MARTCP Aggregate Plant Technician
Graded Aggregate Base Plant
Standard Operating Procedure
Study Guide
Addendum 1A

References:

Maryland Standard Test Methods (MSTM)

AASHTO Test Methods

SHA Graded Aggregate Base (GAB) Quality Control Plan

SHA GAB Job Mix Formula (JMF)

Maryland Standard Specifications for Construction and Materials, Tables 901 A & B Aggregate spec, 915 plants in general and 915.04 GAB plant specific.

Maryland Aggregate Bulletin

Scope:

The purpose of this addendum is to detail the process for becoming and maintaining a qualified Maryland GAB producer status.

Details:

All GAB material sources shall be listed in the Maryland Aggregate Bulletin and listed status shall be maintained for the duration of the JMF approval.

All GAB shall meet the grading requirements in table 901 A for graded aggregate – base design range.

All GAB shall meet the aggregate physical property requirements for GRADED AGGREGATE – Base Materials including T 104 Soundness, D 4792 Flat and Elongated, T 96 LA.

All valid GAB JMF mixes are signed by the Soil and Aggregate Technology Division, Division Chief. The GAB JMF is valid for two years.

All GAB Plants must be inspected every year by a QA tech or by an approved engineer.

All techs that are testing the GAB material at the plant for QC results and acceptance must be MARTCP certified. The MARTCP certification is valid for 5 years with a QA audit once a year.

Technician Certification Renewal Policy

Maryland State Highway Administration

Office of Materials Technology

2015

Aggregate Technician – (Code 2)

Re-certification

Section A: By Examination

If you receive a minimum of one successful Quality Assurance Review in each year of your certification period, you qualify for certification renewal without retaking the Aggregate Technician test and/or passing the written and performance exams.

To become re-certified, prior to your certification card's expiration date, submit the following:

Completed application (form on page 18); Quality Assurance Review receipts; your company's name, address, phone number, and contact person to receive an invoice.

Section B: By Reciprocal Certification

You may obtain re-certification through reciprocity by submitting the following:

Completed application (form on page 18); documentation of an up-to-date certification from an approved certifying organization (such as: VDOT, WVDOT, etc.); your company's name, address, phone number, and contact person to receive an invoice.

Send to: Maryland State Highway Administration

Office of Materials Technology
7450 Traffic Drive
Hanover, Maryland 21076
Attention: Lisa R. Alford

After this information is received, the Certification will be issued. Do not send payment at the time of submission. You will be invoiced later by SHA's Office of Finance for $50.00.

Failure to comply with either Section A or B by your expiration date will result in loss of certification. For Technician Certification Program information and to apply for certification, contact Lisa Alford at 443-572-5040

***Transitional Policy for Determining Quality Assurance (QA) Review**

Requirement for Re-certification of Aggregate Tester Plant/Field

Re-certification by Quality Assurance Review applies to technicians who have taken the Aggregate Tester Plant/Field test in Maryland. Technicians are required to get 1 Quality Assurance Review every year for the next 5 years.

Technicians who have a reciprocal certification from another approved certifying organization such as VDOT or PENNDOT are required to be recertified by their original certifying agency.

The following chart indicates the number of QA Review that you need to become re-certified in accordance with the Mid-Atlantic Region Technician Certification Program (MARTCP) Transition Policy. It is the technician's responsibility to contact the QA Team Leader (Stuart Sommers) at 443-695-0927 to assure required Quality Assurance Review are received.

Certification Expiration Year	QA audits needed for Re-certification
2015	1 audit in 2012
	1 audit in 2013
	1 audit in 2014
	1 audit in 2015
2016	1 audit in 2012
	1 audit in 2013
	1 audit in 2014
	1 audit in 2015
	1 audit in 2016

Geology

Sedimentary Rocks:

These rock types are formed by chemical precipitates and the settlement of sediments or organic matter at or near the earth's surface and usually within bodies of water. Examples of sedimentary rocks include limestone, dolomite, Chert, shale, and sandstone. The generic name "limestone" is used for commonly found carbonate rocks, including limestone, dolomite, and marble (Langer 2011). Limestone and dolomite usually form as a result of the consolidation and sedimentation of the shells of marine animals and/or plants. They may also form as a result of the precipitation of fine carbonate mud from marine waters. Limestone and dolomite constitute approximately 70% of crushed stone production in the United States.

Igneous Rocks:

These rock types are formed by the cooling and solidification of magma or lava. The process of magma solidification can occur below or on the earth's surface. Accordingly, igneous rocks formed below the earth's surface are called intrusive or plutonic rocks, whereas those formed on the earth's surface are called extrusive or volcanic rocks. As to see with a naked eye, and the rock has a coarse grained texture but extrusive igneous rocks, which cool rapidly from magma at or near the earth's surface are too fine-grained to distinguish individual minerals. Igneous rocks often have high amounts of silica. Examples of igneous rocks used in pavement applications include granite (intrusive), basalt (extrusive), Diorite, Gabbro, Felsite and rhyolite (extrusive). The generic classification "granite" sometimes includes coarse-grained igneous or metamorphic rocks such as true granite, syenite, gneiss, and dark-colored gabbro (Langer 2011). Granites account for approximately 16% of crushed stone production in the United States (9% of total aggregate production). Although the hardness of individual particles leads to granite usually being classified as excellent crushed stone, some granitic type aggregates are weak and brittle because of their poorly bonded mineral grains, usually caused by weathering. Fine-grained igneous rocks are also called "trap rocks." Trap rocks include dark-colored, fine-grained, volcanic rocks and make up about 9% of the crushed stone production an Examples of trap rock are basalt and diabase. Excellent resistance to chemical reactions and ability to withstand high mechanical stresses led to the classification of trap rock as an excellent crushed stone material.

Metamorphic Rocks:

These rocks are formed by the transformation of existing rocks (may be sedimentary or igneous) under heat and pressure. Examples of metamorphic rocks include Gnesis, Schist, Amphibolite, Slate, Serpentinite, Quartzite and Marble. Metamorphic rocks as an aggregate can have widely variable characteristics. Many quartzites and gneiss can have properties similar to those of granite, whereas shale can be slabby and schist can be soft and flaky because of its high mica content. Sand and Physical characteristics of the rocks that govern load dissipating and particle-interlocking aspects differentiate "good" and "poor" quality aggregates with respect to the suitability for application in pavement unbound base/subbase courses. Moreover, chemical properties of the aggregates Mineral composition of aggregates have a significant effect on the physical and chemical characteristics that ultimately govern the performance of UAB/subbase layers under loading. This is particularly true as far as degradation and polishing of aggregates resulting from interparticle friction is concerned. Increasing the amount of fines in a mix reduces the permanent deformation resistance (Barksdale 1972, 1991; Thom and Brown 1988). Moreover, the type of fines (nonplastic or plastic fines) in an aggregate layer has been found to affect the performance significantly.

Particle Shape, Surface Texture, and Angularity:

The gradation, shape, and hardness have a great influence on the mechanical behavior and the strength properties of aggregate particles in contact. In general, it is preferable to have somewhat un-dimensional (cubical) and angular particles rather than flat, thin or elongated particles. Aggregate gradation is also critical for achieving good packing and minimal porosity in an aggregate mix.

Degree of Compaction:

Before the aggregate samples are tested for strength, modulus and deformation behavior, the first task is to compact them at the corresponding gradation to determine their moisture–density relationships. Because pavement layers in the field often are compacted to predetermined percentages of the maximum dry density (MDD) values, it is important to establish the values of MDD and optimum moisture content (OMC) for each aggregate gradation. Thus, the objective of compaction is to improve the engineering properties of the soil mass. Through compaction, strength can be increased, deformation tendency can be reduced in the field, bearing capacity of the granular layer can be improved and undesirable volume changes (such as those caused by frost action, swelling, and shrinkage) may be controlled (Holtz 1990).

Moisture Content:

Moisture has been widely recognized to adversely affect the performance of unbound aggregate layers in pavement structures and can affect aggregates in three different ways: (1) make them stronger with capillary suction, (2) make them weaker by causing lubrication between the particles, and (3) reduce the effective stress between particle contact points resulting from increasing pore water pressure, thus decreasing the strength. Increase in moisture content influence the permanent deformation.

TESTS TO CHECK AGGREGATE QUALITY FOR PAVEMENT APPLICATIONS

Different tests recommended by AASHTO for material quality testing, selection and control testing of aggregates are listed here:

- AASHTO T 2: Standard Method of Test for Sampling of Aggregates
- AASHTO T 11: Standard Method of Test for Materials Finer than 75-μm (No. 200) Sieve in Mineral Aggregates by Washing
- AASHTO T 19: Unit Weight and Voids in Aggregate
- AASHTO T 27: Standard Method of Test for Sieve Analysis of Fine and Coarse Aggregates
- AASHTO T 84: Specific Gravity and Absorption of Fine Aggregate
- AASHTO T 85: Specific Gravity and Absorption of Coarse Aggregate
- AASHTO T 88: Standard Method of Test for Particle Size Analysis of Soils
- AASHTO T 89: Standard Method of Test for Determining the Liquid Limit of Soils
- AASHTO T 90: Standard Method of Test for Determining the Plastic Limit and Plasticity Index of Soils
- AASHTO T 96: Standard Method of Test for Resistance to Degradation of Small-Size Coarse

Aggregate by Abrasion and Impact in the Los Angeles Machine

- AASHTO T 103: Freezing and thawing soundness
- AASHTO T 104: Soundness of Aggregate by Use of Sodium or Magnesium Sulfate
- AASHTO T 112: Clay Lumps and Friable Particles in Aggregate
- AASHTO T 113: Lightweight Pieces in Aggregate
- AASHTO T 146: Standard Method of Test for Wet Preparation of Disturbed Soil Samples for Test
- AASHTO T 176: Standard Method of Test for Plastic Fines in Graded Aggregates and Soils by Use of The Sand Equivalent Test
- AASHTO T 210: Aggregate Durability Index
- AASHTO T 248: Reducing Field Samples of Aggregate to Testing Size
- AASHTO T 255: Total Moisture Content of Aggregate by Drying
- AASHTO T 327: Micro-Deval abrasion, coarse and fine aggregates
- Degradation in the SHRP Superpave® Gyratory Compactor Similarly, the following test methods are used to characterize the soundness and durability of aggregates:

Frequency of Checking Aggregate Sources for Quality:

The Maryland State Highway Administration requires all Graded Aggregate Base Plants to have the Material used in their mixes listed in the Maryland Aggregate Bulletin for the duration of the approval period.

The MD-SHA frequency guide requires a State certified Graded Aggregate Base Plant to undergo a Quality Assurance inspection every 10 production days.

Type and Amount of Fines:

The type of fines, often indicated by the plasticity index (PI) value (PI test usually conducted on material finer than 0.425 mm or passing No. 40 sieve), plays an important role in governing the shear strength, resilient modulus, and permanent deformation behavior of unbound aggregate layers in pavement structures. The term “fines” is material finer than 0.075 mm or passing the No. 200 sieve. Aggregate materials with high amounts of plastic fines exhibit higher moisture susceptibility and undergo significant reduction in the shear strength in the presence of moisture when compared with aggregates with non plastic fines.

MD-DOT allows a maximum value of 6 for their Plasticity Index.

Aggregate storage, transportation and construction practices:

Improper material handling and construction procedures often lead to aggregate segregation and/or degradation, ultimately resulting in a poorly compacted aggregate layer. Because aggregate layers function primarily through interparticle load transmission at aggregate contact points, such poorly compacted layers may undergo excessive shear deformation, leading to pavement failure.

AGGREGATE STORAGE AND CONSTRUCTION PRACTICES AFFECTING CONSTRUCTED LAYER PERFORMANCE

Aggregate Stockpiling as a Source of Segregation:

Aggregate segregation as the separation of one size of particles from a mass of particles of different sizes, caused by the methods used to mix, transport, handle or store the aggregate in the plant under conditions on the distribution of the aggregate sizes. One possible source of segregation is during the formation of conical stockpiles by dumping material using a conveyor belt. As the aggregate is transported by a conveyor belt, vibration and motion of the belt causes the fine particles to settle to the bottom of the material stream, whereas coarse particles remain at the top. These coarse particles have a higher velocity at the end of the conveyor, and are thrown a greater distance to the stockpile. In addition, the coarser particles hit the front face of the stockpile with a greater momentum and roll down the outer edge of the pile, creating overrun (an accumulation of particles at the pile's bottom edge or toe). Fine particles, which have settled against the surface of the conveyor belt, tend to cling to the belt and drop to the back face of the pile. The resulting stockpile is segregated, with coarse particles settled at the toes and fine particles in the center portion of the pile.

"Material overrun," particles (regardless of size) moving down the side of the stockpile, is another major source of segregation in stockpiles. As the material moves down the side of the stockpile, larger particles tend to move down to the bottom (owing to higher momentum), whereas finer materials tend to settle into the side of the pile. Such spatial distribution of aggregate particles of different sizes at different portions of the stockpile results in pronounced segregation. Materials with a large variation in particle size usually undergo higher degrees of segregation as a result of improper stockpiling practices. Usually aggregate materials in which the ratio of the largest to the smallest particle size exceeds 2:1 are likely to experience segregation problems during stockpiling.

The most commonly used truck dumping method, although economical was found to cause significant segregation of aggregates. The main segregation issue is associated as such as (1) initial material fabrication, (2) producer stockpile, (3) truck transportation, and (4) jobsite stockpile.

Creating stockpiles using the "windrow concept" is one of the alternatives available for storage of materials where segregation is a likely problem. Involving the creation of "miniature stockpiles" in layers, windrow stockpiles can be built effectively using a telescoping conveyor that can move laterally as well as along the direction of the conveyor to create the stockpile in layers.

- Stockpiles need to be placed on firm, well-drained ground that is free of any material that could cause contamination.
- Stockpiles should be built in layers of uniform thickness and not in cone-shaped piles that result in segregation of piles.
- After the first layer of the stockpile is placed, it is important that heavy transporting equipment not be allowed to run on top of this layer because this tends to degrade the aggregate by grinding the particles together, also contaminating the aggregate with mud and other deleterious substances from the wheels or tracks of the vehicle.

A few points to keep in mind:

- QC plans are to be approved annually.
- GAB Job Mix Formula (JMF) is approved for 2 years.
- Aggregate Tech Cert is good for 5 years, contact Ms Lisa Alford for Tech Certs (443-572-5040)
- Material for Maryland State approved GAB must be listed and maintained in the annual Maryland Aggregate Bulletin.

Annually, the plant (or the terminal) will need to be inspected before shipping can start. After a JMF is established and approved by the State, the QC plan approved and the plant has been inspected, you will be an approved Graded Aggregate Base plant and will be eligible to have approved contracts sent material from your plant. This would start by the contractor naming you as a source of supply (SOS) on a SOS letter. The materials management division (MMD) would then add the contract to the approval list and then send the list to the SATD office to be forwarded to the plant on an approved contract list.

Graded Aggregate Base Material

Quality Control Plan Checklist

The purpose of a Quality Control Plan for Graded Aggregate Base Materials is to ensure that material delivered to State projects are in compliance with both gradation and moisture specifications.

- **What is produced?**
Example:

Pugmill Mixed Production or Stockpile Production Method.

- **Where is it produced?**
Example:

a. Company Letterhead with Quarry & Plant Site location.

b. Correct mailing address

- **Describe production and handling.**
Example:

Explain pugmill or stockpile operation and if the material is put in holding bins,

trucks or stockpiles not to be maintained longer than 72 hours.

- **How is the quality of the finished product checked and how often?**
Example:

The G.A.B. will be manufactured within gradation specifications and shipped within 2% + or - of optimum moisture, which will be established by the Maryland State Highway Administration. In accordance with SHA requirements, one sample shall be taken for sieve analysis (AASHTO T27 omitting T11) and moisture content (MSMT 251) for every 1000 Tons of State production or every 4 hours of State production whichever comes first.

- **Does the plan have details of where the moisture and gradation sample are taken during production and shipping?**

- **Does the plan detail that the split samples should be kept for the past 10 production days?**

- **Does the plan detail what happens if material fails moisture or gradation?**
Example:

In the event that gradation or moisture results fall outside of the allowable tolerance of the job mix formula (JMF), a second sample will be taken. In the event those results fall outside the tolerance, shipments will cease and the SHA Hanover Lab (copy to the Hanover Lab fax 410 787-0464 or GAB@sha.state.md.us) will be notified. When a solution is found, and test results are within tolerance again, a request to resume shipping will be made to SHA Area Lab (copy to Hanover LAB).

- **Does the plan detail what happens to non-spec (unacceptable) material?**

- **Does the QC plan detail the names and phone #'s of site manager/ location manager and certified technicians?**

Example:

Shown below are the certified base course technicians that will sample and test the GAB produced at this location and their supervisors:

Certified Technicians: (name) (certification no.) (phone no.)

Supervisors: (name) (title) (phone no.)

<u>Documentation:</u>

The following are details regarding documentation that must be included on all GAB QC plans:

- **Notification of Shipment or Production** will be faxed or e-mailed to the SHA Hanover Lab (*fax 410 787-0464 or GAB@sha.state.md.us)* on the preceding day.

- **Form SHA 73.0-43 (Graded Aggregate Base Plant Report):** The original, with that day's production on it, will be held at the Producer's lab and a copy faxed to the SHA Hanover Lab or e-mailed to the SHA Hanover Lab (*fax 410787-0464 or GAB@sha.state.md.us)* on the next working day.

- **Form GAB-1 (Certified Base Course Technician on Duty):** An original copy will be sent to each project daily with the first load shipped. The yellow copy will be filed at the producer's lab.

- **Graded Aggregate Base Plant Duty Log** (includes personnel working, plant checklist and other items of interest) will be maintained and filed at the producer's lab.

- **Plant Scales:** Before any proportioning plant starts operation, and at least once each year thereafter, all measuring devices, meters, dispensers, test weights, and other measuring devices shall be inspected, tested, and certified to be in proper operating condition by competent testing agencies approved by the Engineer. Any weighing device by which materials are sold by weight as a basis of payment shall be tested monthly and certified by an approved testing agency.

SHA 73.0-43
Rev. 6/92

STATE HIGHWAY ADMINISTRATION
MATERIALS AND RESEARCH

Acceptance_______
I.A.S.T.__________
Control __________
Other____________

GRADED AGGREGATE BASE PLANT REPORT

Contract No.:__________________________ F.A.P. No.:______________________ Date:__________

Contractor:____

Plant Owner and Location:____

G. A. Base Job Mix Formula Approval Number: _______ - ______ - GA_______ - _________ - _______
(Region) (Mix) (Plant) (JMF No.) (Year)

PLANT LAB TEST DATA

	Sieve Size							Moisture & Additive Data				Sample	Tons	Result
	2"	1-1/2"	3/4"	3/8"	#4	#30	#200	% M/C	Cement	CaCl	Emuls.	Time	Ship'd	(P or F)
JMF														
Toler.	-2	±5	±8	±8	±8	±5	±2		±0.25		±0.25			
Range														
%														
P														
A														
S														
S														
I														
N														
G														

TOTAL TONS [ ]

REMARKS:____

OFFICIAL VISITORS:_____________________

All samples were taken, and tests performed in accordance with applicable SHA standards.

Reported By:_____________________________
(Signature)

Certified Technician No.:__________________________

ORIGINAL: Regional Laboratory COPIES: Plant File

GAB-1
6/92

MARYLAND STATE HIGHWAY ADMINISTRATION

OFFICE OF MATERIAL & RESEARCH

DATE: __________

TIME: __________

SUBJECT: CERTIFIED BASE COURSE TECHNICIAN ON DUTY

TO: Administration Project Engineer

RE: MSHA Project Number ______________________________

This letter certifies that a Certified Base Course Plant Technician is performing Quality Control Duties and is inspecting the production of base course material.

JMF #: ______________________________

Producer: ______________________________

Location: ______________________________

Certified Technician No.: ____________________

Name of Technician: ____________________

Technician's Signature: ____________________

Note: The original letter shall be sent to each project daily with the first truck load. A copy will be retained in the plant file.

Revised: 03/15/10 GWH

The Office of Materials Technology has been requested to change the frequency of tests related to GAB testing at the plant. Also, a request to eliminate stockpile time restrictions for GAB has been submitted for consideration and approval. From these requests, the following changes are now available to approved GAB producers. Please note that an updated addendum or revised QC plan wi be required to support these changes.

- Producer QC sample collection and test frequency for GAB gradations shall be changed one every 1,000 Tons or each production day.
- Frequencies for moisture tests shall remain the same - producer QC sample collection an test frequency for GAB moisture tests shall be one every 1,000 Tons or once every four hours of production shipped (which ever yields the greater frequency).
- Time limits for stockpiling GAB material at the plants are eliminated but care is to be given to avoid segregation issues during stockpiling and loading to ensure a quality product is delivered to the project.

Your updated addendum or revised QC Plan for 2012 (signed by the QC supervisor) must be submitted before these changes can be approved for your plant. As always, please verify personnel, certification numbers, mailing and e-mail addresses, phone and fax numbers.

Please contact me at (443)-572-5271 or ghall@sha.state.md.us if you have any questions regarding this matter.

Sincerely,

George Wm. Hall III
Assistant Division Chief
Soil and Aggregate Technology Division
Office of Materials and Technology