



Manual of Instructions – Section 501 and Section 503

Chapter V - SAMPLING AND CONTROL OF ASPHALT CONCRETE

SECTION 501 GENERAL

(Reference Secs. 211, 248, 315 and 317, *Road and Bridge Specifications*.) See Sec. 206 for Independent Assurance sampling requirements. See Sec. 207 for usage of asphalt concrete under modified acceptance procedures.

The production of high quality asphalt concrete mixtures, requires that the product meets definite specifications. These specifications are not arbitrary figures, but are the result of years of experience, data analysis and research. It shall be the duty of the Producer's Certified Asphalt Mix Design Technician (AMDT) to see that all component materials have been approved for use, and that they are combined into a mixture that meets all specification requirements.

The advantage of an asphalt concrete mixture that meets the specifications is in low cost maintenance. Thus, with the Producer's Certified AMDT rests the initial responsibility of obtaining a mixture meeting the specification requirements and ensuring the best possible construction at a minimum cost to the State.

VDOT employs a quality assurance program to ensure that quality asphalt concrete mixtures (a.k.a – hot mix asphalt [HMA], warm mix asphalt [WMA] and stone matrix asphalt [SMA]) are produced and placed throughout the Commonwealth. This program consists of a materials acceptance program (quality control (QC) testing, and verification sampling and testing (VST)) and an independent assurance (IA) program. The QC testing is performed by the Contractor; both VST and IA are performed by the Department. By following this type of program, VDOT is in compliance with federal law 23 CFR 637B.

For all projects where VDOT is the owner/maintainer of the pavement at the completion of construction, the contractor must execute and perform a quality control program during production and placement. Depending on the funding source (i.e., federal, state, private, etc.) and project location (i.e., National Highway System [NHS], non-National Highway System), VDOT may have to perform VST and IA. Tables 1 and 2 provide guidance on administering the quality assurance program. For AC materials provided to non-VDOT projects (i.e., commercial, private, etc.), no VDOT sampling and testing will be performed during production or placement unless directed by the Engineer as part of the job mix approval process.

Quality Element	Project Funding and/or Type				
	Federal Aid (NHS) – Construction and Maintenance	Federal Aid (non-NHS) – Construction and Maintenance	State Funded - Construction and Maintenance	Local Assistance, PPTA and Design-Build	PPTA With Concessionaire Agreement for Pavement Maintenance
QC	Required	Required	Required	As specified in the agreement with locality or firm	As specified in the agreement
VST	Required	Desired	Desired		
IA	Required	Desired	Desired		

Table 1 – Quality Assurance Program (AC Placement), Project Level Acceptance

Quality Element	Project Funding and/or Type				
	Federal Aid (NHS) – Construction and Maintenance	Federal Aid (non-NHS) – Construction and Maintenance	State Funded - Construction and Maintenance	Local Assistance, PPTA and Design-Build	PPTA With Concessionaire Agreement for Pavement Maintenance
QC	Required	Required	Required	As specified in the agreement	As specified in the agreement
VST	Required	Desired	Desired	Required	
IA	Required	Desired	Desired	Required	

Table 2 – Quality Assurance Program (AC Production), System Level Acceptance

Sec. 501.01 General Responsibility of Materials Division

(a) Personnel Certification

Personnel certification is covered under Section 115 of the Manual of Instructions.

(b) Verification Sampling and Testing (VST)

Verification sampling and testing (VST) is “performed to validate the quality of the product.” (23 CFR 637B Section 203). This testing must be performed by VDOT or a designated agent, but cannot be performed by the contractor and vendor. Simply put, VST should determine if the material is acceptable per specification. The Department will provide VST during production and placement. Testing will be performed by the Central Office Materials Division and/or the District Materials Section. The District Materials Engineer will designate the individual(s) responsible for executing the quality assurance program within their district. The designated individual(s) shall be certified in the areas of their responsibility (i.e. Asphalt Plant, Asphalt Mix Design and/or Asphalt Field Certification).

(c) Independent Assurance Testing

Independent assurance (IA) sampling and testing is defined as “Activities that are an unbiased and an independent evaluation of all Operations, sampling and testing procedures, and equipment used in the acceptance program”(23 CFR 637B Section 203). The Department will provide IA during production and placement. Testing will be performed by the Central Office Materials Division and/or the District Materials Section. The District Materials Engineer will designate the individual(s) responsible for executing the quality assurance program within their district. The designated individual(s) shall be certified in the areas of their responsibility (i.e. Asphalt Plant, Asphalt Mix Design and/or Asphalt Field Certification).

Sec. 501.02 Duties of the Project Inspector

(a) Initial Duties of Inspector

The following instructions cover the sampling, testing, and inspection of asphalt concrete (AC) materials at the job site. Specific instructions are contained herein for the density, depth and temperature measurements. See Sec. 206 for Independent Assurance sampling requirements.

The Inspector shall see that the spray bars on the distributor are of such length as to give the proper tacking/priming width, and make sure that all nozzles are free of any obstructions, so that an even and complete spray will be obtained. He/she shall check the rate of distribution and make necessary computations for the rate of application to be used. The Inspector must make sure that the liquid asphalt material being used for priming or tacking has been approved by the Materials Division before it is used.

Duties in the checking of paving machines, rollers, and small tools are covered in the Construction Manual of Instructions.

The Project Inspector should take and record temperature measurements of the AC at the beginning of paving operations and thereafter at a rate of not less than one measurement every hour. The inspector may increase the frequency of temperature measurements at any time. The temperature should be checked using an appropriate heat-sensing device (i.e. probe thermometer, infrared thermometer, etc.). The temperatures should be recorded in the project diary for a permanent record. When WMA is shipped to the project, the material temperature should be checked for documentation purposes only.

Per specification, WMA does not have a minimum laydown temperature. However, the minimum base temperature should be checked for compliance with specification.

The Inspector should use the following procedure to measure the temperature of asphalt concrete at the job-site:

1) When using a mechanical or digital probe thermometer, it will be inserted into the AC through an appropriate hole in the bed of the delivery truck. The thermometer should be allowed to stabilize (this may take a minute or more) and the temperature recorded. If the truck bed does not have a hole or a heat gun is used by the inspector, then the truck bed shall be raised approximately 3 feet (1 meter) such that the majority of the asphalt in the load is visible and only a minimal amount of material is dumped into the paver or MTV hopper. The probe will be inserted into the AC and allowed to stabilize for temperature recording. For the heat gun, the AC temperature below the crust will be recorded. The Inspector will ensure the asphalt temperature is not less than the specified minimum laydown temperature for the mix (Section 315 in the *Road & Bridge Specifications*) nor higher than 350° F (175° C) or the manufacturer's recommendations for polymer modified asphalt (i.e., PG 70-28 and PG 76-22).

2) Once the measured/recorded asphalt temperature is found to be within specifications, the Inspector will inform the delivery driver and allow the load to be emptied into the paver or Material Transfer Vehicle (MTV) hopper for use on the project.

3) If the initial temperature measurement is not within specifications, then the Inspector will take four (4) additional temperature measurements. When the hole in the truck bed is used, the Inspector should direct the delivery driver to raise the truck bed a few feet (a meter) such that the majority of the asphalt in the load is visible, and only a minimal amount of material is dumped into the paver or MTV hopper. If the truck bed hole is not available or the heat gun is used, then four additional measurements will be made without dumping more material into the hopper.

The Inspector will then measure and record the temperature at five (5) different locations within the bed of the truck. The center points of these measurements should be several feet apart to account for the area over which the infrared device takes its measurements (generally a 1–1.5 foot (0.3 – 0.45 m) diameter area at a distance of 10 feet (3 m)). The average of these five (5) readings will be considered the temperature of the load.

The load is accepted for use on the project if the load's temperature is not less than the minimum laydown temperature for AC nor higher than 350° F (175° C) or the manufacturer's recommendations for polymer modified asphalt (i.e., PG 76-22 and PG 70-28). Additionally, not more than one of the four additional temperature readings may be outside of specification limits for the load to be accepted for use on the project. **Note: care must be taken not to record temperatures from the asphalt material exposed to ambient air and wind during transport to the project site.**

Once the asphalt temperature has been measured/recorded and found to be within specifications, the Inspector will inform the delivery driver that the remainder of the load may be emptied into the hopper for use on the project.

If an excessive amount of rejected material is dumped into the hopper, the Contractor may be instructed to remove the material prior to continuing paving operations.

Nothing, herein, regarding temperature measurement should be taken as requiring acceptance of loads of AC that have crusts of cooler material that would remain in clumps as the material moves through the paver. If a MTV with re-mixing capability is being used, clumps of cooler material should be of lesser concern.

(b) Reports

It is the duty of the Project Inspector to fill out accurately and submit promptly all necessary reports. See Secs. 112.01 and 502.02 for details of collecting weigh tickets, Form TL-102A, and for documentation of delivery of tonnage material.

See Sec. 800 for details of preparing and/or handling the above noted reports and records.

SECTION 503 ROAD SAMPLING, TESTING, AND INSPECTION OF ASPHALT PAVEMENTS

The following instructions cover the sampling, testing, and inspection of asphalt concrete pavements at the job site. Specific instructions are contained herein for the density and depth tests.

Sec. 503.01 General

The Project Inspector will see that the Contractor follows all instructions, and will notify the Construction Manager or Area Construction Engineer if there is any misunderstanding, lack of cooperation, or any other situation that cannot be promptly corrected. The Inspector will maintain an attitude of cooperation and helpfulness with the Contractor to secure maximum production within specification limits. The Inspector should not hold up or delay operations unnecessarily, as continuous operation is essential to uniform results, as well as to economical operation. All instructions shall be issued to the Superintendent or Foreman in charge of the work.

c. 503.02 Density QC Testing (Contractor)

The density testing method to be used for asphalt concrete pavement will be one of the following:

1. The thin lift nuclear method outlined in VTM-76 and Special Provisions or Specifications for Sec. 315.05 *Road and Bridge Specifications*. Only designated scratch courses do not require density testing.
2. Plugs/Cores obtained as outlined in VTM-22 and AASHTO T166.

The method to be used will be as specified in the *Road and Bridge Specifications* or Special Provisions, or as directed by the Engineer. It should be emphasized that the frequencies given for testing are the minimums considered desirable to provide effective control of materials under ideal conditions, and more testing than that specified should be done if deemed necessary by the Engineer.

(a) Method A – Thin Lift Nuclear Method (Dense Graded Mixes)

(1) General

See Secs. 105.02 through 105.04 for details and safety precautions for the use of nuclear equipment. The thin lift nuclear method shall be conducted in accordance with VTM-76 and Special Provisions or Specifications for Sec. 315 of the *Road and Bridge Specifications*. The thin lift gauge shall be furnished and operated by the Contractor.

Thin lift density testing will be conducted using the Control Strip Method of testing as outlined in VTM-76. Under this procedure, the density reading obtained in the test section is compared with the corresponding control strip density. The VST density testing will be accomplished as outlined in Sec. 503.03 Verification Density Testing. The method for IA will be performed as outlined in Section 503.04 Independent Assurance for Density.

A roller pattern and control strip density must be established for each layer or lift placed in order to establish the target density required before testing of test sections.

(2) Frequency of Tests

For thin lift nuclear density testing, the reported density will normally be the average of 5 sublots readings representing a lot of asphalt pavement approximately 5,000 linear feet (1500 meter) in length for each lift and pass of the paver. Each subplot (1,000 linear feet or 300 meters) will have two locations randomly selected for measurement. See Section 315 of the *Road and Bridge Specifications* for the handling of partial length lots and the evaluation of sublots. The reported density will be considered the density of the entire length and width of the roadway represented by that lot. Payment for the tonnage of asphalt mixture contained in the lot will be in accordance with the density payment schedule in Section 315 of the *Road and Bridge Specifications*.

If there is a breakdown in the nuclear testing equipment, then density tests should be continued using other methods such as sawed plugs or cores as approved by the Engineer.

(b) Method B – Plugs/Cores (Dense Graded and SMA Mixes)

(1) General

With cores and plugs, the percent compaction of the completed asphalt concrete pavement is determined by dividing the actual bulk specific gravity of the pavement samples by the theoretical maximum specific gravity of a completely voidless mixture composed of the same materials in like proportions. The actual bulk specific gravity shall be determined, as outlined in AASHTO T166 and modified by VTM-6. The maximum specific gravity shall be determined, as outlined in VTM-22, together with AASHTO T209, if desired.

(2) Frequency of Tests

Sampling for density determination on the mainline will be at the rate of no less than one plug/core per 1,000 feet (300 m) paver pass. Crossovers and connections will not be sampled for density; however, the tonnage contained therein will be included in the lot. The lot size will be 5,000 linear feet (1500 m) and will be determined by the quantity of asphalt concrete furnished by each plant for the contract item. Tests will be performed in accordance with VTM-22.

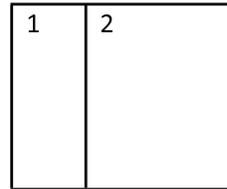
(3) Obtaining the Test Specimens

The test specimens shall be obtained as follows:

(1) Test specimens shall be cut from the pavement with a portable saw or other approved method. If water is used as a cooling agent, then the contractor must have an approved method to dry the core/plug.

(2) The length of the sides of the sawed specimens shall not be less than 3 in. (75 mm) nor more than 4.5 in. (113 mm) [4 in. (100 mm) diameter cores may be used]. The thickness of the specimens shall not be less than 1.0 in. (25 mm)

(3) Mark out squares of pavement as indicated in sketch below.



(4) Cool marked area with gas (CO₂) or dry ice.

(5) Cut out specimens using the approved method. (It will be necessary to cut out past the marked lines, so that a full-depth cut is obtained.)

(6) Recool marked area with gas sufficiently to pry out specimens 1 and 2 without distorting.

(7) Pry out Square 1 by applying pressure to either side and discard. Pry out Square 2 to use as the test sample. (Do not distort.)

(8) Carefully remove saw tailings and clean any loose material from surface of specimens. When placing specimens in basket to weigh in water, take care not to entrap air under the specimen. (Again, do not distort specimens.)

(9) Determination of bulk specific gravity will be in accordance with VTM-6; maximum specific gravity will be determined in accordance with AASHTO T209; and percent compaction will be determined in accordance with VTM-22 section 5.

(c)Computation of Pay Factor

Price adjustment factors will be applied to the quantity of material in accordance with Sec. 315 of the *Road and Bridge Specifications*.

(d)Reports

Results of job acceptance density tests in the field shall be reported on Forms TL-56, TL-57, TL-58, TL-59A/B and TL-60. Results of density tests by other methods shall be reported on forms approved by the District Materials Engineer's representative. Reports are to be submitted to the Engineer at the completion of each roadway segment.

All test reports must be completely filled out, giving all required information. All tests, both passing and failing, must be reported. See Sec. 800 for additional details of completing and distributing these forms.

Sec. 503.03 Verification Density Testing (Department)

Verification sampling and testing will be performed on surface, intermediate and base mixes that have been evaluated by the Contractor. VST will be performed by either obtaining 4" (100 mm) diameter core or 4"x 4" (100 mm x 100 mm) plug according to VTM-6 and VTM-22. The Contractor will be responsible for obtaining the specimens for VST. VST will be performed by or under the direction of a District Materials representative. VST is to be performed on Federal- Aid projects on the NHS and should also be performed on as many non-NHS and state funded projects as practicable (see Table 1).

(a) Procedure for VST on Lot Density Testing

(1) General

Department personnel will randomly select locations for VST Density tests by a randomization procedure similar to the randomization procedure shown in VTM-32, Depth Test of Bituminous Concrete Base Course. VST Density tests obtained by plugs/cores will be sampled and tested under the direction of the Materials Division according to VTM 6 and VTM 22.

Perform VST Density testing by obtaining a plug/core from two (2) stratified random sites in a test section or lot on the roadway. The plugs/cores will be extracted by the Contractor at the sites identified by the Department. The test section for dense graded asphalt is defined as 5,000 linear feet (1500 m) of paved lane width with subsections of 1,000 linear feet (300 m). For SMA, the test section is defined as the length of daily production. For dense grade asphalt, two of the five subsections will be randomly selected for sampling. When practical, the VST test section limits should coincide with the QC lot limits for comparison purposes. For SMA, two random locations from the daily production will be selected.

Determine the in place density for each individual plug/core at each selected location using VTM 6 and VTM 22. The average density of the plug/core from the two individual sites will be compared to the average of the plugs taken from the control strip used to establish the target nuclear density for that mix. For SMA, the average density of the plugs/cores will be compared to the minimum density specified in Section 317 of the *Road and Bridge Specifications*. Once the comparison is performed, the following steps shall be followed:

Step 1) If the test section for dense graded asphalt meets the full payment criteria for density (98% to 102% of the average density of the plugs taken from the control strip density), then continue obtaining two stratified random plugs/cores on 20% of the test sections until completion of the project. If the daily production for SMA meets the full payment criteria for density, then continue obtaining two stratified random plugs/cores on 20% of the daily production lots until completion of the project. The VST densities will be expressed in % and will be reported to the nearest 0.1%.

Step 2) In the event a dispute arises over the average density of the two plugs/cores failing the density testing comparison criteria, then one additional plug/core from the remaining 3 subsections will be obtained for dense graded asphalt. For SMA, three additional cores will be obtained from the daily production lot. If deemed necessary by the District Materials Engineer, one additional plug/core from the previously tested subsections will be obtained for dense graded asphalt. For SMA, two additional cores may be obtain if deemed necessary by the District Materials Engineer. The average density of these five (or 7) plugs/cores will then be compared to the Density testing comparison criteria. If this average density meets the comparison requirement, then the lot is acceptable. Continue obtaining two stratified random plugs/cores on 20% of the test sections/daily production lots until completion of the project.

Step 3) If the density comparison criteria is not met, then the production Rice value(s) corresponding to the test section will be used to determine the average density for the 5 plugs/cores. If this average density meets the comparison requirement, then the QC lot is acceptable. Continue obtaining two stratified random plugs/cores on 20% of the test sections until completion of the project.

Step 4) If the average density in a lot fails the Density testing comparison criteria, then the lot preceding (if accessible) and the lot after must be evaluated by repeating steps 1 thru 3 until the boundaries of the failing lots have been established. Each failing lot will be documented.

(2)Timing of VST Density Testing Using Plugs/Cores

The VST density testing must be completed prior to traffic being placed on the section being evaluated but during or after the Contractor has completed all its QC density testing for that lot.

(3)Frequency for VST Density Testing Using Plugs/Cores

The VST density tests for base, intermediate and surface mixes per project will be conducted on a paver width 5,000 linear foot (1500 m) long test section of roadway. The minimum tonnage of a mix type to warrant VST density testing shall be 500. Mix types are based on the maximum nominal aggregate size (i.e. 4.75, 9.5, 12.5, 19.0 and 25.0) and not the binder used in the mix. The minimum number of VST density test sections required for a given project or contract will be at least 20% of the paved lane length (one test section for every 25,000 lane feet (7500 m) of paving) for all AC lifts. For example, for a one lift AC overlay 10 lane miles long, 2 test sections must be checked through VST. For a two lift AC overlay 10 lane miles long, 4 test sections must be checked through VST. The four test sections should be randomly selected between the first and second lift test sections. The same approach should be used in determining the total number of test sections on construction and maintenance projects (see Table 4 for Guidance).

For construction projects, the total amount of AC placed should be used to determine the total number of VST sections. This total should include not only mainline AC, but shoulders, adjoining roads, etc. For maintenance projects (i.e. RAAP or plant mix schedule), the VST rate is based on the total number of lane miles on the project – not an individual site. A random approach should be used in selecting the test sections for VST.

Number of Lifts	VST Samples for Project						
	Project's Paved Lane Miles						
	1	2	3	4	5	10	20
1	1	1	1	1	1	2	4
2	1	1	2	2	2	4	8
3	1	2	2	3	3	6	12
4	1	2	3	4	4	8	16
5	1	2	3	4	5	10	20

Table 4 – VST Sampling Rates

(4) Recording/Reporting for VST Density Testing Using Plugs/Cores

VST densities will be recorded on form TL-140 (see Sections 803.70).

Sec. 503.04 Independent Assurance for Density (Department)

IA density observations and sampling/testing will be performed on surface, intermediate and base mixes which are evaluated by the Contractor. IA will be performed by District Materials personnel. IA is to be performed on Federal-Aid projects on the NHS and should also be performed on as many non-NHS and state funded projects as practicable. Observation of the QC

Technician will be on a system basis approach. For IA of plugs/cores, the minimum tonnage of a mix type to warrant IA density observations testing shall be 500.

(a) Observation of QC Technician (System Basis)

(1) Procedure

District Materials personnel will verify the Contractor's method of random determination of production reading locations and will verify QC processes by witnessing/observation. The Contractor is required to mark the location and orientation of the gauge at each test location. The Contractor may be required to supply a list of the randomly selected production test locations. The department representative will initial beside the QC readings observed on the Contractors TL-59 (see Section 803.44) form. (Please note, a QC reading is defined as a nuclear gauge test at a single location.) Additionally, the department representative will verify the nuclear gauge calibration date and serial number, and will initial beside this information on the TL-59A form.

(2) Timing of IA Testing

The IA must be completed while the Contractor is performing density (QC) testing.

(3) Frequency

Ideally, each Certified Asphalt Density Technician, performing this duty for the Contractor, will be observed at least once annually. At a minimum, seventy-five percent of the Asphalt Density Technicians will be observed on an annual basis.

(4) Recording/Reporting

In the annual report prepared for FHWA, VDOT will list the number of technicians observed, any problem(s) encountered and the actions taken by the Department/Contractor to remedy the problem(s). These observations will be recorded on TL-141A (See Section 803.71).

(b) IA Density Testing on Plugs/Cores

During the production of asphalt concrete, VDOT will perform IA testing by the approach outlined below. This approach applies to control strips for dense graded asphalt mixes (where the nuclear gauge is used for density acceptance) and stone matrix asphalt (SMA). If the Contractor elects to perform density QC on dense graded asphalt by the plug/core approach, then the procedure following the guidelines for SMA shall apply. No IA of control strip plugs/cores will be required when the contractor uses plugs/cores as the asphalt acceptance procedure.

(1) Procedure for IA Density Testing on Contractor Plugs/Cores

For acceptance of control strips and SMA percent density, plugs/cores are used. At the stratified random plug/core locations provided by VDOT for SMA or the control strip locations per VTM-76, Department personnel or an authorized representative will observe the extraction of plugs/cores (VTM-76), observe the determination of percent density (VTM-6 and VTM-22) by the Contractor and maintain control over the samples throughout this process. Immediately after testing by the contractor, the Department will secure the plugs/cores for IA of results. The Department will retain all plugs/cores during the production and placement of SMA as well as from control strips. SMA plugs/cores will be marked identifying the lot and plug/core number (i.e. Lot 10 and plug/core 3 will be marked as 10C [A = 1, B = 2, C = 3, D =

4, E = 5]). Control strip plugs/cores will be marked with the control strip number and plug/core number from the strip. IA Density tests of contractor obtained plugs/cores will be tested under the direction of the Materials Division according to VTM 6 and VTM 22.

Determine the in place bulk specific gravity (G_{mb}) and percent density for each individual plug/core using VTM 6 and VTM 22. The G_{mb} calculated by the Department will be compared to the contractor's result on the same plug/core. Once the comparison is performed, the following steps shall be followed:

Step 1) If the Department bulk specific gravity (G_{mb}) results are within 0.015 of the contractor's results, then no additional analysis is required. The IA G_{mb} will be reported to the nearest 0.015. The plug/core can be discarded.

Step 2) In the event that the VDOT G_{mb} results are not within the 0.015 tolerance, then the Department will re-run VTM-6 on the non-comparing plugs/cores and compare the new G_{mb} to the contractor's results. If the Department results are now all within 0.015 of the contractor's result, then no additional analysis is required.

Step 3) If the Department's G_{mb} results are not within the 0.015 tolerance after the re-calculation in Step 2, then the sister cores/plugs (remaining plugs/cores from the lot or control strip) to the failing core/plug will be analyzed. A new percent density will be calculated for the plugs/cores on the basis of the Department's G_{mb} results in accordance with VTM-22. If the average of the five density results from the Department's testing does not comply with the specification requirement, then the contractor will be notified of the failing IA comparison. The District Materials representative will conduct an investigation of the contractor's QC technician's testing procedures and equipment to determine the source of the error. Results of this investigation will be documented and provided to the State Materials Engineer. Based on the average percent density determined by Department's test results (for those plugs that did not compare with the contractors) and the contractor's acceptable plugs from the lot, the corresponding percent pay will be applied.

(2) Timing of IA Density Testing on Contractor Plugs/Cores

Step 1 of the IA density testing must be completed within three business days of the production date. If necessary, Step 2 must be completed within one business day of Step 1 in order to minimize the placement of failing material.

(3) Frequency for IA Density Testing on Contractor Plugs/Cores

The IA density tests for SMA mixes per project may be conducted for each lot. The minimum number of IA density test plugs/cores required for a given contract will be at least 10% plugs/cores obtained by the Contractor. For control strips, at least one plug/core will be required per project. If more than 10 control strips are constructed (combination of all mixes laid on a project), then additional control strip plugs/cores will be tested to meet a minimum frequency of 10% of control strips tested.

(4) Recording/Reporting for IA Density Testing on Contractor Plugs/Cores

IA densities will be recorded on form TL-141B. (see Sections 803.71).

Sec. 503.05 Independent Assurance of Department Personnel (Department)

IA personnel will be required to obtain and maintain the proper Materials Division certifications.

Sec. 503.06 Determination of VST/IA Requirements (Example)

VTM-76 is followed in constructing Roller Patterns and Control Strips for dense graded asphalt mix layers. The flowchart shown is to be applied to each mix type (i.e. SM-9.0, SM-9.5, SM-12.5, SM-19.0, IM-19.0 and BM-25.0) as described in Section 503.03(c) and Section 503.04 in a contract or maintenance plant-mix schedule to determine the level of VST testing and IA observations.

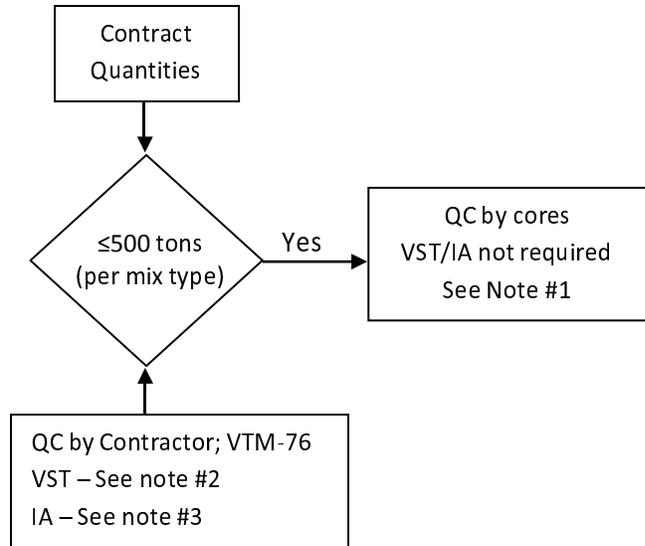
Note #1:

VST/IA testing is not required for any mix type with 500 tons (500 metric tons) or less of that mix on the contract. Contact QC testing is required for the roller pattern, control strip (see VTM-76) and for all test sections. Projects of this size are typically complete once the roller pattern/control strip is finished, or they may have a single short test section. [See *Road and Bridge Specifications* section 315.05(e)1 for exceptions to following VTM-76.]

Note#2:

VST testing is required per Section 503.03

Note#3: IA testing is required per Section 503.04



(a) Example to Determine VST and IA Regulations:

Given: A contract has the following combination of asphalt types and quantities:

SM-9.5A	300 ton (300 metric tons)	BM-25.0A	300 ton (300 metric tons)
SM-9.5D	150 ton (150 metric tons)	BM-25.0D	1000 ton (1000 metric tons)
IM-19.0A	750 ton (750 metric tons)		

Find: How many VST and IA tests are required to satisfy VDOT’s Quality Assurance program?

Solution: For each mix type, the total quantities are: SM = 450 tons (450 metric tons), IM = 750 tons (750 metric tons), and BM = 1300 tons (1300 metric tons). These are the quantities to use with the flowchart.

NOTE: The amount of project level VST and IA testing shown in this example is the minimum required for a Federal aid project on the NHS.

Surface Mix: The total quantity of all surface mixes on the project is 450 tons (450 metric tons). This quantity is less than 500 tons (500 metric tons) so QC testing by the Contractor is done with cores. The density of the cores is compared to the theoretical maximum density of the mix (see VTM-22 for the procedure). If the average density of the cores meets the requirements of Table III-3 in

Section 315.05 of the *Road & Bridge Specifications*, then the pavement's density is deemed acceptable. VST/IA density testing will not be required if the cores are verified by testing in the Department's laboratory before determining acceptance. Possession of the **Cores must be maintained until project completion or until verified by the Department for Federal Aid Projects on NHS routes.**

IM Mix: The total quantity of all IM mixes on the project is 750 tons (750 metric tons). This quantity is greater than 500 tons (500 metric tons) so VST and IA testing is required. QC testing for this project would likely consist of the roller pattern/control strip (VTM-76), and one test section of 10 stratified nuclear test locations.

One full VST test section (2 cores) is required. VST testing performed by coring 2 stratified random locations; the density is determined following VTM-22. The average density of the cores is compared to the requirements of Table III-3 in Section 315.05 of the *Road & Bridge Specifications* to determine if the test section density meets specification.

The *minimum* number of IA tests on this project is one plug/core from the control strip. If the Contractor is performing plugs/cores for density acceptance, then one plug/core must be verified by the Department.

BM mix: The total quantity of base mix on the project is 1300 tons (1300 metric tons). This quantity is greater than 500 tons (500 metric tons) so both VST and IA testing are required.

Case 1a – Assume all the base mix is placed in a single 4" (100 mm) thick lift and covers approximately 4400 lane feet (lf) (1340 m). The Contractor tests the roller pattern, the control strip (see VTM-76), and a test section of about 3900 lf (1200 m). Contractor QC testing consists of 2 nuclear readings in each of the 4 sublots of the test section for a total of 8 readings.

One VST test is needed for the 'short' test section, i.e. two cores/plugs.

IA is needed by reweighing one core/plug from the control strip or by reweighing one core/plug used by the contractor for density acceptance from the test section.

Case 1b – Assume the BM is placed in 2 - 4" (50 – 100 mm) lifts. The first lift is placed on the aggregate base and the second is placed on top of the first BM lift. Separate roller patterns and control strips are required for each lift since the surface upon which the base mix is placed is different for each lift.

For each lift, QC testing consists of the roller pattern /control strip testing, and a single test section of about 1700 lf. (500 m) QC testing of the test section consists of 4 stratified random nuclear test readings in the 1700 ft. (500 m) (test section (2 readings in the first 1000 ft. (300 m) subplot plus 2 readings in the last 700 ft. (200 m)).

VST testing needs to be done for only one of the two BM lifts. Each lift constitutes a lot of material and the minimum testing requirement is 20% of the lots. VST will require two plugs/cores from one of the lifts of BM – not both lifts.

IA is needed by reweighing one core/plug from one of the control strips or by reweighing one core/plug used by the contractor for density acceptance from the test section.

Example Summary – VST/IA testing is not required on the surface mix due to the limited quantity. For the intermediate and base mixes, VST/IA testing is required.

Sec. 503.06 Depth Control (Department)

(a)General

Job acceptance depth tests are to be made by a person other than project personnel. This person shall be an impartial party, namely the District Materials Engineer's representative.

Measurements are to be taken periodically for each course after completion of the course depth as the work progresses. This should not be construed as requiring that the entire project be completed before conducting depth tests. Depth tests should be made as sections of the project are completed. It shall be the responsibility of the Inspector or Construction Manager to notify the District Materials Engineer when any part of the construction is ready for depth tests.

(b)Frequency of Depth Tests

For the purpose of determining depth, and to define areas of deficient or excessive depth, the asphalt concrete base course will be sampled, as outlined in VTM-32B. (Tests of asphalt concrete binder and surface courses are required only if specific plan depths are specified, not when plans specify a rate of application.)

The project shall be divided into lots, with each lot stratified, and the location of each test within the stratified section determined randomly. A lot of material is defined as the quantity being tested for acceptance, except that the maximum lot size will be one mile of 24 ft. width base course. The randomization procedure used will be at the discretion of the Engineer. (See VTM-32B for example). Samples will be taken from the lot at the following rate:

Lot Size	No. of Samples Required
0 - 1/2 Mile (0 – 1.0 km)	2
1/2 - 3/4 Mile (1.0 – 1.5 km)	3
3/4 - 1 Mile (1.5 – 2.0 km)	4

A separate boring will be taken from each intersection, entrance, crossover, storage lane, or ramp having an area of 500 yds² (500 m²) or more. This boring will not be taken at random; however, care is to be taken not to set up a uniform pattern of testing. The tolerance for an individual test result shall apply for these miscellaneous borings.

The same frequency of testing as used on the mainline will be used for asphalt concrete shoulders requiring specific plan depths, except that the tests will be alternated from one shoulder to the other.

It is not the intent of the test procedure to prohibit sampling and testing of the material at any location which is visually determined to be out of specification tolerance for an individual test.

(c) Corrections for Areas Outside of Tolerance

If any areas are found to be outside of specification tolerances for depth, then corrections shall be made in accordance with the particular specification related to the material in question.

(d) Reports

Results of job acceptance depth tests of the above noted materials shall be retained as part of the permanent project records. The data may be kept in the form of a worksheet. Those depth tests that fail to meet specification requirements and subsequent delineation determinations shall be recorded on Form TL-105. See Sec. 800 for details of completing and distributing these forms.

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