** *Backup samples shall be all uncontaminated portions of materials removed from beneath the gauge to perform the “one point”.*

If the equipment or material changes, the QC technician shall verify by testing that the specified densities are attained.

Verification

QA performs verification tests, taken randomly, according to the Manual of Field Test Procedures Acceptance Guide (Section 4(D)).

If the soil tested, according to the “one-point” method, does not match the established curves, the Contractor shall establish a new curve from the soil at the test location and provide the test results within a 48 hr. period, based on the time the sample was acquired. Do not add new lifts until compaction is proven to meet the specified densities. QA shall notify the Contractor and PM of the test results by the end of the work shift for T-99 Method A applications and within a 24 hr. period for T-99 Method D applications, based on the time the test information was collected in the field.

If the density test fails, the Contractor shall identify the limits of failing compaction, take corrective action, and notify the PM. The PM will schedule a new verification test. Do not add new lifts until the verification tests demonstrate that specified densities exist.

Independent Assurance

All parties involved in the testing process shall employ ODOT certified technicians, use ODOT certified labs, and use nuclear density gauge(s) meeting the requirements of ODOT TM 304.

CONCRETE

(Sections 00440, 00512, 00540, 00559, 00660, 00754, 00755, 00756, 00758 and 00921)

AGGREGATE PRODUCTION

<i>Quality Control</i>	<i>Verification</i>	<i>Independent Assurance</i>
Required	Required	Required
See Aggregate Production details, page 29.	See Aggregate Production details, page 29.	See Aggregate Production details, page 29.
Not required for commercial grade concrete	Not required for commercial grade concrete	Not required for commercial grade concrete

MIXTURE

<i>Quality Control</i>	<i>Verification</i>	<i>Independent Assurance</i>
Required	Required	Required
	Not required for commercial grade concrete	

Quality Control

The Contractor's QC technician shall perform quality control sampling and testing required to ensure a quality product at the frequencies indicated in Section 4(D) of the MFTP. The Contractor shall deliver the test results, of the plastic properties of the concrete, to the PM by the end of the work shift. Concrete Strength test results shall be delivered to the PM within 24 hours of the specified break date.

The Contractor's quality control (QC) plan shall identify the method used for standard curing, the type of capping system used in the strength testing of concrete cylinders and the size of cylinders to be cast.

Verification

QA performs verification tests for strength, taken randomly, according to the Manual of Field Test Procedures Materials Acceptance Guide (Section 4(D)). Cylinders cast shall be of the same size identified in the QC plan. Strength testing shall use the same capping methods identified in the QC plan. Cylinders cast for strength verification will be delivered to the ODOT-CML for further testing.

If verification strength testing fails to meet the specifications. The PM will evaluate the results and resolve the discrepancy.

Independent Assurance

All parties involved in the testing process shall employ ODOT certified technicians and use ODOT certified laboratories.

The PM will perform random inspections to ensure that the Contractor's quality control plan is followed.

The Contractor's QC technician shall test the same load and portion of load from which the verification samples are taken. The sample may be taken by QC or independent samples may be taken by both QC and QA. When independent samples are taken, acquire portions as close as possible to each other. Concrete with Nominal Aggregate size of 1 ½" will often require individual samples taken by QC and QA, due to sample size(s) and wet sieving requirements.

This testing will be for plastic properties and strength testing. The QC technician shall immediately report the results of the plastic properties testing to QA. QA will verify that the contractor's plastic properties test results and QA's plastic properties test results are within IA parameters.

If the Contractor's plastic properties test results and QA's plastic properties test results for the verification sample are not within IA parameters, QA will evaluate the results, resolve the discrepancy and notify the PM of the resolution. If either parties' plastic properties test results are out of specification, then QC will follow the requirements of specification sections 00540.16 and 02001.50(b).

The QA test results, of the plastic properties of the concrete, or the investigation of IA issues will be given to the PM by the end of the work shift, if an agency representative is available.

The Contractor's QC technician shall make and cure three (3) cylinders of the same size identified in the QC plan. Strength testing of the three concrete cylinders shall be in accordance with AASHTO T 22, using the same capping method identified in the QC plan. The PM shall compare the Contractor's results for these cylinders to the verification cylinders and to the ongoing quality control. The PM shall resolve discrepancies.

On a single truck placement when verification/IA is performed by the region quality assurance lab, the Contractor's test results may be used for normal quality control testing.

AGGREGATE BASE, SUBBASE, AND SHOULDERS

(Section 00641)

AGGREGATE PRODUCTION

Quality Control	Verification	Independent Assurance
Required	Required	Required
See Aggregate Production details, page 29.	See Aggregate Production details, page 29.	See Aggregate Production details, page 29.

ESTABLISHING MAXIMUM DENSITIES

Quality Control	Verification	Independent Assurance
Required	Not Required	Required

Quality Control

The Contractor's QC technician is responsible for establishing maximum densities and optimum moisture content for each unique aggregate mixture type incorporated into the project. *Backup samples shall be a minimum mass of (45 lbs).*

Verification

None Required

Independent Assurance

All parties involved in the testing process shall employ ODOT certified technicians and use ODOT certified laboratories. QA will test the Contractor's split of the aggregate sample and provide the results to the PM the next day. The PM will verify that the Contractor's test results and QA's test results are within IA parameters.

If the Contractor's test results and the QA's test results are not within IA parameters, the PM will perform an investigation (see Investigation Criteria), evaluate the results and resolve the discrepancy.

AGGREGATE MIXTURE

Quality Control Required	Verification Required	Independent Assurance Required
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Quality Control

The Contractor's QC technician shall establish a random sampling and testing program and submit it to the PM prior to the start of production.

The Contractor's QC technician shall perform quality control sampling and testing required to ensure a quality product at the frequencies indicated in Section 4(D) of the MFTP. The Contractor shall deliver the test results to the PM by middle of the following work shift. *Backup samples shall be a minimum mass shown in Table 1 of T 255 / T 265 and kept in an airtight container.*

Verification

QA performs verification tests, taken randomly, according to the Manual of Field Test Procedures Acceptance Guide (Section 4(D)).

If the moisture content exceeds the limits according to specification, the Contractor shall take corrective action and notify the PM. The PM will schedule a new verification test.

Independent Assurance

All parties that test materials shall employ ODOT certified technicians and use ODOT certified laboratories.

If the Contractors test results and QA's test results for IA samples are not within IA parameters, the PM will perform an investigation (see Investigation Criteria), evaluate the results and resolve the discrepancy.

COMPACTION

Quality Control	Verification	Independent Assurance
Required	Required	Required

Quality Control

The Contractor's QC technician shall establish a random sampling and testing program and submit it to the PM prior to the start of production.

The Contractor shall perform quality control sampling and testing required to ensure a quality product at the frequencies indicated in Section 4(D) of the MFTP. The Contractor shall deliver the test results to the PM on the same day the testing is performed.

The Contractor's QC technician shall also perform the following:

- Use the test procedures applicable for determination of the maximum density for this material indicated in Section 4(D) of the MFTP.
- Establish a rolling pattern to provide the specified compaction.
- Stop placement if the specified densities are not met.

Verification

QA performs verification tests, taken randomly, according to the Manual of Field Test Procedures Acceptance Guide (Section 4(D)).

If the density test fails, the Contractor shall identify the limits of failing compaction, take corrective action, and notify the PM. The PM will schedule a new verification test. Do not add new lifts until the verification test demonstrates that the specified density has been achieved.

Independent Assurance

All parties involved in the testing process shall employ ODOT certified technicians, use ODOT certified laboratories, and use nuclear density gauge(s) meeting the requirements of ODOT TM 304.

EMULSIFIED ASPHALT PRODUCTS/MATERIALS

(Sections 00710, 00711, 00712, 00715 and 00730)

AGGREGATE PRODUCTION

Quality Control	Verification	Independent Assurance
Required	Required	Required
See Aggregate Production details, page 29.	See Aggregate Production details, page 29.	See Aggregate Production details, page 29.

EMULSIFIED ASPHALT CEMENT

Quality Control	Verification	Independent Assurance
Required	Not Required	Not Required

Quality Control

Sample all required materials as specified in Sections 4(C) and 4(D). Complete *ODOT Sample Data Sheet* (Form 734-4000), place in the proper containers and label as specified in Section 4(C), and deliver to the PM by the middle of the following work shift.

EMULSIFIED ASPHALT CONCRETE PAVEMENT (EAC)

(Section 00735)

AGGREGATE PRODUCTION

Quality Control	Verification	Independent Assurance
Required	Required	Required
See Aggregate Production details, page 29.	See Aggregate Production details, page 29.	See Aggregate Production details, page 29.

MIXTURE PRODUCTION

Quality Control	Verification	Independent Assurance
Required	Required	Required

Quality Control

The Contractor's QC technician shall establish a random sampling and testing program and submit it to the PM prior to the start of production.

The Contractor's QC technician shall perform quality control sampling and testing required to ensure a quality product at the frequencies indicated in Section 4(D) of the MFTP. The Contractor shall deliver the test results to the PM by the middle of the following work shift. *Backup samples for aggregates shall be a minimum of 1/2 the minimum mass shown in Table 1 of AASHTO R 90 for the appropriate nominal maximum size aggregate.*

The Contractor's QC technician is responsible for monitoring plant operation to ensure that specification materials are delivered to the project. Monitoring activities may include, but are not limited to, the following:

- Calibrate the asphalt plant
- Maintain an inventory of materials, including generated waste
- Control segregation in silo(s) and truck loading operations
- Reject any mixture that is visually defective. Inform the PM of the quantity and disposition of the rejected material
- Sample all required materials as specified in Sections 4(C) and 4(D) (e.g. liquid asphalt, emulsion, cement, tack, etc.), place in the proper container and label as specified in Section 4(C), complete the *ODOT Sample Data Sheet* (Form 734-4000) and deliver to the PM by the middle of the following work shift.

Verification

QA performs verification tests, taken randomly, according to the Manual of Field Test Procedures Acceptance Guide (Section 4(D)). A split of the sample taken by QC will be given to QA for testing.

If verification testing fails to meet specifications, QA will immediately notify the PM. The PM will evaluate the results and resolve the discrepancy.

Independent Assurance

All parties that test materials shall employ ODOT-certified technicians and use ODOT-certified laboratories.

The PM will perform random inspections to ensure that the Contractor's quality control plan is followed.

The Contractor's QC technician shall test the Contractor's split of IA samples and provide the results to the PM the next day. The PM will verify that the Contractor's test results and QA's test results are within IA parameters.

If the Contractor's test results and QA's test results for IA samples are not within IA parameters, the PM will perform an investigation (see Investigation Criteria), evaluate the results and resolve the discrepancy.

COMPACTION

<i>Quality Control</i>	<i>Verification</i>	<i>Independent Assurance</i>
Not Required See specifications – 00735.46	Not Required	Not Required

POROUS ASPHALT CONCRETE & ASPHALT CONCRETE PAVEMENT (STATISTICAL ACCEPTANCE)

(Sections 00743 and 00745)

AGGREGATE PRODUCTION

Quality Control	Verification	Independent Assurance
Required	Required	Required
See Aggregate Production details, page 29.	See Aggregate Production details, page 29.	See Aggregate Production details, page 29.

MIXTURE PRODUCTION

Quality Control	Verification	Independent Assurance
Required	Required	Required

Quality Control

The Contractor's QC technician shall establish a random sampling and testing program and submit it to the PM prior to the start of production.

The Contractor's QC technician shall perform quality control sampling and testing required to ensure a quality product at the frequencies indicated in Section 4(D) of the MFTP. The Contractor shall deliver the test results to the PM by the middle of the following work shift. *Backup samples shall be a minimum mass of (20 lbs) or for porous asphalt concrete (PAC), accepted under the cold feed method, a backup sample of 1/2 the minimum mass shown in Table 1 of AASHTO R 90 for the appropriate nominal maximum size aggregate can be used.*

The Contractor's QC technician is responsible for monitoring plant operation to ensure that specification materials are delivered to the project. Monitoring activities may include, but are not limited to the following:

- Calibrate the asphalt plant
- Maintain an inventory of materials, including generated waste
- Control segregation in silo(s) and truck loading operations
- Monitor mix temperature
- Reject any mixture that is visually defective (e.g. graybacks, overheated, contamination, slumping loads etc.) Inform the PM of the disposition and quantity of rejected material
- Sample all required materials as specified in Sections 4(C) and 4(D) (e.g. liquid asphalt, emulsion, cement, tack, etc.), place in the proper container and label as specified in Section 4(C), complete *ODOT Sample Data Sheet* (Form 734-4000), and deliver to the PM by the middle of the following work shift.

Verification

QA performs verification tests, taken randomly, according to the Manual of Field Test Procedures Acceptance Guide (Section 4(D)). A split of the sample taken by QC will be given to QA for testing.

If verification testing fails to meet the specifications, QA will immediately inform the PM. The PM will evaluate the results and resolve the discrepancy.

Independent Assurance

All parties that test materials shall employ ODOT certified technicians and use ODOT certified laboratories.

The PM will perform random inspections to ensure that the Contractor's quality control plan is followed.

The Contractor's QC technician shall test the Contractor's split of IA samples and provide the results to the PM the next day. The PM will verify that the Contractor's test results and QA's test results are within IA parameters.

If the Contractor's test results and QA's test results for IA samples are not within IA parameters, the PM will perform an investigation (see Investigation Criteria), evaluate the results and resolve the discrepancy.

COMPACTION

Quality Control	Verification	Independent Assurance
Required	Required	Required

Quality Control

Dense Graded: The Contractor's QC technician shall establish a random sampling and testing program and submit it to the PM prior to the start of production.

The Contractor’s QC technician shall perform quality control sampling and testing required to ensure a quality product at the frequencies indicated in Section 4(D) of the MFTP. The Contractor shall deliver the test results to the PM on the same day the test is completed.

The Contractor's QC technician shall also perform the following:
(Activities listed below are not exhaustive and are considered minimums.)

- Establish a rolling pattern according to (TM-306) to provide the specified compaction;
- Notify PM and CAT-II if rolling pattern is not being maintained;
- Notify the PM and CAT-II if the specified densities are not achieved;
- Monitor the mix temperature during laydown and compaction to keep the mix within the Specifications;
- Coordinate with the plant technician when changing lots;
- Notify the region Sr. QAC and PM when performing Core Correlations;
- Notify the CAT-II of Control Strip Results;
- Notify PM, CAT-I and CAT-II if any density results exceed 95%.

Porous Asphalt Concrete: Compaction to a specified density is not required. See 00743.49 in the specifications.

Verification

Dense Graded: QA performs verification tests, taken randomly, according to the Manual of Field Test Procedures Acceptance Guide (Section 4(D)).

QA selects random numbers for the test locations within the Contractor's subplot size. If verification testing fails to meet the specifications, QA will immediately notify the PM.

Failing verification requires retesting an additional verification within the next 2 shifts to confirm density specification and to isolate the original failure.

The PM will initiate an investigation. If the investigation determines there is non-specification material, the PM will evaluate the test results using the Failing ACP Compaction Guidelines (located on the following page) and perform the resolution process as needed.

Porous Asphalt Concrete: None Required

Independent Assurance

Dense Graded: All parties involved in the testing process shall employ ODOT certified technicians, use ODOT certified labs and use nuclear density gauge(s) meeting the requirements of ODOT TM 304.

The region Sr. QAC may elect to perform a gauge check as outlined in Appendix C and ODOT TM 304.

Porous Asphalt Concrete: None Required

Failing ACP Compaction Guidelines

1. QC Density Results Fail
 - a. PM will investigate and evaluate the material to determine if the material is suitable for the intended use per Section 00150.25.
 - b. PM consults the Pavements Services and Quality Assurance Unit for recommendations on:
 - Methods of investigating, evaluating, and isolating non-specification material.
 - Application of appropriate corrective action and/or price adjustment for non-specification material.
 - c. If the material is suitable for intended use the PM will apply the test results to acceptance procedures in accordance with Section 00165. The Contractor should take corrective action.
2. QA Density Results Failing
 - a. PM determines the quantity of material represented by this verification. The PM should consider all material back to the last passing verification.
 - b. PM consults Pavement Services and QA for recommendations on:
 - Methods of investigating, evaluating, and isolating non-specification material
 - Application of appropriate corrective action and/or price adjustment for non-specification material

When cores are used, laboratory testing will be conducted by the ODOT Central Materials Laboratory. Third-party resolution can be initiated by the PM or Contractor.

The PM can apply a price adjustment based on values entered into StatSpec, or can use Form 734-3946 for a small number of sublots. The PM also has the ability per section 165.50(c) to isolate material that is shown to be non-specification. Core density results or isolated non-specification material, will be evaluated as a separate lot per section 165.40 or 165.50(c).

APPENDIX A

ODOT APPROVED AGGREGATE PRODUCT PROGRAM

A supplier may submit in writing a request for aggregate product(s) approval through the region SQAC. The State QAE and the region SQAC will review the request and, if it is a benefit to the Department, a product(s) may be put on the ODOT Approved Aggregate Product Program (OAAPP). The request shall include the following information for review:

- Production history or prior use on an ODOT project
- Location and Source Identification
- Intended use of supplied material(s)
- Quality Control Plan

The State QAE will notify the region SQAC of final approval of the Quality Control Plan. The region SQAC will notify the supplier of the approved products. The products covered by the approved Quality Control Plan are classified as ODOT Approved Aggregate Products.

The supplier shall retain backup samples, for the previous 10 sublots, until the test results are verified by the region QA group or as required by the region SQAC.

The supplier shall obtain, under the supervision of the region SQAC, at the minimum required frequency as shown in Section 4A of the MFTP, samples for Product Compliance and then the region SQAC shall submit them for testing at the ODOT Central Materials Laboratory.

The supplier shall send requests to waive tests, as allowed by the FTMAG, to the region SQAC. The region SQAC will consult with the SQAE for any waivers to be granted. The region SQAC will notify the supplier of any waivers granted. Waivers will apply to all projects which are supplied from that source.

When a waiver requires periodic testing by the supplier, the test results shall be sent to the region SQAC.

The supplier shall maintain files of all QC tests for each stockpile. It shall enter the test results into the ODOT StatSpec program to calculate the Quality Level for each stockpile. The QL for gradation shall meet the requirements of Section 00165 of the Oregon Standard Specifications for Construction. Other required test results shall be shown in columns to the right in the program. The region SQAC may, with approval of the State QAE, accept alternate means of statistical analysis for the supplier's product. The supplier shall deliver weekly or at an interval determined by the region SQAC, copies of the ongoing subplot test results, along with the ongoing QL (quality levels).

The supplier shall keep the region SQAC informed about production schedules so that verification testing can be scheduled. The region QA group will obtain verification samples on a random basis and the split of this verification sample shall be ran by the supplier's QC technician to test for independent assurance. The test results shall be available within 24 hours of the time of sampling. If the test results indicate that the produced material meets quality requirements and the results are within IA parameters, the region SQAC may allow all backup QC samples prior to the verification sample to be discarded.

The region SQAC will randomly audit the QC files to verify that the quality levels reflect actual test results. The region SQAC will retain QL information for each stockpile along with verification and IA test results. When requested by the Project Manager, the region SQAC will send a memo to the PM verifying and identifying what materials were produced under the OAAPP and meet the required specifications.

If verification test results, for tests other than gradation, do not meet the quality requirements, no material from the stockpile in question will be accepted until the problem has been resolved. The region SQAC will notify each PM, for the projects being supplied from that source, that the material in question shall not be used until the problem has been satisfactorily resolved. The resolution may involve rejection of the stockpile, if the investigation confirms non-specification material. If the material test results do not meet IA Parameters, the region SQAC will work with the supplier to resolve the problem.

The region SQAC will provide data to other regions that are using material considered ODOT Approved Aggregate Products.

The region SQAC may discontinue a supplier's approved aggregate product status for those product(s) affected based upon, but not limited to:

- The supplier not following their quality control plan,
- IA and/or verification issues,
- Product(s) failing to meet a product compliance testing requirement,
- The determination that an approved aggregate product(s) is no longer a benefit to the Agency under the program.

The approved aggregate product status may be returned upon approval of the State QAE and region SQAC.

APPENDIX B

CONTRACTOR QUALITY CONTROL PLAN

This plan is intended to provide a description of the personnel involved in the testing activities and identify the system or process for material quality control. The quality control plan must contain at a minimum the following information.

- Include: Project name, Contract number and date of anticipated use and author of submitted plan.
- Provide office telephone, cellular phone & fax numbers for contractor's superintendent & quality control manager.
- Describe personnel & methods to deliver accurate, legible & complete test results to designated agency representative, within required time limits.
- Designate who will provide required QL analysis.
- Describe location and methods for backup sample storage.
- Provide random numbers and include examples of your method for applying, to provide representative samples.
- Provide technician and lab certifications for all equipment, laboratories, & technicians used to perform testing on and offsite for the project.
- Provide current scale license and certification for all weighting devices used on the project. Identify the location of the scales and type of scale (e.g. platform, silo, etc).
- For every material that has tolerances or limits for tests listed in the Manual of Field Test Procedures, provide:
 - Bid item & Specification section number(s) for product to be used.
 - Source and supplier of material
 - Proposed production rate, methods & source of testing
 - Anticipated earliest date of use
- For each material supplier & subcontractor, provide:
 - Company name, address, & physical location.
 - Quality Control contact name and telephone #.
 - Location, type, & quantity of materials to be used.

APPENDIX C

TROUBLESHOOTING GUIDE

The following information is a guide to assist in the evaluation of discrepancies that commonly occur between independent assurance test results and verification test results. This information is only a guide and is not necessarily a comprehensive list of all potential areas to be investigated. A best practice is to consult the region SQAC for help early in the troubleshooting process.

General

1. Check if the technician signing the report is the person performing the tests.
2. Check that the technician performing the testing is certified.
3. Check that the lab and equipment used are ODOT certified.
4. Check that the proper procedures and methods were performed.
5. Check all mathematics.
6. Check Balances for accuracies and functionality.
7. Check constant mass calculations if available, comparing moistures can also indicate incomplete drying of sample.
8. Contact region SQAC, their involvement can significantly reduce time spent troubleshooting and getting to resolution.

AGGREGATE TESTING

Gradation (AASHTO T 27 & T 27/11)

1. Check sample size meets minimum requirements.
2. Inspect sieves for deformed wires or torn fabric.
3. Compare both test results for sample initial wet weights, initial dry weights, after wash dry weights, individual sieve weights and any tare weights if used. May point to a transposed or incorrectly recorded weight. May point to a splitting error.
4. Check sieve loss calculations.
5. Are their screens overloaded?
6. Check to see if the hand sieving procedure shows equipment operating correctly.
7. Check wash loss. May point to error in initial dry weight.
8. Have QC run QA split and observe. This action might indicate equipment, procedural discrepancies and /or splitting issues.
9. Compare results to ongoing StatSpec mean values.

Woodwaste Test (ODOT TM 225)

1. Is the drying method burning up wood?
2. Check equipment used for the procedure for correct size and state of repair.

Fracture Test (AASHTO T 335)

1. Did both parties test the same? (Splitting the sample or not splitting the sample.)
2. If samples not split, do F+Q+N match closely to the retained mass(s) for gradation?
3. Do both parties have approximately the same amounts of F, Q, and N? If not may indicate a difference in interpretation of fractured particles.
4. Have QC run QA split and observe. This action might reveal procedural discrepancies and if results do not vary from originals, may indicate difference introduced during splitting.

Flat & Elongated Test (ODOT TM 229)

1. Did both parties test the same? (Based on individual screens during gradation analysis and summed up or material recombined and split out with one evaluation.)
2. Does MS closely match the retained masses for gradation (+ No. 4 material)
3. Proper caliper ratio used by both parties?
4. Have QC run QA split and observe. May indicate differences introduced during splitting.
5. Check caliper for tight fit between points when closed and smooth operation of armature.

Sand Equivalent Test (AASHTO T 176)

1. Compare sand reading, if significant differences present this is an indication a under sized tin or insufficient compacting effort when filling the tin.
2. Did both parties test at the same moisture content?
3. Are the methods of shaking suspending all fines?
4. Check lab temperatures and SE stock solution's age and the SE working solution's age and temperature. When in doubt observe technician prepare new batch of working solution.
5. Have QC run QA split of sample and observe procedures.
 - a. Look for vibration in surface where SE's tubes are set.
 - b. Were all the fines put into suspension?
 - c. Check shaking device for proper throw distance and proper number of strokes.
 - d. Check irrigation wand to insure good fluid flow from both openings.
 - e. Digital timer being used.
 - f. Weighted foot assembly in good condition and properly lowered.
 - g. Graduated marks properly read
6. Observe parties cleaning the +4.75mm (No. 4) material insuring fine particles are removed.
7. If results do not vary from originals, may point to a splitting issue.

SOIL/AGGREGATE RELATIVE MAXIMUM DENSITY AND OPTIMUM MOISTURE (AASHTO T 99, Methods A & D and ODOT TM 223)

1. Was the sample initially oven-dried (not allowed)? Separate samples at each point or re-compact? Samples tested immediately or "marinated" moistures overnight?
2. Check plotting of data. Correct scale used. Dry densities plotted vs. dry basis moistures.
3. Check tare weights on molds/base plates. Collar removed?
4. Check mold volumes according to T 19; is there a significant difference from the standard volume?

5. Check surface on which samples were compacted. Is it unyielding surface?
6. Check constant mass on individual samples if available.
7. If available, check planning sheets for correct moisture addition calculations.
8. When held up to a light (or placed on a light table) do the two curve shapes match closely? Same shape, but one curve plots higher and to the left, indicates different compaction energy consistently applied to samples.
9. Was the passing No.4 or 3/4" material brushed off the retained # 4 or 3/4" material?
10. Have QC run a point at optimum moisture from their curve on the passing # 4 or 3/4". Observe them perform the sample preparation and compaction procedure. Correct moisture computed and material properly mixed? Correct layers and layer heights? Hammer dropped from the correct height? Correct number of blows? Correct trimming and cleaning of mold? Moisture samples obtained correctly tested?

Coarse Aggregate Bulk Specific Gravity Test (AASHTO T 85)

1. Check thermometers.
2. How do values compare with pit history?
3. Were samples oven dried prior to soaking?
4. Do both parties have approximately the same G_{sa} ? This indicates the difference is probably in interpretation of the SSD point. If these results are very different this points to weight in water error, so was empty basket weighed in water or "zeroed" in water?
5. Screen over a nested 1/4" and # 4 sieve. Significant material passing the # 4 indicates an error in screening of material.
6. Have QC run QA sample and observe the sample preparation procedure.

COMPACTION OF SOILS & PROCESSED AGGREGATE (AASHTO T 310 with T 99, T 255/265 (or T 217) & T 85 and T 272 & R 75 (Soils) or ODOT TM 223 (Aggregate Base))

There are no IA parameters for compaction. If verification for compaction fails see the specification specific section for how the QC is to resolve the failing area.

1. Is the correct curve being used? Is the correct density information being used?
2. Coarse particles fit the rules for AASHTO T 99, Method A or Method D? Fits curve used?
3. Observe testing in the field and look for the following: Random representative location selected. Correct site preparation, drilling of the test hole, placement and seating of the gauge, data recorded.
4. For soils. Observe proper fabrication of the one point and look for the following: Proper screening of material, in-place moisture measured prior to addition of additional moisture if needed, proper compaction of sample in correct mold, stable surface for compaction of one point?
5. Check speedy moisture tester, balances and has density gauge been calibrated and calibration been verified by the region QA lab.

ACP TESTING

The following should be considered in addition to the items listed in the Aggregate section.

Ignition Oven – AC Content Test (AASHTO T 308)

1. Was the correct calibration factor used?
2. Were calibration samples batched properly and calculations performed correctly?
3. Was companion moisture used or sample dried prior to testing?
4. Sample has a clean burn? Sample achieved constant mass?
5. Check basket weights. Check sample size.
6. Check gradation results. The coarse half of a split may have lower asphalt content than the fine half.
7. Is the Oven set at the correct temperature?
8. Does the manufacture scale drift test meet parameters?
9. Was the thermometer removed prior to initial and final weighing?
10. Were the initial and final weights taken at the same temperatures?
11. Was the mix moisture removed from the initial mass reading?

Rice Gravity Testing (AASHTO T 209)

1. Check tare weights of pycnometers and lids.
2. Check sample sizes.
3. Check pycnometers calibration numbers.
4. Check equipment. Proper vacuum pressure? Calibrated thermometer?
5. Is the “dry back” procedure appropriate for this material?
6. Check gradation results. The coarse half of a split will have a higher Rice Gravity than the fine half.

Bulk Gravity Testing (AASHTO T 166)

1. Check sample heights.
2. Check measured volumes compared to heights. Tallest specimen should have largest volume.
3. Check equipment. Suspension apparatus hanging free? Calibrated thermometers? Tank overflow? Damp towel for SSD?
4. Check compaction equipment. Proper gyrations, pressure, angle of gyration, compaction temp?
5. Observe testing. Swap samples and observe performing procedure. Watch immersion and SSD procedures. Is basket and wire assembly free floating?
6. If results do not vary from originals, may point to a splitting or compaction error.
7. If results vary from originals, may point to a technician or equipment error.

ACP DENSITY TESTING (AASHTO T 355)

There is no opportunity to rework ACP; therefore, it is imperative to troubleshoot density testing issues immediately.

QC Best Practice

Once the gauge has been initially ODOT calibrated, identify a location that can act as a reference, this site should be an area of flat concrete. Set the gauge on the flat concrete surface and scribe a line around the case. Take a four-minute test on the site and document the result. It is a good idea to paint the density on the concrete so that others may use it too. Test the gauge at this site prior to going to the project to assure that the gauge is still reading consistently. Performing standard counts on project site before starting daily work is required and running another set at mid shift helps to maintain consistent readings.

Project Manager

1. Has the Contractor's gauge calibrated or verified by the region QA group? Ask to see Cert.
2. Correct MAMD used? Core Correlation factor applied if needed (ODOT TM 327)?
3. Check the following correct; site preparation, placement and seating of the gauge, footprint marked, data recorded, rotation gauge.
4. Does the first subplot MDT match the JMF MDT within reasonable parameters? Specification is 50 kg/m^3 (3.0 lb/ft^3) this is really a large variation - check the asphalt content of the mixture.
5. If compaction is low, are there sufficient rollers of proper weight (according to specifications), to achieve compaction? Does compaction correlate with voids i.e. high voids low compaction?
6. Is the mix tender? Seek help from SQAC or ODOT Pavements.
7. Is rolling compacting the whole panel, not just the center? Consistent with the control strip?
8. Is the lay down temperature correct according to the JMF or has temperature changed during production? Has there been a substantial change in lift thickness?
9. Is weather a factor (colder, wetter, or windy)?
10. Is the existing surface being paved on in question (i.e. paving over open-graded ACP, PCC surfaces or extremely distressed existing pavement)?
11. Does coring need to be performed to validate in-place compaction? Call the pavements unit for guidance.

If any problems are found that cannot be resolved, the inspector or QCCS should contact the region QA group immediately.

QA

QA is to verify compaction using separate, randomly selected sites. There is no direct comparison, independent assurance parameter for nuclear density testing.

1. Periodically during the construction, perform counts on the region calibration blocks in the backscatter position.
2. On the project, choose one or two sites at random and perform the normal tests on these sites with both the QC and QA gauges. The average for each gauge when compared to the other should be within 2 lb/ft³.
3. If the difference between the two gauges is greater than 2 lb/ft³, the Contractor's QC technician should rerun the tests while the QAT observes.
4. If the two gauges are not in agreement, re-standardize both gauges and re-shoot the location two shots in the same direction. If the gauges still do not compare take both gauges back to the calibration blocks and check their calibration and follow TM 304.
5. If either gauge is out of calibration, recalibrate prior to project testing.
6. If the gauges are in calibration. Core correlation should be performed to remove gauge differences.
7. The Project Manager and region SQAC should work together to resolve QC sublots brought into question by verification results.

PLASTIC CONCRETE TESTING

General for All Concrete Tests

1. Was the test started within prescribed time limits of obtaining the sample?
2. Were the QA and QC samples taken from the same portion of the load?
3. Was the sample adequately recombined if taken from two parts of the load?
4. Was the concrete covered if ambient conditions were adverse?
5. Was all equipment used within specification/tolerance, clean and damp prior to test?
6. Was excess water removed from the sampling container prior to obtaining the sample?

Slump (AASHTO T 119)

1. Once the test was started was it completed in the allotted 2 ½ minutes and immediately measured?
2. Does Equipment meet specification?
3. Tamping rod w/hemispherical tip
4. Flat, rigid, non-absorbent base, level and on a surface free of vibration or disturbance (not a warped water damaged piece of plywood)
5. Cone that is free of dents, rust damage and concrete build up on the inside
6. Correct amount of layers and quantity/volume in each layer?
7. Was each layer rodded 25 times extending into the preceding layer?
8. On the top layer, was a head kept above the top of the cone at all times?
9. Was the excess concrete cleaned away from the base of the cone prior to lifting?
10. Was the cone pulled too fast/slow?
11. Was the cone pulled straight with no twisting or lateral movement?
12. Was the measurement reading taken from the displaced original center?

Note: If mix has retained 1 ½ inch or larger aggregate, it must be removed by the wet sieve method prior to performing the test.

Air Content (AASHTO T 152)

1. Was the test started within 5 minutes of obtaining the sample?
2. Has the air meter gauge been calibrated within the last three months?

NOTE: The air meter calibration can be checked in the field.

3. Was the bowl filled in approximately equal 1/3 layers?
4. Was each layer rodded 25 times extending into the preceding layer?
5. Were the sides of the bowl tapped 10 to 15 times with a mallet after each layer had been rodded?
6. Was the cover seal moistened and seated properly on the bowl?
7. Was water injected into the petcocks and meter rocked until no air bubbles appeared?

8. Was air pumped into the initial air chamber until it passed the initial pressure setting (as determined in the calibration process) and allowed to cool? Was any air noted seeping out of open petcocks at this time?
9. Was initial gauge adjusted to initial air pressure before opening main air valve?
10. Were the sides of the bowl tapped “smartly” during release of main air valve?
11. During release of main air valve was there any air leaking out the sides due to an incomplete seal?

Temperature (AASHTO T 309)

1. Has the measuring device been calibrated or verified for accuracy within the last year?
2. Was there adequate concrete cover around the measuring device sensor (at least 3”)?
3. Was the concrete pressed around the measuring device at the surface?
4. Was the temperature recorded after a minimum of 2 minutes and the measuring device allowed to stabilize?

Unit Weight (AASHTO T 121)

Since the unit weight test is usually performed in conjunction with the air content test, see steps 3, 4 and 5 under the air content portion of this guide.

1. Check math
2. Was the dry mass of the measure accurately recorded?
3. Has the measure’s volume been accurately calibrated?
4. Was a strike off plate used to create a smooth surface free of voids and level with the rim?
5. Is the scale accurate? Cross check QA and QC scales to field verify accurate measurement.

INSERT TAB

SECTION 3
Report Forms & Examples

NUCLEAR COMPACTION TEST REPORT

PROJECT NAME (SECTION)				CONTRACT NUMBER	
CONTRACTOR OR SUPPLIER			PROJECT MANAGER		BID ITEM NUMBER
TEST LOCATION (STATION)			OFFSET (DISTANCE FROM CENTERLINE)		SOURCE POSITION
TEST NUMBER	DISTANCE BELOW GRADE	LIFT	LIFT THICKNESS	DATE	
CODES FOR ROLLER TYPES SDV-SINGLE DRUM VIBRATORY SF-SHEEP FOOT DDV-DOUBLE DRUM VIBRATORY GR-GRID ROLLER			ROLLER TYPE AND DESCRIPTION (MANUFACTURE, WEIGHT, ETC)		

REPRESENTS MATERIAL / AREA INCORPORATED

FROM: STATION OFFSET DIST. BELOW GRADE

TO: STATION OFFSET DIST. BELOW GRADE

CHECK BOX DEFLECTION OBSERVED UNDER LOADED EQUIP. NO DEFLECTION OBSERVED UNDER LOADED EQUIP.

MOISTURE IS NOT WITHIN SPECIFICATION MOISTURE IS WITHIN SPECIFICATION

AASHTO T 310	Wet Density lb/ft ³	Moisture lb/ft ³	Dry Density	Percent Moisture
Shot 1	<input type="text"/>	<input type="text"/>	WD - M	(M / DD) X 100
Shot 2	<input type="text"/>	<input type="text"/>		
Average	WD <input type="text"/>	M <input type="text"/>	DD <input type="text"/>	%M <input type="text"/>
<small>(shots within 2 lb/ft³)</small>				
AASHTO T 99	A №4 or 4.75	COARSE <input type="text"/>	FINE <input type="text"/>	% Coarse <input type="text"/>
	D ¾ or 19.0	COARSE <input type="text"/>	FINE <input type="text"/>	% Coarse <input type="text"/>

MASS OF MOLD AND MATERIALS	MASS OF MOLD	MASS OF WET MATERIAL (M)	WET DENSITY (A)	SPEEDY MOISTURE %			AASHTO T 255 / T 265 MOISTURE %			DRY DENSITY (D)
				WET (B)	DRY (C)	WET (a)	DRY (b)	% M (c)		
UNSCREENED COMBINED IN-PLACE MOISTURE →										
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	

WD (A) = (M) X (MF)MOLD FACTOR MOLD FACTOR (MF) <input type="text" value="0.06614"/>	SPEEDY MOISTURE % (C)= $\frac{(B)}{100 - (B)} \times 100$	T 255 / T 265 MOISTURE % (C)= $\frac{(a) - (b)}{(b)} \times 100$	DRY DENSITY (D)= $\frac{(A)}{(C)+100} \times 100$
4 inch MOLD (WD) = (M) x 0.06614 6 inch MOLD (WD) = (M) x 0.02939			

Pc	Pf	CURVE NO.	DRY DENSITY ρ _f	OPTIMUM MOISTURE	MC _f	k (Gsb x 62.4)	MC _c
(from A or D above)	(Pf = 100 - Pc)	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>

COMBINED IN-PLACE MOISTURE
 (C) = unaltered one-point moisture
 $W = \frac{(C)Pf + MCcPc}{100}$
 Within 1% of T 310 % Moisture?
 (If not Correct T 310 DD) W=

COMBINED OPTIMUM MOISTURE (MCT)
 (Based on Curve Info.)
 $MCT = \frac{MCfPf + MCcPc}{100}$
 MCT=

RELATIVE MAXIMUM DRY DENSITY
 "lb/ft³
 $\rho_d = \frac{Pf}{Pf} + \frac{Pc}{k}$
 $\rho_d = \frac{100}{\frac{Pf}{Pf} + \frac{Pc}{k}}$
 $\rho_d = \frac{100}{\frac{100}{Pf} + \frac{Pc}{k}}$

CORRECTED DRY DENSITY
 $DD = WD / (1+(W/100))$
 DD = $\frac{WD}{1+(W/100)}$

PERCENT COMPACTION
 Original or Corrected $(DD / \rho_d) \times 100$
 Percent Required PERCENT OBTAINED

REMARKS

QUALITY CONTROL	VERIFICATION	TYPE GAUGE-SERIAL NUMBER:
CERTIFIED TECHNICIAN (PLEASE PRINT) AND CARD NUMBER	COMPANY NAME	SIGNATURE DATE

NUCLEAR COMPACTION TEST REPORT

PROJECT NAME (SECTION) Forms Example			CONTRACT NUMBER 12345		
CONTRACTOR OR SUPPLIER ODOT Forms			PROJECT MANAGER Sean Parker		
TEST LOCATION (STATION) 65+15			OFFSET (DISTANCE FROM CENTERLINE) 15' Rt.		
TEST NUMBER 1-1			DISTANCE BELOW GRADE Subgrade		
LIFT N/A			LIFT THICKNESS N/A		
DATE 10/9/20			ROLLER TYPE AND DESCRIPTION (MANUFACTURE, WEIGHT, ETC) CAT CF 560 SDV		
CODES FOR ROLLER TYPES SDV-SINGLE DRUM VIBRATORY DDV-DOUBLE DRUM VIBRATORY			SF-SHEEP FOOT GR-GRID ROLLER		

REPRESENTS MATERIAL / AREA INCORPORATED

FROM: STATION OFFSET DIST. BELOW GRADE

TO: STATION OFFSET DIST. BELOW GRADE

CHECK BOX DEFLECTION OBSERVED UNDER LOADED EQUIP. NO DEFLECTION OBSERVED UNDER LOADED EQUIP.

MOISTURE IS NOT WITHIN SPECIFICATION MOISTURE IS WITHIN SPECIFICATION

AASHTO T 310	Wet Density lb/ft³	Moisture lb/ft³	Dry Density	Percent Moisture
Shot 1	150.2	10.1	WD - M	(M / DD) X 100
Shot 2	150.9	10.3		
Average	WD 150.6	M 10.2	DD 140.4	%M 7.3 %

(shots within 2 lb/ft³)

AASHTO T 99	A	N#4	COARSE	<input type="text" value="4582.0"/>	FINE	<input type="text" value="5939.0"/>	% Coarse	<input type="text" value="44"/>
	D	3/4"	COARSE	<input type="text" value="845.0"/>	FINE	<input type="text" value="9691.0"/>	% Coarse	<input type="text" value="8"/>

MASS OF MOLD AND MATERIALS	MASS OF MOLD	MASS OF WET MATERIAL (M)	WET DENSITY (A)	SPEEDY MOISTURE % WET (B)	DRY (C)	AASHTO T 255 / T 265 MOISTURE % WET (a) DRY (b) % M (c)			DRY DENSITY (D)
UNSCREENED COMBINED IN-PLACE MOISTURE →						2005.2	1850.1	8.4	
10317	5655.5	4661.5	137.0			1097.7	1065.3	3.0	133.0
10491.8	5655.5	4836.3	142.1			1044.7	991.1	5.4	134.8

WD (A) = (M) X (MF) MOLD FACTOR		SPEEDY MOISTURE %		T 255 / T 265 MOISTURE %		DRY DENSITY	
MOLD FACTOR (MF)	<input type="text" value="0.02939"/>	(C) =	<input type="text" value="8.4"/> X 100	(C) =	<input type="text" value="8.5"/> X 100	(D) =	<input type="text" value="139"/> X 100
4 inch MOLD (WD) = (M) x 0.06614		100 - (B)		(a) - (b)		(C)+100	
6 inch MOLD (WD) = (M) x 0.02939				(b)			

Pc (from A or D above)	Pf (Pf = 100 - Pc)	CURVE NO.	DRY DENSITY ρ_f	OPTIMUM MOISTURE	MC_f	k (Gsb x 62.4) or (Gsb x 1000)	MC_c
8	92	Exit 99-03	139	8.5		165	2.2

COMBINED IN-PLACE MOISTURE
(C) = unaltered one-point moisture

$$W = \frac{(C)Pf + MCcPc}{100}$$

Within 1% of T 310 % Moisture?
(If not Correct T 310 DD)

W = 8.4

COMBINED OPTIMUM MOISTURE (MCT)
(Based on Curve Info.)

$$MCT = \frac{MCfPf + MCcPc}{100}$$

MCT = 8.5

RELATIVE MAXIMUM DRY DENSITY

$$\rho_d = \frac{Pf}{\rho_f} + \frac{Pc}{k}$$

ρ_d = 139

CORRECTED DRY DENSITY
DD = WD / (1+(W/100))

DD = 138.9 = 150.6 / 1.084

PERCENT COMPACTION
Original or Corrected (DD / ρ_d) x 100

Percent Required PERCENT OBTAINED

REMARKS

QUALITY CONTROL VERIFICATION

TYPE GAUGE-SERIAL NUMBER: **Troxler 16029**

CERTIFIED TECHNICIAN (PLEASE PRINT) AND CARD NUMBER: **Zoid #40001**

COMPANY NAME: **ODOT**

SIGNATURE: _____ DATE: **11/21/2022**

NUCLEAR COMPACTION TEST REPORT

PROJECT NAME (SECTION) Forms Example			CONTRACT NUMBER 12345		
CONTRACTOR OR SUPPLIER ODOT Forms		PROJECT MANAGER Sean Parker		BID ITEM NUMBER 123	
TEST LOCATION (STATION) 117+17			OFFSET (DISTANCE FROM CENTERLINE) 16' Lt.		SOURCE POSITION 8"
TEST NUMBER 1-1	DISTANCE BELOW GRADE 7 ft.	LIFT 3 rd	LIFT THICKNESS 12"	DATE 10/9/20	
CODES FOR ROLLER TYPES SDV-SINGLE DRUM VIBRATORY SF-SHEEP FOOT DDV-DOUBLE DRUM VIBRATORY GR-GRID ROLLER			ROLLER TYPE AND DESCRIPTION (MANUFACTURE, WEIGHT, ETC) CAT CF 460 SF		

REPRESENTS MATERIAL / AREA INCORPORATED

FROM: STATION **115+25** OFFSET **15' Lt.** DIST. BELOW GRADE **8'**
 TO: STATION **200+25** OFFSET **20' Rt.** DIST. BELOW GRADE **7'**
 CHECK BOX DEFLECTION OBSERVED UNDER LOADED EQUIP. NO DEFLECTION OBSERVED UNDER LOADED EQUIP.
 MOISTURE IS NOT WITHIN SPECIFICATION MOISTURE IS WITHIN SPECIFICATION

AASHTO T 310		Wet Density	lb/ft ³	Moisture	lb/ft ³	Dry Density	Percent Moisture
Shot 1		121.8		5.4		WD - M	(M / DD) X 100
Shot 2		121.5		5.5			
Average		WD 121.7		M 5.5		DD 116.2	%M 4.7 %
(shots within 2 lb/ft ³)							
AASHTO T 99	A	No.4	COARSE	2789.1	FINE	14947	% Coarse 16
	D	3/4"	COARSE	1829.1	FINE	15906.9	% Coarse 10

MASS OF MOLD AND MATERIALS	MASS OF MOLD	MASS OF WET MATERIAL (M)	WET DENSITY (A)	SPEEDY MOISTURE % WET (B)	DRY (C)	AASHTO T 255 / T 265 MOISTURE % WET (a) DRY (b) % M (c)			DRY DENSITY (D)
UNSCREENED COMBINED IN-PLACE MOISTURE →									
5941.1	4223.7	1717.4	113.6			110.6	103	7.4	105.8
6101.5	4223.7	1877.8	124.2			165.9	147.5	12.5	110.4

WD (A) = (M) X (MF) MOLD FACTOR	SPEEDY MOISTURE %	T 255 / T 265 MOISTURE %	DRY DENSITY
MOLD FACTOR (MF) 0.06614	(C) = $\frac{(B)}{100 - (B)} \times 100$	(C) = $\frac{(a) - (b)}{(b)} \times 100$	(D) = $\frac{(A)}{(C) + 100} \times 100$
4 inch MOLD (WD) = (M) x 0.06614			
6 inch MOLD (WD) = (M) x 0.02939			

Pc	Pf	CURVE NO.	DRY DENSITY ρ _f	OPTIMUM MOISTURE	MC _f	k	(G _{sb} x 62.4)	MC _c
(from A or D above)	(Pf = 100 - Pc)							
16	84	Exit 19-1	111.4	14.1		138		4.8

COMBINED IN-PLACE MOISTURE (C) = unaltered one-point moisture Within 1% of T 310 % Moisture? (If not Correct T 310 DD)	$W = \frac{(C)Pf + MCcPc}{100}$ 7.4 84 + 4.8 16 /100 W = 7.0
COMBINED OPTIMUM MOISTURE (MCT) (Based on Curve Info.)	$MCT = \frac{MCfPf + MCcPc}{100}$ 14.1 84 + 4.8 16 /100 MCT = 12.6
RELATIVE MAXIMUM DRY DENSITY lb/ft ³	$\rho_d = \frac{100}{\frac{Pf}{\rho_f} + \frac{Pc}{k}}$ 114.9 = $\frac{100}{\frac{84}{111.4} + \frac{16}{138}}$

CORRECTED DRY DENSITY DD = $WD / (1 + (W/100))$ DD WD 1+(W/100) 113.7 = 121.7 / 1.07
PERCENT COMPACTION Original or Corrected (DD / ρ _d) x 100 Percent Required 95 PERCENT OBTAINED 99

REMARKS

<input type="checkbox"/> QUALITY CONTROL	<input checked="" type="checkbox"/> VERIFICATION	TYPE GAUGE-SERIAL NUMBER: Troxler 16029	
CERTIFIED TECHNICIAN (PLEASE PRINT) AND CARD NUMBER Zoid #40001	COMPANY NAME ODOT	SIGNATURE	DATE 11/21/2022

NUCLEAR COMPACTION TEST REPORT FOR BASE AGGREGATE

PROJECT NAME (SECTION)			CONTRACT NUMBER
CONTRACTOR OR SUPPLIER		PROJECT MANAGER	BID ITEM NUMBER
PANEL WIDTH	LIFT THICKNESS	TYPE GAUGE-SERIAL NUMBER	MIX NOMINAL SIZE

ROLLER TYPE AND DESCRIPTION (MANUFACTURE, WEIGHT, ETC)

TEST NUMBER					
DATE OF TEST					
TEST LOCATION (STATION)					
DISTANCE LT. OR RT. OF CENTERLINE (FEET)					
SOURCE POSITION					
LIFT	DIST BELOW GRADE				

WET DENSITY MAX DIFFERENCE 2 lb/ft ³	1D				
	2D				
MOISTURE	1M				
	2M				

AVE. WET DENSITY	AD				
AVE. MOISTURE	AM				
DRY DENSITY (AD-AM)	DD				
% MOISTURE (AM / DD) x 100	%M				

Curve #					
Source #					
RELATIVE MAXIMUM DRY DENSITY	ρ_d				
Combined Optimum Moisture					

% COMPACTION FOR INDIVIDUAL TESTS (DD / ρ_d) X 100		% REQ			
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CHECK APPROPRIATE MATERIAL DEFLECTED UNDER LOADED EQUIPMENT MATERIAL DID NOT DEFLECT UNDER LOADED EQUIPMENT

REPRESENTS MATERIAL INCORPORATED

FROM STATION

TO STATION

FROM OFFSET

TO OFFSET

REMARKS

<input type="checkbox"/> QUALITY CONTROL	<input type="checkbox"/> VERIFICATION		
CERTIFIED TECHNICIAN (PLEASE PRINT) AND CARD NUMBER	COMPANY NAME	SIGNATURE	DATE

NUCLEAR COMPACTION TEST REPORT FOR BASE AGGREGATE

PROJECT NAME (SECTION) Forms Example			CONTRACT NUMBER 12345
CONTRACTOR OR SUPPLIER ODOT Forms		PROJECT MANAGER Sean Parker	BID ITEM NUMBER 123
PANEL WIDTH 13 Ft.	LIFT THICKNESS 6"	TYPE GAUGE-SERIAL NUMBER Troxler 3430 #11111	MIX NOMINAL SIZE 3/4"-0

ROLLER TYPE AND DESCRIPTION (MANUFACTURE, WEIGHT, ETC)
Ingersoll Rand - SDV - 10 Ton

TEST NUMBER	1	2	3	4	5
DATE OF TEST	10/9/2020	10/9/2020	10/9/2020	10/9/2020	10/9/2020
TEST LOCATION (STATION)	135+15	142+50	148+30	155+45	161+00
DISTANCE LT. OR RT. OF CENTERLINE (FEET)	5' Rt	2' Rt	10' Rt	9' Rt	3' Rt
SOURCE POSITION	6"	6"	6"	6"	6"
LIFT DIST BELOW GRADE	1st 6"	1st 6"	1st 6"	1st 6"	1st 6"

WET DENSITY MAX DIFFERENCE 2 lb/ft³	1D	144.4	145.6	147.0	146.5	145.7
	2D	143.8	145.3	147.2	146.5	145.9
MOISTURE	1M	7.2	7.9	8.1	7.4	7.6
	2M	7.1	7.7	8.3	7.3	7.7

AVE. WET DENSITY	AD	144.1	145.5	147.1	146.5	145.8
AVE. MOISTURE	AM	7.2	7.8	8.2	7.4	7.7
DRY DENSITY (AD-AM)	DD	136.9	137.7	138.9	139.1	138.1
% MOISTURE (AM / DD) x 100	%M	5.3%	5.7%	5.9%	5.3%	5.6%

Curve #		#1	#1	#1	#1	#1
Source #		10-001-3	10-001-3	10-001-3	10-001-3	10-001-3
RELATIVE MAXIMUM DRY DENSITY	ρ_d	135.4	135.4	135.4	135.4	135.4
Combined Optimum Moisture		7.3%	7.3%	7.3%	7.3%	7.3%

% COMPACTION FOR INDIVIDUAL TESTS (DD / ρ_d) X 100	95	% REQ	101%	102%	103%	103%	102%
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CHECK APPROPRIATE MATERIAL DEFLECTED UNDER LOADED EQUIPMENT MATERIAL DID NOT DEFLECT UNDER LOADED EQUIPMENT

REPRESENTS MATERIAL INCORPORATED

FROM STATION **120+00**
FROM OFFSET **Centerline**

TO STATION **162+00**
TO OFFSET **13' Rt.**

REMARKS

<input checked="" type="checkbox"/> QUALITY CONTROL	<input type="checkbox"/> VERIFICATION	CERTIFIED TECHNICIAN (PLEASE PRINT) AND CARD NUMBER Scott Aker #43048		COMPANY NAME ODOT	SIGNATURE <i>Scott Aker</i>	DATE 10/9/2020
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CONCRETE YIELD AND W/C RATIO WORKSHEET

PROJECT NAME (SECTION)					CONTRACT NUMBER						
CONTRACTOR				PROJECT MANAGER				BID ITEM NUMBER			
CONCRETE SUPPLIER				SUBMITTED BY				QUANTITY REPRESENTED yd ³			
CONCRETE FOR USE IN (LOCATION OR PLACEMENT)					BRIDGE NUMBER			SPECIFIED STRENGTH PSI @ _____ DAYS			
DATA SHEET NUMBER		SET NUMBER		DATE		INVOICE NUMBER		BATCH SIZE		TRUCK NO & DRIVER	

CONCRETE BATCH TICKET AND FIELD TEST DATA

CEMENTITIOUS MATERIAL		AGGREGATES		AGG % FREE MOISTURE
CEMENT _____ lb	#1 _____ lb			_____ %
SLAG _____ lb	#2 _____ lb			_____ %
FLYASH _____ lb	#3 _____ lb			_____ %
SILICA FUME _____ lb	FINE AGG (SAND) #4 _____ lb			_____ %
TOTAL CEMENT _____ lb	TOTAL AGG _____ lb			
ADMIXTURES		1 _____ oz		
		2 _____ oz		
ADD WATER		3 _____ oz		
BATCHED _____ lb		4 _____ oz		
JOBSITE _____ lb	TOTAL ADMIXTURES _____ oz			
TOTAL WATER _____ lb	TOTAL ADMIXTURES _____ lb			
TOTAL BATCH MASS _____ lb				

CONVERSIONS

WATER

Gal x 8.34 = lb

Admixtures

oz / 16 = lb

PLASTIC PROPERTIES

TIME CYLINDERS CAST _____	AMBIENT _____ °F	SLUMP _____ in
	CONCRETE _____ °F	AIR _____ %

DENSITY

CONCRETE + POT _____ lb		
- POT MASS _____ lb		
CONCRETE MASS= _____ lb	÷ POT CALIBRATION _____	= _____ lb/ft ³
YIELD TOTAL BATCH MASS _____		
lb/ft ³ x 27 _____		= _____ lb/ft ³
CEMENT CEMENT, FLYASH & SILICA _____		
CONTENT YIELD _____		= _____ lb/ft ³

WATER CEMENT RATIO

A. AGGREGATE FREE WATER

(FREE MOISTURE FACTOR = % FREE MOISTURE DIVIDED BY 100. EG.: 5.5% = 0.055)

BATCH MASS -	$\left(\frac{\text{BATCH MASS}}{(1 + \text{FREE MOISTURE FACTOR})} \right)$	= AGG. FREE WATER	W/C RATIO =	$\frac{\text{TOTAL FREE WATER (A+B+C)}}{\text{TOTAL CEMENT \& FLYASH}}$
#1 _____	- (_____ / 1+ _____)	= _____ lb		
#2 _____	- (_____ / 1+ _____)	= _____ lb		
#3 _____	- (_____ / 1+ _____)	= _____ lb		
FINE AGG (SAND) #4 _____	- (_____ / 1+ _____)	= _____ lb		
	A. AGGREGATE FREE WATER TOTAL	= _____ lb		
_____ lb	=	W/C RATIO	B. WATER ADDED AT PLANT&JOBSITE	= _____ lb
_____ lb			C. ADMIXTURES ADDED	= _____ lb

<input type="checkbox"/> QUALITY CONTROL	<input type="checkbox"/> VERIFICATION		
CERTIFIED TECHNICIAN (PLEASE PRINT) AND CARD NUMBER	COMPANY NAME	SIGNATURE	DATE

CONCRETE YIELD AND W/C RATIO WORKSHEET

PROJECT NAME (SECTION) Forms Example					CONTRACT NUMBER 12345	
CONTRACTOR ODOT Forms			PROJECT MANAGER Sean Parker		BID ITEM NUMBER 123	
CONCRETE SUPPLIER The Best Ready Mix			SUBMITTED BY Scott Aker		QUANTITY REPRESENTED 150 yd³	
CONCRETE FOR USE IN (LOCATION OR PLACEMENT) Deck			BRIDGE NUMBER 1234a		SPECIFIED STRENGTH 5000 PSI @ 28 DAYS	
DATA SHEET NUMBER F-43048-001	SET NUMBER 1	DATE 10/10/12	INVOICE NUMBER 123456	BATCH SIZE 9.00yd3	TRUCK NO & DRIVER #21 T. Driver	

CONCRETE BATCH TICKET AND FIELD TEST DATA

CEMENTITIOUS MATERIAL		AGGREGATES		AGG % FREE MOISTURE	
CEMENT	4735 lb	3/4" Round #1	17600 lb		0.30 %
SLAG	165 lb	#2			%
FLYASH	2000 lb	#3			%
SILICA FUME	288 lb	FINE AGG (SAND) #4	10080 lb		7.90 %
TOTAL CEMENT	7188 lb	TOTAL AGG	27680 lb		
ADMIXTURES		Rheobuild	1 580 oz		
		997	2 512 oz		
ADD WATER		AE-90	3 64 oz		
BATCHED	1186 lb		4 oz		
JOBSITE	lb	TOTAL ADMIXTURES	1156 oz		
TOTAL WATER	1186 lb	TOTAL ADMIXTURES	72 lb		
TOTAL BATCH MASS			36126 lb		

CONVERSIONS

WATER

Gal x 8.34 = lb

Admixtures

oz / 16 = lb

PLASTIC PROPERTIES

TIME CYLINDERS CAST 11:30 AM AMBIENT 40.5 °F SLUMP 6 1/2 in
 CONCRETE 61 °F AIR 4.9 %

DENSITY

CONCRETE + POT	43.90 lb			
- POT MASS	7.68 lb			
CONCRETE MASS=	36.22 lb	+ POT CALIBRATION	0.249900 =	144.9 lb/ft³
YIELD	TOTAL BATCH MASS = 36126			
	lb/ft³ x 27 = 3912.30			9.23 lb/ft³
CEMENT CONTENT	CEMENT, FLYASH & SILICA = 7188			
	YIELD = 9.23			779 lb/ft³

WATER CEMENT RATIO

A. AGGREGATE FREE WATER (FREE MOISTURE FACTOR = % FREE MOISTURE DIVIDED BY 100. EG.: 5.5% = 0.055)

BATCH MASS -	$\left(\frac{\text{BATCH MASS}}{(1 + \text{FREE MOISTURE FACTOR})} \right) = \text{AGG. FREE WATER}$		W/C RATIO=	$\frac{\text{TOTAL FREE WATER (A+B+C)}}{\text{TOTAL CEMENT & FLYASH}}$
3/4" Round #1	17600	- (17600 / 1+ 0.0030) =	53	lb
#2		- (/ 1+) =		lb
#3		- (/ 1+) =		lb
FINE AGG (SAND) #4	10080	- (10080 / 1+ 0.0790) =	738	lb
		A. AGGREGATE FREE WATER TOTAL =	791	lb
<u>2049</u> lb	= <u>0.29</u> = W/C RATIO	B. WATER ADDED AT PLANT&JOBSITE =	1186	lb
<u>7188</u> lb		C. ADMIXTURES ADDED =	72	lb

<input type="checkbox"/> QUALITY CONTROL	<input type="checkbox"/> VERIFICATION		
CERTIFIED TECHNICIAN (PLEASE PRINT) AND CARD NUMBER	COMPANY NAME	SIGNATURE	DATE

INSERT TAB

**SECTION 4(B)
Small Quantity Schedule**

FIELD TESTED MATERIALS SMALL QUANTITY GUIDELINE

This Guideline defines a method for accepting relatively small quantities of field tested materials without following the normal Quality Control sampling and testing frequencies. These quantities are usually less than the subplot amounts shown in the Field Tested Materials Acceptance Guide.

The Contractor may request, in writing, that normal QC sampling and testing of materials be waived for the quantities listed in the table below. The written request should clearly identify the equipment and process proposed before commencement of the work.

The Project Manager has the option to waive normal QC sampling and testing on the basis of one or more of the following conditions, if the Contractor submits the appropriate documentation with their request. Aggregate Product Compliance testing or documentation (Section 4A) shall be included with the submitted request. All asphalt cement products require a certificate of compliance.

- (1) If similar material from the same source has been accepted for use on ODOT projects within the past two years, and was found satisfactory under the Department's QA Program. Include the QC test data with the request.
- (2) Provide a Quality Compliance Certificate verifying that the material conforms to the contract requirements.
- (3) Provide other information indicating, by what method or workmanship that the Contractor will assure that all the contract requirements will be met.
- (4) For Section 00330 (Earthwork) provide a minimum of one Deflection test (TM 158) per area, performed by a ODOT Certified Density Technician (CDT). The Contractor's written request must identify the distinct work areas that small quantity acceptance is requested.
- (5) For section 00440, Small Quantity usage is not allowed for Structural Items.
- (6) For Section 00745 (ACP, Statistical Acceptance), acceptance shall be based on 00745.17 or on QC and QA data for the same Mix Design used on other projects within the past 12 months.
- (7) For Sections 00495, 00510, 0A596, 0B596 and 0C596 Small Quantity usage only applies to Quality Control Testing and sampling during Aggregate Production.

The Project Manager will report the basis of acceptance for the materials used in the project documents, including references to the appropriate test results and attachments.

See next page for Small Quantity Table.

Small Quantity Table

Section	Type of Material	Approximate Quantity
00330	Earthwork (Embankment)	500 yd ³
00330	Earthwork (Excavation)	500 yd ²
00390	RipRap	100 yd ³
00405	Ditch & Trench Excavation, Bedding and Backfill	50 yd ³
00440	Commercial Grade Concrete (Non-Structural Items)	50 yd ³
00495	Trench Resurfacing	500 Ton
00510	Structure Excavation and Backfill	500 Ton
0A596, 0B596 & 0C596	Retaining Walls	500 Ton
00641	Aggregate Sub-base, Base & Shoulders	2000 Ton
00680	Stockpiled Aggregate	2000 yd ³
00730	Asphalt Tack Coat	50 Ton
00735	Emulsified Asphalt Concrete Pavement (includes asphalt cement)	2500 Ton
00745	Asphalt Concrete Pavement (Statistical Acceptance) (ACP-each Level) (includes asphalt cement).	2500 Ton

INSERT TAB

**SECTION 4(D)
Field Tested Materials
Guide**

FIELD TESTED MATERIALS ACCEPTANCE GUIDE				(Revised November 2022)				Same Frequency for all Tests (Minimums)			
MATERIAL AND OPERATION	DESCRIPTION OF TEST	TEST METHOD			FORM 734-	QUALITY ASSURANCE					
		ODOT	WAQTC	AASHTO		Contractor Quality Control	Project Manager	Region Quality Assurance	Materials Laboratory		
SECTION 00330 - EARTHWORK											
Establishing Maximum Density (for Compaction)	Density Curve			T 99	3468						
	Specific Gravity of Coarse Aggregates			T 85	3468		1/Soil type			1/Project	
	Family of Curves			R 75	3468FC						
	Deflection Testing	TM 158			1793S		1 test per 3 ft. in depth				1 test per 10 QC Tests per Table 00330-1
Compaction	Nuclear Density Soils/Aggregates			T 310	1793S						
	Coarse Particle Correction			T 99			See Table 00330-1 Below				
	Deflection Testing	TM 158			1793S						
TABLE 00330-1 Frequency of Quality Control Testing (English)											
Individual Areas		Under 3500 yd² or yd³				Over 3500 yd² or yd³					
Existing Ground Surface		1 test per 1000 yd ²				1 test per 3000 yd ²					
Embankments		1 test per 500 yd ³				1 test per 3000 yd ³					
Excavations and Finished Subgrade		1 test per 1000 yd ²				1 test per 3000 yd ²					
Stone Embankment Material (See Sec. 330.16(a))	Gradation							Visual			
	Deflection Testing	TM 158			1793S		1 per Layer	See Section 00330.16(b)			
Contractor must demonstrate, by compaction testing or acceptable visual means, that the material, equipment, and process used for compaction achieves the specification requirements. If the material, equipment, or process changes, or if other conditions indicate a non-specification product, the Contractor must re-demonstrate that specification requirements are being achieved.											
Imported Topsoil (See Section 01040.14(b))	Compliance	See Section 4C				4000		Submit to Lab			
		1/Source & 1/Type of Soil									

FIELD TESTED MATERIALS ACCEPTANCE GUIDE					(Revised November 2022)			Same Frequency for all Tests (Minimums)		
MATERIAL AND OPERATION	DESCRIPTION OF TEST	TEST METHOD			FORM 734-	Contractor Quality Control	QUALITY ASSURANCE			
		ODOT	WAQTC	AASHTO			Independent Assurance/Verification	Project Manager	Region Quality Assurance	Materials Laboratory
SECTION 00331 - SUBGRADE STABILIZATION Aggregate backfill										
		Material must meet the requirements of Section 00331.10				Visual				
	Water	Material must meet the requirements of Section 00340								
Compaction		Material must meet the requirements of Section 00331				Visual				
SECTION 00332 - SURFACING STABILIZATION Aggregate Base		Material must meet the requirements of Section 00332.10				Visual				
	Compaction	Material must meet the requirements of Section 00332				Visual				
SECTION 00333 - AGGREGATE DITCH LINING Aggregate	Sampling Aggregates Reducing Aggregates Sieve Analysis	R 90 R 76 T 27/T 11				1/Project or 1/Source				

FIELD TESTED MATERIALS ACCEPTANCE GUIDE				(Revised November 2022)				Same Frequency for all Tests (Minimums)				
MATERIAL AND OPERATION	DESCRIPTION OF TEST	TEST METHOD			FORM 734-	QUALITY ASSURANCE						
		ODOT	WAQTC	AASHTO		Contractor Quality Control	Independent Project Manager	Region Quality Assurance	Materials Laboratory			
SECTION 00344 - TREATED SUBGRADE												
Granular Quicklime	Sieve Analysis Calcium Hydroxide Content in lime			T 27 T 219	4000	1/Project or 1/Source	Submit to Lab			1/Project or 1/Source		
Hydrated Lime Calcium Chloride Sodium Chloride	Materials must meet the requirements of Section 00344.10 and Test Results Certificate provided according to Section 00165.35(a)											
Portland Cement	Material must meet the requirements of Section 02010											
Water	Material must meet the requirements of Section 00340											
Establishing Maximum Density	Density Curve			T 99	3468	See Table 00344-1 Below for Testing Frequency					1/Project and 1 Test per 10 QC tests per Table 00344-1	
	Deflection Testing	TM 158			1793S							
Compaction	Deflection Testing Nuclear Density Soils/Aggregates	TM 158		T 310	1793S							
	Coarse Particle Correction			T 99								
TABLE 00344-1 Frequency of Quality Control Testing												
Individual Areas												
Finished Subgrade												
						Under 3500 yd ²			Over 3500 yd ²			
						1 test per 1000 yd ²			1 test per 3000 yd ²			

FIELD TESTED MATERIALS ACCEPTANCE GUIDE				(Revised November 2022)		Same Frequency for all Tests (Minimums)			
MATERIAL AND OPERATION	DESCRIPTION OF TEST	TEST METHOD		FORM 734-	Contractor Quality Control	QUALITY ASSURANCE			
		ODOT	WAQTC			AASHTO	Project Manager	Region Quality Assurance	Materials Laboratory
SECTION 00360 - Drainage Blankets									
Granular Drainage Blanket	Sampling Aggregates Reducing Aggregates Sieve Analysis	R 90 R 76 T 27/T 11		1792	1/sublot minimum 1/Source per Project	A sublot equals 1000 Tons			
Sand Drainage Blanket	Sampling Aggregates Reducing Aggregates Sieve Analysis	R 90 R 76 T 27/T 11		1792					
Establishing Maximum Density	Density Curve	T 99		3468	1/Source and Type			1/Project	
Compaction	Specific Gravity of Coarse Aggregates	T 85		3468					
	Deflection Testing	TM 158		1793S	1 test per 3 ft. in depth				
	Deflection Testing Nuclear Density Soils/Aggregates Coarse Particle Correction	TM 158		1793S	See Table 00360-1 Below			1 Test per 10 QC Tests per Table 00360-1	
TABLE 00360-1 Frequency of Quality Control Testing									
Individual Areas				Under 3500 yd²		Over 3500 yd²			
Existing Ground Surface				1 test per 1000 yd ²		1 test per 3000 yd ²			
Finished Surfaces				1 test per 1000 yd ²		1 test per 3000 yd ²			

FIELD TESTED MATERIALS ACCEPTANCE GUIDE				(Revised November 2022)				Same Frequency for all Tests (Minimums)			
MATERIAL AND OPERATION	DESCRIPTION OF TEST	TEST METHOD			FORM 734-	QUALITY ASSURANCE					
		ODOT	WAQTC	AASHTO		Contractor Quality Control	Independent Project Manager	Region Quality Assurance	Materials Laboratory		
SECTION 00390 - RIPRAP PROTECTION											
Fill Material & Riprap											
Gradation See 00390.11(c-1)								Visual			
⁽¹⁾ Apparent Specific Gravity and Absorption	Degradation Soundness Specific Gravity of Coarse Aggregates	TM 208			T 104	See Section 4(A)	Submit To Lab				See Section 4(A)
					⁽¹⁾ T 85						
Filter Blanket								Visual			
Gradation See 00390.13											
Grouted Riprap Sand	Sampling Aggregates Reducing Aggregates Sieve Analysis				R 90 R 76 T 27/T 11	1/Project					
					T 104 T 113						
Portland Cement	Soundness Lightweight Pieces				4000	See Section 4(A)	Submit to Lab				See Section 4(A)
					Material must meet the requirements of Section 02010						

FIELD TESTED MATERIALS ACCEPTANCE GUIDE				(Revised November 2022)				Same Frequency for all Tests (Minimums)			
MATERIAL AND OPERATION	DESCRIPTION OF TEST	TEST METHOD			FORM 734-	QUALITY ASSURANCE					
		ODOT	WAQTC	AASHTO		Contractor Quality Control	Project Manager	Region Quality Assurance	Materials Laboratory		
SECTION 00396 -SHOTCRETE SLOPE STABILIZATION											
Aggregate Production and Mixture											
(1) QAE may waive after 5 sublots/shifts	Sampling Aggregates					R 90					
	Reducing Aggregates					R 76					
(2) Coarse Aggregate (See Section 02690.20)	(2)(3) Sieve Analysis				1792	T 27/T 11					
	(3) Fineness Modulus					T 27/T 11					
	(1)(2) Wood Particles	TM 225									
(3) Fine Aggregate (See Section 02690.30)	(3) Sand Equivalent					T 176					
	Soundness					T 104					
(3) Fine Aggregate (See Section 02690.30)	Abrasion				4000	T 96					
	Degradation	TM 208				T 113					
	Lightweight Pieces					T 21					
	Organics										
Portland Cement Admixtures	(2) Dry Rodded Unit Weight					T 19					
	(2) Specific Gravity of Coarse Aggregate					T 85					
	(3) Specific Gravity of Fine Aggregate					T 84					
Mixing Water	Material must meet the requirements of Section 02010										
	Material must meet the requirements of Section 02040										
	Material must meet the requirements of Section 02020										
Production Testing (See Section 00396.14)	(5) Test Panel										
	(5) 3 Cores minimum per Panel										
Compression Test Cores	Strength					T 22					

FIELD TESTED MATERIALS ACCEPTANCE GUIDE					(Revised November 2022)			Same Frequency for all Tests (Minimums)		
MATERIAL AND OPERATION	DESCRIPTION OF TEST	TEST METHOD			FORM 734-	Contractor Quality Control	QUALITY ASSURANCE			
		ODOT	WAQTC	AASHTO			Project Manager	Region Quality Assurance	Materials Laboratory	
SECTION 00405 - TRENCH EXCAVATION, BEDDING, AND BACKFILL										
TRENCH FOUNDATION (Excavation Below Grade Only) (See Section 405.44)										
Selected general backfill								Visual		
Selected granular backfill								Visual		
Selected stone backfill								Visual		
Other approved material								Visual		
Establishing Maximum Density	Density Curve			T 99	3468					
	Specific Gravity of Coarse Aggregates			T 85	3468		1/Soil Type or Aggregate Gradation			
	Family of Curves			R 75	3468FC					
	Nuclear Density Soils/Aggregates Coarse Particle Correction			T 310 T 99	1793S		1 Test per 300 ft. of Trench			
<p>Contractor must demonstrate, by compaction testing or acceptable visual means, that the material, equipment, and process used for compaction achieves the specification requirements. If the material, equipment, or process changes, or if other conditions indicate a non-specification product, the Contractor must re-demonstrate that specification requirements are being achieved.</p>										

FIELD TESTED MATERIALS ACCEPTANCE GUIDE					(Revised November 2022)			Same Frequency for all Tests (Minimums)					
MATERIAL AND OPERATION	DESCRIPTION OF TEST	TEST METHOD			FORM 734-	QUALITY ASSURANCE			Contractor Quality Control	Independent Assurance/Verification	Region Quality Assurance	Project Manager	Materials Laboratory
		ODOT	WAQTC	AASHTO		Project Manager	Region Quality Assurance						
SECTION 00405 - TRENCH EXCAVATION, BEDDING, AND BACKFILL (CONTINUED)													
Bedding 3/8" - 0	Sampling Aggregates Reducing Aggregates Sieve Analysis				R 90 R 76 T 27/T 11	1792	1/Source or Aggregate Gradation						
PCC fine aggregate (See Section 02690.30(h))													
Commercial 3/4" - 0 Aggregate									Visual				
No. 10 - 0 Sand drainage blanket material (See Section 00360.10)	Sampling Aggregates Reducing Aggregates Sieve Analysis				R 90 R 76 T 27/T 11	1792	1/Source or Aggregate Gradation						
Reasonably well graded sand, maximum 3/8" to dust													
Commercial available 3/8"-0 or No.10 - 0 sand									Visual				
Continuous cradle of Commercial Grade Concrete	Material must meet the requirements of Section 00440												

FIELD TESTED MATERIALS ACCEPTANCE GUIDE					(Revised November 2022)			Same Frequency for all Tests (Minimums)			
MATERIAL AND OPERATION	DESCRIPTION OF TEST	TEST METHOD			FORM 734-1792	Contractor Quality Control	QUALITY ASSURANCE				
		ODOT	WAQTC	AASHTO			Project Manager	Region Quality Assurance	Materials Laboratory		
SECTION 00405 - TRENCH EXCAVATION, BEDDING, AND BACKFILL (CONTINUED)											
Pipe Zone Material Flexible Pipe		Use the Listed Material requirements under Bedding									
Rigid Pipe: Aggregate Base 1" - 0 or 3/4" - 0 Aggregate (See Section 02630.10)	Sampling Aggregates			R 90		1/Source or Gradation					
	Reducing Aggregates Sieve Analysis			R 76 T 27	1792						
Rigid Pipe: Commercial 1" - 0 or 3/4" - 0 Aggregate							Visual				
Establishing Maximum Density (Flexible and Rigid Pipe)	Density Curve			(1) T 99	3468	1/Source or Aggregate Gradation					
	Specific Gravity of Coarse Aggregates			T 85							
	Coarse Particle Correction			(1) T 99	3468						
Compaction	Nuclear Density Soils/Aggregates			T 310	1793B	1 Test per 300 ft. of Trench and every 1.5 ft. of Fill					
<p>Contractor must demonstrate, by compaction testing or acceptable visual means, that the material, equipment, and process used for compaction achieves the specification requirements. If the material, equipment, or process changes, or if other conditions indicate a non-specification product, the Contractor must re-demonstrate that specification requirements are being achieved.</p>											

FIELD TESTED MATERIALS ACCEPTANCE GUIDE					(Revised November 2022)			Same Frequency for all Tests (Minimums)					
MATERIAL AND OPERATION	DESCRIPTION OF TEST	TEST METHOD			FORM 734-	Contractor Quality Control	QUALITY ASSURANCE						
		ODOT	WAQTC	AASHTO			Project Manager	Region Quality Assurance	Materials Laboratory				
SECTION 00405 - TRENCH EXCAVATION, BEDDING, AND BACKFILL (CONTINUED)													
Trench Backfill													
Class A Backfill - Native or common Material		Material must meet the requirements of Section 00330.43											
Class B Backfill - 1"-0 or 3/4"-0 Granular Material		Material must meet the requirements of Section 00641											
Class C Backfill - Clean sand with 100% minus 1/4" material								Visual					
Class D Backfill - Pit run or bar run material with 3" maximum dimension and well graded from coarse to fine								Visual					
Class E Backfill - Controlled Low Strength Material (CLSM)		Material must meet the requirements of Section 00442											
Establishing Maximum Density (1) Method "A" & ODOT TM 223 for Dense Graded Base Aggregate	Density Curve				(1) T 99	3468							
	Specific Gravity of Coarse Aggregates				T 85	3468			1/Soil Type or Aggregate Gradation				
	Family of Curves				R 75	3468FC							
Compaction (C) Density testing is based on cumulative lineal feet of pipe placement.	Nuclear Density Soils/Aggregates				T 310	1793S or 1793B			(C) 1 test per 300 ft. of Trench and every 1.5 ft. of Fill				
	Coarse Particle Correction				T 99								
Contractor must demonstrate, by compaction testing or acceptable visual means, that the material, equipment, and process used for compaction achieves the specification requirements. If the material, equipment, or process changes, or if other conditions indicate a non-specification product, the Contractor must re-demonstrate that specification requirements are being achieved.													

FIELD TESTED MATERIALS ACCEPTANCE GUIDE				(Revised November 2022)			Same Frequency for all Tests (Minimums)		
MATERIAL AND OPERATION	DESCRIPTION OF TEST	TEST METHOD			FORM 734-734-	QUALITY ASSURANCE			
		ODOT	WAQTC	AASHTO		Contractor Quality Control	Independent Assurance/Verification	Region Quality Assurance	Materials Laboratory
SECTION 00430 - SUBSURFACE DRAINS									
Granular Drain Backfill Material									
	Sampling Aggregates			R 90					
	Reducing Aggregates			R 76					
	Sieve Analysis			T 27	1792				
	Abrasion Degradation	TM 208		T 96	4000		Submit To Lab		See Section 4A
Special Filter Material See Section 00430.46(a)	Compaction								
SECTION 00440 - COMMERCIAL GRADE CONCRETE									
Mixture	Sampling Concrete		TM 2						
	Air Content of Concrete			T 152					
	Density (Unit Weight) of Concrete			T 121	3573WS or 4000 C			(S) 1 per each set of cylinders	
	Yield			T 121					
	Slump of Concrete			T 119					
Concrete Temperature			T 309						
Modifiers									
Admixtures									
Portland Cement									
Structural Items									
Except Visual Acceptance Items (See section 00440.14(a))				R 100	4000C			(M)(S) 1 Set Per Day Minimum	
				T 22					
(S) 1 Set Represents a Minimum of 3 Cylinders				R 100	4000C			(M) (S) 1 Set/20 yd ³ Cumulative (Maximum 1 Set/day)	
				T 22					
(M) Per Mix Design & Source									

FIELD TESTED MATERIALS ACCEPTANCE GUIDE					(Revised November 2022)			Same Frequency for all Tests (Minimums)		
MATERIAL AND OPERATION	DESCRIPTION OF TEST	TEST METHOD			FORM 734-	Contractor Quality Control	QUALITY ASSURANCE			
		ODOT	WAQTC	AASHTO			Independent Assurance/Verification	Project Manager	Region Quality Assurance	Materials Laboratory
SECTION 00442 - CONTROLLED LOW STRENGTH MATERIALS (CLSM)										
CLSM Mixture	Mix Proportions					1/Project or Source				
	Trial Batch									
	Fabrication of Concrete			R 100						
	Cylinders/Beams			T 22	4000C					
Compressive Strength of Concrete										
Modifiers										
Admixtures										
Portland Cement										
SECTION 00445 - SANITARY, STORM, CULVERT, SIPHON, AND IRRIGATION PIPE - INCLUDED WITH SECTION 00405										
Trench Work										
Excavation, bedding, pipe zone and trench backfill										
Excavation, bedding, pipe zone and trench backfill										
Concrete Blocks										

FIELD TESTED MATERIALS ACCEPTANCE GUIDE				(Revised November 2022)				Same Frequency for all Tests (Minimums)		
MATERIAL AND OPERATION	DESCRIPTION OF TEST	TEST METHOD			FORM 734-	QUALITY ASSURANCE				
		ODOT	WAQTC	AASHTO		Contractor Quality Control	Independent Assurance/Verification	Region Quality Assurance	Project Manager	Materials Laboratory
SECTION 00450 - STRUCTURAL PLATE SHAPED STRUCTURES										
Commercial Grade Concrete in appurtenances		<i>Material must meet the requirements of Section 00440</i>								
Trench Work										
Excavation and Backfill		<i>Operations must meet the requirements of Section 00510</i>								
Trenches in Unstable Areas										
Granular Structural Backfill		<i>Material must meet the requirements of Section 00510</i>								
<i>Establishing Maximum Density</i>					(¹) T 99					
⁽¹⁾ Method "A" & ODOT TM 223 for Dense Graded Base Aggregate	Density Curve				T 85			1/Aggregate Gradation and Source		
	Specific Gravity of Coarse Aggregates Coarse Particle Correction	TM 223								
Compaction	Nuclear Density of Soils/Aggregates				T 310			1 Test per 100 ft. and 1 ft. of fill		
Structure Backfill (Section 00450.46)		<i>Material and Operation must meet the requirements of Section 00510.48(d)</i>								
SECTION 00459 - CAST IN PLACE CONCRETE										
Concrete		<i>Material must meet the requirements of Section 00540, with acceptance in accordance with Section 00540.17</i>								
Backfill Material		<i>Material must meet the requirements of Section 00405.14 and be incorporated into the project in accordance with Section 00405.46</i>								

FIELD TESTED MATERIALS ACCEPTANCE GUIDE				(Revised November 2022)			Same Frequency for all Tests (Minimums)		
MATERIAL AND OPERATION	DESCRIPTION OF TEST	TEST METHOD			FORM 734-	Contractor Quality Control	QUALITY ASSURANCE		
		ODOT	WAQTC	AASHTO			Independent Assurance/Verification	Region Quality Assurance	Materials Laboratory
SECTION 00460 - PAVED CULVERT END SLOPES									
Commercial Grade Concrete	<i>Material must meet the requirements of Section 00440</i>								
SECTION 00470 - MANHOLES, CATCH BASINS AND INLETS									
Commercial Grade Concrete	<i>Material must meet the requirements of Section 00440</i>								
Base Drain Backfill	<i>Material must meet the requirements of Section 00470.17</i>								
Excavation, Backfill and Foundation Stabilization	<i>Material must meet the requirements of Section 00405</i>								
SECTION 00480 - DRAINAGE CURBS									
Commercial Grade Concrete	<i>Material must meet the requirements of Section 00440</i>								
Dense Graded ACP Mixture	<i>Material must meet the requirements of Section 00740</i>								

FIELD TESTED MATERIALS ACCEPTANCE GUIDE				(Revised November 2022)		Same Frequency for all Tests (Minimums)			
MATERIAL AND OPERATION	DESCRIPTION OF TEST	TEST METHOD			FORM 734-	Contractor Quality Control	QUALITY ASSURANCE		
		ODOT	WAQTC	AASHTO			Independent Assurance/Verification	Project Manager	Region Quality Assurance
SECTION 00490 - WORK ON EXISTING SEWERS AND STRUCTURES									
Commercial Grade Concrete		<i>Material must meet the requirements of Section 00440</i>							
High Early Strength Concrete		<i>Material must meet the requirements of Section 00440, but cement contents adjusted according to 00490.11</i>							
Backfill Operations		<i>Backfill Excavations according to section 405</i>							
Filling Abandoned Pipes, Manholes and Catch Basins (See section 00490.44)									
Backfill Operations (Roadway)		<i>Material must meet the requirements of Section 2630</i>							
Establishing Maximum Density (¹) Method "A" & ODOT TM 223 for Dense Graded Base Aggregate	Density Curve				(¹) T 99				
	Specific Gravity of Coarse Aggregates Coarse Particle Correction			TM 223	T 85		1/Aggregate Gradation and Source		
Compaction	Nuclear Density of Soils/Aggregates				T 310		1 Test per 100 ft. and every 1.5' of Fill		
Backfill Operations Landscaped or Unimproved Roadways		<i>Material must meet the requirements of Section 00330.13</i>							
Top 1.0' of Backfill Region		<i>Material must meet the requirements of Section 00330.11</i>							
SECTION 00495 - TRENCH RESURFACING									
Resurfacing Materials		<i>See Section 00495.40 for Material Requirements</i>							

FIELD TESTED MATERIALS ACCEPTANCE GUIDE				(Revised November 2022)			Same Frequency for all Tests (Minimums)		
MATERIAL AND OPERATION	DESCRIPTION OF TEST	TEST METHOD		FORM 734-	QUALITY ASSURANCE				
		ODOT	WAQTC		AASHTO	Contractor Quality Control	Independent Assurance/Verification	Region Quality Assurance	Materials Laboratory
SECTION 00510 - STRUCTURE EXCAVATION AND BACKFILL									
Soils, Soil/Aggregate Mixtures and Graded Aggregates									
Granular Structure Backfill (See Section 02630.10) (1) Perform a minimum of 3 tests QL's required	Sampling Aggregates								
	Reducing Aggregates				R 90 R 76 T 27				
	(1) Sieve Analysis Fracture (Method 1) Sand Equivalent				T 335 T 176		1/Sublot (Minimum 1/Project)		
Product Compliance	Abrasion Degradation Plasticity Index Sieve Analysis	TM 208			T 96 T 90 T 11		See Section 4C 1/Source	Submit to Lab	Minimum 1/Project or 1/Source
Establishing Maximum Density	Density Curve				(2) T 99		1/Soil type or Aggregate Gradation		
(2) Method "A" & ODOT TM 223 for Dense Graded Base Aggregate	Specific Gravity of Coarse Aggregates				T 85				
	Coarse Particle Correction				T 99				
Compaction	Nuclear Density Soils/Aggregates				T 310				
							1/100 yd ³ minimum 1/project		
<p>Contractor must demonstrate, by compaction testing or acceptable visual means, that the material, equipment, and process used for compaction achieves the specification requirements. If the material, equipment, or process changes, or if other conditions indicate a non-specification product, the Contractor must re-demonstrate that specification requirements are being achieved.</p>									

FIELD TESTED MATERIALS ACCEPTANCE GUIDE				(Revised November 2022)		Same Frequency for all Tests (Minimums)		
MATERIAL AND OPERATION	DESCRIPTION OF TEST	TEST METHOD		FORM 734-	QUALITY ASSURANCE			
		ODOT	WAQTC		AASHTO	Contractor Quality Control	Independent Assurance/Verification	Region Quality Assurance
SECTION 00510 - STRUCTURE EXCAVATION AND BACKFILL (CONTINUED)								
Soils, Soil/Aggregate Mixtures and Graded Aggregates								
Granular Wall Backfill (See Section 02630.11) (1) Perform a minimum of 3 tests QL's required	Sampling Aggregates Reducing Aggregates (1) Sieve Analysis Fracture (Method 2)							
					1/Sublot (Minimum 1/Project)			
Product Compliance	Abrasion Degradation	TM 208			See Section 4C 1/Source	Submit to Lab		Minimum 1/Project or 1/Source
(2) Compaction	(2) Deflection Testing	TM 158			1/Sublot (Minimum 1/Project)			
Note: Compaction must meet the requirements of section 00330.43c								
Contractor must demonstrate, by compaction testing or acceptable visual means, that the material, equipment, and process used for compaction achieves the specification requirements. If the material, equipment, or process changes, or if other conditions indicate a non-specification product, the Contractor must re-demonstrate that specification requirements are being achieved.								

FIELD TESTED MATERIALS ACCEPTANCE GUIDE				(Revised November 2022)				Same Frequency for all Tests (Minimums)				
MATERIAL AND OPERATION	DESCRIPTION OF TEST	TEST METHOD			FORM 734-734-	QUALITY ASSURANCE						
		ODOT	WAQTC	AASHTO		Contractor Quality Control	Project Manager	Region Quality Assurance	Materials Laboratory			
SECTION 00512 - DRILLED SHAFTS												
Aggregate Production												
<p>(1) QAE may waive after 5 sublots/shifts</p> <p>(2) Perform a minimum of 3 tests, QL's required</p> <p>(3) Coarse Aggregate (See Section 02690.20)</p> <p>(4) Fine Aggregate (See Section 02690.30)</p>	Sampling Aggregates											
	Reducing Aggregates											
	(2)(3)(4) Sieve Analysis				1792	R 90 R 76 T 27/T 11 T 27/T 11						
	(4) Fineness Modulus				1792	T 176						
	(1)(3) Wood Particles	TM 225										
	(4) Sand Equivalent											
	Soundness				4000	T 104 T 96						
	Abrasion				4000	T 113 T 21						
	Degradation	TM 208										
	Lightweight Pieces											
Organics												
(3) Dry Rodded Unit Weight					1825 1825C	T 19						
(3) Specific Gravity of Coarse Aggregate					1825	T 85						
(4) Specific Gravity of Fine Aggregate						T 84						
Portland Cement												
Modifiers												
Admixtures												
Drilling Slurry												
Grout												
Mixing Water												

FIELD TESTED MATERIALS ACCEPTANCE GUIDE				(Revised November 2022)			Same Frequency for all Tests (Minimums)		
MATERIAL AND OPERATION	DESCRIPTION OF TEST	TEST METHOD			FORM 734-	QUALITY ASSURANCE			
		ODOT	ASTM	AASHTO		Contractor Quality Control	Project Manager	Region Quality Assurance	Materials Laboratory
SECTION 00535 - POST-INSTALLED ANCHOR SYSTEMS									
Resin Bonded Anchor System									
Anchor Bolts, reinforcing steel and resin (Polyester, vinyl ester or epoxy)									
<i>Materials must meet the requirements of Section 00535.10(a)</i>									
Anchor Installation									
Demonstration Testing (See Section 00535.45(a))	Strength of Anchors in Concrete Elements	E 488			5189	One demonstration Test includes 3 anchors (Resin shall be from same lot)	Visual		
Production Testing (See Section 00535.45(b))	Strength of Anchors in Concrete Elements	E 488			5189	^(A) 1 Anchor/Sublot or portion thereof (Minimum 1/Shift)	Visual per Sublot		
^(A) Anchor testing is required per critical element identified in the Special Provisions or Plan Drawings.									

FIELD TESTED MATERIALS ACCEPTANCE GUIDE				(Revised November 2022)		Same Frequency for all Tests (Minimums)		
MATERIAL AND OPERATION	DESCRIPTION OF TEST	TEST METHOD		FORM 734-	Contractor Quality Control	QUALITY ASSURANCE		
		ODOT	ASTM			AASHTO	Project Manager	Region Quality Assurance
SECTION 00535 - POST-INSTALLED ANCHOR SYSTEMS (continued)								
Mechanical Anchor System								
Mechanical Anchors		Materials must meet the requirements of Section 00535.10(b)			A Sublot equals 50 Anchors			
Anchor Installation								
Demonstration Testing (See Section 00535.45(a))	Strength of Anchors in Concrete Elements	E 488		5292	One demonstration Test includes 3 anchors	Visual		
Production Testing (See Section 00535.45(b))	Strength of Anchors in Concrete Elements	E 488		5292	(A) 1 Anchor/Sublot or portion thereof (Minimum 1/Shift)	Visual per Sublot		
(A) Anchor testing is required per critical element identified in the Special Provisions or Plan Drawings.								

FIELD TESTED MATERIALS ACCEPTANCE GUIDE				(Revised November 2022)				Same Frequency for all Tests (Minimums)			
MATERIAL AND OPERATION	DESCRIPTION OF TEST	TEST METHOD			FORM 734-	QUALITY ASSURANCE					
		ODOT	WAQTC	AASHTO		Contractor Quality Control	Project Manager	Region Quality Assurance	Materials Laboratory		
SECTION 00540 - STRUCTURAL CONCRETE											
Aggregate Production											
(1) QAE may waive after 5 sublots/shifts	Sampling Aggregates			R 90							
	Reducing Aggregates			R 76	1792						
	(2)(3)(4) Sieve Analysis			T 27/T 11 T 27/T 11					1 per 10 Sublots		
(2) Perform a minimum of 3 tests, QL's required	(4) Fineness Modulus			T 176	1792						
	(1)(3) Wood Particles	TM 225									
(3) Coarse Aggregate (See Section 02690.20)	(4) Sand Equivalent										
	Soundness			T 104	4000						
(4) Fine Aggregate (See Section 02690.30)	Abrasion			T 96							
	Degradation	TM 208									
	Lightweight Pieces			T 113	4000						
	Organics			T 21							
	(3) Dry Rodded Unit Weight			T 19	1825						
	(3) Specific Gravity of Coarse Aggregate			T 85	1825C						
	(4) Specific Gravity of Fine Aggregate			T 84	1825						
Portland Cement											
Modifiers											
Admixtures											
Mixing Water											
Materials must meet the requirements of Section 02001.10											
Material must meet the requirements of Section 02020											
See Section 4A											

FIELD TESTED MATERIALS ACCEPTANCE GUIDE				(Revised November 2022)		Same Frequency for all Tests (Minimums)												
MATERIAL AND OPERATION	DESCRIPTION OF TEST	TEST METHOD		FORM 734-	QUALITY ASSURANCE													
		ODOT	WAQTC		AASHTO	Contractor Quality Control	Project Manager	Region Quality Assurance	Materials Laboratory									
SECTION 00540 - STRUCTURAL CONCRETE (CONTINUED)																		
Portland Cement Concrete																		
⁽¹⁾ AASHTO T 196 required for lightweight concrete	Sampling Concrete		TM 2															
	⁽¹⁾ Air Content of Concrete			T 152														
	Slump of Concrete			T 119														
	Concrete Temperature			T 309														
	Density (Unit Weight) of Concrete			T 121														
	Yield			T 121														
	Water/Cement Ratio			T 121														
	Fabrication of Concrete			R 100														
	Cylinders/Beams			T 22														
	Compressive Strength of Concrete																	
^(S) 1 Set Represents a minimum of 3 Cylinders																		
^(M) Per Mix Design & Source																		
<p>TABLE 00540-1 Frequency of Quality Control Testing</p> <p>Minimum frequencies per Class of concrete based on Daily Production Records.</p> <table border="1"> <thead> <tr> <th>Production</th> <th>Frequencies</th> </tr> </thead> <tbody> <tr> <td>0 to 100 yd³ on a single day</td> <td>1 Set each day</td> </tr> <tr> <td>Quantity Over 100 yd³</td> <td></td> </tr> <tr> <td>100 to 600 yd³ on a single day</td> <td>1 Set per each 100 yd³ or portion thereof</td> </tr> <tr> <td>over 600 yd³ on a single day</td> <td>1 Set per each 200 yd³ or portion thereof after reaching 600 yd³</td> </tr> </tbody> </table>									Production	Frequencies	0 to 100 yd ³ on a single day	1 Set each day	Quantity Over 100 yd³		100 to 600 yd ³ on a single day	1 Set per each 100 yd ³ or portion thereof	over 600 yd ³ on a single day	1 Set per each 200 yd ³ or portion thereof after reaching 600 yd ³
Production	Frequencies																	
0 to 100 yd ³ on a single day	1 Set each day																	
Quantity Over 100 yd³																		
100 to 600 yd ³ on a single day	1 Set per each 100 yd ³ or portion thereof																	
over 600 yd ³ on a single day	1 Set per each 200 yd ³ or portion thereof after reaching 600 yd ³																	

FIELD TESTED MATERIALS ACCEPTANCE GUIDE				(Revised November 2022)			Same Frequency for all Tests (Minimums)		
MATERIAL AND OPERATION	DESCRIPTION OF TEST	TEST METHOD			FORM 734-734-	Contractor Quality Control	QUALITY ASSURANCE		Materials Laboratory
		ODOT	WAQTC	AASHTO			Project Manager	Region Quality Assurance	
SECTION 00556 - MULTI-LAYER POLYMER CONCRETE OVERLAY									
Aggregate Production	Moisture Content of Aggregate & Soil			T 255/265	1792	At time of mixing the polymer resin. See 00556.10-b			
Polymer Resin	Material must meet the requirements of section 00556.10								

FIELD TESTED MATERIALS ACCEPTANCE GUIDE				Same Frequency for all Tests (Minimums)			
MATERIAL AND OPERATION	DESCRIPTION OF TEST	TEST METHOD		FORM 734-	Contractor Quality Control	QUALITY ASSURANCE	
		ODOT	WAQTC			AASHTO	Independent Assurance/Verification
SECTION 00557 - PREMIXED POLYMER CONCRETE OVERLAYS							
Resin Primer	Material must meet the requirements of section 00557.10						
Polyester Resin Binder Including (Initiator, Accelerators & Inhibitors)	Material must meet the requirements of section 00557.12 (a-c)						
Aggregate Production Product Compliance	Specific Gravity of Coarse Aggregate			T 85	1/Project and Source	Submit to Lab	See Section 00557.12(d)
	Specific Gravity of Fine Aggregate			T 84			
(Submit 2- 50 lb. samples of blended aggregate	Sieve Analysis			T 27/11			
(00557.02) during the trial overlay)	Moisture Content of Aggregate & Soil Fracture (Method 1)			T 255/265			
	Moisture Content of Aggregate & Soils Sieve Analysis			T 27/11	During the Trial Overlay Strip		
(¹) See Section 00557.12(d)	(¹) Moisture Content of Aggregate & Soils			T 255/265	During Production		
Surface Texture Sand (see section 00557.12(e))	Sieve Analysis			T 27/11	1/Project and Source		
Premixed Polymer Concrete	Density (Unit Weight) of Concrete			T 121	(^B) 1/Batch		
	Static Modulus of Elasticity		TM 759		(^M) Minimum 1 set/batch		
(^M) 1 set Represents a minimum of 3 (4"x8") cylinders cast per 00557.44(e)				4000C	1 set per 10 batches placed or minimum 1 set/day	Submit to Lab	See section 00557.44(e)
(^B) Batch is defined "Per Mixer or Portion placed".							

FIELD TESTED MATERIALS ACCEPTANCE GUIDE				(Revised November 2022)			Same Frequency for all Tests (Minimums)					
MATERIAL AND OPERATION	DESCRIPTION OF TEST	TEST METHOD			FORM 734-	QUALITY ASSURANCE						
		ODOT	WAQTC	AASHTO		Contractor Quality Control	Independent Assurance/Verification	Project Manager	Region Quality Assurance	Materials Laboratory		
SECTION 00559 - STRUCTURAL CONCRETE OVERLAYS												
Aggregate Production												
(1) QAE may waive after 5 sublots/shifts	Sampling Aggregates Reducing Aggregates (2)(3)(4) Sieve Analysis				R 90 R 76 T 27/T 11	1792						
(2) Perform a minimum of 3 tests, QL's required	(4) Fineness Modulus (4) Sand Equivalent				T 27/T 11 T 176	1792						
(3) Coarse Aggregate (See Section 02690.20)	(1)(3) Elongated Piece (1)(3) Wood Particles	TM 229 TM 225				1792		1 per 10 Sublots				
(4) Fine Aggregate (See Section 02690.30)	Abrasion Degradation Soundness Lightweight Pieces Organics	TM 208			T 96 T 104 T 113 T 21	4000			Submit to Central Lab			See Section 4(A)
	(3) Dry Rodded Unit Weight				T 19	1825 1825C						
	(3) Specific Gravity of Coarse Aggregate (4) Specific Gravity of Fine Aggregate				T 85 T 84	1825						
Portland Cement Modifiers Admixtures	Materials must meet the requirements of Section 02001.10											
Mixing Water	Material must meet the requirements of Section 02020											

FIELD TESTED MATERIALS ACCEPTANCE GUIDE					(Revised November 2022)			Same Frequency for all Tests (Minimums)					
MATERIAL AND OPERATION	DESCRIPTION OF TEST	TEST METHOD			FORM 734-734-	QUALITY ASSURANCE			Materials Laboratory				
		ODOT	WAQTC	AASHTO		Contractor Quality Control	Project Manager	Region Quality Assurance					
SECTION 00559 - STRUCTURAL CONCRETE OVERLAYS (CONTINUED)													
Portland Cement Concrete											A subplot equals 1 set of tests per 50 yd3		
⁽¹⁾ AASHTO T 196 required for lightweight concrete	Sampling Concrete		TM 2	T 152	3573W S or 4000 C	1 / Sublot or Minimum 1 per Shift	1 per 10 Sublots						
	⁽¹⁾ Air Content of Concrete			T 119									
^(M) Per Mix Design & Source	Slump of Concrete			T 309		^{(M) (S)} 1 Set Cylinders per 50yd ³ Minimum 1 set/shift	1 Set per 500 yd ³						
	Concrete Temperature			T 121									
^(S) 1 Set Represents a minimum of 3 Cylinders	Density (Unit Weight) of Concrete			T 121									
	Yield			T 121									
	Water/Cement Ratio												
	Fabrication of Concrete			R 100									
Broadcast Aggregate	Cylinders/Beams			T 22									
	Compressive Strength of Concrete												
SECTION 00590 - POLYMER MEMBRANE													
Broadcast Aggregate	Moisture Content of Aggregates & Soils			T 255/265	1792	Test at time of packaging and shipment. See Section 00590.10-c							
	Moisture Content of Aggregates & Soils			T 255/265	1792	Field Test at time of Mixing Polymer Resin. See Section 00590.10-c							

FIELD TESTED MATERIALS ACCEPTANCE GUIDE				(Revised November 2022)		Same Frequency for all Tests (Minimums)														
MATERIAL AND OPERATION	DESCRIPTION OF TEST	TEST METHOD			FORM 734-734-	QUALITY ASSURANCE														
		ODOT	WAQTC	AASHTO		Contractor Quality Control	Project Manager	Region Quality Assurance	Materials Laboratory											
SECTION 00596A - MECHANICALLY STABILIZED EARTH RETAINING WALLS																				
Aggregate Production																				
Gravel Leveling Pads Backfill (See Section 02630.10)	Abrasion Degradation	TM 208		T 96	4000	See Section 4A	Submit to Lab	See Section 4A	See Section 4A	See Section 4A										
											A Sublot equals 1,000 Tons Minimum 1/Project									
											Sampling Aggregates Reducing Aggregates Sieve Analysis Un-washed Sand Equivalent Fracture (Method 1)	R 90	1/Sublot	1/5 Sublots	Testing Frequency for Product Compliance per Source 1/5,000 Tons Minimum 1/Project	4000	See Section 4C & 02690	Submit To Lab	See Section 4C	See Section 4C
												R 76								
												T 27								
⁽³⁾ Modular Block Core and Backfill (Product Compliance)	Soundness Abrasion Degradation Lightweight Pieces	TM 208		T 104 T 96 T 113	4000	See Section 4C & 02690	Submit To Lab	See Section 4C	See Section 4C											
⁽³⁾ (See Section 2690.20(a) thru 2690.20(d) & 2690.20(f))																				
A Sublot equals 1,000 Tons																				
⁽³⁾ Modular Block Core and Drainage Backfill ⁽¹⁾ QAE may waive after 5 sublots/shifts	Sampling Aggregates Reducing Aggregates ⁽²⁾ Sieve Analysis ⁽¹⁾ Wood Particles Fracture (Method 2) Elongated Pieces	TM 225 TM 229		R 90 R 76 T 27/T 11 T 335	1792 1792	1/Sublot														
											⁽²⁾ Perform a minimum of 3 tests, QL's required									
																				Pipe Drain Backfill (Product Compliance) (See Section 00430.11)
Pipe Drain Backfill (Product Compliance) (See Section 00430.11)	Abrasion Degradation Sieve Analysis Un-washed	TM 208		T 96 T 27	4000 4000	See Section 4C	Submit To Lab	See Section 4C	See Section 4C											

FIELD TESTED MATERIALS ACCEPTANCE GUIDE				(Revised November 2022)				Same Frequency for all Tests (Minimums)			
MATERIAL AND OPERATION	DESCRIPTION OF TEST	TEST METHOD			FORM 734-	QUALITY ASSURANCE					
		ODOT	WAQTC	AASHTO		Contractor Quality Control	Project Manager	Region Quality Assurance	Materials Laboratory		
SECTION 00596A - MECHANICALLY STABILIZED EARTH RETAINING WALLS											
Aggregate Production											
Gabion Basket Fill (Product Compliance) (See Section 00390.11(b))	Degradation Soundness Specific Gravity of Coarse Aggregates	TM 208		T 104 (1) T 85	4000	See Section 4C	Submit to Lab			Testing Frequency for Product Compliance per Source 1/5,000 Tons Minimum 1/Project	See Section 4C
(1) Apparent Specific Gravity and Absorption	Gradation										

FIELD TESTED MATERIALS ACCEPTANCE GUIDE				Same Frequency for all Tests (Minimums)					
MATERIAL AND OPERATION	DESCRIPTION OF TEST	TEST METHOD		FORM 734-734-	QUALITY ASSURANCE				
		ODOT	WAQTC			AASHTO	Contractor Quality Control	Independent Assurance/Verification	
SECTION 00596A - MSE RETAINING WALLS									
Aggregate Production									
MSE Granular Wall Backfill (Product Compliance) (Also reference 02630.10)	Abrasion Degradation Sieve Analysis Plasticity Index pH of Soil Soil Resistivity Organic Content	TM 208		T 96 T 11 T 90 T 289 T 288 T 267	4000	Testing Frequency for Product Compliance per Source 1/5,000 Tons Minimum 1/Project			
					4000	See Section 4C	Submit to Central Lab	See Section 4C	
					A Sublot Equals 2,000 Tons				
					1792	1/Sublot			
					1792	1/5 Sublots			
MSE Granular Wall Backfill (¹) Perform a minimum of 3 tests, QL's required	Sampling Aggregates Reducing Aggregates (¹) Sieve Analysis Un-Washed Sand Equivalent Fracture (Method 1)			R 90 R 76 T 27 T 176	4000	Testing Frequency for Product Compliance per Source 1/5,000 Tons Minimum 1/Project			
					1792	1/Sublot			
					3468	1/Aggregate Gradation/Per Source			
					3468				
					1793B	1/ 100 yd3 (Minimum 1/day)			
Placement Establishing Maximum Density (²) Method A	Density Curve Specific Gravity of Coarse Aggregates			(2) T 99 T 85	4000	Testing Frequency for Product Compliance per Source 1/5,000 Tons Minimum 1/Project			
					1793B	1/ 100 yd3 (Minimum 1/day)			
Compaction	Nuclear Density of Soils/Aggregates Deflection Testing	TM 223 TM 158		T 310	4000	Testing Frequency for Product Compliance per Source 1/5,000 Tons Minimum 1/Project			
					1793B	1 per layer	(³) Visual		
⁽³⁾ See Section 00596A.47(c-5) Contractor must demonstrate, by compaction testing or acceptable visual means, that the material, equipment, and process used for compaction achieves the specification requirements. If the material, equipment, or process changes, or if other conditions indicate a non-specification product, the Contractor must re-demonstrate that specification requirements are being achieved.									

FIELD TESTED MATERIALS ACCEPTANCE GUIDE				(Revised November 2022)		Same Frequency for all Tests (Minimums)															
MATERIAL AND OPERATION	DESCRIPTION OF TEST	TEST METHOD			FORM 734-	QUALITY ASSURANCE															
		ODOT	WAQTC	AASHTO		Contractor Quality Control	Independent Assurance/Verification	Region Quality Assurance	Materials Laboratory												
SECTION 00596B - PREFABRICATED MODULAR RETAINING WALLS																					
Aggregate Production Gravel Leveling Pads Backfill (See Section 02630.10)	Abrasion Degradation	TM 208		T96	4000	See Section 4A	Submit to Lab	See Section 4A	See Section 4A	See Section 4A											
											A Sublot equals 1,000 Tons Minimum 1/Project										
											Sampling Aggregates Reducing Aggregates Sieve Analysis Un-Washed Sand Equivalent	R 90 R 76 T 27 T 176	1792	1/Sublot	1792	1/5 Sublots	Testing Frequency for Product Compliance per Source 1/5,000 Tons Minimum 1/Project	See Section 4C & 02690	Submit To Lab	See Section 4C	
																					Fracture (Method 1)
Soundness Abrasion Degradation Lightweight Pieces	TM 208	T 104 T 96 T 113	4000	A Sublot equals 1,000 Tons																	
					Sampling Aggregates Reducing Aggregates (2) Sieve Analysis (1) Wood Particles Fracture (Method 2) Elongated Pieces	TM 225 TM 229	R 90 R 76 T 27/T 11 T 335	1792 1792	1/Sublot												
Abrasion Degradation	TM 208	T 96	4000	See Section 4C						Submit To Lab	See Section 4C										
					Sieve Analysis Un-Washed	T 27	4000	1/Sublot													
(3) Modular Block Core and Backfill (Product Compliance)	(3) (See Section 2690.20(a) thru 2690.20(d) & 2690.20(f))	(3) Modular Block Core and Drainage Backfill (1) QAE may waive after 5 sublots/shifts	(2) Perform a minimum of 3 tests, QL's required Pipe Drain Backfill (Product Compliance) (See Section 00430.11)	T 27					4000	See Section 4C	Submit To Lab	See Section 4C									

FIELD TESTED MATERIALS ACCEPTANCE GUIDE				(Revised November 2022)				Same Frequency for all Tests (Minimums)			
MATERIAL AND OPERATION	DESCRIPTION OF TEST	TEST METHOD			FORM 734-	QUALITY ASSURANCE					
		ODOT	WAQTC	AASHTO		Contractor Quality Control	Project Manager	Region Quality Assurance	Materials Laboratory		
SECTION 00596B - PREFABRICATED MODULAR RETAINING WALLS											
Aggregate Production											
Gabion Basket Fill (Product Compliance) (See Section 00390.11(b))	Degradation Soundness Specific Gravity of Coarse Aggregates	TM 208			T 104 (¹) T 85	4000	See Section 4C	Submit to Lab			See Section 4C
						1825					
(¹) Apparent Specific Gravity and Absorption	Gradation							Visual			
Testing Frequency for Product Compliance per Source 1/5,000 Tons Minimum 1/Project											

FIELD TESTED MATERIALS ACCEPTANCE GUIDE					Same Frequency for all Tests (Minimums)		
MATERIAL AND OPERATION	DESCRIPTION OF TEST	TEST METHOD		FORM 734-734-	QUALITY ASSURANCE		
		ODOT	WAQTC		AASHTO	Contractor Quality Control	Project Manager
SECTION 00596B - PREFABRICATED MODULAR RETAINING WALLS							
Aggregate Production							Testing Frequency for Product Compliance per Source 1/5,000 Tons Minimum 1/Project
Retaining Wall Granular Backfill (Product Compliance) (Also reference 02630.10)	Abrasion Degradation Sieve Analysis Plasticity Index	TM 208		T96 T 11 T 90	4000 4000	See Section 4C	Submit to Central Lab See Section 4C
Retaining Wall Granular Backfill (¹) Perform a minimum of 3 tests, QL's required	Sampling Aggregates Reducing Aggregates (¹) Sieve Analysis Un-Washed Sand Equivalent Fracture (Method 1)			R 90 R 76 T 27 T 176 T 335			A Sublot Equals 2,000 Tons
Placement Establishing Maximum Density (²) Method A	Density Curve Specific Gravity of Coarse Aggregates Agg. Base Coarse Particle Correction	TM 223		(²) T 99 T 85	3468 3468	1/Aggregate Gradation/Per Source	
Compaction	Nuclear Density of Soils/Aggregates Deflection Testing	TM 158		T 310	1793B 1793B	1/ 100 yd3 (Minimum 1/day) 1 per layer	(³) Visual
(³) See Section 00596B.47(b-6)							
Contractor must demonstrate, by compaction testing or acceptable visual means, that the material, equipment, and process used for compaction achieves the specification requirements. If the material, equipment, or process changes, or if other conditions indicate a non-specification product, the Contractor must re-demonstrate that specification requirements are being achieved.							

FIELD TESTED MATERIALS ACCEPTANCE GUIDE				(Revised November 2022)			Same Frequency for all Tests (Minimums)			
MATERIAL AND OPERATION	DESCRIPTION OF TEST	TEST METHOD			FORM 734-	QUALITY ASSURANCE				
		ODOT	WAQTC	AASHTO		Contractor Quality Control	Project Manager	Region Quality Assurance	Materials Laboratory	
SECTION 00596C - CAST-IN-PLACE CONCRETE RETAINING WALLS										
Aggregate Production										
Pipe Drain Backfill (Product Compliance) (See Section 00430.11)	Abrasion Degradation	TM 208		T 96	4000	See Section 4C	Submit To Lab			See Section 4C
	Sampling Aggregates Reducing Aggregates			R 90 R 76 T27						
	Sieve Analysis Un-Washed				4000	1/Sublot				
Retaining Wall Granular Backfill					Testing Frequency for Product Compliance per Source 1/5,000 Tons Minimum 1/Project					
Retaining Wall Granular Backfill (Product Compliance) (Also reference 02630.10)	Abrasion Degradation Sieve Analysis Plasticity Index	TM 208		T 96 T 11 T 90	4000	See Section 4C	Submit to Central Lab			See Section 4C
					4000					
Retaining Wall Granular Backfill ⁽¹⁾ Perform a minimum of 3 tests QL's required	Sampling Aggregates Reducing Aggregates ⁽¹⁾ Sieve Analysis Un-Washed Fracture (Method 1)			R 90 R 76 T 27 T 335	A Sublot Equals 2,000 Tons					
						1/Sublot				
						1/5 Sublots				

FIELD TESTED MATERIALS ACCEPTANCE GUIDE				(Revised November 2022)			Same Frequency for all Tests (Minimums)		
MATERIAL AND OPERATION	DESCRIPTION OF TEST	TEST METHOD		FORM 734-	Contractor Quality Control	QUALITY ASSURANCE			
		ODOT	WAQTC			AASHTO	Project Manager	Region Quality Assurance	Materials Laboratory
SECTION 00596C - CAST-IN-PLACE CONCRETE RETAINING WALLS									
Placement									
Retaining Wall Granular Backfill	Density Curve			(1) T 99	3468				
Establishing Maximum Density	Specific Gravity of Coarse Aggregates			T 85	3468	1/Aggregate Gradation/Per Source			
(1) Method A	Agg. Base Coarse Particle Correction	TM 223							
Compaction	Nuclear Density of Soils/Aggregates			T 310	1793B	1/ 100 yd3 (Minimum 1/day)			
	Deflection Testing	TM 158			1793B	1 per layer	(2) Visual		
(2) See Section 00596C.42(f)									
Contractor must demonstrate, by compaction testing or acceptable visual means, that the material, equipment, and process used for compaction achieves the specification requirements. If the material, equipment, or process changes, or if other conditions indicate a non-specification product, the Contractor must re-demonstrate that specification requirements are being achieved.									

FIELD TESTED MATERIALS ACCEPTANCE GUIDE				(Revised November 2022)		Same Frequency for all Tests (Minimums)		
MATERIAL AND OPERATION	DESCRIPTION OF TEST	TEST METHOD		FORM 734-	Contractor Quality Control	QUALITY ASSURANCE		
		ODOT	WAQTC			AASHTO	Project Manager	Region Quality Assurance
SECTION 00635 - GRID-ROLLED AGGREGATE SUBBASE								
Aggregate Subbase Grading (See 00635.10)	Abrasion			T 96	4000	A Sublot equals 1000 Tons		
				Submit To Central Lab		See Section 4(A)		
	Sampling Aggregates Reducing Aggregates Sieve Analysis Un-Washed Sand Equivalent			R 90 R 76 T 27	1792	1/Sublot		
				T 176				

FIELD TESTED MATERIALS ACCEPTANCE GUIDE				Same Frequency for all Tests (Minimums)				
MATERIAL AND OPERATION	DESCRIPTION OF TEST	TEST METHOD			FORM 734-734-	QUALITY ASSURANCE		
		ODOT	WAQTC	AASHTO		Contractor Quality Control	Independent Project Manager	Region Quality Assurance
SECTION 00641 - AGGREGATE SUBBASE, BASE, AND SHOULDERS								
Aggregate Production Aggregate Subbase Grading (See 00641.10(b))	Abrasion			T 96	4000	See Sec. 4A	Submit To Central Lab	See Section 4(A)
	Sampling Aggregates Reducing Aggregates			R 90 R 76 T 27		1/Project or 1/Source	Visual	
	Sieve Analysis Un-Washed Sand Equivalent			T 176	1792			
	Aggregate Base and Shoulders	TM 208		T 96	4000	See Section 4A	Submit to Lab	See Section 4A
Grading Aggregate Base (See 02630) Aggregate Shoulder (See 02640) Open Graded Aggregate Base (See 02630.11)	Sampling Aggregates Reducing Aggregates			R 90 R 76 T 27		1/Sublot		1 per 10 Sublots
	(1) Sieve Analysis Un-Washed			T 176	1792			
	(2) Sand Equivalent Fracture (Method 1)			T 335	1792	1/5 Sublots		
Placement								
Aggregate Base Plant Mix Applications Only Aggregate (Mixture)	Sampling Aggregates Reducing Aggregates			R 90 R 76 T 255/265		1/Sublot or minimum 1/Day		1 per 10 Sublots
	Moisture Content of Aggregates & Soils			(3) T 99	1792	Each Size per Source		1/Project
Establishing Maximum Density & Optimum Moisture (Mix Design)	Density Curve			T 85	3468 B			
	Agg. Base Coarse Particle Correction	TM 223		T 310	3468 B			
Compaction (3) Method A	Specific Gravity of Coarse Aggregates				1793B	1 per Sublot		
	Deflection Testing Nuclear Density of Soils/Aggregates	TM 158			1793B	(D) 5 Tests Per Sublot		(D) 1 (5 Tests) per 10 Sublots
(D) (Individual tests must meet Specification)								

FIELD TESTED MATERIALS ACCEPTANCE GUIDE				(Revised November 2022)			Same Frequency for all Tests (Minimums)		
MATERIAL AND OPERATION	DESCRIPTION OF TEST	TEST METHOD			FORM	QUALITY ASSURANCE			
		ODOT	WAQTC	AASHTO		Contractor Quality Control	Project Manager	Independent Assurance/Region Quality Assurance	Materials Laboratory
SECTION 00641 - AGGREGATE SUBBASE, BASE, AND SHOULDERS (Continued)									
Placement									
Aggregate Subbase									
Compaction	Deflection Testing	TM 158			1793 B	1 per Layer	Visual		

FIELD TESTED MATERIALS ACCEPTANCE GUIDE				Same Frequency for all Tests (Minimums)				
MATERIAL AND OPERATION	DESCRIPTION OF TEST	TEST METHOD		FORM 734-734-	QUALITY ASSURANCE			
		ODOT	WAQTC		AASHTO	Contractor Quality Control	Independent Project Manager	Region Quality Assurance
SECTION 00680 - STOCKPILED AGGREGATES								
Aggregate Base and Shoulders (See Section 00641)	Abrasion Degradation	TM 208		T 96	4000	See Section 4A	Submit to Lab	See Section 4A
	Sampling Aggregates Reducing Aggregates (1) Sieve Analysis Un-Washed (2) Sand Equivalent			R 90 R 76 T 27	1792	1/Sublot		1 per 10 Sublots
(1) Perform at least 3 tests, QL's required				T 176	1792			
(2) May be waived by QAE	Fracture (Method 1)			T 335	1792	1/5 Sublots		
Aggregate (Sanding Aggregate)								
(1) May be waived by QAE	Sampling Aggregates Reducing Aggregates			R 90 R 76 T 27		1/Sublot		1 per 10 Sublots
	Sieve Analysis Un-Washed (1) Cleanness Value	TM 227		T 96	4000	See Section 4A	Submit to Lab	See Section 4A
	Abrasion Degradation Lightweight Pieces	TM 208		T 113	4000			
	Fracture (Method 1) Elongated Pieces Wood Particles	TM 229 TM 225		T 335	1792	1/5 Sublots		1 per 10 Sublots
					1792			

FIELD TESTED MATERIALS ACCEPTANCE GUIDE					(Revised November 2022)				Same Frequency for all Tests (Minimums)					
MATERIAL AND OPERATION	DESCRIPTION OF TEST	TEST METHOD			FORM 734-	QUALITY ASSURANCE								
		ODOT	WAQTC	AASHTO		Contractor Quality Control	Project Manager	Region Quality Assurance	Materials Laboratory					
SECTION 00705 - EMULSIFIED ASPHALT PRIME COAT and EMULSIFIED ASPHALT FOG COAT													A sublot equals 1000 Tons. A minimum 1 per shift	
Aggregate Production Aggregate Cover Material	Sampling Aggregates Reducing Aggregates Sieve Analysis Un-Washed	R 90 R 76 T 27	R 66	1792	1/Sublot	1 per 10 Sublots	1/5 QC Samples (Random)							
Asphalt Prime and Fog Coat Asphalt Cement (Emulsion)	Sampling Asphalt Materials	R 66		4000	See Section 4C 1/50 Tons (Submit All)	Submit to Central Lab								
SECTION 00706 - EMULSIFIED ASPHALT SLURRY SEAL SURFACING													A sublot equals 500 Tons. A minimum 1 per shift whichever results in the greatest sampling frequency	
Aggregate Production (¹) Perform at least 3 tests, QL's required	Sampling Aggregates Reducing Aggregates (¹) Sieve Analysis	R 90 R 76 T 27/T 11	R 66	1792	1/Sublot									
Emulsified Asphalt Cement Emulsified Asphalt Polymer Modified Emulsion	Sampling Asphalt Materials	R 66		4000	See Section 4C 1/50 Tons (Submit All)	Submit to Central Lab								1/5 QC Samples (Random)
Additives Mineral Filler	Material must meet the requirements of Section 00706.13													
Mixture	Material must meet the requirements of Section 00706.16													

FIELD TESTED MATERIALS ACCEPTANCE GUIDE					Same Frequency for all Tests (Minimums)			
MATERIAL AND OPERATION	DESCRIPTION OF TEST	TEST METHOD			FORM 734-	QUALITY ASSURANCE		
		ODOT	WAQTC	AASHTO		Contractor Quality Control	Project Manager	Region Quality Assurance
SECTION 00710 - SINGLE APPLICATION EMULSIFIED ASPHALT SURFACE TREATMENT								
Aggregate Production								
<p>(1) QAE may waive after 5 sublots/shifts</p> <p>(2) Perform at least 3 tests (QL's required), QAE may waive wet sieve after 5 sublots/shifts if a correlation to dry sieve can be demonstrated</p> <p>(3) May be waived by QAE</p> <p>(4) Not required for Dry Key Material</p> <p>(5) 1/5 Sublots & Start of Production</p> <p>Asphalt Cement (Emulsion)</p>	Abrasion	TM 208	T 96	4000	See Section 4A	Submit to Central Lab	1 per 10 Sublots	See Section 4A
	Degradation		R 90					
	Soundness		R 76					
	Lightweight Pieces		T 335	1792	1/Sublot			
	Dry Rodded Unit Weight		T 27/T 11	1792				
	Sampling Aggregates		T 19	1825	Start of production and when changes in aggregate occurs			
	Reducing Aggregates			1825C				
	(5) Fracture (Method 1)							
	(1) Wood Particles	TM 225						
	(1)(4) Elongated Piece	TM 229						
(2) Sieve Analysis	TM 227							
(3) Cleanness Value								
Dry Rodded Unit Weight								
Sampling Asphalt Materials			R 66	1/50 Tons Submit All	Submit to Lab		1/5 QC Samples (Random)	
Preproduced Aggregate								
Compliance of aggregates produced and stockpiled before the award date or notice to proceed of this contract will be determined by the following:								
1. Continuing production records meeting the above requirements of Section 00710.10 and 710.15, Aggregate Production.								
2. Furnish records of testing for the entire stockpile according to Section 00710.10 and 710.15 Aggregate Production except change the sampling frequency to the following:								
a. One Per 5 sublots means "One Set of Tests Per 2500 Tons".								
b. One Per sublot means "One Set of Tests Per 500 Tons" with a minimum of 3 sets of Sieve Analysis tests per project.								
c. Provide one stockpile sample for each set of tests required above.								

FIELD TESTED MATERIALS ACCEPTANCE GUIDE					Same Frequency for all Tests (Minimums)			
MATERIAL AND OPERATION	DESCRIPTION OF TEST	TEST METHOD		FORM 734-	QUALITY ASSURANCE			
		ODOT	WAQTC		AASHTO	Contractor Quality Control	Project Manager	Region Quality Assurance
SECTION 00711 - PRE-COATED AGGREGATE ASPHALT SURFACE TREATMENT								
Aggregate Production								
<p>⁽¹⁾ QAE may waive after 5 sublots/shifts</p> <p>⁽²⁾ Perform at least 3 tests (QL's required), QAE may waive wet sieve after 5 sublots/shifts if a correlation to dry sieve can be demonstrated</p> <p>⁽³⁾ May be waived by QAE</p> <p>⁽⁴⁾ Not required for Dry Key Material</p> <p>⁽⁵⁾ 1/5 Sublots & Start of Production</p> <p>Asphalt Cement</p>	Abrasion	TM 208	T 96	4000	See Section 4A	Submit to Central Lab	See Section 4A	
	Degradation		T 104	4000				
	Soundness		T 113					
	Lightweight Pieces		T 19					
	Dry Rodded Unit Weight		R 90					
	Sampling Aggregates		R 76					
	Reducing Aggregates		T 335					
	⁽⁵⁾ Fracture (Method 1)		T27/T 11	1792	1/Sublot		1 per 10 Sublots	
	⁽¹⁾ Wood Particles	TM 225						
	⁽¹⁾⁽⁴⁾ Elongated Piece	TM 229						
⁽²⁾ Sieve Analysis	TM 227							
⁽³⁾ Cleaness Value								
Dry Rodded Unit Weight		T 19		1825	Start of production and when changes in aggregate occurs			
				1825C				
Sampling Asphalt Materials		R 66		4000	1/50 Tons Submit All	Submit to Lab	1/5 QC Samples (Random)	
Preproduced Aggregate								
<p>Compliance of aggregates produced and stockpiled before the award date or notice to proceed of this contract will be determined by the following:</p> <ol style="list-style-type: none"> Continuing production records meeting the above requirements of Section 00711.10 and 711.15, Aggregate Production. Furnish records of testing for the entire stockpile according to Section 00711.10 and 711.15 Aggregate Production except change the sampling frequency to the following: <ul style="list-style-type: none"> a. One Per 5 sublots means "One Set of Tests Per 2500 Tons". b. One Per sublot means "One Set of Tests Per 500 Tons" with a minimum of 3 sets of Sieve Analysis tests per project. c. Provide one stockpile sample for each set of tests required above. 								

FIELD TESTED MATERIALS ACCEPTANCE GUIDE					Same Frequency for all Tests (Minimums)					
MATERIAL AND OPERATION	DESCRIPTION OF TEST	TEST METHOD			FORM 734-	QUALITY ASSURANCE				
		ODOT	WAQTC	AASHTO		Contractor Quality Control	Project Manager	Region Quality Assurance	Materials Laboratory	
SECTION 00711 - PRE-COATED AGGREGATE ASPHALT SURFACE TREATMENT (CONTINUED)										
Mixture Acceptance										A sublot equals 500 Tons. A minimum 1 per shift, whichever results in the greatest sampling frequency
Meter Method	Readings backed by Tank Measure & Production Records Daily	TM 321 (¹) TM 322			2277	1/Sublot or Min. 1/Day				
⁽¹⁾ ACP Plant Calibration Required at start of production and if meters fail to meet specification					2043 & 2401	Daily Production				
Plant Discharge Moisture	Cold Feed Moisture				2277	1/Sublot or Min. 1/Day				
	ACP Moisture Content				2277	1/Sublot				
Asphalt Cement	Sampling Asphalt Materials				4000	1/50 Tons Submit All	Submit to Lab			1/5 QC Samples (Random)

FIELD TESTED MATERIALS ACCEPTANCE GUIDE					Same Frequency for all Tests (Minimums)												
MATERIAL AND OPERATION	DESCRIPTION OF TEST	TEST METHOD			FORM 734-	QUALITY ASSURANCE											
		ODOT	WAQTC	AASHTO		Contractor Quality Control	Project Manager	Region Quality Assurance	Materials Laboratory								
SECTION 00712 - DRY KEY EMULSIFIED ASPHALT SURFACE TREATMENT																	
Aggregate Production																	
<p>Abrasion Degradation Soundness Lightweight Pieces Dry Rodded Unit Weight</p> <p>Sampling Aggregates Reducing Aggregates (5) Fracture (Method 1) (1) Wood Particles (1)(4) Elongated Piece (2) Sieve Analysis (3) Cleanness Value</p> <p>Dry Rodded Unit Weight</p> <p>(1) QAE may waive after 5 sublots/shifts</p> <p>(2) Perform at least 3 tests (QL's required), QAE may waive wet sieve after 5 sublots/shifts if a correlation to dry sieve can be demonstrated</p> <p>(3) May be waived by QAE</p> <p>(4) Not required for Dry Key Material</p> <p>(5) 1/5 Sublots & Start of Production</p> <p>Asphalt Cement (Emulsion)</p>	<p>TM 208</p>	<p>T 96 T 104 T 113 T 19 R 90 R 76 T 335 T 27/T 11 T 19</p>	<p>4000 4000 1792 1792 1825 1825C 4000</p>	<p>See Section 4A</p> <p>1/Sublot</p> <p>Start of production and when changes in aggregate occurs</p> <p>1/50 Tons Submit All</p>	<p>Submit to Central Lab</p> <p>1 per 10 Sublots</p> <p>Submit to Lab</p>	<p>See Section 4A</p> <p>1/5 QC Samples (Random)</p>	<p>A sublot equals 500 Tons. A minimum 1 per shift, whichever results in the greatest sampling frequency</p>										
									Preproduced Aggregate								
									<p>Compliance of aggregates produced and stockpiled before the award date or notice to proceed of this contract will be determined by the following:</p> <ol style="list-style-type: none"> Continuing production records meeting the above requirements of Section 00712.10 and 712.15, Aggregate Production. Furnish records of testing for the entire stockpile according to Section 00712.10 and 712.15 Aggregate Production except change the sampling frequency to the following: <ul style="list-style-type: none"> One Per 5 sublots means "One Set of Tests Per 2500 Tons". One Per sublot means "One Set of Tests Per 500 Tons" with a minimum of 3 sets of Sieve Analysis tests per project. Provide one stockpile sample for each set of tests required above. 								

FIELD TESTED MATERIALS ACCEPTANCE GUIDE				(Revised November 2022)				Same Frequency for all Tests (Minimums)			
MATERIAL AND OPERATION	DESCRIPTION OF TEST	TEST METHOD			FORM 734-	QUALITY ASSURANCE					
		ODOT	WAQTC	AASHTO		Contractor Quality Control	Project Manager	Region Quality Assurance	Materials Laboratory		
SECTION 00715 - MULTIPLE APPLICATION EMULSIFIED ASPHALT SURFACE TREATMENT											
Aggregate Production											
Aggregate Production (1) QAE may waive after 5 sublots/shifts (2) Perform at least 3 tests (QL's required), QAE may waive wet sieve after 5 sublots/shifts if a correlation to dry sieve can be demonstrated (3) May be waived by QAE (4) Not required for Dry Key Material (5) 1/5 Sublots & Start of Production Asphalt Cement (Emulsion)	Abrasion	TM 208	T 96	4000	A sublot equals 500 Tons. A minimum 1 per shift, whichever results in the greatest sampling frequency	See Section 4A	Submit to Central Lab	1 per 10 Sublots	See Section 4A	1/5 QC Samples (Random)	
	Degradation		T 104	4000							
	Soundness		T 113	4000							
	Lightweight Pieces		T 19	4000							
	Dry Rodded Unit Weight		R 90	1792							
	Sampling Aggregates		R 76	1792							
	Reducing Aggregates		T 335	1792							
	(5) Fracture (Method 1)		T 27/T 11	1792							
	(1) Wood Particles		T 19	1825							
	(1)(4) Elongated Piece		R 66	1825C							
(2) Sieve Analysis				Start of production and when changes in aggregate occurs	Submit to Lab						
(3) Cleanness Value				1/50 Tons Submit All							
Dry Rodded Unit Weight											
Sampling Asphalt Materials											
Preproduced Aggregate											
Compliance of aggregates produced and stockpiled before the award date or notice to proceed of this contract will be determined by the following: 1. Continuing production records meeting the above requirements of Section 00715.10 and 715.15, Aggregate Production. 2. Furnish records of testing for the entire stockpile according to Section 00715.10 and 715.15 Aggregate Production except change the sampling frequency to the following: a. One Per 5 sublots means "One Set of Tests Per 2500 Tons". b. One Per sublot means "One Set of Tests Per 500 Tons" with a minimum of 3 sets of Sieve Analysis tests per project. c. Provide one stockpile sample for each set of tests required above.											

FIELD TESTED MATERIALS ACCEPTANCE GUIDE				(Revised November 2022)		Same Frequency for all Tests (Minimums)			
MATERIAL AND OPERATION	DESCRIPTION OF TEST	TEST METHOD		FORM 734-	QUALITY ASSURANCE			Materials Laboratory	
		ODOT	WAQTC		AASHTO	Contractor Quality Control	Project Manager		Region Quality Assurance
SECTION 00720 - COLD IN-PLACE RECYCLED ASPHALT CONCRETE PAVEMENT (CIR)									
SECTION 00721 - COLD RECYCLED EMULSIFIED ASPHALT CONCRETE PAVEMENT (CRP)									
Asphalt Cement (Emulsified Recycling Agent)	Sampling Asphalt Materials	R 66		4000	See Section 4C 1/50 Tons (Submit All)	Submit to Central Lab		1/5 QC Samples (Random)	
					See Sec.00340.10				
Water	Compliance				A Sublot equals 1000 Tons				
Aggregate Production Choke Aggregate (See 00705)	Sampling Aggregates Reducing Aggregates Sieve Analysis Un-Washed	R 90 R 76 T 27		1792	1/Sublot		Minimum 1/Project		
SECTION 00725 - HOT IN-PLACE RECYCLED (HIR) ASPHALT CONCRETE PAVEMENT									
<i>The type of recycling agent will be listed in the Special Provisions</i>									
Recycling Agent (See 00745.11)	Sampling Asphalt Materials	R 66		4000	See Section 4C	Submit to Lab		1/5 QC Samples (Random)	
Recycling Agent	Sampling Asphalt Materials	R 66		4000	1/50 Tons	Submit to Lab			
Asphalt Concrete Mixture									
SECTION 00730 - ASPHALT TACK COAT									
Tack	Sampling Asphalt Materials	R 66		4000	See Section 4C 1/50 Tons	Submit to Lab		1/50 Tons or All QC Samples	

FIELD TESTED MATERIALS ACCEPTANCE GUIDE				Same Frequency for all Tests (Minimums)				
MATERIAL AND OPERATION	DESCRIPTION OF TEST	TEST METHOD		FORM 734-	QUALITY ASSURANCE			
		ODOT	WAQTC		AASHTO	Contractor Quality Control	Project Manager	Region Quality Assurance
SECTION 00735 - EMULSIFIED ASPHALT CONCRETE PAVEMENT								
Aggregate production	Abrasion Degradation Soundness Lightweight Pieces	TM 208		T 96 T 104 T 113	4000 4000	See Section 4A Submit to Lab		See Section 4A
(1) Perform at least 3 tests, QL's required					A Sublot equals 1000 Tons. A minimum one per shift, whichever results in the greatest sampling frequency. (For preproduced aggregates, 1 shift shall mean 1000 Tons)			
(2) May be waived by QAE	Sampling Aggregates Reducing Aggregates			R 90 R 76 T 27/T 11				
(3) QAE may waive after 5 sublots/shifts	(1) Sieve Analysis (2) Cleaness Value Fracture (Method 1 & 2)	TM 227		T 335	1792	1/Sublot		1 per 10 Sublots
Choke Aggregate	Sieve Analysis Un-Washed			T 27	1792	1/Sublot		
								1/Project

FIELD TESTED MATERIALS ACCEPTANCE GUIDE				(Revised November 2022)				Same Frequency for all Tests (Minimums)			
MATERIAL AND OPERATION	DESCRIPTION OF TEST	TEST METHOD			FORM 734-	QUALITY ASSURANCE					
		ODOT	WAQTC	AASHTO		Contractor Quality Control	Project Manager	Region Quality Assurance	Materials Laboratory		
SECTION 00735 - EMULSIFIED ASPHALT CONCRETE PAVEMENT (CONTINUED)											
Mixture Acceptance											
% Emulsified Asphalt	Sampling Aggregates Reducing Aggregates Sieve Analysis Moisture Content of Aggregate & Soil Meter										
				R 90 R 76 T 27/T 11 T 255/265							
			TM 321								
% Emulsified Asphalt	Meter Backed by Tank Measure Daily	TM 321 (¹) TM 322			2401 & 2043		Daily Production				
⁽¹⁾ ACP Plant Calibration Required at start of production and if meters fail to meet specification											
Emulsified Asphalt Cement	Sampling Asphalt Materials			R 66	4000		See Section 4C 1/Sublot (Submit All)	Submit to Lab	1 per 10 Sublots	1/5 QC Samples (Random)	
SECTION 00740 - COMMERCIAL ASPHALT CONCRETE PAVEMENT (CACP)											
See Specifications when Testing is Required by Agency											

FIELD TESTED MATERIALS ACCEPTANCE GUIDE					(Revised November 2022)				Same Frequency for all Tests (Minimums)				
MATERIAL AND OPERATION	DESCRIPTION OF TEST	TEST METHOD			FORM 734-	QUALITY ASSURANCE							
		ODOT	WAQTC	AASHTO		Contractor Quality Control	Project Manager	Region Quality Assurance	Materials Laboratory				
SECTION 00743 - POROUS ASPHALT CONCRETE (PAC) (CONTINUED)													
Mixture Acceptance - PAC with RAP													
Gradation													
Ignition method	(¹) Calibrate Incinerator	TM 323			2327IC	A Sublot equals 1000 Tons							
Ignition method	Sampling (ACP) Reducing (ACP)			R 97 R 47		1/JMF & Each Calendar Year.							
(Residual aggregate from AASHTO T 308)	Sieve Analysis of Extracted Aggregate			T 30	2277	1/Sublot or Min. 1/day							
⁽¹⁾ Submit Samples a minimum of 2 Days Prior to ACP Production													
Asphalt Content													
Ignition Method		TM 323			2327IC	A Sublot equals 1000 Tons							
Ignition Method	Sampling (ACP) Reducing (ACP)			R 97 R 47		1/JMF & Each Calendar Year.							
Meter Method	Asphalt Content			T 308	2277	1/Sublot or Min. 1/day							
	Readings backed by Tank Measure & Production Records Daily	TM 321 ⁽²⁾ TM 322			2277	1/Sublot or Min. 1/day							
⁽²⁾ ACP Plant Calibration Required at start of production and if meters fail to meet specification													
<u>Meter Method is required for PAC even when acceptance is by Ignition Method</u>													

FIELD TESTED MATERIALS ACCEPTANCE GUIDE					(Revised November 2022)			Same Frequency for all Tests (Minimums)						
MATERIAL AND OPERATION	DESCRIPTION OF TEST	TEST METHOD			FORM 734-	QUALITY ASSURANCE			Materials Laboratory					
		ODOT	WAQTC	AASHTO		Contractor Quality Control	Project Manager	Region Quality Assurance						
SECTION 00743 - POROUS ASPHALT CONCRETE (PAC) (CONTINUED)														
Mixture Acceptance - PAC without RAP														
Gradation											A Sublot equals 1000 Tons			
Cold Feed Method	Sampling Aggregates Reducing Aggregates Sieve Analysis			R 90 R 76 T 27/T 11	2277	1/Sublot or Min. 1/Day								
Ignition method	(¹) Calibrate Incinerator	TM 323			2327IC	1/JMF & Each Calendar Year.								
Ignition method	Sampling (ACP) Reducing (ACP)			R 97 R 47		1/Sublot or Min. 1/Day								
(¹) Not required if Asphalt Content Accepted by Meter														
(Residual aggregate from AASHTO T 308)	Sieve Analysis of Extracted Aggregate			T 30	2277	1/Sublot or Min. 1/day								
(¹) Submit Samples a minimum of 2 Days Prior to ACP Production														
Asphalt Content											A Sublot equals 1000 Tons			
Ignition Method	(¹) Calibrate Incinerator	TM 323			2327IC	1/JMF & Each Calendar Year.								
Ignition Method	Sampling (ACP) Reducing (ACP)			R 97 R 47		1/Sublot or Min. 1/day								
(²) ACP Plant Calibration Required at start of production and if meters fail to meet specification	Asphalt Content			T 308	2277									
Meter Method	Readings backed by Tank Measure & Production Records Daily	TM 321 (²) TM 322			2277	1/Sublot or Min. 1/day								
<u>Meter Method is required for PAC even when acceptance is by Ignition Method</u>					2043 and 2401	Daily Production								

FIELD TESTED MATERIALS ACCEPTANCE GUIDE				Same Frequency for all Tests (Minimums)			
MATERIAL AND OPERATION	DESCRIPTION OF TEST	TEST METHOD		FORM 734-	QUALITY ASSURANCE		
		ODOT	WAQTC		AASHTO	Contractor Quality Control	Project Manager
SECTION 00743 - POROUS ASPHALT CONCRETE (PAC) (CONTINUED)							
Mixture Acceptance - PAC with and without RAP							
Mix Design Verification Testing							
					A Sublot equals 1000 Tons		
	Cold Feed Moisture			T255/T265	2277	1/Sublot or Min. 1/Day	
	ACP Moisture Content			T 329	2277	1/Sublot or Min. 1/Day	
Plant Discharge Moisture				T 329	2277	1/Sublot or Min. 1/Day	
(1) RAP Percentage	(1) RAP Moisture						
(1) If applicable	Readings backed by Tank Measure & Production Records Daily		TM321 (2) TM 322		2401 & 2043	Daily Production	
Asphalt Cement	Sampling Asphalt Materials			R 66	4000	1/Sublot - See section 4C	1/5 QC Samples (Random)
(2) ACP Plant Calibration Required at start of production and if meters fail to meet specification							

FIELD TESTED MATERIALS ACCEPTANCE GUIDE				Same Frequency for all Tests (Minimums)			
MATERIAL AND OPERATION	DESCRIPTION OF TEST	TEST METHOD		FORM 734-734-	QUALITY ASSURANCE		
		ODOT	WAQTC		AASHTO	Contractor Quality Control	Project Manager
SECTION 00744 - ASPHALT CONCRETE PAVEMENT							
Aggregate Production							
See Specifications when Aggregate Testing is Required by the Agency							
Mixture Acceptance							
Gradation							
Ignition method	(¹) Calibrate Incinerator	TM 323			2327IC	A Sublot equals 1000 Tons	
Ignition method	Sampling (ACP) Reducing (ACP)		R 97 R 47			1/JMF & Each Calendar Year.	
(Residual aggregate from AASHTO T 308)	Sieve Analysis of Extracted Aggregate		T 30		2277	1/Sublot or Min. 1/Day	
⁽¹⁾ Submit Samples a minimum of 2 Days Prior to ACP Production							
Asphalt Content							
Ignition Method	(¹) Calibrate Incinerator	TM 323			2327IC	A Sublot equals 1000 Tons	
Ignition Method	Sampling (ACP) Reducing (ACP)		R 97 R 47			1/JMF & Each Calendar Year.	
	Asphalt Content		T 308		2277	1/Sublot or Min. 1/day	
Mix Design Verification Testing							
Plant Discharge Moisture	ACP Moisture Content		T 329		2277	1/Sublot	
Maximum Density Test G _{mm}	Max. Specific Gravity MAMD		T 209		2050	1st Sublot Daily or Min. 1/Day	

FIELD TESTED MATERIALS ACCEPTANCE GUIDE				(Revised November 2022)				Same Frequency for all Tests (Minimums)			
MATERIAL AND OPERATION	DESCRIPTION OF TEST	TEST METHOD			FORM 734-	QUALITY ASSURANCE					
		ODOT	WAQTC	AASHTO		Contractor Quality Control	Project Manager	Region Quality Assurance	Materials Laboratory		
SECTION 00744 - ASPHALT CONCRETE PAVEMENT (CONTINUED)											
Compaction (D) See T 355 Yellow sheet for Density Test Locations	Nuclear Density of ACP			T 355	1793A						
							(D) Average 10 tests per Sublot or Min. 10/Day, See Section 00744.49				

FIELD TESTED MATERIALS ACCEPTANCE GUIDE				(Revised November 2022)			Same Frequency for all Tests (Minimums)			
MATERIAL AND OPERATION	DESCRIPTION OF TEST	TEST METHOD			FORM 734-	QUALITY ASSURANCE				
		ODOT	WAQTC	AASHTO		Contractor Quality Control	Project Manager	Region Quality Assurance	Materials Laboratory	
SECTION 00745 - ASPHALT CONCRETE PAVEMENT - STATISTICAL ACCEPTANCE										
Aggregate Production	Soundness Abrasion Degradation Lightweight Pieces Plasticity Index	TM 208		T 104 T 96 T 113 T 90	4000 4000	See Section 4A	Submit to Lab			See Section 4A
(¹) QAE may waive after 5 sublots/shifts										
(²) Perform a minimum of 3 tests QL's required										
(³) Coarse Agg (+ No. 4)				R 90 R 76 T 27/T 11 T 176						
(⁴) Fine Agg (- No. 4)										
Note: Sample Aggregate before Lime Treatment										
RAS Production (Reclaimed Asphalt Shingles)	Sieve Analysis Un-Washed Deleterious Materials	TM 229 TM 225		T 335 T 27	1792 4000	1/Sublot	Submit to Lab		1 per 10 Sublots	
	Sampling Aggregates Reducing Aggregates Sieve Analysis Un-Washed			R 90 R 76 T 27						
	Deleterious Materials	TM 335								
	Sampling Aggregates Reducing Aggregates Sieve Analysis Un-Washed									
	Deleterious Materials	TM 335			1792					
Preproduced Aggregate										
Compliance of aggregates produced and stockpiled before the award date or notice to proceed of this contract will be determined by the following:										
1. Continuing production records meeting the above requirements of Section 00745.10 Aggregate Production.										
2. Furnish records of testing for the entire stockpile according to Section 00745.10 Aggregate Production except change the sampling frequency to the following:										
a. One Per 5 sublots means "One Set of Tests Per 5000 Tons".										
b. One Per sublot means "One Set of Tests Per 1000 Tons" with a minimum of 3 sets of Sieve Analysis tests per project.										
c. Provide one stockpile sample for each set of tests required above.										

FIELD TESTED MATERIALS ACCEPTANCE GUIDE					Same Frequency for all Tests (Minimums)					
MATERIAL AND OPERATION	DESCRIPTION OF TEST	TEST METHOD			FORM 734-	Contractor Quality Control	QUALITY ASSURANCE			
		ODOT	WAQTC	AASHTO			Project Manager	Region Quality Assurance	Materials Laboratory	
SECTION 00745 - ASPHALT CONCRETE PAVEMENT - STATISTICAL ACCEPTANCE (CONTINUED)										
Mixture Acceptance - ACP "With and Without RAP"										
Mix Design Verification Testing Fabrication Maximum Density Test	Gyratory Specimen Max. Specific Gravity of ACP	TM 326	T 209		2050GV 2050 *5068	1/Sublot & according to Section 00745.16 (b)-1-d			1 per 10 Sublots	
Determination of G _{mb}	Bulk Specific Gravity of Compacted ACP		T 166		*2560 *5069					
Stripping Susceptibility	Tensile Strength Ratio		T 283			1/JMF See Section 00745.16 (b)-1-f				
*Cat-II complete & submit as required, See Section 745.16(b)					2050tsr					
Plant Discharge Moisture	ACP Moisture Content		T 329		2277	1/Sublot or Min. 1/Day				
Maximum Density Test G _{mm}	Max. Specific Gravity of ACP MAMD	TM 305	T 209		2050	1st Sublot Daily or Min. 1/Day				
Performing Control Strip	Control Strip	TM 306			2084 *5069	Develop Rolling Pattern See				
Compaction	Nuclear Density of ACP		T 355		1793A	^(D) Average 5 tests per Sublot or Min. 1/Day, See Section 00745.49 (b)-2			^(D) 1 per 10 Sublots	
Asphalt Cement	Sampling Asphalt Materials		R 66		4000	1/Sublot See Section 4C			1 per 10 Sublots	1/5 QC Samples (Random)
^(D) See T 355 YellowSheet for Density Test Locations										

FIELD TESTED MATERIALS ACCEPTANCE GUIDE					Same Frequency for all Tests (Minimums)				
MATERIAL AND OPERATION	DESCRIPTION OF TEST	TEST METHOD			FORM 734-	Contractor Quality Control	QUALITY ASSURANCE		
		ODOT	WAQTC	AASHTO			Independent Assurance/Verification	Project Manager	Region Quality Assurance
SECTION 00754 - PLAIN CONCRETE PAVEMENT REPAIR									
SECTION 00755 - CONTINUOUSLY REINFORCED CONCRETE PAVEMENT									
SECTION 00756 - PLAIN CONCRETE PAVEMENT									
SECTION 00758 - CONTINUOUSLY REINFORCED CONCRETE PAVEMENT REPAIR (CONTINUED)									
Portland Cement Concrete							A Sublot equals 1000 lane feet of slip formed pavement or 100 yd ³ of non-slip formed PCC		
Portland Cement Modifiers Admixtures		Materials must meet the requirements of Section 02001.10							
Curing Compounds		Material must meet the requirements of Section 02050							
Mixing Water		Material must meet the requirements of Section 02020							
(S) 1 Set Represents a minimum of 3 Cylinders	Sampling Concrete	TM 2	T 152 T 119 T 121	3573W S or 4000C	1/ sublot or Minimum 1 per Day	1 per 10 Sublots			
	Air Content of Concrete								
	Slump of Concrete								
	Density (Unit Weight) of Concrete								
	Yield								
	Concrete Temperature								
(M) Per Mix Design & Source	Water/Cement Ratio				(M) (S) 1 Set of Cylinders per Sublot or Minimum 1 set per Day	1 per 10 Sublots			
	Fabrication of Concrete Cylinders/Beams								
Smoothness	Compressive Strength of Concrete		R 100 T 22	4000C					
	Certification of Profiler Equipment	TM 769					See Special Provisions		
Determining International Roughness Index (IRI)		TM 772							
	Thickness of Pavement	TM 775					See Specs		

FIELD TESTED MATERIALS ACCEPTANCE GUIDE				(Revised November 2022)			Same Frequency for all Tests (Minimums)		
MATERIAL AND OPERATION	DESCRIPTION OF TEST	TEST METHOD			FORM 734-	QUALITY ASSURANCE			
		ODOT	WAQTC	AASHTO		Contractor Quality Control	Project Manager	Region Quality Assurance	Materials Laboratory
SECTION 00850 - COMMON PROVISIONS FOR PAVEMENT MARKINGS									
Placement Evaluation "Retroreflectivity"									
In-Place Procedure evaluates Durable and High Performance Pavement Markings	Evaluation of Retroreflectivity	TM 777			4101 thru 4105	See Special Provisions and Test Procedure for Testing Frequency			

FIELD TESTED MATERIALS ACCEPTANCE GUIDE				(Revised November 2022)				Same Frequency for all Tests (Minimums)			
MATERIAL AND OPERATION	DESCRIPTION OF TEST	TEST METHOD			FORM 734-	QUALITY ASSURANCE					
		ODOT	WAQTC	AASHTO		Contractor Quality Control	Project Manager	Region Quality Assurance	Materials Laboratory		
SECTION 00921 - MAJOR SIGN SUPPORT DRILLED SHAFTS											
Aggregate Production											
(1) QAE may waive after 5 sublots/shifts	Sampling Aggregates	R 90									
	Reducing Aggregates	R 76									
	(2)(3)(4) Sieve Analysis	T 27/T 11			1792	1 per 10 Sublots					
(2) Perform a minimum of 3 tests, QL's required	(4) Fineness Modulus	T 27/T 11			1792						
	(1)(3) Wood Particles	T 176									
(3) Coarse Aggregate (See Section 02690.20)	(4) Sand Equivalent	TM 225									
	Soundness	T 104			4000						
(4) Fine Aggregate (See Section 02690.30)	Abrasion	T 96									
	Degradation	T 113									
	Lightweight Pieces Organics	T 21			4000						
Portland Cement Modifiers Admixtures	(3) Dry Rodded Unit Weight	T 19			1825						
	(3) Specific Gravity of Coarse Aggregate	T 85			1825C						
	(4) Specific Gravity of Fine Aggregate	T 84			1825						
Drilling Slurry	Materials must meet the requirements of Section 02001.10										
	Slurry material must meet the requirements of Section 00921.14 & 00921.43(g)										
	Material must meet the requirements of Section 02080										
Grout	Material must meet the requirements of Section 02020										
Mixing Water											

FIELD TESTED MATERIALS ACCEPTANCE GUIDE					(Revised November 2022)			Same Frequency for all Tests (Minimums)			
MATERIAL AND OPERATION	DESCRIPTION OF TEST	TEST METHOD		FORM 734-	Contractor Quality Control	QUALITY ASSURANCE					
		ODOT	WAQTC			AASHTO	Project Manager	Region Quality Assurance	Materials Laboratory		
SECTION 00921 - MAJOR SIGN SUPPORT DRILLED SHAFTS											
Portland Cement Concrete											
	Sampling Concrete Slump of Concrete		TM 2								QA Testing
	Concrete Temperature			T 119							<u>Projects under 100 yd³ all classes</u> 1/Project representing all classes of PCC
	Density (Unit Weight) of Concrete			T 309							
	Yield			T 121							
	Water/Cement Ratio			T 121							<u>Projects over 100 yd³ all classes</u> 1/500 yd ³ per class minimum 1/class
	Fabrication of Concrete Cylinders/Beams			T 121							
	Compressive Strength of Concrete			R 100							
				T 22							
(S) 1 Set Represents a minimum of 3 Cylinders (M) Per Mix Design & Source											
TABLE 00512-1 Frequency of Quality Control Testing Minimum frequencies per Class of concrete based on daily production records.											
Production Frequencies 0 to 100 yd ³ on a single day 1 Set each day Quantity Over 100 yd³ 100 to 600 yd ³ on a single day 1 Set per each 100 yd ³ or portion thereof over 600 yd ³ on a single day 1 Set per each 200 yd ³ or portion thereof after reaching 600 yd ³											

INSERT TAB

SECTION 5
Field Tested Materials
Guide (Type D&E Projects)

FIELD TESTED MATERIALS ACCEPTANCE GUIDE				(Revised November 2022)				Same Frequency for all Tests (Minimums)				
MATERIAL AND OPERATION	DESCRIPTION OF TEST	TEST METHOD		FORM 734-	Quality Control		Quality Assurance					
		ODOT	WAQTC		AASHTO	Contractor Quality Control Type D		Contractor Quality Control Type E				
SECTION 00330-EARTHWORK												
(See Sec. 330.16(a)) Soil and Soil/Aggregate Mixtures	Gradation								Contractor Quality Control Type D	Contractor Quality Control Type E		Project Manager Type D & E
Establishing Maximum Density (for Compaction)	Density Curve			T 99			3468		1/Soil type	Requires Signed and Notarized Statement of Compliance From Contractor For All Items Under Section 00300	Visual	Review Documentation for Acceptance
	Specific Gravity of Coarse Aggregates			T 85			3468					
	Family of Curves			R 75			3468FC					
Compaction	Deflection Testing						1793S	1 Test per 3 ft. in depth				Review Documentation for Acceptance
	Nuclear Density Soils/Aggregates			T 310			1793S		See Table 00330-1 Below			
	Coarse Particle Correction Deflection Testing			T 99			1793S			Visual		
TABLE 00330-1 Frequency of Quality Control Testing												
Individual Areas												
Existing Ground Surface												
Over 3500 yd ² or yd ³												
1 test per 1000 yd ²												
Embankments												
1 test per 500 yd ³												
Excavations and Finished Subgrade												
1 test per 1000 yd ²												
1 test per 3000 yd ³												
1 test per 3000 yd ²												
Stone Embankment Material (See Sec. 330.16(a))	Gradation								Contractor Quality Control Type D	Contractor Quality Control Type E		Review Documentation for Acceptance
	Deflection Testing						1793S	1 per Layer		Visual		Review Documentation for Acceptance
Compaction	Deflection Testing			TM 158								
Contractor must demonstrate, by compaction testing or acceptable visual means, that the material, equipment, and process used for compaction achieves the specification requirements. If the material, equipment, or process changes, or if other conditions indicate a non-specification product, the Contractor must re-demonstrate that specification requirements are being achieved.												
Imported Topsoil (See Section 01040.14(b))	Compliance											Review Documentation for Acceptance
										Contractor Testing 1/Source & 1/Soil type	Visual	

FIELD TESTED MATERIALS ACCEPTANCE GUIDE					(Revised November 2022)			Same Frequency for all Tests (Minimums)		
MATERIAL AND OPERATION	DESCRIPTION OF TEST	TEST METHOD			FORM 734-	Quality Control		Quality Assurance		
		ODOT	WAQTC	AASHTO		Contractor Quality Control Type D	Contractor Quality Control Type E			
SECTION 00331 - SUBGRADE STABILIZATION Aggregate backfill	Material must meet the requirements of Section 00331.10					Contractor Testing		Review Documentation for Acceptance		
	Material must meet the requirements of Section 00340					Contractor Testing	Visual			
	Material must meet the requirements of Section 00331					Visual				
SECTION 00332 - SURFACING STABILIZATION Aggregate Base	Material must meet the requirements of Section 00332.10							Review Documentation for Acceptance		
	Material must meet the requirements of Section 00332					Visual	Visual			
SECTION 00333 - AGGREGATE DITCH LINING Aggregate	Sampling Aggregates			R 90				Review Documentation for Acceptance		
	Reducing Aggregates			R 76		1/Project or 1/Source	Visual			
	Sieve Analysis			T 27/T 11	1792					

FIELD TESTED MATERIALS ACCEPTANCE GUIDE				(Revised November 2022)		Same Frequency for all Tests (Minimums)		
MATERIAL AND OPERATION	DESCRIPTION OF TEST	TEST METHOD		FORM 734-	Quality Control		Quality Assurance	
		ODOT	WAQTC		AASHTO	Contractor Quality Control Type D		Contractor Quality Control Type E
SECTION 00344 - TREATED SUBGRADE								
Granular Quicklime	Sieve Analysis Calcium Hydroxide Content in lime			T 27 T 219	4000	Contractor Testing 1/Source	Manufacture Compliance Statement	Review Documentation for Acceptance
Hydrated Lime Calcium Chloride Sodium Chloride	Materials must meet the requirements of Section 00344.10 and Test Results Certificate provided according to Section 00165.35(a)							
Portland Cement Water	Material must meet the requirements of Section 02010							
Establishing Maximum Density (for Compaction)	Material must meet the requirements of Section 00340							
Compaction	Density Curve				3468			
	Deflection Testing	TM 158			1793S	See Special Provisions and Table 00344-1 Below	Visual	
	Deflection Testing Nuclear Density Soils/Aggregates	TM 158		T 310	1793S			Review Documentation for Acceptance
	Coarse Particle Correction			T 99				
TABLE 00344-1 Frequency of Quality Control Testing								
Individual Areas				Under 3500 yd²		Over 3500 yd²		
Finished Subgrade				1 test per 1000 yd ²		1 test per 3000 yd ²		

FIELD TESTED MATERIALS ACCEPTANCE GUIDE				(Revised November 2022)		Same Frequency for all Tests (Minimums)		
MATERIAL AND OPERATION	DESCRIPTION OF TEST	TEST METHOD		FORM 734-	Quality Control		Quality Assurance	
		ODOT	WAQTC		AASHTO	Contractor Quality Control Type D		Contractor Quality Control Type E
SECTION 00360 - Drainage Blankets								
Granular Drainage Blanket	Sampling Aggregates Reducing Aggregates Gradation			R 90 R 76 T 27/T 11	1792	Visual	A sublot equals 1000 Tons	Review Documentation for Acceptance
Sand Drainage Blanket	Sampling Aggregates Reducing Aggregates Gradation			R 90 R 76 T 27/T 11	1792	Visual		
Establishing Maximum Density (for Compaction)	Density Curve			T 99	3468	1/Source and Type		
Compaction	Specific Gravity of Coarse Aggregates			T 85				
Compaction	Deflection Testing			TM 158	1793S	1 Test per 3 ft. in depth		
Compaction	Deflection Testing Nuclear Density Soils/Aggregates Coarse Particle Correction			TM 158	1793S	See Table 00360-1 Below	Visual	Review Documentation for Acceptance
TABLE 00360-1 Frequency of Quality Control Testing								
Individual Areas				Under 3500 yd²		Over 3500 yd²		
Existing Ground Surface				1 test per 1000 yd ²		1 test per 3000 yd ²		
Finished Surfaces				1 test per 1000 yd ²		1 test per 3000 yd ²		

FIELD TESTED MATERIALS ACCEPTANCE GUIDE				(Revised November 2022)				Same Frequency for all Tests (Minimums)			
MATERIAL AND OPERATION	DESCRIPTION OF TEST	TEST METHOD			FORM 734-	Quality Control		Quality Assurance			
		ODOT	WAQTC	AASHTO		Contractor Quality Control Type D	Contractor Quality Control Type E				
SECTION 00390 - RIPRAP PROTECTION											
Fill Material & Riprap	Gradation See 00390.11(c)1					Contractor Furnished Testing	Visual	Review Documentation for Acceptance			
	Degradation Soundness Specific Gravity of Coarse Aggregates	TM 208		T 104 (1) T 85	4000 1825	Contractor Furnished Testing	Provide History of Passing Tests				
Filter Blanket	Gradation See 00390.13					Contractor Testing When Required	Visual	Review Documentation for Acceptance			
	Sampling Aggregates Reducing Aggregates Sieve Analysis			R 90 R 76 T 27/T 11	1792	1/Project	Visual				
Grouted Riprap Sand	Soundness Lightweight Pieces			T 104 T 113	4000	Contractor Furnished Testing	Provide History of Passing Tests	Review Documentation for Acceptance			
	Portland Cement	Material must meet the requirements of Section 02010									

FIELD TESTED MATERIALS ACCEPTANCE GUIDE					(Revised November 2022)			Same Frequency for all Tests (Minimums)		
MATERIAL AND OPERATION	DESCRIPTION OF TEST	TEST METHOD			FORM 734-	Quality Control		Quality Assurance		
		ODOT	WAQTC	AASHTO		Contractor Quality Control Type D	Contractor Quality Control Type E			
SECTION 00405 - TRENCH EXCAVATION, BEDDING, AND BACKFILL TRENCH FOUNDATION (Excavation Below Grade Only) (See Section 405.44)								Review Documentation for Acceptance		
	Selected general backfill						Requires Signed and Notarized Statement of Compliance From Contractor For All Items Under Section 00400			
	Selected granular backfill									
	Selected stone backfill									
	Other approved material									
Establishing Maximum Density	Density Curve			T 99			Visual	Review Documentation for Acceptance		
	Specific Gravity of Coarse Aggregates			T 85	3468	1/Soil Type or Aggregate Gradation				
	Family of Curves			R 75						
	Nuclear Density of Soils/Aggregates			T 310	1793S					
	Coarse Particle Correction			T 99		1 Test per 300 ft. of Trench				
Compaction							Visual			
<p>Contractor must demonstrate, by compaction testing or acceptable visual means, that the material, equipment, and process used for compaction achieves the specification requirements. If the material, equipment, or process changes, or if other conditions indicate a non-specification product, the Contractor must re-demonstrate that specification requirements are being achieved.</p>										

FIELD TESTED MATERIALS ACCEPTANCE GUIDE					(Revised November 2022)			Same Frequency for all Tests (Minimums)		
MATERIAL AND OPERATION	DESCRIPTION OF TEST	TEST METHOD			FORM 734-	Quality Control		Quality Assurance		
		ODOT	WAQTC	AASHTO		Contractor Quality Control Type D	Contractor Quality Control Type E			
SECTION 00405 - TRENCH EXCAVATION, BEDDING, AND BACKFILL (CONTINUED)										
Bedding 3/8" - 0 PCC fine aggregate (See Section 02690.30(h))	Sampling Aggregates Reducing Aggregates Sieve Analysis				R 90 R 76 T 27/T 11		Contractor Provided Testing	Visual	Review Documentation for Acceptance	
						1792	Contractor Provided Testing	Visual		
Commercial 3/4" - 0 Aggregate							Contractor Provided Testing	Visual	Review Documentation for Acceptance	
No. 10 - 0 Sand drainage blanket material (See Section 00360.10)	Sampling Aggregates Reducing Aggregates Sieve Analysis				R 90 R 76 T 27/T 11		Contractor Provided Testing	Visual		
Reasonably well graded sand, maximum 3/8" to dust							Contractor Provided Testing	Visual	Review Documentation for Acceptance	
Commercial available 3/8"-0 or No.10 - 0 sand							1 per Sublot	Visual		
Continuous cradle of Commercial Grade Concrete	Material must meet the requirements of Section 00440						Contractor Provided Testing	Visual	Review Documentation for Acceptance	

FIELD TESTED MATERIALS ACCEPTANCE GUIDE					(Revised November 2022)			Same Frequency for all Tests (Minimums)			
MATERIAL AND OPERATION	DESCRIPTION OF TEST	TEST METHOD			FORM 734-734-	Quality Control		Quality Assurance			
		ODOT	WAQTC	AASHTO		Contractor Quality Control Type D	Contractor Quality Control Type E				
SECTION 00405 - TRENCH EXCAVATION, BEDDING, AND BACKFILL (CONTINUED)											
Pipe Zone Material											
Flexible Pipe	Use the Listed Material requirements under Bedding										
Rigid Pipe: Aggregate Base 1" - 0 or 3/4" - 0 Aggregate (See Section 02630.10)	Sampling Aggregates Reducing Aggregates Sieve Analysis			R 90 R 76 T 27					Contractor Provided Testing	Visual	Review Documentation for Acceptance
Rigid Pipe: Commercial 1" - 0 or 3/4" - 0 Aggregate									Contractor Provided Testing	Visual	
Establishing Maximum Density (Flexible and Rigid Pipe) (¹) Method "A" & ODOT TM 223 for Dense Graded Base Aggregate	Density Curve			(¹) T 99					1/Source or Aggregate Gradation	Visual	
	Specific Gravity of Coarse Aggregates			T 85							
	Coarse Particle Correction			T 99							
Compaction	Nuclear Density Soils/Aggregates			T 310					1 test per 100 ft. of Trench and every 2.0 ft. of Fill	Visual	Review Documentation for Acceptance
<p>Contractor must demonstrate, by compaction testing or acceptable visual means, that the material, equipment, and process used for compaction achieves the specification requirements. If the material, equipment, or process changes, or if other conditions indicate a non-specification product, the Contractor must re-demonstrate that specification requirements are being achieved.</p>											

FIELD TESTED MATERIALS ACCEPTANCE GUIDE					(Revised November 2022)			Same Frequency for all Tests (Minimums)		
MATERIAL AND OPERATION	DESCRIPTION OF TEST	TEST METHOD			FORM 734-	Quality Control		Quality Assurance		
		ODOT	WAQTC	AASHTO		Contractor Quality Control Type D	Contractor Quality Control Type E			
SECTION 00405 - TRENCH EXCAVATION, BEDDING, AND BACKFILL (CONTINUED)										
Trench Backfill										
Class A Backfill - Native or common Material		Material must meet the requirements of Section 00330.43				Contractor Provided Testing	Visual	Review Documentation for Acceptance		
Class B Backfill - 1"-0 or 3/4"-0 Granular Material		Material must meet the requirements of Section 00641				Contractor Provided Testing	Visual	Review Documentation for Acceptance		
Class C Backfill - Clean sand with 100% minus 1/4" material						Contractor Provided Testing	Visual	Review Documentation for Acceptance		
Class D Backfill - Pit run or bar run material with 3" maximum dimension and well graded from coarse to fine						Contractor Provided Testing	Visual	Review Documentation for Acceptance		
Class E Backfill - Controlled Low Strength Material (CLSM)		Material must meet the requirements of Section 00442				Contractor Provided Testing	Visual	Review Documentation for Acceptance		
Establishing Maximum Density (1) Method "A" & ODOT TM 223 for Dense Graded Base Aggregate	Density Curve		(1) T 99		3468	Contractor Provided Testing	Visual	Review Documentation for Acceptance		
	Specific Gravity of Coarse Aggregates		T 85		3468	1/Soil Type or Aggregate Gradation	Visual	Review Documentation for Acceptance		
	Family of Curves		R 75		3468FC	1/Soil Type or Aggregate Gradation	Visual	Review Documentation for Acceptance		
Compaction (C) Density testing is based on cumulative lineal meters or feet of pipe placement.	Nuclear Density Soils/Aggregates		T 310		1793S	(C) 1 test per 100 ft. of Trench and every 2.0 ft. of Fill	Visual	Review Documentation for Acceptance		
	Coarse Particle Correction		T 99		or 1793B	(C) 1 test per 100 ft. of Trench and every 2.0 ft. of Fill	Visual	Review Documentation for Acceptance		
<p>Contractor must demonstrate, by compaction testing or acceptable visual means, that the material, equipment, and process used for compaction achieves the specification requirements. If the material, equipment, or process changes, or if other conditions indicate a non-specification product, the Contractor must re-demonstrate that specification requirements are being achieved.</p>										

FIELD TESTED MATERIALS ACCEPTANCE GUIDE				(Revised November 2022)		Same Frequency for all Tests (Minimums)								
MATERIAL AND OPERATION	DESCRIPTION OF TEST	TEST METHOD		FORM 734-734-	Quality Control		Quality Assurance							
		ODOT	WAQTC		AASHTO	Contractor Quality Control Type D		Contractor Quality Control Type E						
SECTION 00430 - SUBSURFACE DRAINS														
Granular Drain Backfill Material	Sampling Aggregates Reducing Aggregates Sieve Analysis		R 90 R 76 T 27		1792	Contractor Provided Testing	Visual	A Sublot equals 1000 Tons Review Documentation for Acceptance						
									Abrasion Degradation	TM 208	T 96	4000	Contractor Provided Testing	Minimum 1 Per Project
SECTION 00440 - COMMERCIAL GRADE CONCRETE														
Mixture	Sampling Concrete Air Content of Concrete Density (Unit Weight) of Concrete Yield Slump of Concrete	TM 2	T 152 T 121 T 119 T 309	3573WS or 4000C		(S) 1 per each set of cylinders	Contractor Provided Testing	Review Documentation for Acceptance						
									Modifiers Admixtures Portland Cement	Material must meet the requirements of Section 02030 Material must meet the requirements of Section 02040 Material must meet the requirements of Section 02010	Manufacture Compliance Statement			
Structural Items	Fabrication of Concrete Cylinders/Beams Compressive Strength of Concrete		R 100 T 22	4000C		(M) (S) 1 Set / Day Minimum	Contractor Provided Testing	Review Documentation for Acceptance						
									Except Visual Acceptance Items (See section 00440.14(a))	Fabrication of Concrete Cylinders/Beams Compressive Strength of Concrete	R 100 T 22	4000C	(M) (S) 1 Set/20 yd ³ Cumulative (Maximum 1 Set/day)	Contractor Provided Testing
									(S) 1 Set Represents a minimum of 3 Cylinders					
(M) Per Mix Design & Source														

FIELD TESTED MATERIALS ACCEPTANCE GUIDE					(Revised November 2022)			Same Frequency for all Tests (Minimums)		
MATERIAL AND OPERATION	DESCRIPTION OF TEST	TEST METHOD			FORM 734-	Quality Control		Quality Assurance		
		ODOT	WAQTC	AASHTO		Contractor Quality Control Type D	Contractor Quality Control Type E			
SECTION 00442 - CONTROLLED LOW STRENGTH MATERIALS (CLSM)										
CLSM Mixture	Mix Proportions Trial Batch Fabrication of Concrete Cylinders/Beams Compressive Strength of Concrete									
		R 100			4000C	1/Project or Source	Contractor Provided Testing	Review Documentation for Acceptance		
		T 22								
Modifiers		Material must meet the requirements of Section 02030								
Admixtures		Material must meet the requirements of Section 02040								
Portland Cement		Material must meet the requirements of Section 02010								
SECTION 00445 - SANITARY, STORM, CULVERT, SIPHON, AND IRRIGATION PIPE - INCLUDED WITH SECTION 00405										
Trench Work										
Excavation, bedding, pipe zone and trench backfill		See Section 00405 for pipes less than 72"								
Excavation, bedding, pipe zone and trench backfill		See Section 00510 for pipes greater than 72"								
Concrete Blocks		Material must meet the requirements of Section 00440								
		Contractor Provided Testing				Contractor Provided Testing	Review Documentation for Acceptance			

FIELD TESTED MATERIALS ACCEPTANCE GUIDE					(Revised November 2022)			Same Frequency for all Tests (Minimums)		
MATERIAL AND OPERATION	DESCRIPTION OF TEST	TEST METHOD			FORM 734-	Quality Control		Quality Assurance		
		ODOT	WAQTC	AASHTO		Contractor Quality Control Type D	Contractor Quality Control Type E			
SECTION 00450 - STRUCTURAL PLATE PIPE, PIPE ARCH AND ARCH										
Commercial Grade Concrete in appurtenances		Material must meet the requirements of Section 00440								Review Documentation for Acceptance
Trench Work										
Excavation and Backfill		Operations must meet the requirements of Section 00510								
Trenches in Unstable Areas										
Granular Structural Backfill		Material must meet the requirements of Section 00510						Contractor Provided Testing	Contractor Provided Testing	Visual
Establishing Maximum Density		Density Curve		(1) T 99						
(1) Method "A"		Specific Gravity of Coarse Aggregates		T 85				Contractor Provided Testing	Contractor Provided Testing	Visual
		Coarse Particle Correction	TM 223							
Compaction		Nuclear Density of Soils/Aggregates		T 310				Contractor Provided Testing	Contractor Provided Testing	Visual
Structure Backfill (Section 00450.46)		Material and Operation must meet the requirements of Section 00510.48(d)								Review Documentation for Acceptance
SECTION 00459 - CAST IN PLACE CONCRETE										
Concrete		Material must meet the requirements of Section 00540, with acceptance in accordance with Section 00540.17						Contractor Provided Testing	Contractor Provided Testing	Review Documentation for Acceptance
Backfill Material		Material must meet the requirements of Section 00405.14 and be incorporated into the project in accordance with Section 00405.46						Contractor Provided Testing	Contractor Provided Testing	Visual

FIELD TESTED MATERIALS ACCEPTANCE GUIDE				(Revised November 2022)		Same Frequency for all Tests (Minimums)		
MATERIAL AND OPERATION	DESCRIPTION OF TEST	TEST METHOD			FORM 734-	Quality Control		Quality Assurance
		ODOT	WAQTC	AASHTO		Contractor Quality Control Type D	Contractor Quality Control Type E	
SECTION 00460 - PAVED CULVERT END SLOPES								
Commercial Grade Concrete	Material must meet the requirements of Section 00440					Contractor Provided Testing	Contractor Provided Testing	Review Documentation for Acceptance
SECTION 00470 - MANHOLES, CATCH BASINS AND INLETS								
Commercial Grade Concrete	Material must meet the requirements of Section 00440							
Base Drain Backfill	Material must meet the requirements of Section 00470.17					Contractor Provided Testing	Visual	Review Documentation for Acceptance
Excavation, Backfill and Foundation Stabilization	Material must meet the requirements of Section 00405							
SECTION 00480 - DRAINAGE CURBS								
Commercial Grade Concrete	Material must meet the requirements of Section 00440					Contractor Provided Testing	Visual	Review Documentation for Acceptance
Dense Graded H/MAC Mixture	Material must meet the requirements of Section 00740							

FIELD TESTED MATERIALS ACCEPTANCE GUIDE					(Revised November 2022)			Same Frequency for all Tests (Minimums)		
MATERIAL AND OPERATION	DESCRIPTION OF TEST	TEST METHOD			FORM 734-	Quality Control		Quality Assurance		
		ODOT	WAQTC	AASHTO		Contractor Quality Control Type D	Contractor Quality Control Type E			
SECTION 00490 - WORK ON EXISTING SEWERS AND STRUCTURES										
Commercial Grade Concrete		Material must meet the requirements of Section 00440				Contractor Provided Testing	Visual	Review Documentation for Acceptance		
High Early Strength Concrete		Material must meet the requirements of Section 00440, but cement contents adjusted according to 00490.11								
Backfill Operations		Backfill Excavations according to section 405								
Filling Abandoned Pipes, Manholes and Catch Basins (See section 00490.44)										
Backfill Operations (Roadway)		Material must meet the requirements of Section 2630								
Establishing Maximum Density (1) Method "A"	Density Curve			(1) T 99		Contractor Provided Testing	Visual	Review Documentation for Acceptance		
	Specific Gravity of Coarse Aggregates Coarse Particle Correction	TM 223		T 85	3468 B					
Compaction	Nuclear Density of Soils/Aggregates			T 310	1793B	1 Test per 100 ft. and every 1.5' of Fill	Visual			
Backfill Operations Landscaped or Unimproved Roadways		Material must meet the requirements of Section 00330.13								
Top 1.0' of Backfill Region		Material must meet the requirements of Section 00330.11								
SECTION 00495 - TRENCH RESURFACING										
Resurfacing Materials		See Section 00495.40 for Material Requirements				Contractor Provided Testing	Visual	Review Documentation for Acceptance		

FIELD TESTED MATERIALS ACCEPTANCE GUIDE					(Revised November 2022)			Same Frequency for all Tests (Minimums)		
MATERIAL AND OPERATION	DESCRIPTION OF TEST	TEST METHOD			FORM	Quality Control		Quality Assurance		
		ODOT	WAQTC	AASHTO		Contractor Quality Control Type D	Contractor Quality Control Type E			
SECTION 00510 - STRUCTURE EXCAVATION AND BACKFILL										
Soils, Soil/Aggregate Mixtures and Graded Aggregates										
Granular Structure Backfill (See Section 02630.10) (1) Perform a minimum of 3 tests QL's required	Sampling Aggregates Reducing Aggregates (1) Sieve Analysis Fracture (Method 1) Sand Equivalent									
		R 90 R 76 T 27 T 335 T 176				1/Sublot (Minimum 1/Project)	Requires Signed and Notarized Statement of Compliance From Contractor For All Items Under Section 00500			
Product Compliance	Abrasion Degradation Plasticity Index Sieve Analysis									
		TM 208			4000	Contractor Provided Testing	Minimum 1 per Project			
Establishing Maximum Density (2) Method "A" & ODOT TM 223 for Dense Graded Base Aggregate	Density Curve			(2) T 99	3468					
	Specific Gravity of Coarse Aggregates			T 85		1/Soil type or Aggregate Gradation	Visual			
	Coarse Particle Correction			T 99	3468					
Compaction	Nuclear Density									
	Soils/Aggregates			T 310	1793B	Min of 1 per lift	Visual			
<p>A Sublot equals 1000 Tons</p> <p>Review Documentation for Acceptance</p> <p>Review Documentation for Acceptance</p>										
<p>Contractor must demonstrate, by compaction testing or acceptable visual means, that the material, equipment, and process used for compaction achieves the specification requirements. If the material, equipment, or process changes, or if other conditions indicate a non-specification product, the Contractor must re-demonstrate that specification requirements are being achieved.</p>										

FIELD TESTED MATERIALS ACCEPTANCE GUIDE				(Revised November 2022)		Same Frequency for all Tests (Minimums)		
MATERIAL AND OPERATION	DESCRIPTION OF TEST	TEST METHOD		FORM 734-	Quality Control		Quality Assurance	
		ODOT	WAQTC		AASHTO	Contractor Quality Control Type D		Contractor Quality Control Type E
SECTION 00510 - STRUCTURE EXCAVATION AND BACKFILL (CONTINUED)								
Soils, Soil/Aggregate Mixtures and Graded Aggregates								
Granular Wall Backfill (See Section 02630.11)	Sampling Aggregates Reducing Aggregates				R 90 R 76 T 27 T 335			
	⁽¹⁾ Sieve Analysis Fracture (Method 2)					1/Sublot (Minimum 1/Project)	Contractor Provided Testing	Review Documentation for Acceptance
⁽¹⁾ Perform a minimum of 3 tests QL's required								
Product Compliance	Abrasion				T 96			
	Degradation	TM 208				Contractor Provided Testing	Minimum 1 per Project	
⁽²⁾ Compaction	⁽²⁾ Deflection Testing							
		TM 158				1/Sublot (Minimum 1/Project)	Visual	Review Documentation for Acceptance
Note: Compaction must meet the requirements of section 00330.43c								
Contractor must demonstrate, by compaction testing or acceptable visual means, that the material, equipment, and process used for compaction achieves the specification requirements. If the material, equipment, or process changes, or if other conditions indicate a non-specification product, the Contractor must re-demonstrate that specification requirements are being achieved.								

FIELD TESTED MATERIALS ACCEPTANCE GUIDE				(Revised November 2022)		Same Frequency for all Tests (Minimums)		
MATERIAL AND OPERATION	DESCRIPTION OF TEST	TEST METHOD		FORM 734-	Quality Control		Quality Assurance	
		ODOT	WAQTC		AASHTO	Contractor Quality Control Type D		Contractor Quality Control Type E
SECTION 00512 - DRILLED SHAFTS								
Aggregate Production	Sampling Aggregates Reducing Aggregates (2)(3)(4) Sieve Analysis (4) Fineness Modulus (1)(3) Wood Particles (4) Sand Equivalent						A Sublot equals 1000 Mg or 1000 Tons	Review Documentation for Acceptance
(1) QAE may waive after 5 sublots/shifts				R 90 R 76 T 27/T 11 T 27/T 11			Contractor Provided Testing	
(2) Perform a minimum of 3 tests QL's required	TM 225			T 176				
(3) Coarse Aggregate (See Section 02690.20)	Soundness Abrasion Degradation Lightweight Pieces Organics	TM 208			T 104 T 96 T 113 T 21		Contractor Provided Testing	
(4) Fine Aggregate (See Section 02690.30)								
	(3) Dry Rodded Unit Weight				T 19			
	(3) Specific Gravity of Coarse Aggregate				T 84		Minimum of 1 per Project	
	(4) Specific Gravity of Fine Aggregate				T 85		Minimum of 1 per Project	
Portland Cement Modifiers Admixtures	Materials must meet the requirements of Section 02001.10						Manufacture Compliance Statement	
Drilling Slurry	Slurry material must meet the requirements of Section 00512.14 & 00512.43(g)						Contractor Provided Testing	
Grout	Material must meet the requirements of Section 02080						Manufacture Compliance Statement	
Mixing Water	Material must meet the requirements of Section 02020						Manufacture Compliance Statement	

FIELD TESTED MATERIALS ACCEPTANCE GUIDE

(Revised November 2022)

Same Frequency for all Tests (Minimums)

MATERIAL AND OPERATION	DESCRIPTION OF TEST	TEST METHOD			FORM 734-734-	Quality Control		Quality Assurance
		ODOT	WAQTC	AASHTO		Contractor Quality Control Type D	Contractor Quality Control Type E	
SECTION 00512 - DRILLED SHAFTS (CONTINUED)								
Portland Cement Concrete	Sampling Concrete Slump of Concrete Concrete Temperature Density (Unit Weight) of Concrete Yield Water/Cement Ratio	TM 2		T 119 T 309 T 121 T 121 T 121	3573WS or 4000C	(M) (S) 1 per Shaft and Test at minimum frequencies according to table 00512-1. Review specs.	(M) (S) 1 per Shaft and Test at minimum frequencies according to table 00512-1. Review specs.	Review Documentation for Acceptance
(S) 1 Set Represents a minimum of 3 Cylinders								
(M) Per Mix Design & Source								

TABLE 00512-1 Frequency of Quality Control Testing

Minimum frequencies per Class of concrete based on daily production records.	
Production	Frequencies
0 to 100 yd ³ on a single day	1 Set each day
Quantity Over 100 yd³	
100 to 600 yd ³ on a single day	1 Set per each 100 yd ³ or portion thereof
over 600 yd ³ on a single day	1 Set per each 200 yd ³ or portion thereof after reaching 600 yd ³

FIELD TESTED MATERIALS ACCEPTANCE GUIDE				(Revised November 2022)		Same Frequency for all Tests (Minimums)		
MATERIAL AND OPERATION	DESCRIPTION OF TEST	TEST METHOD		FORM 734-	Quality Control		Quality Assurance	
		ODOT	ASTM		AASHTO	Contractor Quality Control Type D		Contractor Quality Control Type E
SECTION 00535 - POST-INSTALLED ANCHOR SYSTEMS								
Resin Bonded Anchor System								
Anchor Bolts, reinforcing steel and resin (Polyester, vinyl ester or epoxy)					A Sublot equals 50 Anchors			
Anchor Installation								
Demonstration Testing (See Section 00535.45(a))	Strength of Anchors in Concrete Elements	E 488		5189		One demonstration Test includes 3 anchors (Resin shall be from same lot)	Visual	
Production Testing (See Section 00535.45(b))	Strength of Anchors in Concrete Elements	E 488		5189		^(A) 1 Anchor/Sublot or portion thereof (Minimum 1/Shift)	Visual per Sublot	
^(A) Anchor testing is required per critical element identified in the Special Provisions or Plan Drawings.								

FIELD TESTED MATERIALS ACCEPTANCE GUIDE				(Revised November 2022)		Same Frequency for all Tests (Minimums)		
MATERIAL AND OPERATION	DESCRIPTION OF TEST	TEST METHOD		FORM 734-	Quality Control		Quality Assurance	
		ODOT	ASTM		AASHTO	Contractor Quality Control Type D	Contractor Quality Control Type E	Project Manager Type D & E
SECTION 00535 - POST-INSTALLED ANCHOR SYSTEMS (continued)								
Mechanical Anchor System								
Mechanical Anchors								
<i>Materials must meet the requirements of Section 00535.10(b)</i>								
Anchor Installation								
Demonstration Testing (See Section 00535.45(a))	Strength of Anchors in Concrete Elements	E 488		5292	One demonstration Test includes 3 anchors			Visual
Production Testing (See Section 00535.45(b))	Strength of Anchors in Concrete Elements	E 488		5292	(A) 1 Anchor/Sublot or portion thereof (Minimum 1/Shift)			Visual per Sublot
(A) Anchor testing is required per critical element identified in the Special Provisions or Plan Drawings.								

FIELD TESTED MATERIALS ACCEPTANCE GUIDE				(Revised November 2022)		Same Frequency for all Tests (Minimums)		
MATERIAL AND OPERATION	DESCRIPTION OF TEST	TEST METHOD		FORM 734-	Quality Control		Quality Assurance	
		ODOT	WAQTC		AASHTO	Contractor Quality Control Type D		Contractor Quality Control Type E
SECTION 00540 - CONCRETE BRIDGES								
Aggregate Production	Sampling Aggregates						A Sublot equals 1000 Mg or 1000 Tons	
(1) QAE may waive after 5 sublots/shifts	Reducing Aggregates (2)(3)(4) Sieve Analysis (4) Fineness Modulus	R 90 R 76 T 27/T 11 T 27/T 11						Review Documentation for Acceptance
(2) Perform a minimum of 3 tests	(1)(3) Wood Particles (4) Sand Equivalent	T 176						
(3) Coarse Aggregate (See Section 02690.20)	Soundness Abrasion Degradation Lightweight Pieces Organics	T 104 T 96 T 113 T 21		4000			Minimum 1 per Project	
(4) Fine Aggregate (See Section 02690.30)	(3) Dry Rodded Unit Weight	T 19		1825 1825C			Contractor Provided Testing Minimum 1 per Project	
	(3) Specific Gravity of Coarse Aggregate (4) Specific Gravity of Fine Aggregate	T 85 T 84		1825			Contractor Provided Testing Minimum 1 per Project	
Portland Cement Modifiers Admixtures	Materials must meet the requirements of Section 02001.10							
Mixing Water	Material must meet the requirements of Section 02020							

FIELD TESTED MATERIALS ACCEPTANCE GUIDE				(Revised November 2022)		Same Frequency for all Tests (Minimums)												
MATERIAL AND OPERATION	DESCRIPTION OF TEST	TEST METHOD		FORM	Quality Control		Quality Assurance											
		ODOT	WAQTC		AASHTO	Contractor Quality Control Type D		Contractor Quality Control Type E										
SECTION 00540 - CONCRETE BRIDGES (CONTINUED)																		
Portland Cement Concrete																		
(1) AASHTO T 196 required for lightweight concrete	Sampling Concrete	TM 2																
	(1) Air Content of Concrete																	
	Slump of Concrete																	
	Concrete Temperature																	
	Density (Unit Weight) of Concrete																	
	Yield																	
	Water/Cement Ratio																	
	Fabrication of Concrete																	
	Cylinders/Beams																	
	Compressive Strength of Concrete																	
(S) 1 Set Represents a minimum of 3 Cylinders																		
(M) Per Mix Design & Source																		
<p>TABLE 00540-1 Frequency of Quality Control Testing</p> <p>Minimum frequencies per Class of concrete based on daily production records.</p> <table border="1"> <thead> <tr> <th><u>Production</u></th> <th><u>Frequencies</u></th> </tr> </thead> <tbody> <tr> <td>0 to 100 yd³ on a single day</td> <td>1 Set each day</td> </tr> <tr> <td><u>Quantity Over 100 yd³</u></td> <td></td> </tr> <tr> <td>100 to 600 yd³ on a single day</td> <td>1 Set per each 100 yd³ or portion thereof</td> </tr> <tr> <td>over 600 yd³ on a single day</td> <td>1 Set per each 200 yd³ or portion thereof after reaching 600 yd³</td> </tr> </tbody> </table>									<u>Production</u>	<u>Frequencies</u>	0 to 100 yd ³ on a single day	1 Set each day	<u>Quantity Over 100 yd³</u>		100 to 600 yd ³ on a single day	1 Set per each 100 yd ³ or portion thereof	over 600 yd ³ on a single day	1 Set per each 200 yd ³ or portion thereof after reaching 600 yd ³
<u>Production</u>	<u>Frequencies</u>																	
0 to 100 yd ³ on a single day	1 Set each day																	
<u>Quantity Over 100 yd³</u>																		
100 to 600 yd ³ on a single day	1 Set per each 100 yd ³ or portion thereof																	
over 600 yd ³ on a single day	1 Set per each 200 yd ³ or portion thereof after reaching 600 yd ³																	

FIELD TESTED MATERIALS ACCEPTANCE GUIDE				(Revised November 2022)		Same Frequency for all Tests (Minimums)		
MATERIAL AND OPERATION	DESCRIPTION OF TEST	TEST METHOD			FORM 734-	Quality Control		Quality Assurance
		ODOT	WAQTC	AASHTO		Contractor Quality Control Type D	Contractor Quality Control Type E	
SECTION 00556 - MULTI-LAYER POLYMER CONCRETE OVERLAY								
Aggregate Production	Moisture Content of Aggregate & Soil							
				T 255/265	1792	At time of mixing the polymer resin. See 00556.10-b.		
Polymer Resin		Material must meet the requirements of section 00556.10				Contractor Provided Testing	Contractor Provided Testing	Review Documentation for Acceptance
								Review Documentation for Acceptance

FIELD TESTED MATERIALS ACCEPTANCE GUIDE				(Revised November 2022)		Same Frequency for all Tests (Minimums)		
MATERIAL AND OPERATION	DESCRIPTION OF TEST	TEST METHOD		FORM 734-	Quality Control		Quality Assurance	
		ODOT	WAQTC		AASHTO	Contractor Quality Control Type D		Contractor Quality Control Type E
SECTION 00557 - PREMIXED POLYMER CONCRETE OVERLAYS								
Resin Primer	Material must meet the requirements of section 00557.10				Contractor Provided Testing	Contractor Provided Testing	Review Documentation for Acceptance	
Polyester Resin Binder Including (Initiator, Accelerators & Inhibitors)	Material must meet the requirements of section 00557.12 (a-c)				Contractor Provided Testing	Contractor Provided Testing	Review Documentation for Acceptance	
Product Compliance	Specific Gravity of Coarse Aggregate			T 85				
	Specific Gravity of Fine Aggregate			T 84				
(Submitt 2- 50 lb. samples of blended aggregate (00557.02)during the trial overlay). See Section 00557.12(d)	Sieve Analysis			T 27/T 11	1/Project or Source	1/Project or Source		
	Moisture Content of Aggregate & Soil Fracture (Method 1)			T 255/265				
	Moisture Content Sieve Analysis			T 27/11				
	(¹) Moisture Content of Aggregate & Soils				During the Trial Overlay Strip	During the Trial Overlay Strip		
(¹) See Section 00557.12(d)	Sieve Analysis			T 255/265				
Surface Texture Sand (see section 00557.12(e))					During Production			
					Contractor Provided Testing	Contractor Provided Testing	Review Documentation for Acceptance	
Premixed Polymer Concrete	Density (Unit Weight) of Concrete			T 27/11	1792	1792		
	Static Modulus of Elasticity			T 121	(^B) 1/Batch	(^B) 1/Batch		
					3573WS	3573WS		
					(^M) Minimum 1 set/batch	(^M) Minimum 1 set/batch		
(^M) 1 set Represents a minimum of 3 (4"x8") cylinders cast per 00557.44(e).					4000C	4000C		
(²) Submit to ODOT - CML					(²) 1 set per 10 batches placed or minimum 1 set/day	(²) 1 set per 10 batches placed or minimum 1 set/day		
(^B) Batch is defined "Per Mixer or Portion placed".							Review Documentation for Acceptance	

FIELD TESTED MATERIALS ACCEPTANCE GUIDE					(Revised November 2022)			Same Frequency for all Tests (Minimums)		
MATERIAL AND OPERATION	DESCRIPTION OF TEST	TEST METHOD			FORM 734-	Quality Control		Quality Assurance		
		ODOT	WAQTC	AASHTO		Contractor Quality Control Type D	Contractor Quality Control Type E			
SECTION 00559 - STRUCTURAL CONCRETE OVERLAYS										
Aggregate Production										
(1) QAE may waive after 5 sublots/shifts	Sampling Aggregates									A Sublot equals 500 Tons. A minimum one per shift, whichever results in the greatest sampling frequency. (For preproduced aggregates, 1 shift shall mean 500 Tons.)
	Reducing Aggregates									
(2) Perform a minimum of 3 tests, QL's required	(2)(3)(4) Sieve Analysis			R 90	1792					Contractor Provided Testing
	(4) Fineness Modulus			T 27/T 11	1792					
(3) Coarse Aggregate (See Section 02690.20)	(4) Sand Equivalent			T 27/T 11						Contractor Provided Testing
	(1)(3) Elongated Piece			T 176						
(4) Fine Aggregate (See Section 02690.30)	(1)(3) Wood Particles	TM 229			1792					Contractor Provided Testing
	Abrasion	TM 208								
(3) Dry Rodded Unit Weight	Degradation				4000					Minimum 1 Per Project
	Soundness									
(4) Specific Gravity of Fine Aggregate	Lightweight Pieces				4000					Minimum 1 Per Project
	Organics									
Portland Cement	(3) Specific Gravity of Coarse Aggregate			T 19	1825					Start of production and when changes in aggregate occurs
	(4) Specific Gravity of Fine Aggregate			T 85	1825C					
Modifiers				T 84	1825					Start of production and when changes in aggregate occurs
Admixtures										
Mixing Water										Manufacture Compliance Statement
Materials must meet the requirements of Section 02001.10										
Material must meet the requirements of Section 02020										

FIELD TESTED MATERIALS ACCEPTANCE GUIDE				(Revised November 2022)				Same Frequency for all Tests (Minimums)			
MATERIAL AND OPERATION	DESCRIPTION OF TEST	TEST METHOD			FORM 734-	Quality Control		Quality Assurance			
		ODOT	WAQTC	AASHTO		Contractor Quality Control Type D	Contractor Quality Control Type E				
SECTION 00559 - STRUCTURAL CONCRETE OVERLAYS (CONTINUED)											
Portland Cement Concrete											
⁽¹⁾ AASHTO T 196 required for lightweight concrete	Sampling Concrete	TM 2	T 152 T 119 T 309 T 121 T 121 T 121	3573WS or 4000 C	A subplot or Minimum 1 per Shift	Contractor Provided Testing	Review Documentation for Acceptance				
	⁽¹⁾ Air Content of Concrete										
	Slump of Concrete										
	Concrete Temperature										
	Density (Unit Weight) of Concrete										
	Yield W/C Ratio										
Latex Modified Concrete	Fine Aggregate Moisture	T 255 / T 265	1792	Contractor Provided Testing	Review Documentation for Acceptance						
^(M) Per Mix Design & Source	Mixer Calibration					Contractor Provided Testing					
	Fabrication of Concrete Cylinders/Beams Compressive Strength of Concrete	R 100 T 22	4000C	(M) (S) 1 Set Cylinders per 50yd ³ Minimum 1 set/shift	(M) (S) 1 Set Cylinders per 50yd ³ Minimum 1 set/shift	Review Documentation for Acceptance					
^(S) 1 Set Represents a minimum of 3 Cylinders											
SECTION 00590 - POLYMER MEMBRANE											
Broadcast Aggregate											
Moisture Content of Aggregates & Soils	Moisture Content of Aggregates & Soils		T 255/265	1792	Test at time of packaging and shipment. See Section 00590.10-c	Test at time of packaging and shipment. See Section 00590.10-c	Review Documentation for Acceptance				
Moisture Content of Aggregates & Soils	Moisture Content of Aggregates & Soils		T 255/265	1792	Field Test at time of Mixing Polymer Resin. See Section 00590.10-c	Field Test at time of Mixing Polymer Resin. See Section 00590.10-c	Review Documentation for Acceptance				

FIELD TESTED MATERIALS ACCEPTANCE GUIDE					(Revised November 2022)		Same Frequency for all Tests (Minimums)		
MATERIAL AND OPERATION	DESCRIPTION OF TEST	TEST METHOD			FORM 734-734-	Quality Control		Quality Assurance	
		ODOT	WAQTC	AASHTO		Contractor Quality Control Type D	Contractor Quality Control Type E		
SECTION 00596A - MECHANICALLY STABILIZED EARTH RETAINING WALLS									
Aggregate Production									
Gravel Leveling Pads Backfill (See Section 02630.10)	Abrasion Degradation	TM 208		T 96	4000	Contractor Provided Testing	Minimum 1 Per Project	Review Documentation for Acceptance	
	Sampling Aggregates			R 90					
	Reducing Aggregates			R 76					
	Sieve Analysis Un-washed Sand Equivalent Fracture (Method 1)			T 27 T 176 T 335	1792 1792	1/Sublot 1/5 Sublots	Visual	Review Documentation for Acceptance	
Testing Frequency for Product Compliance per Source 1/5,000 Tons Minimum 1/Project									
⁽³⁾ Modular Block Core and Drainage Backfill (Product Compliance)	Soundness			T 104	4000	Contractor Provided Testing	Minimum 1 Per Project	Review Documentation for Acceptance	
	Abrasion Degradation	TM 208		T 96					
	Lightweight Pieces			T 113	4000				
A Sublot equals 1,000 Tons									
⁽³⁾ Modular Block Core and Backfill ⁽¹⁾ QAE may waive after 5 sublots/shifts	Sampling Aggregates			R 90					
	Reducing Aggregates			R 76					
	⁽²⁾ Sieve Analysis			T 27/T 11	1792	1/Sublot or Minimum 1 Per Project	Visual	Review Documentation for Acceptance	
	⁽¹⁾ Wood Particles Fracture (Method 2)	TM 225		T 335	1792				
Elongated Pieces	TM 229								
⁽²⁾ Perform a minimum of 3 tests, QL's required Pipe Drain Backfill (Product Compliance) (See Section 00430.11)	Abrasion Degradation	TM 208		T 96	4000	Contractor Provided Testing	Minimum 1 Per Project	Review Documentation for Acceptance	
	Sieve Analysis Un-washed			T 27	4000	1/Sublot	Visual		

FIELD TESTED MATERIALS ACCEPTANCE GUIDE				(Revised November 2022)			Same Frequency for all Tests (Minimums)		
MATERIAL AND OPERATION	DESCRIPTION OF TEST	TEST METHOD			FORM 734-	Quality Control		Quality Assurance	
		ODOT	WAQTC	AASHTO		Contractor Quality Control Type D	Contractor Quality Control Type E		
SECTION 00596A - MECHANICALLY STABILIZED EARTH RETAINING WALLS									
Aggregate Production									
Gabion Basket Fill (Product Compliance) (See Section 00390.11(b))	Degradation Soundness Specific Gravity of Coarse Aggregates	TM 208			T 104 (1) T 85	4000	Contractor Provided Testing	Minimum 1 per Project	Review Documentation for Acceptance
						1825			
(1) Apparent Specific Gravity and Absorption	Gradation						1/Sublot (Minimum 1/Project)	Visual	
Testing Frequency for Product Compliance per Source 1/5000 Tons Minimum 1/Project									

FIELD TESTED MATERIALS ACCEPTANCE GUIDE				(Revised November 2022)		Same Frequency for all Tests (Minimums)																											
MATERIAL AND OPERATION	DESCRIPTION OF TEST	TEST METHOD		FORM 734-734-	Quality Control		Quality Assurance																										
		ODOT	WAQTC		AASHTO	Contractor Quality Control Type D		Contractor Quality Control Type E	Project Manager Type D & E																								
SECTION 00596A - MSE RETAINING WALLS																																	
Aggregate Production																																	
MSE Granular Wall Backfill (Product Compliance) (Also reference 02630.10)	Abrasion Degradation Sieve Analysis Plasticity Index pH of Soil Soil Resistivity Organic Content	TM 208		T 96 T 11 T 90 T 289 T 288 T 267	4000	Contractor Provided Testing	Minimum 1 per Project	Review Documentation for Acceptance																									
									MSE Granular Wall Backfill	Sampling Aggregates Reducing Aggregates (¹) Sieve Analysis Un-Washed Sand Equivalent Fracture (Method 1)				R 90 R 76 T 27 T 176 T 335	1/Sublot (Minimum 1/Project)	Visual	Review Documentation for Acceptance																
																		Placement Establishing Maximum Density (²) Method A	Density Curve			(2) T 99	1/5 Sublots	Visual	Review Documentation for Acceptance								
																										Compaction	Specific Gravity of Coarse Aggregates			T 85	1/Aggregate Gradation/Per Source	Visual	Review Documentation for Acceptance
Nuclear Density of Soils/Aggregates	TM 158																																
Deflection Testing																																	
<p>Contractor must demonstrate, by compaction testing or acceptable visual means, that the material, equipment, and process used for compaction achieves the specification requirements. If the material, equipment, or process changes, or if other conditions indicate a non-specification product, the Contractor must re-demonstrate that specification requirements are being achieved.</p>																																	

FIELD TESTED MATERIALS ACCEPTANCE GUIDE					(Revised November 2022)			Same Frequency for all Tests (Minimums)		
MATERIAL AND OPERATION	DESCRIPTION OF TEST	TEST METHOD			FORM 734-	Quality Control		Quality Assurance		
		ODOT	WAQTC	AASHTO		Contractor Quality Control Type D	Contractor Quality Control Type E		Project Manager Type D & E	
SECTION 00596B - PREFABRICATED MODULAR RETAINING WALLS										
Aggregate Production										
Gravel Leveling Pads Backfill (See Section 02630.10)	Abrasion Degradation	TM 208			T96	4000	Contractor Provided Testing	Minimum 1 Per Project	Review Documentation for Acceptance	
	Sampling Aggregates				R 90				Review Documentation for Acceptance	
	Reducing Aggregates				R 76		1/Sublot	Visual		
	Sieve Analysis Un-Washed Sand Equivalent				T 27					
	Fracture (Method 1)				T 176	1792				
				T 335	1792	1/5 Sublots	Visual			
A Sublot equals 1000 Tons Minimum 1/Project										
Testing Frequency for Product Compliance per Source 1/5000 Tons Minimum 1/Project										
⁽³⁾ Modular Block Core and Backfill (Product Compliance)	Soundness				T 104	4000			Review Documentation for Acceptance	
	Abrasion Degradation	TM 208			T 96		Contractor Provided Testing	Minimum 1 Per Project		
	Lightweight Pieces				T 113	4000				
A Sublot equals 1000 Tons										
⁽³⁾ Modular Block Core and Backfill ⁽¹⁾ QAE may waive after 5 sublots/shifts	Sampling Aggregates				R 90				Review Documentation for Acceptance	
	Reducing Aggregates				R 76					
	⁽²⁾ Sieve Analysis ⁽¹⁾ Wood Particles Fracture (Method 2) Elongated Pieces	TM 225 TM 229			T 27/T 11 T 335	1792 1792	1/Sublot (Minimum 1 Per Project)	Visual		
A Sublot equals 1000 Tons										
⁽²⁾ Perform a minimum of 3 tests, QL's required										
Pipe Drain Backfill (Product Compliance) (See Section 00430.11)	Abrasion Degradation	TM 208			T 96	4000	Contractor Provided Testing	Minimum 1 Per Project	Review Documentation for Acceptance	
	Sieve Analysis Un-Washed				T 27	4000	1/Sublot	Visual		

FIELD TESTED MATERIALS ACCEPTANCE GUIDE				(Revised November 2022)		Same Frequency for all Tests (Minimums)			
MATERIAL AND OPERATION	DESCRIPTION OF TEST	TEST METHOD			FORM 734-	Quality Control		Quality Assurance	
		ODOT	WAQTC	AASHTO		Contractor Quality Control Type D	Contractor Quality Control Type E		
SECTION 00596B - PREFABRICATED MODULAR RETAINING WALLS									
Aggregate Production									
Gabion Basket Fill (Product Compliance) (See Section 00390.11(b))	Degradation Soundness Specific Gravity of Coarse Aggregates	TM 208			4000 1825	T 104 (1) T 85	Contractor Provided Testing	Minimum 1 Per Project	Review Documentation for Acceptance
							1/Sublot	Visual	
(1) Apparent Specific Gravity and Absorption	Gradation								
Testing Frequency for Product Compliance per Source 1/5000 Tons Minimum 1/Project									

FIELD TESTED MATERIALS ACCEPTANCE GUIDE					(Revised November 2022)			Same Frequency for all Tests (Minimums)		
MATERIAL AND OPERATION	DESCRIPTION OF TEST	TEST METHOD			FORM 734-734-	Quality Control		Quality Assurance		
		ODOT	WAQTC	AASHTO		Contractor Quality Control Type D	Contractor Quality Control Type E			
SECTION 00596B - PREFABRICATED MODULAR RETAINING WALLS										
Aggregate Production										
Retaining Wall Granular Backfill (Product Compliance) (Also reference 02630.10)	Abrasion Degradation									
	Sieve Analysis	TM 208			4000	T96	Contractor Provided Testing	Minimum 1 Per Project	Review Documentation for Acceptance	
	Plasticity Index				4000	T 11 T 90				
A Sublot Equals 2000 Tons										
Retaining Wall Granular Backfill (1) Perform a minimum of 3 tests, QL's required	Sampling Aggregates					R 90				
	Reducing Aggregates					R 76 T 27		1/Sublot (Min. 1 Per Project)	Visual	Review Documentation for Acceptance
	(1) Sieve Analysis Un-Washed Sand Equivalent				1792	T 176				
Placement Establishing Maximum Density (2) Method A	Fracture (Method 1)					T 335		1/5 Sublots	Visual	
	Density Curve					(2) T 99				
	Specific Gravity of Coarse Aggregates					T 85		1/Aggregate Gradation/Per Source	Visual	Review Documentation for Acceptance
Compaction	Agg. Base Coarse Particle Correction	TM 223			3468					
	Nuclear Density of Soils/Aggregates				1793B	T 310		1/100 yd ³ (Minimum 1/day)	Visual	
	Deflection Testing	TM 158			1793B			1 per layer	Visual	
Contractor must demonstrate, by compaction testing or acceptable visual means, that the material, equipment, and process used for compaction achieves the specification requirements. If the material, equipment, or process changes, or if other conditions indicate a non-specification product, the Contractor must re-demonstrate that specification requirements are being achieved.										

FIELD TESTED MATERIALS ACCEPTANCE GUIDE						(Revised November 2022)				Same Frequency for all Tests (Minimums)						
MATERIAL AND OPERATION	DESCRIPTION OF TEST	TEST METHOD			FORM 734-	Quality Control		Quality Assurance								
		ODOT	WAQTC	AASHTO		Contractor Quality Control Type D	Contractor Quality Control Type E	Project Manager Type D & E	Project Manager Type D & E							
SECTION 00596C - CAST-IN-PLACE CONCRETE RETAINING WALLS																
Aggregate Production																
Pipe Drain Backfill (Product Compliance) (See Section 00430.11)	Abrasion Degradation															
	Sampling Aggregates Reducing Aggregates	TM 208			4000				Contractor Provided Testing	Minimum 1 Per Project					Review Documentation for Acceptance	
	Sieve Analysis Un-Washed				4000				1/Sublot	Visual						
Retaining Wall Granular Backfill													Testing Frequency for Product Compliance per Source 1/5000 Tons Minimum 1/Project			
Retaining Wall Granular Backfill (Product Compliance) (Also reference 02630.10)	Abrasion Degradation Sieve Analysis Plasticity Index	TM 208			4000				Contractor Provided Testing	Minimum 1 Per Project					Review Documentation for Acceptance	
					4000											
Retaining Wall Granular Backfill													A Sublot Equals 2000 Tons			
⁽¹⁾ Perform a minimum of 3 tests, QL's required	Sampling Aggregates Reducing Aggregates															
	⁽¹⁾ Sieve Analysis Un-Washed				1792				1/Sublot	Visual					Review Documentation for Acceptance	
	Fracture (Method 1)				1792				1/5 Sublots	Visual						

FIELD TESTED MATERIALS ACCEPTANCE GUIDE				(Revised November 2022)				Same Frequency for all Tests (Minimums)			
MATERIAL AND OPERATION	DESCRIPTION OF TEST	TEST METHOD			FORM 734-	Quality Control		Quality Assurance			
		ODOT	WAQTC	AASHTO		Contractor Quality Control Type D	Contractor Quality Control Type E				
SECTION 00596C - CAST-IN-PLACE CONCRETE RETAINING WALLS											
Placement											
Retaining Wall Granular Backfill											
Establishing Maximum Density	Density Curve			(1) T 99	3468						Review Documentation for Acceptance
(1) Method A	Specific Gravity of Coarse Aggregates			T 85	3468			1/Aggregate Gradation/Per Source	Visual		
Compaction	Agg. Base Coarse Particle Correction		TM 223								
	Nuclear Density of Soils/Aggregates			T 310	1793B			1/100 yd ³ (Minimum 1/day)	Visual		Review Documentation for Acceptance
	Deflection Testing		TM 158		1793B			1 per layer	Visual		
<p>Contractor must demonstrate, by compaction testing or acceptable visual means, that the material, equipment, and process used for compaction achieves the specification requirements. If the material, equipment, or process changes, or if other conditions indicate a non-specification product, the Contractor must re-demonstrate that specification requirements are being achieved.</p>											

FIELD TESTED MATERIALS ACCEPTANCE GUIDE				(Revised November 2022)				Same Frequency for all Tests (Minimums)			
MATERIAL AND OPERATION	DESCRIPTION OF TEST	TEST METHOD			FORM 734-	Quality Control		Quality Assurance			
		ODOT	WAQTC	AASHTO		Contractor Quality Control Type D	Contractor Quality Control Type E				
SECTION 00635 - GRID-ROLLED AGGREGATE SUBBASE											
Aggregate Subbase Grading (See 00635.10)	Abrasion	T 96		AASHTO	4000	Contractor Quality Control Type D	Contractor Quality Control Type E	Project Manager Type D & E			
	Sampling Aggregates Reducing Aggregates Sieve Analysis Un-Washed Sand Equivalent	R 90 R 76 T 27	T 176		1792	Contractor Provided Testing	Contractor Provided Testing	Review Documentation for Acceptance			
							Requires Signed and Notarized Statement of Compliance From Contractor For All Items Under Section 00600	Review Documentation for Acceptance			

FIELD TESTED MATERIALS ACCEPTANCE GUIDE					(Revised November 2022)					Same Frequency for all Tests (Minimums)				
MATERIAL AND OPERATION	DESCRIPTION OF TEST	TEST METHOD			FORM 734-	Quality Control		Quality Assurance						
		ODOT	WAQTC	AASHTO		Contractor Quality Control Type D	Contractor Quality Control Type E							
SECTION 00641 - AGGREGATE SUBBASE, BASE, AND SHOULDERS														
Aggregate Production	Abrasion				T 96	4000	Contractor Provided Testing	Submit Required Documentation	Review Documentation for Acceptance					
Aggregate Subbase Grading (See 00641.10(b))	Sampling Aggregates Reducing Aggregates				R 90 R 76 T 27	1792	Contractor Provided Testing	Submit Required Documentation	Review Documentation for Acceptance					
	Sieve Analysis Un-Washed Sand Equivalent				T 176									
Aggregate Base and Shoulders	Abrasion Degradation	TM 208				4000	Minimum 1 per Project	Submit Required Documentation	Review Documentation for Acceptance					
Grading Aggregate Base (See 02630) Aggregate Shoulder (See 02640) Open Graded Aggregate Base (See 02630.11) (¹) Perform at least 3 tests (²) May be waived by QAE	Sampling Aggregates Reducing Aggregates				R 90 R 76 T 27	A Sublot equals 2000 Tons								
	(¹) Sieve Analysis Un-Washed				T 176	1792	Contractor Provided Testing	Submit Required Documentation	Review Documentation for Acceptance					
	(²) Sand Equivalent													
	Fracture (Method 1)				T 335	1792	Contractor Provided Testing	Submit Required Documentation	Review Documentation for Acceptance					
PLACEMENT														
Aggregate Base Plant Mix Applications Only Aggregate (Mixture)	Sampling Aggregates Reducing Aggregates				R 90 R 76 T 255 & T 265 (³) T 99	A Sublot equals 2000 Tons								
	Moisture Content of Aggregates & Soils					1792	1/Sublot or minimum 1 per day	Visual	Review Documentation for Acceptance					
	Density Curve Agg. Base Coarse Particle Correction	TM 223				3468	Each Size Per Source	Visual	Review Documentation for Acceptance					
	Specific Gravity of Coarse Aggregates				T 85			Visual	Review Documentation for Acceptance					
Compaction (⁶) (Individual tests must meet Specification)	Deflection Testing	TM 158				1793B	1 per Sublot	Visual	Review Documentation for Acceptance					
	Nuclear Density of Soils/Aggregates				T 310	1793B	(⁶) 5 Tests Per Sublot	Visual	Review Documentation for Acceptance					

FIELD TESTED MATERIALS ACCEPTANCE GUIDE				(Revised November 2022)			Same Frequency for all Tests (Minimums)		
MATERIAL AND OPERATION	DESCRIPTION OF TEST	TEST METHOD			FORM	Quality Control		Quality Assurance	
		ODOT	WAQTC	AASHTO		Contractor Quality Control Type D	Contractor Quality Control Type E		
SECTION 00641 - AGGREGATE SUBBASE, BASE, AND SHOULDERS (Continued)									
Placement									
Aggregate Subbase									
Compaction	Deflection Testing	TM 158			1793 B	1 per Layer	Visual		Review Documentation for Acceptance

FIELD TESTED MATERIALS ACCEPTANCE GUIDE				(Revised November 2022)		Same Frequency for all Tests (Minimums)			
MATERIAL AND OPERATION	DESCRIPTION OF TEST	TEST METHOD			FORM 734-	Quality Control		Quality Assurance	
		ODOT	WAQTC	AASHTO		Contractor Quality Control Type D	Contractor Quality Control Type E		
SECTION 00680 - STOCKPILED AGGREGATES									
Aggregate Base and Shoulders (See Section 00641)									
(1) Perform at least 3 tests (2) May be waived by QAE	Abrasion Degradation	TM 208		T 96	4000	Minimum 1 per Source/Project	Visual	Review Documentation for Acceptance	
	Sampling Aggregates Reducing Aggregates (1) Sieve Analysis Un-Washed (2) Sand Equivalent			R 90 R 76 T 27 T 176	1792	Contractor Provided Testing	Visual	Review Documentation for Acceptance	
	Fracture (Method 1)			T 335	1792	1/5 Sublots	Visual		
A Sublot equals 2,000 Tons									
Aggregate (Sanding Aggregate)									
(3) May be waived by QAE	Sampling Aggregates Reducing Aggregates (1) Sieve Analysis Un-Washed (3) Cleanness Value	TM 227		R 90 R 76 T 27	1792	Contractor Provided Testing	Visual	Review Documentation for Acceptance	
	Abrasion Degradation Lightweight Pieces	TM 208		T 96 T 113	4000 4000	Minimum 1 per Source/Project	Visual		
	Fracture (Method 1) Elongated Pieces Wood Particles	TM 229 TM 225		T 335	1792 1792	1/5 Sublots & Start of Production	Visual	Review Documentation for Acceptance	
A Sublot equals 1000 Tons									

FIELD TESTED MATERIALS ACCEPTANCE GUIDE					(Revised November 2022)			Same Frequency for all Tests (Minimums)		
MATERIAL AND OPERATION	DESCRIPTION OF TEST	TEST METHOD			FORM 734-	Quality Control		Quality Assurance		
		ODOT	WAQTC	AASHTO		Contractor Quality Control Type D	Contractor Quality Control Type E			
SECTION 00705 - ASPHALT PRIME COAT and EMULSIFIED ASPHALT FOG COAT										
Aggregate Production Aggregate Cover Material	Sampling Aggregates Reducing Aggregates Sieve Analysis Un-Washed			R 90 R 76 T 27			A sublot equals 1000 Tons. A minimum 1 per shift		Review Documentation for Acceptance	
							Provide Process Control	Requires Signed and Notarized Statement of Compliance From Contractor For All Items Under Section 00700		
Asphalt Prime and Fog Coat Asphalt Cement (Emulsion)	Sampling Asphalt Materials			R 66			Provide Suppliers Certificate of Compliance	Review Documentation for Acceptance		
SECTION 00706 - EMULSIFIED ASPHALT SLURRY SEAL SURFACING										
Aggregate Production	Sampling Aggregates Reducing Aggregates (¹) Sieve Analysis			R 90 R 76 T 27/T 11			A sublot equals 500 Tons. A minimum 1 per shift, whichever results in the greatest sampling frequency		Review Documentation for Acceptance	
							Provide Process Control	Visual		
Emulsified Asphalt Cement Emulsified Asphalt Polymer Modified Emulsion	Sampling Asphalt Materials			R 66			Provide Suppliers Certificate of Compliance	Visual		
Additives Mineral Filler	Material must meet the requirements of Section 00706.13									
Mixture	Material must meet the requirements of Section 00706.16									
							Visual	Review Documentation for Acceptance		

FIELD TESTED MATERIALS ACCEPTANCE GUIDE				(Revised November 2022)		Same Frequency for all Tests (Minimums)						
MATERIAL AND OPERATION	DESCRIPTION OF TEST	TEST METHOD		FORM 734-	Quality Control							
		ODOT	WAQTC		AASHTO	Contractor Quality Control Type D	Contractor Quality Control Type E	Project Manager Type D & E				
SECTION 00710 - SINGLE APPLICATION EMULSIFIED ASPHALT SURFACE TREATMENT												
Aggregate Production												
Abrasion Degradation Soundness Lightweight Pieces Dry Rodded Unit Weight Sampling Aggregates Reducing Aggregates ⁽⁵⁾ Fracture ⁽¹⁾ Wood Particles ⁽¹⁾⁽⁴⁾ Elongated Piece ⁽²⁾ Sieve Analysis ⁽³⁾ Cleaness Value Dry Rodded Unit Weight ⁽⁴⁾ Not required for Dry Key Material ⁽⁵⁾ 1/5 Sublots & Start of Production Asphalt Cement (Emulsion)	TM 208 TM 225 TM 229 TM 227 Dry Rodded Unit Weight	T 96 T 104 T 113 T 19 R 90 R 76 T 335 T27/T 11 T 19	4000 4000 1792 1792 1825 1825C 4000	A sublot equals 500 Tons. A minimum 1 per shift, whichever results in the greatest sampling frequency					Review Documentation for Acceptance			
				Contractor Provided Testing					Contractor Provided Testing Minimum 1 per Project			
				1 per Sublot					Visual			
				Start of production and when changes in aggregate occurs					Visual			
				Provide Suppliers Certificate of Compliance					Provide Suppliers Certificate of Compliance			
				Preproduced Aggregate								
				Compliance of aggregates produced and stockpiled before the award date or notice to proceed of this contract will be determined by the following:								
				1. Continuing production records meeting the above requirements of Section 00710.10 and 710.15, Aggregate Production.								
				2. Furnish records of testing for the entire stockpile according to Section 00710.10 and 710.15 Aggregate Production except change the sampling frequency to the following:								
				a. One Per 5 sublots means "One Set of Tests Per 2500 Tons".								
b. One Per sublot means "One Set of Tests Per 500 Tons" with a minimum of 3 sets of Sieve Analysis tests per project.												
c. Provide one stockpile sample for each set of tests required above.												

FIELD TESTED MATERIALS ACCEPTANCE GUIDE				(Revised November 2022)		Same Frequency for all Tests (Minimums)				
MATERIAL AND OPERATION	DESCRIPTION OF TEST	TEST METHOD		FORM 734-	Quality Control					
		ODOT	WAQTC		AASHTO	Contractor Quality Control Type D	Contractor Quality Control Type E	Project Manager Type D & E		
SECTION 00711 - PRE-COATED AGGREGATE ASPHALT SURFACE TREATMENT										
Aggregate Production										
<p>Abrasion Degradation Soundness Lightweight Pieces Dry Rodded Unit Weight</p> <p>Sampling Aggregates Reducing Aggregates⁽⁵⁾ Fracture⁽¹⁾ Wood Particles⁽¹⁾ Elongated Piece⁽¹⁾⁽⁴⁾</p> <p>Sieve Analysis⁽²⁾ Cleanness Value⁽³⁾ Dry Rodded Unit Weight</p> <p>Asphalt Cement (Emulsion)</p> <p>⁽¹⁾ QAE may waive after 5 sublots/shifts</p> <p>⁽²⁾ Perform at least 3 tests (QL's required), QAE may waive wet sieve after 5 sublots/shifts if a correlation to dry sieve can be demonstrated</p> <p>⁽³⁾ May be waived by QAE</p> <p>⁽⁴⁾ Not required for Dry Key Material</p> <p>⁽⁵⁾ 1/5 Sublots & Start of Production</p>	TM 208	T 96 T 104 T 113 T 19	4000 4000	Contractor Provided Testing	Contractor Provided Testing Minimum 1 per Project	<p>A sublot equals 500 Tons. A minimum 1 per shift, whichever results in the greatest sampling frequency</p> <p>Review Documentation for Acceptance</p>				
	TM 225 TM 229	R 90 R 76 T 335	1792	1 per Sublot	Visual		Review Documentation for Acceptance			
	TM 227	T 27/T 11	1792	Start of production and when changes in aggregate occurs	Visual					
	Sampling Asphalt Materials	R 66	4000	Provide Suppliers Certificate of Compliance	Provide Suppliers Certificate of Compliance		Review Documentation for Acceptance			
	Preproduced Aggregate									
	<p>Compliance of aggregates produced and stockpiled before the award date or notice to proceed of this contract will be determined by the following:</p> <p>1. Continuing production records meeting the above requirements of Section 00711.10 and 711.15, Aggregate Production.</p> <p>2. Furnish records of testing for the entire stockpile according to Section 00711.10 and 711.15 Aggregate Production except change the sampling frequency to the following:</p> <p>a. One Per 5 sublots means "One Set of Tests Per 2500 Tons".</p> <p>b. One Per sublot means "One Set of Tests Per 500 Tons" with a minimum of 3 sets of Sieve Analysis tests per project.</p> <p>c. Provide one stockpile sample for each set of tests required above.</p>									

FIELD TESTED MATERIALS ACCEPTANCE GUIDE				(Revised November 2022)				Same Frequency for all Tests (Minimums)			
MATERIAL AND OPERATION	DESCRIPTION OF TEST	TEST METHOD			FORM 734-	Quality Control		Quality Assurance			
		ODOT	WAQTC	AASHTO		Contractor Quality Control Type D	Contractor Quality Control Type E				
SECTION 00711 - PRE-COATED AGGREGATE ASPHALT SURFACE TREATMENT (CONTINUED)											
Mixture Acceptance											
Meter Method	Readings backed by Tank Measure & Production Records Daily	TM 321 (¹) TM 322			2277	1/Sublot or Min. 1/Day	Production Control Testing	Review Documentation for Acceptance			
⁽¹⁾ ACP Plant Calibration Required at start of Production and if Meters Fail to meet Specification	Cold Feed Moisture		T 255/265		2043 and 2401	Daily Production	Production Control Testing				
Plant Discharge Moisture	ACP Moisture Content		T 329		2277	1/Sublot or Min. 1/Day	Production Control Testing				
Asphalt Cement	Sampling Asphalt Materials		R 66		4000	1/50 Tons Submit All	Provide Suppliers Certificate of Compliance	Review Documentation for Acceptance			

FIELD TESTED MATERIALS ACCEPTANCE GUIDE					(Revised November 2022)		Same Frequency for all Tests (Minimums)						
MATERIAL AND OPERATION	DESCRIPTION OF TEST	TEST METHOD			FORM 734-	Quality Control			Quality Assurance				
		ODOT	WAQTC	AASHTO		Contractor Quality Control Type D	Contractor Quality Control Type E	Project Manager Type D & E					
SECTION 00712 - DRY KEY EMULSIFIED ASPHALT SURFACE TREATMENT													
Aggregate Production													
<p>Abrasion Degradation Soundness Lightweight Pieces Dry Rodded Unit Weight</p> <p>Sampling Aggregates Reducing Aggregates⁽⁵⁾ Fracture⁽¹⁾ Wood Particles⁽¹⁾⁽⁴⁾ Elongated Piece⁽²⁾ Sieve Analysis⁽³⁾ Cleaness Value Dry Rodded Unit Weight</p> <p>⁽¹⁾ QAE may waive after 5 sublots/shifts</p> <p>⁽²⁾ Perform at least 3 tests (QL's required), QAE may waive wet sieve after 5 sublots/shifts if a correlation to dry sieve can be demonstrated</p> <p>⁽³⁾ May be waived by QAE</p> <p>⁽⁴⁾ Not required for Dry Key Material</p> <p>⁽⁵⁾ 1/5 Sublots & Start of Production</p> <p>Asphalt Cement (Emulsion)</p> <p>Sampling Asphalt Materials</p>	TM 208		T 96 T 104 T 113 T 19	4000	Contractor Provided Testing	Contractor Provided Testing Minimum 1 per Project	Review Documentation for Acceptance	Review Documentation for Acceptance					
	R 90 R 76 T 335			1792	1 per Sublot	Visual			Review Documentation for Acceptance				
	T 27/T 11			1792	Start of production and when changes in aggregate occurs	Visual							
	T 19			1825 1825C	Provide Suppliers Certificate of Compliance	Provide Suppliers Certificate of Compliance							
	R 66			4000	Provide Suppliers Certificate of Compliance	Provide Suppliers Certificate of Compliance							
	Preproduced Aggregate												
	Compliance of aggregates produced and stockpiled before the award date or notice to proceed of this contract will be determined by the following:												
	1. Continuing production records meeting the above requirements of Section 00712.10 and 712.15, Aggregate Production.												
	2. Furnish records of testing for the entire stockpile according to Section 00712.10 and 712.15 Aggregate Production except change the sampling frequency to the following:												
	a. One Per 5 sublots means "One Set of Tests Per 2500 Tons".												
b. One Per sublot means "One Set of Tests Per 500 Tons" with a minimum of 3 sets of Sieve Analysis tests per project.													
c. Provide one stockpile sample for each set of tests required above.													

FIELD TESTED MATERIALS ACCEPTANCE GUIDE					(Revised November 2022)		Same Frequency for all Tests (Minimums)		
MATERIAL AND OPERATION	DESCRIPTION OF TEST	TEST METHOD			FORM 734-	Quality Control		Quality Assurance	
		ODOT	WAQTC	AASHTO		Contractor Quality Control Type D	Contractor Quality Control Type E		
SECTION 00720 - COLD IN-PLACE RECYCLED ASPHALT CONCRETE PAVEMENT (CIR)									
SECTION 00721 - COLD RECYCLED EMULSIFIED ASPHALT CONCRETE PAVEMENT (CRP)									
Asphalt Cement (Emulsified Recycling Agent)	Sampling Asphalt Materials	R 66			4000	Provide Suppliers Certificate of Compliance	Provide Suppliers Certificate of Compliance	Review Documentation for Acceptance	
Water					Material must meet the requirements of Section 00340.10		Visual	Review Documentation for Acceptance	
Aggregate Production Choke Aggregate (See 00705)	Sampling Aggregates Reducing Aggregates Sieve Analysis Un-Washed	R 90 R 76 T 27				Provide Process Control	Visual	Review Documentation for Acceptance	
					1792				
SECTION 00725 - HOT IN-PLACE RECYCLED (HIR) ASPHALT CONCRETE PAVEMENT									
<i>The type of recycling agent will be listed in the Special Provisions</i>									
Recycling Agent (See 00745.11)	Sampling Asphalt Materials	R 66			4000	Provide Suppliers Certificate of Compliance	Provide Suppliers Certificate of Compliance	Review Documentation for Acceptance	
Recycling Agent	Sampling Asphalt Materials	R 66			4000				
<i>New Asphalt Concrete mixture will meet the requirements of Section 00744</i>									
SECTION 00730 - ASPHALT TACK COAT									
Asphalt Concrete Mixture	Sampling Asphalt Materials	R 66			4000	Provide Suppliers Certificate of Compliance	Provide Suppliers Certificate of Compliance	Review Documentation for Acceptance	
Tack	Sampling Asphalt Materials	R 66			4000				

FIELD TESTED MATERIALS ACCEPTANCE GUIDE				(Revised November 2022)		Same Frequency for all Tests (Minimums)		
MATERIAL AND OPERATION	DESCRIPTION OF TEST	TEST METHOD		FORM 734-	Quality Control			
		ODOT	WAQTC		AASHTO	Contractor Quality Control Type D	Contractor Quality Control Type E	Quality Assurance
SECTION 00735 - EMULSIFIED ASPHALT CONCRETE PAVEMENT								
Aggregate production	Abrasion Degradation Soundness Lightweight Pieces	TM 208		T 96 T 104 T 113	4000 4000	Contractor Provided Testing Minimum 1 per Project	Contractor Provided Testing Minimum 1 per Project	Review Documentation for Acceptance
(1) Perform at least 3 tests, QL's required	Sampling Reducing			R 90 R 76 T 27/T 11				
(2) May be waived by QAE	(1) Sieve Analysis (2) Cleaness Value	TM 227		T 335	1792	1/Sublot	Visual	Review Documentation for Acceptance
(3) QAE may waive after 5 sublots/shifts	Fracture (3) Elongated Pieces (3) Wood Particles	TM 229 TM 225			1792			
Choke Aggregate	Sieve Analysis Un-Washed			T 27	1792	Provide Process Control	Visual	

FIELD TESTED MATERIALS ACCEPTANCE GUIDE				(Revised November 2022)		Same Frequency for all Tests (Minimums)				
MATERIAL AND OPERATION	DESCRIPTION OF TEST	TEST METHOD			FORM 734-	Quality Control		Quality Assurance		
		ODOT	WAQTC	AASHTO		Contractor Quality Control Type D	Contractor Quality Control Type E	Contractor Quality Control Type D & E	Project Manager Type D & E	
SECTION 00735 - EMULSIFIED ASPHALT CONCRETE PAVEMENT (CONTINUED)										
Mixture Acceptance										
% Emulsified Asphalt	Sampling Aggregates Reducing Aggregates									
	Sieve Analysis									
	Moisture Content of Aggregate & Soil Meter									
% Emulsified Asphalt ⁽¹⁾ ACP Plant Calibration Required at start of Production and if Meters Fail to meet Specification		TM 321			2277		Provide Process Control	Visual		Review Documentation for Acceptance
		TM 321 (¹) TM 322			2401 & 2043		Daily Production	Visual		Review Documentation for Acceptance
	Sampling Asphalt Materials				4000		Provide Suppliers Certificate of Compliance	Provide Suppliers Certificate of Compliance		Review Documentation for Acceptance
SECTION 00740 - COMMERCIAL ASPHALT CONCRETE PAVEMENT (CACP)										
See Specifications when Testing is Required by Agency										
							Provide Process Control	Visual		Review Documentation for Acceptance

FIELD TESTED MATERIALS ACCEPTANCE GUIDE					(Revised November 2022)			Same Frequency for all Tests (Minimums)		
MATERIAL AND OPERATION	DESCRIPTION OF TEST	TEST METHOD			FORM 734-	Quality Control				
		ODOT	WAQTC	AASHTO		Contractor Quality Control Type D	Contractor Quality Control Type E	Quality Assurance		
SECTION 00743 - POROUS ASPHALT CONCRETE (PAC) (CONTINUED)										
Mixture Acceptance - PAC with RAP										
Gradation										
Ignition method	(¹) Calibrate Incinerator	TM 323			2327IC	A Sublot equals 1000 Tons				
Ignition method	Sampling (ACP) Reducing (ACP)			R 97 R 47		1/JMF & Each Calendar Year.	Production Control Testing			Review Documentation for Acceptance
(Residual aggregate from AASHTO T 308)	Sieve Analysis of Extracted Aggregate			T 30	2277	1/Sublot or Min. 1/Day				
⁽¹⁾ Submit Samples a minimum of Days Prior to ACP Production										
Asphalt Content										
Ignition Method	(¹) Calibrate Incinerator	TM 323			2327IC	A Sublot equals 1000 Tons				
Ignition Method	Sampling (ACP) Reducing (ACP)			R 97 R 47		1/JMF & Each Calendar Year.	Production Control Testing			Review Documentation for Acceptance
Meter Method	Asphalt Content			T 308	2277	1/Sublot or Min. 1/day				
	Readings backed by Tank measure & Production Records Daily	TM 321 ⁽²⁾ TM 322			2277	1/Sublot or Min. 1/day				
⁽²⁾ ACP Plant Calibration Required at start of Production and if Meters fail to meet Specification										
Meter Method is required for PAC even when acceptance is by Ignition Method										

FIELD TESTED MATERIALS ACCEPTANCE GUIDE				(Revised November 2022)			Same Frequency for all Tests (Minimums)		
MATERIAL AND OPERATION	DESCRIPTION OF TEST	TEST METHOD		FORM 734-	Quality Control		Quality Assurance		
		ODOT	WAQTC		AASHTO	Contractor Quality Control Type D		Contractor Quality Control Type E	Project Manager Type D & E
SECTION 00743 - POROUS ASPHALT CONCRETE (PAC) (CONTINUED)									
Mixture Acceptance - PAC without RAP									
Gradation									
Cold Feed Method	Sampling Aggregates Reducing Aggregates Sieve Analysis	R 90 R 76 T 27/T 11							
Ignition method	(¹) Calibrate Incinerator	TM 323		2327IC	1/JMF & Each Calendar Year.	Production Control Testing			Review Documentation for Acceptance
Ignition method	Sampling (ACP) Reducing (ACP)								
(¹) Not required if Asphalt Content Accepted by Meter									
(Residual aggregate from AASHTO T 308)	Sieve Analysis of Extracted Aggregate	T 30		2277	1/Sublot or Min. 1/day	Production Control Testing			Review Documentation for Acceptance
(¹) Submit Samples a minimum of 2 Days Prior to ACP Production									
Asphalt Content									
Ignition Method	(¹) Calibrate Incinerator	TM 323		2327IC	1/JMF & Each Calendar Year.	Production Control Testing			Review Documentation for Acceptance
Ignition Method	Sampling (ACP) Reducing (ACP)								
(²) ACP Plant Calibration Required at start of production and if meters fail to meet specification	Asphalt Content								
Meter Method	Readings backed by Tank measure & Production Records Daily	TM 321 (²) TM 322		2277	1/Sublot or Min. 1/day	Production Control Testing			
Meter Method is required for PAC even when acceptance is by Ignition Method				2043 and 2401	Daily Production	Production Control Testing			Review Documentation for Acceptance

FIELD TESTED MATERIALS ACCEPTANCE GUIDE				(Revised November 2022)				Same Frequency for all Tests (Minimums)			
MATERIAL AND OPERATION	DESCRIPTION OF TEST	TEST METHOD			FORM 734-	Quality Control					
		ODOT	WAQTC	AASHTO		Contractor Quality Control Type D	Contractor Quality Control Type E	Quality Assurance			
SECTION 00743 - POROUS ASPHALT CONCRETE (PAC) (CONTINUED)											
Mixture Acceptance - PAC with and without RAP											
Mix Design Verification Testing											
	Cold Feed Moisture				T255/T265						
Plant Discharge Moisture	ACP Moisture Content				T 329				1/Sublot or Min. 1/Day	Production Control Testing	Review Documentation for Acceptance
⁽¹⁾ RAP Percentage	⁽¹⁾ RAP Moisture				T 329				1/Sublot or Min. 1/Day	Production Control Testing	Review Documentation for Acceptance
⁽¹⁾ If applicable	Readings backed by Tank measure & Production Records Daily										
Asphalt Cement	Sampling Asphalt Materials				R 66				Daily Production	Production Control Testing	Review Documentation for Acceptance
⁽²⁾ ACP Plant Calibration Required at start of production and if meters fail to meet specification									1/Sublot See Section 4C	Provide Suppliers Certificate of Compliance	

FIELD TESTED MATERIALS ACCEPTANCE GUIDE				(Revised November 2022)				Same Frequency for all Tests (Minimums)																	
MATERIAL AND OPERATION	DESCRIPTION OF TEST	TEST METHOD		FORM 734-	Quality Control		Quality Assurance																		
		ODOT	WAQTC		AASHTO	Contractor Quality Control Type D		Contractor Quality Control Type E																	
SECTION 00744 - ASPHALT CONCRETE PAVEMENT																									
Aggregate Production								Provide Process Control				Visual				Review Documentation for Acceptance									
Mixture Acceptance																									
Gradation												A Sublot equals 1000 Tons													
Ignition method								TM 323				2327IC		1/JMF & Each Calendar Year.		Production Control Testing		Review Documentation for Acceptance							
Ignition method										R 97 R 47				1/Sublot or Min. 1/Day		Production Control Testing									
(Residual aggregate from AASHTO T 308)										T 30				1/Sublot or Min. 1/Day		Production Control Testing		Review Documentation for Acceptance							
⁽¹⁾ Submit Samples a minimum of Days Prior to ACP Production																									
Asphalt Content												A Sublot equals 1000 Tons													
Ignition Method								TM 323				2327IC		1/JMF & Each Calendar Year.		Production Control Testing		Review Documentation for Acceptance							
Ignition Method										R 97 R 47				1/Sublot or Min. 1/day		Production Control Testing									
Asphalt Content										T 308				2277											
Mix Design Verification Testing												A Sublot equals 1000 Tons													
Plant Discharge Moisture										T 329				2277		1/Sublot				Review Documentation for Acceptance					
Maximum Density Test G _{mm}								Max. Specific Gravity MAMD		TM 305		T 209				2050		1st Sublot Daily or Min. 1/Day		Production Control Testing					

FIELD TESTED MATERIALS ACCEPTANCE GUIDE				(Revised November 2022)		Same Frequency for all Tests (Minimums)		
MATERIAL AND OPERATION	DESCRIPTION OF TEST	TEST METHOD			FORM	Quality Control		
		ODOT	WAQTC	AASHTO		Contractor Quality Control Type D	Contractor Quality Control Type E	Quality Assurance
SECTION 00744 - ASPHALT CONCRETE PAVEMENT (CONTINUED)								
Compaction ^(D) See T 355 Yellow sheet for Density Test Locations	Nuclear Density			T 355	1793A	(D) Average 10 tests per Sublot or Min. 10/Day, See Section 00744.49	Production Control Testing	Review Documentation for Acceptance

FIELD TESTED MATERIALS ACCEPTANCE GUIDE				(Revised November 2022)		Same Frequency for all Tests (Minimums)		
MATERIAL AND OPERATION	DESCRIPTION OF TEST	TEST METHOD		FORM 734-	Quality Control			
		ODOT	WAQTC		AASHTO	Contractor Quality Control Type D	Contractor Quality Control Type E	Project Manager Type D & E
SECTION 00745 - ASPHALT CONCRETE PAVEMENT - STATISTICAL ACCEPTANCE								
Aggregate Production (1) QAE may waive after 5 sublots/shifts (2) Perform a minimum of 3 tests QL's required	Soundness Abrasion Degradation Lightweight Pieces Plasticity Index	TM 208	T 104 T 96 T 113 T 90	4000 4000	Contractor Provided Testing Minimum 1 per Project	Contractor Provided Testing Minimum 1 per Project	Review Documentation for Acceptance	
					A Sublot equals 1000 Tons. A minimum one per shift whichever results in the greatest sampling frequency			
(3) Coarse Agg (+ No. 4) (4) Fine Agg (- No. 4)	Sampling Aggregates Reducing Aggregates (2)(3)(4) Sieve Analysis (1)(4) Sand Equivalent	R 90 R 76 T 27/T 11 T 176	1792	1/Sublot	Contractor Provided Testing	Review Documentation for Acceptance		
				Note: Sample Aggregate before Lime Treatment				
RAS Production (Reclaimed Asphalt Shingles)	Sieve Analysis Un-Washed Deleterious Materials Sampling Aggregates Reducing Aggregates Sieve Analysis Un-Washed Deleterious Materials	TM 229 TM 225 TM 335	T 335 T 27 R 90 R 76 T 27	1792 4000 1792	1/5 Sublots	Contractor Provided Testing	Review Documentation for Acceptance	
					Contractor Provided Testing 1/500 Tons	Contractor Provided Testing	Review Documentation for Acceptance	
Preproduced Aggregate								
Compliance of aggregates produced and stockpiled before the award date or notice to proceed of this contract will be determined by the following:								
<ol style="list-style-type: none"> 1. Continuing production records meeting the above requirements of Section 00745.10 Aggregate Production. 2. Furnish records of testing for the entire stockpile according to Section 00745.10 Aggregate Production except change the sampling frequency to the following: <ol style="list-style-type: none"> a. One Per 5 sublots means "One Set of Tests Per 5000 Tons". b. One Per sublot means "One Set of Tests Per 1000 Tons" with a minimum of 3 sets of Sieve Analysis tests per project. c. Provide one stockpile sample for each set of tests required above. 								

FIELD TESTED MATERIALS ACCEPTANCE GUIDE				(Revised November 2022)				Same Frequency for all Tests (Minimums)			
MATERIAL AND OPERATION	DESCRIPTION OF TEST	TEST METHOD		FORM 734-	Quality Control		Quality Assurance				
		ODOT	WAQTC		AASHTO	Contractor Quality Control Type D		Contractor Quality Control Type E			
SECTION 00745 - ASPHALT CONCRETE PAVEMENT - STATISTICAL ACCEPTANCE (CONTINUED)											
Mixture Acceptance - ACP "With and Without RAP"								A Sublot equals 1000 Tons			
Mix Design Verification Testing Fabrication Maximum Density Test	Gyratory Specimen Max. Specific Gravity of ACP	TM 326	T 209	2050GV	1/Sublot & according to Section 00745.16 (b)-1-d	Production Control Testing	Review Documentation for Acceptance				
								T 166	*5068		
Determination of G_{mb}	Bulk Specific Gravity of Compacted ACP			*2560							
Stripping Susceptibility	Tensile Strength Ratio		T 283	*5069							
*Cat-II complete & submit as required, See Section 745.16(b)											
Plant Discharge Moisture	ACP Moisture Content		T 329	2050tsr	1/JMF See Section 00745.16 (b)-1-f	Production Control Testing	Review Documentation for Acceptance				
Maximum Density Test G_{mm}	Max. Specific Gravity MAMD			2277	1/Sublot or Min. 1/Day	Production Control Testing	Review Documentation for Acceptance				
Performing Control Strip	Control Strip	TM 305	T 209	2050	1st Sublot Daily or Min. 1/Day	Production Control Testing	Review Documentation for Acceptance				
Compaction	Nuclear Density of ACP	TM 306	T 355	2084 *5069	Develop Rolling Pattern See Specs.	Production Control Testing	Review Documentation for Acceptance				
Asphalt Cement	Sampling Asphalt Materials		R 66	1793A	^(D) Average 5 tests per Sublot or Min. 1/Day, See Section 00745.49 (b)-2	Production Control Testing	Review Documentation for Acceptance				
^(D) See T 355 Yellow Sheet for Density Test Locations				4000	1/Sublot See Section 4C	Provide Suppliers Certificate of Compliance	Review Documentation for Acceptance				

FIELD TESTED MATERIALS ACCEPTANCE GUIDE					(Revised November 2022)			Same Frequency for all Tests (Minimums)					
MATERIAL AND OPERATION	DESCRIPTION OF TEST	TEST METHOD			FORM 734-	Quality Control		Quality Assurance					
		ODOT	WAQTC	AASHTO		Contractor Quality Control Type D	Contractor Quality Control Type E		Project Manager Type D & E				
SECTION 00754 - PLAIN CONCRETE PAVEMENT REPAIR													
SECTION 00755 - CONTINUOUSLY REINFORCED CONCRETE PAVEMENT													
SECTION 00756 - PLAIN CONCRETE PAVEMENT													
SECTION 00758 - CONTINUOUSLY REINFORCED CONCRETE PAVEMENT REPAIR													
Aggregate Production											A Sublot equals 1000 Tons		
⁽¹⁾ QAE may waive after 5 sublots/shifts	Sampling Aggregates				R 90								
	Reducing Aggregates ⁽²⁾ ⁽³⁾ ⁽⁴⁾ Sieve Analysis ⁽⁴⁾ Fineness Modulus holder				R 76 T 27/T 11				Contractor Provided Testing				Review Documentation for Acceptance
⁽²⁾ Perform a minimum of 3 tests, QL's required	⁽⁴⁾ Sand Equivalent				T 176								
	⁽¹⁾ ⁽³⁾ Wood Particles				T 335				Contractor Provided Testing				Review Documentation for Acceptance
⁽³⁾ Coarse Aggregate (See Section 02690.20)	⁽³⁾ Fracture (Method 2)												
	⁽¹⁾ ⁽³⁾ Elongated Piece				TM 225 TM 229								
⁽⁴⁾ Fine Aggregate (See Section 02690.30)	Abrasion												
	Degradation				TM 208								
	Soundness												
	Lightweight Pieces Organics								Minimum 1 per Project				Review Documentation for Acceptance
	⁽³⁾ Dry Rodded Unit Weight												
	⁽³⁾ Specific Gravity of Coarse Aggregate												
	⁽⁴⁾ Specific Gravity of Fine Aggregate												
					1825 1825C								Review Documentation for Acceptance
					1825				Start of production and when changes in aggregate occurs				

FIELD TESTED MATERIALS ACCEPTANCE GUIDE				(Revised November 2022)		Same Frequency for all Tests (Minimums)		
MATERIAL AND OPERATION	DESCRIPTION OF TEST	TEST METHOD		FORM 734-	Quality Control		Quality Assurance	
		ODOT	WAQTC		AASHTO	Contractor Quality Control Type D		Contractor Quality Control Type E
SECTION 00754 - PLAIN CONCRETE PAVEMENT REPAIR								
SECTION 00755 - CONTINUOUSLY REINFORCED CONCRETE PAVEMENT								
SECTION 00756 - PLAIN CONCRETE PAVEMENT								
SECTION 00758 - CONTINUOUSLY REINFORCED CONCRETE PAVEMENT REPAIR (CONTINUED)								
Portland Cement Concrete								A Sublot equals 1000 lane feet of slip formed pavement or 100 yd ³ of non-slip formed PCC
Portland Cement	Materials must meet the requirements of Section 02001.10							
Modifiers								
Admixtures								
Curing Compounds	Material must meet the requirements of Section 02050							
Mixing Water	Material must meet the requirements of Section 02020							
Mixture	Sampling Concrete	TM 2	T 152	3573WS	Contractor Provided Testing - 1/sublot or Minimum 1 per Day	Visual	Review Documentation for Acceptance	
	Air Content of Concrete		T 119	or				
	Slump of Concrete		T 121	4000C				
	Density (Unit Weight) of Concrete		T 121					
	Yield		T 121					
	Concrete Temperature		T 309					
	Water/Cement Ratio		T 121					
	Batching							
	Fabrication of Concrete		R 100		(M) (S) 1 Set of Cylinders per sublot or Minimum 1 set per Day	Visual	Review Documentation for Acceptance	
	Cylinders/Beams		T 22	4000C				
	Compressive Strength of Concrete							
		TM 769			See Special Provisions	Production Control Testing		
		TM 772			See Specs	Visual		
	Sitting Measure	TM 775						
Smoothness	Certification of Profiler Equipment Determining IRI with an Inertial Laser Profiler							
Thickness of Pavement								

FIELD TESTED MATERIALS ACCEPTANCE GUIDE				(Revised November 2022)			Same Frequency for all Tests (Minimums)		
MATERIAL AND OPERATION	DESCRIPTION OF TEST	TEST METHOD			FORM 734-	Quality Control			
		ODOT	WAQTC	AASHTO		Contractor Quality Control Type D	Contractor Quality Control Type E	Quality Assurance	
SECTION 00850 - COMMON PROVISIONS FOR PAVEMENT MARKINGS									
In-Place Procedure evaluates Durable and High Performance Pavement Markings	Evaluation of Retroreflectivity	TM 777			4101 thru 4105	See Special Provisions and Test Procedure for Testing Frequency	Visual	Review Documentation for Acceptance	

FIELD TESTED MATERIALS ACCEPTANCE GUIDE					(Revised November 2022)			Same Frequency for all Tests (Minimums)		
MATERIAL AND OPERATION	DESCRIPTION OF TEST	TEST METHOD			FORM 734-	Quality Control		Quality Assurance		
		ODOT	WAQTC	AASHTO		Contractor Quality Control Type D	Contractor Quality Control Type E			
SECTION 00921 - MAJOR SIGN SUPPORT DRILLED SHAFTS										
Aggregate Production										
(1) QAE may waive after 5 sublots/shifts	Sampling Aggregates									
	Reducing Aggregates									
(2) Perform a minimum of 3 tests, QL's required	(2)(3)(4) Sieve Analysis				1792	R 90 R 76				
	(4) Fineness Modulus				1792	T 27/T 11 T 27/T 11				
(3) Coarse Aggregate (See Section 02690.20)	(1)(3) Wood Particles				4000	T 176				
	(4) Sand Equivalent			TM 225						
(4) Fine Aggregate (See Section 02690.30)	Soundness				4000	T 104 T 96				
	Abrasion				4000	T 113 T 21				
Portland Cement Modifiers Admixtures	Degradation			TM 208	1825 1825C	T 19				
	Lightweight Pieces				1825	T 85 T 84				
Drilling Slurry	Organics									
	(3) Dry Rodded Unit Weight									
Grout	(3) Specific Gravity of Coarse Aggregate									
	(4) Specific Gravity of Fine Aggregate									
Mixing Water	Materials must meet the requirements of Section 02001.10									
	Slurry material must meet the requirements of Section 00921.14 & 00921.43(g)									
Material must meet the requirements of Section 02080										
Material must meet the requirements of Section 02020										
Review Documentation for Acceptance										
Review Documentation for Acceptance										

FIELD TESTED MATERIALS ACCEPTANCE GUIDE				(Revised November 2022)		Same Frequency for all Tests (Minimums)												
MATERIAL AND OPERATION	DESCRIPTION OF TEST	TEST METHOD		FORM 734-	Quality Control													
		ODOT	WAQTC		AASHTO	Contractor Quality Control Type D	Contractor Quality Control Type E	Project Manager Type D & E										
SECTION 00921 - MAJOR SIGN SUPPORT DRILLED SHAFTS																		
Portland Cement Concrete																		
	Sampling Concrete Slump of Concrete		TM 2	T 119	3573WS													
	Concrete Temperature			T 309	or													
	Density (Unit Weight) of Concrete			T 121	4000C		(M) (S) 1 per Shaft and Test at minimum frequencies according to table 00512-1. Review specs.	(M) (S) 1 per Shaft and Test at minimum frequencies according to table 00512-1. Review specs.										
	Yield			T 121														
	Water/Cement Ratio			T 121														
	Fabrication of Concrete			R 100														
	Cylinders/Beams			T 22														
	Compressive Strength of Concrete							Review Documentation for Acceptance										
<p>(S) 1 Set Represents a minimum of 3 Cylinders</p> <p>(M) Per Mix Design & Source</p>																		
<p>TABLE 00512-1 Frequency of Quality Control Testing</p> <p>Minimum frequencies per Class of concrete based on daily production records.</p> <table border="1"> <thead> <tr> <th>Production</th> <th>Frequencies</th> </tr> </thead> <tbody> <tr> <td>0 to 100 yd³ on a single day</td> <td>1 Set each day</td> </tr> <tr> <td>Quantity Over 100 yd³</td> <td></td> </tr> <tr> <td>100 to 600 yd³ on a single day</td> <td>1 Set per each 100 yd³ or portion thereof</td> </tr> <tr> <td>over 600 yd³ on a single day</td> <td>1 Set per each 200 yd³ or portion thereof after reaching 600 yd³</td> </tr> </tbody> </table>									Production	Frequencies	0 to 100 yd ³ on a single day	1 Set each day	Quantity Over 100 yd³		100 to 600 yd ³ on a single day	1 Set per each 100 yd ³ or portion thereof	over 600 yd ³ on a single day	1 Set per each 200 yd ³ or portion thereof after reaching 600 yd ³
Production	Frequencies																	
0 to 100 yd ³ on a single day	1 Set each day																	
Quantity Over 100 yd³																		
100 to 600 yd ³ on a single day	1 Set per each 100 yd ³ or portion thereof																	
over 600 yd ³ on a single day	1 Set per each 200 yd ³ or portion thereof after reaching 600 yd ³																	

INSERT TAB

Yellow Sheets



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October 31, 2022

To: All Holders of the Manual of Field Test Procedures

Section: **Test Procedure AASHTO T 27/11**

The Oregon Department of Transportation has specified method(s) for this Test Procedure. Please observe the following for our projects:

- Under procedure Method A, step 1, the initial dry mass of the sample may be determined utilizing a companion moisture sample (this is an option not a requirement).
- Perform the moisture test according to T 255/ T 265.
- Under procedures (A, B and C) Delete the $110 \pm 5^{\circ}\text{C}$ ($230 \pm 9^{\circ}\text{F}$) temperature reference for drying.
- Shaking time for all methods will be a minimum of 10 minutes.
- Use the following formula to adjust the wet mass of the sample to the initial dry mass:

$$\text{Initial Dry Mass} = \left\{ \frac{WM}{1 + \left(\frac{\% M}{100} \right)} \right\}$$

Where: WM = Initial Wet Mass of T 27/11 sample.

%M = Moisture content of companion moisture sample.

- Document the Initial Wet Mass of the sample when utilizing a companion moisture.



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October 31, 2022

To: All Holders of the Manual of Field Test Procedures

Section: **Test Procedure AASHTO T 166**

The Oregon Department of Transportation has specified method(s) for this Test Procedure. Please observe the following for our projects:

- **Absorption Calculations are not required.**
- **When performing the Bulk Specific Gravity determination for the Core Correlation process (ODOT TM-327), use Method A. Method C is required for dry mass determination.**
- **Under Procedure – Method C (Rapid Test for Method A or B), delete step 4 and replace with the following: Place in an oven at a minimum of 105°C (221°F). Do not exceed the Job Mix Formula mixing temperature.**
- **When performing the Bulk Specific Gravity determination for Lab Fabricated Gyrotory Specimens, use Method A. The Method C option is not allowed.**
- **When performing the Bulk Specific Gravity determination for Cores removed for “density acceptance” purposes, see TM 327, “Procedure Density Cores”, section 4.4.**



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October 31, 2022

To: All Holders of the Manual of Field Test Procedures

Section: **Test Procedure AASHTO T 176**

The Oregon Department of Transportation has specified method(s) for this Test Procedure. Please observe the following for our projects:

- **Under Materials, 2nd bullet, the use of potable water for the working solution is allowed, but the Agency may require distilled or demineralized water, if test results are in question or potable water is found detrimental to the test.**
- **Under Procedure, Delete Step 10f.**
- **Run a minimum of Two Sand Equivalent samples. If these results do not meet the requirements of "Procedure, Step 10e." run an additional three samples discarding the high and low results and average the remaining three samples.**



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October 1, 2022

To: All Holders of the Manual of Field Test Procedures

Section: **Test Procedure AASHTO T 217**

The Oregon Department of Transportation has specified method(s) for this Test Procedure. Please observe the following for our projects:

- **Procedure- Delete step 7 and replace with the following: Rotate the vessel for 30 seconds, rest for 30 seconds and repeat until gauge dial reflects no further increase. A minimum of 3 rotations (3 minutes) is required. Allow time for the dissipation of heat generated by the chemical reaction, before taking the final reading.**
- **Moisture Determination - Addendum to step 1, Use the following equation in lieu of the conversion curve to calculate the moisture content based on the dry weight of material.**

$$\% \text{ Moisture based on Dry} = \frac{\% \text{ Moisture Gauge Reading}}{100 - \% \text{ Moisture Gauge Reading}} \times 100$$



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October 31, 2022

To: All Holders of the Manual of Field Test Procedures

Section: **Test Procedure AASHTO T 272**

The Oregon Department of Transportation has specified method(s) for this Test Procedure. Please observe the following for our projects:

- **AASHTO T 99 (Methods B & C) are not allowed on ODOT contracts.**
- **Use AASHTO T 99 (Methods A or D) based on the following criteria:**
- **The moisture content of the one point may be determined according to AASHTO T 217.**
- **The moisture content of the one point must be determined according to AASHTO T 255/265 for Method D applications.**
- **Under the calculations section, add the following: Wet density may be determined according to T 99 - Yellow Sheet, using a "Mold Factor".**
- **Delete Section "Maximum Dry Density and Optimum Moisture Content Determination Using an Individual Moisture / Density Curve".**
- **Under Section Maximum Dry Density and Optimum Moisture Content Determination Using a Family of Curves, if the one-point plot doesn't meet the requirements of this section (steps 2, 3, & 5), then a full curve must be developed or the guidelines for Selecting a Single Curve (Appendix A) located at the end of AASHTO T 272.**
- **Delete the Individual Moisture / Density Curve figure and example on page E&B/ID 15-5.**



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October 31, 2022

To: All Holders of the Manual of Field Test Procedures

Section: **Test Procedure AASHTO R 100**

The Oregon Department of Transportation has specified method(s) for this Test Procedure. Please observe the following for our projects:

- **Under Procedure - Initial Curing, Use Method 1, cure in a cooler with controlled water temperature. See test procedure for temperature requirements.**
- **Use a high/low temperature-recording device to monitor the water temperature during curing process. Record the high/low temperature range during the cure process on agency approved form.**
- **Under Procedure - Transporting Specimens, Delete Bullet 4 and replace with the following:**
 - **For concrete cylinders that are not able to be placed in final cure at the site where the compression testing will be performed, within 48 hours, a “temporary final cure” environment will be provided and maintained. Cylinders placed into this “temporary final cure” environment will then be transported to the final cure location within 12 days of casting. Temporary final cure is defined as;**
 - **Temporary final cure –An environment that meets the temperature and moisture requirements of bullet 2 under “Final Curing” of AASHTO T23. Curing may be accomplished in a moist room or water tank conforming to AASHTO M201. Molds do not have to be removed for Cylinders in Temporary final cure**
- **Under Procedure for Making Cylinders—Rodding step 3, the use of a mallet meeting the requirements under apparatus may be used for single-use plastic molds conforming to AASHTO M-205.**