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**Tennessee Department of Transportation
Division of Materials and Tests**

**Procedures for Aggregate Approval and Quality Monitoring
(SOP 2-1)**

Purpose: The purpose of this document is to establish a formal process for evaluating, testing, and approving aggregate sources and their products for use in general Tennessee Department of Transportation (TDOT) construction and bituminous or concrete surface mixtures.

Background: Aggregates must exhibit certain physical and chemical properties that reflect their ultimate quality and durability. TDOT Standard Specifications have several aggregate properties specified, including abrasion resistance, freeze-thaw durability, gradation, particle shape, deleterious materials, and others. Aggregates used for bituminous or concrete riding surfaces must demonstrate additional properties that would indicate the aggregate's ability to satisfactorily provide a polish-resistant pavement. These properties may include silica dioxide content, insoluble residue content, calcium carbonate content, and British Pendulum Numbers (BPN), etc.

1. Approval Process

All aggregate sources shall submit the following required documents to Headquarters Materials & Tests (HQMT) and complete the following procedures to have their products be considered for use in TDOT projects. Additional tests may be required for materials with certain uses (e.g., surface aggregates). Testing requirements for all surface aggregates are listed in Table 903.24-1. These procedures are required for any source which is not currently on the approved list.

1.1 Submittal Letter

The Producer shall submit in writing their request to be considered for their aggregate products to be listed on the TDOT Producer List. This letter shall include all aggregate products (type, sizes, uses, etc.) the Producer is requesting to be considered and shall be submitted to HQMT at the following email: TDOT.AggregateMTR@tn.gov

1.2 Quality Control Plan (QCP)

The Producer shall prepare a written QCP that is specific to the site requesting approval. Appendix A details the minimum information required in the QCP. A [TDOT Generic Aggregate QC Plan](#) has also been prepared which includes the minimum information required and is listed on TDOT's Field Operations website.

1.3 Independent Lab Test Results

1.3.1 The Producer shall submit test results detailed in Tables 903.25-1 and 903.25-2 from an AASHTO Accreditation Program (AAP) accredited, independent laboratory or other State DOT laboratory. The tests shall be performed on material produced within the previous six (6) months of the request. The tests shall include, at minimum, the following:

- Sieve Analysis (Gradation)
 - ASTM C136/AASHTO T 27
- Specific Gravities (Bulk, SSD, and Apparent) and Absorption
 - ASTM C127 & C128/AASHTO T 84 & T 85
- Sodium Sulfate Soundness (see appendix E for TDOT specific procedure)
 - ASTM C88/AASHTO T 104
- L.A. Abrasion
 - ASTM C131/AASHTO T 96

1.3.2 Aggregates for use in riding surfaces (Surface Aggregates) must meet additional requirements:

- Silica Dioxide Content
 - ASTM C25
- Calcium Carbonate Content
 - ASTM C25
- Acid Insoluble Residue
 - ASTM D3042
- Accelerated British Pendulum Numbers (limestone only)
 - ASTM D3319/AASHTO T 279

1.4 Verification

Upon receipt of a complete QCP and satisfactory independent test data, HQMT will notify Regional Materials and Tests. Regional Materials and Tests will then acquire a sample and submit it to the HQMT lab for complete verification testing.

1.5 Consistency

Upon verification of the test results, Regional Materials and Tests will take another sample and submit it to the HQMT lab for consistency testing. Two consecutive samples shall meet the applicable requirements to show consistency of the aggregate.

1.6 Referee Sample

If a sample fails to meet the requirements of the approval criteria, then a referee sample of the same material **may** be obtained for testing. **The sample may be split with the Producer for testing the material independently, but TDOT's test data will be used as the deciding result.** If the referee sample fails to meet the approval criteria, then the Department will not reconsider the material for approval for six (6) months.

1.7 Laboratory

Aggregate facilities must provide a Type A laboratory as specified in Section 106.06 of the TDOT Standard Specifications.

1.8 Surface Aggregate (Polish-Resistant) Test Strip – If Requested

In addition to the verification of the aggregate properties detailed in 1.3.1 and 1.3.2, a test section will be required to verify the field performance of the aggregate, except for Type I material detailed in TDOT Standard Specification, Section 903.24 and Appendix B.

The Producer must submit the requested location of the test strip no less than ten (10) days prior to construction of the test strip. HQMT must give approval of the test strip location prior to any construction.

During construction of the test strip, Regional Materials and Tests or designee shall take a sample of the surface aggregate at the asphalt plant and submit it to the HQMT laboratory for chemical test verification.

1.9 Approval

Once the above process is complete and all requirements are met, the Producer Form shall be completed and submitted to HQMT. The Producer will be notified by HQMT once they have been made approved and added to the TDOT Producer List.

1.10 Stockyards and other non-producing suppliers

Stockyards supplying material to TDOT projects must also be approved on the TDOT Producer List. If the source material (quarry, dredge, pit, etc.) being supplied by the stockyard **is not** currently approved on the TDOT Producer List, then the stockyard must submit for approval as detailed in the approval process listed above. If the source material **is** currently approved on the TDOT Producer List, then the stockyard may submit for approval based on other acceptance testing such as gradation to indicate proper storage and handling procedures.

1.11 Certified Aggregate Technician

Each facility shall have a certified aggregate technician responsible for the facility's Quality Control program. The certification shall be in accordance with SOP 1-3: Field Technician Certification Requirements. The responsible individual(s) must be listed in the annual QCP with current contact information.

2. Quality Monitoring Process

An aggregate's approval status is contingent on satisfactory field performance and periodic laboratory evaluation. In addition to the quality monitoring outlined below, an aggregate's approval status may also be rescinded if there is any concern for safety that may be related to the approved material.

2.1 Quality Testing Program

- 2.1.1 Coarse aggregate and manufactured sand sources will be continuously sampled and tested for quality by TDOT. Semiannually, a sample of the approved material shall be obtained by Regional Materials and Tests and submitted to the HQMT laboratory for a verification of the applicable aggregate properties. The semiannual tests will represent January through June and July through December. No two (2) verification samples shall be taken within ninety (90) days of each other.

If at any time TDOT deems additional testing necessary, such sample(s) will represent the most recent semiannual test. Aggregate that does not meet TDOT Standard Specifications will not be accepted for use on projects or in products for TDOT.

- 2.1.2 Natural Sand (dredged, pit) will be sampled and tested for quality by TDOT at a minimum of once per year.

- 2.1.3 Surface Aggregates (Polish-Resistant) will be continuously sampled and tested for quality by TDOT. Semiannually, a sample of any approved limestone material shall be obtained by Regional Materials and Tests and submitted to the HQMT laboratory for a verification of both the applicable physical and chemical aggregate properties. The semiannual tests will represent January through June and July through December. No two verification samples shall be taken within ninety (90) days of each other. All other crushed aggregate types will only require a physical verification testing at the same frequency.

- 2.1.4 If there is any change to the Producer's QCP (changes in procedures, key personnel, etc.), then an updated QCP shall be submitted to HQMT immediately.

2.2 Quality Failure

- 2.2.1 If a sample fails to meet any of the approval criteria, then a referee sample of the same material shall be obtained for testing. The sample shall be split with the Producer for testing the material independently. When two consecutive samples fail quality testing, the aggregate source's approval shall be immediately rescinded and the use of the failing material and products utilizing the failing material shall cease. **If the referee sample passes quality testing, a consistency sample shall be collected to confirm the result. If the consistency sample fails quality testing, then the producer shall be inactivated.**

- 2.2.2 Regional Materials and Tests shall notify the Producer of the failing test results as soon as possible; at which time a representative from the Producer, Regional Materials and Tests, and HQMT will hold a conference to identify the location/distribution of the failing material and to develop a plan for both the utilization of any existing material and the acceptance of newly produced material.

3. Facility Removal

- 3.1 If a facility is removed from the TDOT Producer List, TDOT shall notify the Producer in writing within seven (7) days. This notification shall direct the Producer that they shall not supply any material to a TDOT project. Upon such notice, the Producer shall immediately cease production, shipment, and placement of such material that is to be supplied to TDOT projects and products. After such notice is issued, the Producer reserves the right to request meeting with HQMT to discuss the cease of material(s) for TDOT projects.
- 3.2 Installed material may be left in place at TDOT's discretion.
- 3.3 Producers shall provide TDOT with a list of material and quantities supplied to TDOT projects, including contract numbers, and TDOT approved asphalt and concrete plants from the date of the last passing inspection.
- 3.4 Materials on the Producer's yard produced from the date of the last passing test until the date of the failing test may not be acceptable for use on TDOT projects. All cost incurred will be the responsibility of the Producer.
- 3.5 Time of Facility Removal
 - 3.5.1 The producer will be removed from the TDOT Producer List for a suitable time period in which new material can be produced and can be demonstrated to consistently meet the appropriate approval criteria.
 - 3.5.2 Once consistent, quality material can be produced, the Producer must submit a letter to HQMT stating the appropriate material(s) that will be provided to TDOT projects. This letter shall be accompanied with acceptable tests listed in Section 1.3 of this SOP completed by an AAP accredited, independent laboratory, and dated between the date removed and the date to be reactivated.
 - 3.5.3 The Producer must provide a revised QCP addressing the corrective actions taken to resolve any issues of non-compliance.
 - 3.5.4 Upon receipt of the above requirements, Regional Materials and Tests will sample and test the new material for verification and consistency in accordance with Section 1.4 and 1.5.
 - 3.5.5 Once the above process is complete and all requirements are met, the Producer will be reactivated on the TDOT Producer List and will be notified by HQMT of their updated status.

Appendix A: Quality Control Plan

A. Minimum Requirements

- A.1. The plan must indicate in detail how the Producer proposes to control the equipment, materials, and production methods to ensure that the specified products are obtained. The plan must list the personnel responsible for production and quality control at the site and include information on how to contact each person (phone, email, etc.).
- A.2. The following specific information must also be included in the plan
 - A.2.1. Identification of the physical location of the source, to include a description of the property site and reference to the nearest identifiable points such as highways and towns. The physical address and map shall be included.
 - A.2.2. A description of the signs used to identify each stockpile as intended for TDOT usage. Stockpile signs must be legible from the cab of a truck fifty feet from the identified pile. A photo of the signage shall be submitted with the plan.
 - A.2.3. A loading and shipping control plan which includes a description of the methods by which the products are to be loaded and shipped for use by TDOT, including safeguards against loading improper aggregate, contamination, degradation, and segregation of the aggregate. The plan must also include methods of insuring that all products are accurately identified and that all shipping units are clean. A diagram of the process, from mining/dredging through the loading and transporting offsite, shall be included.
 - A.2.4. A plan for dealing with quality control sample failures. This plan must include how the Producer plans to initiate an immediate investigation and how the Producer will implement corrective action to remedy the cause of the problem. The plan shall state how loading operators are trained to identify problems.
 - A.2.5. A binder with the following information shall be readily available at the facility:
 - 1. QCP meeting minimum requirements
 - 2. QC technician certification(s)
 - 3. Most recent quality results

Appendix B: Surface Aggregate (Polish-Resistant) Requirements

B.1. Chemical Testing Requirements and Specifications

B.1.1. Based on the chemical and physical properties, the Producer must identify the TYPE of aggregate the approval pertains to. Initial approval of coarse aggregates such as crushed granite, crushed gravel, crushed gneiss, crushed quartzite, crushed sandstone, or crushed slag shall be tested for both physical and chemical properties. Physical testing results are required to meet the current TDOT Standard Specifications while the chemical testing is required to verify the composition of the material. Other crushed aggregate - such as limestone - may be used provided it meets the chemical, physical, and performance characteristics shown in Table 903.24-1.

B.1.2. Current TYPE requirements and limitations are listed in Table 903.24-1 for other material (limestone for example).

Table 903.24-1. Quality Requirements for Type I, II, III, and IV Aggregate

Type	Applications	Min Silica Dioxide SiO ₂ ⁽¹⁾ (%)	Max Calcium Carbonate CaCO ₃ ⁽¹⁾ (%)	Min Acid Insol. ⁽²⁾ (%)	Min 9-Hour BPN ⁽³⁾	Traffic Test Section for Approval
I	All Pavements	40	32	50	30	N/A
II	All Pavements	30	N/A	35	30	20,000 ADT ⁽⁴⁾ min. for two (2) years, or 7.3 million vehicle passes per test lane for min. two (2) years (4-lane rural interstate, Max. ADT ⁽⁴⁾ 35,000 allowable)
III	Non-Interstate < 15,000 ADT ⁽⁴⁾	20	N/A	25	25	20,000 ADT ⁽⁴⁾ min. for two (2) years, or 7.3 million vehicle passes per test lane for min. two (2) years (non-interstate)
IV	2-Lane < 5,000 ADT ⁽⁴⁾	10	N/A	N/A	22	10,000 ADT ⁽⁴⁾ min. for two (2) years, or 3.65 million vehicle passes per test lane for min. two (2) years (non-interstate)

⁽¹⁾ASTM C25

⁽²⁾ASTM D3042

⁽³⁾AASHTO T 278, T 279 (limestone only)

⁽⁴⁾ADT = Average Daily Traffic

B.2. Field Performance (Test Strip)

- B.2.1. Other material (limestone for example) which has been laboratory tested and conforms to the chemical and physical properties of Table 903.24-1 (above) and Subsection 903.24 of the Standard and any Supplemental Specifications must then demonstrate satisfactory test strip performance. Material meeting TYPE I requirements are exempt from providing a test section for approval; however, must maintain a satisfactory field performance to remain an approved source.
- B.2.2. The aggregate Producer, with TDOT assistance, will be responsible for identifying existing or proposed asphalt paving construction project for a test strip location. The test strip shall be within the traffic range identified in Table 903.24-1 for the TYPE of aggregate which approval is being requested. Traffic ranges shown are for two lane roadways. Since it may be difficult to identify two lane roads with ADT volumes shown, the outside lanes of rural four (4) lane roadways will be considered, provided the minimum number of vehicle passes are obtained in that lane. The test section shall have a minimum speed limit of forty (40) mph, be 0.5-0.6 mile in length in each direction and the entire test section shall be free of controlled intersections (traffic signals or stop signs). The number of vehicle passes will be calculated by assuming the outside lane will receive 30% of the ADT. The Producer shall provide project documentation such as the title sheet which will include the project description, location, and the ADT. Also, the Producer shall submit the calculations of traffic requirements for specified type of surface aggregate requested.
- B.2.3. The aggregate Producer will be responsible for coordinating the test section with the prime contractor. No additional payment will be made for the test section or other costs associated with the test section. Coordination will include the submittal of a bituminous mixture design by a TDOT certified asphalt mix design technician, and appropriate contract Supplemental Agreement.
- B.2.4. Once the bituminous mixture design is approved the test strip may be constructed in accordance with TDOT Standard Specifications and Contract requirements. The Contractor will be required to place, at the Producer's expense, a blue sign at the beginning and end of each test strip. The signs shall read: "Begin Test Strip" and "End Test Strip".
- B.2.5. After the test strip is completed, TDOT will conduct periodic friction tests to determine the actual in place performance. If the test section demonstrates a frictional value greater than forty (40)* after a minimum two (2) year test period, that source material will be considered acceptable. When the total number of vehicle passes must be met, a test strip may need to be in place for more than two (2) years.

* Tested in accordance with AASHTO T 242, a test will be performed each 0.1 mile (minimum five (5) per direction) with no individual test below forty (40).

B.2.6. EXAMPLE:

Type III aggregate is to be tested on a four (4) lane rural roadway with an ADT of 18,000.

7.3 Million Vehicle passes are required. (from TABLE 903.24-1)

- 18,000 ADT x 0.30 for outside lane = 5400 ADT in the outside lane
- 7,300,000 vehicle passes $\div$ 5400 vehicles per day = 1352 days = 3.70 years = ~ 3 years and 8 months

Appendix C: Aggregate Specification Tables

Table 903.25-1: Fine Aggregate Quality Requirements

Application	Sodium Sulfate Soundness Loss AASHTO T 104, %max	L A Abrasion AASHTO T 96, %max	Absorption AASHTO T 84, %max
Concrete (903.01)	10	40 ⁽¹⁾	N/A
Mortar (903.02)	10	N/A	N/A
Hot Mix Asphalt Mix Base and Leveling Courses (903.06)	12	40 ⁽¹⁾	N/A
Hot Mix Asphalt Surface Courses (903.11)	12	40 ⁽¹⁾	N/A
Slurry Seal (903.12)	12	40 ⁽¹⁾	N/A
Microsurface (903.12)	12	40 ⁽¹⁾	N/A

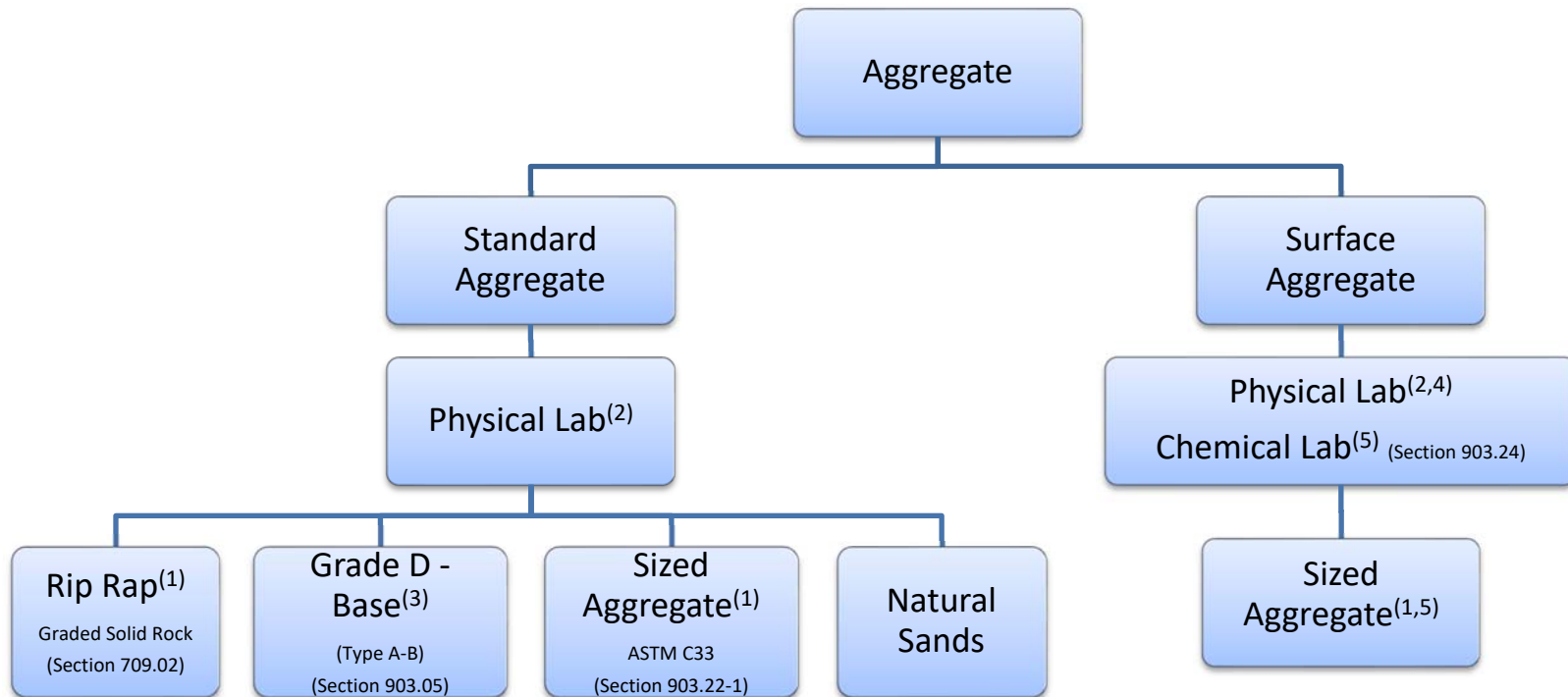
⁽¹⁾Applicable for fine aggregate manufactured from limestone or dolomite.

Table 903.25-2: Coarse Aggregate Quality Requirements

Application	Sodium Sulfate Soundness Loss AASHTO T 104, %max	L A Abrasion AASHTO T 96, %max	Absorption AASHTO T 85, %max
Concrete (903.03)	9	40	5
Mineral Aggregate Base – Type A (903.05)	15	50	N/A
Mineral Aggregate Base – Type B (903.05)	20	50	N/A
Recycled Concrete Aggregate (903.05)	N/A	50	N/A
Hot Mix Asphalt Mix Base and Leveling Courses (903.06)	9	50	5 ^{(1) (2)}
Hot Mix Asphalt Surface Courses (903.11)	9	40	5 ^{(1) (3)}
Bituminous Seal Coat (903.13)	12	40	N/A
Double Bituminous Surface Treatment (903.14)	12	40	N/A
Aggregate Cement Base Course (903.15)	15	50	N/A
Underdrains (903.17)	12	50	N/A
Lightweight Concrete (903.19)	9	40	10
Machined Riprap (709.02)	12	N/A	N/A
Graded Solid Rock (203.02)	12	N/A	N/A
Solid Rock (203.02)	12	N/A	N/A
Masonry Stone (921.07)	12	N/A	N/A

⁽¹⁾ To be based on the properties of the combined coarse aggregate blend.
⁽²⁾ For Grading CW only.
⁽³⁾ Maximum absorption for OGFC is 3.0%.

Appendix D: Sampling Guideline



If TDOT deems additional testing necessary outside of these guidelines, please provide HQMT with an explanation on the T-2 form:

- 1) Sample only one size aggregate from the category if from the same ledge/wall
- 2) Physical Lab should receive one bag for testing:
 - a. 50 lbs. of coarse aggregate
 - b. 15 lbs. of natural sand
- 3) Soil Lab should receive one bag for testing at 25 lbs. for Type A & B base
 - a. Regions 1 & 4 will perform testing at their respective laboratories
- 4) Coarse aggregate: crushed gravel, crushed granite, crushed slag, crushed quartzite, crushed gneiss, or crushed sandstone
- 5) Only new Surface Aggregates and Limestone will have chemical analysis performed
 - a. If BPN is needed, do NOT select Hard Screenings; use #78s if possible

Appendix E: TDOT Procedure For Specified Tests

TN M27(T104)

TDOT Method for testing Aggregate using AASHTO T104

Scope—To identify changes and/or clarification of AASHTO T104 for use with TDOT Materials and Tests testing.

Summary of Procedure—Testing will be performed in accordance with AASHTO T104 except where noted in this procedure.

Section 4 Special Solutions—

- TDOT will only use the Sodium Sulfate Solution as in section 4.1.1

Section 5 Samples—

- Samples shall be obtained in accordance with AASHTO R90.
- Section 5.2.3 and 5.2.4 shall not be used on coarse aggregate sources.
- Fine Aggregate samples shall be obtained from a single stockpile source.

Section 6 Preparation of Test Sample—

- In Table 2, the Grading of Original Sample and Weighted Percent Loss will be removed and a column for Mass of Test Fractions After Test will be added after Mass of Test Fractions Before Test. The Totals row will be replaced with Total Mean Loss, % and will have results under Percentage Passing Designated Sieve after Test column.
- Revised Table 2 with example data.

Sieve Size	Grading of Original Sample, %	Mass of Test Fractions Before Test, g	Mass of Test Fractions After Test, g	Passing Designated Sieve after Test, %	Weighted Percent Loss, %
Soundness Test of Fine Aggregate					
No 30 to No 50	35	100.0	95.8	4.2	1.5
No 16 to No 30	30	100.0	95.2	4.8	1.4
No 8 to No 16	27	100.0	92.0	8	2.2
No 4 to No 8	5	100.0	88.8	11.2	0.6
3/8 to No 4	3	100.0	88.8	11.2	0.3
Total Mean Loss, %					1.2
Soundness Test of Coarse Aggregate					
2-1/2 to 1-1/2		4783.0	4553.4	4.8	
1-1/2 to 3/4		1525.0	1403.0	8	
3/4 to 3/8		1008.0	911.2	9.6	
3/8 to No 4		298.0	264.6	11.2	
Average Percent Loss, %					8.4

Section 7 Procedure—

- Number of cycles in 7.3 shall be 5.

Section 9 Qualitative Analysis—

- Qualitative Analysis will not be performed.

Section 10 Report—

- For Coarse Aggregate Samples section 10.1.3, 10.1.4, 10.1.5 and all subsections will not be reported. Instead, the Arithmetic Mean of the percentage of loss for each fraction shall be calculated and reported.
- For Fine Aggregate Samples the weighted percent loss will be reported.