CHAPTER 2
QUALITY ASSURANCE PROGRAM
DENSE GRADED AGGREGATES

Producer's Responsibility - Quality Assurance Program

The producer shall furnish and maintain a plant laboratory, meeting the requirements of Section 106.07 of the Road and Bridge Specifications.

Under the QA program, a certified technician must be present at all times during the mixing of the final product. Such technician shall be capable of designing, sampling, testing and adjusting the mixture.

Sample, using an approved random method, and test in accordance with the Specifications. A rate of 4 samples per 2000 ton lot shall be used (a 4000 ton lot may be used at the discretion of the District Materials Engineer, **and will still be sampled at the rate of 4 samples for the entire lot)**. The specification requires that samples be obtained from the approximate center of truckloads of material or from a mini-stockpile. A statistically acceptable method of randomization is to be used to determine the time and location of the stratified random sample to be taken. The Department shall be advised of the method to be used prior to start of production.

Record test results and maintain quality control charts that are kept visibly posted. Furnish the Department copies of the test results on forms furnished by the Department and maintain current control charts at the plant for review by the Department. Maintain all records and test results associated with materials production (e.g. hydraulic cement, etc.).

Notify the District Materials Engineer when production is to start or resume after a delay.

Obtain a sample at the request of the monitor and analyze half of the sample. The Department will analyze the other half. This sample shall be quartered or processed through a sample splitter in accordance with standard procedures. This sample will be used as the next production control sample. Properties to be determined include, but are not limited to, gradation, Atterberg limits, cement content and moisture content for subbase, aggregate base material, and select material. This information is recorded on the TL-52A, (see page 2-11), and on a control chart at the plant.

Job-Mix Formula - Form TL-127 (see page 2-3)

The Producer shall submit for the Engineer's approval a job-mix formula for each type of material. Approval must be received by the Producer from the Materials Division prior to starting production of the material. The job-mix shall be in effect until modified in writing by the Engineer. When unsatisfactory results or other conditions make it necessary, the Producer shall prepare and submit a new job-mix formula for approval. Approximately one week may be required for the evaluation of a new job-mix formula.

An explanation of the sections of the report is as follows:

A. Heading

1. Fill out as indicated.

B. Materials

1. Fill out as indicated.

C. Job-Mix

1. List control sieves.

2. In the "Design Range" column, list design range, which is obtained from Table II-9 of the specifications.

3. In "Total % Passing" column, list the values of percent passing for each of the indicated job-mix sieves that were determined when you blended different stockpiled aggregates to derive a job-mix formula.

4. If stabilized material, write in cement design.

5. List the tolerances in the tolerance column. Note that the tolerances given are those based on four tests.

6. Apply the tolerances to the job-mix to form the acceptance range and minimum cement content.

Form TL-127 (Rev. 11/05)

VIRGINIA DEPARTMENT OF TRANSPORTATION

MATERIALS DIVISION

STATEMENT OF ASPHALT CONCRETE OR CENTRAL-MIX AGGREGATE JOB-MIX FORMULA

Submit to the District Administrator, Virginia Department of Transportation. Approval must be received by the contractor from the Materials Division before work is begun. This job-mix design is approved for all projects of the Department for the type of mix and the calendar year shown below.

Contractor Design Mix No. _____ Design Lab No. _____

Date 6/22/2008 Job Mix ID No. 7033-08-03 Calendar Yr. 2008 TSR Test No. _____

Type Mix / Size Aggregate Aggregate Base Type I 21-A Size 76 Type 79

Producer Name & Plant Location Vulcan Materials, Springfield, VA Phone 703-354-5783

Materials					Kind	Source
Approval Phase	A	B*	C			
Aggregate		90-100		%	Crusher Run	Warrenton, VA
Aggregate				%		
Rap				%		
Sand				%		
Screening		0-10		%	Stone Screenings	Warrenton, VA
Lime				%		
Asphalt Cement						
Asphalt Prime/Tack						
Additives:						

Job-Mix Sieves	Total % Passing		Tolerance % + or -	Acceptance Range Average of 4 Test(s)		End of Year Average	Design/Spec. Range
	Lab JMF	Production JMF					
Approval Phase	A	B*		A	B	C	
2"		100	0		100		100
1"		95	5		90-100		94-100
3/8"		70	9.5		60.5-79.5		63-72
#10		33	7		26-40		32-41
#40		19	4		15-23		14-24
#200		10	2		8-12		6-12
L.L.					Max - 23		
P.I.					Max - 2		
Asphalt (%)							

Lay Down Temperatures	_____ - _____ °F(°C)	Muffle Furnace Correction Factor:	
		Field Correction Factor ($G_{se} - G_{sb}$):	
Lab Compaction Temperatures	_____ - _____ °F (°C)	Pill Weight:	
		SMA Mixes	
		VCA_{DRC}:	
Producer Technician's Certification Number	0421	G_{CA}:	

MATERIALS DIVISION USE ONLY

Remarks							
Nominal Max. Size Aggregate		Application Rates:	Min.	lb/yd² (kg/m²)	Max.	lb/yd² (kg/m²)	
Mix Properties at the Job-Mix Asphalt Content:	Compacted Unit Weight	lb/ft³ (kg/m³)	VTM:		G_{mm}:		
Checked By: John Smith							

Approved tentatively subject to the production of material meeting all other applicable requirements of the specification.
* Note: Part B 'Production JMF' and corresponding Material percentages will be filled out by the DME upon receipt of the additional requirements of the HMA producer within the first three lots under Section 502.01(b)

Copies:	Approvals			
State Materials Engineer District Materials Engineer Project Inspector Sub-Contractor and/or Producer			Part A:	Date:
		☒	Part B: John Smith	Date: 6/24/2008
			Part C:	Date:

Department's Responsibility

District Materials Engineer's Staff and Monitor Quality Assurance Program

The term "Department Monitor" shall mean either a Department employee or contract personnel hired by the Department to conduct the monitor sampling.

1. Provide classroom or self-study technical instruction, examination and certification for all appropriate personnel.
2. Inspect the plant before production for compliance with specification requirements governing plant and testing equipment.
3. In the case of aggregates, furnish optimum moisture to the Producer.
4. Perform unannounced periodic inspections of plants during production, including that of stockpiles, equipment, weighing operations, sampling, testing, and records kept by the Producer's technician.
5. Keep a diary of plant visits, observations and comments made to the Producer's representative.
6. Accept the product in accordance with the specifications, based upon the Producer's test results, provided such results are statistically comparable (VTM 59) to the Department's monitor test results, (see pages 2-12 & 2-13) and provided the material passes a visual examination for contamination and segregation at the job site. The sole purpose of the monitor sample taken by the Department is to verify the accuracy of the producer's testing program. If the comparison indicates the monitor test results are not in agreement with the Producer's results, an investigation will be made to determine the cause of difference. If the differences can be determined, the material will be accepted, adjusted or rejected in accordance with the specification. If the difference cannot be explained, the Department may call for the referee system to determine the final disposition of the material. In the event it is determined that the contractor's test results are not representative of the product, the Department will take such action as it deems appropriate to protect the interest of the Commonwealth.
7. Provide a referee system which may be invoked at the request of the producer or Department and which will involve use of test results obtained from samples secured from the road.
8. Monitor samples (also called Independent Assurance (IA) samples) shall be obtained at a rate that both provides a statistically significant number of samples for each mix produced and allows verification of unstable mixes. One (1) monitor (IA) sample shall be obtained and tested from each lot and as necessary to ensure statistical significance and to monitor unstable or nonconforming mixes. Unstable mixes are those that exceed variablity tolerances provided in VTM-59. Where the same material is used as two different types, such as 21-A and Select Material, for testing purposes it shall be considered as one material. This rate of monitor sampling is mandatory and it is the responsibility of the District Materials Engineer to see that it is accomplished. Should the monitoring effort fall behind the required frequency of sampling and/or testing, the District Administrator is to be advised immediately. Sufficient manpower is to be provided for the monitoring effort.

The Department's monitor will observe the manner in which sampling is performed by the producer. Not only is the when, where and how of taking the sample important but also the care taken to properly reduce the sample to testing size. The monitor directs when the sample shall be taken. They shall observe the producer's technician taking and splitting the sample. The monitor technician takes 1/2 of the sample to a lab of their discretion for testing. The producer's technician will perform the test on the other half, which is to be considered as the next production sample for the producer.

During the time of the monitor's visit to the plant, they will pick up the producers test results and the District Materials Engineer's copy of the daily summary sheets. The forms are reviewed for correctness and legibility. The contract number and tonnage are obtained from the weigh sheets (TL- 102A) and recorded on the input form, (TL-52A, page 2-11). They are submitted to the computer terminal for input and storage. No display is needed for this entry.

The original and one copy of the test report will be returned through the terminal, automatically. The report should be reviewed for correctness. The original should be put in the District Materials Engineer's project folder. The other copy should be forwarded to the producer. If there is more than one contract on the lot, only one lot copy is to be sent. One copy of the lot should also be put in a plant file. This is the only distribution that is needed. The materials notebook only requires a one line entry identifying the period of time over which the material was shipped, grading or type mix, total tonnage, source and location.

In case of non-conformance to the specifications, a copy of the test report will be furnished to the Prime Contractor.

The results of the monitor technician tests are recorded on a monitor report form and submitted to the computer terminal, No display is needed for this entry. A request is made for the production and monitor comparisons for each plant to the terminal. When making this request, use dates that include at least seven monitor results. Also, if there is a change, begin with the date of the change. A report comparing the production results with the monitor results will be returned. When the report returns, review it for correctness and send one copy to the producer by way of the monitor. If the results are not in agreement, an investigation should be made to determine the reason for differences. Suggested checks are:

1. Check the monitor test results for compliance with the Specifications for Average and Standard Deviation.
2. Check the producer's result on the mate of the monitor sample to see if the results are comparable.
3. Check to see if one of the systems is indicating a trend (consistently fine, course, etc.).
4. Check sampling and testing procedure.
5. Check equipment.

When the next comparison is requested, send the prior monitor comparison data to the State Materials Engineer for review.

The success of the Quality Assurance Program depends on the effectiveness of the monitoring effort. Deficiencies revealed through this effort should be addressed promptly and decisively.

Department's Responsibility
The Project Inspector and the Quality Assurance Program

It is imperative that close communication be maintained between the Project Inspector and the District Material Engineer's staff and/or monitor Technician.

By the end of the next working day, the bonded weighperson will send the Weighperson Daily Summary Sheet to the Project Inspector, who will check the tonnage of material shipped against the total tonnage obtained from the weigh tickets, noting any loads that were not received, totaling the tonnage of those loads not received; add the tonnage deleted to the tonnage of material that was received, compare total tonnage to that indicated by the weighperson, and sign the verification statement. The Project Inspector should notify the producer or contractor of any differences in tonnage. Record in the Material Notebook general location, date and tonnage, with a note stating "QA".

Also, particular note should be made by the Project Inspector of any loads that appear to have required an abnormal transit time. These loads should be noted on the Weighperson Daily Summary Sheet. Time is very critical in the case of hydraulic cement stabilized aggregates. There is a 60 minute time limit between the start of mixing and the time that compaction of the hydraulic cement treated mixture begins.

Should visual examination reveal that the material in any load is contaminated or segregated, that load will be rejected without additional sampling or testing of the lot as specified in Section 208.06 of the Road and Bridge Specifications.

The Project Inspector shall retain the Weighperson Daily Summary Sheet, attach the corresponding weigh tickets to it, and keep it in the project files until completion of the project.

At the completion of the project, the Project Inspector will forward the summary sheets and attached weigh tickets to the District Office together with other project records.

Material Acceptance
QA Program--Specifications

The Producer shall have a CMA Technician present at the plant during the initial set up and during subsequent production. The Technician shall perform sampling, testing, designing and adjusting mixes as needed.

Sampling and testing for the determination of gradation, liquid limit and plasticity index shall be performed by the Producer, and the Department will perform independent monitor checks. The producer shall provide copies of such test results to the Department on forms furnished by the Department.

If the Producer's test results indicate the material produced meets the appropriate requirements, the material will be accepted for use.

However, in the event a statistical comparison of the Producer's test results and the monitor test results indicates a statistically significant difference, an investigation will be made to determine the reason for differences. If it is determined that the material does not conform to the requirements of the contract, appropriate price adjustments will be made.

Normally, acceptance for gradation, liquid limit, plasticity index and hydraulic cement content (when aggregate is to be stabilized) will be based upon a mean of the results of 4 tests performed on samples taken in a stratified random manner from each 2000 ton lot. Monitor samples (also called Independent Assurance (IA) samples) shall be obtained at a rate that both provides a statistically significant number of samples for each mix produced and allows verification of unstable mixes. One (1) monitor (IA) sample shall be obtained and tested from each lot and as necessary to ensure statistical significance and to monitor unstable or nonconforming mixes. Unstable mixes are those that exceed variablity tolerances provided in VTM-59.

A lot will be considered acceptable for gradation if the mean of the test results is within the deviation allowed from the job-mix formula shown in Table II-10.

A lot will be considered acceptable for Atterberg Limits if the mean of the test results is less than the maximum allowed for the liquid limit and plasticity index as shown in Table II-11.

Because the type of 75µm (minus 200) fines significantly affects the load bearing capacity of aggregate materials, there is a one point control on each individual sample run.

In the event the liquid limit exceeds 30; the plasticity index exceeds 6 for Type I base material or the plasticity index exceeds 9 for Type II base material or subbase material No. 21A, 21B or 22 on any individual sample; that portion of the lot from which the sample was taken will be considered a separate part of the lot and shall be removed from the road, unless otherwise directed by the Engineer.

There is also a one point control on hydraulic cement stabilized material. If an individual test result indicates that the cement content of the material represented by the test is deficient by more than 1.6 percent from the design cement content, the portion of the material represented by the sample will be considered a separate part of the lot and shall be removed from the road.

Instances which cause a lot to be less than the normal size are: the contract requires less than a complete lot; the job-mix formula is modified within a lot; a portion of the lot is rejected on the basis of the one point controls mentioned above; or the final lot of the year produced on the annual job mix is less than a complete lot. In any of these events the mean test results of the samples taken will be compared to the requirements of Table II-10 and Table II-11 for the number of tests performed.

It is important to remember that acceptance of gradation and Atterberg Limits for Central Mixed Aggregates and Select Material, Type I is normally based on the average of 4 test results. Anything else is an exception, such as those previously mentioned. It is equally important to remember that the samples must be chosen randomly - each ton of each lot must have an equal chance of being sampled. The when and where of each sample must be chosen solely by chance, not by the sampler!

Specification requirements of Select Material, Type I, are found in Section 207 of the VDOT Road and Bridge Specification Manual; for Central Mixed Aggregate Bases and Subbases in Section 208; cement stabilized aggregates in Section 307.

Acceptance of Dense Graded Aggregates
Statistical Quality Assurance Program

In modern concepts of materials control and acceptance, a means has been adopted by the Department, by which the Producer can exercise product control while the Department can exercise product acceptance. The tool that enables this be accomplished is the Statistical method. Those who have not been exposed to statistics quite often are fearful of the term, but it should not be confusing. Statistics is simply a mathematical analysis of accumulated data.

Statistical quality control is not complicated. We now accept or reject material on the average of test results in lieu of accepting or rejecting on an individual basis.

Stratified Random Sampling

An important phase of any acceptance or rejection plan is the process of "sampling". Samples are selected using statistical systems requiring that "samples be taken in such a manner that every part of the quantity of material to be checked for compliance has an equal chance of being sampled"; that is, that the samples be taken randomly.

Another important phase of any acceptance or rejection plan is the quantity of material to be checked for compliance with specifications. In Statistical Quality Control, the term "lot" is used to denote the quantity of material to be checked for compliance with specifications, then accepted, rejected or subjected to price adjustment. 4 samples per 2000 ton lot shall be used.Monitor samples (also called Independent Assurance (IA) samples) shall be obtained at a rate that both provides a statistically significant number of samples for each mix produced and allows verification of unstable mixes. One (1) monitor (IA) sample shall be obtained and tested from each lot and as necessary to ensure statistical significance and to monitor unstable or nonconforming mixes. Unstable mixes are those that exceed variability tolerances provided in VTM-59. A statistically acceptable method of randomization is to be used to determine the time and location of the stratified random sample to be taken.

There are several acceptable methods for obtaining the 30-40 pounds of material required for testing. They are:

(1) Obtain a representative sample from the approximate center of the loaded truck.

(2) A loaded truck dumps at a convenient location within the plant facility to create a representative mini-stockpile. With the bucket of a front-end loader strike the top of the truck dumped load creating a flat spot on top of the pile from which a representative sample is obtained

(3) When the truck containing the load that is to be sampled is in the process of being loaded, remove a randomly selected front-end loader bucket of aggregate from the post pugmill shipping stockpile. Dump it at a convenient location within the plant facility creating a mini-stockpile. Strike the top of the mini-stockpile with the bucket of the front-end loader creating a flat spot from which to obtain the representative sample.

In order for a Plant Quality Control Technician to use Statistical Quality Control, it will be necessary to know: 1. When to take a sample? 2. Where to take a sample? 3. How to take a sample?
4. How to test the sample? 5. What to do with the test results?

As previously stated, statistical systems use random sampling. Therefore, Statistical Quality Control of Central-Mix Aggregates utilizes random sampling of a lot. Virginia's Statistical Quality Control Program, however, goes one step further than just random sampling. In Virginia, the stratified random sampling method is used. Stratified random sampling is sampling from equal portions of a lot at locations which have been selected solely by chance. The following pages of this guide will describe and discuss step by step a procedure used in stratified random sampling.

Step 1 - Determine lot size (2000 ton or 4000 ton lot). This is found or determined by the number of tons to be produced based on production.

Step 2 - Stratify Lot. (500 tons per sample for 2000 ton lot or 1000 tons per sample for 4000 ton lot.) Four samples per lot.

Example: One sample shall be on or between each group of tons shown below.

2000 ton lot	4000 ton lot
1 - 500	1 - 1000
501 - 1000	1001 - 2000
1001 - 1500	2001 - 3000
1501 - 2000	3001 - 4000

Step 3 - Secure stratified numbers and cans. Cans should be marked 1st, 2nd, and 3rd.

2000 ton lot	4000 ton lot
1st can, place nos. 0-4	1st can, place nos. 0-9
2nd can, place nos. 0-9	2nd can, place nos. 0-9
3rd can, place nos. 0-9	3rd can, place nos. 0-9

Step 4 - Shake cans and draw sample number (3-digit number) from cans. Draw first digit of number from first can, second digit of number from second can, and third digit of number from third can. (No. 000 indicates ton No. 500 or ton. No. 1000 depending upon lot size.) (Numbers should be drawn just prior to beginning of production of a stratified portion of a lot.)

Step 5 - Record results for each of the four drawings and replace nos. in cans. Shake them up before new drawings. (Plant Quality Control Technician should notify the Weighperson of the number so that, in turn, he can let the Plant Quality Control Technician know which truck will contain that ton.

Example:	1st	2nd	3rd
	3	8	6

Step 6 - Ton to be sampled.

Example: 2000 ton lot

1st sample	0 + 386	=	386 ton
2nd sample	500 + 429	=	929 ton
3rd sample	1000 + 500	=	1500 ton
4th sample	1500 + 224	=	1724 ton

1st	2nd	3rd
3	8	6
1st	2nd	3rd
4	2	9
1st	2nd	3rd
0	0	0
1st	2nd	3rd
2	2	4

Example: 4000 ton lot

1st sample	0 + 724 =	724 ton
2nd sample	1000 + 132 =	1132 ton
3rd sample	2000 + 904 =	2904 ton
4th sample	3000 + 556 =	3556 ton

1st	2nd	3rd
7	2	4
1st	2nd	3rd
1	3	2
1st	2nd	3rd
9	0	4
1st	2nd	3rd
5	5	6

Step 7 - Take the sample. The sample shall be taken from approximately, 150 mm (6 in.) to 300 mm (12 in.) beneath the surface of the mini-stockpile. (Strike off the top 150 mm (6 in.) of material and take the sample vertically.)

***Note**: **Hydraulic Cement Stabilized Central Mix Aggregate**. The sample for the cement content should be taken first and as described above. The cement flow to the aggregate should be stopped or cut-off and the sample for the gradation, L.L. and P.I. taken from the next load which would not have any cement in it. This load would be wasted. The procedure for sampling should be the same as described above.

FORM TL-52A

REV. 5/08

VIRGINIA DEPARTMENT OF TRANSPORTATION
MATERIALS DIVISION
CENTRAL MIX AGGREGATES - TEST RESULTS INPUT FORM

INPUT SUBMITTED BY ______________ ROOM NO. ______________ DISTRICT ______________

DATE SUBMITTED ______________ PHONE NO. ______________

COMP. NO	PROJECT NUMBER: CO.	ROUTE	CITY/CO	SECT	TYPE	ACT

Row A: PLANT ID (cols 2–5) · CONTRACT NUMBER · TONNAGE · UNIT PRICE · JOB MIX ID (61–64) · SIZE (65–66) · TYPE MAT'L (67–69) · LOT NO. (70–72)

Row B: SAMPLE # · TON · DATE (YY, MM, DD) · TIME (HR, MIN) · PERCENT PASSING - SIEVE: 75 MM (3") · 50 MM (2") · 25.0 MM (1") · 19.0 MM (3/4") · 9.5 MM (3/8") · 2.00 MM (#10) · .425 MM (#40) · .075 MM (#200) · LIQUID LIMIT · P.I. · MOIST. % · CEMENT CONTENT

Row	Plant ID / #	Contract No. / Ton	Tonnage / YY	MM	DD	HR	MIN	75 MM (3")	50 MM (2")	25.0 MM (1")	19.0 MM (3/4")	9.5 MM (3/8")	2.00 MM (#10)	.425 MM (#40)	.075 MM (#200)	Liquid Limit	P.I.	Moist. %	Cement Content	Job Mix ID	Size	Type Mat'l	Lot No.
A	4002	3231	2000																	0801	76	79	8
B	1	475	08	07	19	8	15		100.0	100.0		63.4	34.6	22.2	7.5	18.1	0.0	5.6					
B	2	812	08	07	19	10	11		100.0	100.0		76.3	46.4	28.2	9.8	19.1	0.0	7.8					
B	3	1460	08	07	20	1	45		100.0	100.0		71.5	41.7	26.0	8.7	19.9	0.0	5.6					
B	4	1862	08	07	20	3	26		100.0	100.0		71.3	37.8	23.7	7.6	19.0	0.0	5.4					
A	4002	3231	2000																	0801	76	79	9
B	1	374	08	07	25	7	53		100.0	100.0		73.9	45.4	28.3	10.4	17.8	0.0	6.7					
B	2	901	08	07	25	11	21		100.0	100.0		82.8	54.4	33.3	10.8	18.5	0.0	9.0					
B	3	1342	08	07	26	2	12		100.0	100.0		62.3	34.6	20.9	6.9	18.9	0.0	6.6					
B	4	1820	08	07	26	4	30		100.0	100.0		83.0	53.2	33.1	12.4	21.4	0.0	5.1					
A																							
B																							
B																							
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E12-1710-01
Rev 8/98

Virginia Department of Transportation
Materials Division
Central Mix Aggregate
Point Adjustment Analysis Report

09/11/2000

Report Number:

Plant ID: 1009 Cardinal Stone Company, Galax, VA
Job Mix ID: 9701 Type Material: 79 Aggregate Base Material-Type I
Lot Number: 1 Size Material: 76 Subbase/Base Material-Size 21 A

Contract/Schedule Information

Contract Number	Item	Tonnage	Price
000330	0	2000	$0.00

Sample Information

Sample Number	Ton Number	Quad	Date	Time	75 MM (3")	50 MM (2")	25 MM (1")	19 MM (3/4")	9.5 MM (3/8")	2.0 MM (#10)	0.425 MM (#40)	0.075 MM (#200)	Liquid Limit	Plasticity Index	Moisture Percentage	Cement Content
1	350	C	02/04/1997	10:56	0.0%	100.0%	100.0%	0.0%	71.0%	25.4%	14.6%	6.7%	16.1%	0.0%	5.3%	0.0%
2	869	A	02/05/1997	08:32	0.0%	100.0%	100.0%	0.0%	65.0%	28.7%	18.5%	9.1%	16.6%	0.0%	5.2%	0.0%
3	1288	D	02/05/1997	12:25	0.0%	100.0%	100.0%	0.0%	55.1%	26.3%	16.8%	8.1%	16.4%	0.0%	5.1%	0.0%
4	1799	B	08/17/1997	09:12	0.0%	100.0%	100.0%	0.0%	68.3%	29.5%	18.8%	7.2%	16.3%	0.0%	5.1%	0.0%

Analysis of Mixtures

	75 MM (3")	50 MM (2")	25 MM (1")	19 MM (3/4")	9.5 MM (3/8")	2.0 MM (#10)	0.425 MM (#40)	0.075 MM (#200)	Liquid Limit	Plasticity Index	Moisture Percentage	Cement Content
Job Mix	0.0%	100.0%	95.0%	0.0%	63.0%	32.0%	19.0%	8.0%	21.0%	1.0%	4.0%	0.0%
Upper Limit	0.0%	100.0%	100.0%	7.0%	72.5%	39.0%	23.0%	10.0%	23.0%	2.0%	6.0%	NA
Average	0.0%	100.0%	100.0%	0.0%	64.8%	27.5%	17.2%	7.8%	16.3%	0.0%	5.2%	0.0%
Lower Limit	0.0%	100.0%	90.0%	0.0%	53.5%	25.0%	15.0%	6.0%	0.0%	0.0%	2.0%	NA
Pass / Fail (Process)												

Total Adjustment **0.0**

Virginia Department of Transportation
Materials Division
Central Mix Aggregate
Comparison Analysis Report

Plant ID: 1032 Tri State Lime Co., Blountville, TN
Job Mix ID: 1002 Subbase/Base Material-Size 21 B, Aggregate Base Material-Type I

	Lot Number	Sample Number	75 MM (3")	50 MM (2")	25 MM (1")	19 MM (3/4")	9.5 MM (3/8")	2.0 MM (#10)	0.425 MM (#40)	0.075 MM (#200)	Cement Content	Liquid Limit	Plasticity Index
Job Mix			0.0%	100.0%	95.0%	0.0%	64.0%	23.0%	12.0%	7.0%	0.00%	21.0%	1.0%
Plant Data													
	1	1	0.0%	100.0%	95.3%	0.0%	57.8%	18.8%	10.7%	7.0%	0.00%	10.8%	0.0%
	1	2	0.0%	100.0%	93.9%	0.0%	60.3%	19.8%	11.1%	7.2%	0.00%	0.0%	0.0%
	1	3	0.0%	100.0%	93.8%	0.0%	59.0%	19.8%	11.0%	7.4%	0.00%	14.2%	0.0%
	1	4	0.0%	100.0%	94.1%	0.0%	59.5%	21.8%	11.0%	7.1%	0.00%	0.0%	0.0%
	2	1	0.0%	100.0%	93.4%	0.0%	59.7%	21.3%	11.1%	7.1%	0.00%	11.5%	0.0%
	2	2	0.0%	100.0%	91.7%	0.0%	49.9%	16.9%	8.6%	5.6%	0.00%	0.0%	0.0%
	2	3	0.0%	100.0%	94.6%	0.0%	57.7%	20.0%	10.7%	6.7%	0.00%	12.9%	0.0%
	2	4	0.0%	100.0%	95.4%	0.0%	64.2%	24.0%	11.5%	7.2%	0.00%	0.0%	0.0%
	3	1	0.0%	100.0%	93.8%	0.0%	54.0%	19.8%	10.7%	6.9%	0.00%	12.0%	0.0%
	3	2	0.0%	100.0%	96.6%	0.0%	64.9%	25.6%	11.3%	6.7%	0.00%	0.0%	0.0%
	3	3	0.0%	100.0%	97.7%	0.0%	61.9%	24.9%	12.4%	7.4%	0.00%	14.2%	0.0%
	3	4	0.0%	100.0%	97.0%	0.0%	61.5%	24.5%	12.5%	7.5%	0.00%	0.0%	0.0%
	4	1	0.0%	100.0%	96.4%	0.0%	60.7%	23.7%	11.9%	7.0%	0.00%	16.0%	0.0%
	4	2	0.0%	100.0%	99.0%	0.0%	68.1%	23.0%	11.7%	6.9%	0.00%	0.0%	0.0%
	4	3	0.0%	100.0%	97.6%	0.0%	66.1%	22.3%	11.3%	6.6%	0.00%	14.9%	0.0%
	4	4	0.0%	100.0%	98.2%	0.0%	65.6%	22.6%	11.5%	6.9%	0.00%	0.0%	0.0%
	5	1	0.0%	100.0%	97.4%	0.0%	70.2%	25.5%	12.8%	7.5%	0.00%	12.7%	0.0%
	5	2	0.0%	100.0%	97.0%	0.0%	63.2%	22.0%	11.2%	6.8%	0.00%	0.0%	0.0%
	5	3	0.0%	100.0%	95.2%	0.0%	63.7%	22.1%	11.0%	6.5%	0.00%	14.9%	0.0%
	5	4	0.0%	100.0%	91.5%	0.0%	63.7%	22.6%	11.3%	6.5%	0.00%	0.0%	0.0%
Plant Data													
		Count:	20	20	20	20	20	20	20	20	20	20	20
		Mean:	0.0%	100.0%	95.5%	0.0%	61.6%	22.0%	11.3%	6.9%	0.0%	6.7%	0.0%
		Standard Deviation:	0.00	0.00	2.12	0.00	4.72	2.34	0.86	0.44	0.00	6.98	0.00
Monitor													
	1	1	0.0%	100.0%	96.0%	0.0%	55.8%	18.1%	10.0%	3.4%	0.00%	14.0%	0.0%
	1	2	0.0%	100.0%	94.4%	0.0%	63.0%	26.0%	13.5%	8.7%	0.00%	14.0%	0.0%
	1	3	0.0%	100.0%	92.2%	0.0%	48.0%	17.9%	10.0%	6.2%	0.00%	14.0%	0.0%
	1	4	0.0%	100.0%	93.8%	0.0%	49.4%	16.6%	8.9%	5.8%	0.00%	14.0%	0.0%
	2	2	0.0%	100.0%	92.0%	0.0%	48.4%	16.8%	8.9%	5.9%	0.00%	14.0%	0.0%
	3	1	0.0%	100.0%	94.3%	0.0%	55.4%	19.5%	10.7%	7.2%	0.00%	14.0%	0.0%
	3	2	0.0%	100.0%	97.4%	0.0%	64.4%	25.0%	10.4%	6.2%	0.00%	14.0%	0.0%
	3	3	0.0%	100.0%	98.9%	0.0%	65.3%	26.3%	11.9%	7.1%	0.00%	14.0%	0.0%
	4	1	0.0%	100.0%	97.8%	0.0%	66.8%	22.0%	10.7%	6.8%	0.00%	14.0%	0.0%
	5	1	0.0%	100.0%	96.7%	0.0%	67.9%	23.4%	9.9%	6.2%	0.00%	14.0%	0.0%
	5	4	0.0%	100.0%	98.3%	0.0%	66.0%	23.9%	9.2%	5.8%	0.00%	14.0%	0.0%
Monitor Data													
		Count:	11	11	11	11	11	11	11	11	11	11	11
		Mean:	0.0%	100.0%	95.6%	0.0%	59.1%	21.4%	10.4%	6.3%	0.0%	14.0%	0.0%
		Standard Deviation:	0.00	0.00	2.42	0.00	7.89	3.74	1.36	1.29	0.00	0.00	0.00
Report													
		(F):	0.00	0.00	1.31	0.00	2.79	2.56	2.48	8.56	0.00	0.00	0.00
		(F.99):	3.43	3.43	3.43	3.43	3.43	3.43	3.43	3.43 *******	3.43	3.43	3.43
		AM-AC:	0.0	0.0	0.1	0.0	2.5	0.6	0.9	0.6	0.0	7.3	0.0
		MU:	0.0	0.0	2.5	0.0	7.7	3.7	1.3	1.2	0.0	4.5 *******	0.0

Chapter 2
Quality Assurance Program
Questions

1. What determines the lot size for a specified material accepted under the Statistical QA Program?

   A. Production tonnage
   B. Discretion of the Engineer
   C. Size aggregate
   D. Percent of cement

2. A normal lot is represented by how many test samples?

   A. 8
   B. 2
   C. 3
   D. 4

3. The Producer's Technician is responsible for making batch adjustments.

   A. True
   B. False

4. The job-mix formula is approved by the:

   A. Project Inspector
   B. Producer's Technician
   C. District Materials Engineer
   D. Resident Engineer

5. The Project Inspector is responsible for the submission of the job-mix formula.

   A. True
   B. False

6. One of the duties of the District Materials Engineer's CMA staff technician is to provide technical guidance to the Producer's Technician.

   A. True
   B. False

7. The inspection, sampling, and testing of the aggregates for conformance with the VDOT Specifications are the responsibilities of the:

   A. Project Inspector
   B. Weighperson
   C. Producer's Technician
   D. VDOT Monitor Technician

Chapter 2
Quality Assurance Program
Questions

8. Actuating of dials, gauges, scales, meters, or other plant control or weighing devices is the responsibility of the Producer.

   A. True
   B. False

9. The District CMA Monitor Technician is the field representative of the Resident Engineer.

   A. True
   B. False

10. Must the Producer's Technician in plants producing Aggregate Base, Subbase and Select Material, Type I be certified CMA Technicians?

    A. Yes
    B. No

11. When should the job mix formula be submitted by the producer?

12. What is the length of time that the Department has to evaluate a job mix formula change?

13. A system to allow resampling and retesting where there is doubt that the original test results are valid is the:

    A. Referee System
    B. Variability System
    C. Process Tolerance System
    D. Standard Deviation System

14. A chart that is set up to alert the Producer when to investigate his process is a Control Chart.

    A. True
    B. False

Chapter 2
Quality Assurance Program
Questions

15. The Job-Mix Formula for Aggregate Bases, Subbases, and Select Material, Type I is chosen from the:

    A. Standard Deviation
    B. Design Range
    C. Process Tolerance
    D. Acceptance Range

16. In the production of Cement Stabilized Aggregate, no one sample shall have a cement content more than 1.3 percent below that stated on the Job-Mix Formula.

    A. True
    B. False

17. Is it permissible to accept Central-Mix Aggregate by visual inspection?

    A. Yes
    B. No

18. Who approves the source and quality of materials for use in central-mix aggregates?

19. Who conducts the inspection of central-mix aggregate plants?

20. Who is required to furnish a plant laboratory?

21. The job acceptance sample for central-mix aggregate bases, subbases and select material is taken from:

    A. Conveyer belt
    B. Mini-stockpile
    C. Barge
    D. Truck

22. What is the difference in taking a sample of stabilized and non-stabilized material?

23. Does the Plant Quality Control Technician run job acceptance samples when the producer is stockpiling?

    A. Yes
    B. No