LOUISIANA DEPARTMENT OF
TRANSPORTATION & DEVELOPMENT

APPLICATION OF QUALITY ASSURANCE SPECIFICATIONS FOR ASPHALT CONCRETE MIXTURES

2016 Edition

Jointly Developed by
The Louisiana Transportation and Research Center
Technology Transfer and Training Section
and the Louisiana Department of Transportation and Development

La Gov 10305
Application of Quality Assurance Specifications for Asphalt Concrete Mixtures

APPLICATION OF QUALITY ASSURANCE SPECIFICATIONS FOR ASPHALT CONCRETE MIXTURES

Developed by

TECHNOLOGY TRANSFER AND TRAINING

LOUISIANA TRANSPORTATION AND RESEARCH CENTER

For

Louisiana Department of Transportation and Development

2016

CREDITS

This manual was developed by Brian Owens, DOTD Materials Engineer Administrator, with the assistance of the technical review committee listed below. The manual was edited and prepared for publication by the LTRC Publications Department

The Construction and Materials Sections of the Louisiana Department of Transportation and Development and the DOTD Chief Engineer have approved this manual for publication.

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Special Thanks To
Mr. John Victory
for his expertise in Asphalt
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POLICY & GENERAL INFORMATION

POLICY SECTION

This document supports the implementation of Part V, 2016 *Standard Specifications for Roads and Bridges* incorporating new policies: Contractor data used in the acceptance decision, planned verification, dispute resolution, and System Independent Assurance.

This manual is part of project specifications by reference for inclusion and compliance with Part V of Louisiana Standard Specification for Roads and Bridges 2016 Edition. By extension, to any subsequent Special Provision and/or Supplemental Specifications not covered otherwise.

The purpose of this manual is to supplement Part V of the 2016 LA *Standard Specifications for Roads and Bridges*. To standardize policies and procedures, provide detail, explanation and examples, denote personnel requirements, and denote equipment and process requirements. All with the goal of facilitating uniform application of the specifications during design, production and placement of asphalt concrete and associated work.

Specifications – Use this manual in conjunction with the 2016 Edition of the *Louisiana Standard Specifications for Roads and Bridges,* or "Spec Book." Relevant specifications are referenced throughout this manual. Specifications may be repeated in order to further detail or demonstrate how they are applied. **All specifications, manuals, forms, and software are subject to change. It is imperative that contract documents for each project be reviewed for specific change, Special Provision, Supplemental Specification, update, and/or addition.**

Manuals – Numerous manuals that are essential for performing DOTD asphalt-related work are listed below. The latest edition of each shall be available at the asphalt mixture production plant and district laboratory. Documents can be obtained from the Department at a published price through General Files at 225-379-1107. Many manuals may be found at http://wwwsp.dotd.la.gov **,** hereafter referred to as "website."
Documents are:

- CONTRACT DOCUMENTS – the legally binding written agreement between the DOTD and the Contractor setting forth obligations for the performance of work for a specific project. *(not on website)* This may include Special Provisions or Supplemental Specifications.

- *2016 EDITION of the LOUISIANA STANDARD SPECIFICATIONS* for ROADS and BRIDGES – (known as "Standard Specifications") the terms and stipulations for providing materials, services and the finished constructed product.

- MATERIALS SAMPLING MANUAL – (known as "MSM") SAMPLING PLAN – The MSM establishes and standardizes sampling and acceptance requirements for Louisiana Department of Transportation and Development. The MSM determines what contract items are sampled and tested. Documentation, frequency, quantity and procedures for meeting project sampling requirements are detailed in the MSM. It can be found on the Materials Lab website: http://wwwsp.dotd.la.gov/Inside_LaDOTD/Divisions/Engineering/Materials_Lab/Pages/default.aspx

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- TEST PROCEDURES MANUAL – all standardized DOTD test procedures, which are denoted, “DOTD TR-xxx.”

- ENGINEERING DIRECTIVES AND STANDARDS MANUAL – (known as “EDSM”) establishes policies and procedures for DOTD Design, Construction, and Maintenance. An example is “haul truck certification.”

- APPROVED MATERIAL LIST (AML) - (Formerly known as “QPL”) – a listing of materials evaluated by DOTD. It lists companies that have demonstrated the ability to supply a product of acceptable quality. Project acceptance or verification testing is required of many products appearing on the Approved Materials list. Qualification Procedures for Approved Materials are given.

- DOTD CONSTRUCTION MEMORANDA – The DOTD’s internal office documentation to explain various construction issues. (Only available to DOTD Employees on the Intranet. Go to ***Construction Home Page***, to ***Construction Memos.)***

- CONSTRUCTION CONTRACT ADMINISTRATION MANUAL – Instructions for DOTD Project Engineers and their representatives includes procedures for change orders, estimates, diaries and field book entries.

- AASHTO TEST PROCEDURES – a set of nationally recognized test procedures and specifications published by the American Association of State Highway and Transportation Officials.
  http://www.transportation.org/ and go to the ***bookstore.***
  At the time of this writing, DOTD personnel have access through the LTRC “Library/Information Services” through the intranet.

- ASTM TEST PROCEDURES – a set of nationally recognized test procedures published by the American Society for Testing and Materials.
  www.astm.org, go to ***Standards***, then search. At the time of this writing, DOTD personnel have access through the LTRC “Library/Information Services” through the intranet.

- ADMINISTRATIVE MANUAL for CONSTRUCTION TECHNICIAN TRAINING AND CERTIFICATION – certification and training requirements for performing construction inspection.
  http://www.ltrc.lsu.edu/certification.html

- APPLICATION OF QUALITY ASSURANCE SPECIFICATIONS FOR ASPHALT CONCRETE MIXTURES – used in conjunction with and supplement Part V of the *Louisiana Standard Specifications for Roads and Bridges* for the design, production, and placement of Asphalt Concrete and associated work.
  http://wwwsp.dotd.la.gov/Inside_LaDOTD/Divisions/Engineering/Materials_Lab/Pages/default.aspx

POLICY & GENERAL INFORMATION

Documentation

Forms, Software and Spreadsheets – Data input by the Contractor and DOTD personnel will be required. The District Laboratory Engineer (DLE) will provide information on the current program and software requirements.

Internet Connection – An internet connection shall be required that is capable of connecting to DOTD websites for data entry into LaPave.

Rounding for Test Procedures – Site Manager Materials and DOTD approved software will utilize computer rounding for all test results and sample locations.

Rounding for Pay – Rounding for estimates and pay determination are to be in accordance with the Construction Contract Administration Manual or current Site Manager® construction policies. Asphalt mixture will be paid to the whole percent. If the tenths position is less than 5, round downward, if it is greater than or equal to 5, round upward. For example 99.3 rounds to 99% and 99.5% rounds to 100% pay. Intermediate hand calculations are rounded two more decimal places beyond the final answer.

LaPave Rounding – LaPave carries intermediate calculation to infinite places. Reportable calculations will be used to the reported decimal place in future calculations.

Example: G_{mm} calculation of 2.4512578 - reported value of 2.451 will be used to calculate G_{mb} values.

Definitions

Acceptance
The process of deciding, through inspection, whether to accept or reject a product, including what pay factor to apply. [Where contractor test results are used in the agency's acceptance decision, the acceptance process includes contractor testing, agency verification, and possible dispute resolution.]

Acceptance Program
All factors that comprise DOTD's determination of the quality of the product as specified in the contract requirements.

Aggregates

- Material retained on the No. 4 sieve is coarse aggregate.
- Material passing the No. 4 sieve is fine aggregate.

Approved Materials List (AML)
Formerly known as the **Qualified Product List (QPL)** - a list of qualified products available to construction and maintenance personnel for use on Departmental projects. AML products are subject to verification and acceptance testing.

Asphalt District Inspector (ADI)
DOTD Asphalt Plant Certified Inspector and is the representative of the District Laboratory Engineer.

Asphalt Technology Laboratory (ATL)
DOTD laboratory located at the Materials and Testing Section. The ATL may be used for resolution and/or forensic testing of asphalt mixtures.

Conditional Validation
A Job Mix Formula (JMF) has met plant parameters for continued production, but is awaiting plant produced Loaded Wheel Test (LWT) or Tensile Strength Ratio results (or other testing required on plant produced mix.) The final approval comes from the DLE. **Until density requirements and roadway performance are achieved** and evaluated, a JMF is deemed Conditionaly Validated.

District Laboratory Engineer (DLE)
The coordinating authority of the district's quality assurance program and the representative of the Department in the area of materials quality. This coordination is in conjunction with the DOTD Materials Engineer Administrator.

GPC Analysis
Gel permeation chromatography: Used to fingerprint asphalt cements and test for polymers in polymer modified asphalt cements. Samples containing crumb rubber or latex for "grade bumping" will employ methods other than GPC analysis. In areas referenced in this manual for GPC testing, it may be necessary for DOTD to use other methods for analysis.

Independent Assurance Program (IAP)
The IA Program is covered by regulation 23 CFR 637. The technical brief can be viewed at, http://www.fhwa.dot.gov/pavement/materials/hif12001.pdf.
Independent Assurance can be defined as: Activities that are an unbiased and independent evaluation of all the sampling and testing procedures used in the acceptance program.

Independent assurance
A management tool that requires a third party, not directly responsible for process control or acceptance, to provide an independent assessment of the product or the reliability of test results, or both, obtained from process control and acceptance. IA testing may be used for dispute resolution when the Contractor and Department test results differ.

LaPave
The current DOTD approved software for asphalt mixture design submittal and reporting of asphalt mixture testing.

LWT – Loaded Wheel Test
LWT is also referred to as Hamburg Wheel Track Testing. It is used to test samples for rutting and moisture susceptibility. For design, JMF submittals, plant produced specimens, the data from two separate wheel paths shall be submitted to DOTD (AASHTO T 324 9.1.b). When testing roadway cores for rutting, field conditions and/or directives of the DLE will determine the number of samples tested.

Maximum Size (MS)
One sieve size larger than the nominal maximum size

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Mix Design
JMF mix designs for 501 and 502 mixes shall use AASHTO M323 (Superpave Volumetric Mix Design) or AASHTO M 325 (Stone Matrix Asphalt – SMA) guidelines for designing asphalt mixes submitted for DOTD approval.

Nominal Maximum Size (NMS)
One sieve size larger than the first sieve to retain more than 10% by weight of the combined aggregates.

Non Destructive Testing (NDT)
The use of Nuclear, Low Nuclear or Non-Nuclear density testing equipment for roadway density determination. The use of such equipment is subject to Department quidelines.

Producer/Supplier (PS)
DOTD registered entities that produce and/or supply materials for use or potential use on DOTD projects.

Proficiency Samples
Homogeneous samples that are distributed and tested by two or more laboratories. Test results are compared to assure that the laboratories are obtaining the same results.

Qualified Laboratories
Laboratories that are capable as defined by appropriate programs established by DOTD. As a minimum, the qualification program shall include provisions for checking test equipment and the laboratory shall keep records of calibration checks. Qualified laboratories shall be accredited by AMRL, CMEC, or other DOTD approved accreditation body.

Qualified Sampling and Testing Personnel
Personnel who are qualified as defined by LTRC programs established and defined in The Department Administrative Manual for Inspector/Technician Training and Certification.

Quality Assurance (QA)
All those planned and systematic actions necessary to provide confidence that a product or service will satisfy given requirements for quality.

Quality Control (QC)
A procedure or set of procedures intended to ensure that a manufactured product or performed service adheres to a defined set of quality criteria or meets the requirements of the client or customer. Performed by the contractor to assess and adjust production processes so the end result adheres to specifications.

Random Sample
A sample drawn from a lot in which each increment in the lot has an equal probability of being chosen.

Rolling Five Average
When a total of five samples are reached, the average of the five is computed. As the sample population increases, the newest sample is added and the oldest is removed from the average of five samples. This creates the “Rolling Five Average.”

Verification Sampling and Testing
Sampling and testing performed to authenticate the test procedures, testing equipment, and test results for the product. Non-verifying results may warrant further investigation.

Safety

Both DOTD and Contractor personnel are to exercise caution while performing their duties at the plant/laboratory and in the field. They are to follow all safety procedures during sampling, testing, and routine plant/roadway inspection in accordance with the Testing Procedures Safety Guidelines.

For sanitary, health and safety provisions refer to Section 107.06

Environment Protection

Activities that negatively affect the environment potentially exist on every construction project, whether at construction sites, material producing plants, or equipment staging areas. Potential hazards can come from:

- Storm water runoff—it carries residues from asphalts, oils, fuels, fertilizers, and chemicals that can be hazardous to the environment.
- Air—vapors from materials such as fuel and oils can be carried away from the site.
- Noise—vibrations that can cause soil subsidence resulting in structural damage to buildings and water table changes, and high noise levels can affect hearing of individuals.

There are local, state, and federal guidelines that control these activities to minimize environmental harm. The Contractor shall abide by these regulations and take every step necessary to prevent damage to the environment. Section 107.14 of the Standard Specifications covers Environmental Protection procedures.

Erosion control is critical on a project. Pursuant to the Clean Water Act and the Louisiana Environmental Quality Act, coverage under a Louisiana Pollution Discharge Elimination system (LPDES) General Permit is required from the Louisiana Department of Environmental Quality for any construction activity meeting the threshold for land disturbance under the required permit. One single permit is required: for any project that disturbs one or more acres of land, and less than one acre of total land area that is part of a larger common plan of development or sale if the larger plan will ultimately disturb equal to or greater than one acre. DOTD projects, meeting this threshold for land disturbance, are automatically covered and authorized to discharge under this permit (LAR600000). A site specific Storm Water Pollution Prevention Plan (SWPPP) is required for these projects and also normally consists of:

- Plan sheets indicating the location of erosion control items
- Standard Plan EC-01
- Section 204

If there is no erosion control plan in the project plans, the Project Engineer is to contact the Headquarters Construction Section to find out if one should be added. The SWPPP shall be discussed at the pre-construction meeting.

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Contractor Notification

The Contractor shall notify the DLE and/or their designated representative by 3:00 pm of the preceding business day of anticipated plant production. This ensures the DLE the opportunity for inspection during production and shipping.

The Contractor shall make an effort to include, as accurate as possible, the Project(s), JMF(s), anticipated load out time, and anticipated tonnage. Compliance with providing notification shall be part of maintaining asphalt plant and asphalt plant laboratory certification.

Consequences of False Reporting or Misinformation

If an employee of DOTD or the Contractor is performing substandard work and is not able to satisfactorily perform duties routinely required of certified or authorized personnel, or engages in unethical activities, certification or authorization may be revoked.

Proceedings to revoke a certification or authorization may be initiated by DOTD representatives or industry, including, but not limited to: Department Certified Inspectors, District Training Specialists, DLEs, Area Engineers, Project Engineers, Construction Engineers, or any member of the Certification Committee. The appropriate representative of the employing firm may also request revocation of certification or authorizations granted to non-Department personnel

Proceedings to revoke a certification or authorization must be directed to the Materials Engineer Administrator, who is the Certifying Authority, and accompanied by documentation of the unsatisfactory performance. The Certification Committee will evaluate the request. The certification committee membership is in accordance with Engineering Directives and Standards III.1.1.26 – "DOTD Certification Committee Duties and Responsibilities" The certification committee is chaired by the Certifying Authority. The committee is empowered to create, revise, or rescind policies and procedures for the training, certification, and authorization of QA/QC personnel.

Recording and reporting accurate production data into DOTD approved software shall be part of requirements for maintaining laboratory and/or technician certification.

Policy and procedures for revocation of certification or authorization will be conducted and adhered to in accordance with the latest version of the "Administrative Manual for Construction Technician Training and Certification." This document may be found on the LTRC website at http://www.ltrc.lsu.edu/certification.html

Quality Assurance

Quality Assurance is the combined efforts of Quality Control and acceptance processes to assure a project will provide the public with a durable product exhibiting a high level of performance. A quality assurance system provides a level of confidence that our finished product will be of good value.

Preliminary Source Approval of Materials

The Materials Sampling Manual, located on the Materials Section website, outlines the inspection, sampling, and testing requirements of all materials. Source materials requiring long-term testing and regular source verification testing are required to comply with qualification procedures and testing requirements. When approved, the product will be listed in the Approved Materials List (AML) on the Materials website.

Manufacturer's representatives who wish to have products placed on the Approved Materials List must submit the AML Form, all information listed in the qualification procedure and a sample to the proper AML coordinator at the Materials and Testing Section. A list of AML contacts is located on the Materials Lab Website under Approved Materials List.

A qualification procedure for each listing in the AML has been established. This procedure contains a list of information required from the manufacturer of the product including an AML submittal form, sample size, typical laboratory testing time, typical field testing time, tests performed, specification requirements and project acceptance requirements.

Certification or Qualification of Technicians

Certified and/or Qualified Technicians are required to be adequately trained and capable of performing design, sampling, testing, and inspections. The Contractor's Technicians shall be qualified to sample and test, certified to design, produce, control, and adjust their operations. Requiring the use of Certified/Qualified Technicians, equipment and processes further ensures the likelihood of acceptable quality. When producing asphalt concrete, the Contractor shall employ a Certified or Qualified Asphalt Concrete Plant Technician in accordance with specification requirements. The Technician must be present at the plant whenever plant operations are supplying materials to a DOTD project. Daily plant operations shall not commence unless a Certified Technician is present. Technicians for both the Contractor and DOTD shall be qualified and/or certified for testing according to the levels listed below.

During plant operations, the Quality Control Technician for the contractor shall not also serve in another capacity (i.e. plant operator, loader operator, laborer.)

The qualification/certification levels for an Asphalt Plant Technician are as follows:

- Qualified Aggregate Tester
- Qualified Asphalt Concrete Plant Level I
- Certified Asphalt Concrete Plant Level II
- Certified Asphalt Concrete Plant Level III

See Appendix for detailed training requirements.

Requirements for certification as outlined in the Department's Administrative Manual for Inspector/Technician Training and Certification. The manual is available at http://www.ltrc.lsu.edu/certification.html.

All Technicians involved in QA/QC sampling and testing of asphalt mixtures for DOTD are required to complete the appropriate level of training in accordance with the Structured Training Program for Asphalt Mixture Plant Technicians.

Personnel must participate in the proficiency sample program to be active and keep certifications current. Failure to update by the established expiration date will result in the expiration of the certification. The certification will remain expired until required steps are taken to re-establish certification credentials.

The Department's Paving Inspector will be certified in the area of Asphalt Concrete Paving Inspection. Certification in this area requires successful completion of an examination. Following a minimum six months experience, a performance evaluation in roadway paving is administered.

It is expected all Department and non-Department Technicians and Inspectors to continually monitor the production process for conformity to specifications and consistency. Certified personnel are expected to conduct their duties of Quality Control and Quality Assurance in a cooperative, professional, and ethical manner.

It is a requirement of asphalt concrete Technicians to complete all testing, documentation, and submittals in a neat, orderly, and timely fashion. Required documentation is discussed throughout this manual.

Certification of Equipment and Processes

The certified asphalt plant will have a sticker issued showing the date certified. Asphalt plant lab testing equipment shall be calibrated, standardized, and/or verified in accordance with AASHTO R 18, Section 503 of the Standard Specifications and Section 503 of this manual. All plant scales, meters, and measuring devices shall be officially calibrated, standardized, and/or verified by a private, licensed testing company, or the Weights and Standards Division of the Department of Agriculture and Forestry. Contractors utilizing traceable verified/calibrated weights, instruments, and measuring devices may use and properly document the use of for laboratory equipment calibration, standardization, and/or verification and/or calibration.

Calibration:

- Performed under specific conditions such as temperature, humidity and includes measurement uncertainties.
- You must periodically calibrate your instruments, identify if there is a "drift" in the measurements and eliminate it through calibration
- It is performed as per calibration SOP (standard operation procedure.)

- Calibration performance of any equipment is compared against a reference standard. (comparing and unknown to a known)
- Calibration is a process that ensures accuracy is maintained in measurements produced by your equipment.
- Calibration assures accuracy of measurements.
- Calibrations can be used to establish adjustment factors.

In summary:

1. Calibration is a comparison
2. Conducted by following a procedure
3. Corrects for known systematic error (bias)
4. Estimates the measurement uncertainty

Verification:

Checks an instrument or equipment against a standard or reference to confirm it is meeting the broad and specific specifications set by the manufacturer.

Validation:

A documented program that provides a high degree of assurance that a specific process, equipment, method, or system consistently produces a result meeting pre-determined acceptance criteria.

A reference standard is **not** used in validation.

It provides documented evidence a process, equipment, method, or system produces consistent results.

Standardization:

Standardization can be thought of the same as calibration, but **without** the “estimate of the measurement uncertainty.”

Asphalt plant labs must be AASHTO R18 accredited by AMRL, CMEC, or other accreditation body approved by DOTD. It is mandatory that all required tests reported for design submittals and daily production be performed by an accredited laboratory and Certified Technician. Certified equipment and processes ensure the plant and paving equipment are in good working condition and capable of producing the required level of quality. The Contractor shall provide plant, field and testing equipment that is in good condition and appropriate for the tasks for

which it is used. A list of required plant laboratory equipment is included in Section 503 of this manual.

Prior to the beginning of construction on a project, a DOTD Roadway Inspector will inspect the roadway equipment to be used on the project to ensure it is in good working condition and appropriate for the activity and intended use. The Inspector will require equipment that does not perform adequately, (leaks, damaged, disrepair, etc.) be removed, repaired and/or replaced before being allowed to operate on the project. The contractor shall give sufficient notice to the DOTD inspector to allow for equipment inspection before construction activities begin.

Quality Control

Quality Control is the process used by the Contractor to monitor, assess, and adjust material selection, production, and project construction to control the level of quality so that the product continuously and uniformly conforms to specifications.

Minimum requirements for Quality Control sampling and testing are noted in the specifications and the Materials Sampling Manual. The Contractor shall sample and test as needed to ensure quality. All Quality Control required testing listed in the specifications shall be entered into LaPave.

When approaching borderline conditions, a Contractor may adjust operations or materials. When materials or operations result in out of specification plant gradation and volumetric tests, or roadway density tests, immediate adjustments shall be required to correct the deficiency and prevent reoccurrence.

Inspection, Sampling, and Testing

Inspection is the observation of materials, samples, tests, equipment, processes and finished product to determine the quality of the product, to determine the quantity or the amount to pay for the product. Plant technicians document plant test results. Roadway technicians document product placement. Inspection may reveal areas of concern resulting in additional discussion, investigation, or further testing. The Project Engineer is the direct representative of Chief Engineer for the administration of the contract and represents the Department directly, as well as the inspection staff.

Sampling and testing is a support for visual inspection. Although the random, statistically based sampling and testing performed by the Department represents the entire area or lot tested, this methodology does not replace visual inspection. Department personnel will observe the Contractor's operations and inspect the project throughout its construction. When non-uniform materials or non-uniform processes result in areas which do not appear to be acceptable or which are obviously not in conformance with the quality of construction expected, the Department will require the Contractor to correct these deficient areas. It has never been the intent of the Department to accept a project solely on a sampling and testing program. It is always necessary for the Project Engineer and Inspector to be aware of the quality of construction and performance of the project during construction and acceptance phases before final acceptance.

Sampling and testing requirements for materials or processes specified in Supplemental Specifications or Special Provisions are not usually included in the Materials Sampling Manual.

If sampling or testing requirements are not published, the Project Engineer will determine sampling and testing.

Validation Testing

Validation is a specific type of verification testing, performed jointly by the Contractor and DOTD, used to determine the viability of a laboratory-designed asphalt Job Mix Formula based upon test results of plant-produced mixtures. Validation is performed on the first lot of asphalt plant production and determines if the plant-produced mixture conforms to the proposed job mix formula and Department specifications. Validation testing may occur over multiple days and multiple projects, if allowed by the DLE.

If the project that initially receives mix from a validation does not have enough tonnage to complete the validation, the validation shall be continued on the next project.

A validation may have multiple lot numbers when multiple projects are used to achieve the required tonnage for validation.

Validation data establishes JMF production targets and tolerances for plant produced asphalt mixes.

Documentation

Documentation provides a history of each project and a chronicle for Contractors and/or Technicians. Documentation shall be maintained within LaPave and other means specified.

Contractor provided summary reports shall be required to close out DOTD projects with asphalt concrete unless otherwise directed by the DLE. Reports are generated from LaPave.

The Contractor shall maintain records of all testing related to state projects at the production plant. Contractor documentation shall be available to DOTD.

The Contractor shall document **all** Quality Control testing in LaPave. In addition, the Department shall summarize the project-specific sampling and testing at the end of the project in the 2059, or Summary of Test Results, in accordance with EDSM III.5.1.2.

The Contractor shall make all accreditation and asphalt mix testing documents available for review upon the Department's request.

Acceptance

Acceptance is the process of sampling, testing, and inspection that defines the degree of contract compliance. Acceptance is based on the degree of compliance with specifications for acceptance of materials and/or a Contractor's work. Acceptance sampling, testing, and inspection are the responsibility of DOTD. Use of Contractor sampling and testing in the acceptance decision is allowed by specifications. At the end of the construction phase, through evaluation of all sampling, testing, and visual inspection, the Department will determine pay and provide final acceptance notice to the Contractor.

Independent Assurance Program (IA)

The IA Program provides confidence that uniform testing and equipment exists in all facets of the Quality Assurance Program. See the section on Independent Quality Assurance Program for more detailed information.

Laboratory Accreditation and Certification

DOTD District Labs, Materials Lab, ATL, and Contractor asphalt plant labs require accreditation by AMRL, CMEC or other accreditation body approved by DOTD in accordance with AASHTO R 18.

DOTD Materials Engineer is the certifying authority for all laboratories (Contractor and District Labs). AMRL or CMEC accreditation does not guarantee DOTD certification.

DOTD reserves the right to decertify laboratories when Contractors fail to rectify noted non-conformance to policies.

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General testing requirements of DOTD District Labs, Asphalt Production & Design Laboratories for Accreditation through AMRL, CMEC or other DOTD approved accreditation body are listed in Table-1.

Table 1
Test Methods for Accreditation

Description	DOTD Test Method	AASHTO/ASTM
Specific Gravity & Density of Compressed Asphalt Concrete Mixtures [1, 2, 3]	DOTD TR 304	T 166/D2041
Theoretical Maximum Specific Gravity, G_{mm} [1, 2, 3]	DOTD TR 327	T 209/D2041
Asphalt Cement Content, P_b [1, 2, 3]	DOTD TR 323	T 308/D6307
Mechanical Analysis of Extracted Aggregate[1, 2, 3]	DOTD TR 309	T30/D5444
Moisture Content of Loose Asphalt Mixtures [1]	DOTD TR 319	T 329
Coarse Aggregate Angularity (% Double Faced Crushed)[1, 2, 3]	DOTD TR 306	T 335/D5821
Conditioning of Asphalt Mixtures (Aging) [1, 2]		R 30
Preparing Gyratory Samples [1, 2, 3]		T 312
Asphalt Cement Drain Down [1, 2]		D6390
Splitting & Quartering Samples [1, 2]	DOTD TR 108	
Reducing Samples of Asphalt Mixtures to Testing Size [1, 2, 3]		R 47
Sieve Analysis of Fine & Coarse Aggregate [1, 2]	DOTD TR 113	T 27/C136
Determination of Moisture Content (Stockpile Aggregates) [1]	DOTD 403	T 255/C566
Amount of Material Finer than the 75 µm (# 200) Sieve in Aggregate by Wash [1, 2, 3]	DOTD TR 112	T 11/ C117
Fine Aggregate Angularity [2, 3]	DOTD TR 121	T 304/C1252
Flat & Elongated Particles [2, 3]		D4791
Sand Equivalent [2, 3]	DOTD TR 120	T 176/D2419
Hamburg Wheel-Track Testing of Compacted Asphalt Mixtures [2, 3]		T 324
Moisture Sensitivity (Lottman – Tensile Strength Ratio) [2]	DOTD TR 322	T 283/D4867
Coarse Aggregate Bulk Specific Gravity & Absorption [2, 3]		T 85
Fine Aggregate Bulk Specific Gravity & Absorption [2, 3]		T 84
Semi-Circular Bend Test (SCB)[2,4]		D8044

[1] Asphalt Production Laboratories
[2] Asphalt Mix Design Laboratories
[3] DOTD District Laboratories
[4] Optional accreditation for contractors

Independent Quality Assurance Program

Independent Assurance Programs

A system-based IA Program for asphalt materials will be employed which includes the maintenance of accreditation by all laboratories and maintenance of certification and proficiency of assessment of Certified Technicians. System independent assurance will include a technician proficiency testing program and may include random plant and field visits to view test performance, verify equipment calibration, and examine accreditation records.

Independent Assurance is required for National Highway System (NHS) federal funding. FHWA Technical Brief FHWA-HIF-12-001 describes Code of Federal Regulations 23CFR637 that addresses the evaluation necessary for FHWA requirements.

DOTD employs the "System Approach" for independent assurance for asphalt materials where qualifications of involved personnel and facilities are assessed.

Independent Assurance

All laboratories, equipment, and technicians involved in the acceptance decision are covered under the Department's Independent Assurance Program.

Each laboratory performing testing involved in the acceptance decision are required to be accredited to comply with AASHTO R18. This accreditation addresses equipment and test procedures used for each laboratory. All covered laboratories will be AASHTO R18 accredited to maintain DOTD certification and will submit documentation to verify current accreditation to the Independent Assurance Team upon request. Failure to maintain accreditation or failure to submit requested documentation may result in loss of DOTD lab certification.

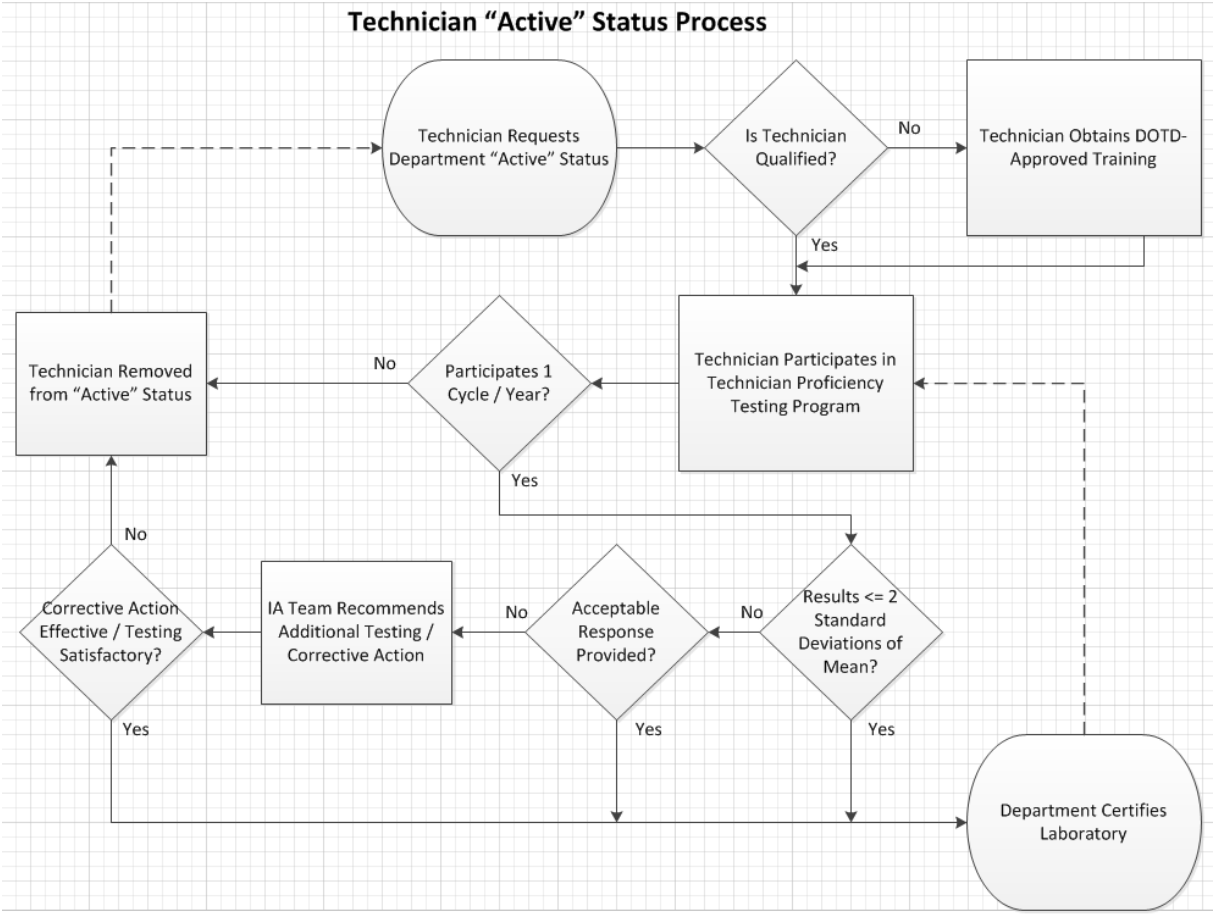
The Technician Proficiency Testing Program is the primary Independent Assurance procedure used to monitor the proficiency of each technician involved in the acceptance decision for asphalt materials. Typically, the Independent Assurance Team will send two sets of proficiency samples per year to all technicians performing tests used in acceptance decisions. Technicians will maintain "active" status by participating in at least one round of proficiency sample testing per year and submitting appropriate responses for any deficiencies noted upon analysis of proficiency testing results.

Note: Information on each technician will be maintained electronically by the Independent Assurance Team. Therefore, it is imperative each technician provide proper contact information and notify the Independent Assurance Team upon transfer to a different work location (i.e. between District Labs or from one contractor's lab to another).
For asphalt mixture materials, the following proficiency tests are required:

Table 2
Proficiency Sample Testing

Asphalt Samples	Tests	Frequency
Gyratory Briquettes,	G_{mb}, Voids	Minimum 1 per year
Loaded Wheel Test (Level 2 & 3 certification)	AASHTO 324, Rut depth	Minimum 1 per year
Oven Extracted Gradation	%AC and % Passing each sieve.	Minimum 1 per year
Loose Mix	Rice Gravity, G_{mm}	Minimum 1 per year

Satisfactory performance for participants in the proficiency program will be test results less than 2 standard deviations from the mean. Any technician with unsatisfactory performance will submit a written response to address each deficiency noted. Depending on the magnitude of the deficiency, the technician may be placed on notice and/or required to perform additional testing to verify proficiency. Repeated deficiencies or failure to provide appropriate responses to deficiencies may result in suspension of "active" status and / or certification.



System Independent Assurance Team

The system Independent Assurance team will be housed at the Asphalt Technology Lab (ATL) at the Materials Lab facility and personnel will be comprised of the Field Quality Assurance Engineer and Independent Assurance Technician(s). The ADI in each District will be responsible for assisting with IA duties such as coordinating IA functions within their district. The team will perform the following:

1. **Material Quantity Report:** Annual Summary Report by district, by plant, by project will be maintained within LaPave.

2. **Individual Lab review:** Each district lab reviewed annually by an AASHTO R 18 accrediting entity. Independent Assurance Technician(s) assist the District Lab personnel with maintaining documentation and preparation for accreditation.

Proficiency Sample Report:

   a. Analyze proficiency data to determine technician compliance and obtain responses from technicians to address deficiencies.
   b. Annual report of proficiency sample program. Report will include number of certified technicians, number of "active" technicians, number of technicians covered by the IA program, number of IA reports that had deviations, and a summary of how the deviations were addressed along with the potential systematic solutions to reoccurring deficiencies.

3. **Accreditation/Certification report:** Summary report listing all accredited labs and ongoing accreditation status of each laboratory.

4. **Independent Assurance (IA) Responsibilities for Plant Verification on System Based Frequency:** The Technician(s) may randomly visit asphalt plant facilities to verify plant operations and audit the quality of production with no advance notification to the contractor or the Department.

   The IA Inspector may take a random independent sample or split sample with the Contractor or District personnel for state projects. The asphalt mix may be run at the Contractor's facility, the District Lab, or the ATL. Enough mix shall be sampled to complete the following tests:

   - G_{mm} – TR 327
   - Gyratory compacted to N_{design} – T 312, TR 304
   - Mix moisture – TR 319 if tested at the production facility
   - Loose mix for %AC and gradation – TR 323, TR 309

   The IA Inspector shall perform test independently of the Contractor or Department personnel. The gyratory briquettes will be tested for bulk specific gravity G_{mb}, V_a, $\%G_{mm}$ @ N_{des}, VFA, and VMA.

In addition, Quality Control charts, equipment maintenance logs, proficiency sample records, or other record keeping required for certification may be reviewed at the time of inspection.

If the tolerances listed in Table 7 of the QA manual are not met, the Technician(s) will advise the Materials Engineer Administration for disposition and further handling.

5. **Dispute Resolution, Forensic Analysis and Other Requests:** When needed, the Independent Assurance Team will be called upon to perform dispute resolution, forensic analysis and/or technical assistance. Any of the nine District Laboratories or the Contractors certified laboratory may be used at the direction of the Field Quality Assurance Engineer for Dispute Resolution and/or Forensic Analysis. The Technician (s) will provide testing, documentation, and test reports to assist DOTD in the dispute resolution(s) and forensic analysis as needed.

SECTION 501 – THIN ASPHALT CONCRETE APPLICATIONS

DESIGN
This section describes procedures and documentation required for designing, validating, and producing an asphalt concrete mixture for use on a DOTD project applying Section 501 of the Standard Specifications (Thin Asphalt Concrete Applications). It details plant Quality Control and acceptance, roadway Quality Control and acceptance, and how to pay for 501 asphalt mixtures.

This section shall be used in conjunction with Section 502 (Asphalt Concrete Mixtures) and Section 503 (Asphalt Concrete Equipment and Processes) of the Standard Specifications. Information in this section applies to Section 1002 (Asphalt Materials and Additives) and Section 1003 (Aggregates).

A finish course is defined as a 501 thin lift mix placed over a new or existing502 asphalt concrete pavement or a Portland cement concrete pavement.

The District Laboratory will verify the Contractor's values of stockpile bulk specific gravities, water absorption, and consensus properties.

Applicable test procedures are listed in Table 502-1 of the Standard Specifications. A copy of the following shall be available at the production facility:

- Contract documents
- Current edition of the Standard Specifications and any Supplementals/Special Provisions
- Material Sampling Manual and Sampling Plans
- All applicable testing procedures
- Approved Materials List
- JMF
- AASHTO R18 Documentation

Section 501 mixture specifications differ from Section 502 in the methods and testing as describe herein.

Mix Design Steps and Approval

Material Procurement and Approval

Material procurement and approval procedures are the same as for Section 502 except the Contractor will submit a Certificate of Analysis for Micro Deval for conformance to Table 501-2 and subsection 501.02.4.

Aggregate

Coarse Aggregate
The combined aggregates shall be in accordance with design gradation requirements in Table 501-3.
Friction requirement shall meet requirements of 502.02.3.1 and Table 502-3.

Fine Aggregate

. Fine Aggregate Angularity (FAA) of each fine aggregate source shall be measured and the calculated average blend (AASHTO T 304) or weighted average of individual components shall be measured in accordance with DOTD TR 121 (mineral filler excluded).

RAP

RAP used in Dense Mix shall meet RAP requirements referenced in sections 502.02.3.2, 1003.01.3.2, and 1003.06.5. **All RAP for dense mix shall be processed to pass a 1" screen.**

Asphalt Cement

Asphalt cement shall be from an approved source listed on the Approved Materials List. Asphalt cement grade shall be in accordance with Table 501-1. Substitutions in accordance with Section 501.02.2 are allowed.

Asphalt cement is accepted at the plant by a Certificate of Delivery (CD). A Certificate of Delivery shall accompany each load delivered to the plant. Asphalt cement testing shall be in accordance with Section 502. **The Contractor shall collect, scan , and email asphalt cement CDs to the DOTD ADI or DLE.** When blending PG67-22 to increase the performance grade of the AC, the contractor shall submit documentation and testing on blending to support quantities produced.

Additives

Anti-strip or hydrated lime (if used) The Contractor shall collect scan and email CDs for additives to the DOTD ADI or DLE.

Cellulose or mineral fibers, . The specific requirements for fibers are listed in Section 501.02.6 and Section 1002.02.5. A Certificate of Compliance (CC) shall be submitted to the DLE for fibers.

Design of Asphalt Mixture, Job Mix Formula (JMF)

Mix design steps and approval process are the same as for Section 502. Except for the following requirements:

- Ensure aggregates meet requirements of Table 501-2
- A Micro Deval Certificate of Analysis must accompany OGFC and Coarse Mix JMF submittals for each aggregate.
- Gradation bands for Dense Mix, Coarse Mix, and OGFC are in Table 501-1
- Gyratory N_{design} revolutions will be in accordance with Table 501-1.

Additional Requirements for OGFC Mixtures

OGFC mixture must have a coarse aggregate (+ No. 4 sieve) skeleton with stone-on-stone contact. Stone-on-stone contact within an OGFC mixture is defined as the point at which the percent voids of the compacted mixture is less than the Voids in Coarse Aggregate (VCA) .
The VCA of the coarse aggregate only fraction (VCA_{DRC}) is determined by compacting the stone with the dry-rodded technique according to ASTM C29.

When the dry-rodded density of the coarse fraction has been determined, calculate the VCA_{DRC} using the following equation from ASTM C29:

$$VCA_{DRC} = \frac{G_{CA}\gamma_w - \gamma_s}{G_{CA}\gamma_w} x\,100$$

Where:

G_{CA} = Bulk specific gravity of the coarse aggregate
γ_s = Bulk density of the coarse aggregate fraction in the dry-rodded condition,
γ_w = Density of water

V_a, and VCA_{MIX}:

- Select three trial blends of aggregate within the aggregate gradation bands as detailed in Table 501 - 3, "JMF Extracted Gradation and Production Tolerances."
- Determine the dry-rodded voids in the coarse aggregate, retained on the No. 4 (4.75 mm) sieve, of the coarse aggregate only, VCA_{DRC} as described above.
- Add between 6.5% to 7.0% asphalt cement to each trial blend and compact blend to 50 gyrations in a Superpave gyratory compactor. (Note: At this stage of design, fiber should be added at the manufacturer's recommended rate. Fibers are required only if the drain down requirements are not met. Typical fiber rates are 0.2% to 0.5% of the total weight [mass] of the mix.)
- Determine the % air voids (V_a), and % voids in the coarse aggregate for each of the compacted mixes (VCA_{MIX}).
    - Determine the bulk specific gravity of the mix (G_{mb}), using the physical volume.
    - Determine the theoretical maximum specific gravity of the mixture (G_{mm}), in accordance with DOTD TR 327.
    - Determine the bulk specific gravity of the coarse aggregate fraction (G_{CA}), in accordance with ASTM C127.
    - Calculate V_a, and VCA_{MIX} using the following equations:

$$V_a = 100 \times \left(1 - \frac{G_{mb}}{G_{mm}}\right)$$

$$VCA_{MIX} = 100 - \left(P_{CA} \times \frac{G_{mb}}{G_{CA}}\right)$$

Where:

P_{CA} = % coarse aggregate in the total mixture
G_{mb} = bulk specific gravity of the compacted mixture
G_{mm} = theoretical maximum specific gravity of the mixture
G_{CA} = bulk specific gravity of the coarse aggregate fraction

- Select the aggregate gradation blend that achieves a minimum 18% air voids (V_a).
- To determine the optimum percent of asphalt in the mixture prepare two additional mixtures using 0.5% and 1.0% additional asphalt cement using the desired aggregate blend as selected previously and compact using 50 gyrations of the Superpave gyratory compactor. The optimum percent of asphalt will be determined based on specification

compliance for % air voids and asphalt cement draindown. The percent VCA_{MIX} shall be reported for information.

- For design, the asphalt cement draindown test shall be conducted in accordance with ASTM D6390 on the loose mix at a temperature 18°F (10°C) higher than normal mixing temperatures. A maximum 0.3% draindown of asphalt cement by weight (mass) will be allowed. Draindown will be in accordance with Table 501-1.
- For OGFC mixes, use the Physical Volume

Open or coarse asphalt mixtures may be tested for voids using ASTM D3203 (Percent Air Voids in Compacted Dense and Open Bituminous Paving Mixtures) (Physical Volume) if voids are greater than 10.0% or water absorption of the compacted gyratory sample is greater than 2.0% by volume as measured per T 166 – 7.2.

Where:
A = mass of the specimen in air, g:
B = mass of the surface-dry specimen in air, g: and
C = mass of the specimen in water, g.

$$\text{Percent of water absorbed by volume} = \frac{B-A}{B-C}\ x\ 100$$

Traceable calibrated or standardized calipers will be used for measurements used in calculating volume.

Four measurements for thickness will be at approximately quarter points along the periphery of the gyratory. Average the four measurements for height for use of calculations. Make two measurements perpendicular to each other (for a total of four) on both flat surfaces and average for diameter of the gyratory.

An example for measuring voids using Physical Volume is as follows:

3915.0g = Dry weight of gyratory

2.355 = G_{mm} of mix

150.0mm = Averaged diameter of gyratory

Radius (*r*) = 150mm (diameter) ÷ 2 = 75mm

115.0mm (*h*) = Averaged height of gyratory

π = 3.1416

0.99707 = factor to convert from density (g/cm^3) to bulk specific gravity (G_{mb})

v = volume

V_a = voids

h = height of gyratory sample

Volume of a cylinder (gyratory), $\boldsymbol{v = \pi r^2 (h)}$

(3.1416)(75.0mm^2)(115.0mm) = v mm^3

(3.1416)(5625)(115.0) = 2032222.5 mm^3 x 0.001 (convert mm^3 to cm^3) = 2032.222<u>5</u> cm^3

Rounded to 2032.223 (two places past the final answer)

Density of the gyratory sample = mass (g) ÷ volume (v)

3915g ÷ 2032.223cm^3 = 1.926 grams per cubic centimeter (g/cm^3)

1.926 ÷ .99707 = 1.932G_{mb} Converts from density to bulk specific gravity

100 – [100 (G_{mb} ÷ G_{mm})] = % voids in gyratory sample

100 - [100 (1.932 ÷ 2.355)] = V_a

100 – [100 x .82038] = V_a

100 – 82.0 = V_a

18.0 = V_a

STEPS IN SUBMITTAL PROCESS:

Trial Blends with Varying Asphalt Cement Contents (Except OGFC)
Refer to Section 502: *Trial Blends with Varying Asphalt Cement Contents* of this manual.

Selection of Optimum Asphalt Cement Content
Conform to requirements of Table 501-1. Refer to Section 502 and Table 501-1: *Selection of Optimum Asphalt Cement Content* to determine optimum values.

Dust to Effective Asphalt Cement Ratio Evaluation
Dust to Effective Asphalt Cement Ratio of 0.6 – 1.6 applies to Dense 501 mixes only, not Coarse Mixes or OGFC.

LWT, Loaded Wheel Test, (AASHTO T 324)
The Contractor will submit LWT results for specimens indicating conformance to Table 501-1. LWT may be tested at the plant laboratory or using the district laboratory LWT equipment.

Validation of JMF proposal
Validation procedures shall be in accordance with Section 501.05.

A 501 validation lot is the first 1200 tons of a JMF comprised of three 400-ton sublots. Test each sublot as follows to ensure conformance with Table 501-1:

- One aggregate gradation and %AC
- One briquette tested for volumetrics (V_a)
- One corresponding Maximum Theoretical Specific Gravity (G_{mm})

In addition, for the validation lot, the contractor shall take for QC:

- One asphalt cement draindown (ASTM 6390) for OGFC and coarse mix
- One % anti-strip additive rate verification
- One Boil Test AASHTO T195 for 98% minimum aggregate coating

With mutual agreement of the contractor and the Department, a fourth sample of plant mixture may be taken during validation. This sample may be used in place of the first validation plant sample for purposes of determining lot averages and establishing JMF targets.

LWT (Rut Testing) Validation of JMF Proposal
After conditional validation, LWT testing shall be performed the next day of production in accordance with Section 502A minimum of four gyratories or roadway cores that include the top lift of the underlying surface may be used for LWT testing.

Once completed, the validation data is promptly forwarded to the DLE, the average gradation and G_{mm} measured during validation will be become the JMF targets as per Table 501-3.

The JMF is validated if all of the below are met:

1. The average of test results shall meet 100% pay requirements in Table 501-4
2. The individual test results must meet the tolerances of Table 501-3.

Upon validation of the JMF, the validation results shall be used for acceptance. The average of the validated results will be used to establish the JMF targets and tolerances.

The Department will evaluate the performance of the mixture on the roadway and ensure the JMF is not contributing to laydown deficiencies, such as segregation, tenderness, workability, or surface texture problems. Mixtures identified as causing any laydown deficiency will not be approved. The Project Engineer or the DLE may reject a JMF or not validate a JMF due to roadway deficiencies or visible mixture deficiencies.

Individual tests must meet the tolerances of Table 501-3. For validation, if the first sublot does not meet the tolerances in Table 501-3, the Contractor may exclude that sublot from the validation, provided adjustments are made to the mix. The validation tonnage may be extended if necessary to include a fourth sublot and tests. The tonnage for the excluded first validation sublot will be paid according to table 501-4 and **paid as a separate lot**.

Failure to Validate
If the mix fails to validate, the DLE may allow one additional attempt before requiring a redesign of the mixture.

If a JMF fails to validate on a second attempt, a new JMF must be submitted and validation testing repeated or the Producer may use a previously approved Job Mix Formula. If the JMF does not validate, the DLE will disapprove the JMF in DOTD's software. The DLE will notify the Producer and Project Engineer of the termination of the JMF.

Final Approval of JMF
After meeting the Validation requirements, the DLE makes final approval.

Materials Laboratory Sample Requirements
Approximately 20 grams of –No. 4 and +No. 8 asphalt coated aggregate from loose mix obtained during validation will be submitted to the Materials Lab for GPC analysis.

One quart can of Asphalt Cement will be submitted along with asphalt coated aggregate for GPC analysis (finger printing) from the validation.

When an asphalt cement source is changed, one quart can and loose mix as referenced above shall be submitted to the Materials Lab for GPC analysis.

Definition of a Lot (Thin Asphalt Concrete mixtures)

A standard lot size is 2400 tons comprised of 3 – 800 ton sublots in accordance with Section 501.04.

The final sublot of the project may be increased to 1200 tons with the mutual agreement of the Contractor and Project Engineer. The total tons for the final lot can be increased up to 2800 tons.

Plant Testing for 501 Mixes

A Qualified DOTD Inspector will perform acceptance testing for 501 mixtures.

General requirements are the same as for Section 502, except that draindown must be performed on OGFC and Coarse Mix to ensure the mixture is within specification limits. Gradation, %AC, G_{mm}, and air voids shall be measured in accordance with Section 501.

The sample requirements for each sublot shall be as follows:

1. Air void contents - QC
2. Theoretical Maximum Specific Gravity Tests, G_{mm} - Acceptance
3. Asphalt content determination by ignition- QC
4. Extracted gradations – QC for Dense Mix, Acceptance for OGFC and Coarse Mix
5. Coarse Aggregate Angularity – QC

One draindown test per lot shall be performed on OGFC and Coarse Mix for QC

LWT testing will be performed every 10,000 tons of production per JMF (4 - 60mm gyratory specimens). The LWT may be witnessed by the ADI at the plant or sent to the district lab for testing.

If the average tests for the lot are not within specification requirements, corrective actions shall be taken or operations ceased. Test results are recorded along with other Contractor/Producer data within LaPave.

The specified Quality Control Program is a minimum requirement and should not prevent the QC Technician from performing any tests to ensure consistent production, meeting specifications.

For production days that do not require acceptance testing, the contractor and DOTD inspector shall jointly sample and test for Quality Control when production is 100 tons or greater. Test data for this testing shall be entered into LaPave as QC.

The asphalt cement content is based on the Ignition Oven (TR 323) test results along with correction factors. One correction factor accounts for moisture performed each sample set. The other for fibers, and loss of aggregate during ignition (JMF correction factor). If the plant delivery rate of asphalt cement (metered) plus the asphalt credit from RAP (if used) differs by more than ±0.3% from the Ignition Oven (with correction factor) for two consecutive tests, take corrective

action. Corrective action can be reestablishing the correction factor, recalibrating the asphalt cement metering system or other systems of the plant. Document and forward to the DLE the cause and corrective action taken.

The Contractor shall check the rate of anti-strip, mineral filler, lime, or fibers at the beginning of each operational period, and when necessary thereafter, to ensure the mixture is receiving the JMF amounts of each material.

Verification

Project sample requirements are as follows:

1. One sample per shipment or Certificate of Compliance (CC) for fibers
2. One transport sample per grade per project for asphalt cement submitted for complete analysis.
3. One working tank sample per day per grade used for 501 for verification.

Verification sample requirements are as follows:

1. Verify aggregates are on the "Approved Materials List" with current Micro-Deval (Note: The Materials Lab will test one full sample sack per project if Micro-Deval values are in question.)
2. Tests for Flat and Elongated and CAA should be performed on the 12-month or new-source stockpile samples at the district lab.
3. Verify Anti-Strip additive quantity from meter each production day.

The ADI will sample for verification, to be tested at the district lab, a minimum of one per project for 501 mixes and every 9600 tons thereafter per project. Adequate mix will be collected and sent to the district lab to perform the following tests:

District Laboratory Verification of plant results are as follows:

1. One loose mix for G_{mm} testing
2. Enough loose mix for one gyratory specimen prepared at N_{design} and subsequent V_a, VMA, and VFA volumetric calculations. Except for OGFC.
3. One loose mix for asphalt extraction, gradation (No. 4 and No. 200) and %CAA for OGFC

Applicable tolerances from Table 7 in section 502 in this manual will be used for verification.

Roadway Acceptance

Tack coat application rates will be for acceptance once per lot. Tack coat rate will be measured and calculated for proper application rate. Tack coat visual acceptance will be in addition to measurable criteria.

Tack coat application rates for OGFC and Coarse Mix are subject to payment adjustments in accordance with table 501-4.

Tack coat application rates above the minimum specified in Table 501-1 must be approved by the Engineer.

For surface tolerance, see Section 502.12 – Surface Tolerance and Table 501-5 in the Standard Specifications.

Thin lift mixes with high AC content and high voids may need adjustment factors to adjust for yield and payment. See Appendix

Plant and Stockpile Verification
The DLE will verify the Contractor's aggregate gradations, bulk specific gravities, absorptions, and consensus properties, a minimum of, once every 12-months.

Asphalt Cement
When AC is questionable, send mix and/or asphalt cement to the Materials Lab for analysis. See GPC testing in section 502 of this manual.

See Additives in the 502 section of this manual for requirements of blending Latex or Crumb Rubber (CR).

Measurement and Payment

Measurement
Weight measure by the ton will be based on Section 501. Measure the square yards paved and total gallons of tack coat applied. Report in gallons per square yards. Record tonnage received based on truck tickets as delivered to roadway.

Payment
Payment for Thin Asphalt Concrete mixtures will be made at the contract unit price per ton. Apply pay adjustment based on Table 501-4 for G_{mm} and Gradation. Pay adjustment is the lowest determined value. A separate payment adjustment for IRI will be applied per travel lane to the theoretical tonnage of each lane for the entire length of the project in accordance with Table 501-5

Asphalt tack coat is a pay adjustment item for OGFC and Coarse mix, but is considered incidental to 501 Dense Mix. It will be applied in accordance with Section 504. If the engineer adjusts the application rate of tack coat from that specified by the contract document, payment for the asphalt mixture will be increased or decreased based on the difference in the applied quantity of asphalt emulsion shown on paid invoices. The contractor shall provide copies of paid invoices for this determination.

Section 502 – Asphalt Concrete Mixtures

This section describes the procedures and documentation required for designing, validating, and producing an asphalt concrete mixture for use on a DOTD project while applying Section 502 of the Standard Specifications (Asphalt Concrete Mixtures). It details Plant Quality Control, Roadway Quality Control and Acceptance, and How to Pay for Asphalt Mix. Sections 503 (Asphalt Concrete Equipment and Processes), 1002 (Asphalt Materials and Additives) and 1003 (Aggregates) also apply.

Applicable test procedures are listed in Table 502-1 of the Standard Specifications. A copy of each applicable test procedure shall be available at the plant for immediate reference. The preface contains a listing of appropriate manuals.

Warm Mix Asphalt (WMA) is defined as asphalt concrete mixture that is modified by approved foaming methods or chemical additives to reduce mixing and compaction temperatures.

Mainline Mixtures ≤1000 current plan ADT

Projects with current plan ADT ≤1000 have an option for the contractor to have Mainline Mixture pay calculated by PWL or average core density.

The contractor shall declare the method of pay calculation for Mainline Mixtures at the Pre-construction Conference for the project with ≤1000 current plan ADT. If the contractor does not make a declaration at the pre-construction conference on Mainline Mixture pay method for ≤1000 current plan ADT, pay shall be calculated by PWL.

When the contactor chooses Mainline Mixture average core density pay calculations, Table 502-6b shall be used for JMF design and production specifications.

Payment for Mainline Mixture average core density shall be in accordance with 502.15.2.2.

Mix Design Steps and Approval

Material Procurement and Approval

The Contractor selects and procures materials to utilize in the mix design process. Materials for an asphalt mix design include, but are not limited to, aggregates, asphalt cement, and anti-strip.

Source Approval–All materials are to be on the Approved Materials List (AML). RAP is not listed on the AML. It is approved by the district lab that the production facility is covered by. RAP is assigned a Producer Supplier code.

Aggregate

All aggregates used for production of asphalt mixtures shall be submitted to the district laboratory for verification.

Stockpile Samples–Stockpile samples will be tested for verification of the Contractor's submitted values, a minimum of, every 12-months. Samples for new sources shall be submitted at **least three weeks prior to the submission of a job mix proposal (JMF).** No proposed JMF will be accepted until all mix components have been verified and approved. **RAP stockpiles will be sampled and tested every six-months.**

The contractor shall report results for aggregate properties when the district lab tests for verification and again in six months. The contractor's six-month interval report between district lab verification testing will include G_{sb}, absorption, and gradation.

Qualification requirements for coarse aggregate and fine aggregates will comply with section 1003.06 and 502.02.3 Aggregates. Plus No. 4 sieve material is considered coarse aggregate and minus No. 4 sieve material is considered fine aggregate. Individual aggregate sources with greater than 10% material passing the No. 4 sieve of a primarily coarse material shall require both fine and coarse aggregate consensus property testing. Individual aggregate sources with greater than 10% material retained on the No. 4 sieve of a primarily fine material shall require fine and coarse aggregate consensus properties. Aggregates tested for fine and coarse properties shall be mathematically combined for a single value.

For JMF submittals, whatever percentage of a stockpile passes or is retained on the No. 4 sieve greater than 50.0 percent will classify the material as either fine or coarse for LaPave JMF entry purposes.

Aggregates shall comply with Table 502-6 or 502-6b Asphalt Concrete General Criteria and Table 502-4 Plant Produced Asphalt Mixture Requirements and Tolerances.

Reclaimed Asphalt Pavement (RAP) is allowed in 502 mixtures at specified percentages. RAP shall be tested for $G_{mm,}$ %AC and gradation. G_{se} shall be calculated from the G_{mm}, and a G_{sb} shall be calculated from the G_{se}. Working stockpiles of RAP will be verified by the District Lab. Verified RAP stockpiles receive a **SiteManager Materials "Producer Supplier" code** (PS code). RAP shall be cold planed in accordance with Section 509, and shall meet the requirements of Section 1003.

The %AC, gradation, G_{mm}, calculated G_{se} and calculated G_{sb} of RAP shall be reported to the District Lab by the Contractor when stockpile verification samples are taken. The procedures are in the ***Determination of Gradation and Bulk Specific Gravity (G_{sb}) for Aggregates*** section of this manual.

RAP is allowed in 502 mixes except for airports and SMA when:

- RAP is stockpiled separately with all material passing a 1 in. screen.
- RAP may be further separated into different stockpiles based on gradation and asphalt content

RAP shall be processed (screened) to pass the 1" sieve before testing.

Friction Rating - For travel lane wearing courses, the total aggregate combination shall comply with Table 502-3 Aggregate Friction Rating. The table specifies allowable usage according to mixture type and current plan average daily traffic (ADT). The mixture type will be shown on the pavement typical sections in the contract plans.

Asphalt Cement
Asphalt cement shall be on the AML. Asphalt cement grade shall comply with Subsections 1002 and 502.02.1 and Table 502-2 – Asphalt Cement Usage. Substitutions are allowed in accordance with Table 502-2. A Certificate of Delivery shall accompany each load delivered to the plant. The District Laboratory will test working tank samples. The Materials Laboratory will request the District Laboratory sample transports for refinery verification samples. District Lab employees will coordinate plant production and transport delivery with Materials Laboratory sample request.

The Contractor shall collect asphalt cement CDs, scan, and email to the DOTD ADI or DLE.

Additives

The Contractor shall collect scan and email CDs, CCs and/or CAs for additives to the DOTD ADI or DLE.

Anti-Strip
Anti-strip shall be added to all mixtures at the minimum rate of 0.6% by weight of asphalt cement in accordance with Subsection 502.02.2.1. Anti-strip used shall be on the Approved Materials List. A Certificate of Delivery for Asphalt Anti-strip Additives shall accompany each load of anti-strip. Rates less than 0.6% for new formulations of anti-strip shall be approved on a case by case basis by the DLE.

Hydrated lime, if used, shall be in accordance with Subsection 502.02.2.2 and from a source listed in the AML. The minimum rate shall not be less than 1.5% by weight of the total mixture. Hydrated lime shall be added to and thoroughly mixed with aggregates in accordance with Subsection 502.02.2.2. Hydrated lime may be also added as mineral filler in accordance with Subsection 502.02.3.3. A Certificate of Delivery shall accompany each load of hydrated lime.

Mineral filler, if used, shall be in accordance with Subsection 502.02.3.3 and Subsection 1003.06.1.6 and an approved product listed in the AML. It shall consist of limestone dust, pulverized hydrated lime, Portland cement, or cement stack dust. A Certificate of Delivery, matching a format similar to the CD for Asphalt Materials, shall accompany each load of mineral filler.

Waste Tire Rubber additive, when used, shall be blended with an AML PG 67-22 material. Add Crumb rubber as required to meet grade PG 76-22rm. Use a maximum size rubber particle of 30 mesh crumb (90-100% passing the No. 30 sieve). In accordance with 1002.02.2, Waste Tire Rubber additive shall require the Contractor to perform DSR testing of the blended material. The contractor shall test DSR daily while in production and enter test results in LaPave.

Latex Additive, when used, shall be in accordance with Subsection 502.02.2.4. Latex added at the Contractor's plant shall be blended at a minimum of 1.0% residual latex by weight of asphalt cement to an AML PG 67-22 material and in accordance with Section 503.05.2. Latex blended asphalt shall meet PG 70-22m specification requirements using pre-qualified asphalt material and latex. Latex additive shall require the Contractor perform DSR testing of the blended material. The contractor shall DSR test daily while in production and enter test results in LaPave.

SECTION 502 – ASPHALT (Design)

Approval Process for Plant-Modified Asphalt Cement

The following procedures are required for plant blending latex or crumb-rubber with a Performance Graded (PG) asphalt cement (AC), listed on the Approved Materials list, to meet a higher Performance Grade. This is also referred to as grade bumping. Pre-blended and post blended AC shall meet the requirements of Section 1002 and Table 1002-3 of the Louisiana DOTD Standard Specifications.

The initial request for approval of plant blending for modifying asphalt cement shall be submitted to the Materials Engineer Administrator.

The contractor shall maintain equipment and conform to DOTD specifications to maintain approval for blending. After initial approval for plant blending from the Materials Engineer Administrator, continuing approval shall be part of the biennial plant certification.

1. Plant
    a. Submit a proposed Plant Equipment Design Diagram to the Materials Engineer Administrator
    b. Provide manufacturer documentation stating the equipment is appropriate for the proposed materials and flow rates. Mixers, Mills, etc.
    c. Latex blending requires an inline sampling point after mixing and before the addition of anti-strip
    d. A totalizing meter or other verifiable measuring system shall be used to measure the quantity of additive and verify AC quantities used
    e. Documentation for equipment calibration shall be provided and maintained for review
    f. Documentation for additive quantities and AC quantities used shall be maintained and provided on request
    g. The DLE shall inspect the plant and blending equipment before it's use for DOTD projects

2. Asphalt Design Blend (ADB) for DOTD Materials Lab Submittal
    a. Provide complete laboratory tests results for the proposed asphalt cement. The test results shall be of the proposed AC and modifier at the proposed mixing ratios.
    b. The blend shall conform to the specifications of Table 1002-3 in the Standard Specs
        i. AC feed stock shall be PG 67-22
        ii. Latex shall meet specifications for PG 70-22m
        iii. Crumb-rubber shall meet specification for PG 76-22rm
    c. All proposed types, brands, and percentages shall match those actually used. NO SUBSTITUTIONS or MODIFICATIONS
    d. Any changes to products or percentages shall require a separate sample submittal to the Materials Lab for verification
    e. The supplier shall provide verification of the compatibility of materials
    f. The contractor shall provide a split sample for DOTD verification (see Sampling and Testing)
    g. All blends shall be approved by the Materials Engineer
    h. Modifications to the blend shall require a new blend submittal and approval

3. Sampling, Testing and Approval
    a. Process Approval Sample – Prior to producing mix for a DOTD project, provide 5 split samples of production plant-modified liquid AC. The contractor shall provide a full analysis of production material for at least 2 of the 5 split samples. The Materials Lab shall randomly select and test 2 of the 5 split samples to verify results. No mix shall be produced for DOTD projects until the complete analysis results are complete and approved the Materials Lab.
    b. Approval for production by the Materials Engineer shall be based on compliance of testing results and review of documentation. Approval shall be communicated to the contractor and the District Lab Engineer.
    c. During production, the quantity of additive shall be monitored and documented twice daily by approved methods for conformance to Asphalt Design Blend
    d. Quality Control
        i. The Contractor shall provide full analysis on at least 2 samples per month (approximately every 15 days)
        ii. The contractor shall provide high-temperature analysis of the material on a daily basis using the Dynamic Shear Rheometer (DSR). Samples shall be taken during JMF validation days, but not required to test until validation is complete.
        iii. Samples shall be taken and documented daily for visual observation to determine if there is any incompatibility. Documentation shall be reviewed by the ADI during plant visits. Signs of incompatibility are white or yellow flecks, clumps of rubber or polymer, sludge, separation of materials, and/or an obvious skin of material over the top of the sample. If any of these are observed, reject the material and/or process based on incompatibility.
    e. Verification - The ADI shall take a minimum of one additional random sample per project per type of AC to send to the Materials Lab for complete analysis.
    f. Substandard material – Projects that have identified substandard material will be subject to:
        i. Removal and replacement, or at the Chief Engineer's option:
        ii. 50% pay

Fibers, when used, shall be in accordance with Subsection 1002.02.5. Fibers shall be a cellulose or mineral fiber. Fibers shall be added at a minimum rate of 0.1% by weight (mass) of mixture and at a rate sufficient to prevent draindown.

Natural sand, when used, shall be in accordance with the requirements of Table 502-6 or 502-6b, and Section 1003.06.3 with a maximum of 25% passing the No. 200 sieve.

Warm Mix additives, when used, shall be in accordance with Section 1002.02.4.

Foaming with water or chemicals may be used for warm mix with approval of the DLE.

Design of Asphalt Mixture, Job Mix Formula (JMF)

Listed below are the general steps required to design, validate, and approve an asphalt mixture according to Section 502. Using the material and procurement process listed above, proceed with the following steps for approval of JMFs.

Determination of Gradation and Bulk Specific Gravity (Gsb) for Aggregates

Gradation

The Contractor shall obtain samples from each proposed stockpile for gradation determination. An accurate gradation analysis is required for blending analysis, and the determination of the consistency of incoming material. The District Lab will perform gradation testing on 12-month stockpile verifications. **RAP stockpiles will be sampled and tested for verification from each asphalt plant a minimum of every six-months.**

It is recommended Contractors secure samples of all bulk shipments of aggregates delivered to the plant site. The gradation results of these shipments should be determined prior to their addition to a working stockpile. Documentation of these continuous stockpile gradation and specific gravity results shall be kept on file so varying trends of the aggregate source may be documented. The Contractor shall report stockpile gradations to the DLE every 12-months along with G_{sb}, absorption, and consensus properties. Gradation, G_{sb}, and absorption shall be reported by the contractor at the 6-month interval between complete stockpile sample verification. The contractor shall continue to use 12-month District Lab verified values unless values change enough to warrant full verification testing to establish new values.

Aggregates shall be handled in a manner that will not be detrimental to the final mixture. Stockpiles shall be built in a manner that will not cause segregation. Segregation can be minimized if stockpiles are built in successive layers, not in a conical shape. Constructing stockpiles in layers enables different aggregate fractions to remain evenly mixed and reduces the tendency of large aggregates to roll to the outside and bottom of the pile. Stockpiles shall be located on a clean, stable, well-drained surface to ensure uniform moisture content throughout the stockpile. The area in which the stockpiles are located shall be large enough for stockpile separation, so no intermixing of materials occurs. Stockpiles shall not become contaminated with deleterious materials such as clay balls, leaves, sticks or non-specification aggregates. Materials shall not become contaminated nor segregated when they are transported from stockpiles to cold feed bins. Aggregates are often moved from stockpiles to cold feed bins with a front-end loader. The operator should proceed directly into the stockpile, load the bucket and move directly out, and should not scoop aggregate from only the outside edges of the stockpile.

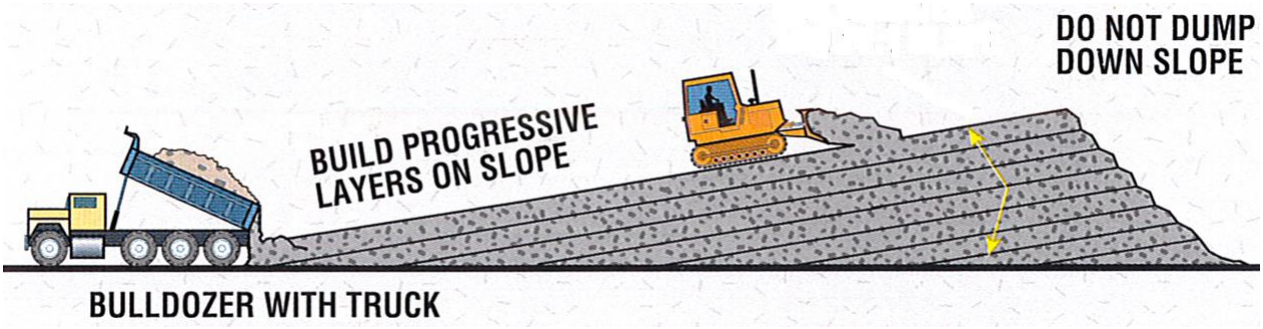


Figure 2-1

There may be aggregate sources that have 10% or more passing or retained on the No. 4 sieve, but because of the overall gradation, it may be impractical to obtain enough of the lesser material to conduct testing associated with the smaller fraction. It will be at the discretion of the DLE to exclude testing in such situations.

Bulk Specific Gravity (Gsb)

- Coarse aggregate is defined as material retained on the No. 4 sieve.
- Fine aggregate is defined as material passing the No. 4 sieve.

Once aggregate materials have been stockpiled at the plant and are approved for use, the bulk specific gravity of each mineral aggregate shall be determined. The Department will verify G_{sb} of samples from each aggregate stockpile. The Contractor shall test a sufficient number of samples to ensure consistency of their stockpiles.

Use AASHTO Test Procedure T 84 to determine bulk specific gravity (G_{sb}) and absorption for each proposed fine aggregate. When a primarily fine stockpile material has more than 10% retained on the plus No. 4 sieve, both T 84 and T 85 shall be performed. The material tested for G_{sb} shall be washed (AASHTO T84 X1.1) over the No. 200 sieve.

The after wash gradation should have less than 4% passing the No. 200 sieve. If there is doubt this has been met, the technician can check the sample by weighing the after washed-dried sample, then re-sieve, calculating the passing #200. Divide the weight of the material in the pan that passed the #200 by the after wash-dried weight of the whole sample. (Wt. of material in pan (passing #200)/Wt. of dried washed aggregate) x 100 = % passing #200)

When a stockpile material has > 20% passing the No. 200, the sample shall be dry sieved over the No. 100 sieve (the +100 material will be washed over the No. 200 sieve). T 84 will be used for the G_{sb} and absorption of the minus No. 4 to the plus No. 100. An Apparent Gravity will be run on the minus No. 100 material.

The reason for breaking the sample at the No. 100 sieve is for ease of acquiring enough fine material for testing.

Test as follows:

AASHTO T-100 Specific Gravity of Soils

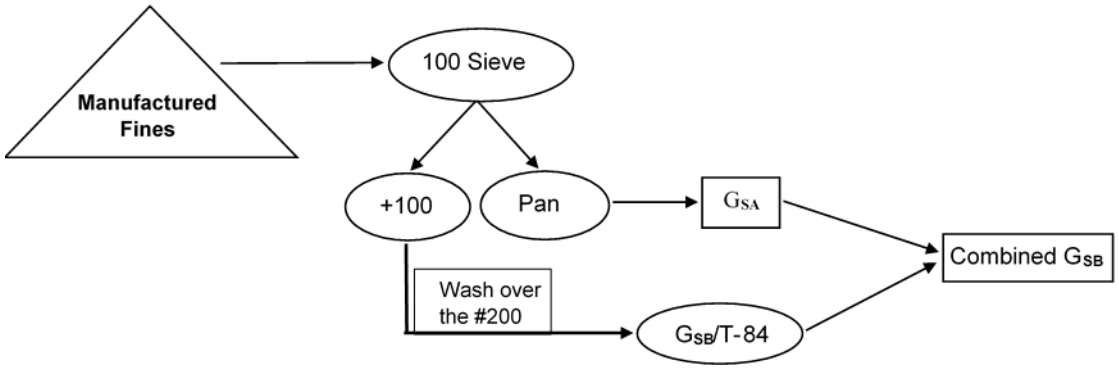
Modified:

Balance accurate to 0.1 gram
500 ml volumetric flask
Use boiling method
Allow sample to cool to room temperature
Condition in a 23° C ±1.7° C water bath for 1 hour

- Sample size: 250 g ± 10 g
- **Gently** boil the sample on a hot plate for 30 minutes
- Allow sample to cool before placing in a 23° C ±1.7° C water bath

No. -4 G_{SB} (T-84) – Wash 200 Sieve

Material with greater than 20% passing the No. 200 sieve



The Apparent Gravity of the minus No. 100 material shall be mathematically combined in proportion to the G_{sb} of plus No. 100 and minus No. 4 material. Absorption will be that of the minus No. 4 and plus No. 100

Example:

49% passing the No. 100 with a G_{se} of 2.675
51% retained on the No. 100 with a AASHTO T 84 G_{sb} of 2.642 and absorption of 0.78

.49 x 2.675 = 1.31075
.51 x 2.642 = 1.34742
combined 2.65817 → 2.658 absorption 0.78

Use AASHTO Test Procedure T 85 to determine bulk specific gravity (G_{sb}) and absorption for each proposed coarse aggregate source.

For aggregate sources that are primarily coarse and contain 10% or less material by weight passing the No. 4 sieve, a G_{sb} determination on that passing portion will not be required. Should the proposed aggregate stockpile contain more than 10% passing the No. 4 sieve, the finer portion

shall be separated and tested in accordance with AASHTO T 84. The results, for both coarse and fine portions, shall be mathematically combined in proportion to amounts retained on the No. 4 and passing the No. 4 to produce a single G_{sb} value for the source. The G_{sb} is used to calculate VMA and asphalt absorption. False high values for G_{sb} will lead to false high VMAs and negative asphalt absorptions. If negative asphalt absorptions are calculated, the G_{sb} is in error. When negative asphalt absorption is reported on a JMF or reported during production, the DLE shall investigate.

The Contractor may use the calculated (weighted average) values for G_{sb} on the proposed JMF provided each individual aggregate test value is within the ranges of Table 3 at the time of verification testing when compared to the district laboratory's values. The **tolerances** for stockpiles tested using both T 84 and T 85 shall be a weighted average based on percentage of the fine and coarse fractions.

Example:

-4 material 50% - tolerance - 0.030 = 0.015
+4 material 50% - tolerance – 0.020 = 0.010

Combined gravity tolerance = 0.025

The values obtained for annual stockpile verification testing shall be used on JMF submittals until the next yearly verification testing is completed. If the contractor has data to show values have drifted before annual testing, they may present the data to the DLE and request re-testing.

The DLE is responsible for collecting data for each verification stockpile sample tested by the Contractor and District Lab independently.

Table 3
Bulk Specific Gravity Tolerances

Multi-Laboratory Precision for Bulk Specific Gravity (G_{sb})	
	G_{sb}
Fine Aggregate –No. 4 Sieve	±0.030
Coarse Aggregate +No. 4 Sieve	±0.020

Should the Contractor's values be outside the range(s) shown in Table 3 when compared to the district laboratory, both parties shall jointly run a third sample with results used for the proposed JMF submittals.

Bulk specific gravity values agreed upon by this procedure shall be used on subsequent job mix formula submittals. The G_{sb} may be retested when requested by the contractor and at the discretion of the DLE.

RAP must be dried to a constant mass in accordance with DOTD TR 323 prior to testing.

A minimum of three RAP samples representing each RAP stockpile will be tested and the results averaged. The contractor is required to report the results of the individual tests along with the averaged value. The averaged value shall be used on JMFs.

RAP %AC will be determined in the ignition furnace per TR 323. A correction factor of 0.4 (at the time of this publication the TR is in the process of being approved to match this value) will be deducted from the "Percent Loss" obtained from the furnace. If contractor results are within ±0.3% AC content of the District laboratory results, the Contractor %AC results will be approved for use (this comparison and final value used will be automatically determined in LAPAVE). Aggregate from the determination of %AC will be sieved to determine the RAP gradation. Measure the $G_{mm(RAP)}$ to calculate the $G_{se(RAP)}$ of the minus 1" RAP. The $G_{se(RAP)}$ shall be used to back calculate a G_{sb} of the RAP aggregate for use on JMF submittals. $G_{mm(RAP)}$, %AC, $G_{se(RAP)}$, and back calculated G_{sb} of the RAP aggregate will be verified by the DOTD District Lab when conducting six-month RAP stockpile sample testing. RAP values may be retested and reverified at the discretion of the DLE. Contractors that fractionate RAP into different nominal sizes shall stockpile and test separately.

Values used for RAP testing:

- G_b = 1.03
- $P_{b(RAP)}$ = Ignition furnace percent loss minus the correction factor of 0.4
- $P_{ba(RAP)}$ = 1.0%

Formula for determining $G_{se(RAP)}$:

$$G_{se(RAP)} = \frac{100 - P_{b(RAP)}}{\frac{100}{G_{mm(RAP)}} - \frac{P_{b(RAP)}}{G_b}}$$

Formula for back calculating $G_{sb(RAP)}$:

$$G_{sb(RAP)} = \frac{G_{se(RAP)}}{\left[\frac{P_{ba(RAP)} \times G_{se(RAP)}}{100 \times G_b}\right] + 1}$$

When determining the composite gradation for mixtures containing RAP, consider the RAP aggregate as an aggregate source, so that the total aggregate percentages, including RAP aggregate, equal 100%.

A water absorption of 1.0% will be used when entering RAP on the JMF input page.

Consensus Aggregate Test Evaluations

The consensus aggregate tests determine properties of aggregates that contribute to the performance within asphalt pavements. The consensus tests are:

- Coarse Aggregate Angularity (DOTD TR 306 – Double Face)
- Fine Aggregate Angularity (DOTD TR 121)
- Flat and Elongated Count (ASTM D4791)
- Sand Equivalency (DOTD TR 120)

The required specifications for these aggregate properties are in Tables 502-6 and 502-6b. They are based on traffic level and position within the pavement structure. Materials near the pavement surface subjected to high traffic require more stringent consensus property specifications. They are intended for application to a proposed aggregate blend, not to individual components. However, they may be run on individual aggregate sources and mathematically combined. Individual components may be tested so that poor materials may be identified.

Coarse Aggregate Angularity (CAA)

CAA is required only for aggregate stockpiles having 10% or more retained on the No. 4 sieve.

CAA is determined in accordance with TR 306 (Double Faced) on the coarse material. The test ensures a high degree of aggregate internal friction and rutting resistance. [The minimum values for the test are in Tables 502-6 and 502-6b for each Level, type of mix, and nominal maximum size (NMS) aggregate.]

If contractor results are within ±3% CAA content of the District laboratory results, the Contractor CAA results will be approved for use. If not, the Contractor shall run a third sample jointly with the DLE's representative. The Contractor shall use this jointly determined value for JMF submittal.

The Contractor shall determine and report individual source CAA on the JMF. The CAA of the composite mixture is calculated by weighted average based on aggregate proportions and individual CAA values.

When mathematically combining CAA, use the following equation:

$$C = \left(\frac{P_1}{P_T} \times A_{p1} \right) + \left(\frac{P_2}{P_T} \times A_{p2} \right) + \left(\frac{P_3}{P_T} \times A_{p3} \right)$$

Where:

C = Composite, CAA
P_1, P_2, and P_3 = % Aggregate From Cold Feed Used for Consensus Properties
P_T = Total of % Aggregate Used for Consensus Properties
A_p = Aggregate CAA Properties

Fine Aggregate Angularity (FAA)

FAA is required only for aggregate stockpiles having 10% or more passing the No. 4 sieve. To calculate fine aggregate angularity for a blend, use a weighted average based on the percentages of each aggregate in the blend that meets the above criteria.

FAA is determined in accordance with DOTD TR 121 using the bulk specific gravity, (G_{sb}), of the aggregate washed over the No. 200 sieve. The property ensures a high degree of fine aggregate

internal friction and rutting resistance. Higher FAA values (voids) means more fractured faces. (The minimum values for this test are in Tables 502-6 and 502-6b for each level, type of mix and NMS size.)

If contractor results are within ±2% FAA of the District laboratory results, the Contractor FAA results will be approved for use. If not, the Contractor/Producer shall then test a third sample jointly with the DLE's representative. The Contractor shall use the jointly determined value for proposed JMFs.

Although the individual source (FAA) is reported on the JMF, the FAA of the composite mixture is calculated by weighted average based on aggregate proportions and individual FAA values reported on the JMF.

When mathematically combining FAA, use the following equation:

$$C = \frac{P_1(\%P_{1\#8} - \%P_{1\#100})Ap_1 + P_2(\%P_{2\#8} - \%P_{2\#100})Ap_2}{P_1(\%P_{1\#8} - \%P_{1\#100}) + P_2(\%P_{2\#8} - \%P_{2\#100})}$$

Where:

C = Composite FAA
P_1, P_2 = % Aggregate From Cold Feed Used for Consensus Properties
$\%P_{1\#8}$ & $\%P_{2\#8}$ = % Passing No. 8
$\%P_{1\#100}$ & $\%P_{2\#100}$ = % Passing No. 100
A_p = FAA Aggregate Properties

There may be aggregate sources with 10% or more passing the No. 4 sieve, but because of the overall gradation, it may not be practical to obtain enough material to perform FAA. It will be at the discretion of the DLE to perform FAA testing on such stockpiles.

Flat and Elongated (F&E)

F&E is required only for aggregate stockpiles having 10% or more retained on the No. 4 sieve .

Flat and elongated is determined in accordance with ASTM D4791 using the coarse aggregate portion retained on the No. 4 sieve. The characteristic is the percentage by weight of coarse aggregates that have a maximum to minimum dimension greater than five to one. Elongated particles are undesirable because they have a tendency to break during construction and under traffic. The maximum values for this test are ins Tables 502-6 and 502-6b.

The district laboratory will verify the F&E value. If both are within specification limits, the Contractor/Producer's results may be used. If not, the Contractor/Producer shall test a third sample jointly with the DLE representative. The Contractor shall use this jointly determined value for JMF submittal.

The individual source results for F&E particles are reported on the JMF, the F&E of the composite mixture is calculated by weighted average based on aggregate proportions and the individual F&E values.

When mathematically combining F&E, use the following equation:

$$C = \left(\frac{P_1}{P_T} \times A_{p1}\right) + \left(\frac{P_2}{P_T} \times A_{p2}\right) + \left(\frac{P_3}{P_T} \times A_{p3}\right)$$

Where:

C = Composite, F&E
P_1, P_2, and P_3 = % Aggregate From Cold Feed Used for Consensus Properties
P_T = Total of % Aggregate Used for Consensus Properties
A_p = Aggregate F&E Properties

Sand Equivalent (SE)

SE is required for all natural sands, having 10% or more passing the No. 4 sieve and less than 25% passing the No. 200 sieve. **Natural sands having greater than 25% passing the No. 200 sieve are not allowed (1003.06.3).** Clay lumps shall not exceed 0.5 percent by weight when tested in accordance with DOTD TR 119. Sand equivalency requirements shall apply to **individual natural sand sources only and do not apply to manufactured fines or fines produced from crushing operations** (e.g., screenings, No. 10s and No. 11s). The minimum values for this test are in Tables 502-6 and 502-6b for each level, type of mix, and NMS size.

SE, sometimes referenced as clay content, is determined in accordance with TR 120 using fine aggregate portions of the composite blend (natural sands only) passing the No. 4 sieve. Clay content is the percentage of clay material contained in the aggregate fraction passing the No. 4 sieve.

The contractor shall determine the SE value for each individual natural sand used. The SE of the composite mixture is calculated by weighted average based on aggregate proportions and the individual SE values. The district laboratory will verify SE values. The district lab's and contractor's results must meet specification limits. If not, the Contractor/Producer shall then test a third sample jointly with the DLE representative. The Contractor shall use the jointly determined values for JMF submittals.

When mathematically combining SE, use the following equation:

$$C = \left(\frac{P_1}{P_T} \times A_{p1}\right) + \left(\frac{P_2}{P_T} \times A_{p2}\right)$$

Where:

C = Composite SE
P_1, P_2 = % of individual natural sands from the cold feed
P_T = % of total natural sand from the cold feed
A_{p1}, A_{p2} = SE Properties

Table 4
Contractor and DOTD Tolerances for Stockpile Testing

Test	Description	Tolerance
T 84	AASHTO G_{sb} of Fine Aggregate	±0.030
T 85	AASHTO G_{sb} of Coarse Aggregate	±0.020
T 84 & T 85	Water Absorption	±0.5%
TR 121	Fine Aggregate Angularity (FAA)	±2*
TR 306	Coarse Aggregate Angularity (CAA)	± 3%*
ASTM D4791	Flat and Elongated (5:1)	*
TR 323	RAP Asphalt Content - %AC	±0.3%
TR 120	Sand Equivalent	±9*

* Both DOTD district laboratory and the Contractor's results must be within specification. If the DOTD results are not within specification or tolerance, the Contractor and DOTD will jointly perform the test that does not meet specification.

NOTE:
The aggregate source properties, Gradation, Gsb, CAA, FAA, F&E, and SE must be verified by the District Lab personnel at minimum of every 12-months. RAP must be verified at a minimum of every 6 months. If material properties change beyond the allowable verification limits, the DLE will disapprove the existing JMF.

Blending Aggregates to Meet Specified Gradation

Following bulk specific gravity (G_{sb}) determinations, gradation, and aggregate consensus tests analysis, the Technician must determine a master composite blend of the proposed, approved aggregates to meet the requirements of the mixture type indicated on the typical sections in the project plans. Table 502-4 in the Standard Specifications lists a nominal maximum size aggregate for each type, a specification gradation limit for each mixture type, and tolerances for the proposed JMF blend.

The following are defined as:

- **Nominal Maximum Size** (NMS)–One sieve size larger than the first sieve to retain more than 10% by weight of the combined aggregates.

- **Maximum Size** (MS)–One sieve size larger than the nominal maximum size.

With the mixture type known, the Contractor can begin to mathematically blend the proposed aggregates to meet requirements of Table 502-4. Tables 502-6 and 502-6b specify the maximum percentage of natural sand and RAP allowed in asphalt concrete mixtures.

- **The maximum natural sand percentage is calculated by the percentage of new aggregate**
- **The maximum percentage of RAP is calculated by percentage of total mix.**

Once the aggregates are mathematically blended to meet requirements of Section 502, the composite gradation is plotted on the appropriate *Asphalt Concrete Gradation – 0.45 Power Curve* for the corresponding nominal maximum size aggregate. The 0.45 power curve uses a unique graphing technique to show the cumulative particle size distribution of an aggregate blend. The ordinate (vertical axis) of the chart is percent passing. The abscissa (horizontal axis) is an arithmetic scale of sieve size in mm of the opening, raised to the 0.45 power. On these charts, the maximum density grading for a particular maximum size corresponds to a straight line drawn from the origin to the selected maximum aggregate size. This maximum density line is approximate, but serves as a useful reference in proportioning aggregates. These power curves also depict other features.

DOTD allows for all mixtures produced under Section 502 to be either on the coarse or the fine side. A coarse and fine gradation plot on the 0.45 power curve is shown in Figure 2-2.

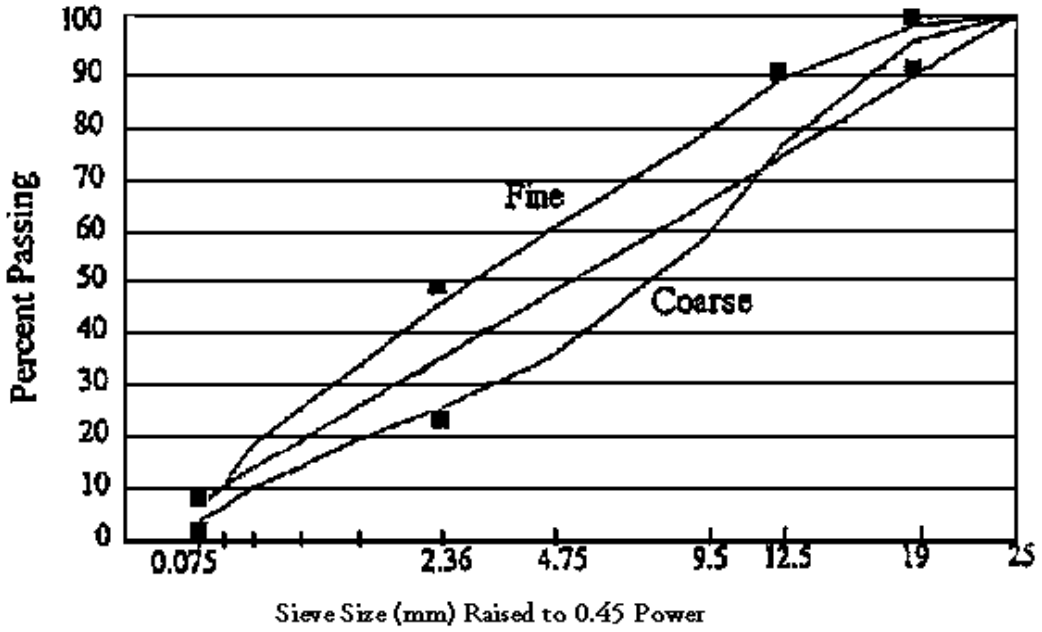


Figure 2-2 – 0.45 Power Curve with Coarse and Fine Gradations

Care should be taken in the selection of the final composite aggregate blend. Many coarse graded blends may, if not properly designed and compacted, lead to very porous pavements that allow water to permeate the base and subbase.

Following is an example of gradation requirements and a typical fine side proposed composite gradation ½-in. NMS:

Table 5
Example Gradation Tolerances and Limits

Sieve Size	Control Points	Mix Tolerance	Proposed JMF	*Validated JMF Limits
1.0 in.		± 4	100	100
¾ in.	100	± 4	100	100
½ in.	90-100	± 4	99	95-100
3/8 in.	89 max	± 4	89	*85-93
No. 4		± 4	57	53-61
No. 8	29-58	± 3	34	31-37
No. 16		± 2	23	21-25
No. 30		± 2	17	15-19
No. 50		± 2	12	10-14
No. 100		± 2	7	5-9
No. 200	4.0-10.0	± 0.7	5.1	4.4-5.8

For gradation purposes, all values are reported to the nearest whole number with the exception of the No. 200 sieve size, which is rounded to the nearest tenth.
Note the mix tolerances are applied to the proposed JMF to determine the allowable upper and lower limits. Tolerance limits may only exceed control points during production, but not on the JMF, nor during validation. *For example, during validation, the JMF limits in the example above for the 3/8-in. sieve are 85 – 89.

Blending Aggregates to Meet Friction Rating Requirements for Travel Lane Wearing Courses

Friction Rating – A friction rating is a relative indicator of the skid resistant properties of the aggregate. Friction ratings are assigned by the DOTD Materials and Testing Section to an aggregate source in accordance with Table 1003-3. These assigned friction ratings are listed for each aggregate on AML.

Aggregates used in asphaltic mixtures for the **final lift of the travel lane wearing course** have friction rating requirements in accordance with Table 502-3. Friction requirements are based on current plan average daily traffic (ADT) as shown on the plans and based on mix use and type. Generally frictional aggregates are not required in binder or base courses, shoulders, or in mixtures used for bike paths, curbs, driveways, guardrail widening, islands, joint repair, leveling, parking lots, patching, or widening. If the mixture type specified on the typical section of the plans is ***Level 1F or 2F***, special friction rating requirements apply. Level 1F or 2F asphalt mixtures have the same requirements as travel lane wearing course with current plan ADT > 7000.

Table 502-3 on the next page is a reprint from the Standard Specifications:

Table 502-3

Aggregate Friction Rating

Friction Rating	Allowable Usage[1,2]
I	All mixtures
II	All mixtures
III	All mixtures, except mainline wearing courses with plan current plan average daily traffic (ADT) greater than 7000
IV	All mixtures, except mainline wearing courses

[1]When current plan ADT is greater than 7000, blending of Friction Rating III aggregates and Friction Rating I and/or II aggregates will be allowed for travel lane wearing courses at the following percentages. At least 30 percent by weight (mass) of the total aggregates shall have a Friction Rating of I, or at least 50 percent by weight (mass) of the total aggregate shall have a Friction Rating of II. The Friction Rating I and Friction Rating II aggregates used to obtain the required percentages shall not have more than 10 percent passing the No. 8 (2.36 mm) sieve.
[2] When the current plan average daily traffic (ADT) is less than 2500, blending of Friction Rating IV aggregates with Friction Rating I and/or II aggregates will be allowed for travel lane wearing courses at the following percentages. At least 50 percent by weight (mass) of the total aggregate in the mixture shall have a Friction Rating of I or II. The Friction Rating I and Friction Rating II aggregates used to obtain the required percentages shall not have more than 10 percent passing the No. 8 (2.36 mm) sieve.

This chart shows the allowable usage of aggregates.

Table 6

ALLOWABLE USE				
CURRENT PLAN ADT	**FR I**	**FR II**	**FR III**	**FR IV**
> 7000	Allowed	Allowed	*Allowed only with 30% FR I or 50% FR II	Not Allowed
2500 to 7000	Allowed	Allowed	Allowed	Not Allowed
<2500	Allowed	Allowed	Allowed	*Allowed only with 50% FR I or 50% FR II

***In the two special "*Allowed only with…" cases above, the FR I or FR II aggregates must not have more than 10 percent passing the No. 8 sieve. Otherwise, they are too fine to be counted as a friction aggregate.**

Consider aggregates C and D found in Example 1 on the next page. Using the Allowable Use Chart above, notice that FR I is allowed. However, Aggregates A and B with FR III, are ***only allowed if there are sufficient amounts of FR I or II in the blend.*** Combining the percentages

of Aggregate's C and D, equals 34% (14 + 20,) which is greater than the 30% required. Both have more than 10% passing through the No. 8 sieve, and cannot be counted as frictional aggregate, and are considered **"not approved"** as an appropriate blend. Note that RAP is not considered frictional aggregate.

EXAMPLE 1:
Consider this JMF submitted for a travel lane wearing of current plan ADT 21,000.

AGGREGATE NAME	% of Total Aggregate on JMF	FR from AML	% passing No. 8
A - # 78 LS	22	III	0
B - # 7 LS	20	III	2
C - # 11	14	I	29
D – Black # 11	20	I	16
E – RAP	18	N/A	50
F – Coarse Sand	6	N/A	86
	100 % total		

EXAMPLE 2:

Consider this JMF submitted for a travel lane wearing of current plan ADT 8200.

AGGREGATE NAME	% of Total Aggregate on JMF	FR from AML	% passing No. 8
A - # 78 SS	36	I	0
B - #7 LS	24	III	2
C - # 11 LS	25	III	29
D – Coarse Sand	15	N/A	86
	100 % total		

Using the Allowable Use Chart from the previous page and Example 2, notice Aggregate A is allowed. Aggregates B and C are allowed only if there is a sufficient % of FR I aggregate. The % of Aggregate A is 36%, which is greater than the 30% required. Aggregate A has less than 10% passing the No. 8. It can be counted. This blend is **approved.**

Determination of RAP JMF Composite

Given:

15% RAP in mixture
0.8% AC from RAP
3.4% New AC to be added

Step 1: Calculate % AC in reclaimed material.

Already completed in assumption

To determine total AC content that will be attributable by RAP:
(% RAP/100)(% AC Residual from RAP)

Step 2: Determine the % of RAP (by weight) in mixture.

Subtract %AC in RAP from % RAP in mixture
15% - 0.8% = 14.2% Total RAP aggregate in mixture

Steps 3 through 5 Determine Total New Aggregate.

For this example new aggregates have been given as follows for VCF%
35.0% - SST #78
33.0% - LS #78
17.0% - LS #11
15.0% - Coarse Sand
100% Total New Aggregate

Step 6: Calculate total material to be added to the new aggregate.

A) Add: % RAP Aggregate (14.2%)
% Reclaimed Asphalt (0.8%)
% New Asphalt Cement (3.4%)

14.2% + 0.8% + 3.4% = 18.4%

B) Subtract this percentage of material to be added to the new aggregate

100% - 18.4% = 81.6%

C) Convert to Decimal
81.6% = 0.816

D) Multiply this decimal times the bin proportions to determine mix percentages. (% Total of new aggregate for each material) determined in Steps 3 through 5.

SST #78	35.0% x 0.816 = 28.6%
LS #78	33.0% x 0.816 = 26.9%
LS #11	17.0% x 0.816 = 13.9%
Coarse Sand	15.0% x 0.816 = 12.2%

Step 7: Mix Percentages

SST #78	28.6%
LS #78	26.9%
LS #11	13.9%
Coarse Sand	12.2%
RAP Aggregate	14.2%
%AC from RAP	0.8%
% New AC	3.4%

TOTAL:	**100.00%**

Step 8: Aggregate Percentages for Bulk Specific Gravity Computation

A.) Total aggregate = 28.6 + 26.9 + 13.9 + 12.2 + 14.2 = 95.8
B.) New % of each aggregate by % of total aggregate = (for example) 28.6/.958 = 29.9

SST #78	29.9%
LS #78	28.1%
LS #11	14.5%
Coarse Sand	12.7%
RAP Aggregate	14.8%
TOTAL:	**100.00%**

Trial Blends at Varying Asphalt Cement Contents
The Contractor, after determining the composite aggregate blend, shall prepare three trial blends of asphalt mixtures with varying percentages of asphalt cement. Trial blends are usually produced in the design laboratory but may be produced through the asphalt plant.

One blend shall be prepared at an asphalt cement content near anticipated optimum (as defined by a specified air void content, V_a). A second trial blend shall be prepared at an asphalt cement content approximately 0.5% less than the first trial blend. A third trial blend shall be prepared at an asphalt cement content approximately 0.5% greater than the first trial blend. A minimum of two gyratory briquettes @ N_{des} shall be prepared at each of the trial asphalt cement contents. The mixing and compaction temperature used for preparing the trial mixes shall be as recommended by the Supplier.

Unless procedures require otherwise, the laboratory produced mix shall be aged 2 hours and plant produced hot mix shall be aged 1 hour at the compaction temperature (±10°F). Warm mix aging time is 2 hours. **When the aggregate water absorption is > 2%, the oven aging time for plant-produced mix shall be 2 hours.**

For design purposes, the Contractor may either:

1. test one loose mix near optimum AC content for G_{mm} and calculate the new G_{mm}'s for the high and low AC content trials or
2. test 3 loose mix samples for G_{mm} at each trial blend asphalt cement content.

Gyratory briquettes shall be tested for the following:

1. Bulk Specific Gravity, G_{mb} at N_{design}
2. Air Voids, V_a at N_{design}
3. Voids in Mineral Aggregate, VMA at N_{design}
4. Voids Filled with Asphalt, VFA at N_{design}
5. % G_{mm} at $N_{initial}$
6. % G_{mm} at N_{design}

Plot % AC versus volumetrics (Voids, VMA, VFA). Select the %AC at the voids required by the specifications for the type mix in order to create a verification blend with this %AC. This means that design asphalt cement content of the mixture is selected at the percentage yielding the median percentage of the range of air voids (which is 3.5% for all 502 asphalt mixtures) and yielding the required design target for VFA (See note 5 – Table 502-6 and table 502-6b). All calculated and measured mix properties at this asphalt cement content should be evaluated and compared to specified values in Table 502-6 or 502-6b. If all design criteria are not met, some adjustment is necessary or the mix may need to be redesigned.

For this verification blend, retest $G_{mm,}$ %AC and the following volumetrics:

1. Bulk Specific Gravity, G_{mb} at N_{design}
2. Air Voids, V_a at N_{design}
3. Voids in Mineral Aggregate, VMA at N_{design}
4. Voids Filled with Asphalt, VFA at N_{design}
5. % G_{mm} at $N_{initial}$
6. % G_{mm} at N_{design}
7. % G_{mm} at N_{max}

The verification blend will require two G_{mm} tests averaged to report a single value.
Based on the above results, the Contractor will establish an AC Correction Factor according to TR 323, subject to verification by the DLE. The DLE may require that additional mix for JMF correction factors be submitted as part of the JMF submittal.

If required by specifications perform Loaded Wheel Tests (LWT), Semicircular Bend Test (SCB), and Tensile Strength Ratio (TSR or Lottman).

Additional information regarding testing, definitions and mix details can be found at the end of this section.

Stone Matrix Asphalt (SMA) Design Criteria

SMA is hot-mix asphalt consisting of two parts: a coarse aggregate skeleton and binder rich mastic. SMA is a gap-graded stone-on-stone coarse graded asphalt hot mix. SMA shall have a minimum 6.0% PG 76-22m or PG 76-22rm AC in design and production. VMA shall be a minimum of 16.0% in design and production. Mineral fillers and/or fibers may be used to help minimize draindown. Draindown shall not exceed 0.3% in design or production. Design criteria shall meet specifications in Table 502-6 of the Standard Specifications. RAP is not allowed in SMA. SMA will not have a maximum VFA limit.

SMA shall be designed according to the Superpave method utilizing these design steps:

1. Select proper aggregate materials in accordance to section 1003.06 of the Standard Specifications
2. Determine an aggregate gradation yielding stone-on-stone contact meeting VCA requirements as outlined below
3. Flat and Elongated percentages shall conform to footnotes 2 and 3 in Table 1003-2 of the Standard Specifications
4. Ensure the chosen gradation meets or exceeds minimum VMA requirements

5. Choose an asphalt content that provides the desired air void level
6. Evaluate moisture susceptibility and asphalt cement draindown

VCA (Voids in the Coarse Aggregate) determination

(AASHTO R46), Designing Stone Matrix Asphalt
(AASHTO T 19), Bulk Density ("Unit Weight")

Calculate the dry rodded VCA_{DRC} on the plus #4 aggregate portion of a ½" SMA mix to determine stone on stone contact of the SMA mixture. Stone on stone contact is defined as the point which the VCA_{mix} of the compacted mixture is less than VCA_{DRC} of the coarse aggregate in the dry-rodded test.

The dry-rodded VCA of the coarse-aggregate is determined by compacting with the dry-rodded technique in accordance with AASHTO T 19M/T 19. When the dry-rodded density of the stone fraction has been determined, the VCA_{DRC} can be calculated using:

$$VCA_{DRC} = \frac{G_{CA}Y_w - Y_s}{G_{CA}Y_w} \times 100$$

Where:

G_{CA} = the bulk specific gravity of the coarse aggregate (T85)
Y_s = the unit weight of the coarse aggregate (+4) fraction in the dry-rodded condition [$kg/m^3(lb/ft^3)$] (T 19m/T19)
Y_s = *(G – T)/V, where: G = mass of aggregate and measure vessel* [$kg/m^3(lb/ft^3)$], *T = mass of the measure vessel* [$kg/m^3(lb/ft^3)$], *V = volume of the measure vessel* [$kg/m^3(lb/ft^3)$]
Y_w = the unit weight of water [1000 kg/m^3 (62.4 lb/ft^3)]

$$VCA_{mix} = 100 - (G_{mb}/G_{CA})P_{CA}$$

Where:

G_{mb} = bulk specific gravity of the compacted mixture
G_{CA} = bulk specific gravity of the coarse aggregate. This is the composite bulk gravity of the +4 aggregates of the mixture.
P_{CA} = percent of coarse aggregate in the total mixture

SMA JMFs shall be submitted a minimum 10 days prior to anticipated production along with a laboratory specimen at optimum design cut in half for stone-on-stone contact evaluation by the DLE.

Any previously mentioned requirements for asphalt mixtures other than SMA that are not redefined in this section must be met.

Submittal Process and Documentation – (JMF Submittal Form)

Once the optimum asphalt cement content has been determined, for the proposed aggregate blend, the consensus properties, dust to asphalt ratio, LWT results (or optionally TSR for Minor

Mix) and SCB analysis have been completed, the certified Contractor Technician shall submit the proposed JMF to the DLE through LaPave.

The JMF shall indicate the optimum mixing temperature and range as suggested by the asphalt cement Supplier. The following information is also submitted to the DLE in LaPave.

1. A proposed blend summary with individual source and composite gradations, volumetric analysis at optimum asphalt cement content, including two N_{design} and one N_{max} briquette.
2. Bulk specific gravity, G_{sb}, of each aggregate and combined bulk specific gravity for the mineral aggregate blend. Friction ratings if applicable. Calculated bulk specific gravity (G_{sb}) of RAP aggregate and %AC of RAP.
3. A graphical representation of:
    - Asphalt Concrete Gradation – Power Curve form, showing proposed composite gradation plotted to the 0.45 power curve
    - Design points along with the verification point for:
        - Voids
        - VMA
        - VFA
4. A quantitative summary of three (minimum) trial blends at optimum and ± 0.5% asphalt cement along with volumetric calculations. A minimum of two N_{design} gyratory specimens for each blend point.
5. A verification blend at Optimum Asphalt Cement Content – Summary of Test Properties showing VMA, V_a, VFA, versus asphalt cement content.
6. Coarse aggregate angularity (CAA) test results
7. Fine aggregate angularity (FAA) test results
8. Flat and Elongated Count (FE) test results
9. Sand equivalency (SE) test results
10. LWT Testing Data.
11. SCB Testing Data.
12. Water Susceptibility (Lottman Test) results (Minor Mixes).
13. Draindown test for SMA mixes.

Verification point of the proposed JMF shall include:

1. Gyratory compactor test results for at least two samples (laboratory or plant produced) prepared at optimum asphalt cement content for the proposed trial blend compacted to N_{design} and one sample compacted to N_{max}.
2. Two loose mix samples tested for G_{mm} at optimum asphalt cement and averaged for a single value.
3. When required by the DLE, provide loose mix for correction factor verification as follows:
    a. the contractor shall submit sufficient lab design loose mix, for a minimum of two burns, to the district lab with documentation of the gradation, AC content and correction factor the contractor determined for the contractor's ignition furnace(s). The district lab will burn the contractor-supplied mix in their furnace to establish a correction factor for DOTD's furnace. The correction factor will be the average of the two burns. Gradation will be compared to the contractor submitted results to evaluate aggregate breakage. If the difference of the two burns is greater than 0.15 (AASHTO T 308), perform 2 more burns.
    b. If it is necessary to complete 4 burns because of a difference > than 0.15, the high and low values will not be used. The average of the 2 middle values will be averaged and used for the specific ignition furnace used for the burns.

c. It is normal for furnaces to not match correction factors. They should be close, so if there is greater than 0.4, it should be investigated and resolved as per direction from the DLE. The purpose of the contractor submitted mix is to establish correction factors for the district lab's ignition furnace.

The JMF proposal shall be submitted to the DLE through LaPave software for approval no less than 7 days before anticipated production is to begin.

Approval of JMF Proposal

Prior to approval of a submitted JMF, the DLE will review the following:

1. Header information
2. Aggregate properties
    a. Listed on AML
    b. Gradation
    c. Specific gravities
    d. Consensus properties
    e. Friction rating for wearing courses
3. Asphalt cement
4. Anti-Strip
5. Additives (if used)
6. Asphalt mixture general criteria (Table 502-6 or Table 502-6b for low ADT option)
7. LWT or TSR (for Minor Mixes)
8. Draindown for SMA mixtures
9. All submittal documents

Upon approval, LaPave will issue the JMF a Sequence Number. The sequence number must be legible on any printed copies of the JMF.

The DLE will electronically approve the JMF and notify the Contractor of approval. The DLE or their representative must approve the JMF proposal before any mixture is produced for the Department.

The JMF may be approved pending testing of the JMF correction factor.

It is the responsibility of the Contractor to verify with the Project Engineer that the approved JMF proposal meets project specifications. The contractor shall coordinate the anticipated validation schedule prior to production for a particular project with the Project Engineer. The Contractor shall also coordinate with the DLE and ADI for DOTD staffing of validation testing in accordance with the "Contractor Notification" in the Policy Section of this manual.

Validation of JMF Proposal

After DLE approval of the JMF and after the Project Engineer verifies that the mix type is appropriate for its use according to project specifications, the plant may begin the validation process by producing mix using the JMF, as approved.

The first production lot up to a maximum of 2000 tons of mix shall be used to validate a JMF. The Contractor and the Department ADI using the stratified random sampling approach (See Appendix) shall jointly take and test five samples, one per validation sublot. Validation of a ***mainline*** JMF requires a minimum of 1000 tons. A multiple day validation is acceptable across multiple projects. Validation shall consist of 5 tested sublots totaling between 1000 and 2000 tons at the discretion of the DLE.

The Contractor, with the approval of the Department, may exclude the first sublot test set from validation calculations provided a 6th test is taken within the validation lot. The dropped 1st sublot test data is retained, but the data for the 6th test will be used to calculate validation PWL and averages for setting JMF targets. The dropped 1st test will not be used for validation calculations. It must be noted that roadway core PWL calculations are not related to JMF validation. Acceptable roadway performance, as per specifications and to the satisfaction of the Project Engineer, is a requirement for continued use of a JMF.

Pay on the validation roadway lot will be in accordance with acceptance pay parameters, based on core density. The assigned roadway lot numbers must correspond to the assigned plant lot numbers. The pay on the asphalt from the validation lot will be based on one roadway core per sublot for each sublot. Calculations for pay for validation lots will be the same as regular roadway lots, always based on 5 cores.

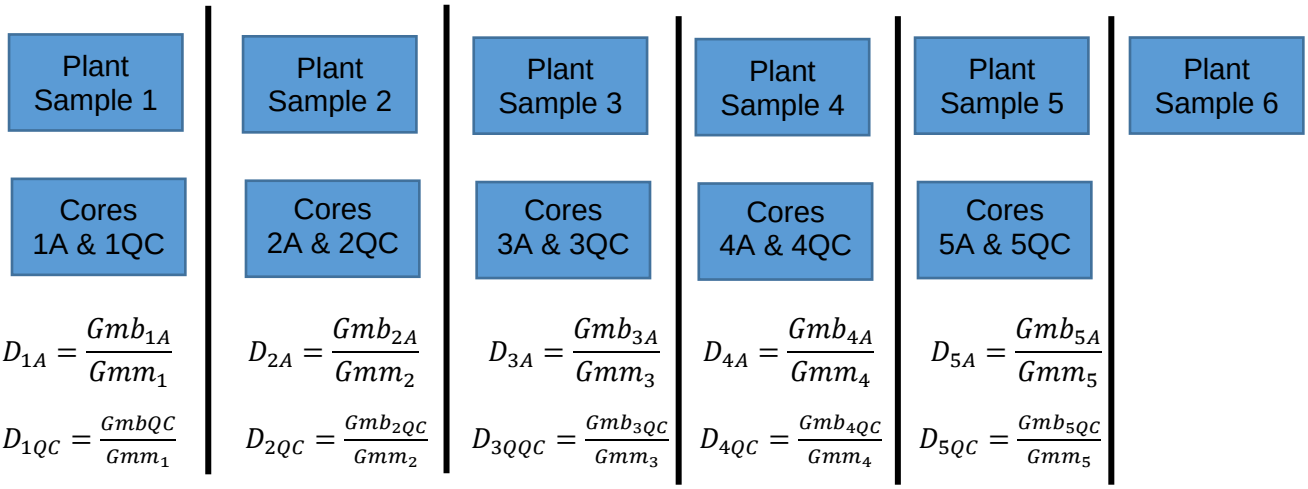
Roadway core density will be calculated on the corresponding plant sublot G_{mm}. One acceptance roadway core per sublot will be cut for acceptance and delivered to the District Lab. Quality control cores are to be cut within 12 inches of the acceptance cores in the direction of traffic for the contractor. After all cores are tested for density and the time has lapsed for the contractor to question density results, the district lab will randomly choose one core for G_{mm} verification against the corresponding plant sublot G_{mm} with a ±0.024 tolerance. If the G_{mm} does not verify, the DLE will notify the contractor. See the “Core Handling Flow Chart” in District Laboratory Acceptance for testing protocol.

Approximately 20 grams of –No. 4 and +No. 8 asphalt coated aggregate from **loose mix obtained during validation** will be sent by the DLE to the Materials Lab (Section 22) for GPC analysis.

One quart can of Asphalt Cement will be submitted along with asphalt coated aggregate for GPC analysis (finger printing) from the validation.

When an asphalt cement source is changed, one quart can and loose mix as referenced above shall be submitted to the Materials Lab (Section 22) for GPC analysis.

Validation Lot Example



Density = D1A, D1QC, etc.

For each core, the corresponding plant sublot Gmm will be used for roadway density of each validation sublot

However, if plant sample 1 test results are inconsistent with the other sublots, the contractor may collect one additional plant sample at the end of validation and use in place of the first for determining JMF targets and JMF validation acceptability.

The JMF proposal validation will be completed on the first production lot for that JMF in accordance with specifications. The validation is intended to ensure the mixture produced in the plant meets tolerances set forth in the JMF proposal and to establish the targets for the approved JMF. The contractor is to ensure the minimum lift thickness is maintained based on the nominal maximum size aggregate per Table 502-6 or 502-6b.

The performance of the mixture on the roadway will be evaluated to ensure the JMF is not contributing to laydown deficiencies, such as segregation, tenderness, workability, compactability, or surface texture problems. When the Roadway Inspector observes roadway deficiencies during or after validation, they will inform the Plant Inspector, the Project Engineer, and the DLE. The Project Engineer in charge of the project or the DLE may discontinue the use of a JMF because of roadway deficiencies attributed to the JMF.

LWT (Rut Testing) Validation of JMF Proposal

The ADI shall prepare 4 gyratory specimens 60 mm in height at 7 ±0.5% air voids in accordance with AASHTO T 312 (larger specimens may be gyrated and cut to height). The estimated weight required for the specimen will depend upon the G_{mm} of the mixture. The specimens shall be delivered to the District Lab for LWT testing in accordance with AASHTO T 324. When the LWT rut depth results exceed requirements in Table 502-6 or 502-6b, discontinue production and reevaluate the JMF.

Failure to Validate Procedure

If a mixture design fails to validate, a second validation attempt is allowed.

If the first and second validation attempt fails any quality characteristic or roadway pay is less than 100% on both attempts, then the contractor must redesign, submit the JMF proposal for approval, and validate off site at no direct pay. While this off site validation remains incomplete and unapproved, the Producer will not be allowed to submit any new JMF's for approval for mixtures of this type on any DOTD project. **The off-site validation plan must be pre-approved by the DLE**. The validation data is entered into LaPave for DLE review. The DLE will determine if an additional validation is required **on** the state project. If the Contractor must validate off-site, they must coordinate with the DLE who may require that the ADI be present for the off-site validation attempt in order to avoid another validation on a state project.

Pending off site validation, the Producer may use a previously approved JMF on DOTD projects.

If the Producer is not able to adjust the mix within allowable bin tolerances (±4% for validation), disapprove the JMF.

If the JMF does not validate, the DLE will disapprove the JMF in LaPave.

Repeated validation failures indicate a possible problem with equipment, processes and/or mix design.

Final Approval of JMF

Upon validation of the JMF, validation averages become JMF production target values.

For mixes that do not require validation, such as minor mixes, the average of the first five sublot test results from a specific JMF become production target values. The ADI or DLE will duplicate the data entry into the validation portion of LaPave.

The DLE, upon review of the validated JMF and supporting PWL calculations, will approve the validated JMF for production. Once a completed mixture design has been validated and approved, the same JMF may be assigned for use, with DLE approval, for any project having the same specification requirements.

It is the responsibility of the Contractor to ensure the Project Engineer has received notification of the approved JMF prior to production. The Project Engineer is responsible for sending a copy to the Roadway Inspector.

LaPave will notify the Contractor, Producer, Department plant personnel, and the Project Engineer who is receiving the mixture of final approval of the JMF.

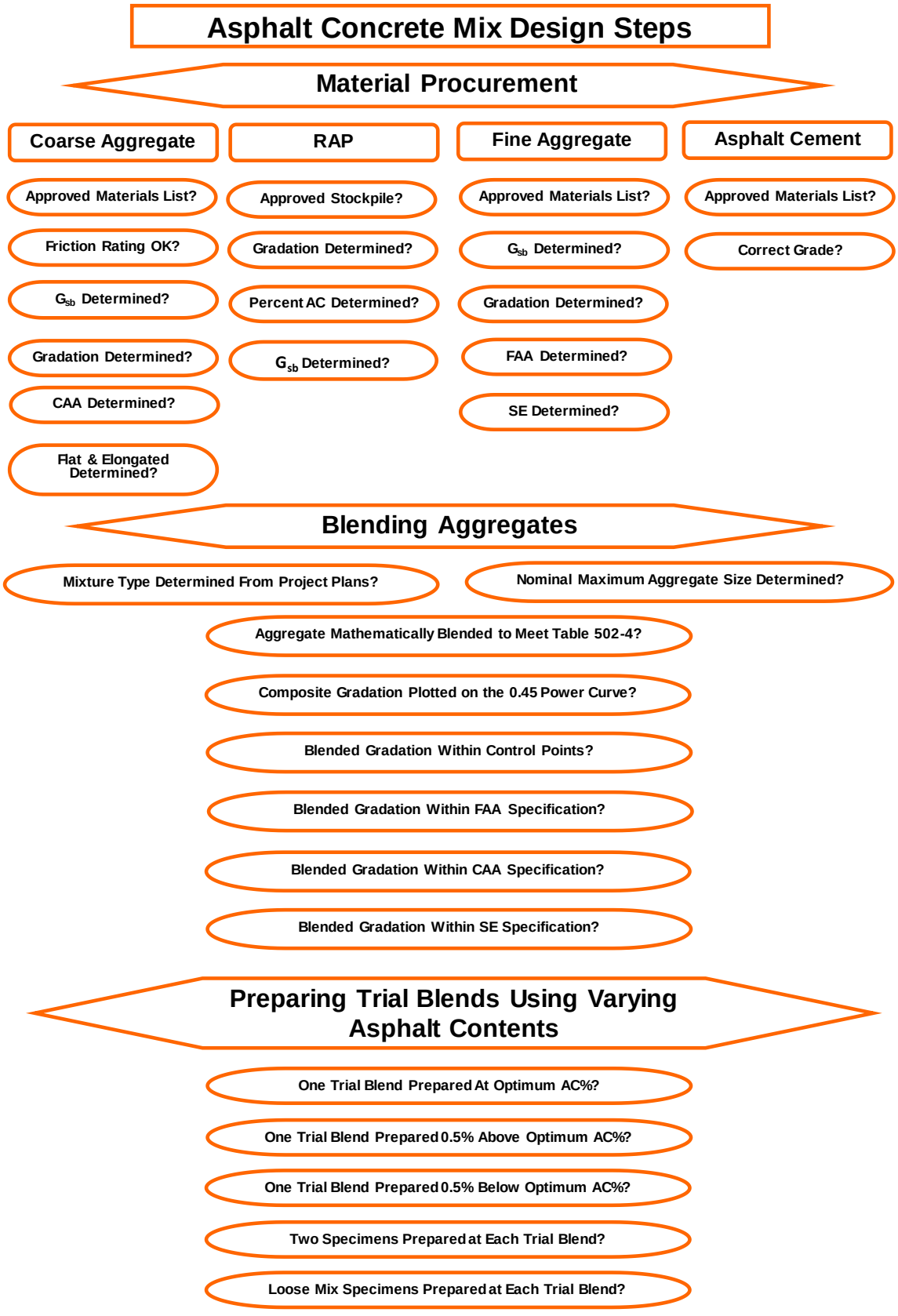
In summary:

1. Contractor submits a proposed JMF to DLE
2. DLE approves the JMF for validation
3. Validation is performed, data analyzed
4. DLE (or designee) reviews and approves

5. Validated proposal becomes a new approved JMF

All JMF's shall be re-validated a minimum of every 2 years. Re-validation may consist of reviewing ongoing production plant data and plant verification data or a full validation, if required by the DLE. If production data does not maintain specification requirements whether required for pay or not, the DLE may require re-validation or terminate the JMF.

Figure 2-5 illustrates asphalt mix design and submittal steps.


Asphalt Concrete Mix Design Steps
Material Procurement
Coarse Aggregate
Approved Materials List?
Friction Rating OK?
Gsb Determined?
Gradation Determined?
CAA Determined?
Flat & Elongated Determined?
RAP
Approved Stockpile?
Gradation Determined?
Percent AC Determined?
Gsb Determined?
Fine Aggregate
Approved Materials List?
Gsb Determined?
Gradation Determined?
FAA Determined?
SE Determined?
Asphalt Cement
Approved Materials List?
Correct Grade?
Blending Aggregates
Mixture Type Determined From Project Plans?
Nominal Maximum Aggregate Size Determined?
Aggregate Mathematically Blended to Meet Table 502-4?
Composite Gradation Plotted on the 0.45 Power Curve?
Blended Gradation Within Control Points?
Blended Gradation Within FAA Specification?
Blended Gradation Within CAA Specification?
Blended Gradation Within SE Specification?
Preparing Trial Blends Using Varying Asphalt Contents
One Trial Blend Prepared At Optimum AC%?
One Trial Blend Prepared 0.5% Above Optimum AC%?
One Trial Blend Prepared 0.5% Below Optimum AC%?
Two Specimens Prepared at Each Trial Blend?
Loose Mix Specimens Prepared at Each Trial Blend?

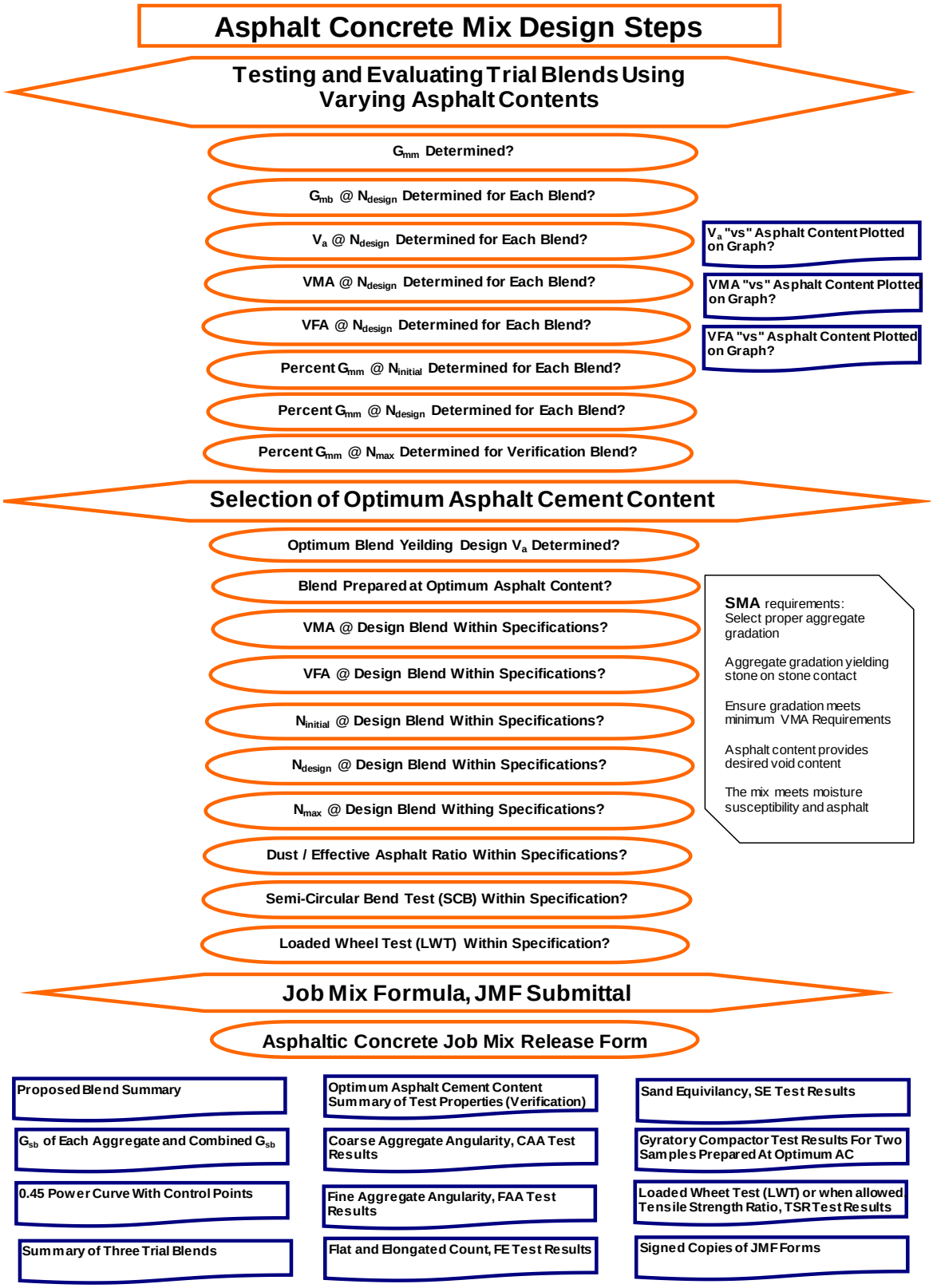


Figure 2-5: Asphalt Mix Design and Submittal Steps

SECTION 502 – ASPHALT (Lots)

Definition of a Lot

1 Lot is 5,000 tons consisting of 5 – 1,000 ton sublots.

For Quality Control and contractor plant testing, obtain a **minimum** of 1 mixture sample from each 1000 tons of plant-produced mixture using a stratified random sampling approach (see appendix). A representative sample shall be of sufficient size for all Quality Control testing.

A lot is a segment of production of asphalt concrete mixture from the same JMF produced for the Department at an individual plant for a specific project. Although the plant lot and sublots testing data is used for quality assurance purposes, there are no pay adjustments associated with this data. Plant lots will be specific to projects. Lot designation shall be reported on each haul ticket delivered to each state project.

It may take multiple days to complete a lot, in which case the Contractor shall perform and report multiple Quality Control tests on an individual lot, at a minimum of 1 set of tests per day when production is ≥ 100 tons per day per "Mainline" JMF and/or ≥ 250 per day per "Minor" JMF. Contractor QC testing shall be performed and reported into LaPave.

Minor adjustments will be made in the 5000-ton lot size to accommodate hauling unit capacity. When total lot quantity of 5000 tons is reached in the partial load of a truck, the full legal load of the truck shall be included in the lot. For example, if 4988 tons of asphalt mixture are produced and sent to a project and the next truck hauls 24 tons, the actual lot size will be 5012 tons (4988 + 24).

For 502 mixtures, the last lot of each mix type per project (Base, Binder, Wearing, Incidental) may be extended 1 sublot up to a maximum total of 6000 tons. The last lot of each mix type that is extended shall have six sublots.

The Contractor shall ensure "Haul Ticket' information on each ticket includes:

- Date
- Project number
- DOTD JMF sequence number
- Mix Type
- Lot No.
- Ticket number
- Quantity of mix in tons
- Accumulated tons shipped
- DOTD truck certification number

Roadway Lot Tracking

The corresponding roadway lot shall be tracked at 5000 tons from the plant. Roadway lots shall be either mainline asphalt mix, minor asphalt mix use or a combination use of both from the same JMF. Roadway lot numbers will be the same as the plant lot number. Tonnage and lot placement is documented on each project using station to station placement locations. Daily Work Reports (DWRs), field books and roadway reports are ways to document mix placement.

SECTION 502 – ASPHALT (Lots)

Roadway lot tonnage may be less than tonnage for a plant lot. Some reasons:

- Rejected mix – partial or whole loads
- Too much mix sent to the roadway. Then sent back to the plant.
- Mix has to be removed and replaced during laydown operations

The wearing course is the final lift placed. The binder course is the lift placed prior to the final lift. When a 501 mixture is placed over a 502 mixture, it is a "Finish Course."

Mainline mixtures include wearing, binder, and base courses for travel lanes, ramps greater than 300 ft., turnouts greater than 300 ft. interstate acceleration/deceleration lanes, center turn lanes, and the two center lanes for airports.

Minor mixes include mixture used for bike paths, crossovers, curbs, detour roads, driveways, guardrail widening, islands, joint repair, leveling, medians, parking lots, shoulders, turnouts less than 300 ft., ramps less than or equal to 300 ft., patching, widening, miscellaneous handwork, and any other mixture that is not mainline.

Mainline
Travel Lane – Wearing, Binder, Base
Ramps >300' long
Turnouts > 300' long
Interstate Acceleration/Deceleration Lanes
Turn Lanes

Minor Mix with Density	**Minor Mix without Density**
Shoulders	Curbs
Patching	Driveways
Widening > 2.5' wide	Widening ≤ 2.5' wide
Leveling > 1.5" thick and uniform	Leveling ≤ 1.5" thick, and used in spots
Turnouts ≤ 300' long	Turnouts < 300' long
Ramps ≤ 300'	Detour Roads
Crossovers	Guardrail Widening
Bike Path	Islands
Parking Lots	Joint Repair
Tapers	Everything Else

When a roadway lot is a combination of mix uses, separate roadway reports, with station number begin and end, shall be used to record the tonnage for each mix use. For example, roadway paving and shoulder paving is a common combination mix use lot. Shoulders paved with mainline mixture, would be considered a minor mix use. Theoretical quantity for the shoulder would be part of the lot but tracked as minor mix. A separate roadway report would be made for the mainline mix use as well as for the shoulder mix use.

Example:

If 200 tons is placed on a 12' wide roadway and a 4' wide shoulder (total paving is 16' wide), paved with the mainline, divide the tonnage as follows:

(12/16)*100 = 75% travel lane and (4/16)*100 =25% shoulder = 100% paved width

200 tons x 0.75 = 150 tons mainline mix
200 tons x 0.25 = 50 tons shoulder minor mix

Roadway Lot Sampling and Testing

Minor without density requirements compacted to the satisfaction of the Engineer

The P.E. may require coring ≤ 4 ft. shoulders when the contractor is not compacting to their satisfaction

The sublot is divided into two equal sections with an acceptance and QC core from each section Using random numbers (see appendix) for location, an acceptance core is taken from each section.
If a sublot has both mainline and minor uses, at least one acceptance core is required to represent the minor mix type. If the lot has any mixture used for mainline, a minimum of three cores is required to represent the mainline portion. Take additional acceptance cores randomly from the respective portions as needed to meet these requirements.

The Contractor will cut and trim all cores in the presence of the DOTD Inspector. The DOTD Inspector will take custody of the cores for delivery to the district lab. Contractors may request to transport roadway acceptance cores, via the approved method, to the district lab. The request shall be in writing and approved by the DLE.

The Contractor will take Quality Control cores within 12 inches of the acceptance cores in the direction of travel. If additional acceptance cores are taken, take additional quality control cores approximately 12 inches in the direction of travel from the any additional acceptance core collected. The contractor will take custody of these cores for testing at the asphalt plant.

Both the Contractor and Department shall report core results in LaPave on the same day tested.

All cores shall be properly identified by the corresponding roadway lot, core identification number, and project number. The Certified Roadway Inspector shall list the generated random numbers on the Roadway Report.

See the Roadway Acceptance section of this manual for core handling procedures.

Roadway Lot Pay Determination Based on Core Densities

Based on minor mix core densities, the portion of the lot that is minor mix is subject to pay adjustments, based on averages, in accordance with 502.15.2, and Tables 502-5 and 502-7.

Based on mainline mix core densities, the portion of the lot that is mainline mix is subject to pay adjustments, based on PWL or average, in accordance to 502.15.2 and tables 502-5, 502-7, and/or 502-10.

For projects, or separate locations within a project, requiring less than 250 tons per mix type, the job mix formula, materials, and plant and paving operations shall be satisfactory to the Engineer. The Engineer may modify sampling and testing requirements and may waive the payment adjustment for deviations.

Minor mix without density requirements will be accepted based on contractor plant testing data.

Quality Control

Plant Quality Control

Whenever asphalt mixtures are being produced for a DOTD project, the Contractor shall, at all times during operations, have a Certified Asphalt Concrete Plant Technician (QC Tech) at the plant with the ability and authority to conduct any test or analysis necessary to put the plant into operation and produce a mixture meeting specifications. A Level I qualified technician or above QC Tech may test mix for conformance with specifications. A Level III QC Tech shall be required to design asphalt concrete mixtures and submit JMFs for approval to DOTD.

During plant operations, the QC Tech for the contractor shall not serve in another capacity (i.e. plant operator, loader operator, laborer.)

QC Techs shall provide proof of Asphalt Concrete Plant Technician certification upon request by the Department.

The primary responsibility of the QC Tech is to design asphalt mixtures and control production to ensure it consistently meets Departmental specifications.

The Contractor must ensure all tasks necessary to begin plant operations are completed. This includes, but is not limited to, checking asphalt cement working tanks, material stockpiles and moisture content, aggregate bins, cold feed settings, meters, and scales. The QC Tech is responsible for recommending appropriate actions and ensuring adjustments are made during operations to ensure uniformity and conformance to specifications.

The Contractor shall oversee and monitor the complete production, transport, placement, and compaction phases to ensure compliance with DOTD specifications and to promote consistency.

When the plant is in operation, the QC Tech shall monitor stockpiles to ensure proper construction and moisture contents entered into the plant controls are consistent with actual values for each material bin.

Continuously monitor plant operations to ensure:

- Proper bag house operation (startup and shutdown loads do not impact the return of fines from the dust collection system, causing inconsistent amounts of passing No. 200 material.)
- Sufficient asphalt mix wasted at startup and shutdown to ensure adequate, sufficient, and consistent asphalt cement rates and conformance to JMF specifications.
- Proper loading of trucks to minimize material segregation.

Plant Quality Control Testing

The Contractor shall conduct Quality Control tests to ensure production analysis is within specification ranges. Sampling and testing shall be in accordance with the Materials Sampling Manual.

The Contractor must demonstrate plant processes are under control for voids and G_{mm}. The Contractor will report testing data daily. The following may indicate that plant process or materials are out of control:

a. One point is more than three standard deviations from the mean.
b. Nine (or more) points in a row are on the same side of the mean.

Further investigation may be required if the DLE determines for any reason that the plant process, materials, equipment, etc. may be causing problems in the mix production.

The Contractor shall continuously enter test results of plant data as testing is completed. The following records shall be entered or calculated in LaPave:

1. In LaPave, report results of each individual test and moving average for five samples for the following:
    a. G_{mm}, air voids
    b. VFA
    c. VMA
    d. % G_{mm} at $N_{initial}$,
    e. Required gradation parameters
    f. Asphalt content
2. In addition, LaPave will compute PWL (see Appendix for example calculation) for G_{mm} and air voids.
3. Corrective action when the PWL or average of the five fall outside the specifications limits.
4. Notes of proper adjustments prior to continuing production.

From 502.06, Quality Control and Plant Acceptance, the rolling five test must meet 71 PWL. If the latest rolling five test results are less than 71 PWL, the Contractor will take corrective action or cease production.

Through quality control procedures, the Contractor shall make efforts to maintain mixture-testing tolerances within the ranges specified on the following table:

Table 7
Tolerances for Rolling Five Average

Parameters	Tolerances[1]
G_{mm}	± 0.015 of the validated G_{mm}
G_{mb}	± 0.024
%Voids	± 1.0
%VMA	± 0.5
%AC	± 0.3
VFA	± 1.0
Gradation	
No. 4	± 4
No. 8	± 3

No. 200	± 0.7
[1]Based on the latest QC average, ("rolling 5")	

If quality control data shows mixture production is not uniform, the Contractor shall correct operations to produce a mixture conforming to specifications or discontinue operations for DOTD.

Production adjustments resulting in subsequent production tolerance adjustments will require a new JMF should they exceed:

1. 4% of cold feed proportions from original submittal percentages
2. 0.3% virgin asphalt content
3. Greater than or less than 0.015 of the validated G_{mm} as noted in Table 7.

The Contractor shall maintain a daily record of cold feed percentages and asphalt content settings.

The Contractor shall document all corrections to control the mixture and prevent any aspect of the mixture from moving outside specified limits or from varying erratically within limits. This documentation shall include the action taken, date and time, and technician making corrections.

Minimum Contractor Quality Control Testing

***Loose Mix / Sublot**

1. Theoretical Maximum Specific Gravity, G_{mm}
2. % Asphalt Content
3. Gradation
4. % Crushed
5. Temperature of Mix – Minimum of 1 per sublot, per day, per JMF written on the haul ticket
6. Mix moisture

***Compacted Specimen / Sublot**

1. LWT (Every 20,000 Tons)
2. % G_{mm} @ $N_{initial}$
3. %G_{mm} @ N_{design}
4. % Air Voids, V_a
5. % VMA

6. % VFA
7. %G_{mm} @ N_{max} 1 per 5 Sublots for information only

Age all loose mix prior to testing for one hour (warm mix age: 2 hours) in a shallow pan in accordance with AASHTO R 30. This includes $G_{mm,}$ LWT and mixture for gyratory briquettes.

*****The Contractor will test for Quality Control when 100 tons or more are shipped per mainline per JMF per day and/or 250 tons of minor mix per JMF per day. Test results will be entered into LaPave with comments entered in the remarks section.

For WMA mixtures and JMFs with ≥ 2% composite water absorption, age samples for 2 hours.

LWT Testing

In addition to validation requirements, perform LWT testing in accordance with DOTD S 201 - Asphaltic Materials for every 20,000 tons of plant-produced mixture.

4 – 60mm gyratory specimens compacted to 7.0 ± 0.5% air voids are tested.

Gradation

Proper sampling is crucial for accurate results that represent actual plant production.

The Contractor should regularly check to ensure the aggregate proportioning system, as well as the RAP proportioning system, are in calibration. This may be a two-step process. Check weighbridges to ensure they are in calibration. This is determined by running a known mass of material, including moisture, over it and correcting the weighbridge factor to bring it in calibration over the full span of expected flow rates. Each cold feed bin should be calibrated as needed to ensure the proper mass of material/per unit time is being proportioned from the individual bin.

Should the extracted gradation begin to vary erratically, the aggregate and RAP proportion systems should be immediately checked along with individual stockpile gradations and moisture contents.

Additives

The Contractor shall check the rate of anti-strip at the beginning of each operational period, and when necessary, to ensure the mixture is receiving the percentage of anti-strip required by the JMF.

When other additives are used, the Contractor shall also check the rate at the beginning of each operational period, and when necessary, to ensure the mixture is receiving the percent of additive required by the JMF.

Temperature

The temperature of the asphalt cement and asphalt mixture is very critical. It is also critical that the temperature of these two products be as specified and be consistent.

Specifications require a thermometer to indicate mixture discharge temperature (typically at the discharge of the drum mixer). Mixture temperature consistency is essential in obtaining consistent roadway compaction. The QC Tech may check this thermocouple temperature against an infrared gun-type thermometer device or a standardized dial thermometer.

The JMF stipulates an optimum mixing temperature range of ± 25°F of the optimum mixing temperature for the asphalt cement used. The discharge temperature shall be within this range. **Mixing temperature must never exceed 350°F at the point of discharge, regardless of the supplier's recommendations.** Section 502.09 of the Standard Specifications states: No mixtures shall be delivered to the paver cooler than 25°F below the lower limit of the compaction temperature as allowed by the JMF. **The temperature of the mix going through the paver shall not be cooler than 245°F**.

Moisture

Stripping of asphalt mixtures is **less likely** to occur in the **absence of moisture** or moisture vapor. All hot-mix asphalt materials shall be produced in a manner that minimizes internal moisture because internal aggregate moisture can weaken the molecular bond between the asphalt cement and the mineral aggregate.

The average annual rainfall and humidity present in Louisiana, makes it difficult to remove all free and absorbed moisture from aggregate in the production process. In a typical plant, when fuel is burned, a quantity of heat is produced. Heat transferred to the aggregate evaporates moisture and heats the aggregate. As moisture evaporates, each pound of water expands to 33 ft^3 of steam. This enormous volume of steam must be removed by the plant's exhaust system. When aggregate moisture values increase, the plant's production rate and burner settings must be adjusted to maintain and achieve consistent mixture temperatures and remove sufficient moisture. Excessively worn or missing flights will greatly affect the plant's ability to heat and dry aggregates. The drum mixer shall be routinely inspected for excessive flight wear.

The presence of moisture also influences the process of accurately measuring mix volumetrics. Excessive moisture in hot-mix asphalt may lead to an abrupt collapse in VMA.

The QC Tech shall monitor and record the moisture in LaPave for Quality Control purposes. The stockpile moisture records shall be maintained in LaPave and plant laboratory.

Calculate moisture content (M.C.) for each aggregate by the following equation:

$$\text{M.C.\%} = \frac{(\text{Wet Weight} - \text{Dry Weight})}{\text{Dry Weight}} \times 100$$

To determine the *dry* mass/weight, knowing moisture content, the following equation may be used:

$$\text{Total Dry Weight} = \frac{\text{Total Wet Weight} \times 100}{100 + \text{M.C.\%}}$$

Report percent moisture (maximum 0.3% allowed by specification) in loose mix as part of QC testing of plant-produced mixture. Test in accordance with DOTD TR 319. Mix moisture shall be tested and entered into LaPave a minimum of once daily. Both the mix moisture and the AC correction factor shall be used to determine AC content.

Plant Inspection

When QC/QA inspection or tests indicate the Contractor's QC program is ineffective, the ADI or DLE will require modifications to the program. DOTD has the right to require changes in personnel, equipment, construction methods, testing methods, or frequency. The Contractor will not proceed with construction operations without an effective QC program, as determined by the DLE, that complies with specifications.

A key element of inspection is the review of Contractor's QC results and program. Evaluations of the QC effort to ensure that out-of-specification mix does not occur may include, but are not limited to, the following:

1. Observation of the Contractor's sampling and testing procedures for conformance to Department procedures and proper testing techniques
2. Evaluation of the Contractor's testing equipment for proper working condition and conformance to requirements of appropriate test procedure
3. Observation of construction procedures for uniformity of effort and results

Department Certified ADI Responsibilities for Plant Verification

The Department's ADI is a Department official representative. The Department's ADI will randomly visit each plant at a minimum of once per month to verify plant operations and audit quality of production without advance notification to the contractor.

The ADI will either take a random independent sample or split sample with the Contractor during random plant visits for each JMF produced for state projects. The ADI will perform all testing, independent of the contractor technician. The ADI will perform the following tests:

1. G_{mm} – TR 327
2. Gyratory compacted to N_{design} – T 312, TR 304
3. Mix moisture – TR 319 - Completed during plant visit; and
4. Loose mix for %AC and gradation – TR 323, TR 309

The sample will be aged for 1 hour for hot mix, 2 hours for warm mix and/or aggregates with greater than 2% water absorption. After aging, the ADI may test using the Contractor's laboratory equipment or district lab equipment to perform required tests to specifications in Table 502-6 or 502-6b. Best practice is for the ADI to initially test a split sample using the contractor's equipment and the district lab equipment. Investigate any differences when results do not meet testing tolerances.

The ADI will indicate in LaPave whether the sample is independent of the Contractor's or a split sample with the Contractor. The gyratory briquettes will be tested for bulk specific gravity G_{mb}, V_a, $\%G_{mm}$ @ N_{des}, VFA, and VMA.

When testing by the ADI and/or district lab does not verify with contractor reported data, the DLE will investigate for the cause of the difference. The DLE may request assistance from the IA team when cause cannot be identified. Inability to reconcile will justify the Department's requirement to use an independent certified lab to perform the Contractor's plant testing.

The ADI shall also take a lot verification sample, a minimum of one per quarter per plant, to be tested at the district lab for $G_{mm,}$ AC%, gradation, and voids (gyratory compacted to N_{design} to be made at the district lab) in order to ensure that Contractor and District Laboratory equipment verify.

Individual sample test results shall meet parameters of Table 502-04.

Table 7
Tolerances between Plant Test and District Lab Verification Test

Parameters	Tolerances
G_{mm}	±0.015
G_{mb}	±0.024
%Voids	±1.0
%VMA	±1.0
%AC[1]	±0.2%
No. 4	±4%
No. 8	±3%
No. 200	±0.7%

[1] Differences between furnaces require a correction factor for the DOTD ignition furnace. Research has shown variances between furnaces.

When tolerances listed in the table above are not met, the Department's ADI will revisit the plant and test split samples. Split samples will be tested by the Department's ADI and QC Tech using the same equipment until a cause is found.

Equipment maintenance logs, proficiency sample records, or other record keeping required for certification will be reviewed quarterly by the ADI.

The Department's ADI is responsible for ensuring plant equipment and processes are in accordance with Section 503.

Asphalt Cement Content and Properties

Determine asphalt cement content by ignition furnace testing (DOTD TR 323) with the pre-determined JMF ***correction factor*** and test results of moisture content (DOTD TR 319). When the plant control delivery rate of asphalt cement plus the asphalt credit from RAP (if used) differs by more than ±0.2% from the ignition oven (with correction factor) for two out of five on the rolling 5 average, take corrective action. Corrective action can be re-establishing the correction factor or recalibrating the asphalt cement metering system or other systems of the plant. Document and the cause and corrective action taken and enter in LaPave.

Excess moisture in the mix may falsely appear as asphalt cement during ignition furnace testing; it may artificially decrease the G_{mm}. Higher or lower asphalt content can reduce or raise the G_{mm}.

The Contractor shall ensure asphalt cement strainers and screens are clear and operational.

SECTION 502 – ASPHALT (Production)

Asphalt cement shall be sampled and tested in accordance with Sections 502 of the *Materials Sampling Manual.*

The Approved Materials List Asphalt Cement Supplier shall:

- Sample and test the product
- Provide a Certificate of Analysis to the Materials Laboratory (electronic media is acceptable)
- Provide a Certificate of Delivery (CD) with every transport representing the material shipped to the asphalt production facility

Transports will arrive at the plant with a CD. **The Contractor's certified technician shall collect, scan, and email (at a frequency approved by the DLE) the CD's to the DOTD ADI or DLE**. CDs constitute acceptance for asphalt cement for the project. The contractor shall provide sufficient CDs of the proper grade for mix produced. A representative of DOTD will sample working tanks a minimum of once per month during random visits and transports as requested by the Materials Laboratory. The samples are to be delivered to the district lab for proper handling.

CDs for asphalt cement shall be clearly identified with the following:

1. DOTD lab number/Site Manager Materials Number
2. Asphalt Cement Grade/Material Code
3. Product Source Code
4. Date Shipped
5. Quantity
6. Plant Code

Sample IDs for asphalt cement shall contain:

1. Asphalt mix plant Producer/Supplier Code
2. Asphalt Cement Grade/Material Code
3. Sample ID Number
4. Date Sampled
5. Quantity

It is the contractor's responsibility to ensure asphalt cement added to the asphalt mix meets PG grade requirements for the asphalt mix being produced.

The Department's ADI will sample all asphalt cement working tanks for verification, once per month per plant per grade, and submit for testing. Sampling quantity will be one quart can per grade.

Specific attention shall be given to monitoring temperature in all asphalt cement working tanks and ensure all materials added, particularly from transports, are also at the correct elevated temperatures. Temperature directly correlates with viscosity, which will affect the material's ability to adequately coat the aggregate. **The temperature of the asphalt cement and asphalt mixture is very critical. It is also critical that the temperature of these two products be as specified and be consistent.**

The Materials Laboratory will request refinery verification samples through the District Laboratory. The District Laboratory will coordinate refinery transport delivery with Contractor production to ensure Materials Laboratory sample requests are met.

District Laboratories may test and report Dynamic Shear and phase angle, and one Rotational Viscosity per grade per month per refinery. If the sample meets all criteria, production continues.

Should the working tank sample not verify, the district laboratory will promptly notify the the Contractor, who shall notify the Supplier. Additionally, the DLE must investigate to determine the cause of failure. The following is general guidance for investigating differences:

- Compare working tank results to refinery results, transport results, and previous working tanks results. Does the material have a history of problems that would have resulted in similar problems?
- Send samples to the Materials Laboratory for complete analysis.
- Check maintenance schedules for the working tank to find out what maintenance was performed. For example: When the coils were last cleaned? When the tank was last cleaned?
- Inspect facilities, checking the history of the Supplier material, etc.
- Check the temperature of the working tank.
- Check whether a different brand or grade of material has been added to the tank. Was the tank level sufficiently low before adding new material?
- Test rotational viscosity.

If it is determined that material in the working tank does not meet specification requirements, then plant production shall cease until corrections are made.

Asphalt cement in the plant's working tank shall meet specifications of the asphalt cement required on the JMF.

Percent Anti-Strip

An anti-strip additive shall be added to all mixtures at no less than the minimum rate on the approved JMF.

The Department's ADI and contractor technician will verify the amount of anti-strip. If the check performed indicates the amount of anti-strip added is not in accordance with the JMF, the Contractor must make adjustments so the correct amount of anti-strip additive is added to the mixture. If the second check indicates, the mixture is still not receiving the correct percentage of anti-strip, production for DOTD projects shall be terminated until adequate adjustments can be made to the system or the system can be recalibrated.

The results of the percent anti-strip are entered into LaPave. Readings are to be reported, a minimum, once per lot by the Contractor.

The basic method of checking the percent anti-strip in the mixture is to monitor the flow of additive for a continuous time sufficient for an accurate calculation. In order to proceed with calculations for percent anti-strip, the Certified Technician must know the unit weight of anti-strip additive at any given temperature. The anti-strip Supplier must make the unit weight information available or a one-gallon sample weighed at the plant to determine this value.

This example shows the process of determining percent anti-strip added to asphalt mixtures:

1. Temperature – Read and record the temperature of the anti-strip additive used in the mixture from the thermometer on the anti-strip tank.

2. Readings – Take an initial reading of the amount of anti-strip additive from the anti-strip meter and take an initial reading from the asphalt cement totalizing meter. **It is required that the percent AC and the percent anti-strip be checked simultaneously during continuous production to evaluate the quality of the mixture in terms of both components.**

    a. For anti-strip, record the initial reading to the nearest readable increment (0.1 gallon, 0.25 gallon, or 0.034 gallon). Allow the plant to run for a continuous recorded time sufficient to represent approximately half a lot. Take a final reading to the nearest readable increment and record.

    b. For asphalt cement, record the reading to the nearest gallon. (Some plants will digitally display the mass of asphalt cement added on the computerized operational controls.) Allow the plant to run for the same time as used for anti-strip determination. Take a final reading of AC used and record to the nearest gallon. Subtract the initial reading from the final reading to obtain gallons AC used. Subtract the initial reading from the final reading to obtain the actual amount of anti-strip used during the time.

3. Calculations – Calculate the percent anti-strip in terms of the weight of asphalt cement in pounds **based on the suppliers unit weight.**

    7.28 lb/gal is used for this example. Manufactures and suppliers shall provide the specific gravity for their product on the CD accompanying the transport.

    a. Anti-strip Quantity – Calculate pounds of anti-strip:

        Unit weight of anti-strip = 7.28 lb/gal (from curve)
        Gallons anti-strip used during check = 41.45 gal

        7.28 lb/gal x 41.45 gal = 301.8 lb

    b. Asphalt Cement Quantity – Calculate pounds of asphalt cement:

        Gallons AC used during check = 5820 gal
        Weight of 1 gallon of water = 8.34 lb/gal
        Specific Gravity of AC @ 60°F = 1.03

        5820 gal x 8.34 lb/gal x 1.03 = 49,994.964 lb

    c. Percent Anti-strip – Calculate the percent anti-strip:

$$\%AS = \left(\frac{\text{pounds of anti-strip}}{\text{pounds of asphalt cement}}\right) \times 100$$

$$\% AS = \left(\frac{301.8}{49{,}994.964} \right) x100$$

$$= 0.604$$

$$= 0.6 \% \text{ anti-strip}$$

Report the final percent anti-strip additive to the nearest 0.1%.

4. Alternate Method – An alternate method is to take a printout of anti-strip and asphalt cement quantities at a specific start and stop point in time from the control room. Divide the total anti-strip quantity for the recorded time by the total asphalt cement for the same time. Results shall be within ±0.1 of the JMF. If not, production shall be discontinued until the proper rate can be added.

If lime or other additives are proportioned in the asphalt mixture at the plant (and shown on the JMF), then this rate shall be verified, via the plants meters/scales.

Roadway Quality Control

The Contractor shall perform roadway operations and quality control in accordance with the specifications. The Contractor shall constantly monitor equipment, materials, and processes to ensure density and surface tolerance meet specifications. Quality control testing and inspection shall be sufficient to ensure a smooth and homogenous pavement, free from segregation, truck ends, raveling, tearing, streaking, rutting, cracking, shoving, dragging of rocks, and rippling.

Mixture temperature has a substantial effect on density of the mat and shall be monitored. The Contractor shall coordinate plant production rate with transportation and placement rates to ensure continuous placement of mix. The Contractor shall monitor placement to ensure cross-slope, grade, and transverse requirements meet requirements of specifications and the Materials Sampling Manual.

A best practice recommendation for contractors:
When beginning plant production, dump the third, then second, then first load out of the plant silo into the MTV or paver. Continue with dumping trucks into the MTV as they arrive to the project thereafter.

Density

The contractor shall supply a sufficient number of rollers and experienced operators to ensure consistent density transversely as well as longitudinally along the paving strip. The contractor shall maintain consistent quality control to meet PWL requirements for mainline mixtures on projects with > 1000 current plan ADT as well as required densities for minor mixes. For projects ≤ 1000 current plan ADT acceptance densities will be based on average densities or PWL per sublot, as determined at preconstruction conference.

The contractor shall have roadway quality control that monitors density and smoothness for consistency and implements needed adjustments to meet 100% compliance with specifications.

Roadway Inspection

Inspection of Mixture on Roadway

Department personnel shall visually inspect the asphalt mixture. The Certified Inspectors are to evaluate the mixture at the jobsite. Mixtures exhibiting the following deficiencies shall not be placed:

- Segregation
- Contamination
- Lumps
- Non-uniform coating
- Excessive temperature variations
- Other deficiencies

Mixture contamination, alignment deviations, variations in surface texture and appearance or other deficiencies apparent on visual inspection will not be accepted. Poor construction practices such as inadequate handwork, improper joint construction, or other deficiencies apparent on visual inspection will not be accepted. **Deficiencies revealed by visual inspection both after placement and before final acceptance shall be corrected at the Contractor's expense.**

If a load of asphalt mix is suspect of deficiencies, but placement is allowed, the paving Inspector will sample the asphalt mix for testing. The paving Inspector will document the exact location of material placement. Materials identified as being deficient may require subsequent removal and replacement at the contractor's expense. The contractor assumes risk when deficiencies are suspected. Sample from a safe location. Have the MTV place mix in a safe location, sample from the end of the paver, or in extreme situations sample from the roadway. Mix should be placed in one-gallon friction top cans. When mix cannot be sampled in a safe manner during laydown operations, the contractor will be required to provide loose mix sample or roadway cores for testing.

Department personnel are to observe haul trucks for certification conformity. If haul trucks are not maintained to truck certification standards, they shall not be allowed on state projects. Areas of observation are:

- Tight fitting tailgates
- Dump beds – tight, clean, and smooth
- Tarps – canvas or vinyl large enough to cover the top and extend over the sides (sand tarps not allowed)
- Sufficient tie-downs to secure the tarp
- Certification sticker(s) are legible
- No fuel or fluid leaks
- **Petroleum products such as diesel shall not be allowed in dump beds**

Trucks that do not comply with certification and specification requirements will not operate on state projects. Report continued nonconformance to the P.E. and DLE.

The DOTD Certified Paving Inspector at the laydown site is responsible for observing the performance of surface tolerance testing, checking lane widths and other grade and alignment

checks and equipment suitability. The Certified Paving Inspector is responsible for maintaining a running total of tonnage delivered to the project from each plant lot. The Inspector must also document mix placement on the roadway. Plant Lots are the same as Roadway Lots, and are used to track mix placement. Continuous records of lot placement will be maintained. The Certified Paving Inspector will check yield on a continuing basis during the project and calculate yield for each portion of a lot delivered to the roadway. Beyond these duties, the Certified Paving Inspector must observe the appearance of the mat behind the paver and rollers, for uniformity and acceptability of mat thickness and width, joint construction and performance of the paving train equipment. If material related problems occur at the jobsite, then the Certified Paving Inspector shall make immediate contact with the Department's ADI and DLE so adjustments can be made in the manufacturing and transport processes.

Ensure the Contractor has adequate incidental equipment such as rakes, tampers, lutes, and shovels available at the project for work being performed. Equipment must be clean and in satisfactory condition.

Discarding Material

When dumping asphalt mix into the MTV at the start of paving operations, the contractor will discard approximately the first 200 to 300 lbs of material (approximately a wheel barrow full). This material shall be disposed of by the Contractor/Producer outside the limits of the right-of-way of the project. No deduction in lot tonnage totals will be made for this material waste. The Paving Inspector is to monitor the truck dumping operation for excessive waste.

Lumps, Contamination, Coating

Any material not properly coated, has lumps, or contaminated shall be rejected prior to placement. Lumps may be indicative of moisture problems or a dryer/drum that needs cleaning. If the Paving Inspector observes this deficiency, they are to notify the Contractor, DLE, and/or ADI. Discontinue operations and clean the dryer/drum. Improperly coated mix will be sampled and a Ross Count performed (AASHTO T 195). Contaminated material will also be sampled. When sampling material for future Department investigation, the Inspector must be certain to obtain a sample that is representative of the questionable material.

Temperature

The Paving Inspector is responsible for verifying temperatures of material at the roadway is within specification tolerance. The temperature of material in the truck shall be within 25°F of the bottom limit of the job mix formula (JMF). If the temperature is outside this tolerance or exceeds the upper JMF temperature limit, it is out of specifications and shall not be placed. The paving Inspector will record the job site temperature and tonnage rejected on the back of the haul ticket and void the ticket. The paving Inspector will immediately notify the Contractor, DLE and/or ADI and then check each subsequent truck until the material temperature is within acceptable limits.

Record the material temperature on the haul ticket. The temperature of the mix going through the paver shall not be cooler than 245°F. In such cases, record the temperature of the material and the tonnage discarded on the haul ticket(s) and adjust payment quantities.

An infrared thermal heat-sensing device (temperature gun) shall not be used for temperature acceptance. Questionable temperatures measured using an infrared device shall be verified with a standardized dial (stick) thermometer.

For the beginning of plant production, the first three loads of a JMF for a project may be above the JMF limits but in no case greater than 350ºF. This allows for startup variances at the plant.

Theoretical Yield

The estimated quantity of asphalt mix shown on the plans is the amount for the project based on mixture weights of 110 lbs per square yard per inch of thickness (lbs/yd^2/in. When constructed in accordance with the dimension and mat thickness shown on the plans, plan quantities should be accurate. When asphalt mix placed is less than the plans call for, the mat will probably, on average, be too thin.

When asphalt mix placed is more than the plans call for, the mat probably will be, on average, too thick. Additionally, a cost overrun will result. Failure to keep the actual quantity of asphalt mix used fairly close to plan quantity may require a change order. When using, extra material for minor adjustments due to field conditions, it is imperative that current Departmental policy for overruns are followed.

Plan quantity calculation is on asphalt mix weighing 110 lb/yd^2/in. Some aggregates, such as sandstone or slag, cause the unit weight of the mixture to differ from the standard 110 lb/yd^2/in. value.

To account for this weight difference , the Department established weight-volume adjustment factors to determine theoretical yield of an asphalt mixture with a theoretical maximum specific gravity (G_{mm}) outside the range of 2.400 – 2.540. Factors (from section 502.14 of the Standard Specifications*)* are shown in the following table.

Use Validated G_{mm} to determine adjustment factors. Monitor G_{mm} using QC data and verification samples.

Table 8
Adjustment Factors for Pay and Calculating Yield

Theoretical Maximum Specific Gravity, (G_{mm}) (AASHTO T 209)	Adjustment Factor (F)
2.340 – 2.360	1.02
2.361 – 2.399	1.01
2.400 – 2.540	1.00
2.541 – 2.570	0.99
2.571 – 2.590	0.98

The adjustment factor (F) for mixtures with theoretical maximum specific gravities (G_{mm}) less than 2.340 or more than 2.590 is determined by the following formulas:

Theoretical Maximum Specific Gravity (G_{mm}) less than 2.340:

$$F = \frac{2.400}{S}$$

Theoretical Maximum Specific Gravity (G_{mm}) more than 2.590:

$$F = \frac{2.540}{S}$$

Where:

F = quantity adjustment factor; and
S = theoretical maximum specific gravity (G_{mm}) on JMF.

Example:

Theoretical maximum specific gravity is 2.320.

$$F = \frac{2.400}{2.320}$$

$$F = 1.0345 = 1.03$$

The theoretical maximum specific gravity (G_{mm}) is on the approved job mix formula. For asphalt mixtures with an adjustment factor other than 1.00, the theoretical yield of the mixture is determined by dividing the theoretical yield based on 110 lb/yd^2/in thickness by the applicable adjustment factor. Below is an example for the calculation of the adjusted theoretical yield.

Example:

If the material placed has a theoretical maximum specific gravity (G_{mm}) of 2.390, the factor of 1.01 (from Table 8) will apply. Assume the material placed is in a 2.0-in. lift.

T = Thickness in inches

Theoretical Yield = 110 x T

Theoretical Yield = 110 x 2.0 = 220 lb/yd^2

$$\text{Adjustment Theoretical Yield} = \frac{\text{Theoretical Yield}}{\text{Adjustment Factor}}$$

$$\text{Adjustment Theoretical Yield} = \frac{220\ \text{lb/sqyd/inch}}{1.01}$$

Adjusted Theoretical Yield = 217.8 lb/yd^2

A mixture with a theoretical maximum specific gravity (G_{mm}) of 2.390 would require 2.2 less lbs (220 – 217.8 = 2.2) of asphalt mixture per square yard for the same volume (2.0 in. thick) as a mixture with a theoretical maximum specific gravity (G_{mm}) between 2.400 and 2.540, inclusive.

Factors used to adjust pay quantities, based on actual tonnage used, documented on haul tickets. If plan quantity for a project is 11,620 tons and the material placed has a theoretical gravity of 2.390 (factor 1.01), 11504.950 tons of this material would be needed to occupy the same volume as a mixture with a theoretical maximum gravity (G_{mm}) of 2.400-2.540 (factor 1.00). The target tonnage for this project would be 11,504.950 tons. Assuming this target tonnage is

the tonnage used on the project as documented on haul tickets to calculate payment tonnage, multiply the tons used by the factor 1.01.

11,504.950 tons x 1.01 = 11,620.000 tons

To equal plant quantities, pay the Contractor for 11,620 tons of material. If the Contractor were to place plan quantity (11,620 tons), the mat would be too thick. To be certain the amount of material placed is correct; apply factors when doing yield calculations.

A quick check of theoretical yield can be calculated for paving operations as lbs/yd^2/in. Use the value in a variety of applications such as:

- Establishing distances that one truck or multiple trucks should cover
- Verifying sub lot and lot yield for travel lanes and shoulders
- Determining the amount of asphalt mix needed for irregular areas, driveways, turnouts, crossovers, etc.

Document Theoretical Yield in field books and on the *Asphalt Concrete Pavement Report.*

Below are examples of the different applications. Assume an Adjustment Factor of 1.00 for all examples:

Establishing distances that one truck or multiple trucks should cover:

$$\frac{\text{Weight of Asphalt Concrete in Truck in Tons x 2000}}{\text{(Width of Paving Strip/9) (110 x Plan Thickness in Inches)}}$$

$$\frac{\text{23.60 tons x 2000}}{\text{(11.5 ft. wide paving strip/9) (110lbs x 2 in. plan thickness)}}$$

$$\frac{\text{47200.00 lbs}}{\text{(1.27 sq yds per linear ft.) (220 lbs)}}$$

$$\frac{\text{47200.00 lbs}}{\text{279.40 lbs per linear ft.}}$$

168.93 = 169 linear ft. that this truck *should* cover

An alternate method of tracking and monitoring yield for trucks is to convert the lbs per linear ft. value to tons per linear ft.

279.40 lbs per linear ft./2000 = 0.1397 = 0.139 tons per linear ft.

Apply the converted value as a constant by dividing this value into the tonnage of asphalt mixture delivered as reflected on a haul ticket. This is based on the width of the paving strip and the plan thickness not changing. Note: There will be a slight difference in distances, because of the conversion from lbs per linear ft. to tons per linear ft.

23.60 Tons of Asphalt Concrete in Truck
0.139 tons per linear ft.

169.78 = 170 linear ft. that this truck *should* cover

Confirming sublot and lot yield for travel lanes and shoulders:

Use ≈5000 ton lots to track asphalt mixtures shipped from the plant.

A roadway lot consists of 5 (five) 1000-ton sublots totaling 5000 tons.

Assume the typical section of a roadway is 24 ft. wide and 2 in. thick. The sequence of construction will utilize an 11.5-ft. wide paving strip for a standard 1000-ton sublot. The full width of the roadway would be accomplished by laying an adjacent paving strip of 12.5 ft. Adjacent paving strips may not always be included in the same sublot.

$$\frac{\text{Sublot in Tons x 2000}}{\text{(Width of Paving Strip/9) (110 x Plan Thickness in Inches)}}$$

$$\frac{\text{1000 Tons x 2000}}{\text{(11.5 ft. wide paving strip/9) (110 lbs x 2 in plan thickness)}}$$

$$\frac{\text{2,000,000.00 lbs}}{\text{(1.27 sq yds per linear ft.) (220.00 lbs)}}$$

$$\frac{\text{2,000,000.00 lbs}}{\text{279.40 lbs per linear ft.}}$$

7158.19 = 7158 linear ft. paved from a 1000-ton sublot

Determining the amount of asphalt mixture needed for irregular areas, driveways, turnouts, crossovers, etc.:

Assume an overlay project has 25 residential driveways, with each driveway having an area of 15 square yards and a plan thickness of 4 in. Below is the required calculation necessary to compute the total tons to complete construction of the 25 driveways.

$$\frac{\text{(Total Area in Square Yards) (110 lbs x Plan Thickness in Inches)}}{2000}$$

$$\frac{\text{(25 driveways x 15 Square Yards) (110 lbs x 4 in. plan thickness)}}{2000}$$

$$\frac{\text{(375.0000 sq yds) (440.0000 lbs)}}{2000}$$

$$\frac{\text{165,000.0000 lbs}}{2000}$$

82.5000 = 82.50 tons needed

Actual Yield

Actual yield is the amount of asphalt mixture placed in terms of pounds per square yard. It is the responsibility of the Certified Paving Inspector to maintain a constant check on actual yield during paving operations to ensure actual yield and theoretical yield will match closely at the end of the project. Check actual yield and compare to theoretical yield several times during a paving day, at the end of a lot, and at the end of the project. Average mat thickness is not exact, actual yield may vary slightly from theoretical yield on an individual truck or even for several truckloads. It should never run consistently over or under theoretical yield. If actual yield is consistently over or under theoretical yield, something may not be correct with the paving operation. The Contractor will be required to identify and correct the problem, or the project will not conform to the plans.

The formula for computing actual yield is as follows:

$$\text{Actual Yield} = \frac{\text{Tons Used x 2000}}{\text{Square Yards of Pavement}}$$

Utilizing the example of establishing sublot limits in the previous section on Theoretical Yield, a comparison against the Actual Yield shall be made and documented on the *Superpave Asphalt Concrete Pavement Report.*

A sublot placed containing 1040 tons of asphalt mix in a paving strip 7158 ft. long, by 11.5 ft. wide and 2 in. thick.

Square Yards = (7158 ft x 11.5 ft)/9 ft/yd^2 = (82317.00)/9 = 914$\underline{6}$.33 = 9146 square yards

$$\text{Actual Yield} = \frac{1040 \text{ Tons Used x } 2000}{9146 \text{ square yards}}$$

$$\text{Actual Yield} = \frac{2{,}080{,}000 \text{ lbs}}{9146 \text{ square yards}}$$

Actual Yield = 227.$\underline{4}$21 = 227.4 lbs/yd^2

The difference between Theoretical Yield of 220.0 lbs/yd^2/plan thickness in inches and Actual Yield of 227.4 lbs/yd^2 used is 7.4 lbs/yd^2 over. This indicates the mat may be too thick and an overrun for this sublot has occurred.

One method for calculating percent overruns or underruns is from tonnage. 1000 tons was needed for the area to be paved based on Theoretical Yield for the sub lot. The area uses 1040 tons.

$$\%\ \text{Overrun} = \left(\frac{\text{Actual tons laid} - \text{Theoretical tons}}{\text{Theoretical tons}}\right) \text{x} 100$$

$$\%\ \text{Overrun} = \left(\frac{40 \text{ tons over}}{1000 \text{ tons based on Theoretical Yield}}\right) \text{x} 100$$

$$\%\ \text{Overrun} = (0.4000)\ \text{x}\ 100 = 4.0\%$$

As stated earlier, Actual Yield should never run *consistently* over or under theoretical yield. Overruns or underruns for the Contract Item may require a Change Order in accordance with the *DOTD Construction Contract Administration Manual*.

High AC content mixes such as SMA may need an adjustment factor for calculating roadway yield. **See the appendix for roadway yield correction factor calculations.**

Joint Construction

Construction of all pavement joints shall be according to requirements of the specifications. As described in this manual and Standard Specifications, they shall be inspected by the Department's Inspectors for satisfactory compliance to Department standards and procedures.

Longitudinal Joints

Department specifications stipulate, during construction of a longitudinal joint, no material will be scattered loosely over the uncompacted mat. Overlapped material shall be pushed back to form a vertical edge above the joint. The vertical edge shall then be compacted by rolling to form a smooth, sealed joint.

Coarse aggregate shall not be raked from the asphalt mixture at the joint. Excess material or spillage shall not be pushed onto the uncompacted mat. If workers cast the overlap onto the uncompacted mat, this material will be segregated and not visually appealing. Such material will ravel under traffic. If this occurs, the Inspector must require removal of the material from the fresh mat before the roller approaches the area.

After compaction, a properly constructed longitudinal joint should not be high or low when compared to the adjacent mat. There should be no rough material at the joint location. The contractor shall properly seal the joint. There can be no opening allowed between the mats. The joint should not overlap onto the previously compacted mat. The Inspector must check the joint for all applicable variables after compaction. The Inspector should also place a 10-ft. static straightedge, provided by the contractor, across the joint, transverse to the centerline. If there is any deviation greater than the transverse surface tolerance applicable to the course listed in Table 502-5 of the Standard Specifications, corrective action is required. Checking the joint with a 10-ft. static straightedge is effective on a tangent slope. It will not work on a two-lane roadway with center crown. For a roadway with center crown, the Inspector will place a 10-ft. static straightedge across the joint with approximately 1 ft. resting on the new mat. If the fluff is not adequate, there will be a dip at the joint and the paver shall be adjusted.

Transverse Joints

Form a transverse joint whenever paving operations are discontinued long enough for the temperature of the asphalt mixture being placed to fall more than 50° F from the lower limit of the JMF. This includes the interruption of paving operations at the end of the day. Equipment malfunctions, plant problems, or weather conditions can also cause an interruption of the paving operations, which will require construction of a transverse joint.

The Inspector will visually inspect the joint longitudinally and transversely to determine if there are any apparent deviations in the area. The Inspector will then place a 10 ft. metal static straightedge, provided by the contractor, at several locations across the joint location and attempt

to push a shim the thickness of the applicable specification deviation beneath the straightedge. The joint shall comply with Subsection 502.08.3.2.

If the transverse joint does not meet specification requirements, the Contractor shall correct it before the paving operation proceeds. **The paving operation shall not proceed further than 100 ft. from the transverse joint until the transverse joint meets specifications.** Only the minimum amount of handwork required to correct the deficiency is allowed and only the affected area shall be worked. This handwork must be completed so the area can be recompacted before the mat surface has cooled beyond the point where compaction can be achieved. If the deviation at the joint is excessive (i.e., beyond that which can be satisfactorily repaired with a minimum amount of handwork) the contactor is required to completely remove the material placed and reconstruct the joint with the paver.

After any required corrections are completed and the area compacted, the Inspector must recheck the joint to ensure that the corrective action has met all Department surface finish requirements. The surface texture of the corrected area must be acceptable. If the Inspector is still unable to approve the joint, the Contractor must take additional corrective measures.

Segregation

If material appears segregated in the truck, the Inspector shall determine if the degree of segregation is severe enough to warrant rejection. If placement of the load is allowed, the Inspector is to sample the material for subsequent testing. If the material appears segregated in the truck, the Inspector must check the mat carefully behind the paver. If segregation is apparent, the Inspector shall notify the Project Engineer and the ADI. Future trucks showing segregation will be rejected until the problem is corrected. If material does not appear segregated in trucks, but the mat exhibits segregation, the Inspector shall require the Contractor to identify and correct the problem immediately. Operations shall be discontinued when problems are not corrected. Segregated areas of compacted asphalt mix are subject to Department investigation for acceptability and may be removed and replaced at the Contractor's expense.

As previously stated, Section 503.14 of the Standard Specifications require the use of a material transfer vehicle (MTV) when placing the final two lifts of asphalt mix on the roadway travel lanes. The three main objectives in requiring the MTV are to reduce segregation, improve surface smoothness, and promote continuous, non-stop paving. Asphalt mixtures placed without the use of a MTV when placing base course mixtures, leveling, and shoulders or as allowed by Subsection 503.14. The Certified Paving Inspector should continually monitor the finished mat for any segregated area.

When paving without a MTV (dumping asphalt mix directly into the paver hopper from the haul truck), proper truck exchange is critical to the production of a smooth, uniform mat. The truck should never bump the paver and should not rest on the paver hopper. Dumped or spilled material in front of the paver is not allowed. The material should be dumped into the paver in a large mass to prevent segregation.

Segregation on Mat

Segregated areas of the mat will have a different look from the rest of the roadway surface. These areas will be open-textured. The size of these areas will vary depending on the severity of the cause. It is not uncommon for such open-textured area to be 30 ft. long and the full width of the paver, although many of the areas are confined to 15-ft. lengths and just the center two-thirds of

the paver's width. The areas have a tendency to become more noticeable after being exposed to traffic and can best be observed when the angle of reflective light is low (i.e., early morning or late evening) or just after a rainfall. Under these conditions, the open-textured areas remain wet and dark looking when compared to the drier surrounding areas.

Truck Ends

Truck end segregation is caused by coarse aggregate fractions separating from fine aggregate fractions in either production, transport or laydown processes. In severe cases, separation can be observed at the plant when noticeable roll-down of the coarse aggregate occurs toward the sides, the tailgate, and the cab area of the haul unit. Such roll-down segregation results in a truck end in one or more of the following ways.

- Feeding segregated roll-down material at the tailgate onto an empty slat conveyor back to the paver augers as segregated material causes a truck end.

- Segregated roll-down material on the sides of the haul truck migrates to the wings of the paver hopper. When the wings are dumped (i.e., the material in the wings is fed to the slat feeder), this segregated roll-down material will cause a truck end.

- Segregated roll-down material at the cab end of the truck (which is the last mix from the truck) will roll down the entire length of the bed, and if fed by itself to the augers, will cause a truck end.

Numerous investigations have identified the material at truck end locations to be inferior in quality, possessing low asphalt content, with an extremely coarse gradation and a low roadway density. **The net result of these poor mix qualities is an area of roadway that will crack and/or ravel if used as a wearing course or be structurally deficient and subject to moisture damage if used as a binder or base course.** Beyond poor mixture characteristics associated with truck end segregation, a poor ride is often the result. Poor ride is identified by dips at the same intervals previously described. Dips are due to a paver's screed settling on the coarse mix during construction (i.e., a mixture with high air voids offers less resistance to the screed) or dips develop later under traffic, when high-void areas that have low initial density are compacted more than the well-compacted areas immediately adjacent.

Regardless of where segregation is observed, truck-end segregation areas on the roadway are to be eliminated or minimized to the best degree possible.

It is important to remember material is segregating through whatever handling processes it is subjected to (e.g., coated in a dryer/drum, conveyed into a surge/storage silo, emptied into a large trailer truck and dumped onto a paver's empty slat feeder). It is equally important to know some well-graded and well-coated mixes do not segregate given an identical handling process. Not all attempts to eliminate or effectively minimize truck-end segregation have been taken until one or more mixtures, processes, and handling changes have been tried and implemented.

Take the following steps whenever segregation is observed:

- Paver wings should not be dumped until the end of the paving day. Asphalt mix dumped from paver wings shall be discarded and not incorporated into the roadway.

- Haul trucks are to be loaded to minimalize segregation. When correcting segregation issues, haul trucks should be loaded with a minimum of three drops, the last of which shall be in the middle of the bed. It is the intent of this loading procedure to first load as close to the tailgate and cab areas as possible to minimize roll-down and then complete the load in the middle of the bed.

- During the exchange of trucks at the paver (when no MTV is required), the level of material remaining in the paver hopper should not drop so low as to expose the feed slats. Keeping feed slats covered with material will aid mixing of whatever roll-down material exists with non-segregated material before being fed to the paver augers.

- The paver augers should run at minimum revolutions to reduce segregation. Maintain the level of material to at least the auger shaft. Augers should run at least 95% of the time.

Any segregated areas on the roadway that occur at regular intervals must be eliminated or effectively minimized. The Paving Inspector must be aware of the potential problem and maintain constant communication with the Contractor production and paving personnel when a problem exists. The Project Engineer will instruct the Contractor/Producer to correct problems associated with segregation.

Coordination of Paving Operations

Coordination of Paving Operations with Production and Transport

One of the most important elements of successful asphalt paving operations is the coordination of paving speed to plant production and hauling capacity. A start and stop operation will not produce a uniform mat and smooth riding surface. Start and stop paving operations are prohibited by the specifications. The Standard Specifications require the Contractor/Producer to coordinate and manage plant production, transportation, and laydown operations to ensure reasonably continuous plant and paving operations with minimum idle time between loads. Delivery of material to the paver must be at a uniform rate. There should be no waiting time between truckloads; nor should a large number of trucks be waiting to discharge into the paver or MTV. The correct paver speed is such that as one truck empties and pulls away, one truck is waiting to move into discharge position immediately. If sufficient hauling vehicles are not available to maintain a smooth, coordinated paving operation, specifications authorize the discontinuance of operations or requirement of additional trucks. Paver speed and plant production should also be tied to time required for rollers to achieve compaction in the paving train.

Roadway Acceptance

Roadway lot pay will be based on tons received on the roadway. Pay adjustments will be based on Pavement Density calculated by methods shown below. Surface Tolerance pay will be calculated at the end of the project.

Lots and sublots shall be of the same JMF and sequence number.

SECTION 502 – ASPHALT (Cores)

Core sampling determination.

1. Each sublot will be divided into two equal sections with a randomly selected location in each section for a total of two acceptance cores per sublot. Core location shall be determined by application of random numbers.
2. One QC core will be taken within 12" of each acceptance core in the direction of travel.

Assume a sublot is composed of 1000 tons production of a specific approved JMF. Tonnage is based on field conditions in place.

Sublots may be used for ~~contain~~ both mainline and minor mix use.

Tonnage shall be tracked by station-to-station methods and recorded according to Department policies. Haul Tickets shall be tracked according to lot, JMF, mix type, mix use and mix placement.

Pay adjustments will be applied to quantities:

- By lot for mainline with >1000 current plan ADT,
- By sublot for projects with ≤1000 current plan ADT, if declared at pre-construction conference.
- By sublot for all minor mixes.

Projects with ≤1000 current plan ADT:

- Areas with <90.5% density will be isolated at the direction of the engineer
- By further coring or NDT in both directions from the deficient core in increments not to exceed 100 feet until minimum required roadway density is located
- The localized deficient area will be removed and replaced or a 50% pay adjustment will be applied at the discretion of the Chief Engineer

Mainline Lots: (92.0 min Density); 1000-ton Sublots; 5000-ton Lots

Travel lane base, binder and wearing; ramps > 300', interstate accel/decel lanes, turn lanes, turnouts >300'

Take 2 Acceptance cores per sublot = 10 per lot. (To District Lab)
Take 2 Quality Control cores per sublot = 10 per lot. (To Contractor Lab)

For lots and sublots with both mainline and minor use, identify according to the sublot the core was taken from.

For projects with > 1000 current plan ADT, compute PWL on roadway density.

For projects with ≤1000 current plan ADT (when option is chosen) acceptance is based on average core density per sublot. The average core density of 92.0% is required with no individual core less than 90.5% density for 100% density pay.

If there is also minor with density mix in the sublot, and there is no minor mix core, take one additional acceptance core, using random numbers, from the minor mix.

SECTION 502 – ASPHALT (Cores)

For **lots** with mixed mainline and minor mix use, a minimum of 3 Acceptance and 3 Quality Control cores for mainline will be taken per lot. When minor mix densities apply, a minimum of one core for minor mix shall be taken when minor mix tonnage is the lesser in the sublot.

For mainline **lots** <1000 **tons**, take a minimum of 3 Acceptance and 3 Quality Control cores regardless of current plan ADT. For projects < 250 tons, the PE decides testing requirements.

Minor Lots: (90.0 min Density) five 1000 ton sublots

Bike paths, crossovers, detour roads, leveling > 1.5" thick, parking lots, shoulders > 4' wide, ramps < 300', patching, and widening > 2.5'.

Take 2 minor cores per sublot. (To District Lab) *(For < 250 tons, PE decides testing requirements.)*
Quality Control cores are taken within 12" from Acceptance cores in the direction of travel.

Mainline Roadway Cores ~5000 ton LOT									
~1000 Ton Sublot A		**~1000 Ton Sublot B**		**~1000 Ton Sublot C**		**~1000 Ton Sublot D**		**~1000 Ton Sublot E**	
~500 ton Section	~500 ton Section	~500 ton Section	~500 ton Section	~500 ton Section	~500 ton Section	~500 ton Section	~500 ton Section	~500 ton Section	~500 ton Section
A1 Core	A2 Core	A3 Core	A4 Core	A5 Core	A6 Core	A7 Core	A8 Core	A9 Core	A10 Core
QC1 Core	QC2 Core	QC3 Core	QC4 Core	QC5 Core	QC6 Core	QC7 Core	QC8 Core	QC9 Core	QC10 Core

A = Acceptance QC = Quality Control
Quality Control cores taken within 12" from Acceptance cores in the direction of travel.

Minor ~5000 Ton Lot									
~1000 Ton Sublot A		**~1000 Ton Sublot B**		**~1000 Ton Sublot C**		**~1000 Ton Sublot D**		**~1000 Ton Sublot E**	
~500 ton Section	~500 ton Section	~500 ton Section	~500 ton Section	~500 ton Section	~500 ton Section	~500 ton Section	~500 ton Section	~500 ton Section	~500 ton Section
A1M Core	A2M Core	A3M Core	A4M Core	A5M Core	A6M Core	A7M Core	A8M Core	A9M Core	A10M Core
1QCM Core	2QCM Core	3QCM Core	4CM Core	5QCM Core	6QCM Core	7QCM Core	8QCM Core	9QCM Core	10QCM Core

M = Minor QCM = Quality Control Minor
Quality Control cores taken within 12" from Acceptance cores in the direction of travel

Mainline with Minor ~5000 Ton Lot									
~1000 Ton Sublot A		**~1000 Ton Sublot B**		**~1000 Ton Sublot C**		**~1000 Ton Sublot D**		**~1000 Ton Sublot E**	
~500 ton Section	~500 ton Section	~500 ton Section	~500 ton Section	~500 ton Section	~500 ton Section	~500 ton Section	~500 ton Section	~500 ton Section	~500 ton Section
A1M Core	A2M Core	A3M Core	A4M Core	A5M Core	A6M Core	A7M Core	A8M Core	A9M Core	A10M Core
1QCM Core	2QCM Core	3QCM Core	4CM Core	5QCM Core	6QCM Core	7QCM Core	8QCM Core	9QCM Core	10QCM Core
M1 core and QCM1 Core		M2 core and QCM2 Core		M3 core and QCM3 Core		M4 core and QCM4 Core		M5 core and QCM5 Core	

A = Acceptance .
M = Minor QCM = Quality Control Minor

Quality Control cores taken within 12" from Acceptance cores in the direction of travel

See example in appendix for core sampling with mainline and minor mixes in the same lot.

Minor without density requirements – curbs, driveways, guardrail widening, islands, joint repair, spot leveling, medians, tapers, turnouts <300' and shoulders ≤ 4' paved with the roadway. *(For < 250 tons, PE decides.)*

Minor mix without density requirements is accepted based on contractor plant testing data.

Core Sampling

See the "Core Handling Flow Chart" protocol and time lines for testing, reporting, challenges and resolution of acceptance cores.

Upon completion of compaction procedures, cores shall be taken in accordance with Section 502.11 and its subsections. Sampling shall be performed using the random number tables found in the Appendix titled - *Generating and Using Random Numbers for Sampling Purposes* or the random number generator in MS Excel® 2010 or later.

Coring operation:

- Within 24 hours **after** the sublot is placed ~~closes~~
  - If the 24 hours falls on a holiday or weekend, the next business day
- If a random number places a core with 18 inches of a none supported edge, the inspector will use another random number

The Certified Roadway Inspector shall list the generated random numbers on the Roadway Report.

The Certified Roadway Inspector shall mark core locations on the pavement. Coring shall be performed in the presence of the DOTD Inspector within 18 in. up or down station of the marked location. Transverse location shall be the same distance from the pavement edge as marked. When the Project Engineer or DLE request investigative coring, the coring shall be performed at the marked location or as directed by the engineer. Core barrels for investigative and forensic analysis shall have an internal diameter of 6 in. or as directed by the DLE. Normal coring may use a 6 in. O.D. coring barrel.

If the sample obtained from the pavement is less than 1-3/8 in. (1.375 in.) thick, the Department's Certified Paving Inspector will reject the core and select another sampling location for that section by reapplication of the Random Number Tables. Asphalt mixes placed in design lifts less than 1-3/8 in. (1.375 in.) thick shall be compacted by approved methods to the satisfaction of the Project Engineer and shall not require coring for pay. Informational cores may be taken when the design thickness is less than 1-3/8 in.

Contractor QC cores shall be cut within 12" of acceptance cores in the direction of travel from acceptance cores.

Acceptance cores other than patching and widening shall be cut with a core barrel with either an inside diameter or outside diameter of 6 inches. The diameter of the core shall be approximately 6 inches.

Minor mix use for patching and widening with density requirements may use 4-in. diameter cores. The top 6-inch of patching and widening cores are tested for density.

The DOTD Paving Inspector, along with the Contractor/Producer coring representative, will inspect the cores for damage and acceptability and label them for identification. The DOTD Inspector and the Contractor Technician in the field, upon inspection and mutual agreement, reserve the right to reject damaged or under thickness core(s).

The core sample's official thickness measurement will be obtained by taking 3 measurements spaced uniformly around the circumference of the core before trimming and then averaged. The measurements will be taken and recorded to the nearest 1/16 in. on the Superpave Asphalt Concrete Roadway Report by the technician.

How to measure:

- Measure cores to the nearest 1/16 inch
- Cores shall be measured before trimming
- Cores with multiple lifts shall be measured at/to the lift lines
- Cores taken from cold planed surfaces shall be measured at approximately the midpoint of visible ridges

Patching and widening cores:

- Record the core length to the nearest 1/16 inch
- Trim and keep the top 6 inches
- Send the top 6 inches to the district lab for density testing
- Patching and widening cores may be 4 inch diameter

When a specimen is damaged during coring operations, the recut core shall be taken from a position longitudinally up or down the pavement within 5 ft.

The Contractor shall trim roadway cores on the project at the time coring is performed. This may be done after all cores are cut per lane closure and away from traffic.

The contractor is responsible for providing proper traffic control and lane closures for safe coring operations.

Cores shall be trimmed at the lift line, but shall not trimmed ~~cut~~ into the tested lift any more than necessary to remove:

- Tack
- Base material
    - Soil Cement
    - Aggregate
    - Soil
- The preceeding or subsequent lift
- Ridges and valleys from a milled surface

Lifts placed over milled surfaces, tested for density, shall have enough material removed to eliminate “milling ridges and valleys.” Core thickness measurements shall be taken before trimming.

All acceptance and quality control cores shall be clearly marked for identification with a permanent marker or paint stick. See Table-10 for core identification.
Information written on each core:

- Project number
- Lot number
- Core identification

The acceptance cores shall be delivered to the District Lab. The Contractor’s Quality Control cores shall be delivered to the plant lab. Deliver all cores the same day they are cut, so results for acceptance and Quality Control are available in a timely manner. Cores shall be delivered no later than the next business day. The district lab and contractor’s lab shall dry the cores for testing according to DOTD TR 304 (AASHTO T 166).

Roadway cores that cannot be delivered the same day they are cut shall not be left in a vehicle. Cores are to be stored in a climate controlled environment in an approved transport container or flat with the top surface down. I.e., Air conditioned office.

Contractors may request to transport roadway cores to the district lab. The request shall be in writing and approved by the DLE.

With approval of the DLE for contractor transport of roadway cores, the following requirements must be met:

- The contractor shall supply sufficient clean paper or paper bags and clear packing tape to wrap the cores. The paper shall not be newspaper or other paper with print, writing or graphics that interfere with signature recognition.
- Cores that are to be delivered to the district lab by the contractor or courier shall be wrapped with the roadway inspector placing their signature on the wrapping paper.
- The core will be wrapped across the inspector signature with clear wide packing tape. The core shall be sealed with a second strip of tape 90° to the first.
- The contractor shall deliver the cores to the district lab the same work shift they are cut. The contractor and roadway inspector shall coordinate delivery with the ADI, lab staff and DLE. The contractor will not take possession of the cores until it is confirmed a district lab employee will be available to accept the cores.
- The DLE may require a contractor supplied lockbox for core transport by the contractor or courier.

The contractor may make a written request at the pre-construction conference to waive their core trimming responsibility. It shall be at the DLE discretion to grant such requests.

Density

District Laboratory Acceptance

Cores shall be inspected by district lab personnel upon receipt for damage and minimum thickness in the presence of the technician delivering the cores. The technician delivering the roadway cores shall sign the chain of custody for the roadway cores.

If the contractor does not trim the cores in the field, the core sample's official thickness measurement will be obtained by taking 3 measurements spaced uniformly around the circumference of the core and then averaged. The measurements will be taken and recorded to the nearest 1/16 in. on the Superpave Asphalt Concrete Roadway Report by the technician.

All laboratories shall be equipped with a saw suitable for sawing asphalt pavement cores. This saw may be used to remove base course material (e.g., soil cement and/or curing membrane), different lifts and/or tack. Care must be taken to minimize the amount of material cut and discarded, especially from the upper surface. Cores shall be cut at the lift line to remove tack, but shall not cut into the tested lift. Lifts placed over milled surfaces, tested for density, shall have enough material removed to eliminate "milling ridges and valleys."

NOTE
To ensure that the cores are sufficiently free from moisture, they shall be placed in a force draft oven at 125° F until a constant mass is achieved in accordance with DOTD TR 304 (AASHTO T 166).

The Department will determine the G_{mb} and report G_{mb} results in LaPave with preliminary percent density. The Contractor and the Department shall report core G_{mb} results within 3 business days.

The Contractor will evaluate the pavement QC cores for roadway density, which shall be computed by comparing bulk specific gravity (G_{mb}) of the roadway core to the corresponding sublot theoretical maximum specific gravity (G_{mm}) as tested by the producer The contractor shall enter G_{mb} data for all QC cores into LaPave. The Contractor shall test and report a G_{mm} from one randomly selected QC roadway core from the lot into LaPave. The contractor shall follow the same procedures as the district lab for G_{mm} verification. If the first randomly chosen core does not verify for the corresponding sublot G_{mm}, the contractor shall test one core from each sublot in the lot for G_{mm}.

DOTD reserves the right to test remaining QC cores for verification. The contractor shall retain all cores not used for G_{mm} verification for a minimum of 10 business days after all testing, challenges and/or resolutions are finalized for the lot.

Core handling flow:

- Plant production data entered into LaPave
- 10 Acceptance cores cut – 2 per sublot
- 10 Quality Control cores cut – 2 per sublot
- Cores accepted or rejected on the roadway by the Contractor's technician and DOTD inspector
- Cores properly labeled

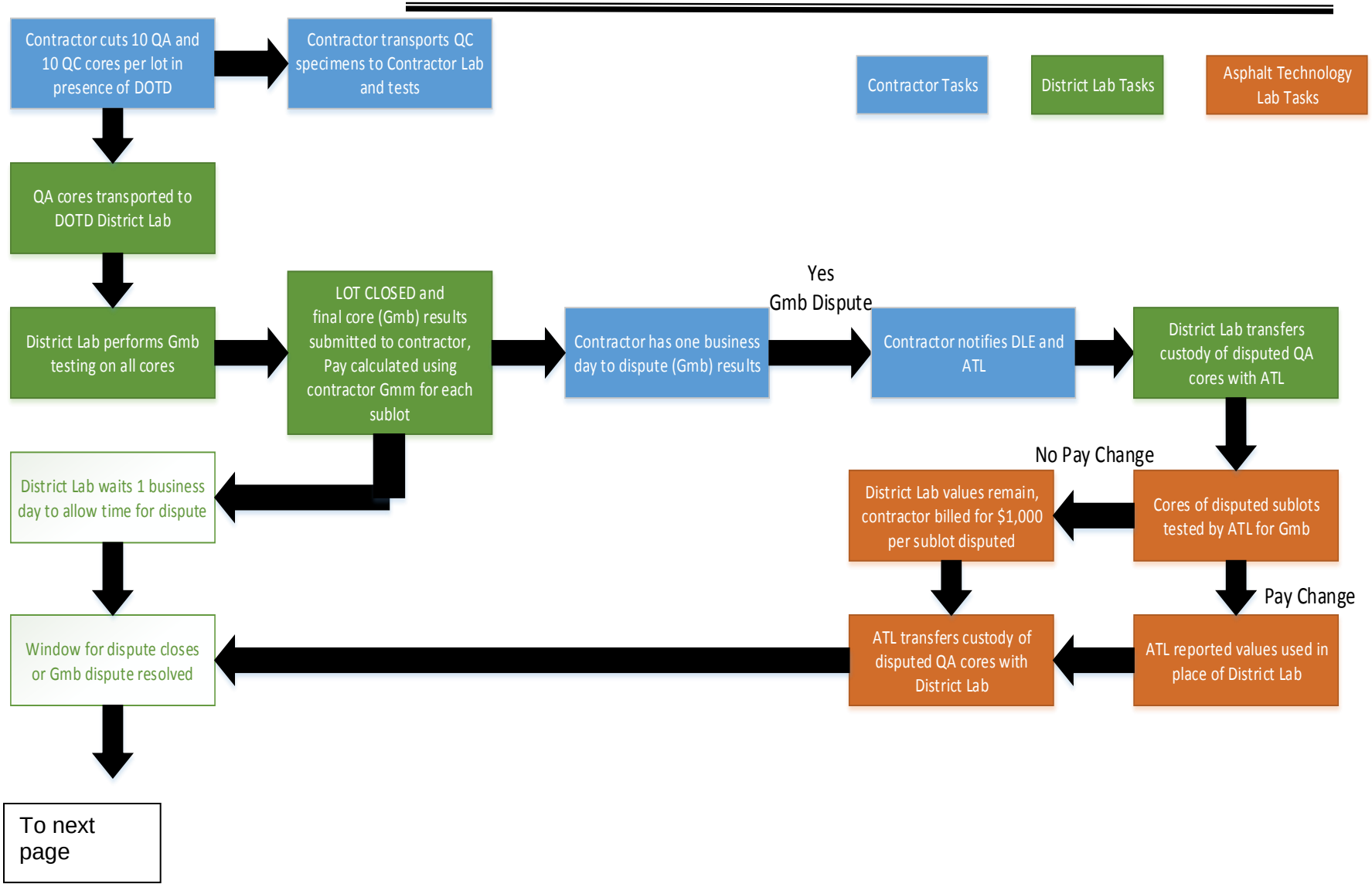
- Cores are trimmed by the contractor in the field
- Cores transported to the DOTD district lab and Contractor's lab
- Cores are dried to constant weight
- Core G_{mb} is measured and reported by both parties into LaPave
- Results are revealed after both parties' results are entered into LaPave
- After all cores in the lot are tested, the lot is complete
- The contractor has one business day to question DOTD G_{mb} results after the lot is complete. The contractor may also question G_{mb} results on a sublot before the lot is complete
- The contractor shall put in writing (email or LaPave) the reason and cause for questioning results. This is sent to the DLE.
- **If disputed,** the cores are transferred to the Asphalt Technology Lab (ATL) at Materials Lab for G_{mb} retesting if G_{mb} results are questioned
    - If G_{mb} of the district lab is verified, the contractor pays a testing fee and lot pay is calculated based on the verified G_{mb}.
    - If G_{mb} changes in favor of the contractor, no testing fee is incurred and the reworked G_{mb} is used to calculate pay.
- After G_{mb} of cores for the lot are finalized, one core from the lot is randomly chosen for G_{mm} verification by the district lab. If the core verifies within ±0.024 of the average lot G_{mm}, use the reported G_{mm} of each sublot reported by QC testing to calculate pay for the corresponding core sublot.
- It the first selected core does not verify, the district lab will select one core from the remaining sublots and test G_{mm}. If the average G_{mm} of all the cores tested for G_{mm} in the lot are within ±0.024 of the average plant lot G_{mm}, calculate the pay of the cores in each sublot using the corresponding QC reported G_{mm} for each sublot.
- If the averaged G_{mm} of all the sublots do not verify, the Contractor has one business day to dispute the results. (DOTD and Contractor G_{mm} results from cores will be compared)
- If the dispute proceeds, the district lab will transfer custody of the remaining roadway cores with the ATL lab for G_{mm} testing.
- If the district lab G_{mm} is verified, the contractor pays a testing fee and pay for the lot is calculated based on the G_{mm} from the roadway cores. If results change in the contractor's favor, no testing fee is incurred and pay for the lot is calculated.
- When the core verification average G_{mm} of all sublots is not within ±0.024 of the average lot plant reported G_{mm}, and any resolution if pursued verifies such, the average G_{mm} from the cores shall be used to calculate density of all sublots in the lot.
- In cases that do not verify, the ATL in conjunction with the district lab will investigate the cause of the core G_{mm} being out of tolerance.
- If a cause cannot be determined or the core G_{mm} from three lots fail to verify without just cause, the JMF will be terminated.

Approximately 20 grams of –No. 4 and +No. 8 asphalt coated aggregate from the G_{mm} verification core will be sent to the Materials Lab for GPC analysis.

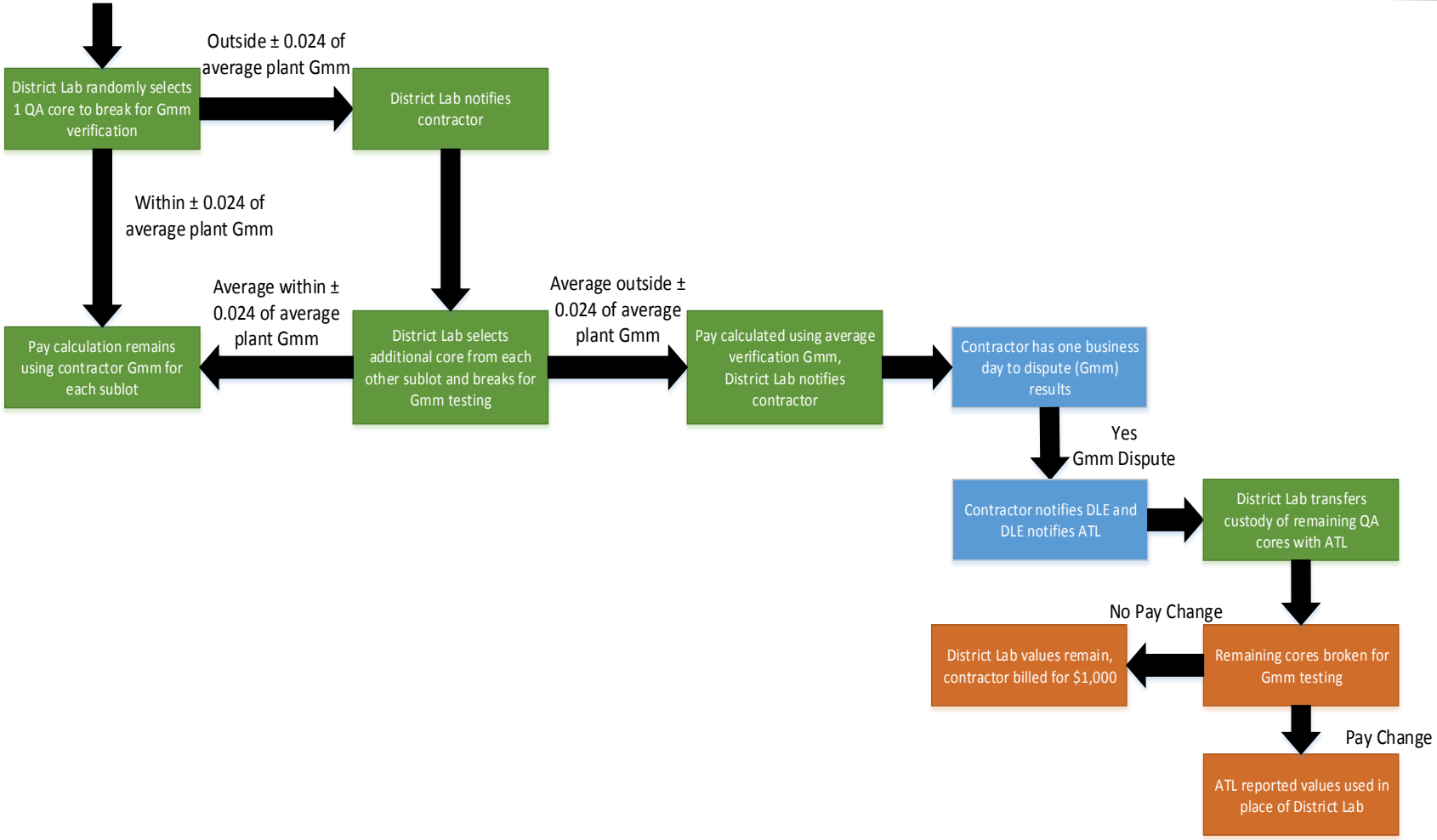
GPC sample submittal is a minimum of **1 per project and 1 per 20,000 tons per project thereafter.**

See the Core Handling Flow Chart for a graphical representation of the above description:

SECTION 502 – ASPHALT (Cores)



SECTION 502 – ASPHALT (Cores)



Weighing an object (as we do with an asphalt core) to determine its mass in air and its mass in a fluid (as we do in water) whose specific gravity is known yields sufficient data to determine its weight (mass), volume, and specific gravity. Specific gravity is defined as the ratio of the weight of a unit volume of the sample to the weight of an equal volume of water at approximately 25° ±1° C, (77 ±1.8° F).

DOTD specifies that the G_{mb} be determined by TR 304. The equation from the test method for calculating G_{mb} is as follows:

$$G_{mb} = \frac{\text{Weight in Air}}{(\text{SSD Weight} - \text{Weight in Water})}$$

Note for Specimens with Obvious Surface Voids:

As the size of the external voids in the specimen increase, it becomes difficult to determine an accurate SSD mass, because the diameter of the voids are of such size that the water will run out of them before an accurate SSD mass can be determined. If air pockets are observed on the core surface, there may be a problem with calculation of voids.
To account for this, alternate test procedures may be used with approval of the DLE. One alternate test procedure is AASHTO T 275 – Bulk Specific Gravity of Compacted Bituminous Mixtures Using Paraffin, used for determining G_{mb} when the percent water absorbed by the specimen exceeds 2.0% as determined by the following equation:

$$\text{Percent } H_2O \text{ Absorbed (by Volume)} = \frac{(\text{SSD Weight} - \text{Weight in Air})}{(\text{SSD Weight} - \text{Weight in Water})}$$

In addition to DOTD TR 304 and AASHTO T 275, an alternative method to determine G_{mb} of a cored pavement specimen is the Pure Volume method. It is performed by measuring the thickness and diameter of the cylindrical specimen in numerous locations to calculate average values and then using the following formula to determine its volume:

$$\text{Volume} = \pi \times \left(\frac{\text{Diameter}}{2}\right)^2 \times \text{Height}$$

This volume is used in the denominator with dry weight in air in the numerator to determine the G_{mb}.

In summary, if the Contractor or the DOTD Inspector suspects that G_{mb} values determined via TR 304 are yielding erroneous values, the DLE is to be notified and may approve use of these alternate methods.

SECTION 502 - ASPHALT (NDT)

Density by Non-Destructive Technologies (NDT):

The Department is evaluating the use of NDT for density determination for pay.

In addition to all required quality control testing, contractors may submit quality control density measurements collected using DOTD approved non-destructive technologies (NDT). Density measurements reported by NDT devices will be for informational purposes only, such as, to provide supporting documentation for a dispute claim. Density measurements reported by NDT devices will not be used in place of any required quality control or quality assurance testing.

Use a non-destructive technologies (NDT) device meeting requirements of AASHTO T-343 or AASHTO T-355.

When performing NDT tests, set the device in the single reading and shallow penetration modes. A density measurement will consist of the average of five readings taken in accordance with the reading pattern described by the manufacturer's procedure manual. Take readings where the pavement surface is flat and no surface moisture is evident. Use a brush to clear loose particles from contact area.

Verify the NDT device operation daily using the standardization plate issued with the gauge. Follow the Manufacturer's instructions for performing the standardization. Ensure each day's standardization result is within the limits established by the manufacture.

Device Off-set Procedure

Prior to using NDT device measurements, an offset will be determined for each JMF, for each project on a control strip, which is defined as the first 2000 tons of production on a roadway. Without sufficient tonnage, as determined by the Project Engineer, this procedure will not be allowed.

On days when a control strip is being placed, the DOTD personnel must witness the contractor's personnel standard count procedure and the establishment of the offset. The NDT device will be used to determine an average density from 20 random locations determined by the DOTD personnel within the validation lot/control strip. The center location of the device readings will be marked. Core specimens will be extruded from marked location within 24 hours from when NDT readings are conducted at that location.

The device readings will be compared with the core densities in order to establish a working offset.

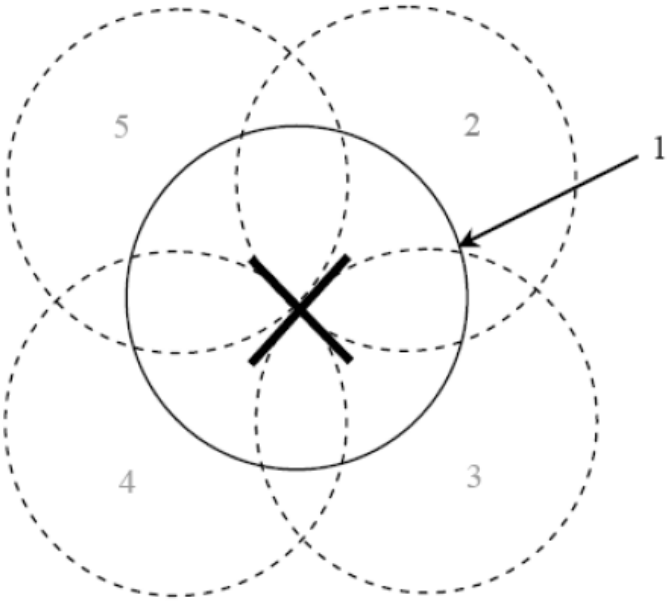
The offset will be specific to that device, for that JMF, for that project. In the event that the JMF changes, or a new device is used, a new offset must be established.

Offset procedures should be followed as listed below:

1. Contractor and DOTD technicians should jointly verify all NDT parameters for each device:
    a. Successful self-test at start up
    b. Daily G_{mm}

c. Lift thickness
d. Test mode
e. Target density
f. Correct any issue(s) prior to proceeding with field confirmation

2. DOTD personnel will select a random site on the mat:
    a. Location of random spots will be recorded
3. NDT readings should be taken in single mode and reading pattern should follow the 5-point star method as seen below for each core location.



4. The QA gauge operator will conduct 100 NDT density tests, 5 readings at each of the 20 random core locations within the validation lot/control strip. The 5 readings from each location will be averaged into a single density measurement for that location.
5. Density gauge readings will be recorded by the contractor and in the density gauge if possible.
6. Follow core sampling, trimming, handling and transport procedures outlined in section 502.11.1.
7. The offset will be determined by subtracting the average device density from the core density for each location. An average offset is determined using the 20 location offsets. The offset will be applied on subsequent lots of the same JMF, with the same device, during the construction of the project.

SECTION 502 – ASPHALT (NDT)

Offset computation example

Non-Destructive Testing (NDT) Offset Procedures

Project:	H.999999	QC Technician:		Date:	
Location:		QA Technician:		NDT Type/Model	
Mix Type:	Wearing	Plant:		Gmm:	2.533

Location	Station	R/C/L	Non-Destructive Gauge Denisty (pcf)					avg.	Core Density (pcf)	
			center	2 o'clock	4 o'clock	8 o'clock	10 o'clock			
1	2+83	R	143.6	141.4	144.8	141.8	139.2	142.2	146.6	
2	3+35	R	144.8	139.5	140.5	143.9	142.1	142.1	151.2	
3	3+57	C	143.2	139.9	143.9	144.5	143.5	143	146.9	
4	4+24	L	144.2	144.4	144	145.1	144.4	144.4	146.7	
5	4+89	R	144.2	142.3	142.1	143.7	139.9	142.4	145.7	
6	5+23	R	144.3	142	141.3	143.4	139.7	142.2	147	
7	5+55	R	141.8	140.4	141.4	140	141	140.9	150.8	
8	5+96	C	139.7	142	143.6	144.2	143.3	142.6	146.2	
9	6+54	L	141.6	145.2	143.8	144.5	139.6	142.9	146.1	
10	6+94	R	142.4	144.1	140.7	142.8	144.6	142.9	147	
11	7+21	R	143.1	143.5	141.8	144.5	143	143.2	148.6	
12	7+60	R	139.2	141.9	141.7	139.8	139.9	140.5	147	
13	7+82	C	139.1	139.7	140.8	143.1	139.1	140.4	151.4	
14	8+42	L	143.1	141.6	140.5	142.1	139.6	141.4	148.1	
15	8+88	R	144	139.2	144.2	145.4	143.1	143.2	151.3	
16	9+13	L	144.5	142.2	141.7	145.3	140	142.7	148.1	
17	9+45	R	142.7	143.7	144.9	145	139.2	143.1	145.8	
18	10+05	C	142.4	145.2	145.4	139.3	140.6	142.6	151.3	
19	10+55	L	142.5	144.4	144.4	140.1	145.4	143.4	149.9	
20	10+90	R	140	144.4	143	140.8	144.9	142.6	147	
	NDT overall avg.		142.4						Core avg.	148.1

Offset is the difference between the core avg. and NDT overall avg. (value can be negative)

Offset (pcf):	Core avg.	-	NDT overall avg.	=	5.7
	148.1		142.4		

Input offset into NDT - ***Important*** - If core avg. is greater than NDT overall avg., then a positive offset is inputted into the NDT, and vice versa

Offset (Gmb):	Core avg.	-	NDT overall avg.	=	0.091
	2.373		2.282		

Offset (Density,%):	Core avg.	-	NDT overall avg.	=	3.6
	93.7		90.1		

Roadway Testing Procedures

This procedure is in addition to any and all acceptance testing done on cores for pay. It is to be done after offset establishment, during production.

There are typically five sublots for each lot.

Mainline and minor mixes may be in the same lot/sublot. Divide each of the sublots into two segments of approximately equal tonnage each.

For each sublot segment, the Department will determine sample locations using random sampling approach.

The department will obtain one quality assurance device density reading (average of 5 spot readings), using the contractor's device when requested by the Project Engineer, at the designated sample location. The contractor will obtain one quality control device density reading (average of 5 spot readings) approximately 12 inches in the direction of travel from the quality assurance reading.

If the sublot segment has mainline mix uses, the quality assurance reading will be taken from the mainline portion. A typical lot will have 25 quality assurance readings and 25 quality control readings. Record the location and mix use of each reading taken.

The NDT density readings will be entered into an approved DOTD software within 1 calendar day. The offset value determined during validation will be applied in the software and reported.

Differences between the Contractor's quality control and the Department's quality assurance density results will be considered acceptable if within ± 1.3%.

One destructive field core will be cut from the roadway every lot for offset and G_{mm} verification. The location will be determined randomly by DOTD.

Disputed NDT Device Readings

In the event of a questionable NDT device reading, a core will be extracted from the center location of the 5 readings.

The core density will replace that NDT device reading for determination of density.

If the core density is found to be unacceptable, the roadway inspector will isolate the questionable section with the NDT device.

SECTION 502 - ASPHALT (NDT)

Roadway Measurement Example

Non-Destructive Testing (NDT) Roadway QA/QC

Date

Project:	H.999999	QC Technician:		NDT Type/Model		Offset From Validation	5.7
Location:		QA Technician:		NDT Type/Model		Offset From Validation	6.8
Mix Type:	Wearing	Plant:		Gmm:	2.533		

Lot-Sublot	Station	R/C/L	Reading Type (QC/QA)	Non-Destructive Gauge Denisty (pcf) – Not offset					avg.	Density with Offset	Difference (QA-QC)
				center	2 o'clock	4 o'clock	8 o'clock	10 o'clock			
1-1	2+83	R	QC	143.6	141.4	144.8	141.8	139.2	142.16	147.86	1.08
			QA	140	142	143	140.8	144.9	142.14	148.94	
1-2	3+35	R	QC	144.8	143	145	143.9	142.1	143.76	149.46	0.7
			QA	142.5	144.4	144.4	140.1	145.4	143.36	150.16	
1-3	3+57	C	QC	143.2	139.9	143.9	144.5	143.5	143	148.7	0.68
			QA	142.4	145.2	145.4	139.3	140.6	142.58	149.38	
1-4	4+24	L	QC	144.2	144.4	144	145.1	144.4	144.42	150.12	-0.22
			QA	142.7	143.7	144.9	145	139.2	143.1	149.9	
1-5	4+89	R	QC	144.2	142.3	142.1	143.7	141	142.66	148.36	0.92
			QA	144.5	142.2	141.7	144	140	142.48	149.28	
2-1	5+23	R	QC	145	144	141.3	143.4	142	143.14	148.84	1.14
			QA	144	139.2	144.2	145.4	143.1	143.18	149.98	
2-2	5+55	R	QC	141.8	140.4	141.4	142	141	141.32	147.02	1.16
			QA	143.1	141.6	140.5	142.1	139.6	141.38	148.18	
2-3	5+96	C	QC	139.7	142	143.6	144.2	143.3	142.56	148.26	-0.72
			QA	141	139.7	140.8	143.1	139.1	140.74	147.54	
2-4	6+54	L	QC	141.6	145.2	143.8	144.5	139.6	142.94	148.64	-0.92
			QA	139.2	141.9	141.7	139.8	142	140.92	147.72	
2-5	6+94	R	QC	142.4	144.1	140.7	142.8	144.6	142.92	148.62	-0.9
			QA	141.8	140.4	141.4	140	141	140.92	147.72	
3-1	7+21	R	QC	143.1	143.5	141.8	144.5	143	143.18	148.88	0.84
			QA	142.4	144.1	140.7	142.8	144.6	142.92	149.72	
3-2	7+60	R	QC	142	141.9	141.7	140	145	142.12	147.82	0.96
			QA	142.4	142	140.7	142.8	142	141.98	148.78	
3-3	7+82	C	QC	141	142	140.8	143.1	145	142.38	148.08	1.22
			QA	141.6	143	143.8	144.5	139.6	142.5	149.3	
3-4	8+42	L	QC	143.1	141.6	140.5	142.1	142	141.86	147.56	1.16
			QA	139.7	142	143.6	141	143.3	141.92	148.72	
3-5	8+88	R	QC	144	139.2	144.2	145.4	143.1	143.18	148.88	-1.16
			QA	141.8	140.4	141.4	140	141	140.92	147.72	
4-1	9+13	L	QC	144.5	142.2	141.7	145.3	140	142.74	148.44	0.5
			QA	144.3	142	141.3	143.4	139.7	142.14	148.94	
4-2	9+45	R	QC	142.7	143.7	144.9	145	139.2	143.1	148.8	2.42
			QA	144.2	144.4	144	145.1	144.4	144.42	151.22	
4-3	10+05	C	QC	142.4	145.2	145.4	139.3	140.6	142.58	148.28	1.52
			QA	143.2	139.9	143.9	144.5	143.5	143	149.8	
4-4	10+55	L	QC	142.5	144.4	144.4	140.1	145.4	143.36	149.06	-0.1
			QA	144.8	139.5	140.5	143.9	142.1	142.16	148.96	
4-5	10+90	R	QC	140	144.4	143	140.8	144.9	142.62	148.32	0.64
			QA	143.6	141.4	144.8	141.8	139.2	142.16	148.96	
5-1	11+40	C	QC	144.8	145	140.5	143.9	142.1	143.26	148.96	0.84
			QA	143.2	139.9	143.9	144.5	143.5	143	149.8	

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5-2	11+88	L	QC	144.2	144.4	144	145.1	144.4	144.42	150.12	-0.88
			QA	144.2	142.3	142.1	143.7	139.9	142.44	149.24	
5-3	12+33	L	QC	144.3	142	141.3	143.4	139.7	142.14	147.84	-0.12
			QA	141.8	140.4	141.4	140	141	140.92	147.72	
5-4	12+74	R	QC	139.7	142	143.6	144.2	143.3	142.56	148.26	0.84
			QA	141.6	142	143.8	144.5	139.6	142.3	149.1	
5-5	13+20	C	QC	142.4	144.1	144	142.8	144.6	143.58	149.28	0.7
			QA	143.1	143.5	141.8	144.5	143	143.18	149.98	

Measurement and Payment

Measurement
Refer to 502.14 of the Standard Specifications

Payment
Refer to 502.15 of the Standard Specifications

If the Engineer adjusts the application rate of tack coat from that specified by the contract document or Standard Specifications, payment for asphalt mixture will be increased or decreased based on the difference in applied quantity of asphalt emulsion shown on paid invoices (total charges). The contractor shall provide copies of paid invoices for this determination.

Density

Mainline Payment

>1000 current plan ADT
After test results have been determined, use Quality Level Analysis in accordance with Tables 502-9 and 502-10 of the specifications to determine percent within limits (PWL), see Appendix and Section 502.15 to determine pay. For an example on calculating PWL, refer to page 67. NOTE – for roadway densities there is only Q_L. Q_U does not apply to roadway density.

≤1000 current plan ADT (When declared at the Pre-construction Conference)
After test results have been determined, average the densities of each sublot and pay using Table 502-7 with density requirements of Table 502-5

Payment for Mainline Small Quantities

Mainline mixtures:

>1000 current plan ADT
Ensure a minimum of three cores per sublot for pay calculations. For project lots less than 1000 tons, a minimum of three cores for density will be taken. Cores for projects with less than 250 tons per JMF may be waived or modified by the Project Engineer. Pay on density PWL.

≤1000 current plan ADT
Ensure a minimum of two cores per sublot for pay calculations. Cores for projects with less than 250 tons per JMF may be waived or modified by the Project Engineer

Payment for Minor Mix Quantities
Two cores per 1000 tons with a minimum of 2 cores. This applies to minor mix with density. Minor mix **without density** will be accepted on Contractor QC plant testing.

Section 502.12 – Surface Tolerance

Surface Tolerance
See Table 502-8 Standard Specifications, Section 502.12 of the Standard Specifications

Profiler Certification

The Materials and Testing Section (MATLAB) certifies Inertial Profilers annually. The Materials Section will contact Contractors whose Profilers have an established history with DOTD for scheduling the annual certification. Any new Contractors shall call the Materials Section at (225) 248-4168 to schedule an appointment for certification. ProVAL software is required to analyze data. ProVAL is available free of charge at www.roadprofile.com**.** During certification, the Contractor is required to provide all data collected from the test track to the Materials Section representative. Data is provided to DOTD on a Contractor supplied USB storage device and shall contain the following formats: raw data, header file, .ERD, and .PRO. Contractors are encouraged to have their equipment (lasers and accelerometer) calibrated by the Profiler manufacturer prior to attending the certification.

The DOTD Roadway Inspector shall check cross slope, grade and transverse surface tolerance in accordance with Table 502-5.

Longitudinal Surface Tolerance Testing

Longitudinal quality control testing shall be in accordance with Subsection 502.12. The Contractor shall furnish a DOTD Certified Inertial Profiler and measure both wheel paths simultaneously. A wheel path is defined as 3 ft. (±½ ft.) on either side of the longitudinal centerline of the lane being tested. The project, lane, and/or segment must meet the requirements of Table 502-8 (depending on Category). Categories are defined in Table 502-8. Individual deficiencies (bumps) greater than - the longitudinal value specified in Table 502-5 when tested with a 10-foot metal static straightedge are to be corrected in accordance with 502.12.2.

How to Identify a Bump

- The Rolling Straightedge Simulation in ProVAL may be used to help identify bumps. ProVAL settings for the Rolling Strainedge Simulation are:
  - Straightedge Length (ft) – 10.00
  - Deviation Threshold (in) – 0.25
  - Filter - Butterworth Low-pass (1.97 ft)
-
- Field verify all deficiencies located with ProVAL to determine if a bump exists.
  - Use distance measuring equipment to locate the possible bump. For example, ProVAL identified a ¼ in. event at Station 102+00.
  - Utilizing a 10-foot static straight edge, start at Station 101+75 and investigate the horizontal surface of the wheel path in question of the roadway to station 102+10 looking for a bump according to Table 502-5.
  - If no bump is found, the DOTD roadway inspector will note this in their field book, and no further work investigation is required.

- If a bump according to Table 502-5 is found, the Contractor must remove the bump by diamond grinding or In lieu of grinding, the Project Engineer may penalize the contractor $1000 per individual bump or ripple
  - After removal, the DOTD roadway inspector will re-evaluate to determine that the bump is removed and note the removal in the field book.
  - DOTD and contractor will repeat this process until the roadway is in compliance.

Pre-op Tests and Observations

The DOTD Roadway Inspector shall ensure that the Contractor is using a DOTD Certified Inertial Profiler for quality control and quality acceptance. Profilers must be certified and operated in accordance with DOTD TR 644 and Section 502.12. To verify that the profiler to be used to be used on a job is certified, the DOTD Roadway Inspector will check the calibration decal or certificate (*DOTD Profiler Inspection and Certification*). The certification sticker will display the date of certification, expiration date, high pass and low pass filter settings, collection filter, and the DOTD Technician certifying the equipment. Inertial Profilers are certified for IRI. When QC testing establishes that the cross slope is deficient, the Contractor shall immediately suspend paving operations

The profiler settings shall match the certification settings during profiler operation on DOTD projects. Since the settings on the profilers *can* be changed by the operator, it is imperative that the certification settings be verified before accepting data from the Contractor. The settings directly affect the data collected. By changing the settings, the data collected can be manipulated.

Before a profiler is used, the following pre-operation tests shall be performed by the Contractor, witnessed by the DOTD Inspector, each **day of testing:**

1. **Tire Pressure Check**–The distance measuring system of the profiler is based on revolutions of the wheel and the rolling radius of the tire. The rolling radius of a tire is dependent upon the air pressure. A tire that is fully inflated has a larger rolling radius than one that is not fully inflated. Tire pressure affects the number of revolutions made in a given distance. **The tire pressure shall be checked each morning on the cold tires and adjusted if necessary.** The correct tire pressure at which each profiler is to be run may be found on the *DOTD Profiler Inspection and Certification* form. The tires must be inflated to the specified pressure used on the day of certification.

If using a lightweight profiler, it should be driven for 15 minutes to warm the tires prior to testing.

2. **Vertical Calibration**–This test is performed on a stationary profiler **by placing various plates under the lasers and taking readings at each block height.** Blocks shall have a thickness of 0.25 in., 0.50 in., and 1.00 in. or 1.00 in., 2.00 in., and 3.00 in., depending on make of the profiler. The vertical calibration check ensures that the height sensor is performing properly. The height sensor measures vertical distance from the sensor to the roadway**. For a profiler to pass the vertical calibration check, the average difference must be 0.01 or less.** The operator should not be in the unit during this test.

3. **Bounce Test**–It is performed on **a stationary profiler while the operator bounces the unit (according to manufacturer's recommendation).** This test is performed in order to check that the accelerometers and height sensors are functioning properly. Accelerometers measure vertical acceleration and are mounted above the height sensor. If the sensors are working properly, the unit will filter out any bouncing or excess movement of the unit itself during the actual surface roughness testing. **The display of the results will differ by profiler make. Some profilers will display "pass" or "fail." Other profilers will show an accelerometer graph. The rise and fall of the graph lines above and below the zero mark must be symmetrical for the test to pass**

4. **Horizontal Calibration**–This procedure calibrates the horizontal measuring system of the profiler. This calibration is performed **by running the profiler over a measured distance of a minimum of 528 ft.** The longer the calibration distance, the more accurate the distance measurement will be over the project length. Whoever is going to be in the profiler during the testing process must be in the profiler during the horizontal calibration. The calibration adjusts for weight distribution. **The profiler will display, "calibration successful" or "calibration unsuccessful." Other manufacturers of profiler simply display the distance traveled. Profilers with a GPS DMI are not required to calibrate the GPS. (See Odometer Check)**

5. **Odometer Check**–This check measures the distance traveled by the profiler and verifies the horizontal calibration. This test needs to be performed by **running the same measured distance** used with the horizontal calibration. Distance is usually measured by a pulsar attached to a wheels. Rotation of the wheel is measured by detection of pulses as the wheel rotates and the notches pass. Each pulse is directly associated with a fixed travel distance through the rolling radius of the tire. The results of the odometer check must be within ±0.1% of the distance measured. Profilers with a GPS DMI will verify a minimum 528 ft distance to comply with the odometer check requirement. GPS units do not have to be calibrated unless the odometer check fails to meet the ±0.1% of the distance measured requirement.

NOTE:
All results of the pre-ops shall be printed (or clearly displayed in data on the USB storage device) and turned in to the DOTD Inspector with the data. The date and time of the test will be indicated with the pre-op results.

Surface tolerance quality is determined by an International Roughness Index, (IRI) and is measured in units of inches per mile.

Longitudinal Quality Assurance Testing

Once Pre-op Tests and setting verification are complete, the Contractor shall measure the mainline wearing course continuously from start to finish in the direction of travel with the DOTD Inspector present. At the completion of the quality assurance run for pay, the

Contractor's Technician will provide the DOTD Certified Inspector a copy of the results on a USB flash drive and a paper copy of the IRI report.

Surface Tolerance Pay

Report one IRI measurement in inches/mile for the entire project or an approved portion of the project. The IRI values for the inside and outside wheel paths shall be averaged and reported as the lane average and the mean of each lane average shall be reported as the project average. Pay adjustment for the project is determined in accordance with Table 502-8 using the average IRI.

Section 503 – Asphalt Concrete Equipment and Processes

This section describes the equipment and processes used in producing asphalt concrete mixture for a DOTD project under Standard Specifications, Section 501 (Thin Asphalt Concrete Applications), Section 502, (Asphalt Concrete Mixtures), and in conjunction with Section 503, (Asphalt Concrete Equipment and Processes).

This section shall be used along with Section 501, Section 502, and Section 503 of the Standard Specifications. This section also applies to subsections of Section 1002 (Asphalt Materials and Additives) and Section 1003 (Aggregates).

Plant Certification

Initial Plant Certification

Plants furnishing asphalt concrete mixtures in accordance with Sections 501 and 502 shall be certified at least every two years pending inspection and approval by the DLE. The district laboratory in the district in which the plant is located will certify the plant. Material shall not be produced or accepted on any DOTD project from an asphalt plant that does not possess a valid certification. Certified plants will have a Plant Inspection Certification sticker placed in an obvious location in the plant control house.

Following is a list of steps required to certify a plant and on-site laboratory:

1. The plant shall be operational with approved materials on-site and be capable of producing mixtures that are correctly proportioned and mixed. The plant shall consistently produce specified materials in accordance with Sections 501 or 502.

2. In accordance with Section 503, the plant and laboratory equipment, meters, scales, measuring devices and plant mixture-weighing device shall be tested, inspected, and certified by the Weights and Measures Division of the LA Department of Agriculture and Forestry or by an independent scale service, licensed by Louisiana and approved by the certifying DLE. The certifications shall be maintained in the Plant Certification File for access by district laboratory personnel with a copy emailed to the district lab. The Service Technician will place a signed sticker in an obvious location in the plant control house. Scales shall be checked in a conventional manner using known weights of sufficient size to check the scale system in its upper ranges with a minimum number of loadings, to the satisfaction of the Department

3. The Producer shall notify the district laboratory that the plant is ready for certification.

4. The DLE will send qualified personnel to certify the plant using the *DOTD Asphalt Concrete Plant Certification Report*. This form documents the inspection of materials, crushing apparatus, individual plant components, storage/surge silos, testing, and laboratory. The DLE must sign and date the form.

5. Upon satisfactory completion of the Asphalt Concrete Plant Certification Report, plant certification will be granted for a two-year period, provided the plant is maintained in accordance with the conditions under which certification was issued.

NOTE:
When a calibration Service Technician located outside of Louisiana must be used to calibrate a scale or metering device, the Service Technician shall be licensed by the state where the Service Technician is located under standards similar to those required by Louisiana and approved by the DOTD Materials Engineer Administrator.

Random Conformance Inspections

The plant will be inspected randomly, a minimum of once per quarter, for conformance to certification requirements by the ADI for the DLE. Upon completion of the conformance inspection, the ADI will report findings to the DLE and Contractor. If deficiencies are identified, the Contractor will need to correct these deficiencies within the agreed upon timeframe with the DLE. Failure to correct these deficiencies may result in a suspension to continue to provide mix to Department projects as determined by DLE.

During these inspections, the ADI will be in charge of reviewing the following:

- Inspect Plant Operations within Certification
- Plant Equipment Inspection
- Lab Equipment
- Lab Technician's Certifications
- Observe Technician's Test Procedures
- Materials
- Re-Certification Deadline
- Testing Frequency Compliance

All these items will be documented in the report.

Re-Certification

Before the two-year certification period expires, the Producer shall notify the district laboratory that the plant is ready for re-certification **within 60 days of certification expiration**.

The Producer shall also notify the DLE of any major change in the manufacturing process at the plant because a new certification inspection will be required. This would include the installation of a new dryer/drum, RAP system, baghouse, storage/surge system, proportioning system, crumb rubber system, chemical additive system (warm mix), or latex system.

Revoked Certification

If a plant fails to conform to the DOTD standards under which certification was issued, the DLE will revoke the plant certification. The certifying DLE may also revoke or suspend plant certification when the mixture demonstrates continued non-conformance to specifications due to plant operations.
Once certification has been revoked, the plant will be prohibited from supplying mix for any Department project until all deficiencies have been corrected and certification is reinstated by the DLE.

Plant Laboratory Equipment and Documentation

The plant shall be equipped with a quality control laboratory. The plant laboratory shall contain equipment to meet the requirements of the specifications and as referenced in applicable test procedures.

The contractor's plant laboratory shall contain equipment to meet the requirements of the specifications for acceptance testing by DOTD personnel for 501 production.

Production and Design Laboratory Equipment Requirements

At the time of this printing, the following equipment is required, but not limited to:

- Constant Temperature Oven [100°F (38°C) to 400°F (204°C)] A 350°F (177°C) capability oven is for heating loose mix. It should be of adequate size to hold 3 gyratory molds.
- An oven of 125°F (52°C) capability is required for moisture content determination and for drying cores
- Oven for conditioning SCB specimens
- Fume hood(s)
- Specimen Ejector
- Shakers, splitters, scales
- Approved SHRP Gyratory Compactor, and extra molds (4 recommended)
- Maximum Specific Gravity (G_{mm}) apparatus, including vibrating table, pycnometer, vacuum pump and drier apparatus, and residual pressure manometer
- Bulk Specific Gravity (G_{mb}) apparatus, including balance, temperature controlled water bath equipped with overflow spigot
- Equipment to perform G_{sb}
- Saw(s), suitable for cutting pavement cores and gyratory specimens (wet saw preferred) including SCB specimens
- Automated Ignition Furnace
- Freezer for TR 322, Tensile Strength Ratio
- Breaking heads for Lottman test
- Water baths, at 77°F (25°C) and at 140°F (60°C)
- Draindown test apparatus
- Computer and adequate connection for internet connectivity (for data tracking software and online reference manuals)
- Laboratory Equipment Manual which documents equipment calibrations – R18 requirements
- Void content apparatus (FAA) and a Flat & Elongated (F&E) Gauge are required

- Approved Loaded Wheel Tracker (LWT) System
- Semi Circular Bend (SCB)
- Sand Equivalent equipment
- Other laboratory equipment used to perform Quality Control Testing

Additional equipment that may be required based on mix design submitted. The following is a list of equipment, but not limited to: DSR

The Contractor shall supply all of this equipment. In addition, the Contractor shall provide sufficient 6-in. diameter molds and auxiliary equipment necessary for the gyratory compactor and its calibration. A loading scoop (chute) for transferring material to gyratory molds is recommended to minimize segregation and temperature loss and help in attaining consistency.

All equipment supplied by the Contractor/Producer (including electronic scales) shall be maintained, serviced and calibrated in accordance with the manufacturers' recommendations and Subsection 503.02.2.

The DLE or their representative will inspect and approve all laboratory equipment supplied by the Contractor/Producer at the time of initial plant certification and during all subsequent inspections.

All laboratory equipment shall be calibrated and verified by the procedures in AASHTO R 18, the appropriate test methods, and by the frequency directed in R 18.

The Contractor shall maintain a Laboratory Equipment Manual containing all records for calibration of plant equipment. See the Preface and website for information and worksheets.

Scales and Meters Certification

In accordance with Subsection 503.02.2, every 90 days (or more frequently, if directed by the DLE), the plant shall have its meters, scales, and measuring devices tested, inspected, and recertified by the Weights and Measures Division of the LA Department of Agriculture and Forestry or by an independent scale service approved by the certifying DLE. The required DOTD Certification Report for Scales and Meters shall be completed and sent to the DLE each 90 days.

There must be a calibration sticker on each scale and meter. If the DOTD ADI has reason to question the calibration of any scale or meter, the Inspector will contact the DLE. The DLE has the authority to require the recalibration of scales or meters even though the ninety-day calibration sticker has not expired. Meters must properly display flow rate and total amount of material and liquid dispensed.

Roadway Equipment Approval

Primary roadway equipment shall be approved on a project by project basis. This equipment includes asphalt distributors, pavers, rollers, hauling, and MTV equipment. A DOTD representative will inspect and complete the Asphalt Concrete Paving Equipment Paving Approval Form. This approval signifies that the equipment is in satisfactory condition and is

capable of performing its function as related to proper paving practices and in accordance with Department standards. Final approval will be granted following an evaluation of the equipment's performance on the project.

For haul trucks, separate tractor/trailer- trucks require certification together as a unit so that an accurate total tare weight may be determined. The DOTD number on separate tractor/trailers must match, showing that they were originally certified together. A new trailer shall require a new certification. Prior to certification, a truck or tractor/trailer shall have its tare weight determined on a truck scale certified by the Weights and Measures Division of the Louisiana Department of Agriculture and Forestry. This tare weight shall be determined with the fuel tank at least three quarters full. The tare weight is used to calculate the maximum payload the truck or tractor/trailer is permitted to legally haul according to its axle size. DOTD Engineering Directives and Standards (EDSM) Number III.1.1.12 outlines the *Enforcement of Legal Load Requirements on Construction and Maintenance Construction Projects* (See LA DOTD website.). A sample copy of the DOTD truck (and trailer, if applicable) Weight Certification Tag is shown in the Appendix.

NOTE:
The Contractor will not be allowed to certify more than 3 tractor and trailer combinations

Transport and roadway paving equipment shall perform to the satisfaction of the Project Engineer. If equipment fails to perform satisfactorily or is not maintained in acceptable condition the Inspector is to notify the Project Engineer. If an equipment malfunction is detrimental to the project, the roadway Inspector has the authority to require the removal of the equipment.

Inspection of Plant and Roadway Equipment

The ADI and the Certified Paving Inspector are the official representatives of the Department through the authority of the DLE and Project Engineer, respectively.

The concept of applying a payment adjustment to certain acceptance tests does not imply that the role of the DOTD Inspector is limited to performing or monitoring these tests. Increased dependence on Contractor/Producer quality control programs has extended the need for DOTD inspectors to be knowledgeable and vigilant concerning the design, production, transport, placement and compaction of hot-mix asphalt materials. It is intended that all requirements of the specifications shall be adhered to, not merely those to which payment adjustments are applied.

If problems arise in the production, transport or paving operations, it is the Inspector's responsibility to notify the Contractor/Producer's representatives that the product is not meeting Department standards. The DOTD Inspector will tell the Contractor/Producer what is wrong, **however, the inspector will not under no circumstances order a solution to the problem by word or action.** Correcting the problem so that the product meets all requirements of the specifications is the responsibility of the Contractor/Producer. If corrective actions are not made, the Inspector is to notify the Project Engineer and DLE and make a subsequent investigation to ensure that corrective action has been taken. The Inspector will document all actions, discussions with other Department personnel and Contractor/Producer

personnel, any other information relevant to the situation and will take measurements or samples, as necessary, to identify the problem.

When deficiencies occur in any area of the production, transport or paving processes, the Contractor/Producer must take immediate action to correct the problem. Failure to do so can result in the discontinuance of operations for DOTD projects. Quality control shall be accomplished by a program independent of, but correlated with, the Department's acceptance testing and shall verify that all requirements of the JMF are being achieved, and that necessary adjustments provide specification compliance. It is the intent of the specifications that mixtures provided meet 100% for all production. Whenever the mixture produced falls into areas under which payment adjustment schedules must be applied, the Contractor/Producer shall make immediate adjustments or the DOTD Inspector will require the discontinuance of operations for DOTD projects.

Plant Inspection

The Department's ADI must continually observe the entire manufacturing process when at the plant. The Inspector is to make a minimum of once per quarter inspection of the plant to ensure that it is in conformance with the standards under which certification was granted. The Inspector must be familiar with Section 503 of the Standard Specifications, Asphalt Concrete Equipment and Processes, and the certification standards for plants. It is also the Inspector's responsibility to observe the Contractor/Producer's testing, monitor the results, and perform any sampling and testing operations assigned to Department personnel. The plant equipment and operations are to be inspected continually during production to ensure that no malfunctions have occurred that will have a detrimental effect on the mixture.

The following headings indicate areas of the plant in which routine inspection is considered essential. These lists are not intended to be comprehensive or to exclude other areas from regular inspection. They are merely intended to serve as a guide to the Inspector in the performance of this responsibility.

Plant Equipment

Stockpiles and Handling–Any new materials delivered to the plant are to be inspected, sampled, and tested in a timely manner so that production is not disrupted.

Aggregates must be handled in a manner that will not be detrimental to the final mixture.

Stockpiles shall be built without causing segregation. Segregation can be minimized if stockpiles are constructed in successive layers, not in a conical shape. Stockpiles shall be located on a clean, stable, well-drained surface to ensure uniform moisture content throughout the stockpile. The area in which the stockpiles are located shall be large enough for the stockpiles to be separated, so that no intermixing of materials will occur. Stockpiles shall not become contaminated with deleterious materials such as clay balls, leaves, sticks or non-specification aggregates.

Material Proportioning–All materials used, such as aggregates, asphalt cement, mineral filler, hydrated lime, fibers, and RAP shall be proportioned by fully integrated measuring systems that maintain the required proportions in conformance with the approved mix design.

Cold Bins–Cold feed apparatus shall conform to Subsection 503.03.2 and shall be inspected routinely. Bins shall be of the proper size to accommodate loader bucket size and plant production. They shall also be of a configuration that will not contribute to segregation and be in good condition. There shall be no holes in any bin. The bin separating partitions shall not be worn or broken. If a partition is damaged to the point that this specification is not met, the Contractor/Producer shall replace the damaged part. Cold feed bins shall be loaded in a manner that will not contribute to segregation. Aggregates shall be dumped into the center of each bin. Bins shall be kept adequately filled with a relatively constant level of material with uniform moisture content.

Belt feeders shall be in good condition, not worn or broken. Gate openings and belt speeds shall be set to distribute the appropriate gradation for the job mix formula being produced. The gate openings and belt speeds shall be periodically inspected to ensure that they remain properly set. Aggregates shall flow uniformly onto the belt. Clogged gates, bridging or excessive moisture can cause non-uniform flow.

Truck Loading–The loading of trucks will be observed to ensure that loading techniques or discharge equipment is not contributing to mixture segregation. Equipment that drops a large amount of mixture at a time into the truck will tend to generate less segregation than compared to equipment that discharges a small flow/stream. The material dropped into the front and back should be placed as close as possible to the front and back of the bed to minimize segregation caused by the rolling of large aggregates. The intent of this truck loading procedure is to minimize the roll down of coarse aggregate at the front and back of the truck and to concentrate any roll down in the center of the load, where it will be more readily mixed with the mass of material during discharge into the paver or MTV. When equipment necessitates deviating from this procedure, the Producer may modify this procedure as long as segregation does not occur.

Drum mix plants will be checked for satisfactory performance by inspecting the material exiting the drum mixer. It will be checked for temperature, coating [Ross Count, (AASHTO T 195), if questionable], moisture, and segregation. If segregation is occurring during the mixing process, one side of the material coming out of the dryer/drum will usually be fine and the other coarse. Such segregation is often caused by improper drum operation.

Material produced at the beginning or termination of production periods shall be diverted from DOTD projects. During startup, the Contractor shall observe the mixture coming out of the diversion chute during these periods to determine that proper mixing and coating are being achieved before allowing the asphalt mixture to enter the surge or storage silos.

The surge or storage silos in use at all plants are components that must be carefully and routinely inspected. The batcher on the top of the silo must operate properly and at all times. The gates must close tightly so that material cannot dribble through. The storage silo or surge silo should maintain the proper cone shape of the material in storage to reduce the height of mix drop, thereby helping to prevent segregation.

SECTION 503 – PLANTS & EQUIPMENT

On a quarterly basis, when the plant is in production, the ADI will, as a part of continuous quality assurance efforts, inspect the plant and its individual components. Section 503 (Asphalt Concrete Equipment and Process) outlines requirements for the inspection of the following items:

- Asphalt cement tanks (storage and working)
- Anti-strip additive equipment
- Cold aggregate feeders (bins)
- Hydrated lime/mineral filler equipment (if used)
- Screening systems
- Dryer/drums
- Thermometers (including thermocouples)
- Dust collection systems (baghouses)
- Asphalt measuring equipment
- Weigh hoppers (if used)
- Scales and printer systems
- Storage and Surge silos
- Mix Release agent dispenser systems

Not only shall proper functioning of these individual components be inspected, their combined operation is to be continually monitored for proper quality assurance.

Inspection of Mixture at Plant

Temperature of the Asphalt Mixture–The temperature is to be checked a minimum of 2 trucks per lot by the Contractor and reported in the DOTD tracking software. For each temperature determination, the temperature shall be checked in more than one location per truck.

Segregation–Asphalt mixtures that exhibit obvious segregation when loaded at the plant shall not be issued a haul ticket. The material shall not be transported to a DOTD project. If there is plant segregation, the loading procedure, stockpile construction, cold feed bin operation, mixing process, and surge/storage bin operations should immediately be inspected for proper function.

Uniformity–The asphalt mixture should be uniform in appearance in all aspects from batch to batch and from one area of the truckload to another. There should be no lumps, areas of differing color, segregation or wet/dry areas. Inconsistent color throughout a truckload may also be the result of excessive dryer/drum flight wear, low or excessive asphalt cement content or inadequate drying/heating. If the mixture does not exhibit acceptable uniform color, the Contractor is to identify and correct the problem.

Odor–Burned or unusual odor may be indicative of oxidized asphalt cement.

Asphalt Coating–Asphalt mixtures that exhibits obvious coating deficiencies shall not be transported to a DOTD project. If the Certified Technician suspects that the mixture is improperly coated, A Ross Count may (AASHTO T 195) be performed. Reference section 502.11 of the Standard Specifications.

Moisture–Excess moisture in asphalt mixtures may cause the mixture to appear to have excessive asphalt cement. Hence, the material will appear to be wet and shiny and slump in the truck. This is because, prior to moisture evaporation, the saturated steam is acting like excess asphalt cement. If the Certified Inspector(s) suspects moisture problems, then the asphalt mixture shall be analyzed for moisture content (DOTD TR 319). **The maximum moisture content allowed by specifications is 0.3%.**

Haul Ticket

All truckloads of asphalt mix shall be accompanied by a properly completed haul ticket. Haul tickets show the exact quantity, by weight, of material in the haul truck. This quantity, in tons, is used to determine pay. No material shall be placed from a truck without a properly completed haul ticket.

The Lot number shall be indicated on each haul ticket. The Lot number may be either printed on the ticket via the printer system or written on the DOTD stamped form on the back of the ticket.
The Contractor shall keep a running total of production to ensure that all lots are terminated at proper tonnage and that the succeeding lot number is placed on the next haul ticket. Lot numbers will be assigned based on the next sequential lot number. Lot numbers will be sequential to plant production for DOTD without regard to delivery points, individual projects, or mix types.

The Contractor shall also maintain a log of the distribution of hot-mix production for DOTD projects from a plant's operation. This log shall contain, as a minimum, the following data:

- Date
- State project mix shipped to
- Sequential lot number
- Tons shipped
- Accumulated tons of the lot
- Remarks
- Initials of the technician making the entry
- AC type

This log is to remain at the plant as a continuing record of plant production and distribution. It is to be maintained separately from all other Department documentation.

Roadway Equipment

Haul Trucks–Trucks are to be routinely inspected to ensure they are clean and that there are no holes in the trailer/truck beds with the exception of a ¼" hole midway of the dump body on the driver's side for thermometer insertion to check mix temperature. Materials shall not be allowed to build up in truck beds. Truck beds must be coated with an approved mix release agent, as needed. Diesel or any other petroleum-based product shall not be used as a mix release agent. Each truck shall have an adequate cover and tie downs. The cover must be in good condition with no holes or tears and must cover the complete bed. Covers shall be used to protect the material from rain and excessive temperature loss. All haul trucks shall have silver weight certification stickers attached to the cab and the trailer unit. These two stickers must match to be valid. If the weight certification stickers are not valid, the haul truck shall be removed from the project.
Pavers–The paver shall be operated at a consistent speed that will produce a smooth, uniformly textured pavement surface and create a continuous operation in conjunction with plant production and hauling capacity. Use a paver insert hopper in conjunction with the MTV

with a minimum capacity of 5 tons. The hopper is to be kept reasonably full at all times; the slat conveyors should never be uncovered. Cold, segregated material in the hopper wings shall not be dumped into the paver. The paving Inspector will check the sensitivity of the paver's electronic controls to ensure they are working properly.

If screed extensions are used, they must be heated and meet all screed requirements and produce the same quality surface as the screed. When auger extensions are required, they must extend to within 1 ft. of the end of the screed. With approval, the use of an auger extension with screed extensions in excess of 1 ft. on one side may be waived for transitions, taper sections and similar short sections or when hydraulically extended screeds, which trail the main screed assembly, are used, provided required density and surface texture are obtained.

MTV–The MTV shall comply with Section 503.14 of the Standard Specifications. If Lightweight MTV (503.14.1) and/or Windrow Paving (503.14.2) are used, then a Thermal Profile System (503.14.3) will be required to be attached to the paver. The DOTD Inspector will check for thermal segregation of the mix. If thermal segregation is found, the operation should be discontinued and changes made to allow continuation of the laydown operation.

Asphalt Distributor–The Asphalt Distributor shall comply with Section 503.13 of the Standard Specifications. The Inspector should check to ensure that the Distributor meets the requirements in Section 503.13.1 and note this on the Asphalt Concrete Paving Equipment Project Approval form.

Within 12 months prior to use, calibrate the asphalt distributor in accordance with ASTM D2995. Provide the ASTM calibration record to the Project Engineer prior to beginning work. At any time, the Engineer may require verification of calibration accuracy of the asphalt distributor in accordance with ASTM D 2995.

Rollers–It is critical to the life of an asphalt pavement that it be properly compacted to develop the strength and proper aggregate interlock intended for the mixture. Sufficient compactive energy should be applied as necessary for adequate design density. A properly compacted pavement will provide a smooth, sealed riding surface.

A best practice is for the breakdown roller to follow closely behind the paver.

It is the Contractor's responsibility to establish a rolling pattern that will ensure optimum and consistent density. Almost every project or mixture type requires a varied rolling pattern. The ability of a mixture to be compacted will be affected by variables such as mixture temperature, aggregate gradation, type of aggregate and asphalt, ambient temperature, moisture content, and condition of the foundation on which the asphalt mixture is being placed and compacted.

Section 503.16 of the Standard Specifications states that all compaction equipment must be self-propelled and be capable of reversing without backlash. It is the Contractor's responsibility to provide the number, type and size of rollers sufficient to compact the mixture to the specified density and surface smoothness. The Contractor shall establish the number, type, size and rolling pattern on the first day of production for a particular mix design. Once established, the same protocol shall be maintained throughout production. If the pavement or mixture characteristics are changed during the project, the Project Engineer may require a revised

protocol deemed appropriate for those changes. Compaction equipment shall comply in accordance with Subsection 503.16.

Steel wheel rollers may be either vibratory or non-vibratory. The wheels shall be true to round and equipped with suitable scraper and watering devices. If used, **vibratory rollers shall be designed for asphalt mixture compaction and shall have separate controls for frequency, amplitude and forward speed.** Non-vibrating steel wheel rollers shall be operated with drive wheels toward the paver. Vibratory rollers shall not be used on the first lift of asphalt pavement placed over asphalt treated drainage blanket. When asphalt mix is placed on newly constructed cement or lime stabilized or treated layers, vibratory rollers shall not be used for at least 5 days after such stabilization or treatment. Steel wheels shall be checked for flat spots.

Drawbar Pull is defined as the horizontal force required to move the roller forward. The most efficient roller is that with the smallest drawbar pull. Rollers with large diameter drums have lower drawbar pull (rolling resistance), because they do not penetrate as far into the mix to develop a contact area as a roller with smaller diameter drums.

All tires for pneumatic tire rollers shall have smooth tread, shall be the same size and ply rating, and shall be inflated to a uniform pressure not varying more than ±5 psi between tires. Wheels shall not wobble and shall be aligned so that tires of the other axle cover gaps between tires on one axle. Tires shall be equipped with scrapers to prevent adhesion to the asphalt mix. The pneumatic tire roller shall be kept 6 in from unsupported edges of the paving strip; however, when an adjacent paving strip is down, the roller shall overlap the adjacent paving strip approximately 6 in. All scrapers and watering systems shall be in good condition and functioning properly.

Rollers shall be operated at uniform speeds that will coordinate with paver speed and within the frequency setting so as to allow for proper drum impacts per linear foot. The more quickly a roller passes over a particular point in the new asphalt pavement surface, the less time the weight of the roller rests on that point. This in turn means that less compactive effort is applied to the mixture. As roller speed increases, the amount of density gain achieved with each roller pass decreases. The roller speed selected is dependent on a combination of the following factors:

- Paver speed
- Layer thickness
- Position of the roller in the roller train.

Typically static steel wheel rollers can operate at speeds of 2 to 5 miles per hour; pneumatic tire rollers typically run 2 to 7 miles per hour; a vibratory roller can operate at speeds of 2 to 3½ miles per hour. Roller speed is also governed by the lateral displacement or tenderness of the asphalt mix. If the mixture moves excessively under the roller, the speed of the compaction equipment should be reduced. As discussed earlier, roller speed affects the impact spacing for vibratory rollers. This spacing is important for controlling the amount of dynamic compaction energy applied to the pavement, as well as for obtaining the proper surface smoothness. In general, at least 10 to 12 impacts per foot are needed to obtain adequate density and layer smoothness.

Rollers are not to reverse in the same location on subsequent passes. Reversal points of continuous passes should be skewed at an angle of approximately 45 degrees across the mat. Rollers should cross their reversal points when moving across the mat surface in order to smooth any dips or bumps caused by changing direction. When a vibratory roller is used for breakdown rolling, the vibrators must be turned off to compact joints or whenever the roller stops or changes direction.

The Paving Inspector will inspect the mat during compaction after the rollers have passed. If the mat tears, blisters, shoves, leaves indelible marks or displaces in any way beneath the roller, the Paving Inspector will require the Contractor to adjust the operation so that the mat is not damaged. Deficiencies shall be corrected.

Rollers for SMA shall be steel wheel weighing a minimum of 10 tons operated at high frequency and low amplitude. SMA mix shall be rolled immediately after placement. The mastic shall not be allowed to migrate to the surface. Rolling shall continue until all roller marks are eliminated and minimum density is obtained, but not after the mat has cooled below 220°F. Traffic will not be allowed on the newly compacted SMA until the mat has cooled to 140°F or lower.

Tender Zone–A mid-temperature *tender zone* has been identified for some Superpave mixes. The tender zone has been identified in temperature ranges of approximately 200°F to 240°F. The mixture can be satisfactorily compacted above this range or below this range, but the mixture is tender within the temperature range and cannot be adequately compacted. This is not true for all mixtures, but it has been observed for some Superpave designed mixtures.

When a mixture is tender within the mid-temperature range, the preferred compaction method is to obtain density prior to cooling to the point of the tender zone. This may require an additional breakdown roller or other changes in rolling techniques, but obtaining density prior to reaching the tender zone is preferable. In some cases, the mixture temperature may be increased slightly to provide more compaction time. However, excessive temperatures will magnify the problem. Another alternative is to use a vibratory steel wheel breakdown roller above the tender zone, followed by a rubber tire roller, which can be operated in the tender zone. The finish roller should be used after the mixture has cooled below the tender zone. This second method may not be satisfactory if the rubber tire roller picks up excessively.

Another possibility is to breakdown with a steel wheel roller above the tender zone, then complete the rolling process after the asphalt mixture has cooled to below the tender zone. This has been used on a number of projects, but problems may occur due to differential cooling of the mixture and due to excessive aggregate breakdown when rolling in the vibratory mode after the mixture has cooled to below 200°F. Therefore, vibratory rolling should not be used below 200°F.
If the tenderness problem yields a pavement with poor in-place density, or if the paving train length is excessively long due to the time required for the mixture to cool, adjustments to the mixture design must be made to eliminate, or at least reduce, the temperature tenderness zone. It is important that the paving crew working at the laydown site communicate with the plant personnel.

Surface Preparation–The requirement to use tack coat, prime coat or curing membrane depends on the type of surface material upon which it is being placed. The different types of asphalt materials, along with their applicable sections in the Standard Specifications, are as follows:

1. Tack Coat - (Section 504) is applied to existing hot-mix asphalt, Asphalt Surface Treatment, or Portland cement concrete pavement surface. The distributor used to apply the tack coat shall be certified.

2. Prime Coat – (Section 505), is applied to untreated base course such as crushed aggregate, stone and concrete base courses. The distributor that is used to apply the prime coat shall be certified.

Curing Membrane – (Section 506), is applied to treated base courses such as on the surface of cement or lime-treated/stabilized materials. The distributor used to apply the curing membrane does not have to be certified, but shall be approved by the Engineer.

Section 504 – Asphalt Tack Coats

Record the temperature of the tack truck for information. Tack coat rate and quantity as measured by the calibrated tack coat distributer will be recorded and used for verification. Shipments of tack coat emulsion must be accompanied with a Certificate of Delivery collected by the Contractor and then delivered to the DOTD Inspector.

If the tack coat distributer has to leave the project, the operator shall inform the DOTD Inspector. The DOTD Inspector will take a gallons reading of the distributor for verification calculations. If the distributor has to refill, the Inspector will take a reading upon the return of the distributor. The quantity reading will be from calibrated measuring devices for the distributer being measured.

Within 12 months prior to use, calibrate the asphalt distributor in accordance with ASTM D 2995. Provide the ASTM calibration record to the Project Engineer prior to beginning work. At any time, the Engineer may require verification of calibration accuracy of the asphalt distributor in accordance with ASTM D 2995.

Measurement will be by the in place gallon per square yard. The DOTD Certified Paving Inspector will compute the square yards covered and gallons placed to calculate application rates.

Tack coat will not be paid for separately but will be incidental to asphalt mixtures.

When questionable, tack coat will be sampled in plastic one-gallon containers as stated in the sampling plan or MSM.

If the Engineer adjusts the application rate of tack coat from that specified by the contract document or Standard Specifications, payment for asphalt mixture will be increased or decreased based on the difference in applied quantity of asphalt emulsion shown on paid invoices (total charges). The contractor shall provide copies of paid invoices for this determination.

Application Rate Calculation

Application rate is based on gallons per square yard and is indicated in the equation following:

$$\frac{\text{gal}}{\text{yd}^2} = \text{application } \textit{rate}$$

yd^2 = area covered = length in feet x width in feet ÷ 9

Example: Station 10+00 to 56+80 = 4680 ft. length, paving width = 12.5 ft.

Area Covered = 4680 ft. x 12.5 ft. ÷ 9 ft.^{2}/sq yd = 58500 ft^2 ÷ 9 ft.^{2}/sq yd = 6500 yd^2

260 gallons of tack used as measured from Tack Distributor

$$\frac{260 \text{ gal}}{6500 \text{ yd}^2} = 0.04 \text{ gal/yd}^2 \text{ application rate}$$

APPENDIX

APPENDIX

For move to appendices:
Mineral aggregate is porous and can absorb water and asphalt to a variable degree. The ratio of water to asphalt absorption varies with each aggregate. Three methods of measuring aggregate specific gravity consider these variations. The methods are bulk, apparent, and effective specific gravities. Differences among the specific gravities come from the different definitions of aggregate volume. The Department, for use when analyzing and documenting Superpave hot-mix asphalt mixtures, adopts the following definitions and nomenclature:

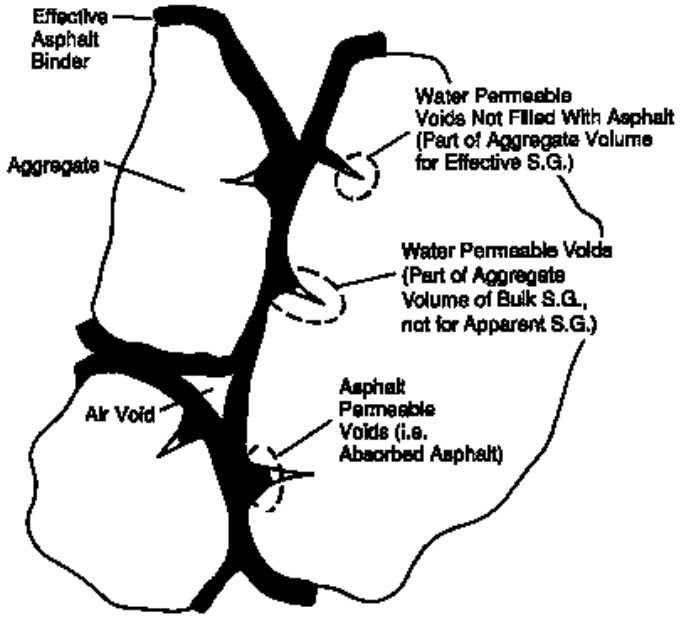

Figure 2-3 – Illustrating Bulk, Effective, and Apparent Specific Gravities, Air Voids, and Effective Asphalt Content in Compacted Asphalt Paving Mixture

Bulk Specific Gravity, G_{sb} – The ratio of the weight in air of a unit volume of a permeable material (including both permeable and impermeable voids normal for the material) at a stated temperature to the weight in air of equal density of an equal volume of gas-free distilled water at a stated temperature. See Figure 2-3.

Apparent Specific Gravity, G_{sa} – The ratio of the weight in air of a unit volume on an impermeable material at a stated temperature to the weight in air of equal density of an equal volume of gas-free distilled water at a stated temperature. See Figure 2-3.

Effective Specific Gravity, G_{se} – The ratio of the weight in air of a unit volume of a permeable material (excluding voids permeable to asphalt) at a stated temperature to the weight in air of equal density of an equal volume of gas-free distilled water at a stated temperature. See Figure 2-3.

Voids in Mineral Aggregate, VMA – The volume of inter-granular void space between the aggregate particles of a compacted paving mixture including air voids and effective asphalt content, expressed as a percent of total sample volume. See Figure 2-4.

Air Voids, V_a – The total volume of the small pockets of air between the coated aggregate particles throughout a compacted paving mixture, expressed as a percentage of the bulk volume of the compacted paving mixture. See Figure 2-4.

Voids Filled with Asphalt, VFA – The portion of the volume of inter-granular void space between the aggregate particles (VMA) occupied by the effective asphalt. See Figure 2-4.

Effective Asphalt Content, P_{be} – The total asphalt content of a paving mixture minus the portion of asphalt lost by absorption into the aggregate particles. See Figure 2-4.

Absorbed Asphalt, P_{ba} – The absorbed asphalt, percent by mass of aggregate. See Figure 2-4.

When evaluating a JMF, the Apparent Gravity is greater than the Effective Gravity is greater than the Bulk Gravity of the aggregates.

$$G_{sa} > G_{se} > G_{sb}$$

Asphalt absorption generally falls somewhere in the middle two thirds of water absorption. If asphalt absorption approaches zero or a negative asphalt absorption (mix makes asphalt) is indicated, the gravity and absorption of the aggregates needs to be reviewed.

Due to the washing of fine aggregates over the 200 sieve for T 84, large aggregate mixes and mixes not containing RAP (SMA), may approach zero absorption. JMFs submitted with negative asphalt absorptions shall not be approved.

JMFs with low composite absorption values, using low water absorption aggregates, are more sensitive to the asphalt aborption to water absorption ratio than higher water absorption composites.

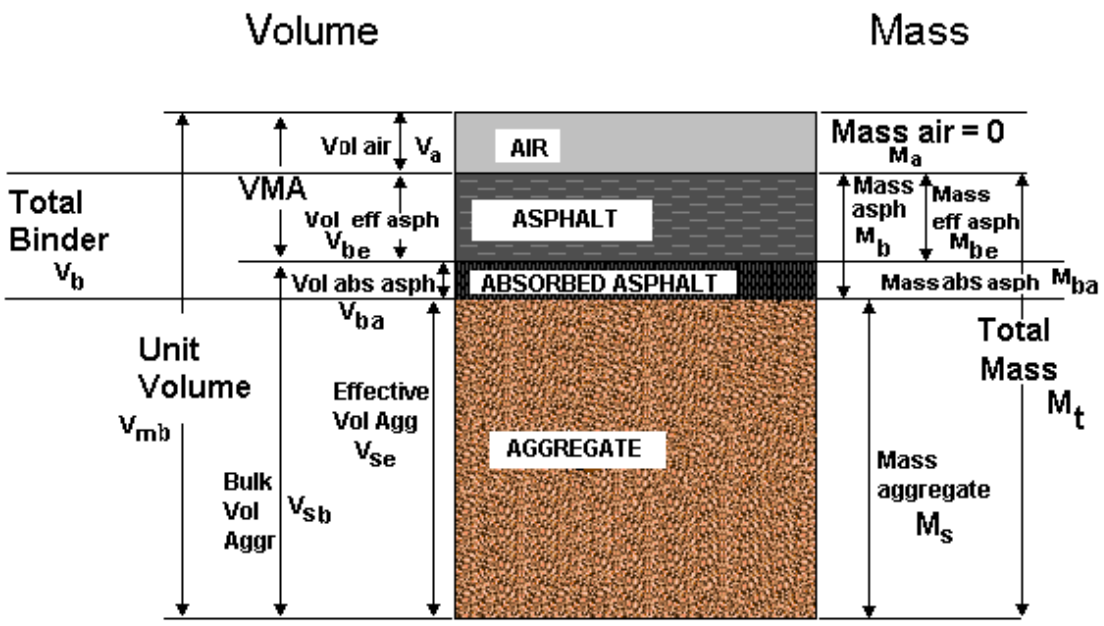

Figure 2-4 – Representation of Volumes in a Compacted Asphalt Specimen (Phase Diagram)

Asphalt Cement Specific Gravity, G_b – The ratio of the mass in air of a given volume of asphalt cement to the mass of an equal volume of water, both at the same temperature. **(Assumed to be 1.03)**

Mixture Bulk Specific Gravity, G_{mb} – The ratio of the mass in air of a given volume of compacted asphalt mixture to the mass of an equal volume of water, both at the same temperature.

Theoretical Maximum Specific Gravity, G_{mm} (Rice Gravity) – The ratio of the mass of a given volume of asphalt mixture with no air voids to the mass of an equal volume of water, both at the same temperature.

Initial Number of Gyrations, $N_{initial}$ – The number of gyrations (7 gyrations) that represents a measure of mixture compactability. Mixtures that compact too quickly may be tender during construction and unstable when subjected to traffic.

Design Number of Gyrations, N_{design} – The number of gyrations required to produce a density in the mix equivalent to the expected density in the field after traffic. In the mix design process, an asphalt content is selected that will provide 3.5% air voids when the mix is compacted to N_{design} gyrations.

Maximum Number of Gyrations, N_{max} – The number of gyrations required to produce a density in the laboratory that should never be exceeded in the field. N_{design} provides an estimate of ultimate field density. N_{max} provides a compacted density with some safety factor to ensure the mixture does not densify too much, which would result in low in-place air voids, which can cause rutting. The air voids at N_{max} are required to be at least 2%. Mixtures that have less than 2% air voids at N_{max} are susceptible to possible rutting.

The VMA values for compacted asphalt paving mixtures are calculated using the G_{sb} of the combined aggregate.

VMA and air voids (V_a) are expressed as percentage by volume of the paving mixture. VFA is the percentage of VMA filled by the effective asphalt cement, (P_{be}). The effective asphalt cement content shall be expressed as a percentage by weight of the total weight of the mixture.

The following equations are used to compute volumetric properties of compacted hot-mix asphalt specimens:

Bulk Specific Gravity of Compacted Asphalt Mixture Specimen G_{mb}:

$$G_{mb} = \frac{\text{Weight in Air}}{\text{SSD Weight} - \text{Weight in Water}}$$

Air Voids, V_a:

$$V_a = 100 \, x \, \frac{G_{mm} - G_{mb}}{G_{mm}}$$

Voids in Mineral Aggregate, VMA:

$$VMA = 100 - \frac{G_{mb} \times P_s}{G_{sb}}$$

Voids Filled with Asphalt, VFA:

$$VFA = 100 \times \frac{VMA - V_a}{VMA}$$

Effective Specific Gravity, G_{se}:

$$G_{se} = \frac{100 - P_b}{\left[\frac{100}{G_{mm}} - \frac{P_b}{G_b} \right]}$$

Percent Absorbed Asphalt, P_{ba}:

$$P_{ba} = \frac{(100 \times G_b)(G_{se} - G_{sb})}{G_{sb} \times G_{se}}$$

Percent Effective Asphalt Cement, P_{be}:

$$P_{be} = P_b - \frac{P_{ba} \times P_s}{100}$$

Dust to Asphalt Ratio, D/P or P_{200}/P_{be}:

$$\text{Dust Ratio} = \frac{P_{200}}{P_{be}}$$

Asphalt mixture volumetric analysis results for trial blends shall be documented in LaPave.

The following relationships, as determined from these equations, are plotted in LaPave to show the Optimum Asphalt Cement Content - Summary of Test Properties.

1. Air Void (V_a) versus asphalt content
2. Voids in Mineral Aggregate (VMA) versus asphalt content
3. Voids Filled with Asphalt (VFA) versus asphalt content

Selection of Optimum Asphalt Cement Content

Examining test property curves reveals information about sensitivity of the mixture to asphalt content. Trends generally noted are:

- Percent Air Voids (**V_a**) decreases with increasing asphalt cement content, ultimately approaching a minimum void content.
- Percent **VMA** generally decreases to a minimum value then increases with increasing asphalt cement content.
- Percent **VFA** steadily increase with increasing asphalt cement content because VMA is being filled with asphalt cement.

Dust to Effective Asphalt Cement Ratio Evaluation

Another mixture requirement, as per Tables 502-6 and 502-6b, is the dust ratio. Computed as the ratio of the percentage by weight of aggregate finer than the No.

200 sieve to effective asphalt content (P_{be}) expressed as a percentage by weight of total mixture. Effective asphalt content is the total asphalt used in the mixture less the percentage of absorbed asphalt.

Dust to Asphalt Ratio, D/P or P_{200}/P_{be}:

$$\text{Dust Ratio} = \frac{P_{200}}{P_{be}}$$

The dust ratio, P_{200}/P_{be}, tolerance for all 502 asphalt mixtures is 0.6 to 1.6 unless otherwise stated.

Moisture Susceptibility Analysis

Subsection 502.02.2.1 requires that a minimum of 0.6% anti-strip be used or a rate approved by the DLE.

Loaded Wheel Tester, LWT Testing

Perform (AASHTO T 312) Preparing and Determining the Density of Asphalt Specimens by Means of the Superpave Gyratory Compactor and (AASHTO T 324) Hamburg Wheel-Track Testing of Compacted Hot Mix Asphalt (LWT) tests. Specimens shall be prepared and tested according to T 312 and T 324. Testing tolerances are listed in Tables 502-6 and 502-6b of the Standard Specifications.

Report values will be included in the LaPave JMF submittal. The LWT Excel file data shall be submitted to the Department with the JMF submittal.

LWT testing of plant produced mix is required to complete the JMF validation process.

If LWT testing was used for minor mix submittal, LWT testing will be done on plant produced mix when the JMF starts production.

4 – 60mm gyratory specimens are used for LWT.

Semi Circular Bend Test (SCB)
Perform according to ASTM D8044. The Contractor shall perform SCB testing for design. SCB test for design submittal may be witnessed by a DOTD employee at the request of the DLE. The Contractor will coordinate with the DLE for an employee to be present for testing. The Contractor will submit the required Excel data file with the JMF proposal.

SCB will not be required for base, PG67-22 leveling or minor mixes. Any mix that is under traffic will be subject to SCB testing.

- 1” binders used on mainline require SCB testing.
- Mixes using polymer asphalt binders are subject to SCB testing (including leveling with PG70-22 and PG76-22)

Perform long term aging of SCB samples in accordance to AASHTO R 30, 7.3.4 (85 ± 3°C for 120 ± 0.5 h), 7.3.5, and 7.3.6.

Laboratory testing temperature for SCB specimens is 25° C.

Upon request by DOTD, the contractor will be required to perform SCB testing on plant produced mix.

Tensile Strength Ratio, (TSR), (Lottman) (Minor Mixes) (Optional)
To complete the design process for minor mixes, at the Contractor's option , in lieu of LWT, may perform moisture sensitivity test (DOTD TR 322) to evaluate the proposed hot-mix asphalt blend for stripping. This test identifies whether a combination of asphalt cement and aggregate is moisture susceptible.

Report results in LaPave and submit with the JMF proposal. Minimum TSR results of 80% are required for approval of a design. TSR testing is required on the first lot of plant produced mix once a JMF is approved. TSR results are entered in LaPave.

Alternate Method for Calculating Roadway Yield Correction Factors

Calculating an adjustment factor for high void mixes (OGFC) and/or low G_{mm} (Rice Gravity) mixes

OGFC and sometimes SMA and 501 Coarse Mix do not follow typical yield. Below are two methods of calculating theoretical yield factors.

Yield correction factor

PCF = Pounds per cubic foot

PCF = G_{mm} (Rice Gravity) from plant x 62.4 (weight of one cubic foot of water)

$$\frac{Lift\ thickness\ in\ inches}{12} x\ 9 = volume\ of\ lift\ per\ square\ yard$$

Volume of lift x PCF = weight of mix in pounds at zero voids.

Weight of mix in pounds at zero voids x inverse of design voids = adjusted yield (pounds per square yard)

Example for OGFC:

OGFC design voids = 20% 0.80 (inverse of design voids) will be used in calculating the adjusted yield.

Lift thickness = 0.75"

G_{mm} = 2.400

PCF = 2.400 x 62.4

PCF = 149.76

$\frac{0.75}{12}\ x\ 9 = 0.5625$ ft^3. This is the volume of one square yard of OGFC at 0.75" lift thickness

Weight of mix at **zero** percent voids = 149.76 x 0.5625 = 84.24 pounds per square yard

Weight per square yard using design voids 84.24 x 0.80 = 67.392 pounds per square yard at 0.75" lift thickness.

High AC content mixes such as SMA may need an adjustment factor for calculating yield.

Calculating a roadway yield "adjustment factor" for high AC content and/or low G_{mm} (Rice Gravity) mixes such as SMA

Yield correction factor
PCF = Pounds per cubic foot
PCF = G_{mm} (Rice Gravity) from plant x 62.4 (weight of one cubic foot of water)

$$\frac{Lift\ thickness\ in\ inches}{12}\ x\ 9 = volume\ of\ lift\ per\ square\ yard$$

Volume of lift x PCF = weight of mix in pounds at zero voids.
Weight of mix in pounds at zero voids x average roadway core density = adjusted yield (pounds per square yard)

Example for SMA:

Average SMA roadway core density = 95% 0.95 will be used in calculating the adjusted yield.
Lift thickness = 2.00"
G_{mm} = 2.395
PCF = 2.395 x 62.4
PCF = 149.45

$\frac{2.00}{12}\ x\ 9 = 01.499$ ft^3. This is the volume of one square yard of SMA at 2.00" lift thickness

Weight of mix at **zero** percent voids = 149.49 x 1.499 = 224.09 pounds per square yard
Weight per square yard using average density of roadway cores from validation or previous production lot.

224.09 x 0.95 = 212.9 pounds per square yard at 2.00" lift thickness.
106.5 lbs per inch per square yard.

Example of core sampling determination

when there are different mix uses in the same sublot.

Assume lot has 5000 tons of continuous mixture production.

Sublot A	Sublot B	Sublot C	Sublot D	Sublot E
800 Tons Roadway Wearing	**500 Tons Roadway Binder**	**200 Tons Rdwy Wear**	**600 Tons Roadway Wearing**	**1000 Tons**
		800 Tons Shoulder		**Driveways[3]**
	500 Tons Roadway Wearing		**400 Tons Shoulder**	
200 Tons Shoulder				

Using random number tables, core locations may occur as follows (select mainline if there are mixed uses in the sublot):

800 Tons Roadway Wearing 2 acceptance cores 2 QC cores	**500 Tons Roadway Binder 1 acceptance & 1 QC Core**	**200 Tons Rdwy Wearing 1 acceptance & 1 QC Core [2]**	**600 Tons Roadway Wearing 2 acceptance & 2 QC cores**	**1000 Tons Driveways 0 cores**
		800 Tons Shoulder 1 acceptance & 1 QC cores		
	500 Tons Roadway Wearing 1 acceptance & 1 QC core		**400 Tons Shoulder 0 cores (from random number results) 1 acceptance core & 1 QC core[1]**	
200 Tons Shoulder 0 cores (from random number results) 1 acceptance core & 1 QC core[1]				

[1]Sublot A – Shoulder is a mix use that is not represented, so take an additional acceptance and additional QC core from the shoulder

[2]Sublot C – Choose wearing for first segment location and choose shoulder for second segment location.

Sublots B, D and E – All mix uses are represented.
[3]Sublot E – compaction shall be to the satisfaction of the Project Engineer (100% pay).

For projects greater than >1000 current plan ADT:

Mainline core density results are used to calculate PWL for pay. Minor core density results are used to calculate average density for pay.

Mainline mix use requires a minimum of three cores for lots >250 tons to calculate PWL.

For projects ≤ 1000 current plan ADT:

Mainline mix pay may be calculated by averaging or by PWL, as designated in the preconstruction conference. When averaging is chosen, the average of each sublot will be used to determine pay. The average core density per sublot is 92.0% with an individual minimum core density of 90.5

Example PWL Calculation

Assume 5 samples taken from 5 consecutive sublots of continuous production of the same mix from a plant.

5000 TONS	¾" NMS Wearing	Category B Roadway

AIR VOIDS – Spec Limits are 2.5% to 4.5%.

Test results for air voids are:

2.3%	2.2%	3.0%	2.9%	3.0%

AIR VOIDS – Compute PWL for 5 air voids results.

1. Compute the mean and the standard deviation. The formula used to determine the mean is:

$$\text{Mean} = \overline{X} = \frac{X_1 + X_2 + X_3 + \ldots + X_n}{n} = \frac{\sum_{i=1}^{n} X_i}{n}$$

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Using the example,

$$\text{Mean} = \overline{X} = \frac{2.3 + 2.2 + 3.0 + 2.9 + 3.0}{5} = \frac{13.4}{5} = 2.68$$

2. Compute standard deviation. The formula to determine standard deviation is:

$$\text{Standard Deviation} = s = \sqrt{\frac{(X_1 - \overline{X})^2 + (X_2 - \overline{X})^2 + ... + (X_i - \overline{X})^2}{n - 1}}$$

$$= \sqrt{\frac{\sum_{i=1}^{n} (X_i - \overline{X})^2}{n - 1}}$$

$$s = \sqrt{\frac{(2.3 - 2.68)^2 + (2.2 - 2.68)^2 + (3.0 - 2.68)^2 + (2.9 - 2.68)^2 + (3.0 - 2.68)^2}{5 - 1}}$$

$$s = \sqrt{\frac{0.38^2 + 0.48^2 + 0.32^2 + 0.22^2 + 0.32^2}{5 - 1}}$$

$$s = \sqrt{\frac{0.1444 + 0.2304 + 0.1024 + 0.0484 + 0.1024}{5 - 1}}$$

$$s = \sqrt{\frac{0.6280}{5 - 1}}$$

$$s = \sqrt{\frac{0.6280}{4}}$$

$$s = \sqrt{0.1570}$$

$$s = 0.396232$$

$$s = 0.3962$$

Standard Deviation = 0.3962

***NOTE: For hand calculations**

When performing computations, please note that the significant digits for the average will be one more place than the significant digits for the value. In addition, the significant digits for the standard deviation will be two more than the significant digits for the average. For Example:

Voids is x.x	Density is xx.x
Voids Average is x.xx	Density Average is xx.xx
Voids Standard Deviation is x.xxxx	Density Standard Deviation is xx.xxxx

*Software carries indefinite places for intermediate calculations. Results from "hand" calculations and LaPave may differ.

3. Compute the Upper Quality Index, Q_u, and Lower Quality Index, Q_L, using these formulas:

$$\text{Upper Quality Index} = Q_U = \frac{USL - \bar{X}}{s} \qquad \text{Lower Quality Index} = Q_L = \frac{\bar{X} - LSL}{s}$$

Example: If the Upper Spec Limit, USL, is 4.5 and the Lower Spec Limit, LSL, is 2.5, then:

$$\text{Upper Quality Index} = Q_U = \frac{4.5 - 2.68}{0.3962} = \frac{1.82}{0.3962} = 4.59$$

$$\text{Lower Quality Index} = Q_L = \frac{2.68 - 2.5}{0.3962} = \frac{0.18}{0.3962} = 0.45$$

4. Compute PWL.

   Use Table 502-9 to convert the Quality Index into the PWL value. PWL is calculated for each Quality Index (upper and lower) and combined for a total PWL calculated in accordance with the formula:

$$PWL = PWL_L + PWL_U - 100$$

Where:

PWL_L = lower percent within limits
PWL_U = upper percent within limits

PWL, for the five void results previously shown, calculates as follows:

From Table 502-9, using n = 5
PWL_U corresponds to 4.59 is 100.

PWL_L corresponds to 0.45 is 66.

Total PWL = $PWL_U + PWL_L - 100 = 100 + 66 - 100 = 66$

Table 502-9

Quality Index Values for Estimating Percent Within Limits (PWL)

PWL	n = 3	n = 4	n = 5 - 6	n = 7 - 9	n = 10 - 12	n = 13 - 15
99	1.16	1.47	1.68	1.89	2.04	2.14
98	1.15	1.44	1.61	1.77	1.86	1.93
97	1.15	1.41	1.55	1.67	1.74	1.80
96	1.15	1.38	1.49	1.59	1.64	1.69
95	1.14	1.35	1.45	1.52	1.56	1.59
94	1.13	1.32	1.40	1.46	1.49	1.51
93	1.12	1.29	1.36	1.40	1.43	1.44
92	1.11	1.26	1.31	1.35	1.37	1.38
91	1.10	1.23	1.27	1.30	1.32	1.32
90	1.09	1.20	1.23	1.25	1.26	1.27
89	1.08	1.17	1.20	1.21	1.21	1.22
88	1.07	1.14	1.16	1.17	1.17	1.17
87	1.06	1.11	1.12	1.12	1.13	1.13
86	1.05	1.08	1.08	1.08	1.08	1.08
85	1.03	1.05	1.05	1.05	1.04	1.04
84	1.02	1.02	1.02	1.01	1.00	1.00
83	1.00	0.99	0.98	0.97	0.96	0.96
82	0.98	0.96	0.95	0.94	0.93	0.92
81	0.96	0.93	0.92	0.90	0.89	0.89
80	0.94	0.90	0.88	0.87	0.85	0.85
79	0.92	0.87	0.85	0.83	0.82	0.82
78	0.89	0.84	0.82	0.80	0.79	0.78
77	0.87	0.81	0.79	0.77	0.76	0.75
76	0.84	0.78	0.76	0.74	0.72	0.72
75	0.82	0.75	0.73	0.71	0.69	0.69
74	0.79	0.72	0.70	0.67	0.66	0.66
73	0.77	0.69	0.67	0.64	0.63	0.62
72	0.74	0.66	0.64	0.61	0.60	0.59
71	0.71	0.63	0.60	0.58	0.57	0.56
70	0.68	0.60	0.58	0.55	0.54	0.54
69	0.65	0.57	0.55	0.53	0.51	0.51
68	0.62	0.54	0.52	0.50	0.48	0.48
67	0.59	0.51	0.49	0.47	0.46	0.45
66	0.56	0.48	0.46	0.44	0.43	0.42
65	0.53	0.45	0.43	0.41	0.40	0.40
64	0.49	0.42	0.40	0.38	0.37	0.37
63	0.46	0.39	0.37	0.35	0.35	0.34
62	0.43	0.36	0.34	0.33	0.32	0.31
61	0.39	0.33	0.31	0.30	0.30	0.29
60	0.36	0.30	0.28	0.27	0.26	0.26
59	0.32	0.27	0.25	0.24	0.24	0.23
58	0.29	0.24	0.23	0.21	0.21	0.21
57	0.25	0.21	0.20	0.19	0.18	0.18
56	0.22	0.18	0.17	0.16	0.16	0.15
55	0.18	0.15	0.14	0.13	0.13	0.13
54	0.14	0.12	0.11	0.11	0.10	0.10
53	0.11	0.09	0.08	0.08	0.08	0.08
52	0.07	0.06	0.06	0.05	0.05	0.05
51	0.03	0.03	0.03	0.03	0.03	0.03
50	0.00	0.00	0.00	0.00	0.00	0.00

Note 1: For negative values of Q_u or Q_L. PWL_U or PWL_L is equal to 100 minus the tabular PWL_U or PWL_L.
Note 2: If the value of Q_U or Q_L does not correspond exactly to a value in the table, use the next higher value.

Generating and Using Random Numbers for Sampling Purposes

Generating random numbers for determining sampling is covered in this section. This section is how to generate the number(s). Applying the number is addressed in another section.

The practice of riding a project and just picking a spot to choose a sample location may seem random, but statistical analysis of this has proven that a pattern emerges. There are multiple ways to utilize random numbers. One way is the use of random number tables covered here. Statistical analysis used in this specification necessitates the use of random numbers that are just that, random.

The following tables have groups of numbers that are 10 across and 5 down. This grouping is used to generate random numbers.

The Inspector can generate numbers on a per lot basis or calculate the number of samples for a project and generate all the numbers for a project. Whichever method started should be used for the whole project.

Random numbers for longitudinal distance will be 10, along with 10 random numbers for transverse distance for a total of 20 required random numbers per lot.

The over and down method will be used to generate random numbers in this example. There are eight pages with seven groups of numbers per page.

The Inspector can use down and then across or across and down. The selection can start left to right or right to left and then up or down depending on the starting point. The limitations are 10 horizontally and five vertically. Choose a pattern and use that pattern until all numbers are chosen or all sections are used. If more numbers are needed, pick another pattern and proceed until enough numbers are generated.

On the first page, the pattern will be three down (vertical) and seven across (horizontal). In each group of 50 numbers, go down three rows and across seven columns. Going down the first page, the seven numbers generated are: 0.133, 0.954, 0.371, 0.393, 0.825, 0.416, and 0.608. The Inspector will use this pattern through the eight pages of random numbers.

Once all the pages and groups are utilized, another pattern will be used to generate numbers if more are needed.

This pattern will be three across and five down generating 56 numbers for later use.

The following numbers were generated from the eight pages of random numbers.

1st page:

0.034, 0.802, 0.474, 0.652, 0.211, 0.203, and 0.522.

2nd page:

0.649, 0.398, 0.229, 0.605, 0.811, 0.094, and 0.690

3rd page:

0.844, 0.701, 0.413, 0.996, 0.994, 0.810, and 0.231

4th page:

0.455, 0.606, 0.751, 0.658, 0.360, 0.814, and 0.073

5th page:

0.138, 0.573, 0.741, 0.705, 0.170, 0.792, and 0.534

6th page:

0.019, 0.656, 0.425, 0.031, 0.525, 0.874, and 0.099

7th page:

0.037, 0.185, 0.074, 0.786, 0.240, 0.355, and 0.703

8th page:

0.555, 0.746, 0.352, 0.251, 0.955, 0.234, and 0.645

Application of Random Numbers for Roadway Core Location

The example lot will use ideal conditions of consistent yield. Each **1000 ton** sublot illustrated is 6800 feet with each section of the sublot 3400 feet.

Total lot is 5000 tons.

For simplicity, the paving width is 12 feet.

Cores cannot be within 18 inches of an unsupported edge.

Transverse core locations are measured from an established alignment (for example, centerline or edgeline) left to right in the direction of travel.

QC cores are cut within 12 inches of the acceptance cores in the direction of travel.

Random numbers for the lot: 0.034, 0.802, 0.474, 0.652, 0.211, 0.208, 0.522, 0.649, 0.398, 0.229, 0.605, 0.811, 0.094, 0.690, 0.844, 0.701, 0.413, 0.996, 0.994, 0.810 - Alternatives: 0.231, 0.455, 0.606, 0.751

Sublot A

Section 1 of sublot A has random numbers of 0.034 and 0.802.

The longitudinal random number 0.034 multiplied by the section length of 3400 feet would place the core 115.6 feet from the beginning of the section of the sublot at station 11+15.6 rounded to 11+16. 10+00 (beginning of section) plus 115.6 feet equals station 11+16.

The transverse location measured from the left edge is 0.802 multiplied by the lane width of 12 feet equals 9.6 feet. The transverse location should be marked to the nearest tenth of a foot. The core would be marked at station 11+16, 9.6 feet from the left edge.

To simplify:

Paving from down station to up station

Sublot A: 10+00 – 78+00

Section 1: 10+00 – 44+00

Random #s: 0.034, 0.802

Section length 3400 feet: 3400’ x 0.034 = 115.6’

10+00 + 115.6’ = 11+15.6 = 11+16

Paving width 12 feet: 12’ x 0.802 = 9.6’ from left edge

Core location: Longitudinal = 11+16, Transverse = 9.6’ measured from left edge

Section 2: 44+00 – 78+00

Random #s: 0.474, 0.652

Section length 3400 feet: 3400’ x 0.474 = 1611.6’

44+00 + 1611.6’ = 60+11.6 = 60+12

Paving width 12 feet: 12’ x 0.652 = 7.8’ from left edge

Core location: 60+12, 7.8’ measured from left edge

Sublot B: 78+00 – 146+00

Section 1: 78+00 – 112+00

Random #s: 0.211, 0.203

Section length 3400 feet: 3400’ x 0.211 = 717.4’

78+00 + 717.4’ = 85+17.4 = 85+17

Paving width 12 feet: 12’ x 0.203 = 2.4’ from left edge

Core location: 85+17, 2.4’ from left edge

Section 2: 112+00 – 146+00

Random #s: 0.522, 0.649

Section length 3400 feet: 3400’ x 0.522 = 1774.8’

112+00 + 1774.8’ = 129+74.8 = 129+75

Paving width 12 feet: 12’ x 0.649 = 7.8’ from left edge

Core location: 129+75, 7.8’ from left edge

Sublot C: 146+00 – 214+00

Section 1: 146+00 – 180+00

Random #s: 0.398, 0.229

Section length 3400 feet: 3400’ x 0.398 = 1353.2’

146+00 + 1353.2’ = 159+53.2 = 159+53

Paving width 12 feet: 12’ x 0.229 = 2.7’ from left edge

Core location: 159+53, 2.7’ from left edge

Section 2: 180+00 – 214+00

Random #s: 0.605, 0.811

Section length 3400 feet: 3400’ x 0.605 = 2057’

180+00 + 2057 = 200+57

Paving width 12 feet: 12’ x 0.811 = 9.7’ from left edge

Core location: 200+57, 9.7’ from left edge

Paving changes to pave the travel lane in the opposite direction

Paving from up station to down station.

Subtract the distance calculated from the random number from the beginning station of the section in the sublot.

Paving is now against the previous paving strip. The left edge is supported and the 18” rule does not apply on the left edge.

Sublot D: 214+00 – 146+00

Section 1: 214+00 – 180+00

Random #s: 0.094, 0.690

Section length 3400 feet: 3400’ x 0.094 = 319.6’

214+00: 319.6 = 210+80.4 = 210+80

Paving width 12 feet: 12’ x 0.690 = 8.3’ from the left edge

Core location: 210+80, 8.3’ from the left edge

Section 2: 180+00 – 146+00

Random #s: 0.844, 0.701

Section length 3400 feet: 3400’ x 0.844 = 2869.6’

180+00 – 2869.6 = 151+30.4 = 151+30

Paving width 12 feet: 12’ x 0.701 = 8.4’ from left edge

Core location: 151+30, 8.4’ from left edge

Sublot E: 146+00 – 78+00

Section 1: 146+00 – 112+00

Random #s: 0.413, 0.996

Section length 3400 feet: 3400’ x 0.413 = 1404.2

146+00 – 1404.2 = 131+95.8 = 131+96

Paving width 12 feet: 12’ x 0.996 = 11.95 from left edge

Another random number will need to be used because this location is on the pavement edge.

The next random number from the alternates = 0.231

12’ x 0.231 = 2.8’ from left edge

Core location: 131+96, 2.8’ from left edge

Section 2: 112+00 – 78+00

Random #s: 0.994, 0.810

Section length 3400 feet: 3400’ x 0.994 = 3379.6’

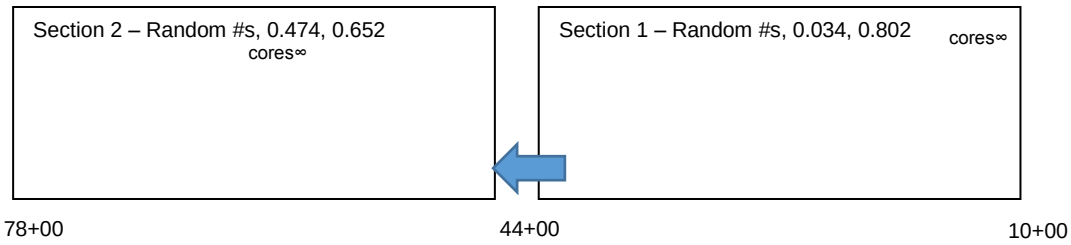
112+00 – 3379.6’ = 78+20

Paving width 12 feet: 12’ x 0.810 = 9.7’ from left edge

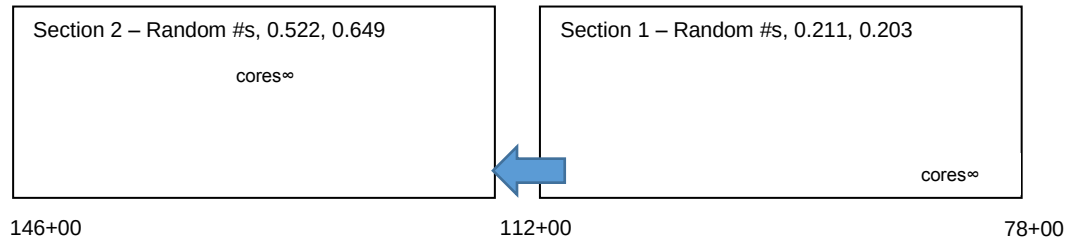
Core location: 78+20, 9.7’ from left edge

Roadway Lot Core Layout

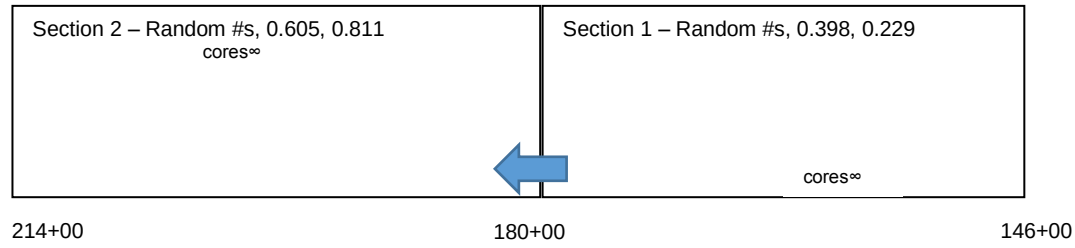
Sublot A



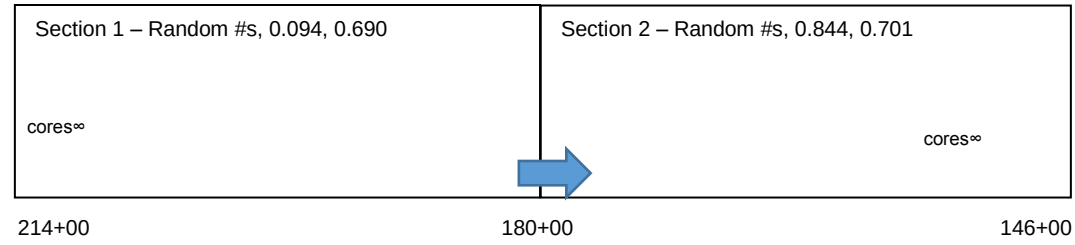
Sublot B



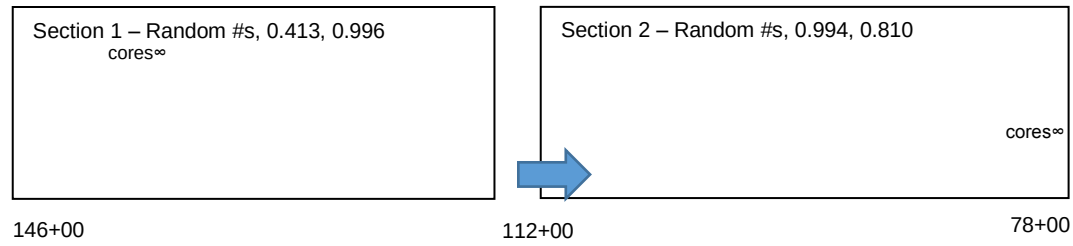
Sublot C



Sublot D



Sublot E



Cores are shown in approximate location

0.002	0.876	0.374	0.746	0.844	0.959	0.730	0.539	0.838	0.996
0.156	0.864	0.413	0.533	0.013	0.131	0.365	0.614	0.371	0.038
0.382	0.335	0.952	0.861	0.792	0.728	0.133	0.582	0.822	0.096
0.533	0.243	0.151	0.492	0.221	0.446	0.034	0.473	0.079	0.404
0.775	0.794	0.334	0.445	0.840	0.199	0.820	0.379	0.386	0.965
0.967	0.629	0.485	0.350	0.080	0.540	0.826	0.610	0.916	0.767
0.180	0.738	0.099	0.147	0.401	0.568	0.409	0.964	0.256	0.432
0.467	0.019	0.853	0.988	0.856	0.396	0.954	0.404	0.198	0.344
0.960	0.541	0.232	0.176	0.833	0.296	0.416	0.593	0.757	0.753
0.079	0.338	0.802	0.315	0.673	0.582	0.383	0.455	0.133	0.958
0.787	0.254	0.893	0.640	0.558	0.375	0.582	0.383	0.011	0.636
0.935	0.914	0.673	0.835	0.942	0.601	0.906	0.981	0.784	0.791
0.521	0.591	0.561	0.727	0.646	0.206	0.371	0.454	0.638	0.786
0.749	0.616	0.312	0.138	0.012	0.553	0.280	0.032	0.532	0.601
0.671	0.163	0.474	0.008	0.018	0.618	0.029	0.359	0.592	0.996
0.668	0.935	0.963	0.844	0.459	0.895	0.075	0.570	0.964	0.696
0.610	0.473	0.766	0.658	0.919	0.063	0.134	0.075	0.316	0.318
0.878	0.780	1.000	0.037	0.916	0.578	0.393	0.945	0.580	0.436
0.183	0.709	0.207	0.860	0.832	0.510	0.024	0.336	0.860	0.348
0.881	0.276	0.652	0.711	0.851	0.336	0.107	0.790	0.226	0.555
0.871	0.872	0.951	0.177	0.471	0.087	0.016	0.604	0.104	0.151
0.841	0.348	0.379	0.273	0.196	0.428	0.786	0.871	0.664	0.075
0.175	0.261	0.205	0.189	0.022	0.976	0.825	0.433	0.776	0.862
0.912	0.374	0.053	0.616	0.238	0.584	0.963	0.927	0.186	0.099
0.361	0.852	0.211	0.144	0.286	0.621	0.086	0.537	0.388	0.487
0.946	0.667	0.603	0.813	0.677	0.465	0.883	0.025	0.668	0.260
0.237	0.601	0.471	0.942	0.878	0.753	0.382	0.321	0.762	0.950
0.496	0.108	0.282	0.946	0.248	0.403	0.416	0.466	0.985	0.113
0.105	0.202	0.589	0.200	0.133	0.289	0.693	0.164	0.307	0.897
0.515	0.665	0.203	0.113	0.839	0.703	0.269	0.765	0.181	0.242
0.559	0.332	0.670	0.707	0.890	0.612	0.665	0.235	0.687	0.304
0.657	0.114	0.314	0.141	0.471	0.293	0.160	0.753	0.307	0.376
0.270	0.910	0.657	0.023	0.797	0.284	0.608	0.130	0.053	0.419
0.592	0.730	0.453	0.028	0.089	0.001	0.117	0.311	0.331	0.282
0.424	0.412	0.522	0.531	0.295	0.708	0.625	0.093	0.484	0.054

0.229	0.224	0.656	0.666	0.541	0.241	0.546	0.781	0.026	0.728
0.967	0.759	0.724	0.702	0.947	0.777	0.791	0.129	0.796	0.782
0.272	0.718	0.356	0.847	0.657	0.383	0.238	0.590	0.241	0.284
0.313	0.818	0.822	0.862	0.253	0.047	0.772	0.758	0.384	0.052
0.997	0.034	0.649	0.113	0.847	0.602	0.952	0.097	0.470	0.260
0.672	0.051	0.670	0.247	0.622	0.449	0.794	0.722	0.235	0.756
0.665	0.076	0.260	0.456	0.110	0.474	0.758	0.216	0.108	0.544
0.651	0.328	0.084	0.615	0.648	0.090	0.385	0.410	0.784	0.288
0.474	0.594	0.393	0.419	0.862	0.104	0.764	0.838	0.322	0.633
0.286	0.455	0.398	0.214	0.346	0.158	0.770	0.276	0.771	0.618
0.468	0.100	0.093	0.618	0.502	0.071	0.416	0.580	0.917	0.633
0.167	0.431	0.810	0.364	0.514	0.473	0.344	0.056	0.732	0.416
0.286	0.229	0.299	0.216	0.101	0.971	0.996	0.896	0.136	0.516
0.801	0.978	0.922	0.460	0.863	0.716	0.125	0.031	0.315	0.754
0.181	0.314	0.229	0.389	0.141	0.831	0.495	0.079	0.766	0.401
0.882	0.365	0.388	0.656	0.086	0.853	0.586	0.155	0.042	0.423
0.199	0.472	0.263	0.304	0.700	0.186	0.520	0.194	0.483	0.157
0.608	0.065	0.069	0.022	0.506	0.806	0.785	0.291	0.705	0.385
0.934	0.969	0.975	0.649	0.985	0.091	0.367	0.458	0.826	0.101
0.723	0.274	0.605	0.455	0.477	0.884	0.187	0.373	0.029	0.409
0.760	0.141	0.469	0.245	0.629	0.861	0.940	0.107	0.717	0.069
0.417	0.819	0.813	0.120	0.179	0.014	0.091	0.743	0.765	0.405
0.947	0.678	0.683	0.764	0.658	0.804	0.670	0.287	0.924	0.648
0.761	0.494	0.800	0.708	0.975	0.310	0.069	0.464	0.878	0.498
0.569	0.521	0.811	0.092	0.520	0.746	0.070	0.987	0.377	0.850
0.813	0.350	0.233	0.287	0.975	0.990	0.317	0.893	0.974	0.365
0.609	0.169	0.493	0.369	0.101	0.611	0.112	0.557	0.749	0.998
0.075	0.967	0.626	0.035	0.973	0.195	0.333	0.270	0.628	0.876
0.168	0.684	0.949	0.230	0.123	0.858	0.055	0.831	0.197	0.125
0.429	0.249	0.094	0.623	0.410	0.731	0.817	0.639	0.771	0.561
0.186	0.158	0.691	0.282	0.834	0.030	0.896	0.401	0.682	0.647
0.240	0.768	0.449	0.547	0.517	0.262	0.214	0.852	0.786	0.945
0.570	0.934	0.982	0.353	0.392	0.231	0.102	0.059	0.758	0.608
0.747	0.183	0.056	0.173	0.292	0.994	0.791	0.958	0.478	0.264
0.156	0.362	0.698	0.536	0.856	0.772	0.766	0.946	0.257	0.264

0.438	0.774	0.364	0.788	0.482	0.372	0.666	0.745	0.565	0.616
0.393	0.367	0.746	0.562	0.187	0.801	0.852	0.433	0.755	0.299
0.524	0.619	0.499	0.432	0.203	0.830	0.686	0.723	0.854	0.062
0.162	0.619	0.688	0.540	0.163	0.182	0.689	0.280	0.241	0.445
0.201	0.443	0.844	0.797	0.376	0.119	0.568	0.333	0.750	0.713
0.637	0.567	0.746	0.583	0.613	0.404	0.361	0.083	0.890	0.797
0.842	0.673	0.992	0.971	0.617	0.245	0.207	0.647	0.267	0.336
0.595	0.148	0.820	0.364	0.890	0.808	0.153	0.556	0.341	0.590
0.771	0.727	0.006	0.305	0.760	0.553	0.553	0.360	0.182	0.510
0.076	0.419	0.701	0.120	0.969	0.909	0.715	0.674	0.394	0.741
0.786	0.078	0.363	0.196	0.637	0.983	0.969	0.344	0.499	0.858
0.804	0.926	0.106	0.150	0.087	0.090	0.091	0.209	0.534	0.908
0.086	0.106	0.507	0.050	0.305	0.029	0.470	0.550	0.876	0.393
0.276	0.055	0.724	0.325	0.336	0.467	0.272	0.687	0.170	0.378
0.743	0.288	0.413	0.223	0.355	0.439	0.760	0.528	0.168	0.510
0.923	0.191	0.897	0.647	0.104	0.176	0.435	0.305	0.028	0.544
0.400	0.749	0.063	0.213	0.463	0.177	0.461	0.368	0.753	0.642
0.244	0.916	0.120	0.394	0.780	0.897	0.520	0.831	0.564	0.256
0.328	0.697	0.248	0.882	0.845	0.691	0.443	0.321	0.781	0.135
0.333	0.073	0.996	0.869	0.620	0.867	0.292	0.018	0.843	0.837
0.515	0.798	0.594	0.993	0.770	0.002	0.673	0.896	0.012	0.345
0.692	0.945	0.813	0.295	0.189	0.185	0.568	0.578	0.757	0.036
0.934	0.987	0.232	0.848	0.777	0.663	0.469	0.702	0.407	0.511
0.741	0.346	0.398	0.883	0.282	0.678	0.740	0.222	0.015	0.696
0.648	0.780	0.994	0.293	0.772	0.106	0.586	0.836	0.109	0.427
0.935	0.903	0.397	0.609	0.725	0.113	0.262	0.823	0.787	0.435
0.911	0.599	0.572	0.894	0.647	0.410	0.024	0.069	0.984	0.442
0.887	0.306	0.651	0.719	0.975	0.034	0.259	0.215	0.432	0.102
0.917	0.141	0.521	0.538	0.575	0.033	0.972	0.642	0.377	0.819
0.410	0.813	0.810	0.509	0.908	0.014	0.915	0.669	0.193	0.296
0.361	0.335	0.525	0.268	0.650	0.523	0.798	0.930	0.237	0.990
0.878	0.780	0.848	0.402	0.718	0.586	0.780	0.570	0.288	0.742
0.456	0.905	0.827	0.613	0.020	0.748	0.478	0.771	0.261	0.735
0.819	0.522	0.638	0.853	0.323	0.652	0.680	0.337	0.283	0.776
0.571	0.078	0.231	0.201	0.164	0.674	0.383	0.724	0.233	0.814

0.143	0.249	0.236	0.116	0.185	0.647	0.360	0.104	0.167	0.758
0.151	0.462	0.589	0.937	0.485	0.228	0.829	0.062	0.183	0.086
0.903	0.396	0.037	0.408	0.953	0.224	0.533	0.203	0.030	0.660
0.058	0.638	0.164	0.532	0.862	0.267	0.287	0.755	0.558	0.648
0.016	0.103	0.455	0.487	0.843	0.767	0.483	0.977	0.749	0.631
0.007	0.476	0.789	0.647	0.313	0.189	0.666	0.242	0.029	0.016
0.829	0.135	0.287	0.198	0.135	0.490	0.885	0.955	0.592	0.810
0.247	0.728	0.223	0.462	0.452	0.226	0.581	0.267	0.115	0.896
0.944	0.024	0.407	0.994	0.730	0.418	0.987	0.915	0.143	0.178
0.134	0.919	0.606	0.918	0.857	0.931	0.996	0.555	0.262	0.558
0.217	0.714	0.966	0.979	0.141	0.025	0.824	0.879	0.456	0.722
0.772	0.060	0.433	0.439	0.041	0.909	0.169	0.627	0.550	0.356
0.318	0.486	0.734	0.503	0.845	0.812	0.612	0.555	0.843	0.689
0.358	0.235	0.932	0.403	0.160	0.312	0.281	0.512	0.663	0.424
0.780	0.450	0.751	0.831	0.388	0.602	0.978	0.272	0.205	0.226
0.401	0.568	0.277	0.151	0.122	0.137	0.683	0.650	0.304	0.069
0.927	0.384	0.941	0.928	0.166	0.843	0.182	0.924	0.309	0.173
0.463	0.623	0.519	0.801	0.256	0.846	0.141	0.773	0.689	0.913
0.595	0.195	0.845	0.885	0.266	0.691	0.999	0.974	0.917	0.296
0.587	0.754	0.658	0.666	0.188	0.358	0.002	0.032	0.289	0.288
0.047	0.791	0.129	0.018	0.298	0.154	0.396	0.028	0.178	0.743
0.055	0.445	0.751	0.547	0.094	0.924	0.685	0.153	0.469	0.945
0.997	0.647	0.026	0.171	0.599	0.091	0.681	0.029	0.182	0.997
0.646	0.164	0.474	0.680	0.969	0.932	0.394	0.922	0.188	0.579
0.141	0.833	0.360	0.262	0.741	0.327	0.264	0.583	0.091	0.118
0.044	0.766	0.032	0.629	0.088	0.164	0.472	0.746	0.409	0.224
0.102	0.799	0.323	0.588	0.725	0.685	0.698	0.471	0.746	0.545
0.552	0.982	0.831	0.895	0.296	0.540	0.291	0.611	0.380	0.040
0.197	0.694	0.644	0.932	0.785	0.200	0.150	0.856	0.155	0.249
0.766	0.010	0.814	0.528	0.297	0.881	0.091	0.181	0.436	0.520
0.943	0.499	0.319	0.002	0.202	0.313	0.962	0.233	0.781	0.504
0.371	0.756	0.873	0.526	0.591	0.718	0.677	0.350	0.492	0.654
0.680	0.749	0.553	0.233	0.029	0.308	0.452	0.643	0.020	0.078
0.713	0.746	0.235	0.288	0.221	0.686	0.366	0.003	0.860	0.081
0.250	0.146	0.073	0.472	0.144	0.784	0.618	0.184	0.783	0.100

0.303	0.243	0.237	0.929	0.978	0.522	0.112	0.290	0.576	0.756
0.116	0.812	0.462	0.598	0.526	0.449	0.901	0.361	0.590	0.412
0.903	0.601	0.389	0.704	0.230	0.211	0.192	0.175	0.861	0.168
0.836	0.502	0.676	0.593	0.172	0.999	0.654	0.286	0.084	0.662
0.364	0.384	0.138	0.355	0.022	0.306	0.377	0.550	0.905	0.635
0.300	0.517	0.405	0.093	0.551	0.380	0.489	0.277	0.355	0.932
0.863	0.290	0.226	0.638	0.612	0.952	0.988	0.704	0.602	0.715
0.624	0.637	0.420	0.971	0.003	0.207	0.140	0.881	0.005	0.189
0.687	0.399	0.074	0.828	0.091	0.640	0.740	0.405	0.406	0.255
0.127	0.824	0.573	0.953	0.998	0.624	0.017	0.850	0.342	0.317
0.246	0.782	0.065	0.465	0.251	0.244	0.783	0.401	0.969	0.115
0.283	0.996	0.606	0.823	0.650	0.383	0.089	0.103	0.618	0.042
0.441	0.011	0.160	0.149	0.348	0.338	0.852	0.606	0.703	0.100
0.050	0.645	0.419	0.240	0.398	0.423	0.271	0.208	0.707	0.500
0.068	0.581	0.741	0.633	0.928	0.360	0.920	0.756	0.935	0.127
0.505	0.585	0.963	0.694	0.260	0.735	0.949	0.411	0.148	0.759
0.391	0.795	0.083	0.026	0.360	0.623	0.270	0.821	0.800	0.154
0.161	0.600	0.401	0.634	0.564	0.793	0.825	0.743	0.934	0.049
0.570	0.136	0.376	0.360	0.245	0.731	0.390	0.943	0.545	0.916
0.897	0.293	0.705	0.309	0.567	0.327	0.714	0.247	0.984	1.000
0.066	0.649	0.685	0.327	0.340	0.410	0.595	0.199	0.376	0.988
0.897	0.895	0.342	0.337	0.860	0.724	0.466	0.834	0.669	0.665
0.709	0.380	0.772	0.447	0.176	0.297	0.786	0.948	0.531	0.209
0.499	0.332	0.202	0.545	0.977	0.839	0.663	0.827	0.332	0.606
0.565	0.391	0.170	0.461	0.006	0.717	0.247	0.064	0.713	0.994
0.374	0.325	0.423	0.111	0.097	0.492	0.243	0.696	0.180	0.819
0.269	0.387	0.430	0.222	0.246	0.974	0.890	0.823	0.553	0.582
0.929	0.801	0.283	0.529	0.271	0.442	0.722	0.044	0.479	0.799
0.979	0.484	0.936	0.876	0.074	0.198	0.857	0.730	0.250	0.724
0.345	0.404	0.792	0.440	0.050	0.103	0.146	0.350	0.435	0.500
0.600	0.156	0.198	0.602	0.327	0.260	0.875	0.066	0.056	0.870
0.156	0.380	0.162	0.857	0.944	0.804	0.455	0.512	0.689	0.493
0.445	0.881	0.033	0.696	0.368	0.809	0.286	0.442	0.751	0.367
0.778	0.621	0.802	0.809	0.605	0.857	0.401	0.725	0.811	0.094
0.982	0.526	0.534	0.290	0.067	0.948	0.140	0.127	0.765	0.703

0.889	0.147	0.987	0.946	0.152	0.219	0.675	0.716	0.723	0.737
0.821	1.000	0.242	0.469	0.559	0.585	0.273	0.446	0.115	0.344
0.067	0.814	0.878	0.123	0.527	0.039	0.405	0.875	0.428	0.391
0.610	0.206	0.408	0.087	0.938	0.983	0.767	0.029	0.794	0.164
0.600	0.516	0.019	0.507	0.304	0.857	0.682	0.305	0.983	0.281
0.983	0.821	0.785	0.048	0.530	0.556	0.701	0.174	0.794	0.035
0.862	0.677	0.003	0.233	0.854	0.741	0.267	0.333	0.099	0.713
0.214	0.938	0.815	0.338	0.917	0.426	0.601	0.131	0.386	0.576
0.169	0.305	0.428	0.138	0.263	0.149	0.129	0.500	0.282	0.269
0.757	0.106	0.656	0.595	0.360	0.781	0.491	0.566	0.849	0.621
0.526	0.390	0.830	0.604	0.921	0.794	0.990	0.578	0.923	0.166
0.291	0.783	0.925	0.491	0.779	0.561	0.958	0.002	0.274	0.411
0.152	0.931	0.724	0.050	0.181	0.287	0.507	0.626	0.240	0.052
0.465	0.752	0.580	0.709	0.943	0.507	0.127	0.508	0.623	0.061
0.218	0.370	0.425	0.093	0.997	0.845	0.270	0.635	0.482	0.020
0.969	0.526	0.848	0.797	0.032	0.107	0.960	0.425	0.675	0.326
0.675	0.719	0.804	0.914	0.952	0.852	0.260	0.777	0.297	0.132
0.104	0.260	0.590	0.682	0.223	0.454	0.792	0.402	0.043	0.189
0.600	0.152	0.624	0.865	0.562	0.538	0.922	0.800	0.677	0.215
0.499	0.219	0.031	0.121	0.459	0.574	0.486	0.530	0.894	0.322
0.956	0.352	0.629	0.836	0.299	0.572	0.523	0.597	0.369	0.231
0.143	0.330	0.239	0.875	0.055	0.228	0.146	0.853	0.545	0.933
0.169	0.392	0.025	0.427	0.196	0.839	0.930	0.482	0.187	0.986
0.366	0.834	0.279	0.883	0.299	0.735	0.760	0.040	0.573	0.033
0.445	0.430	0.525	0.449	0.478	0.197	0.486	0.195	0.104	0.475
0.953	0.591	0.431	0.223	0.700	0.851	0.715	0.489	0.625	0.668
0.211	0.997	0.601	0.785	0.101	0.473	0.124	0.182	0.547	0.620
0.025	0.053	0.395	0.130	0.048	0.217	0.554	0.659	0.546	0.129
0.601	0.165	0.109	0.142	0.613	0.506	0.381	0.173	0.790	0.716
0.855	0.443	0.874	0.866	0.932	0.427	0.913	0.900	0.016	0.685
0.389	0.375	0.939	0.731	0.246	0.491	0.478	0.586	0.860	0.333
0.270	0.175	0.453	0.719	0.881	0.232	0.022	0.569	0.330	0.859
0.278	0.198	0.841	0.402	0.647	0.432	0.097	0.795	0.862	0.975
0.797	0.031	0.169	0.900	0.778	0.923	0.686	0.707	0.487	0.790
0.944	0.821	0.099	0.257	0.136	0.962	0.041	0.790	0.122	0.275

0.215	0.152	0.693	0.642	0.706	0.418	0.156	0.064	0.241	0.704
0.750	0.537	0.194	0.292	0.930	0.322	0.414	0.263	0.057	0.001
0.654	0.344	0.512	0.258	0.883	0.081	0.782	0.750	0.270	0.027
0.531	0.014	0.110	0.081	0.205	0.788	0.483	0.646	0.186	0.659
0.914	0.753	0.037	0.461	0.839	0.816	0.869	0.297	0.126	0.169
0.356	0.629	0.463	0.043	0.425	0.308	0.874	0.135	0.176	0.971
0.154	0.434	0.026	0.710	0.497	0.452	0.642	0.407	0.109	0.523
0.675	0.651	0.075	0.317	0.838	0.648	0.272	0.236	0.340	0.015
0.596	0.840	0.238	0.877	0.305	0.966	0.703	0.168	0.733	0.688
0.764	0.545	0.185	0.784	0.538	0.817	0.261	0.855	0.484	0.300
0.428	0.769	0.721	1.000	0.087	0.559	0.925	0.034	0.938	0.466
0.853	0.195	0.915	0.256	0.013	0.062	0.477	0.471	0.517	0.567
0.528	0.790	0.645	0.423	0.762	0.130	0.155	0.321	0.697	0.661
0.872	0.302	0.191	0.380	0.575	0.200	0.720	0.417	0.726	0.585
0.190	0.701	0.074	0.089	0.580	0.176	0.650	0.534	0.182	0.197
0.199	0.762	0.730	0.272	0.574	0.584	0.190	0.809	0.123	0.739
0.503	0.020	0.601	0.276	0.054	0.639	0.645	0.275	0.149	0.613
0.325	0.298	0.285	0.415	0.825	0.479	0.492	0.145	0.771	0.672
0.531	0.067	0.236	0.545	0.219	0.747	0.965	0.044	0.680	0.436
0.840	0.117	0.786	0.866	0.122	0.118	0.580	0.107	0.496	0.783
0.957	0.652	0.462	0.203	0.387	0.367	0.086	0.679	0.961	0.484
0.656	0.888	0.538	0.282	0.270	0.236	0.280	0.608	0.886	0.845
0.349	0.909	0.865	0.037	0.057	0.912	0.542	0.756	0.237	0.627
0.850	0.809	0.132	0.817	0.535	0.357	0.567	0.594	0.991	0.534
0.702	0.299	0.240	0.624	0.127	0.325	0.100	0.689	0.605	0.031
0.062	0.064	0.222	0.407	0.911	0.609	0.235	0.655	0.626	0.147
0.402	0.324	0.583	0.973	0.069	0.174	0.596	0.854	0.803	0.416
0.832	0.420	0.835	0.476	0.116	0.355	0.125	0.963	0.682	0.288
0.293	0.972	0.873	0.806	0.228	0.391	0.846	0.474	0.644	0.370
0.793	0.281	0.355	0.602	0.729	0.423	0.570	0.570	0.355	0.815
0.976	0.434	0.056	0.245	0.890	0.682	0.532	0.585	0.267	0.241
0.127	0.948	0.846	0.168	0.358	0.211	0.204	0.601	0.697	0.805
0.015	0.116	0.121	0.179	0.284	0.148	0.477	0.841	0.841	0.634
0.177	0.393	0.876	0.529	0.266	0.447	0.799	0.365	0.392	0.851
0.194	0.486	0.703	0.115	0.176	0.138	0.210	0.447	0.891	0.061

0.645	0.307	0.484	0.732	0.342	0.893	0.283	0.932	0.174	0.439
0.496	0.774	0.083	0.773	0.200	0.867	0.224	0.996	0.902	0.756
0.257	0.721	0.454	0.307	0.834	0.768	0.598	0.183	0.778	0.714
0.938	0.074	0.028	0.216	0.596	0.838	0.844	0.505	0.353	0.201
0.322	0.961	0.555	0.181	0.753	0.173	0.548	0.889	0.844	0.393
0.946	0.865	0.345	0.793	0.498	0.594	0.100	0.414	0.837	0.383
0.069	0.244	0.901	0.226	0.342	0.298	0.299	0.835	0.673	0.132
0.400	0.486	0.578	0.680	0.443	0.827	0.519	0.837	0.429	0.324
0.201	0.672	0.084	0.484	0.528	0.697	0.688	0.518	0.238	0.096
0.021	0.601	0.746	0.301	0.241	0.382	0.236	0.851	0.949	0.907
0.530	0.917	0.236	0.599	0.759	0.404	0.994	0.465	0.372	0.047
0.256	0.177	0.521	0.395	0.875	0.187	0.337	0.096	0.288	0.532
0.141	0.383	0.685	0.481	0.126	0.178	0.324	0.692	0.517	0.706
0.308	0.018	0.773	0.039	0.582	0.634	0.834	0.468	0.445	0.631
0.960	0.110	0.352	0.738	0.192	0.658	0.282	0.330	0.956	0.681
0.472	0.369	0.858	0.379	0.772	0.448	0.184	0.200	0.426	0.583
0.149	0.221	0.544	0.913	0.416	0.705	0.061	0.964	0.931	0.742
0.442	0.639	0.585	0.369	0.941	0.575	0.752	0.086	0.679	0.046
0.228	0.176	0.317	0.043	0.594	0.718	0.629	0.708	0.553	0.726
0.724	0.766	0.251	0.290	0.233	0.118	0.129	0.156	0.205	0.245
0.334	0.626	0.034	0.586	0.206	0.195	0.158	0.540	0.901	0.838
0.842	0.255	0.651	0.337	0.808	0.852	0.711	0.566	0.010	0.249
0.518	0.141	0.307	0.233	0.098	0.335	0.354	0.942	0.239	0.661
0.453	0.414	0.482	0.049	0.681	0.351	0.439	0.992	0.042	0.764
0.492	0.602	0.955	0.654	0.380	0.949	0.837	0.373	0.726	0.618
0.075	0.840	0.024	0.866	0.166	0.256	0.123	0.310	0.294	0.474
0.728	0.523	0.148	0.688	0.970	0.474	0.245	0.592	0.556	0.196
0.538	0.661	0.535	0.598	0.608	0.723	0.226	0.832	0.199	0.463
0.314	0.102	0.392	0.030	0.671	0.352	0.200	0.389	0.913	0.702
0.847	0.583	0.234	0.075	0.541	0.568	0.552	0.895	0.996	0.751
0.484	0.271	0.498	0.926	0.196	0.577	0.798	0.723	0.655	0.832
0.598	0.264	0.305	0.779	0.933	0.152	0.714	0.079	0.213	0.467
0.213	0.527	0.212	0.923	0.054	0.682	0.787	0.833	0.136	0.837
0.609	0.050	0.808	0.716	0.681	0.534	0.798	0.822	0.927	0.697
0.791	0.831	0.645	0.196	0.685	0.937	0.078	0.316	0.067	0.561

Levels and Requirements for Asphalt Plant Qualified Tester and Certification

Qualified Aggregate Tester

Introduction to Standard Specifications
Math for Construction Personnel
Sampling of Aggregate and Aggregate Mixtures
Sampling of Asphalt Materials
Determination of Moisture Content of Aggregates
Sieve Analysis of Fine and Coarse Aggregates
Amount of Material Finer than No. 200 Sieve in Aggregate by Wash
Splitting and Quartering Samples
Standard Method of Test for Bulk Density (Unit Weight) and Voids in Aggregate
Aggregate Specialty Area Examination

Technician must begin Asphalt Mixture Level 1 Qualified Technician Training within 1 year of Proficiency Sample Program Participation.

Qualified Asphalt Concrete Plant Level I

Must participate in Proficiency Sample Program
No experience required
Must have completed Qualified Aggregate Tester
Basic Asphalt Concrete Plant Inspection
Lecture:
- Superpave Materials
- Asphalt Mixture Volumetrics
- Gyratory Compaction
- Quality Control and Acceptance
- Basic Asphalt Mixture Plant Operations

Performance:
- Specific Gravity and Density of Compressed Asphalt Mixtures
- Mechanical Analysis of Extracted Aggregate
- Determination of the Moisture Content of Asphalt Concrete
- Determination of the Asphalt Content of Asphalt Mixtures by the Ignition Method
- Theoretical Maximum Specific Gravity of Asphalt Concrete Mixtures
- Preparing and Determining the Density of Hot Mix Asphalt Specimens by Means of the Superpave Gyratory Compactor

Asphalt Mixture Level I Specialty Area Examination

Certified Asphalt Concrete Plant Level II

6 months experience required
Must participate in Proficiency Sample Program
Required for QC Plant Technicians and DOTD Asphalt District Inspectors
May review and verify Job Mix Formula (JMFs) and perform asphalt tests for record.
Math for Construction Personnel Vol. 2
Lecture:
- Asphalt Mixture Superpave Aggregate Properties
- Water Susceptibility of Asphalt Mixtures
- Review of JMF Submittals

Performance:
- Sand Equivalent of Soils and Fine Aggregate

Fine Aggregate Angularity
Coarse Aggregate Angularity
Specific Gravity and Absorption of Fine Aggregates
Specific Gravity and Absorption of Coarse Aggregates
Flat and Elongated Particles
Test for Hamburg Wheel –Track Testing of Compacted Asphalt Mixtures
Loose Mix and Compressed Mix Testing and Analysis

Asphalt Mixtures Level II Specialty Area Examination

Certified Asphalt Concrete Plant Level III

Authorized to submit JMF proposals for record
QC Mix Designer requirement and Asphalt District Inspector DCL requirement
12 months experience in asphalt QC or QA

Lecture:

Mix Design Steps and Approval

Performance:

Batching Aggregates and Asphalt Cement for Producing Trial Blends

Asphalt Mixtures Level III Specialty Area Examination

State of Louisiana

Department of Transportation and Development

DOTD 03-22-3075
Rev. 10/15

ASPHALT CONCRETE PLANT CERTIFICATON REPORT

GENERAL INFORMATION

Last Certification Date on Sticker: _____ Date: _____

Plant Name: _____ District: _____

Plant Owner: _____ Location: _____

Plant Code: H_____ Make/Model: _____ Serial #: _____

Mailing Address: _____

Physical Address: _____

Plant Type: ☐ Drum Mixer ☐ Batch ☐ Screenless Batch Recycle Capability ☐ Yes / ☐ No

Burner Fuel: _____

Remarks: _____

_____

MATERIAL STORAGE AND HANDLING

On Site Virgin Aggregate Crusher: ☐ Yes / ☐ No Type: ☐ Cone ☐ Roller ☐ Sling ☐ Jaw

☐ Other _____ Oversize Re-crush System: ☐ Yes / ☐ No

RAP Processing: Screened over 1" ☐ Yes / ☐ No Is RAP Fractionated ☐ Yes / ☐ No

Is pre-screened/processed RAP Stockpiled Separately ☐ Yes / ☐ No

Stockpile Building Method: ☐ Dozer ☐ Loader ☐ Dragline ☐ Radial Arm Conveyor ☐ Other

Remarks: _____

_____

STOCKPILES

Satisfactory Drainage of Plant Site: ☐ Yes / ☐ No Adequate Room for Equipment: ☐ Yes / ☐ No

Remarks: _____

_____

_____

Material	Approved Source		Satisfactory Drainage		Separation						Contamination		Segregat	
					Adequate		Spacing		Partition					
	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	

COLD AGGREGATE FEEDER

	Virgin Aggregate	Recycled Material
Type of loading……	☐ Front End Loader	☐ Front End Loader
	☐ Other _____	☐ Other _____
Number of Cold Feed Systems Used……	_____	_____
If more than one system is used, are they integrated?....	☐ Yes / ☐ No	☐ Yes / ☐ No
Number of Cold Bins Used……	_____	_____
Number of bins sufficient for operations……	☐ Yes / ☐ No	☐ Yes / ☐ No
Bins are large enough for continuous operation at rated capacity	☐ Yes / ☐ No	☐ Yes / ☐ No
Condition of bins satisfactory…….....	☐ Yes / ☐ No	☐ Yes / ☐ No
Partitions extend a minimum one foot above top between bins	☐ Yes / ☐ No	☐ Yes / ☐ No
Bins equipped with vibrators……	☐ Yes / ☐ No	☐ Yes / ☐ No
Individual Bin Gates:		
Gate rectangular……	☐ Yes / ☐ No	☐ Yes / ☐ No
Positive mechanical adjustment……..	☐ Yes / ☐ No	☐ Yes / ☐ No
Locks in position……	☐ Yes / ☐ No	☐ Yes / ☐ No
Aggregate Proportioning by cold feed……..	☐ Applicable ☐ N/A	☐ Applicable ☐ N/A
Determined by…….....	☐ Belt Speed	☐ Gate Opening
Calib. Curve / each bin per material type used……	☐ Yes / ☐ No	☐ Yes / ☐ No
Automatic shut off on each bin……..	☐ Yes / ☐ No	☐ Yes / ☐ No
Adjusted and operating correctly…….....	☐ Yes / ☐ No	☐ Yes / ☐ No

Remarks: _____

_____

_____

Hydrated Lime Additive Equipment

Interlocked and synchronized with cold feed control……☐ Yes / ☐ No

Positive Signal Auto shut-down…..☐ Yes / ☐ No

Separate Bulk Storage……☐ Yes / ☐ No

with approved feed……..☐ Yes / ☐ No

can be readily calibrated……..☐ Yes / ☐ No

can be easily sampled……..☐ Yes / ☐ No

can be easily verified……☐ Yes / ☐ No

has totalizer……☐ Yes / ☐ No

Approved spray system:

Consistently maintains aggregate in uniform surface wet condition……..☐ Yes / ☐ No

Moisture content can be introduced into automatic moisture controls…..☐ Yes / ☐ No

Approved mixing device…….. ☐ Yes / ☐ No

coats uniformly……..☐ Yes / ☐ No

located between additive point and dryer: …… ☐ Yes / ☐ No

Dispersed directly onto aggregate ☐ Yes / ☐ No

between cold feed and dryer….☐ Yes / ☐ No

minimum required amount added……. ……☐ Yes / ☐ No

included in belt scale weight…. ☐ Yes / ☐ No

Remarks: _____

_____

_____

Mineral Filler Equipment

Capacity _____ (tons)

Adequate…… ☐ Yes / ☐ No

Weatherproof…….. ☐ Yes / ☐ No

Leakage…… ☐ Yes / ☐ No

Hopper w/adjustable feed…….. ☐ Yes / ☐ No

Can be accurately calibrated…….☐ Yes / ☐ No

Mineral Filler Equipment (cont.)

Interlock w/aggr. & asphalt feeds ☐ Yes / ☐ No

Proportions accurately……..☐ Yes / ☐ No

Constant flow of material……☐ Yes / ☐ No

For Drum & Continuous Plants:

Introduced into mix in advance of asphalt for proper drying time……☐ Yes / ☐ No

For Batch Plants:

Batched into mix w/aggregates…..☐ Yes / ☐ No

Screens & Scalpers

Over fine sand bins ……☐ Yes / ☐ No

Size _____ ☐ N/A

Between cold feed discharge & belt scale

Size _____ ☐ N/A ☐ Yes / ☐ No

Vibrating …….. ☐ Yes / ☐ No

Over RAP/Recycle …… ☐ Yes / ☐ No

Size _____ ☐ N/A

Batch Plant Hot Bin Screens …… ☐ Yes / ☐ No

Size _____ ☐ N/A

Remarks: _____

_____

_____

Dust Collection

☐ Baghouse ☐ Other _____

Controller type:

☐ Collector box ☐ Surge bin ☐ Filler Silo

Collected fines returned to mix ….☐ Yes / ☐ No

☐ Auger/Screw ☐ Other _____

Material returned to approved location near asphalt discharge …… ☐ Yes / ☐ No

Uniform rate of fines return …….☐ Yes / ☐ No

Acceptable condition of system ☐ Yes / ☐ No

Remarks: _____

_____

_____

Asphalt Cement & Equipment

Number of Storage/Working tanks _____

Total capacity _____ Agitators ☐ Yes / ☐ No

Circulation system …….. ☐ Yes / ☐ No

Method of heating ☐ Hot oil ☐ Other _____

Uniform Heating …… ☐ Yes / ☐ No

Required temperature …. ☐ Yes / ☐ No

Under positive control …. ☐ Yes / ☐ No

Pipelines & fittings: Insulated ☐ Yes / ☐ No

Heated … ☐ Yes / ☐ No

Leakage, tanks or piping …… ☐ Yes / ☐ No

Automatic shut-off controls …….. ☐ Yes / ☐ No

Controls operable …….. ☐ Yes / ☐ No

Calibration charts & measuring stick provided

☐ Yes / ☐ No

Thermometers

Graduated in 5°F increments ….. ☐ Yes / ☐ No

Accurate ± 5°F …… ☐ Yes / ☐ No

Located near tank discharge …… ☐ Yes / ☐ No

A/C measured by volume

Postive displacement pump ……. ☐ Yes / ☐ No

Recorded in digital form to the nearest gallon

☐ Yes / ☐ No

Automatic temp. correction ..... ☐ Yes / ☐ No

Quantity totalized …….. ☐ Yes / ☐ No

1.0% accuracy of measurement ☐ Yes / ☐ No

Warm Mix capabilities …….. ☐ Yes / ☐ No

☐ Foaming ☐ Chemical

Latex Blending …….. ☐ Yes / ☐ No

Crumb Rubber Blending …….. ☐ Yes / ☐ No

Remarks: _____

_____

_____

_____

_____

_____

Anti-Stripping Additive Storage & Equipment

Recirculating system …….. ☐ Yes / ☐ No

Total capacity _____ gallons

Calibration chart & measuring stick provided

☐ Yes / ☐ No

Uniform heat …….. ☐ Yes / ☐ No

Heating: ☐ Hot oil ☐ Electric ☐ Other _____

Dispensed directly into asphalt feed line

☐ Yes / ☐ No

Between asphalt control valve & end of asphalt

discharge line …….. ☐ Yes / ☐ No

Required quantity of anti-stripping additive

uniformly proportioned …….. ☐ Yes / ☐ No

How is proportioning verified? _____

_____

Is proportioning easily and quickly verifiable?

☐ Yes / ☐ No

Include positive displacement accumulating

meter …….. ☐ Yes / ☐ No

Displays accumulated anti-strip used

☐ Yes / ☐ No

Reads to 0.25 gallons …….. ☐ Yes / ☐ No

Thermometer in 5°F increments ☐ Yes / ☐ No

Accurate ±5°F …….. ☐ Yes / ☐ No

Located near storage discharge point

☐ Yes / ☐ No

Remarks: _____

_____

_____

_____

_____

_____

PRODUCTION AND STORAGE OF MIX

□ DRUM MIXER PLANT □ BATCH PLANT

□ Single Drum □ Separate Mixing Drum □ Double Barrel

Rated capacity tons per hour _____

Mixing unit is continuously supplied with sufficient materials to operate at capacity ..... ☐ Yes / ☐ No

Aggregates properly dried ..... ☐ Yes / ☐ No

Temperature is uniform ..... ☐ Yes / ☐ No

Temperature within specification limits ..... ☐ Yes / ☐ No

Equipped with automatic burners ..... ☐ Yes / ☐ No

Moisture content within specification limits ..... ☐ Yes / ☐ No

Slope of dryer within manufacturer recommended angle limits ..... ☐ Yes / ☐ No

Flights in acceptable condition ..... ☐ Yes / ☐ No

Proper asphalt coating of materials ..... ☐ Yes / ☐ No

Segregation of mix ..... ☐ Yes / ☐ No

Mixture is uniform ..... ☐ Yes / ☐ No

Oxidation of asphalt ..... ☐ Yes / ☐ No

Remarks: _____

_____

_____

THERMOMETERS

Heated aggregates or asphalt mixture – for drum plants the thermometer will be located at the mix discharge from the drum or other approved location.

Graduated in maximum 10°F increments ..... ☐ Yes / ☐ No

Accuracy of ±5°F ..... ☐ Yes / ☐ No

Recording thermometer ..... ☐ Yes / ☐ No

Sensitive to 10°F change in one minute ..... ☐ Yes / ☐ No

Registers & automatically records discharge temperature ..... ☐ Yes / ☐ No

Describe Location: _____

Storage Silo Number of _____ Capacity each _____ tons ☐ Applicable ☐ N/A

Airlock..... ☐ Yes / ☐ No

Surge Bin Capacity _____ tons ☐ Applicable ☐ N/A

☐ Heated ☐ Unheated ☐ Hot oil ☐ Other _____

Type of atmosphere ☐ Air ☐ Inert gas. Can system be purged if inert gas ..... ☐ Yes / ☐ No

Indicator(s) installed at top of slope portion ..... ☐ Yes / ☐ No

High silo indicator(s) ..... ☐ Yes / ☐ No

Signal: ☐ Light ☐ Audible Obvious to plant operator ..... ☐ Yes / ☐ No

Any segregation ..... ☐ Yes / ☐ No

Automatic warning system for gate malfunction ..... ☐ Yes / ☐ No

Discharged mix within 15°F of plant discharge temperature ..... ☐ Yes / ☐ No

Type of discharge: ☐ Clam ☐ Other _____

Method of conveyance to silo or surge bin: ☐ Drag Slat ☐ Bucket ☐ Other _____

Type of anti-segregation system: _____

Conveyance system works continuously ..... ☐ Yes / ☐ No

Remarks: _____

_____

TRUCK WASH DOWN AREA

Area for haul trucks to wash out ..... ☐ Yes / ☐ No

MIX RELEASE AGENT

☐ Spray bar ☐ Hand sprayer ☐ Platform if hand sprayer ☐ Other _____

Approved source ..... ☐ Yes / ☐ No

SAMPLING PLATFORM

Sturdy construction ..... ☐ Yes / ☐ No

Acceptable location ..... ☐ Yes / ☐ No

Acceptable size ..... ☐ Yes / ☐ No

Truck & asphalt mix easily assessable ..... ☐ Yes / ☐ No

Sufficient lighting for non-daylight hours ..... ☐ Yes / ☐ No

Remarks: _____

_____

_____

PLANT LABORATORY: Length _____ Width _____ Square feet _____ Minimum 160 ft^2

R18 Compliant ..... ☐ Yes / ☐ No

Acceptable location in relation to the asphalt plant ..... ☐ Yes / ☐ No

Protected from the weather ..... ☐ Yes / ☐ No

Heated ..... ☐ Yes / ☐ No

Air Conditioned ..... ☐ Yes / ☐ No

Fume hood ..... ☐ Yes / ☐ No

Exhaust fan ..... ☐ Yes / ☐ No

Running water ..... ☐ Yes / ☐ No

Electricity ..... ☐ Yes / ☐ No

Required testing equipment ..... ☐ Yes / ☐ No

Adequate counter space …….. ☐ Yes / ☐ No

Sufficient chairs & desks …… ☐ Yes / ☐ No

File storage …….. ☐ Yes / ☐ No

Sample storage …….. ☐ Yes / ☐ No

Acceptable sanitation facilities …. ☐ Yes / ☐ No

Constant temp. ovens 100 - 400°F ±5°F …….. ☐ Yes / ☐ No

Remarks:_____

_____

_____

SCALES & METERS						
	[1]Asphalt Meter/Scale	[2]Aggregate Scale	Mineral Filler	Anti-Strip	[3]Platform Scales	[4]Silo/Bin Scales
Make						
Graduation						
Date Calib.						
Max Error %						
Type Panel Indicator						
Accurate ± 1%						
Accurate ± 0.5%						

[1]Asphalt Meter/Scale

Material delivery diverted for checking accuracy …….. ☐ Yes / ☐ No

Are readouts & indicators visible to the plant operator …….. ☐ Yes / ☐ No

[2]Aggregate Scales

Scale interlocked with asphalt measuring equipment …….. ☐ Yes / ☐ No

Scale wet weight corrected to dry weight …….. ☐ Yes / ☐ No

Material delivery diverted for checking accuracy …….. ☐ Yes / ☐ No

[3]Platform Scales ☐ Applicable ☐ N/A

Sufficient length to weigh entire transport …….. ☐ Yes / ☐ No

Prints zero weight …….. ☐ Yes / ☐ No

Prints tare weight …….. ☐ Yes / ☐ No

Prints transport & mix weight (gross weight) …….. ☐ Yes / ☐ No

Prints mix weight (net weight) …….. ☐ Yes / ☐ No

[4]Silo/Bin Scales ☐ Applicable ☐ N/A

Type:_____ ☐ Weigh Hopper ☐ Suspended Bin

Type Scale: _____ ☐ Springless ☐ Load Cell

Remarks: _____

_____

_____

_____

BATCH PLANTS

HOT BINS ☐ Applicable ☐ N/A

Adequate size & number for continuous operation at rated capacity ..... ☐ Yes / ☐ No

Adequate storage for individual components ..... ☐ Yes / ☐ No

Provided with overflow to prevent contamination ..... ☐ Yes / ☐ No

Free flowing ..... ☐ Yes / ☐ No

Acceptable condition ..... ☐ Yes / ☐ No

BATCH PLANT GUGMILL ☐ Applicable ☐ N/A

Twin shafts ..... ☐ Yes / ☐ No

All mixing paddles within acceptable wear limits ..... ☐ Yes / ☐ No

Liner condition acceptable ..... ☐ Yes / ☐ No

Clogged spray bars ..... ☐ Yes / ☐ No

Weigh box leaking ..... ☐ Yes / ☐ No

Pugmill gate leaking ..... ☐ Yes / ☐ No

Timing device operating properly ..... ☐ Yes / ☐ No

Discharge gates lock during timing cycle ..... ☐ Yes / ☐ No

Additional material interlock working ..... ☐ Yes / ☐ No

Asphalt bucket locked out during dry mixing ..... ☐ Yes / ☐ No

Signal operational ..... ☐ Yes / ☐ No

Remarks: _____

_____

_____

_____ _____

DISTRICT LABORATORY REPRESENTATIVE DATE

_____ _____

APPROVED BY DISTRICT LAB ENGINEER DATE

Asphalt Concrete Plant Review

Plant:_____ Location:_____

Company:_____ Arrival Time:_____ Departure:_____

Date:_____ Inspector/title:_____

Contractor Technician(s) & Title:_____

_____

Review to be completed & maintained at the District Laboratory. Maintain separate files for each plant in the district.

Completed minimum once every 90 days

	Yes	No
Lab AASHTO R18 current	O	O
Lab Equipment Manual current	O	O
Scales & Meters calibrations current	O	O
Stockpiles		
Proper drainage	O	O

Comments/Findings:_____

_____

Separated with partitions or space between each material	O	O

Comments/Findings:_____

_____

Segregation	O	O

Comments/Findings:_____

_____

Does contractor fractionate RAP	O	O
Stockpiled separately	O	O
Does contractor use 1 inch screen for RAP	O	O

Comments/Findings:_____

_____

	Yes	No
Cold feeds comply with certification requirements (Bins & Belts)	O	O
Drum/burner comply with certification requirements	O	O
Mix drag/conveyor comply with certification requirements	O	O
Silo batchers comply with certification requirements	O	O
Load out gates functioning properly	O	O
Segregation	O	O
Proper aggregate coating with asphalt	O	O

Comments/Findings: _____

_____

	Yes	No
Warm mix equipment &/or additives meet certification requirements	O	O
Lab testing equipment maintained in proper working condition	O	O
Lab sampling & testing equipment clean & free of residue	O	O
Lab technician(s) have proper certification/qualification for duties performed	O	O
CDs for AC up to date in storage file or binder	O	O
CDs for anti-strip up to date in storage file or binder	O	O
CAs for fibers used to control drain down up to date in storage file or binder	O	O
CAs for warm mix additives up to date in storage file or binder	O	O
Data software up to date for all JMFs	O	O
Contractor documentation up to date	O	O
Anti-strip metering verifies	O	O
Mix release for haul trucks operating properly	O	O
Dust collection system operating properly	O	O

Comments: _____

_____

_____

_____

_____

ASPHALT MIXTURE TESTING

Each JMF being produced/shipped during DOTD visit to be sampled & tested. A minimum of one verification sample every 30 days is to be sent to the district lab & tested for G_{mm}, %AC, gradation, %crushed, V_a, VMA, & VFA.

JMF #:_____ Lot_____ Date sampled:_____ Date tested:_____

Sampled by:_____ Tested by:_____ Mix temp____

Gyratory specimens @ N_{design}

			Plant Lab	District Lab
G_{mm}:	_____	_____	O	O
$\%G_{mb}$: @ini	_____	@des_____ _____	O	O
V_a:	_____	_____	O	O
VMA:	_____	_____	O	O
VFA:	_____	_____	O	O
%AC	_____	_____	O	O
Gradation		_____	O	O

% Crushed: _____

Mix Moisture _____

	Yes	No
Mix segregation	O	O
Proper aggregate coating with AC	O	O
Haul trucks compliant	O	O

Contractor Generated Data Review

Rolling five G_{mm} ≥71 PWL	O	O
Rolling five V_a ≥71 PWL	O	O
Rolling five average No. 8 gradation within specification limits	O	O
Rolling five average No. 200 gradation within specification limits	O	O
Is DOTD gradation within verification tolerance of Contractor results	O	O
Rolling five VFA average in specification	O	O
VMA in specification	O	O
Any deficiencies or discrepancies found	O	O
Were any concerns conveyed to plant personnel	O	O

Date:_____

Deficiencies, Comments, etc:_____

ASPHALT CEMENT SAMPLES

Working tank AC samples for each PG grade on site at time of visit. To be tested at the District Lab or Materials Lab. Transport samples taken at the request of the Materials Lab

Inspector:_____

	Date Sampled	Supplier	Working Tank	Transport
PG 58-28	_____	_____	O	O
PG 67-22	_____	_____	O	O
PG 70-22	_____	_____	O	O
PG 76-22	_____	_____	O	O
PG 76-22rm	_____	_____	O	O
			Yes	No
AC tanks & heaters meet certification requirements_____			O	O
AC metering verifies_____			O	O

Comments:_____

_____

_____

_____

Inspector:_____ Date:_____

DLE:_____ Date:_____

CDs from previous month attached. Date: _____ initials: _____

Deficiencies Corrected. Date: _____ initials:_____Comments:_____

_____

_____

_____

Asphalt Concrete Roadway Equipment Review

State of Louisiana

Department of Transportation and Development

CONTRACTOR ASPHALT CONCRETE ROADWAY EQUIPMENT REVIEW

Date:_____ Project No.:_____ District:____ Gang:_____

Inspector:_____

Review of equipment used for Asphalt Concrete cold planning and paving. To be included in project 2059.

Asphalt Milling Machine

Make & Model:_____

	Yes	No
Sufficient power, traction, & stability to provide uniform profile grade & cross slope	O	O
Capable of controlling uniform profile grade & cross slope from an erected string line, shoe device or approved traveling reference plane	O	O
Does method of control accurately reflect the average grade of the surface to be operated on	O	O
Automatic system for controlling cross slope	O	O
Milling drum true to round	O	O
Milling teeth in sufficient number & proper condition to produce a uniform surface & texture	O	O
Fuel or fluid leak	O	O

Asphalt Distributor

Make & Model:_____

Serial No.:_____

ASTM D 2995 Calibrated	O	O
Date Calibrated:_____ Calibration Current	O	O
Copy of Calibration	O	O
Overall condition acceptable	O	O
Fluid or fuel leaks	O	O
Heating system capable of heating material to proper temperature & maintaining temperature	O	O
Thermometer easily readable	O	O
Acceptable accuracy	O	O

Location:_____

	Yes	No
Computerized controls	O	O
Proper function of controls	O	O
Does the application rate verify with the on board rate?	O	O
Spray Bar		
Capable of a sharp line of material parallel to the direction of travel?	O	O
Proper operation	O	O
Uniform pressure & flow of material	O	O
Uniform coverage	O	O
Clogged Nozzles	O	O
Hand Wand capable of applying material to areas inaccessible to spray bar	O	O

Material Transfer Vehicle

MTV

Make & Model: _____

Lightweight MTV	O	O
Fluid or fuel leaks	O	O
Capable of remixing asphalt concrete?	O	O
Minimum 20 storage capacity?	O	O
Does discharge conveyor swivel to facilitate operation from adjoining lane to paving operation?	O	O
Tracked or high flotation tires?	O	O
Attachment for Windrow Paving capable of removing 95% of mixture from paving surface	O	O
Lightweight MTV		
Counter rotating augers	O	O
Offset gravity transfer conveyor chute, or	O	O
Twin interlaced augers	O	O

Thermal Profile System for use with Lightweight MTV

Make & Model: _____

Capable of continuously recording temperature of the full width of pavement as the mixture exits the paver	O	O
GPS - location & distant traveled	O	O
Capable of instant data review	O	O

	Yes	No
Permanent record of temperature & location data	O	O
Capable of correlating thermal profile with roadway lot & roadway sublot	O	O

Paver

Make & Model: _____

Serial #: _____

Automatic grade & slope control used with traveling reference plane or erected string line	O	O
Capable of placing mixtures within specification tolerances	O	O
Screed or strike off the entire width of the paving strip	O	O
Paving strip uniform in appearance & quality	O	O
Capable of adjusting to changing cross slope	O	O
Minimum 5 ton insert hopper when used in conjunction with a MTV	O	O
Screed & extension heaters	O	O
Screed & extension vibrators	O	O
Augers evenly distribute mix in front of screed	O	O
Capable of placing mix to required thickness & width without segregation or tearing	O	O
Fluid or fuel leaks	O	O

Spray Paver

Insulated tack storage	O	O
Calibrated load cells	O	O
Evenly distributes tack	O	O
Variable width heated screed	O	O

Compaction Equipment

#1 Make & Model: _____

Serial #: _____

Steel Wheel O Pneumatic tire O

	Yes	No
Capable of changing direction without distorting the paving mat	O	O
Equipped with scrapers and watering devices that are working properly	O	O
Wheels true to round	O	O
Vibratory	O	O
Separate controls for frequency, amplitude & propulsion	O	O
Fluid or fuel leaks	O	O
Treadless tires if pneumatic	O	O
Tires same size & ply rating if pneumatic	O	O

#2 Make & Model: _____

Serial #: _____

Steel Wheel O Pneumatic tire O

Capable of changing direction without distorting the paving mat	O	O
Equipped with scrapers and watering devices that are working properly	O	O
Wheels true to round	O	O
Vibratory	O	O
Separate controls for frequency, amplitude & propulsion	O	O
Fluid or fuel leaks	O	O
Treadless tires if pneumatic	O	O
Tires same size & ply rating if pneumatic	O	O

#3 Make & Model: _____

Serial #: _____

Steel Wheel O Pneumatic tire O

Capable of changing direction without distorting the paving mat	O	O
Equipped with scrapers and watering devices that are working properly	O	O

	Yes	No
Wheels true to round	O	O
Vibratory	O	O
Separate controls for frequency, amplitude & propulsion	O	O
Fluid or fuel leaks	O	O
Treadless tires if pneumatic	O	O
Tires same size & ply rating if pneumatic	O	O

#4 Make & Model: _____

Serial #: _____

Steel Wheel O Pneumatic tire O

	Yes	No
Capable of changing direction without distorting the paving mat	O	O
Equipped with scrapers and watering devices that are working properly	O	O
Wheels true to round	O	O
Vibratory	O	O
Separate controls for frequency, amplitude & propulsion	O	O
Fluid or fuel leaks	O	O
Treadless tires if pneumatic	O	O
Tires same size & ply rating if pneumatic	O	O

#5 Make & Model: _____

Serial #: _____

Steel Wheel O Pneumatic tire O

	Yes	No
Capable of changing direction without distorting the paving mat	O	O
Equipped with scrapers and watering devices that are working properly	O	O
Wheels true to round	O	O
Vibratory	O	O
Separate controls for frequency, amplitude & propulsion	O	O
Fluid or fuel leaks	O	O
Treadless tires if pneumatic	O	O
Tires same size & ply rating if pneumatic	O	O

#6 Make & Model: _____

Serial #: _____

Steel Wheel O Pneumatic tire O

	Yes	No
Capable of changing direction without distorting the paving mat	O	O
Equipped with scrapers and watering devices that are working properly	O	O
Wheels true to round	O	O
Vibratory	O	O
Separate controls for frequency, amplitude & propulsion	O	O
Fluid or fuel leaks	O	O
Treadless tires if pneumatic	O	O
Tires same size & ply rating if pneumatic	O	O

Comments: _____

Louisiana Department of Transportation and Development

SUPERPAVE ASPHALT CONCRETE ROADWAY REPORT

DOTD 03-22-3094/18
Updated 8/18

Proj. # H.		Lot #		Sublot		*Primary* Mix Use		JMF		Design Level		Mix Type	
Submitter Code		Pavement Code		Spec Code		Plant H		Nom. Max Aggr. Size			Adj. Factor		
Project Engineer				Start Date		End Date			Gmm		Res Gmm		

From Station		+		To Station		+		Location	
From Station		+		To Station		+		Location	
From Station		+		To Station		+		Location	
From Station		+		To Station		+		Location	

Tons in Lot		
Previous	This Sublot (U)	Total
Yield		
Sq Yards (W)	Theo. Yield	Yield
110 lb/yd²/in x Plan Thick ÷ Adj. factor= Theo		U x 2000÷W

Roadway Cores

Core	I.D.	Mix Use	Date	Station	Thickness	Mass in Air (A) (Wt.)	Mass in H_2O (B) (Wt.)	Mass SSD (C) (Wt.)	Bulk Sp Gr (P) A/(C-B)	% Density (P/Gmm x 100)

Lot = 5000 Tons - Sublot = 1000 Tons – 2 or 3 Acceptance cores per sublot – 2 or 3 Quality Control cores per sublot

Random #s	Acceptance	Acceptance	Acceptance
Longitudinal			
Transverse			
Lot Finished?	☐Yes ☐No		
Pay Item:			
Comments:			

Chain of Custody: I attest to the secure transport & safe handling of the listed roadway core samples and that they are indeed the cores sampled by the certified inspector & have not been tampered with while in my custody.

1st _____

2nd _____

3rd _____

DOTD Certified Roadway Inspector: _____ Date: _____ Dist Lab Tech _____ Date: _____

Contractor Represenative: _____ Date: _____ Density, $\%G_{mm}$ Required _____

Approved _____ Date: _____ % Roadway Density Pay _____

Superpave Asphalt Concrete Codes

Design Level Codes

Design Level	Code
1	1
1F	1F
2	2
2F	2F
SMA	SMA
Thin Lift	TL
A	A

Mix Type Codes

Code	Description
1	Incidental Paving
2	Wearing Course
3	Binder Course
4	Base Course

Mix Use Codes

Code	Description
01	WC Roadway
02	Patching Roadway
03	Leveling
04	Widening
05	WC Shoulder
06	Turnouts Roadway *(Full Thickness)*
07	Airport (*Surface Tol. Required)*
08	Misc. *(Including Driveways)*
09	Binder Roadway
10	Base Roadway
11	Binder Shoulder
12	Base Shoulder
13	Patching Shoulder
14	Joint Repair
15	Airport *(No Surface Tol.)*

Pavement Codes

Code	Description
01	All Interstates, multi-lift new construction and overlays more than two lifts
02	One or two lift overlays over cold planed surfaces and two lift overlays over existing surface
03	Single lift overlays over existing surfaces
04	Binder courses
05	Turnouts, crossovers, detour roads, parking areas, and roadway or shoulder sections less than 500 feet in length
06	Secondary areas

Suggested Tie-In Procedure

The first step in attaining smoothness is defining the rate of elevation change at the bridge approach.

Here is the process for attaining smoothness in final surface elevation:

1. Start with a string line attached to the approach slab or bridge end *(or use rod readings.)* Use the string to project the slope until the pavement is touched (there may be occasions when the string does not touch pavement)

2. Attach a second string line to the approach slab *(or use rod readings)* to find the suggested elevation change using the ratio: 1" rise : (1 linear foot x speed limit). Again, projecting the slope until the pavement is touched

   For example:

   If the speed limit is 60 mph, the suggested elevation change should be 1" per 60 linear feet.

3. If the speed limit is 70 mph, the maximum change in elevation is 1 inch per 70 feet.

4. Select the shorter of items 1 or 2 (above) for the tie-in point.

5. Measure the distance under the string line from the bridge end (0") to the tie-in point (0") and mark the pavement for the required fill depth at 5 or 10 ft. intervals. This will be the fill thickness (or in some cases a cut) to get to final surface elevation.

6. Draw plan and profile views with the information then submit them to the PE for review with the estimated asphalt quantity for leveling.

If there is a drastic elevation difference, the 1" per 70 ft. for 70 mph can be modified as necessary, but no greater than 2" per 70 ft. @ 70 mph.

Note: See 502.09 and 502.15.6 for information concerning the "string line.

Weight Certification Tag (example)

STATE OF LOUISIANA

Department of Transportation & Development

Weight Certification Tag

Truck & Trailer No. _____

Tare Weight _____ lbs.

Legal Payload _____ lbs.

Date Certified _____

Stock No. 16-20-5866

Weight Certification Tag
(03-22-5866)