



Central Mix Aggregate Certification

This page intentionally left blank.

Table of Contents

Chapter 1: Introduction

Table Location.....Ch.1 -2

Preface/ Acknowledgments.....Ch.1 -3

Certification InformationCh.1 -4

VDOT Technician ApplicationCh.1 -5

AgendaCh.1 -6

History/ Introduction.....Ch.1 -7

Chapter 2: Quality Assurance Program/ Dense Graded Aggregates

Chapter 3: Sampling and Testing

Chapter 4: Acceptance of Material

Chapter 5: Modified Acceptance Program

Chapter 6: MITS/PLAID Program

Appendix A: Pay Quantities

Appendix B: VTM-40, Titration, Plant Calibration- Cement

Appendix C: Answers to Study Questions

Appendix D: Test Procedures (Proficiency Tests)

Table Location

Table II-1 Fine Aggregate	1-10 & 5-7
Table II-2 Soundness	1-10
Table II-3 Sizes of Open Graded Coarse Aggregates	1-11 & 5-10
Table II-4 Soundness	1-12
Table II-5 Abrasion	1-12
Table II-6 Design Range: Select Material, Type I	1-14 & 4-9
Table II-7 Process(P) and Range(R) Tolerance: Select Material, Type I	4-9
Table II-9 Design Range for Dense Graded Aggregates	1-14 & 4-2
Table II-10 Process Tolerances for Each Laboratory Sieve, (%)	4-2
Table II-11 Atterberg Limits	4-3
Table II-12 Standard Deviation	4-13

Preface and Acknowledgments

This manual is a practical guide for VDOT technicians, inspectors and contractors. Information contained herein is generally compatible with current VDOT specifications, however, it should not be considered a source for these specifications.

The Certification Training School would like to express their appreciation to all the people in the Department and Industry who have helped with the publication of this manual. It is through their dedicated effort that the Certification Program continues to be the standard for other programs to follow.

Certification Requirements

Pass Written Examination -

- Show photo identification before taking exam
- Sign Technician Certification Application
- Open book - 40 multiple choice questions
- Three hours are allowed for the exam.
- Passing score is 70 - one retest is allowed.
- Complete by December 31, 2016

Pass Proficiency Test -

- To schedule proficiency testing, contact Materials Certification Training at (804)328-3158, or if someone with your company is a proficiency checker you may schedule with them.
- Show photo identification
- Demonstrate applicable aggregate tests methods (see Appendix D)
- Complete by December 31, 2016 after passing written exam.

Tests results and card are found at the VDOT University website listed below.

VDOT Employees: <https://virtualcampus.vdot.virginia.gov>

All other students: <https://virtualcampus.vdot.virginia.gov/external>

If you are enrolled in this class, do not register as a new user.

If you do not know your logon or password, call (804) 328-3158



APPLICATION FOR VDOT MATERIALS TECHNICIAN CERTIFICATION

This is to affirm that (print your name) (Technician’s Name), hereinafter “Technician,” desires to be certified by the VDOT as a **Central Mix Aggregate Technician**. By making this Application, Technician acknowledges and agrees that Certification carries inherent rights and responsibilities. The rights include being exclusively sanctioned, along with others so certified by VDOT, to perform sampling, testing, and reporting of test results for quality acceptance, quality control and assurance programs. The responsibilities include performing and reporting tests with the accuracy and precision expected of the Technician in accordance with the required test procedures.

By signing this Application, Technician agrees to strive to maintain compliance with all rules, regulations, specifications, industry standards, procedures and policies, applicable to any work performed under the Certification. A violation of the above as determined by the VDOT Technician Certification Review Board may result in a suspension or revocation of the rights and responsibilities conferred on the Technician. Revocation or suspension of one Certification may be considered a revocation or suspension of all Certifications held by the Technician. Further, any suspension or revocation of Technician’s Certification in any other jurisdiction may result in the VDOT Technician Certification Review Board taking the same or other action, against Technician’s Certification in Virginia.

By signing below, Technician also affirms that he/she is aware that both State and Federal laws may govern construction projects in Virginia, including Title 18, United States Code, Section 1020, that states, in pertinent part, that anyone making falsifications on Federal-aid projects,

“Shall be fined not more than \$10,000 or imprisoned not more than five years, or both.”

I, (Print your name) (Print Name), affirm that I have read and fully understand the foregoing “APPLICATION FOR VDOT TECHNICIAN CERTIFICATION,” and I agree to be bound by these terms.

Technician’s Signature

Date

**Virginia Department of Transportation
Central Mix Aggregate Certification
Agenda**

Day One

7:30 – 8:00	Registration	
8:00 – 8:15	Introduction	Learning Center
8:15 – 9:00	Stockpiling Video	Learning Center
9:00 – 11:00	Chapter 2 - Quality Assurance Producer & VDOT Responsibilities	Tony Sanchez Billy Powers
11:00 – 11:30	Chapter 2 - Stratified Random Sampling	Billy Powers
11:30 – 12:30	Lunch	
12:30 – 3:00	Chapter 3 - Testing of Aggregates	Wayne Melton
3:00 - 4:00	Chapter 3 - Atterberg Limits	Chris Gresham

Day 2

8:00 – 9:00	Chapter 3 - Optimum Moisture	Whitney Butler
9:00 – 11:00	Chapter 4 - Acceptance of Materials Lot Adjustments	Whitney Butler
11:00 – 11:30	Chapter 6 – Test Results Input - MITS/PLAID	Billy Powers
11:30 – 12:30	Lunch	
12:30 - 1:00	Chapter 5 - Modified Acceptance	Ginger Clore
1:00 – 1:30	Appendix B - Titration	Billy Powers Whitney Butler
1:30 - 4:30	Appendix C - Proficiency Class/ Demonstrations	Wayne Melton

Day 3

8:00 - 11:00	Exam	
--------------	------	--

The History of Central Mix Aggregate

During the early 1960s, the Virginia Department of Transportation undertook a program to upgrade aggregate materials. The Department felt this was necessary since the highway construction program was booming and there was a real problem in maintaining passing aggregate materials from the stockpile to the roadway. With an expanded building program, aggregate producers were building large stockpiles and, even though the material met specifications when produced, it often failed after being placed in the roadway. This was due to stockpile segregation and/or so much handling before use. Failing materials caused the Department and Contractor a great deal of trouble as the materials had to be tested, reblended, roadway mixed and then tested again.

As a solution, the Virginia Department of Transportation decided to require that all aggregate base and subbase materials be pugmill mixed in a central mix aggregate plant. This is a process that requires aggregate materials to be mixed and brought to a proper gradation and moisture content just prior to being placed in the roadway. These materials became known as Central Mix Aggregates (CMA).

Aggregates are, for the most part, base or subbase aggregate materials, which range in sizes from 1 ½ inch (37.5 mm) in diameter to particles as fine as dust. These sizes are controlled by screening and blending operations at the aggregate producer's crushers and/or at the central mix aggregate pugmill mixers.

The central mix aggregate plant is required to be equipped with a pugmill mixer and such other equipment as necessary for blending different size aggregates and water into a homogeneous mixture. For special requirements, such as stabilized aggregates, central mix aggregate plants are also required to be equipped with feeders to introduce cement into the mixture. With the blending of aggregates and adding of water and, sometimes, other stabilization agents, the central mix aggregate plant operation is able to produce an aggregate material to meet rigid specifications and, thus, the high strengths required by modern highways.

When the decision was made to require aggregate base materials to be central mixed, provisions were also made to test the materials at the source. This required a laboratory at the production plants and qualified technicians and inspectors to oversee the operation.

With controls in place to insure a uniform gradation and thorough mixing of aggregates and additives, it was time to look at the whole picture of production testing and not just individual loads - statistical quality control was initiated for aggregate bases, subbases and select material.

Statistical quality control was needed to insure that all material has an equal opportunity to be tested without arbitrarily selecting an individual location or time. CMA (Central Mix Aggregate) Producers are aware that under statistical quality control all of their material has an equal chance of being tested. Therefore, quarry technicians were needed to run their own samples. It was now a dual testing system.

Noting this duplication of testing, the Virginia Department of Transportation established a Quality Assurance Program consisting of an industry run sampling and testing program with the Department monitoring the process.

With the question of base and subbase quality control answered, select material and open graded coarse and fine aggregate quality control needed to be addressed. It was determined that select material, if mixed in a pugmill at the source, could be included in a Quality Assurance Program with its own criteria for acceptance and adjustment.

The Modified Acceptance Program was developed for any material other than Select Material Type I, or any type subbase or base dense graded material specified in sections 208 and 209 of the Road and Bridge Specifications. It was agreed on by the Department and Industry with a mandatory starting date of October 1, 1986. This program states that the aggregate producer is to certify on the delivery ticket and TL-102A that the aggregates have been sampled and tested and meets all specification requirements. The Department, in turn, would conduct a monitoring program to verify the acceptability of the product. Unlike the QA program, which is sampled from location on trucks or stockpiles only, the Modified Acceptance Program can be sampled from stockpiles, barges, conveyors and other points which accurately represent the material being produced and shipped.

Introduction to Central Mix Aggregate Programs

The Virginia Department of Transportation currently awards a certificate to those individuals who have successfully completed a program of study which qualifies them to be Aggregate Technicians. This program is presented by the Virginia Department of Transportation and is taught by members of industry and the Materials Division. The purpose of this program is to supply the prospective VDOT or industry technician with a good basic knowledge of aggregates, and to familiarize the individual with the specifications that relate to the production and placement of these aggregates, and to acquaint the individual with the tests that are to be run on this material. This study guide serves as a text for this program and is a good reference book for the technician at the project or plant where aggregates are used.

Mix design requirements form an essential part for all aggregate mixtures. The agency or authority responsible for construction (Department of Transportation) usually establishes the mix design range and the design requirements. Once these are established, it becomes the responsibility of the Producer and their technician to develop the mix within the framework of the design requirements.

Through many years of laboratory testing and actual road application, the Department has established design ranges for aggregate mixtures in Virginia. (See Road and Bridge Specifications, Table II - 9 for dense graded aggregate and Section 207.02 for Select Material, Section 202 for fine aggregates, and Section 203 for coarse.) In this section we will generally discuss the design ranges and types of aggregate mixtures used for highway construction.

To properly design an aggregate mixture for a specific application, consideration must be given to the desirable mix properties. Open graded aggregates used in concrete pavement and other concrete construction, in drainage applications, in surface treatment and for any other use have been designed, through gradation design ranges, abrasion and soundness requirements, to provide the needed properties for each application. The requirements for open graded aggregates are covered in Tables II-1 through II-5 of the Virginia Road & Bridge Specifications:

Road & Bridge Spec. - Section 202.02

TABLE II-1
Fine Aggregate

Grading	Amounts Finer Than Each Laboratory Sieve (Square Openings) (% by Mass)							
	3/8 inch 9.5 mm	No. 4 4.75 mm	No. 8 2.36 mm	No. 16 1.18 mm	No. 30 600 μm	No. 50 300 μm	No. 100 150 μm	No. 200 75 μm
A	Min. 100	95-100	80-100	50-85	25-60	5-30	Max. 10	
B	Min. 100	94-100					Max. 10	
C	Min. 100	94-100				Max. 25		

Road & Bridge Spec. - Section 202.03

TABLE II-2
Soundness

Use	Max. Soundness Loss %	
	Magnesium Sulfate (5 Cycles)	Freeze and Thaw (100 Cycles)
Hydraulic Cement Concrete	18	8
Asphalt concrete surfaces and surface treatments	25	15
Asphalt concrete bases	30	15

Road & Bridge Spec. - Section 203.03

Table II-3
Sizes of Open Graded Coarse Aggregates
Amounts Finer Than Each Laboratory Sieve (Square Openings) (%Mass)

Sta. Size No.	100 mm 4 in.	90 mm 3 1/2 in.	75 mm 3 in.	63 mm 2 1/2 in.	50 mm 2 in.	37.5 mm 1 1/2 in.	25.0 mm 1 in.	19.0 mm 3/4 in.	12.5 mm 1/2 in.	9.5 mm 3/8 in.	4.75 mm No. 4	2.36 mm No. 8	1.18 mm No. 16	300 μm No. 50	150 μm No. 100
1	Min. 100	95±5		43±17		Max. 15		Max 5							
2			Min. 100	95±5		43±17		Max 15	Max 5						
3				Min. 100	90-100	35-70	0-15		Max 5						
357					Min. 100		60±20		20±10		Max 5				
5						Min. 100	95±5	58±17	Max 15	Max 5					
56						Min. 100	95±5	58±17	25±10	Max 15	Max 5				
57						Min. 100	95±5		43±17		Max 7	Max 3			
68							Min. 100	95±5		48±17	Max 20	Max 8	Max 5		
7								Min. 100	95±5	57±17	Max 15	Max 5			
78								Min. 100	95±5	60±20	Max 20	Max 8	Max 5		
8									Min. 100	92±8	25±15	Max 8	Max 5		
8P									Min. 100	75±100	5-30	Max 5			
9										Min. 100	92±8	25±15	Max 10	Max 5	
10										Min. 100	92±8				20±10

Road & Bridge Spec. - Section 203.03**TABLE II-4
Soundness**

Max. Soundness Loss (%)		
Use	Magnesium Sulfate (5 cycles)	Freeze and Thaw (20 cycles)
Hydraulic cement concrete	12	5
Asphalt surface courses	15	6
Asphalt and aggregate bases	20	7
Select material (Type I) and subbase	30	12

**TABLE II-5
Abrasion**

Max. Los Angeles Abrasion Loss (%)		
Use	100 Rev.	500 Rev.
Grade A stone	9	40
Grade B stone	12	45
Grade C stone	14	50
Slag	12	45
Gravel	12	45

Crusher Run

Road & Bridge Spec. - Section 205.03

(a) **Grading:** Grading shall conform to the following when tested in accordance with the requirements of AASHTO T27:

% by Mass of Materials Passing Sieve

Size No.	2 ½ in. 63 mm	2 in. 50 mm	1 ½ in. 37.5 mm	1 in. 25 mm	¾ in. 19.0 mm	No. 4 4.75 mm
24	Min. 100	95±5				32±18
25			Min. 100	95±5		32±18
26				Min. 100	95±5	38±22

Dense Graded Aggregates

Dense graded aggregates: base and subbase material and select material, are used in pavement construction. The following are important for aggregates used for this purpose:

1. **Stability** The ability of an aggregate mixture to resist deformation from imposed loads.
2. **Durability** The ability of an aggregate mixture to resist disintegration by weathering and traffic.
3. **Workability** The ease with which aggregate mixtures may be placed and compacted.

The design ranges as presented in Table II - 9 of the Road and Bridge Specifications have taken into consideration the above mentioned desirable mix properties. Therefore, Table II - 9 is actually stating that a mix design or job mix within the design range for a specific application or size will possess the desirable mix properties discussed above.

Road & Bridge Spec. - Section 208

TABLE II-9
Design Range for Dense Graded Aggregates

Amounts Finer Than Each Laboratory Sieve (Square Openings¹) (% by Weight)						
Size No.	2 in.	1 in.	3/8 in.	No. 10	No. 40	No. 200
21 A	100	94-100	63-72	31-41	14-24	6-12
21 B	100	85-95	50-69	20-36	9-19	4-7
22	---	100	62-78	39-56	23-32	8-12

¹ In inches, except where indicated. numbered sieves are those of the U.S. Standard Sieve Series.

Road & Bridge Spec. - Section 207.01

TABLE II-6
Design Range: Select Material, Type I

% by Weight of Passing Material					
3 in. Sieve	2 in. Sieve	No. 10 Sieve	No. 40 Sieve	No. 200 Sieve	ASTM D4791 Flat & Elongated 5:1
100	95-100	25-55	16-30	4-14	30% max.

There are many types of dense graded aggregate mixtures used in highway construction. In Virginia, however, there are three basic types that are used in the construction of a pavement: Select Material, Aggregate Subbase Material and Aggregate Base Material.