

OUTLINE

MIXTURE AGGREGATES TECHNICIAN

Day 1

8:00 am	Registration and Introduction
10:00 am	Stockpiling and Handling
11:00 am	Field Gradation Sampling
1:00 pm	Gradation Testing

Day 2

8:00 am	Lab
	A review will be completed with each group.

Day 3

8:00 am	Testing*
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*The written test will begin at 8:00 a.m. The lab proficiency times will vary by student.

The written, calculation, and practical exams for the Mixture Aggregate Technician Course are closed book exams.

Note: Schedule and times are approximate. Outline is subject to change to fit class size.

MIXTURE AGGREGATE TECHNICIAN COURSE

- Students **must** attend **all** course sessions.
- Students are required to present photo identification on first day of class and prior to taking the written and physical exams.

Prerequisite Course:

None.

Written Test (Part 1) (Closed book test)

Time limit is 1 hour.

Minimum grade of 70 is required.

Calculation Test (Part 2) (Closed book test)

Time limit is 1 ½ hrs.

Minimum grade of 70 is required.

Practical Test (Part 3) (Closed book test)

No time limit is specified.

Minimum grade of pass is required.

Retest:

If the student fails the written test (Part 1), calculation test (Part 2), or practical test (Part 3), a retest can be performed. A retest must be taken by the end of the academic year that the initial test was taken. The academic year runs from September 1st to August 31st. **(For example, if the test was taken November 3, 2021, the last date to retest is August 31, 2022)** Failure of the written retest, or failure to comply with the academic year retest time limit, shall require the student to retake the class and the test. The student shall be required to pay the appropriate fee for the additional class.

Written Retest: (Closed book test)

A retest will not be performed on the same day as the initial test.

Time limit is 1 hour.

Minimum grade of 70 is required.

Calculation Retest: (Closed book test)

A retest can be performed on the same day as the initial test.

Time limit is 1 ½ hours.

Minimum grade of 70 is required.

Practical Retest: (Closed book test)

A retest will be performed on the same day as the initial test.

No time limit is specified.

Minimum grade of pass is required.

LAKE LAND COLLEGE INSTRUCTOR AND COURSE EVALUATION

Course: Mixture Aggregate Technician Course Section: _____ Date: _____

Lead Instructors Name: Lori Walk Lab Instructor #1's Name: _____

Lab Instructor #2's Name: _____

PURPOSE: The main emphasis at Lake Land College is teaching. In this regard, each instructor must be continuously informed of the quality of his/her teaching and the respects in which that teaching can be improved. As a student, you are in a position to judge the quality of teaching from direct experience, and in order to help maintain the quality of instruction at Lake Land, you are asked to complete this evaluation.

DIRECTIONS: **DO NOT SIGN YOUR NAME.** Your frankness and honesty are appreciated.

First, please record your general impressions and/or comments on the following:

Course _____

Lead Instructor _____

Lab Instructor #1 _____

Lab Instructor #2 _____

For each remaining item, please indicate by number, on a scale from 1 to 5, with 1 being WEAK and 5 being SUPERIOR, which seems most appropriate to you for the instructors and course that you are evaluating. You are strongly encouraged to make any comments that will clarify particular rating on the back of this form; please refer to each item you are discussing by its number.

(1=Weak, 2=Needs Improvement, 3=Average, 4=Good, 5=Superior)

OBJECTIVES AND APPROPRIATENESS OF THE COURSE:

- | | | |
|---------------------------------|---|-------|
| 1. Clarity of Objectives | The objectives of the course were clearly identified. Objectives were adequately covered. | _____ |
| 2. Selection content | Content was relevant and met the level of the class. | _____ |

ORGANIZATION AND CONTENT OF LESSONS:

		<u>LEAD INSTR.</u>	<u>LAB INSTR. 1</u>	<u>LAB INSTR. 2</u>
3. Teacher preparation	Instructor was organized and knowledgeable in subject matter and prepared for each class.	_____	_____	_____
4. Organization of classes	Classroom activities were well organized and clearly related to each other.	_____	_____	_____
5. Selection of materials	Instructional materials and resources used specific, current, and clearly related to the objectives of the course.	_____	_____	_____
6. Clarity of presentation	Content of lessons was presented so that it was understandable to the students.	_____	_____	_____
7. Clarity of presentation	Different point of view and/or methods with specific illustrations were used when appropriate.	_____	_____	_____

OVER

**LAKE LAND COLLEGE
INSTRUCTOR AND COURSE EVALUATION
(PAGE 2)**

PERSONAL CHARACTERISTICS AND STUDENT RAPPORT:

		<u>LEAD INSTR.</u>	<u>LAB INSTR. 1</u>	<u>LAB INSTR. 2</u>
8.	Vocabulary	Instructor's vocabulary level was appropriate for the class and labs.	_____	_____
9.	Pupil participation and interest	Instructor encouraged students to ask questions and actively participate in class and labs.	_____	_____
10.	Personal attributes	Instructor indicated an interest and enthusiasm for teaching the subject matter.	_____	_____
11.	Personal attributes	Instructor was familiar with current industry practices.	_____	_____
12.	Personal	Instructor's mannerisms were pleasing.	_____	_____
13.	Instructor-student rapport	Instructor indicated a willingness to help you in times of difficulty.	_____	_____
14.	Instructor-student rapport	Instructor was fair and impartial in dealings with you.	_____	_____

SUMMARY:

15.	Considering everything, how would you rate these instructors?	_____	_____	_____
16.	Considering everything, how would you rate this course?	_____		

EXAMINATION:

17.	Exam material	The exam correlated to the materials being covered in class.	_____
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COMMENTS: (Please use the area below to add any additional comments regarding the class and exam.)

INTRODUCTION

Quality Management Training Program

(Quality Control / Quality Assurance) [QC/QA]

The Illinois Department of Transportation (IDOT) started the Quality Management Program in 1991. Three segments of the construction industry were chosen to implement the QC/QA process as part of the Quality Management Program: Hot-Mix Asphalt, Portland Cement Concrete, and the aggregates used in asphalt and concrete.

Philosophy of QC/QA:

Under the Quality Management Program, the contractor is responsible for Quality Control and Quality Assurance is the responsibility of IDOT. Some people feel that it is a direct conflict of interest for the contractor or aggregate producer to be doing the testing of his own product and be in charge of his own quality control. This is a major departure from the way the construction industry and IDOT have always done things in Illinois. In reality, this process is used throughout the nation, not only in the road building industry, but in other segments of industry. This movement has been encouraged by the FHWA because it provides for a significantly increased amount of testing and quality monitoring which leads to a significant improvement in the quality of the finished product. In reality, it is easier for the contractor to control quality than some outside source, such as IDOT. The contractor has direct control over those things that go into making up a quality product such as the personnel, the equipment, and the materials being used. When QC/QA is talked about, many people hone in on the Quality Control and forget about the Quality Assurance. The QA is IDOT's part of the program. Under this program, IDOT does not control the quality, but must take all the necessary actions to assure that the contractor is controlling quality. These assurance processes are detailed in the various special provisions and specifications. They include some parallel testing of the materials, observing the contractor's personnel performing tests to see that the tests are being run correctly, and, in general, monitoring the contractor's quality control process.

Aggregates:

One of the basic requirements in the QC/QA program is that the aggregates that are used in Hot Mix Asphalt (HMA) and Portland Cement Concrete (PCC) must be produced under the Aggregates Gradation Control System (AGCS). In this system, the aggregate producer is responsible for his gradation control and he certifies that the aggregates meet the gradation and quality requirements when shipped. In addition, tighter gradation requirements are placed on the critical sieve of the coarse aggregate being produced. There are currently over 500 approved aggregate sources in the AGCS system. A current list of approved sources can be found at IDOT's following webpage:

<http://www.idot.illinois.gov/Assets/uploads/files/Doing-Business/Specialty-Lists/Highways/Materials/Materials-&-Physical-Research/Aggregate/approvedaggregatesources.pdf>

The A.G.C.S. Program was originally designed to produce the coarse aggregate and manufactured sand for P.C.C and H.M.A. QC/QA Projects.

The A.G.C.S. Program has been expanded to include the following products on the date indicated:

Effective July 1, 2000

Coarse Aggregate for All PCC and Class I/Superpave HMA Projects
 Manufactured Sand for All PCC and Class I/ Superpave HMA Projects
 Natural Sand for All PCC and HMA Projects

Effective July 1, 2001

Coarse Aggregate and Manufactured Sand for All Non-Class I/ Superpave HMA Projects
 Aggregate Surface Course
 Granular Shoulders
 Granular Subbase
 Granular Base
 Granular Embankment Special
 Cover/Seal Coat

Hot-Mix Asphalt

The chart below shows the progression of QC/QA in the production of hot mix asphalt. IDOT started with six projects in 1991. By August of 1994, a total of 255 jobs had been built, which used approximately 6,000,000 tons of Hot-Mix. Currently, all of the Districts in the state are practically 100% QC/QA for Hot-Mix production.

DISTRICT	Number of Asphalt QC/QA Contracts Let				Total # of Jobs	Estimated Total Tons
	1991	1992	1993	As of 8/31/94		
1	0	1	2	0	3	62,633
2	2	3	4	21	30	969,765
3	0	4	3	16	23	462,992
4	0	4	5	16	25	896,563
5	1	4	12	14	31	1,076,378
6	0	4	11	24	39	648,796
7	0	2	8	22	32	475,041
8	0	6	11	15	32	862,739
9	3	2	8	27	40	559,610
Totals	6	30	64	155	255	6,013,287

Portland Cement Concrete

The Portland Cement Concrete QC/QA program started in 1992. It is a little more complex than the Hot-Mix Asphalt (HMA) program because typically the concrete mix is produced by a ready mix producer and placed by the contractor. HMA is normally produced and placed by only the contractor. Currently the QC/QA process for concrete is being used on the larger projects throughout the state, and almost 100% in District 1.

Training

IDOT has mandated that the personnel involved in the program be properly trained. They have developed the following courses which are required under the Quality Management program.

CET 020 Mixture Aggregate Technician (3 days)

CET 021 Aggregate Technician (5 days)

CET 027 Mixture Aggregate Technician Upgrade (2 days)

CET 029 Level I Hot-Mix Asphalt (5 days)

Prerequisite: CET 020 3-Day Aggregate for Mixtures **or**
CET 021 5-Day Aggregate Technician

CET 023 Level II Hot-Mix Asphalt (5 days)

Prerequisite: CET 029 Level I Hot-Mix Asphalt
CET 031 Level III Hot-Mix Asphalt (5 days)

Prerequisite: CET 023 Level II Hot-Mix Asphalt

CET 026 Half-Day Nuclear Density

CET 030 Level I Portland Cement Concrete

CET 024 Level II Portland Cement Concrete

CET 039 Level III Portland Cement Concrete

Prerequisite: CET 020 3-Day Aggregate for Mixtures **or**
CET 021 5-Day Aggregate Technician
and CET 030 Level I Portland Cement Concrete
and CET 024 Level II Portland Cement Concrete

Concrete Tester Course

NOTE: The CET 032 AGCS Technician Course has been eliminated. Previous AGCS Technician training is still recognized and valid.

Wonder what IDOT QC/QA training you need? The following may help in determining what classes you should take:

AGGREGATES	
Task	Required Training Course
Quality Control Manager	Aggregate Technician (CET 021 or CET 027)
Visual Inspections	Aggregate Technician (CET 021 or CET 027)
Aggregate Sampling	Aggregate Technician (CET 021) or Mixture Aggregate Technician (CET 020)
Splitting and Gradation Testing	Aggregate Technician (CET 021) or Mixture Aggregate Technician (CET 020) or Gradation Technician (IDOT) <i>note 1</i>
ASPHALT	
Quality Control Manager	Hot-Mix Asphalt Level II (CET 023)
Aggregate Sampling and Gradation Testing	Hot-Mix Asphalt Level I (CET 029) <i>notes 1 & 3</i>
HMA Sampling and Testing	Hot-Mix Asphalt Level I (CET 029)
HMA Mix Design	Hot-Mix Asphalt Level III (CET 031)
PORTLAND CEMENT CONCRETE	
Quality Control Manager	PCC Level II Technician is recommended
Job Site Mix Sampling & Testing	PCC Level I (CET 030) or Concrete Tester (IDOT) <i>note 2</i>
Concrete Plant	PCC Level II (CET 030, CET 024, and CET 020) <i>notes 1 & 3</i>
PCC Mix Design	PCC Level III (CET 039)
Precast	Must have current A.C.I. card (no IDOT certification required)

Note 1 A Gradation Technician must be supervised by a Mixtures Aggregate Technician or an Aggregate Technician. **Under supervision**, a Gradation Technician may perform gradation testing at a PCC or HMA mix plant.

Note 2 A Concrete Tester must be supervised by a PCC Level I or a PCC Level II.

Note 3 Aggregate Technicians and Mixture Aggregate Technicians may perform aggregate sampling and gradation testing at a PCC or HMA mix plant, except they **cannot** sample hot bins at a batch style HMA plant.

Metrification

In the spring of 2000, IDOT decided to return to English units. All jobs proposed after April 2000 would be designed in English units.

Sieve Designations

The following is the English and equivalent Metric sieve designations commonly used:

SIEVE CONVERSIONS

<u>ENGLISH</u>	<u>METRIC</u>	
3"-----	75mm (millimeters)	
2.5"-----	63mm	
2"-----	50mm	
1.75"-----	45mm	
1.5"-----	37.5mm	
1"-----	25mm	
3/4"-----	19mm	
5/8"-----	16mm	
1/2"-----	12.5mm	
3/8"-----	9.5mm	
1/4"-----	6.3mm	Coarse Aggregate
#4-----	4.75mm	↑
#8-----	2.36mm	↓
#10-----	2.00mm	Fine Aggregate
#16-----	1.18mm	
#30-----	600μm (microns)	
#40-----	425μm	
#50-----	300μm	
#80-----	180μm	
#100-----	150μm	Fine Aggregate
#200-----	75μm	↑
		↓
		Dust



Gradation:

The following terms are used to identify the gradation of an aggregate:

CA	Coarse Aggregate	Standard Specifications
CAM	Coarse Aggregate Metric	Standard Specifications
CM	Coarse Modified	Modified Standard Specifications
CMM	Coarse Modified Metric	Modified Standard Specifications
FA	Fine Aggregate	Standard Specifications
FAM	Fine Aggregate Metric	Standard Specifications
FM	Fine Modified	Modified Standard Specifications
FMM	Fine Modified Metric	Modified Standard Specifications

These terms are used in conjunction with numerical codes which indicate specific gradations and uses of material as shown in the following example. The following information is obtained in part from the Standard Specifications for Road and Bridge Construction, adopted on January 1, 2022.

The following is an example of determining material use from aggregate material codes:

Aggregate Material Codes						
Inspected Material	Quality Level	Type of Material	Aggregate Type	Specification	Gradation Number	Superstructure Quality Concrete
0 = Aggregates	0 = No Quality 1 = No Quality 2 = A quality 3 = B quality 4 = C quality 5 = D quality 6 = D Quality Stabilized	0 = Gravel 1 = Crushed Gravel 2 = Crushed Stone 3 = ACBF Slag 7 = Natural Sand 8 = Stone Sand 9 = Special Aggregate	C = Coarse Aggregate F = Fine Aggregate	A = Standard Specification M = Modified Specification	Standard Specifications Article 1003.01(C) or Article 1004.01(C)	01
Example: 032CM16						
<u>0</u> Aggregate	<u>3</u> 'B' Quality	<u>2</u> Crushed Stone	<u>C</u> Coarse Aggregate	<u>M</u> Modified Specification	<u>16</u> Gradation	
A modified 'B' quality crushed stone coarse aggregate 16 gradation						
Class Example:						

Pages 7 & 8 are excerpts from the 2022 Standard Specifications for Road and Bridge Construction, Adopted January 1, 2022:

Art. 1003.01 (10) (c)**Fine Aggregate Gradation Table**

FINE AGGREGATE GRADATIONS											
Grad No.	Sieve Size and Percent Passing										
	3/8	No. 4	No. 8 ^{4/}	No. 10	No. 16	No. 30 ^{5/}	No. 40	No. 50	No. 80	No. 100	No. 200 ^{1/}
FA 1	100	97±3			65±20			16±13		5±5	
FA 2	100	97±3			65±20			20±10		5±5	
FA 3	100	97±3		80±15			50±20		25±15		3±3
FA 4 ^{7/}	100				5±5						
FA 5	100	92±8								20±20	15±15
FA 6		92±8 ^{2/}								20±20	6±6
FA 7		100		97±3			75±15		35±10		3±3
FA 8			100				60±20			3±3	2±2
FA 9			100					30±15		5±5	
FA 10				100			90±10		60±30		7±7
FA 20	100	97±3	80±20		50±15			19±11		10±7	4±4
FA 21 ^{3/}	100	97±3	80±20		57±18			30±10		20±10	9±9
FA 22	100	^{6/}	^{6/}		8±8						2±2
FA 23	100	80±10	57±13		39±11	26±8		18±7		12±6	10±5
FA 24	100	95±5	77±13		57±13	35±10		19±6		15±6	10±5

- 1/ Subject to maximum percent allowed in Fine Aggregate Quality Table.
- 2/ 100 percent shall pass the 1 in. (25 mm) sieve, except that for bedding material 100 percent shall pass the 3/8 in. (9.5 mm) sieve. If 100 percent passes the 1/2 in. (12.5 mm) sieve, the No. 4 (4.75 mm) sieve may be 75 ± 25.
- 3/ For all HMA mixtures. When used, either singly or in combination with other sands, the amount of material passing the No. 200 (75 µm) sieve (washed basis) in the total sand fraction for mix design shall not exceed ten percent.
- 4/ For each gradation used in HMA, the aggregate producer shall set the midpoint percent passing, and the Department will apply a range of ±15 percent. The midpoint shall not be changed without Department approval.
- 5/ For each gradation used in HMA, the aggregate producer shall set the midpoint percent passing, and the Department will apply a range of ±13 percent. The midpoint shall not be changed without Department approval.
- 6/ For the fine aggregate gradation FA 22, the aggregate producer shall set the midpoint percent passing, and the Department will apply a range of ±10 percent. The midpoint shall not be changed without Department approval.
- 7/ When used as backfill for pipe underdrains, Type 3, the fine aggregate shall meet one of the modified FA 4 gradations shown in the following table:

FA 4 Modified		
Sieve Size	Percent Passing	
	Option 1	Option 2
3/8 in. (9.5 mm)	100	100
No. 4 (4.75 mm)		97 ± 3
No. 8 (2.36 mm)		5 ± 5
No. 10 (2 mm)	10 ± 10	
No. 16 (1.18 mm)	5 ± 5	2 ± 2
No. 200 (75 µm)	1 ± 1	1 ± 1

Art. 1004.01 (10) (c)**Coarse Aggregate Gradation Table**

Grad No.	COARSE AGGREGATE GRADATIONS												
	Sieve Size and Percent Passing												
	3 in.	2 1/2 in.	2 in.	1 1/2 in.	1 in.	3/4 in.	1/2 in.	3/8 in.	No. 4	No. 8	No. 16	No. 50	No. 200 ^{1/}
CA 1	100	95±5	60±15	15±15	3±3								
CA 2		100	95±5		75±15		50±15		30±10		20±15		8±4
CA 3		100	93±7	55±20	8±8		3±3						
CA 4			100	95±5	85±10		60±15		40±10		20±15		8±4
CA 5				97±3 ^{2/}	40±25		5±5		3±3				
CA 6				100	95±5		75±15		43±13		25±15		8±4
CA 7				100	95±5		45±15 ^{7/}		5±5				
CA 8				100	97±3	85±10	55±10		10±5		3±3 ^{3/}		
CA 9				100	97±3		60±15		30±15		10±10		6±6
CA 10					100	95±5	80±15		50±10		30±15		9±4
CA 11					100	92±8	45±15 ^{4/ 7/}		6±6		3±3 ^{3/ 5/}		
CA 12						100	95±5	85±10	60±10		35±10		9±4
CA 13						100	97±3	80±10	30±15		3±3 ^{3/}		
CA 14							90±10 ^{6/}	45±20	3±3				
CA 15							100	75±15	7±7		2±2		
CA 16							100	97±3	30±15		2±2 ^{3/}		
CA 17	100								65±20		45±20	20±10	10±5
CA 18	100				95±5				75±25		55±25	10±10	2±2
CA 19	100				95±5				60±15		40±15	20±10	10±5
CA 20							100	92±8	20±10	5±5	3±3		

1/ Subject to maximum percent allowed in Coarse Aggregate Quality table.

2/ Shall be 100 percent passing the 1 3/4 in. (45 mm) sieve.

3/ When used in HMA (High and Low ESAL) mixtures, the percent passing the No. 16 (1.18 mm) sieve for gradations CA 11, CA 13, or CA 16 shall be 4±4 percent.

4/ When using gradation CA 11 for IL-19.0 and IL-19.0L binder, the percent passing the 1/2 in. (12.5 mm) sieve may also be 15±10 percent.

5/ The No. 16 (1.18 mm) requirement will be waived when CA 11 is used in the manufacture of portland cement concrete.

6/ Shall be 100 percent passing the 5/8 in. (16 mm) sieve.

7/ When Class BS concrete is to be pumped, the coarse aggregate gradation shall have a minimum of 45 percent passing the 1/2 in. (12.5 mm) sieve. The Contractor may combine two or more coarse aggregate sizes, consisting of CA 7, CA 11, CA 13, CA 14, and CA 16, provided a CA 7 or CA 11 is included in the blend.

Note: When CA 7, CA 8, CA 11, CA 13, CA 14, CA 15, or CA 16 are used under paved median, Notes 3, 4, 5, and 6 shall apply.

Gradation of Standard Specifications versus AGCS gradations

Under the AGCS, the aggregate producer, with the approval of the Department, is allowed to establish his own targets for gradations. As a part of this process, the producer must also use the master band concept. With the master band concept, the critical sieve is designated by IDOT for each coarse aggregate gradation. The producer then sets a master band target for that sieve. A major factor that needs to be emphasized is that the gradation approved still needs to be compatible with other gradations to produce acceptable mix designs for asphalt and concrete mixtures.

The following are excerpts from the AGCS Policy Memorandum:

Gradation Specifications

Sieve limits for each sieve/each product under the Aggregate Gradation Control System shall be as specified in the Department's Standard Specifications and/or as amended herein. The special critical sieve criteria for certain designated products as described in QC/QA Procedure, "Aggregate Producer Control Chart Procedure" located in the current "Manual of Test Procedures for Materials" are also required.

The midpoint/tolerance range of a designated critical sieve shall be developed from an average as shown in QC/QA Procedure, "Aggregate Producer Control Chart Procedure," noted above. The average shall be a historical average or a production average derived from start-of-production samples that is agreed to by the Department. Critical sieve limits shall take precedence over Standard Specification limits. Requests for critical sieve limits shall be submitted in writing to the District Materials Engineer for approval.

For sieves other than the top and bottom specifications sieves, sieve limits may be developed based on historical or average production values. These sieve limits may be different from those in the Standard Specifications. These modifications are also allowed for fine aggregate. Changes in the top sieve or any No. 200 sieve ranges will not be permitted. In cases where the bottom sieve is other than the No. 200 sieve, a variance in limits may be granted if the Bureau determines the minus No. 200 material to be within acceptable limits. The Source shall request in writing to the District Materials Engineer approval of limits other than those in the Standard Specifications, but the range of the limits shall remain the same as the Standard Specifications.

Although the Department reserves the right to reject unacceptable material at any point prior to incorporation into the final product, the agreed upon gradation limits shall apply at the final point of shipping within the Source's control.

Development of Gradation Bands on Incoming Aggregate at Mix Plants

The aggregate user may use the gradation limits supplied by the producer or may choose to modify the gradation limits in accordance with the Department's "Development of Gradation Bands on Incoming Aggregate at Mix Plants" found in Appendix B in this manual. In general, this policy allows the user to shift the limits of all sieves, except the top and bottom sieve, upwards a maximum of 3% due to the potential for degradation of some materials during shipping and handling. If the user elects to use this procedure, the new gradation limits must be approved by the District Materials Engineer. Once adopted, the new user limits are then used in place of the aggregate source limits for all gradation tests at the users' site.

Master Band/Warning Band and Critical Sieve Designations

<u>Gradation</u>	<u>Critical Sieve*</u>	<u>Master Band (%)</u>	<u>Warning Band (%)</u>
CA/CM 5	1" (25 mm)	± 8	± 6
CA/CM 7	1/2" (12.5 mm)	± 8	± 6
CA/CM 11	1/2" (12.5 mm)	± 8	± 6
CA/CM 13	No. 4 (4.75 mm)	± 8	± 6
CA/CM 14	3/8" (9.5 mm)	± 8	± 6
CA/CM 16	No. 4 (4.75 mm)	± 8	± 6

Critical sieves for coarse aggregates are established per "Specification 201" found in the current Manual of Test Procedures

Master Band requirements for fine aggregate gradations FA 20/21/22 are found in the Manual of Test Procedures document "Specification 201 (page 1).

AGGREGATE GRADATION CONTROL SYSTEM

There are two methods by which aggregates can be certified using the Aggregate Gradation Control System (AGCS).

Method 1 covers aggregate producers who employ their own “trained technicians” and furnish their own “approved laboratory” to control production of aggregates under the Aggregate Gradation Control System.

Method 1 allows an aggregate producer to furnish certified aggregates on a continuing basis to any number of contractors for QC/QA projects as long as the source meets the requirements of the Aggregate Gradation Control System.

Use of Method 1 will allow the aggregate source to be listed as a Certified Source.

Method 2 is a variation of Method 1 where the aggregate producer utilizes the services of an engineering consultant to perform the required testing of the Aggregate Gradation Control System. The consultants must use “trained technicians” and have an “approved laboratory”.

Under Method 2, the aggregate producer may furnish certified aggregates on a continuing basis to any number of contractors for QC/QA projects as long as the producer and the retained consultant continue to meet the requirements of the Aggregate Gradation Control System.

Use of Method 2 will allow the aggregate source to be listed as a Certified Source.

NOTE: “Trained technicians” mean employees who have successfully passed the Department’s “Aggregate Technician Course”. An “approved laboratory” means a laboratory that has been inspected and approved by the Department.

This Page Is Reserved

4.0 STOCKPILING AND HANDLING

Stockpiling and handling are two of the most important aspects in the aggregate production process. Material being produced to a uniform in-specification gradation can become out-of-specification material through poor stockpiling and handling. Several factors affecting aggregate gradation in this manner are segregation and degradation.

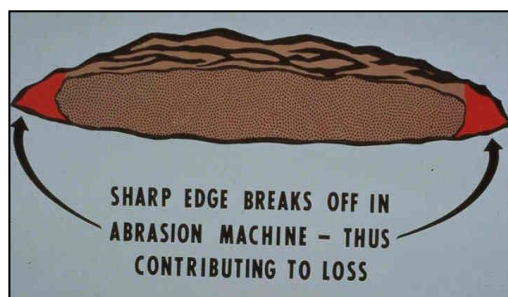
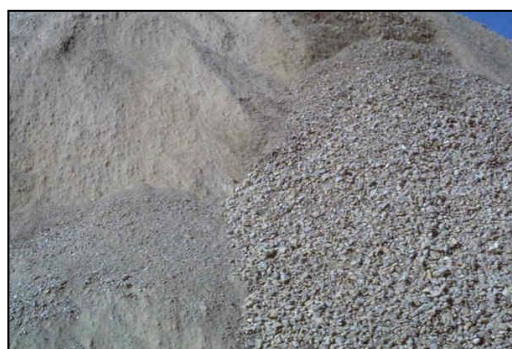
Segregation and degradation can be defined as follows:

- Segregation is the separation of a well graded production aggregate into individual sizes due to gravity. An example is large particles rolling down an inclined pile (cone) farther than smaller particles. This leads to almost all the large particles concentrated at the bottom and a fines pile formed in the center of the pile.
- Degradation is the actual breakdown of the individual aggregate particles due to abrasion and attrition during stockpiling and handling. This is extremely detrimental since the amount of minus 75 μm (minus No. 200) fines can be increased greatly. Increased fines create problems in most uses.

The following discussion will cover the types of stockpiling/handling, the effect of segregation and degradation on each type, and the methods normally used to eliminate or reduce their effects.

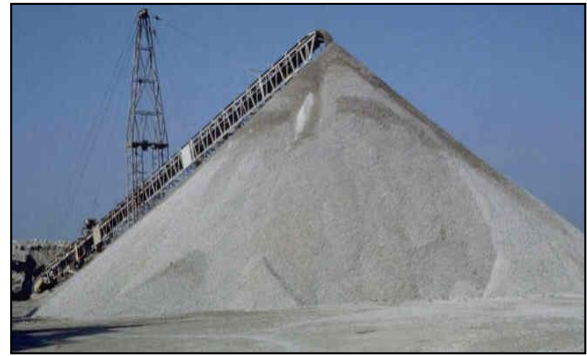
All stockpiling and handling for the Aggregate Gradation Control System shall conform to *Policy Memorandum 11-08.6 Aggregate Gradation Control System (AGCS)* (see Appendix A, page A-77 herein).

Stockpiling & Handling

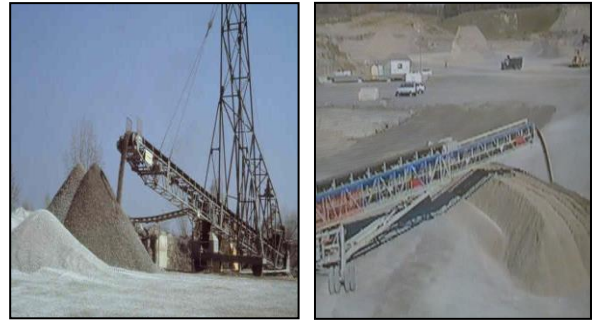


4.1 Conveyor Stockpiles. One of the two most common stockpiling methods in Illinois is material being discharged from a conveyor belt to form a stockpile. There are two kinds of conveyor stockpiles:

- Cone - formed under a fixed or adjustable conveyor belt
- Elongated Cone (tent-shaped) - built by a radial (or movable) stacker or a telescopic portable radial stacker

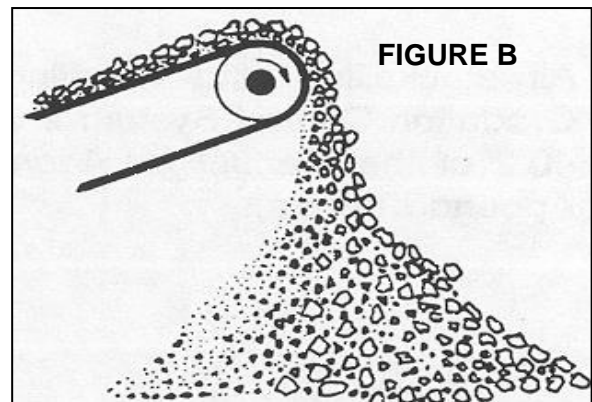
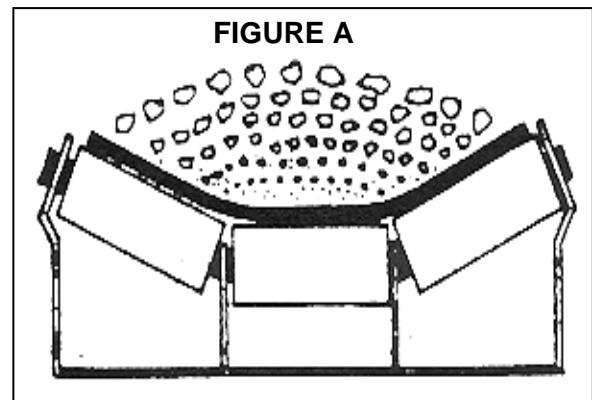


Cone Stockpile



Elongated Cone Stockpiles

4.1.1 These two types of stockpiles create a high degree of segregation. A simple explanation can show the reason for segregation. As the aggregate stream is conveyed up the belt (**Figure A**), vibration of the belt tends to layer the individual sizes and causes the fines to move to the bottom of the belt. When the material comes off the belt into the cone stockpile, the fine material clings to the belt longer and therefore drops straight down or toward the backside of the pile. The larger material falls or is thrown slightly away from the center top point of the pile. Belt speed can also be a large factor. As a result, the large particles have a tendency to roll down the front and sides of the pile and accumulate at the bottom (**Figure B**).



Several factors determine the amount of segregation in a pile. These are: belt speed, the distance of fall from the conveyor, the amount of moisture in the aggregate, the wind conditions, and the height of the pile. The distance of fall is one advantage where an adjustable stacker can produce a less segregated stockpile than a fixed belt by keeping the distance between the discharge end of the belt and the top of the pile to a minimum.

An adjustable radial stacker or an adjustable telescopic portable radial stacker can be used to build elongated tent-shaped piles. The adjustable radial stacker moves horizontally as well as vertically. The telescopic radial stacker not only moves horizontally and vertically, but also moves telescopically in and out creating a flat, instead of coned, surface. Although stockpiles using these two types of stackers also tend to segregate, they are superior to simple cone piles when built and loaded from properly. With either of these two types of stackers, the top of the pile must always be close to the end of the belt, and the stacker must be continually moved to keep the pile uniform without indentations. Load-out must be done across the end opposite the conveyor. Mixing during load-out should be done to incorporate the coarse edges with the finer center.

It should be pointed out that the fall distance from the conveyor/stacker to stockpile cannot be greater than 15 feet for IDOT Class A, B, or C Quality aggregate, unless a change is approved by the Central Bureau of Materials, as specified in Section 5.1.2 of *Policy Memorandum 11-08.6* (See Appendix A, page A-80 herein).

The source's handling/load-out procedures must adequately remix the material into an acceptable gradation when loading from cones/elongated cone piles. This explains why the endloader operator is so vitally important in most aggregate plants. A poor job of remixing means out-of-specification material being shipped.

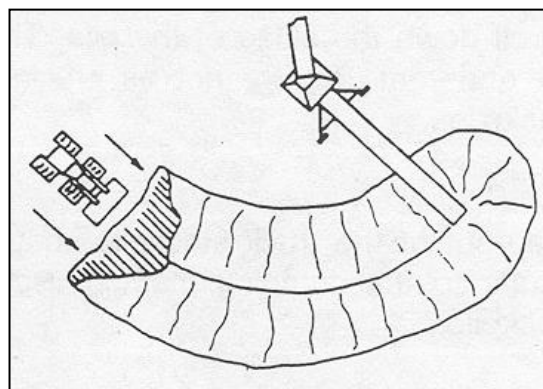
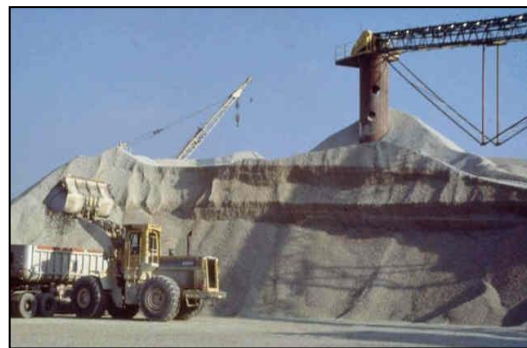
The endloader must load perpendicular to the belt flow when loading out of fixed belt cones (see figure on cone stockpile in Section 4.1). Elongated cone stockpiles must be worked from either end rather than from points along the banana-shaped sides (see figure on elongated cone stockpiles in Section 4.1). The endloader must also remix the material when loading out. Buckets from both the center fines pipe and the fine backside of the pile must be reworked or alternated with buckets of coarse particles at the front, sides, and bottom of the pile. This remixing will help to bring the material back into gradation.



Adjustable Radial Stacker



Telescopic Portable Radial Stacker



4.1.2 Degradation in cone/elongated cone stockpiles normally does not become a major problem. The main abrading action, which is minimum, is in the load-out of the stockpile.

4.2 **Truck Stockpiles.** The second of the two most common stockpiling methods is using large off-road trucks. These trucks normally carry 25 to 100 metric tons per load. The method requires truck dumps to be placed next to each other, effectively building a layer of material. Material can be placed alongside the layer and pushed up by an endloader. This is considered a **single-layer/pushed stockpile**.

Most sources choose to build **multilayered truck stockpiles**. In this case, a ramp of material is constructed to allow the trucks to drive up on the just-completed layer. An endloader or a bulldozer has to level the layer before the trucks can drive on it. The trucks proceed to dump loads across the top of the layer, making sure not to dump closer than 2 to 4 feet (0.6 to 1.3 m) from the layer edge. No material dumped on the second or subsequent layers should roll down the sides of the pile. This process can be continued to build a multilayered stockpile.

4.2.1 Stockpiles built in this manner have very little segregation as long as material is not allowed to roll down the sides of the pile. Therefore, load-out and remixing are not as crucial as in coned stockpiles.

Load-out of the truck stockpile should be perpendicular to the dumping method used to build the stockpile.



4.2.2 Degradation does become a factor when building a multilayered truck stockpile. The movement of trucks on the layered material can cause sufficient abrading and attrition of the aggregate particles to produce an unacceptable amount of minus minus No. 200 (75 μ m) fines.

Care must be exercised when permitting trucks on a stockpile. Aggregate used where excessive fines can cause problems should not be truck-stockpiled. Stockpiles should be constantly monitored for a fines problem and, if necessary, corrective action initiated, even to the extent of halting truck-stockpiling.

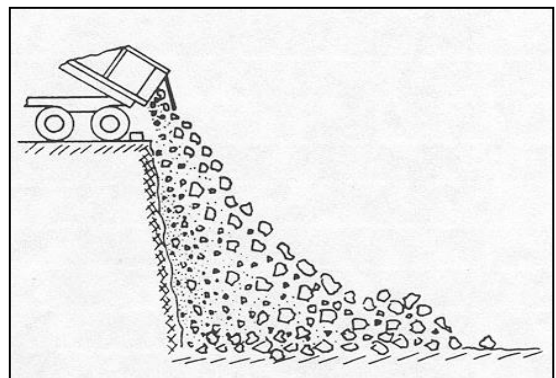


4.3 **Clam Shell Stockpiles.** Very few aggregate sources use a clam shell to build a stockpile. It is used mainly to unload material from river barges. A few Illinois sources and suppliers use this method to build their stockpiles. The clam shell method casts the material that is picked up from the barge in thin layers, building one upon the other. If correctly constructed, very little material rolls down the sides of the pile.



Segregation and degradation are minimal in a clam shell stockpile. The main problem associated with this type of stockpile is the high expense in building it.

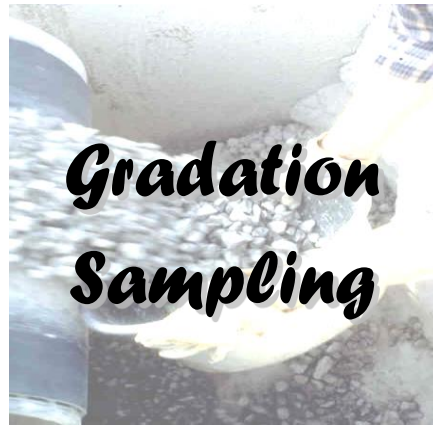
4.4 **Other Methods.** Some sources stockpile material by dumping truckloads over a quarry or pit face. (See adjacent figure.) This method, like conveyor-stockpiling, allows the material to segregate when the larger particles roll down the sloped pile. This is not a recommended stockpiling method because reclaiming normally cannot be done correctly to remix the aggregate.



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5.0 FIELD GRADATION SAMPLING

This chapter is designed to detail the correct sampling procedure to be used when taking gradation samples under the Aggregate Gradation Control System. Sampling shall conform to Illinois Test Procedure 2. **No other sampling procedures will be allowed.** Both production and stockpile sampling methods will be covered in this chapter.



5.1 Importance of Sampling. The *Aggregate Technician Course Manual* discusses the importance of correctly sampling aggregate for testing. Therefore, it should be sufficient to say in this chapter that knowing what is actually being produced is of prime importance in the production and utilization of aggregate. Unless gradation samples are truly **representative** of the material being produced and shipped, the test results are worthless for plant control or material acceptance.



5.2 Production Gradation Sampling.

Production sampling is generally acknowledged as the best sampling method for plant gradation control. It also is noted for providing the most representative samples. Following is a listing of four production sampling methods. Each will be described and any limitations discussed.

- On-belt sampling
- Belt-stream sampling
- Bin-discharge sampling
(requires IDOT approval)
- Truck-dump sampling



5.2.1 On-Belt Sampling - This production sampling method (illustrated on page 5-3) requires the producer to stop the production belt containing the finished product. A template (as illustrated) is inserted into the material on the belt. All the material between the template shall be removed and shall represent one of three increments making up the field sample. Extreme care shall be taken, including the use of a brush, to remove all fines on the belt between the template for inclusion into the increment. The belt shall be stopped at least three times (three increments) during approximately 10 to 15 minutes of operation to obtain a field sample. If additional material is needed beyond three increments due to the amount of material on the belt, additional template cuts may be taken during the three belt stoppages.



Samples shall be taken only during normal plant operation and when the belt is under normal load.

5.2.2 Belt-Stream Sampling - The sample shall be taken by cutting the stream of aggregate as it leaves the end of the production belt (see page 5-3). A sampling device is passed uniformly through the entire (width and depth) stream flow during normal production and belt load. Each sampling pass (increment) is combined with others to make up the field sample. A minimum of three increments shall be taken during a 10 to 15 minute sampling period. Enough increments shall be taken to provide the correct field sample size.



Extreme care shall be taken to make sure the sampling device passes completely and uniformly through the entire stream flow (from outside the stream on one side to outside the stream on the other side) and to ensure the device does not overflow.

On-Belt Sampling



Step 1



Step 2



Step 3



Step 4

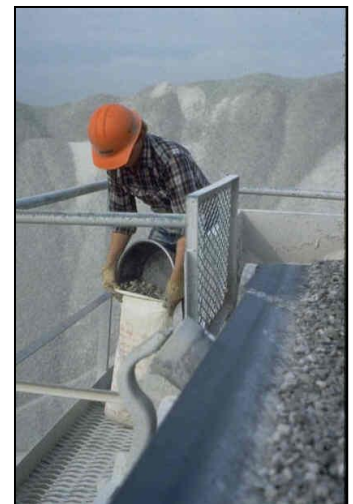
Belt-Stream Sampling



Step 1



Step 2



Step 3

5.2.3 Bin-Discharge Sampling - Bin discharge shall be sampled in a manner similar to belt-stream sampling to get a production sample. A sampling device is passed through the entire bin discharge stream. A minimum of three increments shall be taken during a 10- to 15-minute sampling period and combined to form the field sample.

Before cutting the bin discharge stream, the bin must be emptied until such time that the stream of material entering the bin is the stream of material exiting the bin. Sampling may take place at that time.

Samples shall be taken only during normal plant operation and when the bin is being fed under normal load

The major problems associated with bin-discharge sampling involve segregated material clinging to the sides of the bin. This material can and does break loose which alters the gradation of the bin-discharge stream. This sampling procedure shall therefore be used only when approved by the District Engineer. (This technique of sampling may also be considered as another method for end-point sampling.)



5.2.4 Truck-Dump Sampling – Sampling from inside of transportation units is not permitted. The transportation unit shall be off-loaded and sampled by any of the sampling procedures under Illinois Test Procedure 2.

This sampling method requires taking a field sample from one or two truck dumps which are placed during the building of a stockpile or feeding of a plant. The truck dump(s) shall be cut with an endloader and two or more bucketloads extracted. The bucketloads shall be dumped on one another to form a small pile. **The small pile shall then be mixed from two directions perpendicular to each other.** To mix the pile, the endloader shall cut into the pile along its base until approximately its midpoint. The loader bucket shall be lifted, the loader moved 1 to 2 feet forward, and the bucket dumped on the other half of the pile.



Care shall be exercised to avoid cutting below the base of the truckdumps or small pile and contaminating the material to be sampled.

After mixing twice, the endloader shall drop and angle its bucket downward on one side of the pile into a layer not less the 1 foot thick

The layer shall be sampled using a required shovel to take increments in a random "X" pattern over the layer. The shovel shall be forced vertically to its full depth when sampling each increment except that care shall be used to not dig completely through the layer. This would contaminate the sample being obtained. The equipment wheel paths and the edges of the sample layer should be avoided. Sufficient increments shall be taken to make up a correct field sample. Care shall also be exercised to retain as much material on the shovel when taking increments. Sufficient increments shall be taken to make up a correct field sample.



5.3 Stockpile Sampling. Stockpile sampling is needed to confirm that the material in the stockpile meets a specified gradation or can be remixed during load-out to meet a specified gradation. Care has to be taken to obtain a representative sample.



5.3.1 There are two general rules for getting samples (especially coarse aggregate) from a stockpile.

5.3.1.1 The sample shall be taken from the working face of the stockpile. The working face shall be perpendicular to the direction of flow used to build the stockpile. Stockpiles having no working face shall have one established prior to sampling. The working face shall have the interior of the pile exposed to permit proper reblending of the pile to eliminate segregated aggregate. If necessary, material may be brought out of the main pile's working face into a substockpile for sampling.



5.3.1.2 Take several bucketloads across the opened face of the main stockpile or substockpile with an endloader and combine them in a small pile. Care shall be exercised to avoid having the endloader cut below the base of the existing stockpile. This prevents contamination of the sample.

5.3.2 Stockpile Sampling Procedure – As for the actual sampling procedure (see page 5.7). The stockpile sampling procedure shall follow the truck-dump sampling procedure using an endloader. The endloader shall cut across the working face as detailed in “Truck-Dump Sampling.” Any special mixing procedure used during loading shall be used when taking any samples.



Stockpile Sampling Procedure

Step 1 – Take several bucketloads across the opened face of the main stockpile or substockpile with an endloader and combine them in a small pile.



Step 2 – The small pile shall then be mixed from two directions perpendicular to each other, always dumping back on top of the pile.



Step 3 – After mixing, the endloader shall backdrag the pile into a layer not less than one foot thick.



Step 4 – The layer shall be sampled using a shovel to take increments in "X" pattern. Increments should be taken to the full depth of the shovel and care should be exercised to retain as much material as possible.

5.4 Sampling Equipment. Several pieces of sampling equipment are mentioned in the preceding parts of this chapter. This equipment - template, sampling device, and shovel - must meet certain requirements to be used for sampling. The following paragraphs describe the requirements for each piece.

5.4.1 Template - The template shall consist of two endplates and shall be designed to be adjustable. The distance between the end plates may therefore be changed to gather more material from the belt for each increment. The end plates shall also be machined or cut to the approximate belt size and shape.

A single template end plate may be used in the sampling procedure, if care is exercised.



5.4.2 Sampling Device - The sampling device used to cut the flow stream from the end of the belt or the bin discharge must be strong enough to handle the force of the flow stream. The device must also be large and deep enough to cut the entire flow stream and not overflow when passing through the stream. The device may be a bucket, a pan, or a specifically manufactured sampling container.

****Shelby tubes are not allowed as sampling devices.**



5.4.3 Shovel - The shovel shall be square-nosed and of a size easily handled. It shall also have built-up sides and back (***approximately 1 1/2 inch [37.5mm]***) to facilitate the retention of material on the shovel when sampling.



5.5 Sampling Frequency / Field Sample Size

5.5.1 Sampling Frequency - The frequency of gradation sampling is listed in the "Aggregate Gradation Control System". This program is covered in Chapter 8.0 of the *Aggregate Technician Course Manual*.

5.5.2 Field Sample Size - The field sample size is detailed in the Aggregate Gradation Sample Size Table & Quality Control Sieves, effective December 1, 2017. A copy of the Aggregate Sample Size Table is located on pages 6-18 & 6-19 herein.

Gradation No. * †	Maximum Nominal Size	Minimum Test Sample Size ‡	Minimum Field Sample Size ‡
CA 1	63 mm (2 1/2")	10,000 grams	50 kg (110 lbs)
CA 2	50 mm (2")	10,000 grams	50 kg (110 lbs)
CA 3	50 mm (2")	10,000 grams	50 kg (110 lbs)
CA 4	37.5 mm (1 1/2")	10,000 grams	50 kg (110 lbs)
CA 5	37.5 mm (1-1/2")	10,000 grams	50 kg (110 lbs)
CA 6	25 mm (1")	5,000 grams	25 kg (55 lbs)
CA 7	25 mm (1")	5,000 grams	25 kg (55 lbs)
CA 8	25 mm (1")	5,000 grams	25 kg (55 lbs)
CA 9	25 mm (1")	5,000 grams	25 kg (55 lbs)
CA 10	19 mm (3/4")	5,000 grams	25 kg (55 lbs)
CA 11	19 mm (3/4")	5,000 grams	25 kg (55 lbs)
CA 12	12.5 mm (1/2")	2,000 grams	16 kg (35 lbs)
CA 13	12.5 mm (1/2")	2,000 grams	16 kg (35 lbs)
CA 14	12.5 mm (1/2")	2,000 grams	16 kg (35 lbs)
CA 15	12.5 mm (1/2")	2,000 grams	16 kg (35 lbs)
CA 16	9.5 mm (3/8")	1,000 grams	11 kg (25 lbs)
CA 17	25 mm (1")**	4,000 grams**	16 kg (35 lbs)**
CA 18	25 mm (1")**	4,000 grams**	16 kg (35 lbs)**
CA 19	25 mm (1")**	4,000 grams**	16 kg (35 lbs)**

5.6 Safety. Gradation sampling can pose one of the greatest risks to the safety of the aggregate technician/inspector. Extreme care should be used whenever around the aggregate plant and mobile equipment.

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6.0 GRADATION TESTING

The procedure for determining the gradation or particle size distribution of an aggregate is divided into five parts:

Reduction of field sample (ITP-248)

Drying of the sample (ITP 255)

Wash test (ITP-11)

Dry sieve analysis (ITP-27)

Calculation / Reporting

The following sections will describe each part of the gradation test procedure, in detail, as it is performed on a field sample brought into the laboratory.

In addition, aggregate moisture content may be run on the gradation sample prior to gradation testing or on a separate test sample, both as detailed in Article 6.6 herein.

The necessary laboratory equipment to run a gradation or aggregate moisture content shall be approved by the Bureau specified in the Appendix D3 "Aggregate Laboratory Equipment" in the Manual of Test Procedures for Materials (See Appendix A, Page A-49 herein). This equipment shall be continually monitored and frequently checked by the aggregate technician for compliance to the required Illinois Test Procedures. The producer laboratory will also be checked by the Department during initial source certification and on a biennial basis thereafter.



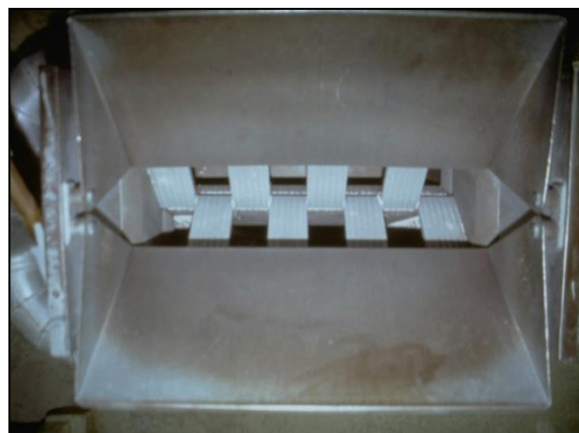
6.1 Reduction of Field Samples. Field samples must be reduced to test sample size before testing. The test sample size for gradation testing shall conform to the Illinois Specification 201, Aggregate Gradation Sample Size Table & Quality Control Sieves, (see page 6-18 herein.) The test sample size shall be as stated in Illinois Specification 201.

Reduction of field samples shall conform to Illinois Test Procedure 248 (see Appendix A, herein). Selection during splitting of an exact predetermined mass for the sample is not permitted.

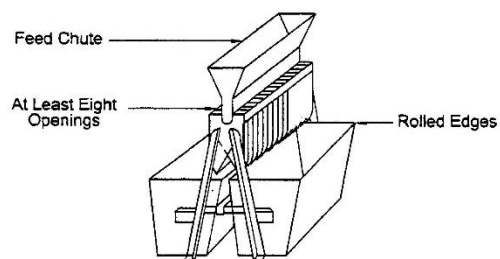
The required splitting method for coarse aggregate in the program shall be mechanical splitters as detailed in Article 6.1.1 (following). The preferred splitting method for fine aggregate shall be mechanical splitters; however, quartering and miniature stockpile sample may be used. If a mechanical splitter is used, it shall conform to Illinois Test Procedure 248, Method 'A' (see Appendix A herein).

6.1.1 Method 'A' - Mechanical Splitters - As stated in the specification, the mechanical splitter shall have an even number of same-width chutes, directed alternately to different sides. There shall be a minimum of eight chutes for coarse aggregate and twelve chutes for fine aggregate. All chutes shall be at least 50% larger than the largest particle in the field sample. Two pans, each of which covers the entire width of the chute area, shall be used to catch the two split halves. The splitter shall be equipped with a hopper (preferred type) or a straight edged pan, either of which shall give a width equal to or slightly less than the overall width of the chutes. The splitter and accessory equipment shall be designed and operated so that the sample will flow smoothly without restriction or loss of material and can be fed at a slow, controlled rate during the splitting process.

Mechanical Splitters Hopper Style

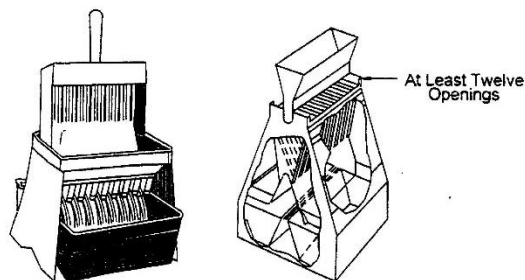


Mechanical Splitters Straightedge Pan Style



Riffle Sample Splitter

(a) Large Sample Splitter for Coarse Aggregate



(b) Small Sample Splitters for Fine Aggregate

All aggregate splitters used must conform to Illinois Test Procedure 248.

The actual splitting procedure requires the field sample be placed in the hopper or pour pan and evenly distributed from edge to edge. This allows the material to be divided into approximately equal amounts by flowing through the chutes. The sample shall be introduced into the chutes in an even flow. A fast discharge or “shot-gunning” the sample into the chutes may cause material to bridge over a chute, creating a non-representative sample. One of the two splits may then be reintroduced into the hopper or pour pan for further splitting. (See page 6-4.) This procedure should be done the appropriate number of times to result in the correct test sample size.

On the final split, the masses of the two halves (after splitting) shall be within +/- 10% of each other. This is determined adding 10% of the mass of the smaller split to the mass of the smaller split; the larger split cannot exceed this calculated mass. If it does, both split halves shall be recombined and split until the mass comparison requirement is met.

Example problem of final split calculation:

Weight of 1st half is 2020 g

Weight of 2nd half is 1853 g

(Smaller split) _____ g x 10% = _____ g

(Add to smaller split) _____ g + _____ g = _____ g

The mass of the larger split half (2020 g) cannot be larger than the calculated mass in order to be a valid split.

If the larger half exceeds the calculated mass, recombine the two halves and split again.



Mechanical Splitting



STEP 1



STEP 2



STEP 3



STEP 4



STEP 5

6.1.2 Method 'B' - Quartering - Quartering, as described in Illinois Test Procedure 248, requires the fine aggregate field sample be placed on a hard, clean, level surface or on a canvas blanket. (See page 6-6.) The sample is then thoroughly mixed by turning over the entire samples four times with a shovel, forming a small conical pile. If the canvas blanket is used, mixing may also be accomplished by alternately lifting each corner of the canvas and pulling it over the sample diagonally toward the opposite corner. This causes the material to be rolled and mixed. The mixing procedure, whether by shove or canvas, shall be repeated three times, resulting with the formation of a small conical pile. Care shall be taken not to lose material or add foreign material in either mixing procedure.

The small conical pile shall be flattened to a uniform thickness and diameter by applying the shovel to the apex of the pile. The diameter should be approximately four to eight times the thickness.

The flattened pile shall then be divided into four equal quarters with a shovel or trowel. Two diagonally opposite quarters shall be removed, including all fine material. A brush may be used to clean the cleared spaces. Remix and quarter the remaining material as many times as necessary following the above-described method to achieve the required test sample size.

On the final split, both split halves shall conform to the +/- 10% mass requirement detailed in Article 6.1.1 herein.



Quartering



Step 1



Step 2



Step 3



Step 4

6.1.3 Method 'C' - Miniature Stockpile –

Miniature stockpile sampling may be used on only damp, fine aggregate. The material is mixed using the same procedure as just described in quartering. The small conical pile is flattened to a sampling pad of uniform thickness and diameter by applying the shovel to the apex of the pile. Each quarter section of the resulting pad will contain the material originally in it. The test sample is then obtained by selecting at least five increments in a random "X" pattern over the miniature sampling pad using a sampling thief, small scoop, or spoon. The number of increments should be sufficient to provide a sample slightly larger than the required minimum test sample size when dried to constant weight.

For all State monitor splits, the number of increments, as described above, shall be doubled to provide a sample twice the required size. This material shall then be dried to constant weight and split in accordance to Method 'A' (mechanical splitter), or, instead of drying and mechanically splitting, the material may be split in accordance to Method 'B' (quartering) of ITP 248. Both split halves shall conform to the $\pm 10\%$ weight requirement detailed in Article 6.1.1 herein.

6.2 Drying of Test Sample – The test sample shall be dried back to constant weight in conformance to the Illinois Test Procedure 255 utilizing an oven, specifically designed for drying, set at and capable of maintaining a uniform temperature of $230 \pm 9^\circ\text{F}$ ($110 \pm 5^\circ\text{C}$). Constant weight is defined as "The sample weight, at which there has not been more than a 0.5-gram weight loss during an additional 1 hour of drying". This shall be verified occasionally.



The sample may also be dried in a pan on an electric hot plate or gas burner in lieu of using an oven. Since this method can create drying temperatures greatly exceeding the allowed oven temperatures, extreme care must be used when using this drying method. The technician shall continually attend the sample on the electric hot plate or gas burner. While microwave ovens are not permitted for drying aggregate gradation samples, microwave ovens can be used when drying non-gradation test samples used for moisture determination only.

The electric hot plate and/or gas burner should be operated on a low-as-needed heat during drying. This will eliminate the popping, crackling, and/or sizzling noise which indicates potential aggregate breakdown. The heat must be turned down if these noises persist, or the sample must be constantly stirred to prevent this potential aggregate particle disintegration.

After the test sample has been dried back to constant weight, the sample shall be cooled down to room temperature. The sample shall then have its weight determined to the nearest 1 gram for coarse aggregate and to the nearest 0.1 gram for fine aggregate on scales or a balance conforming to the *AASHTO Standard M 231, Weighing Devices Used in the Testing of Materials*. All scales or balances shall be tared before being used to determine any weight required in this chapter. This procedure provides the Total Dry Weight of the original test sample.



6.3 Wash Test – The wash test, Illinois Test Procedure 11, “Amount of Material Finer Than No. 200 [75µm] Sieve in Aggregate”, requires the sample be placed in a sufficiently sized pan and covered with water. (See page 6-10.) If necessary, a wetting agent, such as a detergent or dispersing solution, may be added to assure thorough separation of the fines from the coarse particles. (Note: There should be enough wetting agent to produce only a small amount of suds when the sample is agitated. Excessive suds may overflow the sieves and carry some material with them.) The sample shall be agitated by the use of a **large spoon or similar instrument** to bring the fines into suspension in the water. The water is then immediately poured into a nested set of sieves. The nested set of sieves must consist of the No. 200 [75µm] sieve with an additional sieve placed directly on top. The sieve placed on top of the No. 200 (75µm) is used as a protectant sieve and can be any sieve from the #8 (2.36mm) through the No. 16 (1.18mm). Care shall be taken to avoid pouring many of the coarse particles onto the sieves. This procedure is repeated as many times as necessary until the wash water is clear. At this time, all material retained on the wash sieves is then carefully washed back into the sample.

A mechanical device, such as a Ploog washer, may be used for **coarse aggregate samples** providing its results match the manual procedure. If using a mechanical washing device, the protectant sieve needs to be an extra tall sieve (at least 6-8”) to avoid loss of material due to splashing. A loss of fines due to the dripping of water from the outside edge will not be allowed and can be prevented by applying a coating of wax around the outside edge of the drum lip. If sample degradation



Manual Wash Method



Mechanical Wash Method

occurs, then mechanical washing method will not be allowed. After completing the washing, the test sample is dried back to constant weight and its weight determined. This weight is recorded as the Total Wash Weight to the nearest 1 gram for coarse aggregate and the nearest 0.1 gram for fine aggregate.

If the wash test is not required, Section 6.3 may be eliminated.

Wash Test



STEP 1



STEP 2



STEP 3



STEP 4



STEP 5



STEP 6

6.4 Dry Sieve Test – The test sample, after drying back to constant mass and having its mass determined, shall be run in the dry sieve test conforming Illinois Test Procedure 27, “Sieve Analysis of Fine and Coarse Aggregates”. All equipment used shall conform to Illinois Test Procedure 27. (See page 6-13 herein for the step-by-step dry gradation procedures.)

The first step in the test procedure requires a nested set of 12” [300mm] sieves (8” [200mm] are acceptable for fine aggregate samples), be gathered and stacked. As the sieves are being stacked, they should be inspected for cracks, breaks, or any other problem which would exclude their continued use or alter test results in any way. The size of the sieves used shall conform to the gradation specifications of the aggregated tested. The No. 200 (75um) sieve is required to be part of all nested sets when running a gradation test. It is also required, when using 12” (300mm) sieves, the use of additional cutter sieves beyond the specified gradation sieves for all coarse aggregate gradations is required per Illinois Specification 201. Cutter sieves may be required for any aggregate gradation if it is determined that overloading of individual sieves occurs. Please refer to the current Illinois Specification 201-Aggregate Gradation Sample Size Table & Quality Control Sieves (See Appendix A herein) for the listing of required cutter sieves by gradation.

The sample is then introduced into the nested set of sieves and placed on or into a mechanical shaker. The shaker shall impart a vertical, or lateral and vertical, motion to the nested set. This causes the aggregate particles to bounce and turn so as to present different particle orientations to the sieves. This allows every



chance for a particle to pass a certain sized sieve.

The shaker shall be run for a minimum of 7 minutes, controlled by an automatic shut-off timer. Seven (7) minutes of shaking shall be considered the standard unless reduced shaker efficiency is demonstrated through finish hand-shaking as described in Paragraph 8.4 of Illinois Test Procedure 27 (See Appendix B herein). Shaking time shall be increased if necessary to comply with Illinois Test Procedure 27. Shaking time shall not exceed 10 minutes.



Extreme care shall be taken not to overload individual sieves or even approach the overload limits. An **overload** is defined as **several layers of particles, one on top of the other, which do not permit the top layers of particles access to the sieve openings**. Sample results which show overloading or a borderline situation are immediately suspect. If samples continually overload a sieve or sieves, then future samples shall be run in the appropriate number of portions to prevent overloading, or additional cutter sieves shall be added to the nested set to correct the problem.

After mechanical shaking, all sieves shall be finished off by hand-shaking. For hand-shaking, the largest sieve that contains material shall be removed from the stack, visually inspected for an overload, and inverted over an empty pan. While inverted, all particles shall be cleaned from the sieve. The material shall then be placed back on the same sieve and hand-shaken over an empty pan. Any amount of material that is considered to be an overload or to be approaching and overload shall be hand-shaken in at least two increments. Any appreciably large amount of particles passing a sieve may indicate poor mechanical shaking or overloading. The finish hand-shaking noted in Paragraph 8.4 of Illinois Test Procedure 27 shall then be initiated.

After hand-shaking, any retained material shall be removed from the sieve. Particles shall not be forced through the sieves. The sieve shall be inverted and lightly tapped on the sides to facilitate removal for weighing. A dowel rod or putty knife may be used to gently remove wedged particles from all sieves down through and including the No. 10 (2.00mm). A soft brass-wired brush shall be used on the No. 16 (1.18mm) through the No. 40 (425 μ m) sieves, while a soft china brush shall be used the No. 50 (300 μ m) sieve through the No. 200 (75 μ m) sieve.



Dry Sieve Test



STEP 1



STEP 2



STEP 3



STEP 4



STEP 5



STEP 6



STEP 7



STEP 8

After hand-shaking and cleaning, the material retained on each sieve shall have its mass determined and the mass recorded. All determination of mass shall start with the largest sieve in the nested set and proceed down to the pan. Determination of mass shall be to the nearest 1 gram for coarse aggregate and to the nearest 0.1 gram for fine aggregate. Any material that passed the sieve during hand-shaking shall be placed on the next smaller sieve.



After use, all sieves shall be inspected for cracks, breaks, or any other problem which would exclude their continued use.

6.5 Calculation / Reporting - All recording/ calculation and report shall be done on the Department's gradation form. (See page 6-21 herein.) Individual source forms may be used if approved by the District Materials Engineer. The procedure for test calculation and reporting is as follows:

6.5.1 Calculation of Test Results – Calculation of test results shall follow the procedure described below. Refer to the Department's gradation form on page 21 herein.

6.5.1.1 The DIFF. – No. 200 (-0.075) shall be determined by subtracting the Washed Mass (weight) from the Total Dry Mass (weight).

6.5.1.2 The "Minus" 75um (No. 200) by Washing" shall be determined by using the following formula:

$$\% \text{ -200 (-75}\mu\text{m) by Washing} = \frac{\text{TDM-TWM}}{\text{TDM}} \times 100$$

where TDM= Total Dry Mass (weight)

and TWM = Total Wash Mass (weight)

This result shall be rounded to the nearest 0.1% and recorded on the gradation form.

6.5.1.3 Calculate the “Cumulative Mass (weight) Retained” for each sieve by adding its “Individual Mass (weight) Retained” and the “Individual Mass (weight) Retained” for each larger sieve in the nested set of sieves. Record the “Cumulative Mass (weight) Retained”.

6.5.1.4 Calculate the “Maximum Gain-Loss” of the mass (weight) allowed for acceptance by using the following formula; rounding the result to the nearest 1 gram for coarse aggregate and to the nearest 0.1 gram for fine aggregate:

$$\text{Maximum Gain-Loss} = 0.3\% \times \text{TDM}$$

where TDM = Total Dry Mass (weight)

6.5.1.5 Calculate the “Cumulative Percent Retained” for each sieve by using the following formula and record it by rounding to the nearest 0.1%.

$$\text{Cumulative \% Retained} = \frac{\text{CMR}}{\text{TDM}} \times 100$$

where CMR = Cumulative Mass (weight) Retained

and TDM = Total Dry Mass (weight)

6.5.1.6 Calculate the percent passing each sieve by using the following formula:

$$\% \text{ passing} = 100 - \text{Cumulative \% Retained}$$

These results shall be recorded to the nearest 0.1%.

6.5.2 Reporting – All percent passing results except the washed minus 75um (minus No. 200) shall be reported on the gradation form as whole numbers. The washed minus No. 200 (75um) result's shall be reported to the nearest 0.1%. The gradation forms shall be completed with all required information. All forms shall be sent to the District office on a weekly basis for entry into the MISTIC system.

Rounding of values will be according to ASTM E 29.

For all sieves treated as an overload, an “S” will be notated on the worksheet next to the sieve size designation.

6.6 Aggregate Moisture Content - Aggregate moisture content may be run on the gradation sample prior to gradation testing or on a separate test sample. Field samples must be reduced to test sample size before testing according to Section 6.1 herein (according to Illinois Test Procedure 248 and shall meet the minimum sample size requirements of Illinois Specification 201, Aggregate Gradation Sample Size Table and Quality Control Sieves, effective December 1, 2017 (See Appendix A, herein).

Both field and test samples must be stored in sealable, non-absorbing plastic bags and/or plastic containers to prevent moisture loss, prior to determining the mass (weight) of the sample.

The Aggregate Technician may be required, by the source, to perform this test on an infrequent basis for information on aggregate being shipped. The Aggregate Moisture Content test is commonly required to be run at both HMA and P.C. concrete plants per QC/QA specifications. When run, all test results shall be reported on the appropriate report forms and documented in a plant diary.

6.6.1 Test Procedure - Aggregate moisture content test procedure shall conform to Illinois Test Procedure 255.

The test sample shall be initially weighed to the nearest gram for coarse aggregate and to the nearest 0.1 gram for fine aggregate on scales or a balance conforming to AASHTO M 231. All scales shall be tared before being used for any weighing. This weighing procedure provides the "Original Sample Mass (weight), g". The test sample shall be dried back to constant mass according to Section 6.2 herein (according to Illinois Test Procedure 255). When performing an aggregate moisture content test only, a microwave oven or heat lamp may also be used for drying purposes on a non-gradation test samples.

After the test sample has been dried to constant mass and cooled sufficiently, so as not to damage the balance or scale, the mass of the test sample will be determined as required above in this Section (6.6.1). The test sample shall have its mass determined as soon as the container can be safely handled to prevent additional moisture from being pulled from the air into the aggregate structure. This procedure provides the "Total Dry Mass (weight) g".

Calculation / Reporting - The "Aggregate Moisture Content" shall be determined by using the following formula:

$$P = \frac{(OSM - TDM)}{TDM} \times 100$$

Where P = Aggregate Moisture Content (%),

OSM = Original Sample Mass (weight), g,

and TDM = Dried Sample Mass (weight), g

Test results shall be rounded to the nearest 0.1%.

Example:

With the following given information calculate the percent moisture for a sample of CM11 material:

$$OSM = 5,165 \text{ g}$$

$$TDM = 5,045 \text{ g}$$

$$P = \frac{(5,165-5,045)}{5,045} \times 100$$

$$P = \underline{\hspace{2cm}}$$

Illinois Specification 201
Illinois Department of Transportation (IDOT)
AGGREGATE GRADATION SAMPLE SIZE TABLE & QUALITY CONTROL SIEVES

Effective: December 1, 2021

COARSE AGGREGATE GRADATION TABLE																			
CA(CM) ^{1, 2}	Minimum Field Sample Size ³	Minimum Test Sample Size ³	3"	2 1/2"	2"	1 3/4"	1 1/2"	1"	3/4"	5/8"	1/2"	3/8"	1/4"	#4	#8	#16	#40	#50	#200
CA01	110 lbs (50 kg)	10,000 g	X	X ^{MN}	X		X	X											X
CA02	110 lbs (50 kg)	10,000 g		X	X ^{MN}		XC	X	XC		X			X		X	X		X
CA03	110 lbs (50 kg)	10,000 g		X	X ^{MN}		X	X			X								X
CA04	110 lbs (50 kg)	10,000 g			X		X ^{MN}	X	XC		X	XC		X		X	X		X
CA05 ⁵	110 lbs (50 kg)	10,000 g				X	X ^{MN}	X ^{MB,6}	XC		X			X ⁶					X
CA06	55 lbs (25 kg)	5,000 g					X	X ^{MN}	XC		X	XC		X		X	X		X
CA07 ⁵	55 lbs (25 kg)	5,000 g					X	X ^{MN}	XC	XC	X ^{MB,6}	XC	XC	X ⁶					X
CA08	55 lbs (25 kg)	5,000 g					X	X ^{MN}	X	XC	X	XC	XC	X		X			X
CA09	55 lbs (25 kg)	5,000 g					X	X ^{MN}	XC	XC	X	XC	XC	X		X			X
CA10	55 lbs (25 kg)	5,000 g						X	X ^{MN}	XC	X	XC	XC	X		X	X		X
CA11 ⁵	55 lbs (25 kg)	5,000 g						X	X ^{MN}	XC	X ^{MB,6}	XC	XC	X		X ⁶			X
CA12	35 lbs (16 kg)	2,000 g							X		X ^{MN}	X	XC	X	XC	X	X		X
CA13 ⁵	35 lbs (16 kg)	2,000 g							X		X ^{MN}	X	XC	X ^{MB,6}	XC	X ⁶			X
CA14 ⁵	35 lbs (16 kg)	2,000 g								X	X ^{MN}	X ^{MB,6}	XC	X ⁶					X
CA15	35 lbs (16 kg)	2,000 g									X	X ^{MN}	XC	X	XC	X			X
CA16 ⁵	25 lbs (11 kg)	1,500 g									X	X ^{MN}	XC	X ^{MB,6}	XC	X ⁶			X
CA17	35 lbs (16 kg) ⁴	4,000 g ⁴	X		XC			XC			XC	XC		X ^{MN, 4}		X		X	X
CA18	35 lbs (16 kg) ⁴	4,000 g ⁴	X					X ^{MN, 4}			XC	XC		X		X		X	X
CA19	35 lbs (16 kg) ⁴	4,000 g ⁴	X					X ^{MN, 4}			XC	XC		X		X	X	X	X
CA20	25 lbs (11 kg)	2,000 g									X	X ^{MN}	XC	X	X	X			X

Note: See footnotes below Fine Aggregate Gradation Table for explanation of symbols

Illinois Specification 201
Illinois Department of Transportation (IDOT)
AGGREGATE GRADATION SAMPLE SIZE TABLE & QUALITY CONTROL SIEVES

Effective: December 1, 2021

FINE AGGREGATE GRADATION TABLE															
FA(FM) ^{1, 2}	Minimum Field Sample Size ³	Minimum Test Sample Size ³	1"	1/2"	3/8"	#4	#8	#10	#16	#30	#40	#50	#80	#100	#200
FA01	25 lbs (11 kg)	500 g			X	X ^{MN}	X ^{MB}		X	X ^{MB}		X		X	X
FA02	25 lbs (11 kg)	500 g			X	X ^{MN}	X ^{MB}		X	X ^{MB}		X		X	X
FA03	25 lbs (11 kg)	500 g			X	X ^{MN}		X			X		X		X
FA04	25 lbs (11 kg)	500 g			X				X ^{MN}						
FA05	25 lbs (11 kg)	500 g			X	X ^{MN}								X	X
FA06	25 lbs (11 kg)	500 g	X	X	X	X ^{MN}								X	X
FA07	25 lbs (11 kg)	100 g				X		X ^{MN}			X		X		X
FA08	25 lbs (11 kg)	100 g					X				X ^{MN}			X	X
FA09	25 lbs (11 kg)	100 g					X					X ^{MN}		X	X
FA10	25 lbs (11 kg)	100 g						X			X ^{MN}		X		X
FA20 ⁵	25 lbs (11 kg)	500 g			X	X ^{MN}	X ^{MB}		X	X ^{MB, 6}		X		X	X ⁶
FA21 ⁵	25 lbs (11 kg)	500 g			X	X ^{MN}	X ^{MB}		X	X ^{MB, 6}		X		X	X ⁶
FA22 ⁵	25 lbs (11 kg)	500 g			X	X ^{MB}	X ^{MB, 6}		X						X ⁶
FA23 ⁵	25 lbs (11 kg)	500 g			X	X ^{MN}	X ^{MB}		X	X ^{MB, 6}		X		X	X ⁶
FA24 ⁵	25 lbs (11 kg)	500 g			X	X ^{MN}	X ^{MB}		X	X ^{MB, 6}		X		X	X ⁶

Notes below apply to Fine and Coarse Aggregate Gradation Tables Only

X = Required Gradation Specification Sieves

XC = Required Cutter Sieves

MB = Master Band Sieves for Category I Coarse Aggregate for PCC and HMA Mixes; Bituminous use only for fine aggregate.

MN = Maximum Nominal Sieve for Crushed Gravels – Maximum Nominal Size is defined as the first specification sieve in the product gradation on which material may be retained.

1 = CA = Coarse Aggregate; CM = Coarse Aggregate, Modified; FA = Fine Aggregate; FM = Fine Aggregate, Modified

2 = CM and FM gradations shall be sampled and tested the same as the corresponding CA and FA gradations.

3 = Slag should be adjusted accordingly due to its lighter or heavier mass.

4 = Will vary with the gradation of the material being used

5 = Control Charts Required

6 = Required Sieve for Control Charts

Illinois Specification 201
Illinois Department of Transportation (IDOT)
AGGREGATE GRADATION SAMPLE SIZE TABLE & QUALITY CONTROL SIEVES

Effective: December 1, 2021

LARGE SIZED AGGREGATE GRADATION TABLE										
CS/RR ^{1,2}	Minimum Test Sample Size ³	8"	6"	4"	3"	2"	1 ½"	1"	½"	#4
CS01	<u>50,000 g</u>	X	X	X	XC	X		XC	XC	X
CS02	<u>50,000 g</u>		X	X	XC	X		XC	XC	X
RR01	<u>20,000 g</u>				X	XC	X	XC	XC	X
RR02	<u>20,000 g</u>			X	XC	X	XC	XC	XC	X

Notes below apply to Large Sized Aggregate Gradation Table Only

X = Required Gradation Specification Sieves

XC = Required Cutter Sieves

1 = CS = Coarse Aggregate Subgrade; RR/RRM = Rip Rap

2 = Dry Gradations Only

3 = Slag should be adjusted accordingly due to its lighter or heavier mass.

4 = A round nosed shovel may be used for sampling

5 = Metal plates with precisely sized square holes may be used for the gradation

6 = Test sample size shall be taken in the field. No splitting is required.



Field / Lab Gradations

Inspector No. (2) _____ Inspector Name (3) _____ I.D. Number (1) _____
 Mix Plant No. (6) _____ Mix Plant Name (7) _____ Seq. No. (5) _____
 Responsible Loc. (10) _____ Lab (11) _____ Lab Name (12) _____ *Contract No. (8) _____ *Job No. (9) _____
 [Source Name (13)]

Source (14)	Mat. Code # (15)	Type Test (16)	Orig. I.D. # (17)	Insp. Qty (18)	Spec. (19)	Article (20)	Sampled From (21)	Wash/Dry (22)
-------------	------------------	----------------	-------------------	----------------	------------	--------------	-------------------	---------------

CA	75 (3) or 63 (1/4)	63 (2.5) 25 (1)	45 (1.75) 9.5 (3/8)	37.5 (1.5) 4.75 (4)	25 (1) 2.36 (8)	16 (5/8) 1.18 (16)	12.5 (1/2) 0.6 (30)	9.5 (3/8) 0.425 (40)	4.75 (4) 0.3 (50)	2.36 (8) 0.15 (80)	1.18 (16) 0.075 (200)	0.3 (50) 0.15 (100)	0.075 (200) 0.075 (200)
----	-----------------------	--------------------	------------------------	------------------------	--------------------	-----------------------	------------------------	-------------------------	----------------------	-----------------------	--------------------------	------------------------	----------------------------

Wash - #200 (24) _____ PI Ratio (25) _____ Test Results (26) _____ Remarks (27) _____

Sieve	CA	FA	Indiv. Wt. Retained (28)	Cumul. Wt. Retained (29)	Cumul. % Retained (30)	Percent % Passing (31)	Spec. Range % Passing (32)
63 (2.5)							
50 (2)		25 (1)					
45 (1.75)		9.5 (3/8)					
37.5 (1.5)		4.75 (#4)					
25 (1)		2.36 (#8)					
19 (3/4)		2 (#10)					
16 (5/8)		1.18 (#16)					
12.5 (1/2)		0.6 (#30)					
9.5 (3/8)		0.425 (#40)					
6.3 (1/4)							
4.75 (#4)		0.3 (#50)					
2.36 (#8)							
1.18 (#16)		0.18 (#80)					
0.6 (#30)							
0.425 (#40)							
0.3 (#50)		0.15 (#100)					
0.15 (#100)							
0.075 (#200)		0.075 (#200)					
Pan							
Total Dry Mass (33)							
Total Washed Mass (34)							
Diff. -0.075(-#200) (35)							
Max Gain/Loss =							
% Washed - #200 (36)							

Sampled From Codes			
BR	Barge	RD	Road
BE	Belt Stream	SI	Silo/Bin
CF	Cold Feed	SP	Stockpile
HB	Hot Bin	TD	Truck Dump
OB	On Belt (Stopped)	TK	Truck
PR	Production	WB	Weigh Belt
CR	Rail Car		

0.075
(37) 0.425

(Mix Plant Only)

Lot (38)
Bin (39)

Copies (40):

Tester (41)

Agency (42)

MISTIC INPUT
Date Entered (43)
Initials (44)

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BMPR MI504 (Rev. 11/20/12)

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Field / Lab Gradations

Inspector No. (2) _____ I.D. Number (1) _____
 Mix Plant No. (6) _____ Date Sampled (4) _____ Seq. No. (5) _____
 *Contract No. (8) _____ *Job No. (9) _____

Responsible Loc. (10) _____ Lab (11) _____ Lab Name (12) _____ Source Name (13) _____

Source (14)	Mat. Code # (15)	Type Test (16)	Orig. I.D. # (17)	Insp. Qty (18)	Spec. (19)	Article (20)	Sampled From (21)	Wash/Dry (22)
-------------	------------------	----------------	-------------------	----------------	------------	--------------	-------------------	---------------

CA	75 (3) or 6.3 (1/4)	63 (2.5)	50 (2) 25 (1)	45 (1.75) 9.5 (3/8)	37.5 (1.5) 4.75 (4)	25 (1) 2.36 (8)	19 (3/4) 2 (10)	16 (5/8) 1.18 (16)	12.5 (1/2) 0.6 (30)	9.5 (3/8) 0.425 (40)	4.75 (4) 0.3 (50)	2.36 (8) 0.15 (100)	0.3 (50) 0.15 (100)	0.75 (200) 0.75 (200)
----	------------------------	----------	------------------	------------------------	------------------------	--------------------	--------------------	-----------------------	------------------------	-------------------------	----------------------	------------------------	------------------------	--------------------------

Wash - #200 (24) _____ PI Ratio (25) _____ Test Results (26) _____ Remarks (27) _____

CA	Sieve	FA	Indiv. Wt. Retained (28)	Cumul. Wt. Retained (29)	Cumul. % Retained (30)	Percent % Passing (31)	Spec. Range % Passing (32)
63 (2.5)							
50 (2)	25 (1)						
45 (1.75)	9.5 (3/8)						
37.5 (1.5)	4.75 (#4)						
25 (1)	2.36 (#8)						
19 (3/4)	2 (#10)						
16 (5/8)	1.18 (#16)						
12.5 (1/2)	0.6 (#30)						
9.5 (3/8)	0.425 (#40)						
6.3 (1/4)							
4.75 (#4)	0.3 (#50)						
2.36 (#8)	0.18 (#80)						
0.6 (#30)							
0.425 (#40)							
0.3 (#50)	0.15 (#100)						
0.15 (#100)							
0.075 (#200)	0.075 (#200)						
Pan							
Total Dry Mass (33)							
Total Washed Mass (34)							
Diff. -0.075(-#200) (35)							
Max Gain/Loss =							
% Washed - #200 (36)							

Sampled From Codes			
BR	Barge	RD	Road
BE	Belt Stream	SI	Silo/Bin
CF	Cold Feed	SP	Stockpile
HB	Hot Bin	TD	Truck Dump
OB	On Belt (Stopped)	TK	Truck
PR	Production	WB	Weigh Belt
CR	Rail Car		

0.075
(37) 0.425

(Mix Plant Only)

Lot (38) _____
 Bin (39) _____

Copies (40): _____ Tester (41) _____
 _____ Agency (42) _____

MISTIC INPUT

Date Entered (43) _____
 Initials (44) _____

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BMPR MI504 (Rev. 11/20/12)

Is this a valid test? _____

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Field / Lab Gradations

Inspector No (2) (2) Inspector Name (3) (3) Date Sampled (4) (4) I.D. Number (1) (1)
 Mix Plant No. (6) (6) Mix Plant Name (7) (7) *Contract No. (8) (8) Seq. No. (5) (5) *Job No. (9) (9)
 Responsible Loc. (10) (10) Lab (11) (11) Lab Name (12) (12) Source Name (13) (13)

Source (14)	Mat. Code # (15)	Type Test (16)	Orig. I.D. # (17)	Insp. Qty (18)	Spec. (19)	Article (20)	Sampled From (21)	Wash/Dry (22)
(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)

CA	75 (3) or 63 (2.5)	50 (2)	45 (1.75)	37.5 (1.5)	25 (1)	19 (3/4)	16 (5/8)	12.5 (1/2)	9.5 (3/8)	4.75 (4)	2.36 (8)	1.18 (16)	0.6 (30)	0.3 (50)	0.15 (100)	0.075 (200)
FA	63 (1/4)	25 (1)	9.5 (3/8)	4.75 (4)	2.36 (8)	2 (10)	1.18 (16)	0.6 (30)	0.425 (40)	0.3 (50)		0.18 (80)		0.15 (100)		0.075 (200)

Wash - #200 (24) (24) PI Ratio (25) (25) Test Results (26) (26) Remarks (27) (27)

Sieve	CA	FA	Indiv. Wt. Retained (28)	Cumul. Wt. Retained (29)	Cumul. % Retained (30)	Percent % Passing (31)	Spec. Range % Passing (32)
63 (2.5)			(28)	(29)	(30)	(31)	(32)
50 (2)		25 (1)					
45 (1.75)		9.5 (3/8)					
37.5 (1.5)		4.75 (#4)					
25 (1)		2.36 (#8)					
19 (3/4)		2 (#10)					
16 (5/8)		1.18 (#16)					
12.5 (1/2)		0.6 (#30)					
9.5 (3/8)		0.425 (#40)					
6.3 (1/4)							
4.75 (#4)		0.3 (#50)					
2.36 (#8)							
1.18 (#16)		0.18 (#80)					
0.6 (#30)							
0.425 (#40)							
0.3 (#50)		0.15 (#100)					
0.15 (#100)							
0.075 (#200)		0.075 (#200)					
Pan							
Total Dry Mass (33)		(33)					
Total Washed Mass (34)		(34)					
Diff. -0.075(-#200)(35)		(35)					
Max Gain/Loss =							
% Washed - #200 (36)							(36)

Sampled From Codes	
BR Barge	RD Road
BE Belt Stream	SI Silo/Bin
CF Cold Feed	SP Stockpile
HB Hot Bin	TD Truck Dump
OB On Belt (Stopped)	TK Truck
PR Production	WB Weigh Belt
CR Rail Car	

0.075
(37) 0.425

(Mix Plant Only)

Lot (38)

Bin (39)

Copies (40): (40) Tester (41) (41)

Agency (42) (42)

MISTIC INPUT

Date Entered (43) (43)

Initials (44) (44)

/FOR DTY03504

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FIELD/LAB GRADATIONS

MI 504M

(Revised 11/20/12)

1. **I.D. NUMBER:** MISTIC test identification number. Leave blank, because the MISTIC system will generate the test identification number.
2. **INSPECTOR NO.:** Identify the individual who took the sample. For split samples, the same inspector number should be used for both halves of the sample.
 - a) IDOT personnel should enter their MISTIC inspector number.
 - b) Contractor, Subcontractor, Producer, should use a “9”, the District number, and seven zeroes (0’s).
Example: (960000000) for District 6.
 - c) Consultant personnel enter their company’s MISTIC inspector number.
 - d) Local agency personnel are to enter a “9”; followed by the District number, which is repeated until field is filled.
Example: (966666666) for District 6 local agency.
3. **INSPECTOR NAME:** Enter the name of the inspector who took the sample.
4. **DATE SAMPLED:** Enter the date the sample was taken as month, day, and year in mmddyy format. Example: (103112)
5. **SEQ. NO.:** Sequence number. May be any combination of letters and/or numbers up to 6 characters in length. It is used to differentiate multiple samples of the same gradation, taken on the same day. For a split sample, both halves of the split shall have “**SPLIT**” in this field.
6. **MIX PLANT NO.:** The MISTIC code number for the P.C. Concrete or Hot Mix Asphalt Producer. Only one plant may be shown on one report.
7. **MIX PLANT NAME:** Name of mix plant.
8. **CONTRACT NO.:** Leave blank unless the gradation has been sampled at a jobsite for a specific contract. Enter the 5 digit contract number. If it is a local agency contract without a 5 digit number, then enter the 16 or 17 character MFT (Motor Fuel Tax) contract number.
9. **JOB NO.:** Leave blank unless gradation sampled at the jobsite for a specific contract. Enter the 8 character number that corresponds with the 5 digit contract number. If the contract number is not 5 digits, leave this field blank.
10. **RESPONSIBLE LOC.:** Enter the District identification number as a “9” followed by the District number. Example: 96 for District 6

11. LAB: Enter the 2 letter MISTIC lab code.

<u>Laboratory Locations</u>	<u>MISTIC Lab Codes</u>
Producer Plant Site Laboratory	PP
Producer Non-Plant Site Laboratory	PL
Producer Construction Site	PC
Producer Quarry Laboratory	PQ
Independent Plant Site Laboratory	IP
Independent Non-Plant Site Laboratory	IL
Independent Construction Site	IC
Independent Quarry Laboratory	IQ
Independent Laboratory	IN
IDOT/Local Agency Plant Site Laboratory	FP
IDOT/Local Agency Construction Site	FC
IDOT/Local Agency Quarry Laboratory	FQ
DISTRICT LABORATORY	DI
DISTRICT SATELLITE LABORATORY	DS

NOTE: A Contractor, Subcontractor, and Producer are to use one of the “Producer” lab codes. An IDOT Consultant, Contractor Consultant, Subcontractor Consultant, and Producer Consultant are to use one of the “Independent” lab codes.

12. LAB NAME: Enter the name of the company which cannot exceed 20 characters.**13. SOURCE NAME:** Enter the name of the aggregate producer.**14. SOURCE:** Enter the MISTIC code number of the aggregate producer.
Example: 50912-02**15. MAT. CODE NO.:** Material code for the aggregate product. Enter the 8 to 10 character code number of the material being tested.

The following information will help you determine if you have the correct material code number.

- The first space is a “0” to indicate the material is an aggregate.

- The second space indicates the **QUALITY LEVEL** of the aggregate. Concrete coarse and fine aggregates are always “A” quality. Cement aggregate mixture II coarse aggregate is “D” quality “stabilized”, and fine aggregate is “A” quality. Controlled low-strength material fine aggregate is “A” quality, unless alternate fine aggregate materials are used. Hot mix asphalt surface coarse and fine aggregates are generally “B” quality. Hot mix asphalt binder coarse aggregates are generally “C” quality and fine aggregates are “B” quality. (see below).
- The third space indicates the **Type of Material** (see below).
- The fourth space indicates the **Aggregate Type** (see below).
- The fifth space indicates the **SPECIFICATION** of the aggregate (see below).
- The sixth space is always a “M” to indicate **Metric**.
- The seventh and eighth spaces are the **Gradation Number** of the aggregate. See Articles 1003.01(c) and 1004.01(c) of the Standard Specifications.
- The ninth and tenth spaces indicate **superstructure quality aggregate** for concrete use. Always enter “01” if testing superstructure quality aggregate.

QUALITY LEVEL

0 & 1 Have No Quality
 2 = A Quality
 3 = B Quality
 4 = C Quality
 5 = D Quality
 6 = D Quality Stabilized

TYPE OF MATERIAL

0 = Gravel
 1 = Crushed Gravel
 2 = Crushed Stone
 3 = ACBF Slag
 7 = Natural Sand
 8 = Stone Sand
 9 = Special Aggregate

AGGREGATE TYPE

C = Coarse Aggregate
 F = Fine Aggregate

SPECIFICATION

A = Standard Specification
 M = Modified or QC/QA Specification

16. TYPE INSP: Type of inspection (see below). For additional information see Attachment 4 in the Project Procedures Guide.

<u>AGENCY</u>	<u>QC/QA</u>	<u>NON QC/QA</u>
Contractor/Producer/ Consultant	PRO	-----
IDOT/Consultant at Aggregate Source	IND (split), INV	PRO
IDOT/Consultant at Mix Plant	IND (split), INV	IND (split-share), INV

17. ORIG. I.D. #: Original identification number. Use for resample tests only. Enter the original MISTIC test identification number of the failing test.

18. INSP. QTY.: Inspected Quantity. Leave blank. IDOT personnel may enter the quantity that is represented by the gradation test but it is not required.

19. **SPEC.:** Specification. Leave blank. IDOT aggregate personnel should enter the master band ranges under a “PRE” test at the beginning of each production season.
Example: MB2036
20. **ARTICLE:** Leave blank. IDOT aggregate personnel should enter the warning band ranges under a “PRE” test at the beginning of each production season. Example: WB2234
21. **SAMPLED FROM:** Enter the 2 character designation in the first two spaces. Refer to “Sampled From Codes” box, which is on the form.
22. **WASH/DRY:** Enter if the test was a “W” for a washed gradation, or “D” for a dry gradation.
23. **GRADATION RESULTS INPUT TABLE:** Enter the percent passing test results, “percent % passing”, from the calculation table for all sieves. All test results shall be reported to the nearest 1%, except for the 0.075 mm (or 75µm)(-#200) sieve, which shall be reported to the nearest 0.1%.
24. **WASH - 0.075 (-#200):** Enter the washed minus .075 mm (#200) value from the calculation table to the nearest 0.1%.
25. **PI RATIO:** Plasticity index ratio. Leave blank. IDOT personnel, when appropriate, should enter the PI ratio value.
26. **TEST RESULTS:** Enter “APPR” for results meeting specifications or “FAIL” for failure to meet specifications. Show under “Remarks” action taken for samples not meeting specifications. For example, retest, checked equipment, test method incorrect, will monitor.
27. **REMARKS:** This space should be used to record any comments about the aggregates, or the stockpiling and handling methods used.

For “IND” inspection, a comparison remark is required, because the assurance test is from a split sample. For an acceptable comparison, enter the following:

- Enter “C” when tests compare within acceptable limits of precision.
- Enter date of comparison.
- Enter initials for “IND” inspector.
- If the sample was witnessed by the “IND” inspector, indicate as “ws”.
- Example: C - 100197 TCS ws.

For an unacceptable comparison, enter the following:

- Enter “X” when tests do not compare within acceptable limits of precision.
- Enter date of comparison.
- Enter initials for “IND” inspector.

- If the sample was witnessed by the “IND” inspector, indicate as “ws”.
- Explain reason for unacceptable comparison.
- Examples are: Contractor obtained sample incorrectly; IDOT equipment required repair; Contractor performed test method incorrectly; problem was not identified, will investigate further if problem continues.
- Example: X - 100297 TCS ws Contractor obtained sample incorrectly.

- 28. INDIV. WT. RETAINED:** Enter the weight of aggregate on each sieve individually, starting with the largest sieve first. Weigh coarse aggregate to the nearest 1 gram, and fine aggregate to the nearest 0.1 gram. If the **sieve was overloaded** and split into two or more portions to hand sieve, then write a “S” outside the table on that row (right or left side).
- 29. CUMUL. WT. RETAINED:** Cumulative Weight Retained. Add the weight on each sieve, to the weight on any larger sieve(s), and enter that value.
- 30. CUMUL. % RETAINED:** Cumulative Percent Retained. Divide the cumulative weight retained by the total dry weight, and multiply by 100, for each sieve. Round to the nearest 0.1%, and enter that value.
- 31. PERCENT % PASSING:** Subtract the cumulative percent retained, from 100, for each sieve. Record to nearest 0.1%, and enter that value
- 32. SPEC. RANGE % PASSING:** Enter the specification range for all appropriate sieves. These may be Standard Specifications, or modified Standard Specification, or master band limits.
- 33. TOTAL DRY MASS:** Enter the weight of the sample after it has been dried to a constant weight. Weigh coarse aggregate to the nearest 1 gram, and fine aggregate to the nearest 0.1 gram.
- 34. TOTAL WASHED MASS:** Enter the weight of the sample after it has been washed, and dried back to a constant weight. Weigh coarse aggregate to the nearest 1 gram, and fine aggregate to the nearest 0.1 gram.
- 35. DIFF. -0.075 (-200):** Subtract total washed weight from the total dry weight, and enter that value.
- 36. % WASHED -0.075:** Divide the “Diff. - 0.075” by the “Total Dry Wt.” and multiply by 100. Round to the nearest 0.1%, and enter that value.
- 37. 0.075 / 4.25:** Leave blank. IDOT personnel, when appropriate, enter the ratio of the percent passing the .075 mm (#200) sieve and the .425 mm (#40) sieve.
- 38. LOT:** Leave blank. IDOT mix plant personnel use if performing individual hot bin “IND” tests. Enter the lot corresponding to the Daily Plant Output (MI 305). Also, enter this in the remarks.

39. **BIN:** Leave blank. IDOT mix plant personnel use if performing individual hot bin “IND” tests. Enter the appropriate hot bin number. Also, enter this in remarks.
40. **COPIES:** Enter the distribution of this report. The normal distribution for mix plant results is the **original** goes to the District Engineer, a copy goes to the Resident Engineer(s), and a copy goes to the QC Manager(s). The distribution for aggregate source tests is the original goes to the District Engineer and a copy goes to the source’s QC manager. Non-QC/QA – Same as above, except that the file copy stays with the tester or the individual who completed the report.
41. **TESTER:** Print the name of the individual who tested the aggregate. The individual’s signature is also required. If the test is run by a Gradation Technician, then the supervisor should sign here also.
42. **AGENCY:** Enter the tester’s employer.
43. **DATE ENTERED:** Leave blank. IDOT will enter the date the results are entered into MISTIC as month, day and year in mmddyy format.
44. **INITIALS:** Leave blank. IDOT will enter initials of the person entering the test results into MISTIC.

CHAPTER 6 – HOMEWORK

READ ALL OF THE FOLLOWING INSTRUCTIONS ON PAGES HM-1 AND HM-2, BEFORE COMPLETING THE HOMEWORK. THE INSTRUCTIONS ARE FOR THE CALCULATIONS HOMEWORK PROBLEMS 1 THRU 6, WHICH ARE LOCATED ON PAGES HM-3 TO HM-13.

Problem No. 1

- Calculate the Percent Passing.
- Show all weights and percents calculated.
- Report Percent % Passing on the Report line.
- Calculate Max Loss.

Problem No. 2

- Calculate the Percent Passing.
- Show all weights and percents calculated.
- Report Percent % Passing on the Report line.
- Calculate the % Washed -200.
- Calculate Max Loss.

Problem No. 3

- Calculate the Percent Passing.
- Show all weights and percents calculated.
- Report Percent % Passing on the Report line.
- Calculate the % Washed -200.
- Calculate Max Loss.

OVER – (HOMEWORK CONTINUED)

CHAPTER 6 – HOMEWORK (Cont'd)

Problem No. 4

- Calculate the percent passing
- Show all weights and percents calculated.
- Report Percent % Passing on the Report line.
- Calculate the % Washed -200.
- Calculate Max Loss.
- Use given information below and complete as much of the form as possible.
(Directions for filling out the form are located in Chapter 6 on pages 6-27 thru 6-32.)

GIVEN: Jadyn McCall is the Quality Control Manager for Mack Construction Company (956-03). Jadyn took a sample of 022CM16 from a stockpile located at Mack Construction's asphalt plant site on August 3, 2021. Parker Jones, a Mixture Aggregate Technician, who also works for Mack Construction, ran a washed gradation (Seq. No. 009) on this material the same day. The testing took place on site in the Mack Construction's laboratory. The stone came from DeLuca Materials. (50634-02). Mack Construction's plant and laboratory is located in District 8.

Problem No. 5

- Calculate the Percent Passing.
- Show all weights and percents calculated.
- Report Percent % Passing on the Report line.
- Calculate the % Washed -200.
- Calculate Max Loss.

Problem 6 - Sample Comparison Problem

- Transfer the producer % passing from each sieve to this worksheet. (from Problem No. 5)
- Calculate the monitor's and producer's fraction, fraction difference, and write in the applicable tolerance.
- Specify the proper disposition (ok or out)



**Illinois Department
of Transportation**

HOMEWORK - PROBLEM 1

Field / Lab Gradations

I.D. Number

Inspector No. _____ Inspector Name _____ Date Sampled _____ Seq. No. _____

Mix Plant No.	Mix Plant Name	*Contract No.	*Job No.
---------------	----------------	---------------	----------

Responsible Loc.	Lab Name	Source Name
------------------	----------	-------------

[illegible]

Wash - #200	PI Ratio	Test Results	Remarks
-------------	----------	--------------	---------

Sieve		Indiv. Wt. Retained	Cumul. Wt. Retained	Cumul. % Retained	Percent % Passing	Spec. Range % Passing
CA	FA					
63 (2.5)						
50 (2)	25 (1)					
45 (1.75)	9.5 (3/8)					
37.5 (1.5)	4.75 (#4)					
25 (1)	2.36 (#8)	0				100
19 (3/4)	2 (#10)	570				80-96
16 (5/8)	1.18 (#16)	1001				
12.5 (1/2)	0.6 (#30)	1508				34-50
9.5 (3/8)	0.425 (#40)	1305				
6.3 (1/4)		916				
4.75 (#4)	0.3 (#50)	243				0-12
2.36 (#8)						
1.18 (#16)	0.18 (#80)	227				0-8
0.6 (#30)		15				
0.425 (#40)						
0.3 (#50)	0.15 (#100)					
0.15 (#100)						
0.075 (#200)	0.075 (#200)	33				0-2.5
Pan		21				
Total Dry Mass		5842	Max Gain/Loss = _____			
Total Washed Mass						
Diff. -0.075(- #200)			% Washed - #200 _____			

Sampled From Codes		
BR	Barge	RD Road
BE	Belt Stream	SI Silo/Bin
CF	Cold Feed	SP Stockpile
HB	Hot Bin	TD Truck Dump
OB	On Belt (Stopped)	TK Truck
PR	Production	WB Weigh Belt
CR	Rail Car	

$$\frac{0.075}{0.425}$$

(Mix Plant Only)

Lot	Bin

Copies:

Tester

Tester

Agency

Agency

MISTIC INPUT

Date Entered

Initials

/FOR DTY03504

MI 504M (Rev. 11/20/12)

Is this a valid test? _____

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HOMEWORK - PROBLEM 2

Field / Lab Gradations

Inspector No. _____	Inspector Name <table border="1" style="display: inline-table; width: 150px; height: 20px;"></table>	Date Sampled _____	Seq. No. _____	I.D. Number <table border="1" style="display: inline-table; width: 150px; height: 20px;"></table>
Mix Plant No. _____	Mix Plant Name <table border="1" style="display: inline-table; width: 150px; height: 20px;"></table>	*Contract No. _____	*Job No. _____	
Responsible Loc. _____	Lab. _____	Lab Name _____	Source Name <table border="1" style="display: inline-table; width: 150px; height: 20px;"></table>	

[illegible]

Wash - #200	PI Ratio	Test Results	Remarks
-------------	----------	--------------	---------

Sieve		Indiv. Wt. Retained	Cumul. Wt. Retained	Cumul. % Retained	Percent % Passing	Spec. Range % Passing
CA	FA					
63 (2.5)						
50 (2)	25 (1)					
45 (1.75)	9.5 (3/8)	0.0				100
37.5 (1.5)	4.75 (#4)					
25 (1)	2.36 (#8)	131.2				67-97
19 (3/4)	2 (#10)					
16 (5/8)	1.18 (#16)	237.4				36-66
12.5 (1/2)	0.6 (#30)	133.6				20-46
9.5 (3/8)	0.425 (#40)					
6.3 (1/4)						
4.75 (#4)	0.3 (#50)	101.9				7-29
2.36 (#8)						
1.18 (#16)	0.18 (#80)					
0.6 (#30)						
0.425 (#40)						
0.3 (#50)	0.15 (#100)	74.5				2-16
0.15 (#100)						
0.075 (#200)	0.075 (#200)	52.1				0-8
Pan						
Total Dry Mass		760.2	Max Gain/Loss = _____			
Total Washed Mass		734.9				
/Diff. -0.075(- #200)			<div> <div>% Washed - #200</div> <div></div> </div>			

Sampled From Codes		
BR	Barge	RD Road
BE	Belt Stream	SI Silo/Bin
CF	Cold Feed	SP Stockpile
HB	Hot Bin	TD Truck Dump
OB	On Belt (Stopped)	TK Truck
PR	Production	WB Weigh Belt
CR	Rail Car	

0.075	
0.425	

(Mix Plant Only)	
Lot	_____
Bin	_____

Copies:

Tester

Agency

MISTIC INPUT
Date Entered _____
Initials _____
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MI 504M (Rev. 11/20/12)

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Illinois Department
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HOMEWORK - PROBLEM 3

Field / Lab Gradations

Inspector No. _____ Inspector Name _____ I.D. Number _____
 Mix Plant No. _____ Mix Plant Name _____ Date Sampled _____ Seq. No. _____
 Responsible Loc. _____ Lab. _____ *Contract No. _____ *Job No. _____
 Source Name _____

Source	Mat. Code #	Type Insp.	Orig I.D. #	Insp. Qty.	Spec.	Article	Sampled From	Wash/Dry
	027FM02							W
CA 75 (3) or 6.3 (1/4)	50 (2)	37.5 (1.5)	19 (3/4)	12.5 (1/2)	9.5 (3/8)	2.36 (8)	0.6 (30)	0.15 (100)
FA 6.3 (1/4)	25 (1)	4.75 (4)	2 (10)	0.6 (30)	0.425 (40)	0.3 (50)	0.18 (80)	0.15 (100)

Wash - #200 PI Ratio _____ Test Results _____ Remarks _____

CA	Sieve	FA	Indiv. Wt. Retained	Cumul. Wt. Retained	Cumul. % Retained	Percent % Passing	Spec. Range % Passing
63 (2.5)							
50 (2)		25 (1)					
45 (1.75)		9.5 (3/8)	0.0				100
37.5 (1.5)		4.75 (#4)	31.0				94-100
25 (1)		2.36 (#8)	95.8				70-100
19 (3/4)		2 (#10)					
16 (5/8)		1.18 (#16)	104.6				45-85
12.5 (1/2)		0.6 (#30)	156.7				41-67
9.5 (3/8)		0.425 (#40)					
6.3 (1/4)							
4.75 (#4)		0.3 (#50)	294.5				
2.36 (#8)							
1.18 (#16)		0.18 (#80)					
0.6 (#30)							
0.425 (#40)							
0.3 (#50)		0.15 (#100)	119.0				0-10
0.15 (#100)							
0.075 (#200)		0.075 (#200)	7.6				0-6
Pan			0.4				
Total Dry Mass			823.4				
Total Washed Mass			811.1				
Diff. -0.075(- #200)							
			Max Gain/Loss =				
			% Washed - #200				

Sampled From Codes	
BR Barge	RD Road
BE Belt Stream	SI Silo/Bin
CF Cold Feed	SP Stockpile
HB Hot Bin	TD Truck Dump
OB On Belt (Stopped)	TK Truck
PR Production	WB Weigh Belt
CR Rail Car	

0.075
0.425 (Mix Plant Only)

Lot _____
Bin _____

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 _____ Agency _____

MISTIC INPUT
 Date Entered _____
 Initials _____
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Field / Lab Gradations

Source	Mat. Code #	Type Insp.	Orig I.D. #	Insp. Qty.	Spec.	Article	Sampled From	Wash/Dry
CA 75 (3) or 6.3 (1/4)	50 (2) 25 (1)	37.5 (1.5) 4.75 (4)	19 (3/4) 2 (10)	12.5 (1/2) 0.6 (30)	9.5 (3/8) 0.425 (40)	4.75 (4) 0.3 (50)	0.6 (30) 0.18 (80) 0.3 (50) 0.15 (100)	.075 (200) .075 (200)

Remarks

Sampled From Codes		
BR	Barge	RD Road
BE	Belt Stream	SI Silo/Bin
CF	Cold Feed	SP Stockpile
HB	Hot Bin	TD Truck Dump
OB	On Belt (Stopped)	TK Truck
PR	Production	WB Weigh Belt
CR	Rail Car	

(Mix Plant Only)

MISTIC INPUT

Date Entered _____

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Illinois Department
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HOMEWORK - PROBLEM 5

Field / Lab Gradations

Inspector No. _____ Inspector Name _____ I.D. Number _____
 Mix Plant No. _____ Mix Plant Name _____ Date Sampled _____ Seq. No. _____
 Responsible Loc. _____ Lab. _____ Lab Name _____ *Contract No. _____ *Job No. _____
 Source Name _____

Source	Mat. Code #	Type Insp.	Orig I.D. #	Insp. Qty.	Spec.	Article	Sampled From	Wash/Dry
	022CM16							W
CA 75 (3) or 6.3 (1/4)	50 (2)	37.5 (1.5)	19 (3/4)	12.5 (1/2)	9.5 (3/8)	2.36 (8)	0.6 (30)	0.15 (100)
	25 (1)	4.75 (4)	2 (10)	0.6 (30)	0.425 (40)	0.3 (50)	0.18 (80)	0.3 (50)
								0.15 (100)
	</							

Wash - #200 PI Ratio _____ Test Results _____ Remarks _____

CA	Sieve	FA	Indiv. Wt. Retained	Cumul. Wt. Retained	Cumul. % Retained	Percent % Passing	Spec. Range % Passing
63 (2.5)							
50 (2)	25 (1)						
45 (1.75)	9.5 (3/8)						
37.5 (1.5)	4.75 (#4)						
25 (1)	2.36 (#8)						
19 (3/4)	2 (#10)						
16 (5/8)	1.18 (#16)						
12.5 (1/2)	0.6 (#30)	0				100	
9.5 (3/8)	0.425 (#40)	89				94-100	
6.3 (1/4)		460					
4.75 (#4)	0.3 (#50)	920				34-48	
2.36 (#8)		737					
1.18 (#16)	0.18 (#80)	80				0-8	
0.6 (#30)							
0.425 (#40)							
0.3 (#50)	0.15 (#100)						
0.15 (#100)							
0.075 (#200)	0.075 (#200)	36				0-2.5	
Pan		2					
Total Dry Mass		2380					
Total Washed Mass		2322					
Diff. -0.075(- #200)							

Max Gain/Loss = _____

% Washed - #200 _____

Sampled From Codes	
BR Barge	RD Road
BE Belt Stream	SI Silo/Bin
CF Cold Feed	SP Stockpile
HB Hot Bin	TD Truck Dump
OB On Belt (Stopped)	TK Truck
PR Production	WB Weigh Belt
CR Rail Car	

(Mix Plant Only)
 0.075 _____
 0.425 _____

Lot _____
 Bin _____

Copies: _____
 Tester _____
 Agency _____

MISTIC INPUT
 Date Entered _____
 Initials _____
 /FOR DTY03504
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HOMEWORK PROBLEM 6

SAMPLE COMPARISON DATA

If the comparison has no out-of-tolerance fractions, both sample results are considered valid. If an out-of-tolerance situation has been identified, both the producer certified technician and the State inspector shall immediately investigate the splitting procedure, test equipment, test method, and calculations for possible equipment failure or procedure errors. The State Monitor Sample shall always take precedence unless shown to be invalid during investigation.

022CM16	1/2" (12.5 mm)	3/8" (9.5 mm)	1/4" (6.3 mm)	#4 (4.75 mm)	#8 (2.36 mm)	#16 (1.18 mm)	#200 (75 µm)
Monitor, % Passing	100	97	73	33	10	5	2.0
Producer, % Passing							

Comparison Data

Consecutive Sieve Sizes	Monitor Fraction	Producer Fraction	Fraction Difference	Applicable Tolerance	Disposition
1/2" and 3/8" (12.5 mm and 9.5 mm)					
3/8" and 1/4" (9.5 mm and 6.3 mm)					
1/4" and #4 (6.3 mm and 4.75 mm)					
#4 and #8 (4.75 mm and 2.36 mm)					
#8 and #16 (2.36 mm and 1.18mm)					
#16 and #200 (1.18 mm and 75 µm)					
#200 and Pan (75 µm and Pan)					

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MTP = Manual of Test Procedures for Materials

IDOT = Illinois Department of Transportation

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Illinois Specification 201
Illinois Department of Transportation (IDOT)
AGGREGATE GRADATION SAMPLE SIZE TABLE & QUALITY CONTROL SIEVES
Effective: December 1, 2021

COARSE AGGREGATE GRADATION TABLE																				
CA(CM) ^{1, 2}	Minimum Field Sample Size ³	Minimum Test Sample Size ³	3"	2 1/2"	2"	1 3/4"	1 1/2"	1"	3/4"	5/8"	1/2"	3/8"	1/4"	#4	#8	#16	#40	#50	#200	
CA01	110 lbs (50 kg)	10,000 g	X	X ^{MN}	X			X	X										X	
CA02	110 lbs (50 kg)	10,000 g		X	X ^{MN}			XC	X	XC		X		X		X	X		X	
CA03	110 lbs (50 kg)	10,000 g		X	X ^{MN}			X	X		X								X	
CA04	110 lbs (50 kg)	10,000 g			X			X ^{MN}	X	XC		X	XC		X		X	X	X	
CA05 ⁵	110 lbs (50 kg)	10,000 g				X		X ^{MN}	X ^{MB,6}	XC		X			X ⁶				X	
CA06	55 lbs (25 kg)	5,000 g						X	X ^{MN}	XC		X	XC		X		X	X	X	
CA07 ⁵	55 lbs (25 kg)	5,000 g						X	X ^{MN}	XC	XC	X ^{MB,6}	XC	XC	X ⁶				X	
CA08	55 lbs (25 kg)	5,000 g						X	X ^{MN}	X	XC	X	XC	XC	X		X		X	
CA09	55 lbs (25 kg)	5,000 g						X	X ^{MN}	XC	XC	X	XC	XC	X		X		X	
CA10	55 lbs (25 kg)	5,000 g						X	X ^{MN}	XC	X	XC	XC	X		X	X		X	
CA11 ⁵	55 lbs (25 kg)	5,000 g						X	X ^{MN}	XC	X ^{MB,6}	XC	XC	X		X ⁶			X	
CA12	35 lbs (16 kg)	2,000 g							X		X ^{MN}	X	XC	X	XC	X	X		X	
CA13 ⁵	35 lbs (16 kg)	2,000 g							X		X ^{MN}	X	XC	X ^{MB,6}	XC	X ⁶			X	
CA14 ⁵	35 lbs (16 kg)	2,000 g								X	X ^{MN}	X ^{MB,6}	XC	X ⁶					X	
CA15	35 lbs (16 kg)	2,000 g									X	X ^{MN}	XC	X	XC	X			X	
CA16 ⁵	25 lbs (11 kg)	1,500 g									X	X ^{MN}	XC	X ^{MB,6}	XC	X ⁶			X	
CA17	35 lbs (16 kg) ⁴	4,000 g ⁴	X		XC			XC			XC	XC		X ^{MN, 4}		X		X	X	
CA18	35 lbs (16 kg) ⁴	4,000 g ⁴	X					X ^{MN, 4}			XC	XC		X		X		X	X	
CA19	35 lbs (16 kg) ⁴	4,000 g ⁴	X					X ^{MN, 4}			XC	XC		X		X	X	X	X	
CA20	25 lbs (11 kg)	2,000 g									X	X ^{MN}	XC	X	X	X			X	

Note: See footnotes below Fine Aggregate Gradation Table for explanation of symbols

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FINE AGGREGATE GRADATION TABLE															
FA(FM) ^{1, 2}	Minimum Field Sample Size ³	Minimum Test Sample Size ³	1"	1/2"	3/8"	#4	#8	#10	#16	#30	#40	#50	#80	#100	#200
FA01	25 lbs (11 kg)	500 g			X	X ^{MN}	X ^{MB}		X	X ^{MB}		X		X	X
FA02	25 lbs (11 kg)	500 g			X	X ^{MN}	X ^{MB}		X	X ^{MB}		X		X	X
FA03	25 lbs (11 kg)	500 g			X	X ^{MN}		X			X		X		X
FA04	25 lbs (11 kg)	500 g			X				X ^{MN}						
FA05	25 lbs (11 kg)	500 g			X	X ^{MN}								X	X
FA06	25 lbs (11 kg)	500 g	X	X	X	X ^{MN}								X	X
FA07	25 lbs (11 kg)	100 g				X		X ^{MN}			X		X		X
FA08	25 lbs (11 kg)	100 g					X				X ^{MN}			X	X
FA09	25 lbs (11 kg)	100 g					X					X ^{MN}		X	X
FA10	25 lbs (11 kg)	100 g						X			X ^{MN}		X		X
FA20 ⁵	25 lbs (11 kg)	500 g			X	X ^{MN}	X ^{MB}		X	X ^{MB, 6}		X		X	X ⁶
FA21 ⁵	25 lbs (11 kg)	500 g			X	X ^{MN}	X ^{MB}		X	X ^{MB, 6}		X		X	X ⁶
FA22 ⁵	25 lbs (11 kg)	500 g			X	X ^{MB}	X ^{MB, 6}		X						X ⁶
FA23 ⁵	25 lbs (11 kg)	500 g			X	X ^{MN}	X ^{MB}		X	X ^{MB, 6}		X		X	X ⁶
FA24 ⁵	25 lbs (11 kg)	500 g			X	X ^{MN}	X ^{MB}		X	X ^{MB, 6}		X		X	X ⁶

Notes below apply to Fine and Coarse Aggregate Gradation Tables Only

X = Required Gradation Specification Sieves

XC = Required Cutter Sieves

MB = Master Band Sieves for Category I Coarse Aggregate for PCC and HMA Mixes; Bituminous use only for fine aggregate.

MN = Maximum Nominal Sieve for Crushed Gravels – Maximum Nominal Size is defined as the first specification sieve in the product gradation on which material may be retained.

1 = CA = Coarse Aggregate; **CM** = Coarse Aggregate, Modified; **FA** = Fine Aggregate; **FM** = Fine Aggregate, Modified

2 = CM and FM gradations shall be sampled and tested the same as the corresponding CA and FA gradations.

3 = Slag should be adjusted accordingly due to its lighter or heavier mass.

4 = Will vary with the gradation of the material being used

5 = Control Charts Required

6 = Required Sieve for Control Charts

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LARGE SIZED AGGREGATE GRADATION TABLE										
CS/RR ^{1,2}	Minimum Test Sample Size ³	8"	6"	4"	3"	2"	1 ½"	1"	½"	#4
CS01	<u>50,000 g</u>	X	X	X	XC	X		XC	XC	X
CS02	<u>50,000 g</u>		X	X	XC	X		XC	XC	X
RR01	<u>20,000 g</u>				X	XC	X	XC	XC	X
RR02	<u>20,000 g</u>			X	XC	X	XC	XC	XC	X

Notes below apply to Large Sized Aggregate Gradation Table Only

X = Required Gradation Specification Sieves

XC = Required Cutter Sieves

1 = CS = Coarse Aggregate Subgrade; RR/RRM = Rip Rap

2 = Dry Gradations Only

3 = Slag should be adjusted accordingly due to its lighter or heavier mass.

4 = A round nosed shovel may be used for sampling

5 = Metal plates with precisely sized square holes may be used for the gradation

6 = Test sample size shall be taken in the field. No splitting is required.

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ILLINOIS TEST PROCEDURE 2

SAMPLING OF AGGREGATES

Effective Date: April 1, 2012

Revised Date: December 1, 2017

1 SCOPE

1.1 This procedure covers sampling of coarse and fine aggregates for the following purposes.

1.1.1 Preliminary investigation of the potential source of supply.

1.1.2 Control of the product at the source of supply.

1.1.3 Control of the operations at the site of use.

1.1.4 Acceptance or rejection of the materials.

Note 1 – Sampling plans and acceptance and control tests vary with the type of construction in which the material is used.

1.2 The text of this standard references notes which provide explanatory material. These notes (excluding those in tables and figures) shall not be considered as requirements of the procedure.

1.3 The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in non-conformance with the procedure.

1.4 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this procedure to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

Note 2 – The quality of the results produced by this procedure are dependent on the competence of the personnel performing the procedure and the capability, calibration, and maintenance of the equipment used.

2 REFERENCED DOCUMENTS

2.1 Illinois Specification:

- Illinois Specification 201 Aggregate Gradation Sample Size Table

ILLINOIS TEST PROCEDURE 2

SAMPLING OF AGGREGATES

Effective Date: April 1, 2012

Revised Date: December 1, 2017

3 TERMINOLOGY

3.1 *Definitions:*

- 3.1.1 *Maximum size of aggregate, n* —in specifications for, or descriptions of aggregate—the smallest sieve opening through which the entire amount of aggregate is required to pass.
- 3.1.2 *Maximum aggregate size, (Superpave) n* —in specifications for, or descriptions of aggregate—one size larger than the nominal maximum aggregate size.
- 3.1.3 *Nominal maximum aggregate size (of aggregate), n* —in specifications for, or descriptions of aggregate—smallest sieve opening through which the entire amount of the aggregate is permitted to pass.
- 3.1.4 *Nominal maximum aggregate size (Superpave), n* —in specifications for, or descriptions of aggregate—one size larger than the first sieve that retains more than 10% aggregate.
- 3.1.4.1 *Discussion* – These definitions in 3.1.2 and 3.1.4 apply to hot mix asphalt (HMA) mixtures designed using the Superpave system only.
- 3.1.4.2 *Discussion* – Specifications on aggregates usually stipulate a sieve opening through which all the aggregate may, but need not, pass so that a slated maximum portion of the aggregate may be retained on that sieve. A sieve opening so designated is the nominal maximum size.

4 SIGNIFICANCE AND USE

- 4.1 Sampling is equally as important as the testing, and the sampler shall use every precaution to obtain samples that will show the nature and condition of the materials which they represent.

5 APPARATUS

- 5.1 *Template* – The template shall be designed with two end plates and shall be adjustable. The distance between the end plates may therefore be changed to gather more material from the belt for each increment. The end plates shall also be machined or cut to the approximate belt size and shape.

A single template end plate may be used in the sampling procedure, if care is exercised.

- 5.2 *Sampling Device* – The sample device used to cut the flow stream from the end of the belt or the bin discharge must be strong enough to handle the force of the flow stream. The device must also be large and deep enough to cut the entire flow stream

ILLINOIS TEST PROCEDURE 2

SAMPLING OF AGGREGATES

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and not overflow when passing through the stream. The device may be a bucket, a pan, or a manufactured sampling container.

Shelby tubes are not allowed as sampling devices.

- 5.3 *Shovel* – The shovel shall be square-nosed and of a size easily handled. It shall also have built-up sides and back (approximately 1 ½" [37.5mm]) to facilitate the retention of material on the shovel when sampling.

6 SECURING SAMPLES

- 6.1 *General* – Samples to be tested for quality shall be obtained from the finished product. Samples from the finished product to be tested for abrasion loss shall not be subject to further crushing or manual reduction in particle size in preparation for the abrasion test unless the size of the finished product is such that it requires further reduction for the testing purposes.

- 6.2 *Inspection* – The material shall be inspected to determine discernible variations. The seller shall provide suitable equipment needed for proper inspection and sampling.

- 6.3 *Sampling Procedure* – Aggregate production sampling shall be accomplished by one of the following procedures:
1. belt-stream sampling
 2. bin-discharge sampling (requires IDOT approval)
 3. on-belt sampling
 4. truck-dump or stockpile sampling

No other sampling procedures will be permitted.

- 6.3.1 *Sampling from Belt-Stream Discharge or from Bins:*

Belt-Stream Sampling – The sample shall be taken by cutting the stream of aggregate as it leaves the end of the production belt. A sampling device is passed uniformly through the entire width and depth stream flow during normal production and belt load. Each sampling pass (increment) is combined with others to make up the field sample. A minimum of three increments shall be taken during a 10 to 15 minute sampling period. Enough increments shall be taken and combined to provide the correct field sample size.

Extreme care shall be taken to make sure the sampling device passes completely and uniformly through the entire stream flow (from outside the stream on one side to outside the stream on the other side) and to ensure the device does not overflow.

Bin Sampling – Bin discharge shall be sampled in a manner similar to belt-stream sampling. A sampling device is passed through the entire bin discharge stream. A

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minimum of three increments shall be taken during a 10 to 15 minute sampling period and combined to form the field sample.

Before cutting the bin discharge stream, the bin must be emptied until such time that the stream of material entering the bin is the stream of material exiting the bin. Sampling may take place at that time.

Extreme care shall be taken to make sure the sampling device passes completely and uniformly through the entire stream flow (from outside the stream on one side to outside the stream on the other side) and to ensure the device does not overflow.

Samples shall be taken only during normal plant operation and when the bin is being fed under normal load.

The major problems associated with bin-discharge sampling involve segregated material clinging to the sides of the bin. This material can and does break loose which alters the gradation of the bin-discharge stream. The sampling procedure shall therefore be used only when approved by the District Engineer.

- 6.3.2 *On-Belt Sampling* – The sample shall be taken by stopping the belt containing the finished product. A template shall be inserted into the material on the belt. All the material between the template shall be removed and shall represent one of the three increments (minimum) making up the field sample. Extreme care shall be taken, including the use of a brush, to remove all fines on the belt between the template for inclusion in the increment. The belt shall be stopped at least three times (three increments) during approximately 10 to 15 minutes of operation to obtain a field sample. If additional material is needed beyond three increments due to the amount of material on the belt, additional template cuts may be taken during the three belt stoppages. Automatic samplers may be used as long as the gradations compare to samples taken with the sample template. Contact the Central Bureau of Materials for further guidance.

Samples shall be taken only during normal plant operation and when the belt is under normal load.

- 6.3.3 *Sampling from Truck-Dumps or from Stockpiles* – Sampling from inside of transportation units is not permitted. The transportation unit shall be off-loaded and sampled by any of the sampling procedures listed, herein.

Truck-Dump Sampling – The sample shall be taken by placing one or two truck dumps together. This may occur during the building of a stockpile or feeding of a plant. The truck dump(s) shall be cut with an end loader and two or more bucket loads extracted. The bucket loads shall be dumped on one another to form a small pile. The small pile shall then be mixed from two directions perpendicular to each other. To mix the pile, the end loader shall cut into the pile along its base until approximately its midpoint. The loader bucket shall be lifted, the loader moved 1 to 2

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feet forward, and the bucket dumped on the other half of the pile. Care shall be exercised to avoid cutting below the base of the truck dumps or small pile and contaminating the material to be sampled.

After mixing twice, the end loader shall drop the angle of its bucket downward on one side of the pile and back drag the pile into a layer not less than 1 foot thick.

The layer shall be sampled using a required shovel to take increments in a random "X" pattern over the layer. The shovel shall be forced vertically to its full depth when sampling each increment except that care shall be used to not dig completely through the layer. This would contaminate the sample being obtained. Care shall also be exercised to retain as much material on the shovel as possible when taking increments. Sufficient increments shall be taken to make up a correct field sample.

CS01 & CS02 Sampling – The preparation of the sample pile shall be in accordance with section 6.3.3 on truck-dump sampling except after mixing twice the end loader shall not back drag or strike off the top of the pile. The sample pile shall then be split in half by the end loader dragging away one half of the pile leaving a vertical face. Spanning the breadth of the vertical slope the sample shall be taken from higher and lower points in a "W" fashion. Sufficient increments shall be taken to obtain the correct field sample size.

Stockpile Sampling – The sample shall be taken from the working face of the stockpile. The working face shall be perpendicular to the direction of flow used to build the stockpile. Stockpiles having no working face shall have one established prior to sampling. The working face shall have the interior of the pile exposed to permit proper re-blending of the pile to eliminate segregated aggregate. If necessary, material may be brought out of the main pile's working face into the sub-stockpile for sampling.

The stockpile sampling procedure shall follow the truck-dump sampling procedure using an end loader. The end loader shall cut across the working face as detailed in "Truck-Dump Sampling." Any special mixing procedure used during loading shall be used when taking any samples.

This is the only acceptable method for acquiring quality samples.

6.4 *Masses of Field Samples:*

6.4.1 *Field Sample Sizes* – The field sample size shall meet the minimum requirements as detailed in the Illinois Specification 201.

7 Shipping Samples

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- 7.1 Transport aggregates in bags or other containers so constructed as to preclude loss or contamination of any part of the sample, or damage to the contents from mishandling during shipment.
- 7.2 Shipping containers for aggregate samples shall have a LM-5 envelope attached to the container. Written on the outside of the LM-5 shall be the following information: producer number, test id# (including suffix), material code, ledge description. The required information to be written on the outside of the LM-5 shall also be written on the outside of the sample container. Inside the LM-5 shall contain a fully completed LM-6 form. The LM-6 form shall be the most recent version of the Central Bureau of Materials online template.
- 8 *Red Tag Samples* – Used for Quality Samples only.
- 8.1 The Central Bureau of Materials has established a procedure which allows the producer the opportunity to deliver their quality samples directly to the Springfield testing facility.

Your sample, taken by the district, will be sampled following the procedures outlined in 6.3.3. Upon completion of the sampling the District shall “Red Tag” the sample containers. During the tagging process the District shall write the “Red Tag” serial number on the LM-6 form. If the serial number is not indicated on the LM-6 form the samples will not be accepted.

Once the sample containers are tagged and the documentation has been completed the producer will then be allowed to deliver the samples to the Bureau.

ILLINOIS TEST PROCEDURE 11

MATERIALS FINER THAN 75- μ m (No. 200) SIEVE IN MINERAL AGGREGATES BY WASHING

Effective Date: April 1, 2012
Revised Date: December 1, 2017

1 SCOPE

- 1.1 This test procedure covers the determination of the amount of material finer than a No. 200 (75 μ m) sieve in aggregate by washing. Clay particles and other aggregate particles that are dispersed by the wash water, as well as water-soluble materials, will be removed from the aggregate during the test.
- 1.2 There are two methods allowed for this procedure. The first method uses only water for the operation. The second allows the use of a wetting agent to assist in the loosening of the material finer than the No. 200 (75 μ m) sieve from the coarser material. A wetting agent such as detergent or dispersing solution is recommended.
- 1.3 The values stated in SI units are to be regarded as the standard.
- 1.4 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this procedure to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2 REFERENCED DOCUMENTS

- 2.1 Illinois Test Procedures (ITP):
- ITP 2, Sampling of Aggregates
 - ITP 27, Sieve Analysis of Fine and Coarse Aggregates
 - ITP 248, Reducing Samples of Aggregate to Testing Sizes
- 2.2 Illinois Specifications:
- Illinois Specification 201, Aggregate Gradation Sample Size Table
- 2.3 AASHTO Standards:
- M 231, Weighing Devices Used in the Testing of Materials
- 2.4 ASTM Standards:
- E 11, Woven Wire Test Sieve Cloth and Test Sieves
 - E 29 (Illinois Modified), Using Significant Digits in Test Data to Determine Conformance with Specifications
 - C 125, Standard Terminology Relating to Concrete and Concrete Aggregates

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MATERIALS FINER THAN 75- μ m (No. 200) SIEVE IN MINERAL AGGREGATES BY WASHING

Effective Date: April 1, 2012

Revised Date: December 1, 2017

3 SUMMARY OF METHOD

- 3.1 A sample of the aggregate is washed in a prescribed manner, using plain water. The decanted wash water, containing suspended and dissolved material, is passed through a No. 200 (75 μ m) sieve. The loss in mass resulting from the wash treatment is calculated as mass percent of the original sample and is reported as the percentage of material finer than a No. 200 (75 μ m) sieve by washing.

4 SIGNIFICANCE AND USE

- 4.1 Material finer than the No. 200 (75 μ m) sieve can be separated from larger particles much more efficiently and completely by wet sieving than through the use of dry sieving. Therefore, when accurate determinations of material finer than No. 200 (75 μ m) in fine or coarse aggregate are desired, this test method is used on the sample prior to dry sieving in accordance with ITP 27. The results of this test method are included in the calculation in ITP 27, and the total amount of material finer than the No. 200 (75 μ m) by washing, plus that obtained by dry sieving the same sample, is reported with the results of ITP 27. Usually the additional amount of material finer than No. 200 (75 μ m) obtained in the dry-sieving process is a small amount. If it is large, the efficiency of the washing operation should be checked. A large amount of material could also be an indication of degradation of the aggregate.
- 4.2 Plain water is adequate to separate the material finer than the No. 200 (75 μ m) from the coarser material with most aggregates. In some cases, the finer material is adhering to the larger particles, such as some clay coatings and coatings on aggregates that have been extracted from bituminous mixtures. In these cases, the finer material will be separated more readily with a wetting agent in the water.

5 APPARATUS AND MATERIALS

- 5.1 *Balance* – The balance shall have sufficient capacity, be readable to 0.1 percent of the sample mass, or better, and conform to the requirements of M 231.
- 5.2 *Sieves* – A nest of two sieves, the lower being a No. 200 (75 μ m) sieve and the upper being a sieve with openings in the range of No. 8 (2.36mm) to No. 16 (1.18mm), both conforming to the requirement of ASTM E 11. The sieve cloth shall be mounted on substantial frames constructed in a manner that will prevent loss of material during sieving.
- 5.3 *Container* – A pan or vessel of a sufficient size to contain the sample covered with water and to permit vigorous agitation without loss of any part of the sample or water.
- 5.4 *Oven* – An oven of sufficient size, capable of maintaining a uniform temperature of 230 \pm 9°F (110 \pm 5°C). The oven shall be specifically designed for drying. In addition, a

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MATERIALS FINER THAN 75- μ m (No. 200) SIEVE IN MINERAL AGGREGATES BY WASHING

Effective Date: April 1, 2012

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- 5.5 gas burner or electric hot plate may be used. Microwave ovens are not permitted for drying aggregate gradation samples.
- 5.6 *Wetting Agent* – Any dispersing agent, such as a liquid dishwashing detergent, that will promote separation of the fine materials.

Note 1 – A mechanical device, such as a Ploog Washer, may be used for coarse aggregate samples providing its results match the manual procedure. When using a mechanical washing device, loss of fines from damage to the drum or dripping water will not be allowed. Applying wax to the rim of the drum will help prevent water from dripping down the outside of the drum.

6 SAMPLING

- 6.1 Field samples of aggregate shall be taken according to ITP 2. The field sample size shall meet the minimum requirements in the Illinois Specification 201.
- 6.2 Field samples of aggregate shall be reduced to test sample size before testing according to ITP 248.

Test sample size for aggregate gradation samples shall meet the minimum requirements found in the Illinois Specification 201.

7 PROCEDURE

- 7.1 The test sample shall be dried back to constant mass in an oven specifically designed for drying, set at and capable of maintaining a uniform temperature of $230\pm 9^{\circ}\text{F}$ ($110\pm 5^{\circ}\text{C}$). Constant mass is defined as the sample mass at which there has not been more than a 0.5 gram mass loss during an additional 1 hour of drying. This should be verified occasionally.

The sample may also be dried to constant mass in a pan on an electric hot plate or gas burner. The technician shall continually attend the sample when drying on the electric hot plate or gas burner. The electric hot plate or gas burner should be operated on a low-as-needed heat to prevent popping, crackling, and/or sizzling noise from the aggregate during drying. If these noises occur, the heat must be turned down and/or the sample must be constantly stirred during drying to prevent potential aggregate particle breakdown.

After the test sample has been dried to constant mass and cooled down to room temperature, the sample shall have its mass determined to the nearest 1 gram for coarse aggregate and to the nearest 0.1 gram for fine aggregate. All balances or scales shall be tared before being used to determination of mass required by this test procedure. This procedure provides the "Total Dry Mass, g" (TDM) of the original test sample.

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- 7.2 After drying and determining the mass, place the test sample in the container and add sufficient water to cover it. If a wetting agent is warranted as stated in 4.2, add the wetting agent to the water (Note 2). Agitate the sample with sufficient vigor to result in complete separation of all particles finer than the No. 200 (75 μ m) sieve from the coarser particles, and to bring the fine material into suspension. The use of a large spoon or other similar tool shall be used to stir and agitate the aggregate in the wash water. Once the wash water becomes clear pour the wash water containing the suspended and dissolved solids over the nested sieves, arranged with the coarser sieve on top. Take care to avoid, as much as feasible, the decantation of coarser particles of the sample.

Note 2 – There should be enough wetting agent to produce a small amount of suds when the sample is agitated. The quantity will depend on the hardness of the water and the quality of the detergent. Excessive suds may overflow the sieves and carry some material with them.

- 7.3 Add a second charge of water to the sample in the container, agitate, and decant as before. Repeat this operation until the wash water is clear.

Note 3 – If mechanical washing equipment is used, the charging of water, agitating, and decanting may be a continuous operation.

Note 4 – A spray nozzle or a piece of rubber tubing attached to a water faucet may be used to rinse any of the material that may have fallen onto the sieves. The velocity of water, which may be increased by pinching the tubing or by use of a nozzle, should not be sufficient to cause any splashing of the sample over the sides of the sieve.

- 7.4 Return all material retained on the nested sieves by flushing per note 5. Dry the washed test sample to constant mass and determine the mass of the test sample in the same manner as detailed in 8.1 herein. This procedure provides the “Total Wash Mass, g” (TWM).

Note 5 – Following the washing of the sample and flushing any material retained on the No. 200 (75 μ m) sieve back into the container by washing from the back of the sieve. No water should be decanted from the container except through the No. 200 (75 μ m) sieve, to avoid loss of material. Excess water from flushing should be evaporated from the sample in the drying process.

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MATERIALS FINER THAN 75-μm (No. 200) SIEVE IN MINERAL AGGREGATES BY WASHING

Effective Date: April 1, 2012
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8 CALCULATION

- 8.1 The “Percent Minus 75μm (No. 200) by Washing” shall be determined by using the following formula:

$$\% \text{ - No. 200 (-75}\mu\text{m) by Washing} = \frac{TDM - TWM}{TDM} \times 100$$

TDM = Total Dry Mass, g.

TWM = Total Wash Mass, g.

9 REPORT

- 9.1 The test results shall be rounded to the nearest 0.1 percent and recorded on the Illinois Department of Transportation (IDOT) gradation form. All rounding shall be according to ASTM E 29 (Illinois Modified)

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ILLINOIS TEST PROCEDURE 27

SIEVE ANALYSIS OF FINE AND COARSE AGGREGATE

Effective Date: March 1, 2013

Revised Date: ~~January~~December 1, 2017

1. SCOPE

- 1.1 This procedure covers the determination of the particle size distribution of fine and coarse aggregates by sieving.
- 1.2 Some specifications for aggregates, which reference this method, contain grading requirements including both coarse and fine fractions. Instructions are included for sieve analysis of such aggregates.
- 1.3 The values stated in SI units are to be regarded as the standard. The values in parentheses are provided for information purposes only.
- 1.4 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this procedure to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. REFERENCED DOCUMENTS

- 2.1 Illinois Test Procedures (ITP):
 - ITP 2, Sampling of Aggregates
 - ITP 11, Materials Finer Than No. 200 (75µm) Sieve in Mineral Aggregates by Washing
 - ITP 248, Reducing Samples of Aggregate to Testing Size
- 2.2 Illinois Specifications:
 - Illinois Specification 201, Aggregate Gradation Sample Size Table
- 2.3 *AASHTO Standards:*
 - M 231, Weighing Devices Used in the Testing of Materials
- 2.4 *ASTM Standards:*
 - C 125, Standard Terminology Relating to Concrete and Concrete Aggregates
 - E 11, Woven Wire Test Sieve Cloth and Test Sieves

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- E 29 (Illinois Modified), Using Significant Digits in Test Data to Determine Conformance with Specifications

3 TERMINOLOGY

- 3.1 *Definitions* – For definitions of terms used in this standard, refer to ASTM C 125.

4 SUMMARY OF METHOD

- 4.1 A sample of dry aggregate of known mass is separated through a series of sieves of progressively smaller openings for determination of particle size distribution.

5 SIGNIFICANCE AND USE

- 5.1 This procedure is used primarily to determine the grading of materials proposed for use as aggregates or being used as aggregates. The results are used to determine compliance of the particle size distribution with applicable specification requirements and to provide necessary data for control of the production of various aggregate products and mixtures containing aggregates. The data may also be useful in developing relationships concerning porosity and packing.
- 5.2 Accurate determination of material finer than the No. 200 (75µm) sieve cannot be achieved by used of this method alone. ITP 11 for material finer than the No. 200 (75µm) sieve by washing should be employed.

6 APPARATUS

- 6.1 *Balance* – The balance shall have sufficient capacity, be readable to 0.1 percent of the sample mass, or better, and conform to the requirements of AASHTO M 231.
- 6.2 *Sieves* – The sieve cloth shall be mounted on substantial frames constructed in a manner that will prevent loss of material during sieving. The sieve cloth and standard sieve frames shall conform to the requirements of ASTM E 11. Nonstandard sieve frames shall conform to requirements of ASTM E 11 as applicable.

When running Coarse Aggregate samples 12in (305mm) are required, if running Fine Aggregate samples 12in (305mm) or 8in (203mm) sieves are acceptable.

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6.3 *Mechanical Sieve Shaker* – A mechanical sieving device shall create motion of the sieves to cause the particles to bounce, tumble, or otherwise turn so as the present different orientations to the sieving surface. The sieving action shall be such that the criterion for adequacy of sieving described in Section 8.4 is met ~~in a reasonable time period~~.

6.4 *Oven* – An oven of sufficient size, capable of maintaining a uniform temperature of $230\pm 9^{\circ}\text{F}$ ($110\pm 5^{\circ}\text{C}$). The oven shall be specifically designed for drying. In addition, a gas burner or electric hot plate may be used. Microwave ovens are not permitted for drying aggregate gradation samples.

In addition, a gas burner or electric hot plate may be used. Microwave ovens are not permitted for drying aggregate gradation samples.

7 SAMPLING

7.1 Field samples of aggregate shall be taken according to ITP 2. The field sample size shall meet the minimum requirements in the Illinois Specification 201.

7.2 Field samples of aggregate shall be reduced to test sample size before testing according to ITP 248.

Test sample size for gradation samples shall meet the minimum requirements in the Illinois Specification 201.

7.3 In the event that the amount of material finer than No. 200 ($75\mu\text{m}$) sieve is to be determined by ITP 11, proceed as follows: use the procedure described in Section 7.3.1 or 7.3.2, whichever is applicable.

7.3.1 Use the same test sample for testing by ITP 11 and by this method. First test the sample according to ITP 11 through the final drying operation, and then dry-sieve the sample as stipulated in Sections 8.2 through 8.6 of this method.

7.3.2 If the test sample is not to be tested by ITP 11, follow Section 8, "Procedure."

8 PROCEDURE

8.1. If the test sample has not been subject to testing by ITP 11, the test sample shall be dried back to constant mass in an oven specifically designed for drying, set at and capable of maintaining a uniform temperature of $230\pm 9^{\circ}\text{F}$ ($110\pm 5^{\circ}\text{C}$). Constant mass

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is defined as the sample mass at which there has not been more than a 0.5 gram mass loss during an additional 1 hour of drying. This should be verified occasionally.

The sample may also be dried to constant mass in a pan on an electric hot plate or gas burner. The technician shall continually attend the sample when drying on the electric hot plate or gas burner. Microwave ovens are not permitted for drying gradation samples.

The electric hot plate or gas burner should be operated on a low-as-needed heat to prevent popping, crackling, and/or sizzling noise from the aggregate during drying. If these noises occur, the heat must be turned down and/or the sample must be constantly stirred during drying to prevent potential aggregate particle breakdown.

After the test sample has been dried to constant mass and cooled down to room temperature, the sample shall have its mass determined to the nearest 1 gram for coarse aggregate and to the nearest 0.1 gram for fine aggregate. All balances or scales shall be tared before being used for determination of mass required by this test procedure. This procedure provides the "Total Dry Mass, g (TDM) of the original test sample. When testing Recycled Asphalt Pavement (RAP) samples shall be air dried to a constant mass.

- 8.2 A nested set of sieves (8 inch [203mm] or 12 inch [305mm]) shall be gathered and stacked. As the sieves are being stacked, they should be inspected for cracks, breaks, or any other problem which would exclude their continued use. The size of the sieves used shall conform to the gradation specifications of the aggregate tested. The No. 200 (75µm) sieve is required to be part of all nested sets when running a gradation test. It is also required that 8 inch (203mm) and 12 inch (305mm) round sieves use additional cutter sieves beyond the specified gradation sieves for all coarse aggregate gradations. Some cutter sieves may be required for fine aggregate gradations if overloading of individual sieves occurs. Gradations CA/CM 7 and 11 require the 5/8 inch (16.0mm), 3/8 inch (9.5mm), and 1/4 inch (6.3mm) sieves as cutter sieves, while the gradations CA/CM 13, 14, and 16 require the 1/4 inch (6.3mm) and the No. 8 (2.38mm) sieves. Cutter sieves for other gradations can be found in Illinois Specification 201.

The sample shall then be introduced into the nested set of sieves and placed in a mechanical shaker. The shaker shall impart a vertical, or lateral and vertical, motion to the nested set. This causes the aggregate particles to bounce and turn so as to

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present different particle orientations to the sieves. This allows every chance for the particle to pass a certain sized sieve.

The shaker shall be run for 7 minutes, controlled by an automatic shut-off timer. Seven (7) minutes of shaking shall be considered the standard unless reduced shaker efficiency can be demonstrated through finish hand-shaking as described in Section 8.4. Shaking time shall be increased if necessary to comply with the finish hand-shaking procedure in Section 8.4. Shaking time shall not exceed 10 minutes.

- 8.3 Extreme care shall be taken not to overload individual sieves or even approach the overload limits. An overload is defined as several layers of particles, one on top of the other, which do not permit the top layers of particles access to the sieve openings. Sample results which show overloading or a borderline situation are immediately suspect. If samples continually overload a sieve or sieves, then future samples shall be run in the appropriate number of portions to prevent overloading, or additional cutter sieves shall be added to the nested set to correct the problem.
- 8.4 After mechanical shaking, all sieves shall be finished off by hand-shaking. When hand-shaking, the largest sieve that contains material shall be removed from the stack, visually inspected for overload, and inverted over an empty pan. While inverted, all particles shall be cleaned from the sieve. The material shall then be placed back on the same sieve and hand-shaken over an empty pan. Any amount of material that is considered to be an overload or to be approaching an overload shall be hand-shaken in a least two increments. Any appreciable amount of particles passing a sieve may indicate poor mechanical shaking or overloading. The finish hand-shaking described in the following paragraph shall then be initiated.

Continue sieving for a sufficient period and in such manner that, after completion, not more than 0.5 percent by mass of the total sample passes any sieve during 1 minute of continuous hand sieving performed as follows: Hold the individual sieve, provided with a snug-fitting pan and cover, in a slightly inclined position in one hand. Strike the side of the sieve sharply and with an upward motion against the heel of the other hand at a rate of about 150 times per minute, turn the sieve about one-sixth of a revolution at intervals of about 25 strokes. In determining sufficiency of sieving for sizes larger than No. 4 (4.75mm) sieve, limit the material on the sieve to a single layer of particles. If the size of the mounted testing sieves makes the described sieving motion impractical, use 8 inch (203mm) diameter sieves to verify the sufficiency of sieving.

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- 8.5 After hand-shaking, material shall be removed from the sieve. Particles shall not be forced through the sieves. The sieve shall be inverted and lightly tapped on the sides to facilitate removal for weighing. A dowel rod or putty knife may be used to gently remove wedged particles from all sieves down through the No. 10 (2.00mm). A soft brass-wired brush shall be used on the No. 16 (1.18mm) through the No. 40 (425µm) sieve. A soft china brush shall be used on the No. 50 (300µm) through the No. 200 (75µm) sieve. Any material that passed the sieve during hand-shaking shall be placed on the next smaller sieve. After use, all sieves shall be inspected for cracks, breaks, or any other problem which would exclude their continued use

Note: The dowel rod can be made of any material that will not deposit foreign material into the test sample or cause damage to the sieves during the removal of wedged particles.

- 8.6 After hand-shaking and cleaning, the material retained on each sieve shall have its mass determined and the mass recorded. All determination of mass shall start with the largest sieve in the nested set and proceed down to the pan. Determination of mass shall be to the nearest 1 gram for coarse aggregate and to the nearest 0.1 gram for fine aggregate. The total mass of the material after sieving should check closely with original mass of samples placed on the sieves. If the amounts differ by more than 0.3 percent, based on the original dry sample mass, the results should not be used for acceptance purposes.

9 CALCULATION

- 9.1 Calculation of test results shall follow the procedure described below:

Calculated the "Cumulative Mass Retained" for each sieve by adding its "Individual Mass Retained" and the "Individual Mass Retained" for each larger sieve in the nested set of sieves. Record the "Cumulative Mass Retained".

Calculated the "Cumulative Percent Retained" for each sieve by using the following formula and record it by rounding to the nearest 0.1 percent:

$$\text{Cumulative \% Retained} = \frac{CMR}{TDM} \times 100$$

where CMR = Cumulative Mass Retained
and TDM = Total Dry Mass

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Calculated the percent passing each sieve by using the following formula:

$$\% = 100 - \text{Cumulative \% Retained}$$

These results shall be recorded to the nearest 0.1 percent.

- 9.2 Calculate the fineness modulus, when required, by adding the total percentages of material in the sample that is coarser than each of the following sieves (cumulative percentages retained), and dividing the sum by 100; No. 100 (150µm), No. 50 (300µm), No. 30 (600µm), No. 16 (1.18mm), No. 8 (2.36mm), No. 4 (4.75mm), 3/8 in. (9.5mm), 3/4 in. (19.0mm), 1 1/2 in. (37.5mm), and larger, increasing the ratio of 2 to 1.

10 REPORT

- 10.1 Depending upon the form of the specifications for used of the material under test, the report shall include one of the following:
- 10.1.1 Total percentage of material passing each sieve, or
 - 10.1.2 Total percentage of material retained on each sieve, or
 - 10.1.3 Percentage of material retained between consecutive sieves.
- 10.2 All percent passing results except the washed minus No. 200 (75µm) and minus No. 200 (75µm) shall be reported on the gradation form as whole numbers. The washed minus No. 200 (75µm) and minus No. 200 (75µm) results shall be reported to the nearest 0.1 percent. Illinois Department of Transportation (IDOT) gradation forms or forms approved by IDOT shall be used. These forms shall be completed with all required information.
- 10.3 Rounding shall be according to ASTM E 29 (Illinois Modified).
- 10.4 For all sieves that are considered overloaded and split in more than one increment. An "S" next to the sieve must be notated on the worksheet.

11 COMPARISON PROCEDURE

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- 11.1 All comparison testing shall be conducted in accordance with the most current version of the Illinois Department of Transportation Manual of Test Procedures for Materials (Appendix A7).

ILLINOIS TEST PROCEDURE 248

REDUCING SAMPLES OF AGGREGATE TO TESTING SIZE

Effective: April 1, 2012
Revised Date: December 1, 2017

1. SCOPE

- 1.1 This procedure covers the reduction of large samples of aggregate to the appropriate size for testing, employing techniques that are intended to minimize variations in measured characteristics between the test samples so selected and the large sample.
- 1.2 The values stated in SI units are to be regarded as the standard.
- 1.3 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this procedure to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. REFERENCED DOCUMENTS

- 2.1 Illinois Test Procedures (ITP):
- ITP 2, Sampling of Aggregates
 - ITP 11, Materials Finer Than No. 200 (75µm) Sieve in Mineral Aggregates by Washing
- 2.2 Illinois Specifications:
- Illinois Specification 201, Aggregate Gradation Sample Size Table
- 2.3 *ASTM Standards:*
- *C 125, Standard Terminology Relating to Concrete and Concrete Aggregates*

3. TERMINOLOGY

- 3.1 *Definitions* – the terms used in this standard are defined in ASTM C 125.

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REDUCING SAMPLES OF AGGREGATE TO TESTING SIZE

Effective: April 1, 2012
Revised Date: December 1, 2017

4. SIGNIFICANCE AND USE

- 4.1 Specifications for aggregates require sampling portions of the material for testing. Other factors being equal, larger samples will tend to be more representative of the total supply. The methods described in this standard provide for reducing the large sample obtained in the field or produced in the laboratory to a convenient size for conducting a number of tests to describe the material and measure its quality. These methods are conducted in such a manner that the smaller test sample portion will be representative of the larger sample and, thus, of the total supply. The individual test methods provide for minimum masses of material to be tested.
- 4.2 Under certain circumstances, reduction in size of the large sample prior to testing is not recommended. Substantial differences between the selected test samples sometimes cannot be avoided, as for example, in the case of an aggregate having relatively few large-sized particles in the sample. The laws of chance dictate that these few particles may be unequally distributed among the reduced-size test samples. Similarly, if the test sample is being examined for certain contaminants occurring as a few discrete fragments in only small percentages, caution should be used in interpreting results from the reduced-size test sample. Chance inclusion or exclusion of only one or two particles in the selected test sample may importantly influence interpretation of the characteristics of the original sample. In these cases, the entire original sample should be tested.
- 4.3 Failure to carefully follow the procedures in these methods could result in providing a non-representative sample to be used in subsequent testing. Selection during splitting of an exact, predetermined mass for the sample is not permitted.

5. SELECTION OF METHOD

- 5.1 *Fine Aggregate* – The preferred splitting method for fine aggregate shall be a fine aggregate mechanical splitter (Method A). However, quartering (Method B) and miniature stockpile sampling (Method C) may be used.
- 5.1.1 If the use of Method B or Method C is desired, and the sample does not have free moisture on the particle surfaces, the sample may be moistened to achieve this condition, thoroughly mixed, and then the sample reduction performed.

Note 1 – As a quick approximation of free moisture; the fine aggregate will retain its shape when molded in the hand, it may be considered to be wetter than saturated-surface-dry.

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Effective: April 1, 2012
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- 5.1.2 If the use of Method A is desired and the sample has free moisture on the particle surfaces, the entire sample may be dried to at least the surface-dry condition, using temperatures that do not exceed those specified for any of the tests contemplated, and then the sample reduction performed. Alternatively, if the moist sample is very large, a preliminary split may be made using a mechanical splitter having wide chute openings 1 1/2in. (37.5mm) or more to reduce the sample to not less than 5000g. The portion so obtained is then dried, and reduction to test sample size is completed using Method A.
- 5.2 *Coarse Aggregate and Mixtures of Coarse and Fine Aggregate* – The required splitting method for coarse aggregate and mixtures of coarse and fine aggregate shall be a coarse aggregate mechanical splitter (Method A). However, quartering (Method B) may be used for coarse aggregate moisture tests to proportion Portland cement concrete, cement aggregate mixture II, and controlled low-strength material mixtures.

6. SAMPLING

- 6.1 Field samples of aggregate shall be taken according to ITP 2. The field sample size shall meet the minimum requirements in the Illinois Specifications 201.

METHOD A – MECHANICAL SPLITTER

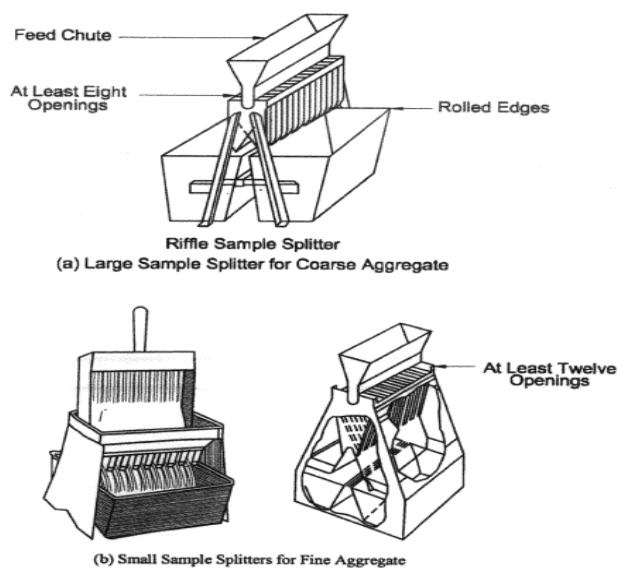
7. APPARATUS

- 7.1 *Sample Splitter* – Sample splitters shall have an even number of equal width chutes, but not less than a total of eight for coarse aggregate, or 12 for fine aggregate, which discharge alternatively to each side of the splitter. For coarse aggregate and mixed aggregate the minimum width of the individual chutes shall be approximately 50 percent larger than the largest particles in the sample to be split (Note 2). For dry fine aggregate in which the entire sample will pass the 3/8in. (9.5mm) sieve, the minimum width of the individual chutes shall be at least 50 percent larger than the largest particles in the sample and the maximum width shall be 3/4in. (19mm). The splitter shall be equipped with two receptacles to hold the two halves of the sample following splitting. It shall also be equipped with a hopper or straight-edged pan, which has a width equal to or slightly less than the overall width of the assembly of chutes, by which the sample may be fed at a controlled rate to the chutes. The splitter and accessory equipment shall be so designed that the sample will flow smoothly without restriction or loss of material (see Figure 1).

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Note: (a) may be constructed as either closed or open type. Closed type is preferred.

Figure 1—Sample Splitters (Riffles)

Note 2 – Mechanical splitters are commonly available in sizes adequate for coarse aggregate having the largest particles not larger than 1 1/2in. (37.5mm).

8. PROCEDURE

- 8.1 Place the original sample in the hopper or pan and uniformly distribute it from edge to edge, so that when it is introduced in the chutes, approximately equal amounts will flow through each chute. The rate at which the sample is introduced shall be such as to allow free flowing through the chutes into the receptacles below. Reintroduce the portion of the sample in one of the receptacles into the splitter as many times as necessary to reduce the sample to the size specified for the intended test. The portion of the material collected in the other receptacle may be reserved for reduction in size for other tests.

On the final split, the mass of the two halves (after splitting) shall be within ± 10 percent of each other. This is determined by adding 10 percent of the mass of the small split to the mass of the smaller split; the larger split cannot exceed this calculated mass. If it does, both split halves shall be recombined and split until the mass comparison requirement is met.

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METHOD B – QUARTERING

9. APPARATUS

- 9.1 Apparatus shall consist of a straight-edge; straight-edged scoop, shovel or trowel; a broom or brush; and a canvas blanket or tear-resistant tarp approximately 6 by 8ft (2 by 2.5m).

10. PROCEDURE

- 10.1 Use either the procedure described in Section 10.1.1 or 10.1.2, or a combination of both.

- 10.1.1 Mix the material thoroughly on a hard, clean, level surface by turning the entire sample over four times using the shovel. Each shovel full shall be deposited on top of the preceding one. This procedure shall be done three times, resulting in the formation of a small conical pile. Carefully flatten the conical pile to a uniform thickness and diameter by pressing down the apex with a shovel or trowel so that each quarter sector of the resulting pile will contain the material originally in it. The diameter should be approximately four to eight times the thickness. Divide the flattened mass into four equal quarters with a shovel or trowel and remove two diagonally opposite quarters, including all fine material, and brush the cleared spaces clean. The two unused quarters may be set aside for later use or testing, if desired. Successively mix and quarter the remaining material until the sample is reduced to the desired size (see Figure 2).

Both halves of the final split shall meet the 10 percent comparison requirement in 8.1 herein.

- 10.1.2 As an alternative to the procedure in Section 10.1.1, the field sample may be placed on a canvas blanket. Mixing may be accomplished by the shovel method listed in 10.1.1 herein or by alternately lifting each corner of the canvas and pulling over the sample diagonally toward the opposite corner. This causes the material to be rolled and mixed. The material shall then be flattened and divided as required in 10.1.1. (see Figure 3) Both halves of the final split shall meet the 10 percent comparison requirement in 8.1 herein.

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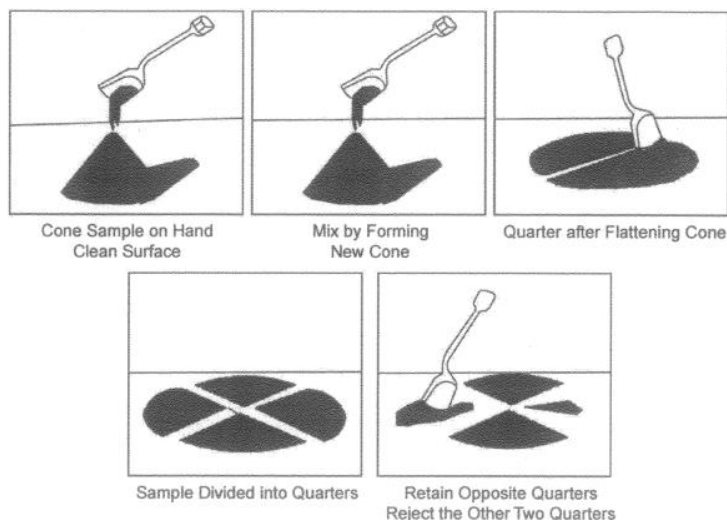


Figure 2—Quartering on a Hard, Clean, Level Surface

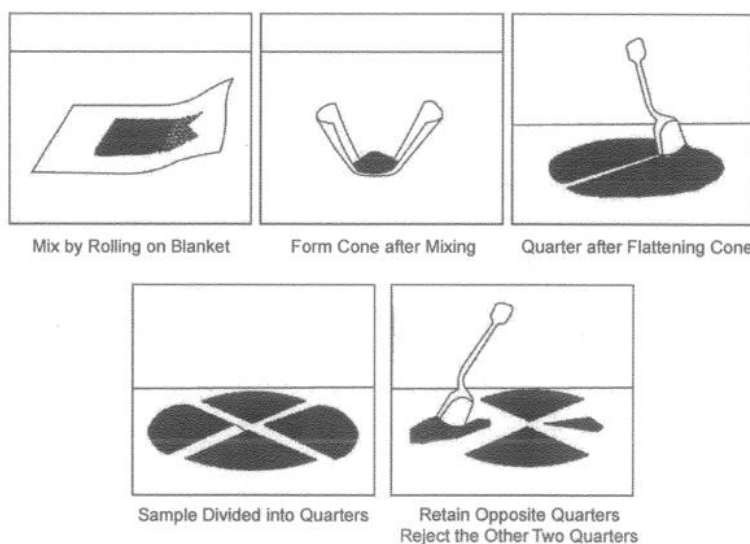


Figure 3—Quartering on a Canvas Blanket or Tear-Resistant Tarp

METHOD C – MINIATURE STOCKPILE SAMPLING (DAMP FINE AGGREGATE ONLY)

11. APPARATUS

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Effective: April 1, 2012
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- 11.1 Apparatus shall consist of a straight-edge; straight-edged scoop, shovel, or trowel for mixing the aggregate; and either a small thief, small scoop, or spoon for sampling.

12. PROCEDURE

- 12.1 Mix the material thoroughly on a hard, clean, level surface as required in 10.1.1 or 10.1.2.

The test sample shall be obtained by selecting at least five increments in a random "X" pattern over the resultant miniature sample pad using a sampling thief, small scoop, or spoon. A sufficient number of increments shall be obtained to provide a test sample slightly larger than the minimum test sample size when dried to a constant mass. (see Figure 4)

For all samples from which a state monitor split will also be obtained, the number of increments shall be doubled to provide a sample twice the minimum required test size. This material shall then be dried to constant mass as specified in the current ITP 11 and split in a fine aggregate mechanical splitter according to Method A – Mechanical Splitter. Alternately, the material may also be quartered according to Method B – Quartering.

Both halves of the final split shall meet the 10 percent comparison requirement in 8.1 herein.



Figure 4 – Miniature Stockpile Method on a canvas blanket or tear resistant tarp.

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ILLINOIS TEST PROCEDURE 255

TOTAL EVAPORABLE MOISTURE CONTENT OF AGGREGATE BY DRYING

Effective Date: April 1, 2012
Revised Date: December 1, 2017

1 SCOPE

- 1.1 This test procedure covers the determination of the percentage of evaporable moisture in a sample of aggregate by drying both surface moisture and moisture in the pores of the aggregate. Some aggregate may contain water that is chemically combined with the minerals in the aggregate. Such water is not evaporable and is not included in the percentage determined by this test method. Aggregate moisture content may be run on a gradation sample prior to gradation testing or on a separate test sample.
- 1.2 The values stated in SI units are to be regarded as the standard. The values in parentheses are provided for information only.
- 1.3 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this procedure to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2 REFERENCED DOCUMENTS

- 2.1 Illinois Test Procedures (ITP):
- ITP 2, Sampling of Aggregates
 - ITP 248, Reducing Samples of Aggregate to Testing Size
- 2.2 Illinois Specifications:
- Illinois Specification 201, Aggregate Gradation Samples Size Table
- 2.3 AASHTO Standards:
- M 231, Weighing Devices Used in the Testing of Materials
- 2.4 ASTM Standards:
- C 125, Standard Terminology Relating to Concrete and Concrete Aggregates
 - E 29 (Illinois Modified), Using Significant Digits in Test Data to Determine Conformance with Specifications

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TOTAL EVAPORABLE MOISTURE CONTENT OF AGGREGATE BY DRYING

Effective Date: April 1, 2012
Revised Date: December 1, 2017

3 TERMINOLOGY

3.1 *Definitions:*

3.2 For definitions of terms used in this test method, refer to ASTM C 125.

4 SIGNIFICANCE AND USE

4.1 This test method is sufficiently accurate for usual purposes such as adjusting batch quantities of ingredients for concrete. It will generally measure the moisture in the test sample more reliably than the sample can be made to represent the aggregate supply. In rare cases where aggregate itself is altered by heat, or where more refined measurement is required, the test should be conducted using a ventilated, controlled-temperature oven.

4.2 Large particles of coarse aggregate, especially those larger than 2in. (50mm), will require greater time for the moisture to travel from the interior of the particle to the surface. The user of this test method should determine by trial if rapid drying methods provide sufficient accuracy for the intended use when drying large-size particles.

5 APPARATUS

5.1 *Balance* – The balance shall have sufficient capacity, be readable to 0.1 percent of the sample mass, or better, and conform to the requirements of AASHTO M 231.

5.2 *Source of Heat* – A ventilated oven capable of maintaining the temperature surrounding the sample at $230\pm 9^{\circ}\text{F}$ ($110\pm 5^{\circ}\text{C}$). The oven shall be specifically designed for drying.

5.2.1 Where close control of the temperature is not required (see Section 4.1), other suitable sources of heat may be used such as an electric or gas hot plate, electric heat lamps, or a ventilated microwave oven. A microwave oven or an electric or gas hot plate may be used only when drying a non-gradation test sample.

5.3 *Sample Container* – A container not affected by the heat, and of sufficient volume to contain the sample without danger of spilling.

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Note 1 – Except for testing large samples, an ordinary frying pan is suitable for use with a hot plate, or any shallow flat-bottomed metal pan.

5.4 *Stirrer* – A metal spoon or spatula of convenient size.

6 **SAMPLE**

6.1 Sampling shall generally be accomplished in accordance with ITP 2, except the field sample size shall be as stated in Illinois Specification 201.

6.2 Field samples of aggregate shall be reduced to test sample size before testing according to ITP 248.

Test samples shall be stored in sealable, non-absorbing bags or containers prior to determining mass to start the test.

7 **PROCEDURE**

7.1 The test sample shall have its mass determined to the nearest 1 gram for coarse aggregate and to the nearest 0.1 gram for fine aggregate. This procedure provides the “Original Sample Mass, g” (OSM).

7.2 The test sample shall be dried back to constant mass by the selected source of heat as specified herein.

7.2.1 **Caution** – When using a microwave oven, occasionally minerals are present in aggregates that may cause material to overheat and explode. If this occurs, it can damage the microwave oven. When a gas burner or electric hot plate is used for drying, the technician shall continually attend the sample. The gas burner or electric hot plate should be operated on a low-as-needed heat to prevent popping, crackling, and/or sizzling noise from the aggregate during drying. If these noises occur, the heat must be turned down and/or the sample must be constantly stirred during drying to prevent potential aggregate particle breakdown.

7.3 Constant mass is defined as the sample mass at which there has not been more than a 0.5 gram mass loss during an additional 1 hour of drying. This should be verified occasionally.

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TOTAL EVAPORABLE MOISTURE CONTENT OF AGGREGATE BY DRYING

Effective Date: April 1, 2012
Revised Date: December 1, 2017

After the test sample has been dried to constant mass, the test sample shall have its mass determined as soon as the pan or container can safely be handled to prevent additional moisture from being pulled from the air into the aggregate structure.

- 7.4 Determine the mass of the test sample to the nearest 1 gram for coarse aggregate and to the nearest 0.1 gram for fine aggregate. .

This procedure provides the “Total Dry Mass, g” (TDM). The TDM will also be used for calculation of gradation samples.

8 CALCULATION

- 8.1 The “Aggregate Moisture Content” shall be determined by using the following formula:

$$P = 100(OSM - TDM) / TDM$$

Where:

P = Aggregate Moisture Content (%)

OSM = Original Sample Mass, g.

and:

TDM = Dried Sample Mass g.

Results shall be reported as required and in the appropriate plant diary.

Test results shall be rounded to the nearest 0.1 percent. All rounding shall be according to ASTM E 29 (Illinois Modified)

Illinois Modified Test Procedure
Effective Date: December 1, 2019

Standard Method of Test
for
**Using Significant Digits in Test Data to
Determine Conformance with Specifications**

Reference ASTM E 29-13 (2019)

Note: Several test procedures reference either ASTM E 29 for rounding of test results. Results for Illinois Department of Transportation tests shall follow the “round up from five” rule, i.e.:

When the digit beyond the last place to be retained (or reported) is equal to or greater than 5, increase by 1 the digit in the last place retained.

The following modification to ASTM shall apply:

<i>ASTM Section</i>	<i>Illinois Modification</i>
6.4.2	Revise as follows: When the digit next beyond the last place to be retained (or reported) is equal to or greater than 5, increase by 1 the digit in the last place retained.
6.4.3	Delete.
6.4.4	Delete.

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Illinois Department of Transportation

**Development of Gradation Bands on Incoming Aggregate at Mix Plants
Appendix A1**

Effective: January 1, 1994

Revised: June 1, 2012**A. Scope**

Quality Control Plans for QC/QA Contracts normally require incoming aggregate to be checked for gradation compliance before use in mix plants. Aggregate is produced to tight gradation bands at the source but will degrade during handling and shipment.

B. Purpose

Establish a procedure to modify aggregate source gradation bands to develop mix plant gradation bands for use in checking gradation compliance on incoming aggregate at mix plants. The mix plant gradation bands will also be used in checking gradation compliance for required stockpile gradation tests at the mix plant.

C. Aggregate Source Gradation Bands

The Contractor shall obtain certified aggregate gradation bands (including master band, if required) from the aggregate source for all certified aggregates prior to any shipment of material to the mix plant. Natural sand gradation bands shall be obtained from the appropriate District Materials Engineer.

D. General Procedure

The Contractor may modify the aggregate source gradation bands according to the following procedures, if necessary, to check incoming aggregate for gradation compliance at the mix plant. If not modified, the aggregate source gradation bands shall be considered the mix plant gradation bands when checking incoming aggregate.

1. **Coarse Aggregate**—The Contractor may shift the aggregate source master band a maximum of three percent (3%) upwards to establish a Mix Plant Master Band for each coarse aggregate used. All other aggregate source gradation bands, except for the top sieve and bottom sieve bands in the gradation specification, may also be shifted upward a maximum of three percent (3%). The top sieve and bottom sieve bands shall not be changed, except as follows:

At portland cement concrete plants, the Contractor may increase the specification limit for the minus 75- μ m (No. 200) Illinois Test Procedure 11 sieve material upwards one half percent (0.5%) if the 75- μ m (No. 200) material consists of dust from fracture, or degradation from abrasion and

Illinois Department of Transportation

Development of Gradation Bands on Incoming Aggregate at Mix Plants**Appendix A1**

(continued)

Effective: January 1, 1994

Revised: June 1, 2012

attrition, during stockpiling and handling (reference Article 1004.01[b] of the Department's *Standard Specifications for Road and Bridge Construction*).

2. **Manufactured Sand**—All aggregate source gradation bands, except the top sieve and bottom sieve bands in the gradation specification, for each certified manufactured sand may be shifted upwards a maximum of three percent (3%). The top sieve and bottom sieve bands shall not be changed.
3. **Natural Sand**—The gradation bands obtained from the Department for each natural sand shall not be changed.

E. Department Approval

All aggregate source gradation bands and mix plant gradation bands must be sent to the District Materials Engineer for approval prior to any shipment of aggregate to the mix plant. Once approved, the mix plant gradation bands shall not be changed without approval of the District Materials Engineer.

Illinois Department of Transportation
QC/QA PROCEDURE
Procedure for Sample Comparison
Appendix A5

Effective Date: November 10, 1997
Revised Date: December 1, 2017

Precision Comparison Table*
State Monitor vs. Producer

	<i>Size Fraction Between Consecutive Sieves (%) †</i>	<i>Tolerance (%)</i>
<i>Coarse Aggregate:</i>	0 to 3.0	2
	3.1 to 10.0	3
	10.1 to 20.0	5
	20.1 to 30.0	6
	30.1 to 40.0	7
	40.1 to 50.0	9
<i>Fine Aggregate:</i>	0 to 3.0	1
	3.1 to 10.0	2
	10.1 to 20.0	3
	20.1 to 30.0	4
	30.1 to 40.0	4

* Split Samples only (reported values)

† The State Monitor Sample shall be used to pick tolerances.

Comparison Method

Calculate size fraction between consecutive sieves, including cutter sieves, for both the State Monitor and Producer test results (% Passing).

Show the fraction retained between consecutive sieves for both gradations, the fraction difference on each consecutive sieve grouping between the Monitor and Producer gradation, the applicable tolerance (if coarse aggregate, use coarse aggregate tolerances and, if fine aggregate, use fine aggregate tolerances- If size fraction between consecutive sieves exceeds largest fraction shown, use tolerance for largest size fraction), and whether they are in-tolerance or out-of-tolerance.

Illinois Department of Transportation
QC/QA PROCEDURE
Procedure for Sample Comparison
Appendix A5

(continued)

Effective Date: November 10, 1997

Revised Date: December 1, 2017

If the comparison has no out-of-tolerance fractions, both sample results are considered valid. If an out-of-tolerance situation has been identified, both the producer certified technician and the State inspector shall immediately investigate the splitting procedure, test equipment, test method, and calculations for possible equipment failure or procedure errors. The State Monitor Sample shall always take precedence unless shown to be invalid during investigation.

Example:

CA11	1" (25 mm)	3/4" (19 mm)	5/8" (16 mm)	1/2" (12.5 mm)	3/8" (9.5 mm)	1/4" (6.3 mm)	#4 (4.75 mm)	#16 (1.18 mm)	#200 (75 µm)
Monitor, % Passing	100	87	67	36	13	4	2	1	0.7
Producer, % Passing	100	89	67	44	14	5	3	2	1.3

Comparison Data

Consecutive Sieve Sizes	Monitor Fraction	Producer Fraction	Fraction Difference	Applicable Tolerance	Disposition
1" and 3/4" (25 mm and 19 mm)	13	11	2	5	OK
3/4" and 5/8" (19 mm and 16 mm)	20	22	2	5	OK
5/8" and 1/2" (16 mm and 12.5 mm)	31	23	8	7	OUT
1/2" and 3/8" (12.5 mm and 9.5 mm)	23	30	7	6	OUT
3/8" and 1/4" (9.5 mm and 6.3 mm)	9	9	0	3	OK
1/4" and #4 (6.3 mm and 4.75 mm)	2	2	0	2	OK
#4 and #16 (4.75 mm and	1	1	0	2	OK
#16 and #200 (1.18 mm and 75 µm)	0.3	0.7	0.4	2	OK
#200 and Pan (75 µm and Pan)	0.7	1.3	0.6	2	OK

GUIDELINE FOR COMPARISON**Example:****CM 11**

If the comparison has no out-of-tolerance fractions, both sample results are considered valid. If an out-of-tolerance situation has been identified, both the producer certified technician and the State inspector shall immediately investigate the splitting procedure, test equipment, test method, and calculations for possible equipment failure or procedure errors. The State Monitor Sample shall always take precedence unless shown to be invalid during investigation.

Example:

CM11	1" (25 mm)	3/4" (19 mm)	5/8" (16 mm)	1/2" (12.5 mm)	3/8" (9.5 mm)	1/4" (6.3 mm)	#4 (4.75 mm)	#16 (1.18 mm)	#200 (75 µm)
Monitor, % Passing	100	95	70	40	20	11	4	3	1.9
Producer, % Passing									

Comparison Data

Consecutive Sieve Sizes	Monitor Fraction	Producer Fraction	Fraction Difference	Applicable Tolerance	Disposition
1" and 3/4" (25 mm and 19 mm)					
3/4" and 5/8" (19 mm and 16 mm)					
5/8" and 1/2" (16 mm and 12.5 mm)					
1/2" and 3/8" (12.5 mm and 9.5 mm)					
3/8" and 1/4" (9.5 mm and 6.3 mm)					
1/4" and #4 (6.3 mm and 4.75 mm)					
#4 and #16 (4.75 mm and					
#16 and #200 (1.18 mm and 75 µm)					
#200 and Pan (75 µm and Pan)					

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Illinois Department of Transportation

Aggregate Laboratory Equipment
Appendix D.3

Effective: October 1, 1995

Revised: December 1, 2020

All equipment listed is required unless noted otherwise. This list recommends 12" sieves and 12" shakers. Individual needs may vary for the specific products. Eight-inch sieves and other alternate equipment may be substituted provided they conform to Illinois Test Procedure or ASTM requirements and are approved by the Engineer.

Quantity	Description
1	Mechanical Sieve Shaker – 8" and 12" sieve capacity
1	Coarse Aggregate Sample Splitter (Illinois Test Procedure 248, Method A)
4	Splitter Pans, for coarse aggregate
1	Fine Aggregate Sample Splitter (as required)
4	Splitter Pans, for fine aggregate
1	Sink and clear Water Supply
1	Oven, electric drying, capable of maintaining a uniform temperature of $110 \pm 5^{\circ}\text{C}$ ($230 \pm 9^{\circ}\text{F}$), (optional – see Hot Plate)
2	Hot Plate, electric, or burner, gas – in lieu of Oven, if approved by the Engineer
1	Gloves, pair, insulated
1	Balance, electronic, see Illinois Specification 101 for capacity and readability requirements
15	Sample Pans, (constructed to minimize loss of material during testing)
2	Spoon, stainless steel, 15 in. minimum
1	Brush, stencil
1	Brush, brass
1	Knife, putty
1	Thermometers, $-18 - 150^{\circ}\text{C}$ ($0 - 300^{\circ}\text{F}$), readable to 0.5°C (1.0°F), to verify Oven temperature
1	Set (11) Fine Aggregate Sieves, brass, 8 in. or 12 in. diameter, with brass or stainless cloth, 9.5 mm, 4.75 mm, 2.36 mm, *2.00 mm, 1.18 mm, 600 mm, 425 mm, 300 mm, 180 mm, 150 mm, 75 mm (3/8 in., No. 4, No. 8, *No. 10, No. 16, No. 30, No. 40, No. 50, No. 80, No. 100, No. 200), according to ASTM E 11. *The 2.00 mm (No. 10) sieve required as needed.
1	Lid for 8 in. and 12 in. sieve
1	Pan, catch, bottom, 8 in. and 12 in.
1	Set (11) Coarse Aggregate Sieves, brass, 12 in. diameter, with brass or stainless cloth, 37.5 mm, 25 mm, 19 mm, 16 mm, 12.5 mm, 9.5 mm, 6.3 mm, 4.75 mm, 2.36 mm, 1.18 mm, 75 mm (1 1/2 in., 1 in., 3/4 in., 5/8 in., 1/2 in., 3/8 in., No. 4, No. 8, No. 16, No. 200), according to ASTM E 11
1	Additional 12 in. brass sieves are required for testing larger coarse aggregate (e.g., a 1 3/4 in. sieve is required for CA 5 testing)
1	Wash Sieve, 12 in. diameter, No. 200, recommended 3 1/4 in. nominal height*
1	Wash Sieve, 12 in. diameter, No. 16, recommended 3 1/4 in. nominal height*

* Distance from the top of the frame to the sieve cloth surface

Illinois Department of Transportation

**Aggregate Laboratory Equipment
Appendix D.3**

(continued)

Effective: October 1, 1995

Revised: [December 1, 2020](#)

VENDOR LIST – For Information Only

Dual Manufacturing Co., Inc.
3522 Martens St.
Franklin Park, IL 60131
Phone: 847-260-5370
info@dualmfg.com

Gilson Company, Inc.
P.O. Box 200
Lewis Center, OH 43035-200
Phone: 800-444-1508
sales@gilson.com
www.globalgilson.com

Humboldt Scientific, Inc.
875 Tailgate Road
Elgin, IL 60123
Phone: 800-544-7220
708-468-6300
Fax: 708-456-0137
www.humboldtmfg.com

Instro Tek, Inc.
1 Triangle Dr.
P.O. Box 13944
Research Triangle Park, NC 27709
Phone: 919-875-8371
Fax: 919-875-8328

McMaster-Carr
600 N. County Line Rd.
Elmhurst, IL 60126-2034
Phone: 630-833-0300
630-600-3600
www.mcmaster.com

Rainhart Company (An Instro Tek company)
P.O. Box 4533
Austin, Texas 78765
Phone: 800-628-0021
512-452-8848
www.rainhart@instrotek.com

VWR Scientific (Part of Avantor)
911 Commerce Ct.
Buffalo Grove, IL 60089
Phone: 847-229-0835
800-932-500

Illinois Department of Transportation

Illinois Specification 101
Minimum Requirements for Electronic Balances
Appendix D5

Effective Date: April 1, 1999

Revised **January 1, 2016**

Electronic balances for materials testing laboratories shall be top-loading, direct-reading, with specified minimum capacity and readability per the table below. Underhooks are required for hot mix asphalt laboratories.

Purchasers are advised to specify balances that are manufactured according to AASHTO M 231. Laboratories may, at their option, provide additional balances that comply with each individual test procedure.

Electronic balances approved for Illinois Department of Transportation use prior to the effective date of this specification may be utilized until replaced.

Minimum Requirements for Laboratory Balances

QC/QA LAB TYPE	MINIMUM CAPACITY	READABILITY
AGGREGATE (AGCS, HMA, PCC) Moisture, Gradation, Specific Gravity		
Fine Aggregate	8 kg	0.1 g
Coarse Aggregate CA/CM 6 through 19	8 kg	0.1 g
Coarse Aggregate CA/CM 1 through 5	12 kg	0.1 g
HOT MIX ASPHALT Volumetric Analysis		
Mix Design Labs (Marshall and Superpave)	15 kg	0.1 g
QC, QA Labs (Marshall and Superpave)	8 kg	0.1 g
Asphalt Content (Nuclear AC Gauge or Ignition Furnace)	12 kg	0.1 g
PORTLAND CEMENT CONCRETE Aggregate Moisture Content*	8 kg	0.1 g
Unit Weight*	†	‡
Cylinder Strength Specimens**	†	50 g maximum

* The weighing equipment may be a balance or scale, and it does not have to be electronic.

** The weighing of the cylinder strength specimens prior to compressive strength testing is optional.

† Sufficient capacity

‡ A 20-gram (0.05 lb.) or smaller readability shall be required for unit weight measures and air meter measuring bowls which have a capacity less than 0.009 cubic meter (0.3 cu.ft.). A 50-gram (0.1 lb.) or smaller readability shall be required for unit weight measures which have a capacity greater than or equal to 0.009 cubic meter (0.3 cu.ft.).

January 1, 2016

Manual of Test Procedures for Materials
Appendix D5

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State of Illinois
Department of Transportation
Bureau of Materials
Springfield

POLICY MEMORANDUM

Revised: May 8, 2020

6-08.5

This Policy Memorandum supersedes number 6-08.4 dated February 20, 2020

TO: REGIONAL ENGINEERS AND HIGHWAY BUREAU CHIEFS
AGGREGATE, HOT-MIX ASPHALT (HMA), AND
PORTLAND CEMENT CONCRETE (PCC) PRODUCERS

SUBJECT: MINIMUM PRIVATE LABORATORY REQUIREMENTS FOR
CONSTRUCTION MATERIALS TESTING OR MIX DESIGN

1.0 SCOPE

This policy governs the minimum qualifications for materials **Private Quality Control (QC)** and **Quality Assurance (QA)** Laboratories operated by **Contractors, Producers and Consultants**.

It applies to three categories of materials testing:

1. Aggregate (Agg)
2. Hot-mix asphalt (HMA)
3. Portland cement concrete (PCC)

Private Quality Control Laboratories shall be approved as one or more of the following laboratory types:

1. Agg QC
2. HMA/Agg QC
3. HMA Design/Agg QC
4. PCC/Agg QC
5. Jobsite PCC QC

Private Quality Assurance Laboratories shall be approved as one or more of the following laboratory types:

1. HMA/Agg QA
2. PCC/Agg QA

Qualified Private Laboratories are permitted to conduct **Acceptance Program** testing for localities such as counties, cities and municipalities. Note, however, that **Qualified Private Laboratories** are not permitted to perform **QC** (including mix design) and acceptance testing on the same project.

2.0 PURPOSE

1. To ensure that **Private QC and QA Laboratories** are equipped and maintained at a uniform and high level of quality.
2. To establish uniform procedures for evaluating and approving **Private QC and QA Laboratories**.
3. To maintain a uniform standard for inspecting test equipment and test procedures.

3.0 AUTHORITY AND REFERENCES

3.1 **Authority.** Federal regulations (23 CFR Part 637) require the **Department** to establish an **Acceptance Program** for qualifying construction testing laboratories.

3.2 References.

1. IDOT Standard Specifications for Road and Bridge Construction.
2. IDOT Manual of Test Procedures for Materials.
3. IDOT Bureau of Design and Environment Special Provisions for Hot-Mix Asphalt and Portland Cement Concrete.
4. AASHTO, ASTM, and IDOT Test Procedures.
5. Code of Federal Regulations (23 CFR Part 637).
6. Department Policy MAT-15, "Quality Assurance Procedures for Construction."
7. IDOT Bureau of Local Roads and Streets Manual

4.0 DEFINITIONS

AASHTO - American Association of State Highway and Transportation Officials.

AASHTO R 18 - The **AASHTO** Standard for "Establishing and Implementing a Quality System for Construction Materials Laboratories." The principles and/or requirements of **AASHTO R 18** are used by the **Bureau** to administer the **Qualified Laboratory** program for **District** and **Private Laboratories**.

AASHTO RE:SOURCE - Administrator of the Accreditation, Laboratory Assessment, and Proficiency Sample Programs for **AASHTO** (formerly the American Materials Reference Laboratory or AMRL). Re:source is part of the Engineering and Technical Services Division of **AASHTO**.

ACCEPTANCE PROGRAM – All factors that comprise the Department's determination of the quality of the product as specified in the contract requirements. These factors include verification (**QA**) sampling, testing, and inspection and may include results of **QC** sampling and testing.

ACCREDITED LAB - A laboratory that is currently accredited by the **AASHTO** Accreditation Program (AAP) or other accrediting body recognized by **FHWA**.

ASTM - American Society for Testing Materials.

ASTM C 1077 - The **ASTM** "Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation"

The principles and/or requirements of **ASTM C 1077** are used by the **Bureau** to administer the **Qualified Laboratory** program for **District** and **Private Laboratories**.

BUREAU - Central Bureau of Materials (CBM), Illinois **Department** of Transportation.

BUREAU LABORATORY - The **Department's** central laboratory maintained and operated by the **Bureau**. The **Bureau Laboratory** administers the **Qualified Laboratory** program for **District** and **Private Laboratories**.

CCRL – Cement and Concrete Reference Laboratory.

CONSULTANT - A private firm which performs construction materials testing for the **Department**, **Producer**, or **Contractor**. **Department** prequalification and **AASHTO** accreditation requirements apply where **Department** construction testing is performed directly for the **Department** under a **Department** contract or subcontract.

CONTRACTOR - The individual, firm, partnership, joint venture, or corporation contracting with the **Department** for performance of prescribed work.

DEPARTMENT - Illinois Department of Transportation (IDOT), including its **Districts** and Central Bureau offices.

DISTRICT - District office, Illinois **Department** of Transportation.

DISTRICT LABORATORY - A **Department** laboratory that is operated by a **District**.

FHWA - Federal Highway Administration.

FIELD TESTS - Tests that may be performed outside of a laboratory. For example, a portland cement concrete (PCC) or hot-mix asphalt (HMA) test performed at the jobsite.

INDEPENDENT ASSURANCE – Activities that are an unbiased and independent evaluation of all the sampling and testing (or inspection) procedures used in the quality assurance program. [IA provides an independent verification of the reliability of the acceptance (or verification) data obtained by the agency and the data obtained by the contractor. The results of IA testing or inspection are not to be used as a basis of acceptance. IA provides information for quality system management.] Policies and procedures contained in this memorandum are also an aspect of independent assurance.

LOCAL AGENCY - Governmental agency such as a county, city, or municipality.

NIST - National Institute for Standards and Technology.

PRIVATE LABORATORY - Any construction materials testing or design laboratory not operated by the **Department** or a **Local Agency**. This includes **Contractor**, **Producer**, or **Consultant** laboratories performing **Quality Control**, **Quality Assurance**, acceptance, **Independent Assurance**, or any other required or contracted testing on a **Department** project.

PRODUCER - An individual or business entity providing materials and/or products for performance of prescribed work.

QUALIFIED LABORATORY - A laboratory that is inspected and approved by the Department. FHWA's regulations (23 CFR 637.203) define these as *Laboratories that are capable as defined by appropriate programs established by each state transportation department. As a minimum, the qualification program shall include provisions for checking test equipment, and the laboratory shall keep records of calibration checks.*

QUALIFIED PERSONNEL - Personnel with demonstrated and documented capability to perform the applicable inspection and testing. The minimum requirement for aggregate, hot-mix asphalt or portland cement concrete testing is successful completion of the prescribed Department Quality Management Training Program classes. (Note: Additional personnel or experience requirements may apply to labs performing professional service work for the Department, e.g. Professional Engineer (P.E.) registrations, resumes, documented experience. When required, such notice will be provided in the prequalification process or solicitation notice.)

QUALITY ASSURANCE (QA) - All those planned and systematic actions necessary to provide adequate Department confidence that materials; manufactured, fabricated or constructed items; processes; products; designs; conducted test procedures; etc. will satisfy the requirements of the Specifications, Quality Control Plan, etc., as applicable.

QUALITY CONTROL (QC) - The sum total of activities performed by a Producer, Contractor, Consultant, Manufacturer, etc. to make sure materials; manufactured, fabricated or constructed items; processes; products; designs; conducted test procedures; etc. will satisfy the requirements of the Specifications, Quality Control Plan, etc., as applicable.

QUALITY ASSURANCE TESTING CONSULTANT - A Professional Engineering firm that is prequalified by the Department to perform field and/or laboratory tests for the Department. Required tests for Quality Assurance Testing Consultants are listed in Attachment A Table 2.

QUALITY ASSURANCE LABORATORY - Any laboratory used for Quality Assurance testing (Department tests) required by the Department. Required tests for Quality Assurance Laboratories are listed in Attachment A Table 2.

QUALITY CONTROL LABORATORY - Any laboratory used for Quality Control testing (Contractor or Producer tests) required by the Department. Required tests for Quality Control Laboratories are listed in Attachment A Table 1.

QUALITY CONTROL MANAGER - A Consultant or an employee of a Contractor, Producer, Manufacturer, etc. who is responsible for compliance with the QC requirements in a Department contract or policy.

STATE - The state of Illinois.

SPECIFICATIONS - Specifications for materials; manufactured, fabricated or constructed items; processes; products; designs; conducted test procedures, etc. which includes the Standard Specifications, supplemental specifications and recurring special provisions, highway standards, shop drawings, contract plans, project special provisions, AASHTO Specifications, ASTM Specifications, etc., as applicable.

STANDARD SPECIFICATIONS - The Department's Standard Specifications for Road and Bridge Construction.

TECHNICAL MANAGER - The individual with responsibility for the overall operations, condition, and maintenance of the Private Laboratory. The Technical Manager shall be identified in writing. The Technical Manager is not required to be the QC Manager defined in the contract. However, the Technical Manager shall be familiar with the Quality Control testing requirements and the specified equipment.

5.0 PRIVATE LABORATORY REQUIREMENTS

5.1 Personnel Qualifications/Responsibilities.

5.1.1 All testing for Department contracts shall be performed by Qualified Personnel as specified in the contract. This includes any testing related to Quality Assurance, Quality Control and Independent Assurance.

5.1.2 The Department will maintain a computer database of Qualified Personnel who have successfully passed the appropriate Quality Management Training Program classes.

5.2 Facilities and Equipment.

5.2.1 The Department will approve all Private Laboratories used on Department projects.

5.2.2 Each Private Laboratory shall maintain the equipment and facilities necessary to perform the tests required for each laboratory type it is approved for. Lists of required Private Laboratory test capabilities for each Qualified Laboratory type are provided in Tables 1 and 2 located in Attachment A.

5.2.3 Each Private Laboratory shall have adequate floor space to efficiently conduct the required tests for each laboratory type it is approved for. Minimum floor space requirements are provided under "Model Quality Control Plans" in Appendices B and C of the Manual of Test Procedures for Materials.

5.2.4 Each Private Laboratory shall have HVAC equipment capable of maintaining a room temperature of 20 to 30°C (68-86°F). A Private Laboratory that performs only aggregate gradation and/or aggregate moisture testing is exempt from this requirement.

5.2.5 Each Private Laboratory shall maintain, at a minimum, the required equipment for each laboratory type it is approved for as outlined in the appropriate appendix to the Manual of Test Procedures for Materials. Appendix D.3 applies to aggregate equipment, Appendix C.3 applies to portland cement concrete equipment, and Appendix D.4 applies to hot-mix asphalt equipment.

6.0 QUALITY SYSTEM CRITERIA

6.1 **AASHTO R 18 and ASTM C 1077.** Each Private Quality Assurance Laboratory shall maintain AASHTO accreditation for the required tests outlined in Attachment A Table 2 for each laboratory type it is approved for. The implemented quality system shall be

according to **AASHTO R 18** for HMA/Agg labs, and **AASHTO R 18** and **ASTM C 1077** for PCC/Agg labs.

- 6.2 **Technical Manager.** Each **Private Laboratory** shall have a **Technical Manager** (however titled) who has overall responsibility for the technical operations of the **Private Laboratory**. The **Technical Manager** shall be responsible for equipment maintenance, calibration, standardization, verification and checks; maintaining records; and ensuring that current test procedures are utilized. If the **Private Laboratory** is prequalified in a Professional **Consultant** service category, a licensed Illinois Professional Engineer shall have direct supervision of the laboratory.

- 6.3 **Equipment Calibration, Standardization, Verification and Checks (C/S/V/C).** The **Private Quality Control Laboratory** shall calibrate, standardize, verify or check all testing equipment associated with tests performed for each laboratory type it is approved for according to Attachment A Table 3. The table also provides descriptive notes and links to forms that may be used to document lab equipment C/S/V/Cs. Heavy use or specific test requirements may require more frequent intervals than those given in Attachment A Table 3. **Department** verification of **Private Quality Control Laboratory** equipment shall not be construed as part of, or substitute for, equipment calibration, standardization, verification or check requirements, except for **Department** verification of the gyratory compactor using the DAV-2 and **Department** verification of the gyratory molds using the bore gauge.

The **Private Quality Assurance Laboratory** shall meet the requirements listed above for the **Private Quality Control Laboratory** for each laboratory type it is approved for. In addition, the **Private Quality Assurance Laboratory** shall calibrate, standardize, verify or check all equipment associated with the tests for which the **Private Quality Assurance Laboratory** is accredited according to **AASHTO R 18** and **ASTM C 1077**, as applicable.

- 6.4 **Department Proficiency Testing.** **Private Laboratory** qualifications may include round-robin proficiency testing conducted by the **Department**. Results of proficiency testing may be considered in the overall evaluation of the **Private Laboratory** to conduct specific tests.

6.5 **Records.**

- 6.5.1 **Test Records.** Each **Private Laboratory** shall maintain test records which contain sufficient information to permit verification of any test report.

- 6.5.2 **Laboratory Quality Records.** Each **Private Laboratory** shall maintain documentation of internal quality controls. At a minimum, the records shall include:

1. Documentation of assignment of personnel responsible for internal quality controls.
2. Documentation of equipment calibration, standardization, verification and checks.
3. All documentation shall be maintained and available for **Department** inspection for a period of three years.

6.5.2.1 Equipment Calibration, Standardization, Verification and Check Records. Calibration, standardization, verification and check records shall include the minimum information listed below. **AASHTO R 18** and **ASTM C 1077** provide additional guidance for recording calibration, standardization, verification and check records for testing equipment.

1. Description.
2. Model & Serial Number.
3. Name of person calibrating, standardizing, verifying or checking.
4. Equipment used for calibration, standardization, verification or checks (e.g., standard weights, proving rings, thermometers).
5. Date calibrated, standardized, verified, or checked & next due date.
6. Reference procedure used.
7. Results of calibration, standardization, verification or checks.

6.5.3 Proficiency Sample Records. Each **Private Laboratory** shall retain results of participation in any proficiency sample program, including the documentation of steps taken to determine the cause of poor results and corrective action taken.

6.6 **Publications.** Each **Private Laboratory** shall maintain current copies or electronic access to the required test procedures for each laboratory type it is approved for. Each **Private Laboratory** shall maintain a current copy or electronic access to the Manual of Test Procedures for Materials.

7.0 LABORATORY INSPECTIONS

7.1 **General.** The Department will approve **Private Quality Control** and **Quality Assurance Laboratories** by inspection and other requirements, as applicable.

7.1.1 Aggregate and Jobsite PCC Private QC Laboratories. Initial inspections and re-inspections will be performed by the District.

7.1.2 All Other Private Laboratories. Initial inspections are performed by the Bureau. Re-inspections are performed by the District.

7.1.3 Documentation review of a **Private Laboratory's** equipment calibration, standardization, verification and check records by the **Bureau** and resolution of any nonconformities is required prior to the initial **Bureau** inspection according to Subsection 7.4.4 for **Private Laboratories** seeking to become a **Quality Control Laboratory** or **Quality Assurance Testing Consultant**.

7.1.4 Initiation of the prequalification process with the Bureau of Design and Environment is required prior to initial **District** pre-inspection according to Subsection 7.4.3 and initial **Bureau** inspection according to Subsection 7.4.4 for **Private Laboratories** seeking to become a **Quality Assurance Testing Consultant**.

7.2 **AASHTO Accredited Private Quality Assurance Laboratories.**

7.2.1 Current **AASHTO** accreditation as well as providing **Departmental** access to the results of participation in the **AASHTO** Proficiency Sample Program is a prerequisite for beginning the prequalification process for a **Private Laboratory** to become a **Quality Assurance Testing Consultant**. Other prerequisites may be found in the prequalification instructions

and forms. **AASHTO re:source** shall provide accreditation assessment for HMA/Agg QA Laboratories. **CCRL** shall provide accreditation assessment for PCC/Agg QA Laboratories. Instructions for providing the **Department** access to a **Private Laboratory's** Proficiency Sample Program results can be found in Attachment B.

7.2.2 **AASHTO** accreditation does not waive the right of the **Department** to conduct inspections and/or re-inspections.

7.3 Initial Private Laboratory Inspection Scope.

1. Facilities - Physical and environmental conditions.
2. Equipment - Test apparatus for specification compliance.
3. Documentation - Calibration, standardization, verification and check records.
4. Personnel - A review of **Qualified Personnel** credentials.
5. Observation - The **Private Laboratory** may be required to demonstrate required tests. Some test procedures, such as **Field Tests**, may be evaluated through discussion with laboratory personnel.
6. Report - The **Private Laboratory** will be provided with a report listing those tests for which it is approved. The report will note deficiencies.

7.4 Initial Private Laboratory Inspection Procedure.

7.4.1 The **Private Laboratory** shall submit a written request for an inspection to the **District**. The request shall indicate the following:

1. The location of the **Private Laboratory**.
2. The type of **Private Laboratory**, i.e., Agg QC, PCC/Agg QC, HMA/Agg QA, etc.
3. The name of the **Technical Manager** who will be present for the inspection.
4. The date the **Private Laboratory** will be ready for inspection.

7.4.2 The **District** will notify the **Bureau** of the inspection request and coordinate with the **Private Laboratory** to submit equipment calibration, standardization, verification, and check records to the **Bureau**. Once all record nonconformities are resolved, **Bureau** personnel will establish a tentative date to perform the inspection (see also Subsection 7.1.3).

7.4.3 The **District** will perform a pre-inspection approximately seven calendar days before the **Bureau** inspection. The **District** will verify that the **Private Laboratory** is ready for inspection and notify the **Bureau**.

7.4.4 **Bureau** personnel will perform the inspection and prepare a preliminary report. Standard inspection forms and a preliminary report, developed and maintained by the **Bureau Laboratory**, will be used.

7.4.5 **Bureau** personnel will assign identification numbers to all test equipment. Unless a **District** has an established numbering system, the following sequences will be used:

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Sieves

e.g., IL07-1418-01

where: IL = State

07 = inspection year

1418-01 = Producer/Supplier Number

Sieves are engraved on the inside of the bottom lip directly beneath the label. If a laboratory does not have a producer/supplier number, all sieves will be engraved with one number that follows the numbering system for HMA or PCC lab equipment, as appropriate.

HMA Equipment

e.g., IL07B1 - 123

where: IL = State

07 = inspection year

B = hot mix asphalt (bituminous)

1 = district number

123 = sequential numbers

PCC Equipment

e.g., IL07C1 - 123

where: IL = State

07 = inspection year

C = concrete

1 = district number

123 = sequential numbers

Note: The numbering system prior to 2007 was IL07-123 for HMA and IL07CND1-123 for PCC. The change was made to make the numbering system more uniform.

- 7.4.6 **Bureau personnel will perform a close-out with the Technical Manager and the District representative. The Technical Manager and the District will be given a copy of the preliminary report.**
- 7.4.7 **If a review of the preliminary report indicates there are no deficiencies, the Bureau will provide written notification to the Private Laboratory indicating the Private Laboratory is now an approved Quality Control or Quality Assurance Laboratory. The notification will include an equipment list. A copy of the notification will be provided to the District.**
- 7.4.8 **If the preliminary report indicates there are deficiencies, the Bureau will provide written notification to the Private Laboratory, indicating the deficiencies and that corrective action is required. A copy of the written notification will be provided to the District.**
- 7.4.9 **After correction of all cited deficiencies, the Private Laboratory shall notify the District. The District will inspect the Private Laboratory to verify the deficiencies have been corrected and will notify the Bureau in writing.**
- 7.4.10 **The Bureau will provide written notification to the Private Laboratory, indicating the Private Laboratory is now an approved Quality Control or Quality Assurance**

Laboratory. The notification will include an equipment list. A copy of the written notification will be provided to the **District**.

7.4.11 Uncorrected deficiencies will not be waived. Equivalent equipment specifications may be approved only with the written approval of the **Bureau's** Engineer of Concrete, Soils, and Metals.

7.5 Initial Private Aggregate Quality Control Laboratory Inspection. For aggregate and Jobsite PCC **Private Quality Control Laboratories**, the procedures outlined in 7.4 shall be followed, except **District** personnel will perform the inspection instead of personnel from the **Bureau**.

7.6 Re-Approval of Approved Private Laboratories.

7.6.1 The re-inspection of **Private Laboratories** shall be conducted at intervals deemed appropriate by the **District**. The interval between inspections shall not exceed two calendar years. The **District's** evaluation may include the following:

1. Physical inspection of the laboratory facility and equipment.
2. Review of the **Private Laboratory's** internal quality plan and documentation in accordance with this policy and those parts of **AASHTO R 18** and **ASTM C 1077** incorporated by this policy.
3. Observations of tests performed by **Qualified Personnel**.
4. Results of split sample testing between the **Private Laboratory** and the **District**.
5. Results of proficiency sample testing programs conducted by the **Department**.
6. Overall past performance and experience.

7.6.2 The **District** may not waive any requirements for **Private Laboratories** or test equipment for required tests.

7.6.3 The **District** shall issue a letter of re-approval to the **Private Laboratory**, or provide a written and itemized deficiency list. The **Private Laboratory** shall notify the **District** when deficiencies are corrected and ready for re-inspection.

7.6.4 At any time, if the **District** identifies deficiencies in the facility, equipment, or test procedures that could affect the results of any **QC** or **QA** tests, the **District** will require the **Private Laboratory** to take immediate action to correct the deficiency.

8.0 EXEMPTIONS – AASHTO ACCREDITATION PROGRAM

If a **Private Laboratory** maintains current accreditation through the **AASHTO** Accreditation Program (AAP) for the appropriate test procedures, the **District** may waive the re-inspection requirements of this policy. To enact the waiver, the **Private Laboratory** shall provide copies of inspection reports and proficiency sample results to the **District**. This waiver does not apply to the initial inspection requirements, including the required equipment list.

9.0 LABORATORY DATABASE

The **Bureau** is responsible for maintaining a database that monitors the approval status of **Department** and **Private Laboratories**. Online queries and reports are available to

the Districts to assist them in tracking Qualified Laboratories. **Districts** shall be responsible for updating the database with approval status of **Local Agency Laboratories and Aggregate Only Private Laboratories**. The database will include the following information:

1. Laboratory Codes (Department, Producer, etc.)
2. Responsible District
3. Type Laboratory (Agg QC, HMA/Agg QC, HMA Design/Agg QC, PCC/Agg QC, Jobsite PCC QC, HMA/Agg QA, or PCC/Agg QA)
4. Demographics (Address, etc.)
5. Date Inspected
6. Approval Status

10.0 CLOSING NOTICE

Archived versions of this policy memorandum may be examined by contacting the **Bureau**.

The current **Bureau** Chief of Materials has approved this policy memorandum. Signed documents are on file with the **Bureau**.

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TABLE 1
PRIVATE QUALITY CONTROL LABORATORY TESTS

<u>PROCEDURE</u>	<u>PRIVATE QC LAB TYPE</u>					TITLE
	AGG	HMA QC	HMA DESIGN	PCC QC	Jobsite PCC QC	
Illinois Test Procedure (ITP)						
ITP 2	✓	✓	✓	✓	✓	Sampling of Aggregates
ITP 11	✓	✓	✓	✓		Materials Finer Than 75-µm (No. 200) Sieve in Mineral Aggregates by Washing
ITP 19	✓ ¹			✓		Bulk Density ("Unit Weight") and Voids in Aggregate
ITP 27	✓	✓	✓	✓		Sieve Analysis of Fine and Coarse Aggregate
ITP 84	✓ ²					Specific Gravity and Absorption of Fine Aggregate
ITP 85	✓ ²					Specific Gravity and Absorption of Coarse Aggregate
ITP 248	✓	✓	✓	✓	✓	Reducing Samples of Aggregate to Testing Size
ITP 255	✓	✓	✓	✓	✓	Total Evaporable Moisture Content of Aggregate by Drying
ITP 306				Required if developing Mix Designs		Voids Test of Coarse Aggregate for Concrete Mixtures

AGGREGATE TESTS

Note 1: Required for laboratories that test Air Cooled Blast Furnace Slag.

Note 2: Required for laboratories that run the Department's Slag Producers' Self-Testing Program

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**TABLE 1 (CONT'D)
PRIVATE QUALITY CONTROL LABORATORY TESTS**

<u>PROCEDURE</u>		<u>PRIVATE QC LAB TYPE</u>		<u>TITLE</u>
AASHTO (Illinois Modified)	ASTM (Illinois Modified)	HMA QC	HMA DESIGN	
T 30 (IL)		✓	✓	Mechanical Analysis of Extracted Aggregate
T 164 (IL)		✓ ³ Or T 287 or T 308 ⁴	✓ ³	Quantitative Extraction of Asphalt Binder from Hot Mix Asphalt (HMA)
T 166 (IL)		✓	✓	Bulk Specific Gravity (Gmb) of Compacted Hot Mix Asphalt (HMA) Using Saturated Surface-Dry Specimens
T 209 (IL)		✓	✓	Theoretical Maximum Specific Gravity (Gmm) and Density of Hot Mix Asphalt Paving Mixtures
T 283 (IL)			✓	Resistance of Compacted Hot Mix Asphalt (HMA) to Moisture-Induced Damage
T 287 (IL)		✓ Or T 164 or T 308 ⁴		Asphalt Binder Content of Asphalt Mixtures by the Nuclear Method
T 308 (IL)		✓ Or T 164 or T 287 ⁴	✓	Determining the Asphalt Binder Content of Hot Mix Asphalt (HMA) by the Ignition Method
T 312 (IL)		✓	✓	Preparing and Determining the Density of Hot Mix Asphalt (HMA) Specimens by Means of the Superpave Gyrotory Compactor
	D 2950 (IL)	✓		Determination of Density of Bituminous Concrete in Place by Nuclear Methods – Field Test; not observed during Lab Inspection

Note 3: Method A or B shall be used for quantitative extraction. Method A or E shall be used to recover binder for qualitative analysis. If a QC HMA Mix Design laboratory does not have the ability to perform AASHTO T 164 (IL), outsourcing the test to a qualified QC or QA laboratory will be permitted.

Note 4: Determined by which piece of equipment is more appropriate for the lab to determine asphalt content.

TABLE 1 (CONT'D)
PRIVATE QUALITY CONTROL LABORATORY TESTS

PORTLAND CEMENT CONCRETE TESTS			
PROCEDURE	PRIVATE QC LAB TYPE		TITLE
AASHTO (Illinois Modified)/Illinois Test Procedure (ITP)	ASTM (Illinois Modified)	PCC QC	Jobsite PCC QC
R 39 (IL)		Required if developing mix designs.	Making and Curing Concrete Test Specimens in the Laboratory
R 60 (IL)		✓	Sampling Freshly Mixed Concrete
T 22 (IL)		✓ ⁵ Either T 22 or T 177	Compressive Strength of Cylindrical Concrete Specimens
T 23 (IL)		✓	Making and Curing Concrete Test Specimens in the Field
T 119 (IL)		✓	Slump of Hydraulic Cement Concrete
T 121 (IL)			Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete
T 152 (IL)		✓	Air Content of Freshly Mixed Concrete by the Pressure Method - Type A or B Air Meter
T 177 (IL)		✓ ⁵ Either T 22 or T 177	Flexural Strength of Concrete (Using Simple Beam with Center-Point Loading)
T 196 (IL)			Air Content of Freshly Mixed Concrete by the Volumetric Method
T 231 (IL)		Either T 231 or C 1231	Capping Cylindrical Concrete Specimens
	C 1064 (IL)	✓	Temperature of Freshly Mixed Hydraulic Cement Concrete
	C 1231 (IL)	Either T 231 or C 1231	Use of Unbonded Caps in Determination of Compressive Strength of Hardened Concrete Cylinders

Note 5: For an exception to the strength testing requirement of performing compressive or flexural testing (Example: Labs at Concrete Producer Plants), refer to the Department's "Required Sampling and Testing Equipment for Concrete" document and check with District for approval of exception.

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TABLE 2
REQUIRED TESTS – QUALITY ASSURANCE TESTING CONSULTANTS ^{1,2}

PROCEDURE		REQUIRED FOR PREQUALIFICATION			TITLE
		Private QA Lab Type: HMA/Agg and PCC/Agg			
Illinois Test Procedure (ITP)/ AASHTO	ASTM	IDOT QA	AAP On-Site Assessment	AAP Proficiency Sample Program	
AGGREGATE	ITP 2	✓			Sampling of Aggregates
	ITP 11	✓			Materials Finer Than 75-µm (No. 200) Sieve in Mineral Aggregates by Washing
	T 11		✓	✓	
	ITP 19	✓			Bulk Density (“Unit Weight”) and Voids in Aggregate
	T 19		✓		
	ITP 27	✓			Sieve Analysis of Fine and Coarse Aggregates
	T 27		✓	✓	
	ITP 84 ³	✓			Specific Gravity and Absorption of Fine Aggregate
	T 84 ³		✓	✓	
	ITP 85 ³	✓			Specific Gravity and Absorption of Coarse Aggregate
T 85 ³		✓	✓		
ITP 248	✓			Reducing Samples of Aggregate to Testing Size	
R76		✓			
ITP 255	✓			Total Evaporable Moisture Content of Aggregate by Drying	
T 255		✓			

Note 1: Compliance with IDOT test methods will be required for IDOT QA lab inspections. However, AASHTO re:source or CCRL lab inspections shall require compliance with the corresponding AASHTO or ASTM test methods.

Note 2: QA labs have the option to be HMA/Agg, PCC/Agg or HMA/PCC/Agg approved.

Note 3: Required for laboratories that run the Department's Slag Producers' Self-Testing Program.

TABLE 2 (CONT'D)
REQUIRED TESTS – QUALITY ASSURANCE TESTING CONSULTANTS ^{1, 2}

PROCEDURE		REQUIRED FOR PREQUALIFICATION			TITLE
		Private QA Lab Type: HMA/Agg			
Illinois Modified/ AASHTO	ASTM Illinois Modified	IDOT QA	AAP On-Site Assessment	AAP Proficiency Sample Program	
HOT-MIX ASPHALT	T 30 (IL)	✓			Mechanical Analysis of Extracted Aggregate
	T 30		✓	✓	
	T 164 (IL)	✓			Quantitative Extraction of Asphalt Binder from Hot Mix Asphalt (HMA)
	T 164		✓	✓	
	T 166 (IL)	✓			Bulk Specific Gravity (Gmb) of Compacted Hot Mix Asphalt (HMA) Using Saturated Surface-Dry Specimens
	T 166		✓	✓	
	T 209 (IL)	✓			Theoretical Maximum Specific Gravity (Gmm) and Density of Hot Mix Asphalt Paving Mixtures
	T 209		✓	✓	
	T 283 (IL)	✓			Resistance of Compacted Hot Mix Asphalt (HMA) to Moisture-Induced Damage
	T 283		✓		
T 287 (IL)	✓ ⁴			Asphalt Binder Content of Asphalt Mixtures by the Nuclear Method	
T 308 (IL)	✓			Determining the Asphalt Binder Content of Hot Mix Asphalt (HMA) by the Ignition Method	
T 308		✓	✓		
T 312 (IL)	✓			Preparing and Determining the Density of Hot Mix Asphalt (HMA) Specimens by Means of the Superpave Gyratory Compactor	
T 312		✓	✓		
	D 2950 (IL)	✓			Density of Bituminous Concrete in Place by Nuclear Method – Field Test

Note 1: Compliance with IDOT test methods will be required for IDOT QA lab inspections. However, AASHTO re:source or CCRL lab inspections shall require compliance with the corresponding AASHTO or ASTM test methods.

Note 2: QA labs have the option to be HMA/Agg, PCC/Agg or HMA/PCC/Agg approved.

Note 4: Requirement determined on case-by-case basis by District in which lab is located.

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TABLE 2 (CONT'D)
REQUIRED TESTS – QUALITY ASSURANCE TESTING CONSULTANTS ^{1, 2}

PROCEDURE		REQUIRED FOR PREQUALIFICATION			TITLE	
		Private QA Lab Type: PCC/Agg				
Illinois Modified/ AASHTO/Illinois Test Procedure (ITP)	ASTM/Illinois Modified	IDOT QA	AAP On-Site Assessment	AAP Proficiency Sample Program		
PORTLAND CEMENT CONCRETE	C 192			✓	Making and Curing Concrete Test Specimens in the Laboratory	
	R 60 (IL)		✓		Sampling Freshly Mixed Concrete	
	C 172		✓			
	T 22 (IL)		✓		Compressive Strength of-Cylindrical Concrete Specimens	
	C 39		✓	✓		
	T 23 (IL)		✓		Making and Curing Concrete Test Specimens in the Field	
	C 31		✓			
	T 119 (IL)		✓		Slump of Hydraulic Cement Concrete	
	C 143		✓	✓		
	T 121 (IL)		✓		Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete	
	C 138		✓	✓		
	T 152 (IL)		✓		Air Content of Freshly Mixed Concrete by the Pressure Method-Type A or B Air Meters	
	C 231			✓		
	T 177 (IL)		✓		Flexural Strength of Concrete (Using Simple Beam with Center-Point Loading)	
	C 293			✓ ⁵		
	T 196 (IL)		6		8	Air Content of Freshly Mixed Concrete by the Volumetric Method
	C 173			6		
	T 231 (IL)		6			Capping Cylindrical Concrete Specimens
	C 617			6		
	C 1064 (IL) C 1064		✓	✓		Temperature of Freshly Mixed Hydraulic Cement Concrete
C 1231 (IL) C 1231		✓	✓		Use of Unbonded Caps in Determination of Compressive Strength of Hardened Concrete Cylinders	
ITP 301		6			Fine Aggregate Moisture Content by the Flask Method	
ITP 302		6			Aggregate Specific Gravity and Moisture Content by the Dunagan Method	
ITP 303		6			Fine or Coarse Aggregate Moisture Content by Pycnometer Jar Method	
ITP 306		7			Voids Test of-Coarse Aggregate for Concrete Mixtures	

Note 1: Compliance with IDOT test methods will be required for IDOT QA lab inspections. However, AASHTO re:source or CCRL lab inspections shall require compliance with the corresponding AASHTO or ASTM test methods.

Note 2: QA labs have the option to be HMA/Agg, PCC/Agg or HMA/PCC/Agg approved.

Note 5: The AAP on-site assessment is not required for Illinois type portable beam breakers but is required for all other types of beam breakers. Additional information regarding use of portable PCC labs and their approval is provided in Department Policy MAT-15, "Quality Assurance Procedures for Construction".

Note 6: Test equipment shall be presented during an inspection if the consultant lab has the ability to perform the test.

Note 7: Test equipment shall be presented during an inspection if consultant lab has the ability to verify PCC mix designs.

Note 8: Test shall be performed if consultant lab has the ability to perform the test.

TABLE 3
EQUIPMENT CALIBRATION, STANDARDIZATION, VERIFICATION AND CHECK SCHEDULE¹

EQUIPMENT	REQUIREMENT	MAX. INTERVAL (MONTHS)	FORM AND/OR PROCEDURE
GENERAL			
General Purpose Balance and Scale	Commercial Service or Verification using Standardized NIST Traceable Masses	12	BMPR QCD01
Standard Masses	Standardize	60	Outside Calibration
Caliper	Standardize	12	BMPR QCD02
Micrometer	Standardize	12	BMPR QCD03
Oven	Standardize Thermometric Device	12	BMPR QCD04
Working Thermometer	Standardize with Calibrated NIST Traceable Reference Thermometer	12	BMPR QCD05
Reference Thermometer	Calibrate	60	Outside Calibration
Timer	Check Accuracy	12	BMPR QCD06
Caliper Checker or Gauge Blocks	Calibrate	60	Outside Calibration
AGGREGATE			
Mechanical Shaker	Check Sieving Thoroughness	12	BMPR QCD07
Agg. Unit Weight Measure	Standardize	12	BMPR QCD08
Conical Mold and Tamper	Check Critical Dimensions	24	BMPR QCD09
Coarse Sieves (Openings ≥ 4.75 mm)	Check Overall Physical Condition and Dimensions of Openings	12	BMPR QCD10 Calipers BMPR QCD11 Go/No-Go Gauges
Fine Sieves (Openings < 4.75 mm)	Check Overall Physical Condition	12	BMPR QCD12

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EQUIPMENT	REQUIREMENT	MAX. INTERVAL (MONTHS)	FORM AND/OR PROCEDURE
HOT MIX ASPHALT			
Gyratory Compactor	Verify Angle ² , Pressure, and Height	Once a Month During Use	Manufacturer's Instructions ²
	Verify Angle using a DAV-2	12	MTP Appendix B.19
Molds, Base Plates, and Ram Face	Check Critical Dimensions	12	BMPR QCD13
Tensile Strength Machine	Verification	12	ASTM E4
Ignition Furnace Balance	Commercial Service or Verification using Standardized NIST Traceable Masses	12	BMPR QCD01
Manometer and Vacuum Pump	Standardize and Check Pressure	12	BMPR QCD14
TSR Breaking Head	Check Critical Dimensions	12	BMPR QCD15
Pycnometer	Standardize Volume	12	BMPR QCD16
Water Baths	Standardize	12	BMPR QCD17
Bore Gauge	Standardize	Each Use	IL Mod AASHTO T312
Master Ring	Calibrate	60	Outside Calibration
Hamburg Wheel Tracking Machine:			
Water Temperature	Verification	6	BMPR QCD18
Speed	Verification	12	
Wheel Weight	Verification	24	
LVDT'S	Verification	12	
I-FIT	Verify with Validator (Servo-hydraulic Machines only)	Once a Month During Use	See I-FIT Validator Lab Worksheet

EQUIPMENT	REQUIREMENT	MAX. INTERVAL (MONTHS)	FORM AND/OR PROCEDURE
PORTLAND CEMENT CONCRETE			
PCC Unit Weight Measure	Standardize	12	BMPR QCDC34 Unit Weight Bucket
Air Meter (Pressure Type)	Standardize	12 (Type A)	BMPR QCDC35 Air Meter Bowl
	Standardize	3 (Type B)	BMPR QCDC36
	Standardize	12	BMPR QCDC37
Air Meter (Volumetric Type)	Standardize	12	BMPR QCDC38
Compression & Flexural Testing Machine	Verification	12	ASTM E4
Capping Material	Check Strength	3 or New Shipment	BMPR QCDC39
Slump Cone	Check Critical Dimensions	12	BMPR QCDC40
Beam Molds	Check Critical Dimensions	12	BMPR QCDC41
Plastic Cylinder Mold 4 x 8	Check Dimensions	Each Shipment	BMPR QCDC42
Plastic Cylinder Mold 6 x 12	Check Dimensions	Each Shipment	BMPR QCDC43
Retaining Rings and Neoprene Pads	Check Critical Dimensions and Neoprene Pad Usage	12	BMPR QCDC44
Metal Stem Thermometer	Standardize with Calibrated NIST Traceable Reference Thermometer	12	BMPR QCDC45
Moist Room/Storage Tank Recording Thermometer or Max/Min Thermometer	Standardize with Calibrated NIST Traceable Reference Thermometer	12	BMPR QCDC46

Note 1: See AASHTO R 18 for equipment calibration, standardization, verification and check terminology definitions.

Note 2: See Manual of Test Procedures Appendix B.19 for permissible verification procedures.

State of Illinois
Department of Transportation
Bureau of Materials
Springfield

POLICY MEMORANDUM

Revised: July 24, 2018

7-08.3

This Policy Memorandum supersedes 7-08.2 dated March 1, 2014

TO: REGIONAL ENGINEERS AND BUREAU CHIEFS IN THE OFFICE OF
HIGHWAYS PROJECT IMPLEMENTATION

SUBJECT: RECYCLING PORTLAND CEMENT CONCRETE INTO AGGREGATE

1.0 SCOPE

Section 1003 and 1004 of the [Standard Specifications for Road and Bridge Construction](#) includes "crushed concrete" as an acceptable source of aggregate material. Care must be taken, however, to assure that quality and gradation requirements are not compromised when recycled concrete is used in lieu of other aggregate materials. Concrete removal and crushed concrete stockpiling and handling must be performed in such a manner as to avoid contamination of the aggregate with dirt and foreign matter.

2.0 SAMPLING/TESTING PERSONNEL

All sampling and testing for gradation shall be conducted by an Aggregate Technician or Mixture Aggregate Technician, as designated in the IDOT Policy Memorandum "[Aggregate Gradation Control System \(AGCS\)](#)". Quality testing sampling, when specified shall be conducted by an IDOT Aggregate Inspector.

The overall program shall be administered by a Quality Control (QC) Manager, as designated in the AGCS.

3.0 GENERAL PROCEDURE

Acceptance of crushed concrete from jobsite recycling, or central recycling shall be according to 3.1 herein. Acceptance of returned Ready-Mix Concrete shall be according to 3.2 herein.

3.1 Acceptance at Jobsite or Central Recycler.

- 3.1.1 Acceptance of crushed concrete begins with approval of the raw feed stockpile. Crushed concrete used as raw feed at a central recycling plant or at a jobsite shall not be contaminated with soil or foreign matter. A small amount of soil embedded in the base of the concrete slab is acceptable. A small amount of construction debris, steel, fabric, wood from forms, and a small amount of RAP leftover from milling is also acceptable. Raw feed piles shall not have excavated soil, bricks, slabs of HMA pavement, or washout from concrete trucks. Previously approved crushed stone or crushed gravel

from the jobsite is allowed but shall be limited to 25 percent of the total raw feed. Contamination in the stockpile area is as detrimental as contamination when picking up the broken concrete. Stockpile pads shall be provided and haul roads/plant areas properly maintained to assure that acceptable material is not contaminated prior to use.

Stockpiling, hauling, and loading shall conform to the AGCS.

- 3.1.2 Quality testing, when specified, shall consist of one quality sample per every 10,000 tons per specific gradation. The quality samples shall be taken from stockpiled material. Quality testing limits by use are specified below.

Aggregate Use	IL Test Procedure 327* (% Loss)	IL Test Procedure 96* (% Loss)
HMA Surface and Binder	15.0	40
Granular Embankment Special, Granular Subbase, Stabilized Subbase, Aggregate Base, Aggregate Surface, and Aggregate Shoulders		45
Aggregate Wedge Shoulders, Type B		45

Aggregate Use	IL Test Procedure 203* (% Deleterious)		
	RAP	OTHER	TOTAL
HMA Surface and Binder		2.0	2.0
Granular Embankment Special, Granular Subbase, Stabilized Subbase, Aggregate Base, Aggregate Surface, and Aggregate Shoulders	5.0	2.0	7.0
Aggregate Wedge Shoulders, Type B		2.0	2.0
Aggregate Subgrade Improvement**			10.0

* Found in the current [Manual of Aggregate Quality Test Procedures](#)

** This shall be performed with a visual of the Raw feed by the IDOT Aggregate Inspector. If disputed a sample of the finished product shall be sent to the Central Bureau of Materials for verification testing. Jobsite stockpiles that are for use on the same contract that the material originated from may be sent to a Central Recycler for crushing but must be kept separate from the other material to ensure no contamination takes place.

3.2 Recycled Returned Ready-Mix Concrete.

Portland Cement Concrete may be recycled by curing returned concrete either at the Concrete Mix Plant or at a Central Recycling Plant as outlined below:

Returned concrete shall be dumped on a clean stockpile area or concrete pad. A small amount of fines scattered on the pad prior to dumping the returned concrete, will assist in removal of the cured concrete.

No water shall be added to the returned concrete before dumping.

After the concrete truck is empty, it shall then proceed to a different area to "wash out". "Wash out" refers to the use of water and agitation to remove the ready-mix residue from the inside the ready-mix truck.

The returned concrete shall be cured for a minimum of 2 weeks to gain strength. Cured concrete is then broken up and placed in piles.

3.2.1 Quality. IDOT reserves the right to test this material for quality, as outlined in Section 3.1.2., herein, if contamination is present in the stockpile.

3.3 Gradation.

Gradation sampling and testing shall comply with the Aggregate Gradation Control System. "Wash out" material may be mechanically blended with the returned concrete during aggregate production as long as the final product still meets the required gradation.

3.4 Stockpiling.

Stockpiling, hauling, and loading shall comply with the Aggregate Gradation Control System. Stockpile pads shall be provided and the haul roads/plant area properly maintained to prevent contamination.

4.0 CLOSING NOTICE

Archive versions of this policy memorandum may be examined by contacting the Bureau of Materials.

The current Bureau Chief of Materials has approved this policy memorandum. Signed documents are on file with the Bureau.

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State of Illinois
Department of Transportation
Bureau of Materials
Springfield

POLICY MEMORANDUM

Revised: December 4, 2018

11-08.6

This Policy Memorandum supersedes number 11-08.5 dated July 24, 2018

TO: REGIONAL ENGINEERS AND BUREAU CHIEFS IN THE OFFICE OF HIGHWAYS
PROJECT IMPLEMENTATION

SUBJECT: AGGREGATE GRADATION CONTROL SYSTEM (AGCS)

1.0 SCOPE

This program shall apply to all Sources that supply certified aggregate for uses identified in this program to projects let under the jurisdiction of the Illinois Department of Transportation (includes local agency projects with state/federal funding). All aggregate shipped for program-designated uses on these projects shall be from a Certified Source.

2.0 PURPOSE

- 2.1 To establish a procedure of certification whereby Sources shall supply aggregate for designated use meeting test properties cited by the Bureau.
- 2.2 To set forth the conditions for Source certification and revocation of certification.

3.0 DEFINITIONS

- 3.1 **AGCS Technician** - A technician at the Source who has successfully completed the Department's AGCS Technician Course. The AGCS training course is no longer available; however, there are still individuals that hold this title. This individual may perform all duties of the Aggregate Technician under the Gradation Control Program except gradation testing. Gradation testing (including splitting) must be performed by an Aggregate Technician or a Mixture Aggregate Technician.
- 3.2 **Aggregate Inspector** - District materials inspector who has successfully completed the Department's Aggregate Technician Course and is responsible for inspection at an aggregate Source. A Consultant, hired by the Department to perform the duties of an Aggregate Inspector, shall not be allowed to take any quality or Freeze-Thaw samples at an aggregate source.
- 3.3 **Aggregate Technician** - Sampling and testing technician at the Source who has successfully completed the Department's Aggregate Technician Course and is responsible for the Gradation Control Program at the Source. The Aggregate Technician course (CET 021) is a 5-day course, offered as a part of the IDOT Quality Management Training Program administered through Lake Land College in Mattoon, IL.
<https://www.lakelandcollege.edu/idot-quality-management-training-program/>

- 3.4 **Bureau** - The Central Bureau of Materials, of the Illinois Department of Transportation, located in Springfield, Illinois.
- 3.5 **Department** - Illinois Department of Transportation.
- 3.6 **District** - Materials Office located at each Illinois Department of Transportation highway district office.
- 3.7 **Failing Gradation Sample** - A gradation sample which, when tested, exceeds the established Master Band on the critical sieve and/or exceeds the specification ranges on the other sieves for that gradation.
- 3.8 **Gradation Technician** - A technician who has successfully completed the Department's Gradation Technician Course and is responsible only for splitting and testing gradation samples. The Gradation Technician shall be monitored on a daily basis by the Aggregate Technician. To become a Gradation Technician, contact the local IDOT Aggregate Inspector. The Gradation Technician Course is a ½ day course that is taught by IDOT District personnel and is not administered by Lake Land College.
- 3.9 **Mechanical Blending** – Blending for gradation or of different types of materials shall be through interlocked feeders or a blending plant such that the prescribed blending percentage is maintained throughout the blending process.
- 3.10 **Mixture Aggregate Technician** - A technician who has successfully completed the Department's Mixture Aggregate Technician course (CET 020) and is responsible only for gradation sampling and gradation testing. The Mixture Aggregate Technician course (CET 020) is a 3-day course, offered as a part of the IDOT Quality Management Training Program administered through Lake Land College in Mattoon, IL.
<https://www.lakelandcollege.edu/idot-quality-management-training-program/>
- 3.11 **Monitor Sample** - Gradation sample taken from the Source, Terminal, Supplier Yard, or mix plant and tested by the Department to monitor the gradation being produced by the Source under its Gradation Control Program. This sample shall also be used to evaluate the adequacy of procedures and equipment used by the Source in its Gradation Control Program.
- 3.12 **Outlying (OS) Source** – A certified aggregate source located out-of-state which is specifically designated by the inspecting District and the Bureau and required to follow the requirements listed in Section 8.0 herein.
- 3.13 **Qualified Products List (QPL)** – An approved or Qualified Aggregate Source List maintained by the Department identifying aggregate sources certified to supply aggregate to Department/Local Agency projects.
- 3.14 **Quality Control (QC) Manager** - The Aggregate Technician or the AGCS Technician designated by the Source who shall be responsible for compliance with the requirements of the Aggregate Gradation Control System. The QC Manager shall have successfully completed the Department's Aggregate Technician Course or the AGCS Technician Course.

- 3.15 **Source** - Individual aggregate source, i.e., a specific quarry or pit location supplying a specific product or products.
- 3.16 **Source Classification** - Under this program, a Source will be classified as Certified, De-Certified, or Non-Certified.
- 3.16.1 **Certified Source** - A Source that has met the requirements for certification and is allowed to supply aggregate for Department/Local Agency projects.
- 3.16.2 **De-Certified Source** - A Source that has had its Certified Source status revoked because requirements warranting certification have not been maintained. A De-Certified Source shall not be allowed to supply aggregate to Department/Local Agency projects.
- 3.16.3 **Non-Certified Source** - A Source that does not initially meet certification requirements or has not applied for certification.
- 3.17 **Source QC Plan** - A QC Plan detailing how a source designated as Outlying will comply with the AGCS.
- 3.18 **Standard Specifications** - Current edition of the Illinois Department of Transportation [Standard Specifications for Road and Bridge Construction](#).
- 3.19 **Supplier Yard** - A Yard which buys aggregate from an AGCS or IDOT-inspected source and resells the aggregate from the yard for use on IDOT contracts (includes local agency projects with state and or federal funding).
- 3.20 **Terminal** - A location owned by, leased to, or provided to an AGCS or IDOT-inspected source from which the source ships aggregate for use on IDOT contracts (includes local agency projects with state and or federal funding).

4.0 GENERAL RESPONSIBILITIES

- 4.1 The Bureau shall maintain a QPL identifying certified sources. Only Certified Sources shall supply material to Department/Local Agency projects. Each Certified Source shall maintain its own Gradation Control Program unless producing Category IV aggregate only. Aggregate shipped from a Certified Source shall be certified to meet the quality and gradation requirements in the Standard Specifications. However, if approved by the District, the Source may choose to certify and supply other than standard Department gradations as established by the criteria in Article 6.2 herein.
- 4.2 A Supplier Yard shall meet the requirements of the AGCS on all aggregates which will be used on IDOT contracts (including local agency with state/federal funding). Start-of-Production (6.3.1) and Normal-Production (6.3.2) sampling/testing shall be waived. The incoming aggregate sampling/testing shall be according to the current Department QC/QA document, Model Annual Quality Control (QC) Plan for Hot-Mix Asphalt (HMA) Production, Section B. Materials, 1. Aggregates, b. Incoming Aggregate Gradation Samples.
- 4.3 A Terminal shall meet all the requirements of the AGCS on all aggregates which will be used on IDOT contracts (including local agency with state/federal funding). Start-of-Production (6.3.1) and Normal-Production (6.3.2) sampling/testing shall be waived.

5.0 REQUIREMENTS FOR SOURCE CERTIFICATION

- 5.1 A Certified Source shall have been checked using the procedures set forth in Section 10.0 herein and found to meet the requirements for Source certification. Any Source subsequently found not meeting these or any other requirements of this program shall be removed from the QPL based on the procedure detailed in Section 11.0.

The requirements for Source certification are as follows:

- 5.1.1 Gradation Control Program - Gradation samples shall be taken and tested as per Section 6.0 herein.

Gradations and their ranges established per Article 6.2 herein which do not meet the Standard Specifications shall be submitted to the District for approval prior to production.

- 5.1.2 Stockpiling and Handling - Degradation is of primary concern in handling aggregates. Steel-tracked equipment shall not be operated on stockpiles. Free-fall from conveyor equipment onto load-out stockpiles shall be held to a maximum of 15 feet. The fall height requirement may be waived if the aggregate source uses special remixing procedures or a device approved by the Bureau. A comparison of a series of samples taken during the reclaiming or loading-out operation to those taken from the production belt should be made to estimate the effect of the aggregate-handling method on degradation.

Stockpiling and handling of aggregate should be designed to hold segregation to a minimum. Coned stockpiles shall not be built with stationary or movable conveyor equipment unless the reclaiming method is such that the loaded-out material visually shows minimal segregation. Radial and longitudinal conveyors or stackers shall be kept in motion to reduce coning. Where possible, a spreader chute on the stacker shall be used to broaden or flatten the wedge shape of the pile. Cascading down the sides of the pile should be held to a minimum. Material shall be reclaimed from wedge-shaped piles with an end-loader or equipment having similar type loading action working from the end of the pile, with care taken to work the entire width of the pile to remix the material as much as possible. Aggregate-handling methods using tunnel conveyor systems to reclaim aggregate from coned surge piles shall be checked for consistency of gradation. The method of aggregate-handling and stockpiling currently in use at a particular Source shall be considered satisfactory provided that the product, when checked at a load-out point, meets the gradation requirements.

Materials certified under this program shall be stockpiled separately and identified by signs. Signs shall have a minimum of 3" lettering. Each individual sign shall be free-standing and moveable. Any changes made to signing must be pre-approved by the District.

- 5.1.3 Approved Laboratory - Laboratory facilities and equipment shall conform to Section 7.0 herein. Laboratories shall be checked by District personnel and reapproved on a biennial basis. One (1) laboratory may be used as an approved laboratory for more than one (1) Source as long as no problems occur in maintaining each Source's Gradation Control Program.

- 5.1.4 **Sampling and Testing Personnel** - Sampling and testing personnel overseeing the Source's control processes (including consultants and contractors) at the Source shall be Aggregate Technicians.

The Source may use an AGCS Technician to perform all duties of an Aggregate Technician except when splitting and gradation testing. When an AGCS Technician is used, splitting and gradation testing shall be performed by an Aggregate Technician or a Mixture Aggregate Technician.

The Source may use Gradation Technicians for splitting and gradation testing only. The Gradation Technician shall be under the direct supervision of the Aggregate Technician when testing gradation samples. The Source may also use Mixture Aggregate Technicians for sampling and gradation testing only. The Mixture Aggregate Technician shall be under the supervision of the Aggregate Technician or the AGCS Technician. The Aggregate Technician, Gradation Technician or Mixture Aggregate Technician, shall demonstrate gradation testing proficiency to the Aggregate Inspector on a quarterly basis.

Any Mixture Aggregate Technician qualified personnel, when performing sampling and testing for a HMA or PCC Contractor, shall not concurrently perform the duties of an Aggregate Technician, an AGCS Technician, or a Mixture Aggregate Technician in the AGCS.

6.0 GRADATION CONTROL PROGRAM

- 6.1 The Gradation Control Program shall be run by an Aggregate Technician or an AGCS Technician as defined in Section 3.0 herein. The QC Manager shall assume responsibility for compliance with the Aggregate Gradation Control System and specifically shall ensure that the Aggregate Technician, AGCS Technician, or Mixture Aggregate Technician is performing all the required duties under the Aggregate Gradation Control System.

All communication concerning the Aggregate Gradation Control System shall be directed to the QC Manager.

Primary duties of the Aggregate Technician shall include frequent visual inspection, gradation sampling and testing, documentation, etc., as detailed herein and in QC/QA Procedure, "Quality Control (QC) Manager / Aggregate Technician / AGCS Technician / IDOT Inspector / Gradation Technician Responsibilities", located in the current Manual of Test Procedures for Materials.

The AGCS Technician may perform the same duties as the Aggregate Technician except splitting and gradation testing. Splitting and gradation testing shall be performed by an Aggregate Technician or a Mixture Aggregate Technician or a Mixture Aggregate Technician.

- 6.2 **Gradation Specifications** - Sieve limits for each sieve/each product under the Aggregate Gradation Control System shall be as specified in the Department's Standard Specifications and/or as amended herein. The special critical sieve criteria applies to designated products as described in QC/QA Procedure, "Aggregate Producer Control Chart Procedure" located in the current [Manual of Test Procedures for Materials](#).

The midpoint/tolerance range of a designated critical sieve shall be developed from an average as shown in QC/QA Procedure, "Aggregate Producer Control Chart Procedure". The average shall be a historical average, or a start of production average derived from 5 start-of-production samples agreed to by the Department. All 5 start of production samples must pass the established critical sieve limit. Critical sieve limits will take precedence over Standard Specification limits. Requests for critical sieve limits shall be submitted in writing to the District Materials Engineer for approval.

The top and bottom sieves shall not be altered. For all other sieves, limits may be developed based on historical or start of production values. These sieve limits may be different from those in the Standard Specifications. These modifications are also allowed for fine aggregate. Changes in the top sieve or any No. 200 sieve ranges will not be permitted. In cases where the bottom sieve is other than the No. 200 sieve, a variance in limits may be granted if the Bureau determines the minus No. 200 material to be within acceptable limits. The Source shall request in writing to the District Materials Engineer approval of limits other than those in the Standard Specifications, but the range of the limits shall remain the same as the Standard Specifications except on critical sieves where critical sieve limits will take precedence. The agreed upon gradation limits shall apply at the final point of shipping within the Source's control.

The Department reserves the right to reject unacceptable material at any point prior to incorporation into the final product.

- 6.3 **Sampling and Testing** - Gradation samples shall be reduced to testing size by Illinois Test Procedure 248. Minimum Field Sample Size and Minimum Test Sample Size shall be as noted in the Sample Size table, Illinois Specification 201. All sampling and gradation testing shall conform to Illinois Test Procedure 2, Illinois Test Procedure 248, Illinois Test Procedure 11, and Illinois Test Procedure 27. The Illinois Test Procedures noted above are located in the current [Manual of Test Procedures for Materials](#).

Sampling and testing frequencies (including washed tests) by category/use shall be as noted in Table 1 herein.

Definitions of each frequency are as follows:

- 6.3.1 **Start-of-Production Frequency** - After a seasonal shutdown of production or when first producing a new product, the sampling and testing of start-up production or of the new product shall be at start-of-production frequencies/requirements noted in Table 1.
- 6.3.2 **Normal-Production Frequency** - During normal production, the minimum production sampling and testing frequency/requirements as noted in Table 1 shall be maintained.
- 6.3.3 **Stockpile Frequency** - During loadout of stockpiles, the minimum stockpile sampling and testing frequency/requirements as noted in Table 1 shall be maintained for each stockpile.
- 6.3.4 **Production Changes (Short-Term Shutdowns for Screen Changes, Crusher Modifications, Different Feed Rates, New Products, etc.)** - If a production change is made, a washed gradation sample shall immediately be run on all affected products. The start-of-production sampling frequency shall be implemented if the result on any critical

sieve in that sample exceeds the warning bands on the critical sieve or if any results fail any specified sieve limits.

- 6.4 **Documentation** - Gradation results shall be charted on control charts, if required in Table 1, according to QC/QA Procedure, "Aggregate Producer Control Chart Procedure", located in the current [Manual of Test Procedures for Materials](#). Within one (1) working day of sampling, all gradation results shall be charted, posted, or entered into a Source computer, each of which shall be located at the Source and/or approved laboratory, at the District's option. Computer-maintained charting must be approved by the Department and accessible in a timely manner during any Department inspection. Computer-maintained charts shall be printed and displayed once per week or at the request of the Department. Control charts are the property of the Department and shall not be removed or altered in any manner. The Aggregate Inspector will check the control charts on a regular basis. Source gradation computation sheets will be maintained by the Department for a minimum of three (3) years after the date run.

A Source diary shall be maintained by the Aggregate Technician or the AGCS Technician. The Aggregate Technician or the AGCS Technician shall log all actions taken during the production day, such as new product production, sampling, resampling, screen changes, separate stockpiling, visual inspections, etc., as noted in QC/QA Procedure, "Quality Control (QC) Manager / Aggregate Technician / AGCS Technician / IDOT Inspector / Gradation Technician Responsibilities" in the current [Manual of Test Procedures for Materials](#).

The Source shall immediately notify the District whenever new products are being produced at the Source under its Gradation Control Program.

- 6.5 **Failing Gradation Samples** - Any Failing Gradation Sample (start-of-production, normal-production, or stockpile) shall be evaluated according to the following procedure and, if necessary, immediate action taken to correct a failing gradation.

If a gradation sample fails, one (1) resample from the same sampling location shall immediately be taken and tested. If the resample passes, the testing frequency being run prior to the failure shall be resumed. If the resample fails, a second resample shall immediately be taken.

If the second resample passes, the start-of-production sampling frequency shall be initiated. All samples in the series must pass before the normal production or stockpile sampling frequency for that location can be restarted.

If the second production resample fails, production of that specified aggregate shall not be incorporated in the approved stock, or, in the case of the second stockpile resample failing, shipment from that stockpile shall cease. Corrective action shall be initiated by the Source. No material shall be placed on or, in the case of stockpile problems, shipped from the certified stock until a passing gradation sample is taken and tested. The start-of-production frequency shall then be run at that location. All samples in the series must pass before the normal-production or stockpile sampling frequency for that location can be restarted.

All resamples shall be washed gradation tests except as stated under Note 2 in Table 1.

Any action taken, such as resampling, screen changes, separate stockpiling, etc., shall be noted in the remarks area of the failing test computation sheet and in the Source diary.

The Aggregate Technician or the AGCS Technician shall monitor the corrective action. Failure to comply with Article 6.5 herein shall cause the Source to be removed from the QPL as per Section 11.0 herein.

- 6.6 **Failing Monitor Gradation Samples** - Any Source's failing Monitor gradation sample taken and tested by the Department and determined to be a Source problem per Section 9.6 will be considered a Failing Gradation Sample under the Source's Gradation Control Program and shall cause the Source to enact Article 6.5 herein.

7.0 APPROVED LABORATORY

- 7.1 An approved Source laboratory shall have the required equipment or alternatives approved by the Bureau specified in the Appendix D3 "Aggregate Laboratory Equipment" in the [Manual of Test Procedures for Materials](#).
- 7.2 If a mixture QC laboratory is used for AGCS testing, the following additional equipment is required for use only on AGCS aggregate samples:
- One set of nested sieves for coarse and/or fine aggregate.
 - One set of wash sieves.
 - One coarse and/or fine aggregate splitter.

8.0 OUTLYING (OS) SOURCE REQUIREMENTS

- 8.1 Each district may designate a certified aggregate Source located out-of-state which shall follow specific requirements in running the AGCS, listed herein. The District shall detail the criteria used to qualify the Source for the Outlying designation. The Source QC plan tentatively approved by the District shall accompany the District request.

The Bureau shall notify the District Materials Engineer in writing as to whether the aggregate Source has met the Outlying criteria, the Source QC Plan is acceptable, and the Source will be designated as an Outlying (OS) Source and placed on the QPL.

- 8.2 The OS Source shall follow all requirements of the AGCS program unless otherwise noted within this section. A Source QC plan shall be submitted for department approval to the inspecting District. Other states' QC/QA programs or parts thereof may be substituted for the Illinois AGCS program, if approved by the Bureau. All substitutions/changes shall be noted in the Source QC Plan. The minimum sampling frequencies noted in the Illinois AGCS program shall be met regardless of frequencies listed in the other state programs.
- 8.3 The District will, at least annually, visit each Source to obtain quality and gradation samples, observe program procedures, and inspect the AGCS laboratory. Laboratory inspections conducted under other states' programs may be used if the OS Source has been approved to use the other states' QC/QA program.

These inspections may be unannounced.

- 8.4 The District will inspect, sample, and test incoming aggregate according to the specified AGCS monitor frequency at Illinois sites (job sites, mix plants, terminals, or supplier yards). Split sample, load-out, and comparison requirements noted in Section 9 herein will be waived.

The District will communicate the test results to the QC Manager at the aggregate Outlying Source (OS) for appropriate action, including any needed corrective action. In addition, the District will communicate the test results to any QC Manager or Resident Engineer at the jobsite, mix plant, terminal, or supplier yard, for appropriate action, including the need for corrective action.

- 8.5 Outlying Sources shall notify their inspecting District of all scheduled AGCS shipments/production (including shipments to mix plants, terminals, and supplier yards) prior to the shipment/production.
- 8.6 Once designated as an Outlying Source (OS), all aggregate, including Category I, III, and IV, shipped to Illinois Department of Transportation projects (including all Local Agency projects) shall be produced under the AGCS program. Category IV shall be run at the Category III frequency.

9.0 DEPARTMENT RESPONSIBILITIES

- 9.1 Sampling and testing for quality shall remain the responsibility of the Department. A Consultant, hired by the Department to perform the duties of an Aggregate Inspector, will not be allowed to take any quality or Freeze-thaw samples at an aggregate Source.
- 9.2 Monitor gradation samples at the Source shall be taken, by or in the presence of an Aggregate Inspector, from each aggregate being produced for designated use at each Certified Source. All Monitor samples shall be split samples of a Source's gradation sample taken as per the Source's Gradation Control Program. Additionally, the Department reserves the right to sample Monitor samples at any time. At least two (2) out of every five (5) Monitor samples shall be taken from the stockpile's loadout face once loadout procedures have started. The Monitor samples will be tested by District personnel on Department testing equipment according to the first paragraph of Section 6.3 herein. All Monitor samples shall be washed gradation tests unless Note 2 in Table 1 is applicable. Each Monitor sample shall be identified as to sampling location.
- 9.3 Sampling and testing frequency for the Monitor gradation samples shall be a minimum of one (1) sample per every twenty (20) production days for each gradation being produced for designated use.
- 9.4 All Monitor gradations run will be reported in the MISTIC system. Computation sheets will be retained for a minimum of three (3) years in the Department's Source file.
- 9.5 The Inspector will compare both the Monitor sample and the Source's split sample for validity as defined by the Department's "Guideline for Sample Comparison" (see Appendix A of the current Manual of Test Procedures for Materials). The reason for any significant difference between the two (2) samples shall be identified and corrected.

- 9.6 All Monitor gradations will be communicated to the QC Manager. All failing monitor gradations will be investigated by the Department. Any failing gradations, which are determined to be a Source problem not already corrected by the Producer, shall cause Article 6.6 herein to be enacted by the Source. The Aggregate Inspector will compare the failing gradation to the Source's control charts and/or split sample computation sheet. If the control chart indicates that the Source is aware of the problem and is taking corrective action, normal Monitor sampling may resume. The Aggregate Inspector will continue to visually monitor the problem and the Source's corrective action. If the control chart indicates the Source is not aware of the problem, a split sample of the Source's next sample as specified in Article 6.5 shall be tested. Failure of the Source to follow Article 6.6 shall result in the Source being removed from the QPL per Section 11.0 herein.

10.0 SOURCE CERTIFICATION PROCEDURE

- 10.1 An aggregate Source wishing to become certified shall verbally contact the District. A preliminary meeting may be held to discuss requirements of the program. After the initial contact or the preliminary meeting, a written request for certification shall be submitted to the District Materials Engineer.
- 10.2 An evaluation team composed of two (2) District personnel shall conduct an inspection of the Source for compliance to the certification checklist for all Sources producing Category I and III aggregate. A formal meeting with the Source's management, QC Manager, and quality control personnel shall be held to discuss the Source's Gradation Control Program requirements. The Source shall submit a certification letter and an [Aggregate Shipping Tickets Information Form for Producers \(BMPR AGG01\)](#) as designated by the Department. Each Source shall provide and maintain their own quality-on-tickets form and a listing of current certified gradations being produced under the Aggregate Gradation Control System. The certification letter and the [Aggregate Shipping Tickets Information Form for Producers Form \(BMPR AGG01\)](#), shall be forwarded to the Bureau before the Source will be added to the QPL.
- 10.3 Each Certified Source will be reevaluated on a biennial basis by District personnel. The reevaluation shall be a complete evaluation of the Source's laboratory and technician(s). A copy of the reevaluation checklist and comments shall be forwarded to the Bureau. Failure to comply with the certification criteria will result in the Source's certification being revoked as per the procedure detailed in Section 11.0 and the Source will be classified as De-Certified and removed from the QPL.
- 10.4 If at any time a Certified Source does not maintain the proper QC personnel, the Source will be given thirty (30) days to comply by either hiring a new QC person, training existing personnel or by contracting with a qualified consultant. If after thirty (30) days the source does not have the proper QC personnel; the Source's Certification will be revoked by the Bureau. Section 11.0 will not apply to this type of Revocation. The Source will be reinstated on the QPL once the proper QC personnel are acquired.

As an option to this type of Revocation, a Source may utilize a Gradation Technician for gradation testing as long as the following criteria are met:

- The Source shall inform the district, in writing, of the QC personnel change.

- The Source shall have an Aggregate Technician visit the Source a minimum of three (3) times a day to oversee the Gradation Technician.
- The Source shall have the proper personnel trained and in place in a timeframe acceptable to the Bureau.

11.0 REVOCATION OF A SOURCE'S CERTIFICATION

11.1 The Department may revoke a Source's Certification for any of the following reasons:

- Failing to follow the procedures and requirements of the Aggregate Gradation Control System (AGCS) Policy Memorandum.
- Misrepresentation of materials or products.
- Failing to follow the approved Quality Control Plan.

11.2 Before removal, the District Materials Engineer will detail, in a non-conformance letter to the Source's QC Manager, reason/s the Department is seeking to revoke the Source's Certification. The Source will have two weeks to reply. The Source shall not place materials in question on certified stockpiles during the two-week period. If the Department's reasons warrant, the Source may be required to stop shipment of any and all products to Department and/or Local Agency projects.

11.3 Within this two-week period, the Source's QC Manager shall reply provide a written response outlining the steps the Source is taking to address the issues outlined in the Department's non-conformance letter.

11.4 After receipt of the Source's letter, the District will schedule a meeting with the Source to discuss the proposed revocation and the Source's response. Based on this meeting, the District Materials Engineer will either (1) conclude the steps taken by the Source's QC Manager are adequate and terminate the revocation process, or (2) conclude the Source's response does not adequately address the issues outlined in the Department's non-conformance letter and recommend in writing to the Bureau that the Source be taken off the QPL. The recommendations shall include details and District/Source comments concerning the proposed revocation. Copies of all correspondence, including meeting minutes, shall be sent to the Bureau and the Source.

11.5 If requested by the Source within seven days of the District's recommendation to revoke the Certification, the Bureau will schedule a meeting with the Source's QC Manager and the District. Based on this meeting, the Bureau will either terminate the revocation process or proceed with removing the Source from the QPL.

The Bureau's decision to revoke the Source's Certification is a final agency decision of the Illinois Department of Transportation.

11.6 The Bureau will notify the District Materials Engineer and Source in writing when a Source's Certification has been revoked and that the Source has been removed from the QPL and has been listed as a De-Certified Source. The Source shall not supply aggregate materials or products for Department and/or Local Agency projects until the Source's Certification has been reinstated on the QPL.

- 11.7 If the revocation process is not based on misrepresentation of materials or products, and/or failure to follow the overall general requirements of this policy, the QC Manager, at any time, may inform the District in writing that the Source is no longer producing or shipping a specific gradation. This action will terminate any revocation process against the Source concerning the materials in question. Production of that gradation for the AGCS shall not be restarted unless the District concurs that corrective action has been completed by the Source.

12.0 REINSTATEMENT OF A SOURCE'S CERTIFICATION

The Source may re-apply for reinstatement of its certification at the end of the revocation period. Re-application shall be in writing to the Bureau and include the specific steps to be taken to correct the cause for loss of certification.

13.0 CLOSING NOTICE

Archive versions of this policy memorandum may be examined by contacting the Bureau of Materials.

The current Bureau Chief of Materials has approved this policy memorandum. Signed documents are on file with the Bureau.

TABLE 1						
Category	Use	Start of Production	Normal Production	Stockpile/Loadout	Control Charts	Master Band
I (Notes 1 & 5)	Coarse Aggregate and Manufactured Sand Used in HMA and PCC Coarse Aggregate for Pavement Drainage	1 per 1,000 T (907 metric tons) for the first 5,000 T (4,536 metric tons) (all wash)	1 per 2,000 T (1,814 metric tons) 2 per day max (wash 1/3 coarse agg.) (wash all manufactured sand)	2/week (all wash) (Note 3)	Yes	Yes (Note 8)
III (Notes 1 & 5)	Natural Sand for All PCC and HMA Projects Aggregate Surface Course Granular Shoulders Granular Sub-base Granular Base Granular Embankment Special Cover/Seal Coat Sand Bedding Porous Granular Embankment and Bedding, Sand Backfill for Underdrains French Drains Membrane Waterproofing Mortar Sand Blotter Granular Embankment Aggregate Subgrade (Note 9)	1 per 2,000 T (1,814 metric tons) for the first 4,000 T (3,629 metric tons) (all wash) (Note 2)	1 per 10,000 T 2 per day max 1 per week min (all wash) (Notes 2 & 6)	1/week (all wash) (Notes 2 & 7)	No	No

Table 1 (cont.)						
Category	Use	Start of Production	Normal Production	Stockpile/ Loadout	Control Charts	Master Band
IV (Note 4)	Rock Fill	Department Testing				
	Erosion and Sediment Control					
	Rip-Rap Bedding					
	Ice Control Abrasives					
	Trench Backfill					

Note 1: A producer may adjust gradation bands for any product in accordance with Article 6.2 of the AGCS.

Note 2: Wash only products used for HMA, PCC, Seal/cover coat and products with # 200 sieve requirements.

Note 3: No loadout tests for quantities under 500 tons (454 metric tons) or less shipped weekly. When loadout occurs but no weekly loadout test is run, the tonnage shipped shall be accumulated from the start of that week. When the accumulated tonnage exceeds 500 tons (454 metric tons), a loadout sample shall be run.

Note 4: Testing to be performed by IDOT personnel.

Note 5: Testing frequency may be reduced based on conformance to QC requirements, consistency in meeting sieves' midpoints, statistical consistency, etc.

Note 6: Minimum of 1 per week after the first 10,000 tons (9,072 metric tons) of production per week for aggregate surface course, granular shoulders, granular subbase, granular base, and granular embankment special; minimum of 1 every 2 weeks if production less than 10,000 tons (9,072 metric tons) per 2-week period.

Note 7: No loadout tests for quantities under 1,000 tons (907 metric tons) or less shipped weekly. When loadout occurs but no weekly loadout test is run, the tonnage shipped shall be accumulated from the start of that week. When the accumulated tonnage exceeds 1,000 tons (907 metric tons), a loadout sample shall be run.

Note 8: Refer to current QC/QA Procedure, "Aggregate Producer Control Chart Procedure" for required gradation.

Note 9: Only Normal Production testing shall apply. No Wash.

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1002.03 Water Intake. Water from shallow, muddy, or marshy surfaces shall not be used. The intake of the pipeline shall be enclosed to exclude silt, mud, grass, and other solid materials; and there shall be a minimum depth of 2 ft (600 mm) of water below the intake at all times.

SECTION 1003. FINE AGGREGATES

1003.01 Materials. Fine aggregate materials shall be according to the following.

(a) Description. The natural and manufactured materials used as fine aggregate are defined as follows.

- (1) Sand. Sand shall be the fine granular material resulting from the natural disintegration of rock. Sand produced from deposits simultaneously with, and by the same operations as, gravel coarse aggregate may contain crushed particles in the quantity resulting normally from the crushing and screening of oversize particles.
- (2) Silica Sand. Silica sand shall be composed of not less than 99.5 percent silica (SiO_2).
- (3) Stone Sand. Stone sand shall be produced by washing, or processing by air separation, the fine material resulting from crushing rock quarried from undisturbed, consolidated deposits, or crushing gravel. The acceptance and use of crushed gravel stone sand shall be according to the Bureau of Materials Policy Memorandum, "Crushed Gravel Producer Self-Testing Program".
- (4) Chats. Chats shall be the tailings resulting from the separation of metals from rocks in which they occur.
- (5) Wet Bottom Boiler Slag. Wet bottom boiler slag shall be the hard, angular by-product of the combustion of coal in wet bottom boilers.
- (6) Slag Sand. Slag sand shall be the graded product resulting from the screening of air-cooled blast furnace slag. Air-cooled blast furnace slag shall be the nonmetallic product, consisting essentially of silicates and alumino-silicates of lime and other bases, which is developed in a molten condition simultaneously with iron in a blast furnace.

The acceptance and use of air-cooled blast furnace slag sand shall be according to the Bureau of Materials Policy Memorandum, "Crushed Slag Producer Certification and Self-Testing Program".

- (7) Granulated Slag Sand. Granulated slag sand shall be the graded product resulting from the screening of granulated slag. Granulated slag shall be the nonmetallic product, consisting essentially of silicates and alumino-silicates of lime and other bases, which is developed in a molten condition simultaneously with iron in a blast furnace. Granulated

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slag sand is formed by introducing a large volume of water under high pressure into the molten slag.

- (8) Steel Slag Sand. Steel slag sand shall be the graded product resulting from the screening of crushed steel slag. Crushed steel slag shall be the nonmetallic product which is developed in a molten condition simultaneously with steel in an open hearth, basic oxygen, or electric arc furnace. The acceptance and use of steel slag sand shall be according to the Bureau of Materials Policy Memorandum, "Slag Producer Self-Testing Program".
- (9) Crushed Concrete Sand. Crushed concrete sand shall be the angular fragments resulting from crushing portland cement concrete by mechanical means. The acceptance and use of crushed concrete sand shall be according to the Bureau of Materials Policy Memorandum, "Recycling Portland Cement Concrete Into Aggregate".
- (10) Construction and Demolition Debris Sand. Construction and demolition debris sand shall be the angular fragments resulting from mechanical crushing/screening of unpainted exterior brick, mortar, and/or concrete with small amounts of other materials. Construction and demolition debris sand shall be according to the Bureau of Materials Policy Memorandum, "Construction and Demolition Debris Sand as a Fine Aggregate for Trench Backfill".
- (b) Quality. The fine aggregate shall meet the quality standards listed in the following table. Except for the minus No. 200 (75 μ m) sieve material, all fine aggregate shall meet specified quality requirements before being proportioned for mix or combined to adjust gradation. The blended materials shall meet the minus No. 200 (75 μ m) sieve requirements.

FINE AGGREGATE QUALITY			
QUALITY TEST	CLASS		
	A	B	C
Na ₂ SO ₄ Soundness 5 Cycle, Illinois Modified AASHTO T 104, % Loss max.	10	15	20
Minus No. 200 (75 μ m) Sieve Material, Illinois Modified AASHTO T 11, % max. ^{4/}	3	6 ^{1/}	10 ^{1/}
Organic Impurities Check, Illinois Modified AASHTO T 21	Yes ^{2/}	---	---
Deleterious Materials: ^{3/5/}			
Shale, % max.	3.0	3.0	---
Clay Lumps, % max.	1.0	3.0	---
Coal, Lignite, & Shells, % max.	1.0	3.0	---
Conglomerate, % max.	3.0	3.0	---
Other Deleterious, % max.	3.0	3.0	---
Total Deleterious, % max.	3.0	5.0	---

1/ Does not apply to Gradations FA 20 or FA 21.

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- 2/ Applies only to sand. Sand exceeding the colorimetric test standard of 11 (Illinois Modified AASHTO T 21) will be checked for mortar making properties according to Illinois Modified ASTM C 87, and shall develop a compressive strength at the age of 14 days when using Type I or II Cement of not less than 95 percent of the comparable standard.
- 3/ Applies only to sand.
- 4/ Fine aggregate used for hot-mix asphalt (HMA) shall not contain more than three percent clay (2 micron or smaller) particles as determined by Illinois Modified AASHTO T 88.
- 5/ Tests shall be run according to ITP 204.
- (c) Gradation. All aggregates shall be produced according to the Bureau of Materials Policy Memorandum, "Aggregate Gradation Control System".

The gradations prescribed may be manufactured by any suitable commercial process and by the use of any sizes or shapes of plant screen openings necessary to produce the sizes within the limits of the sieve analysis specified.

The gradation of the material from any one source shall be reasonably uniform and shall not be subject to the extreme percentages of gradation represented by the tolerance limits of the various sieve sizes.

The gradation numbers and corresponding gradation limits are listed in the following tables.

FINE AGGREGATE GRADATIONS											
Grad No.	Sieve Size and Percent Passing										
	3/8	No. 4	No. 8 ^{4/}	No. 10	No. 16	No. 30 ^{5/}	No. 40	No. 50	No. 80	No. 100	No. 200 ^{1/}
FA 1	100	97±3			65±20			16±13		5±5	
FA 2	100	97±3			65±20			20±10		5±5	
FA 3	100	97±3		80±15			50±20		25±15		3±3
FA 4 ^{7/}	100				5±5						
FA 5	100	92±8								20±20	15±15
FA 6		92±8 ^{2/}								20±20	6±6
FA 7		100		97±3			75±15		35±10		3±3
FA 8			100				60±20			3±3	2±2
FA 9			100					30±15		5±5	
FA 10				100			90±10		60±30		7±7
FA 20	100	97±3	80±20		50±15			19±11		10±7	4±4
FA 21 ^{3/}	100	97±3	80±20		57±18			30±10		20±10	9±9
FA 22	100	6/	6/		8±8						2±2
FA 23	100	80±10	57±13		39±11	26±8		18±7		12±6	10±5
FA 24	100	95±5	77±13		57±13	35±10		19±6		15±6	10±5

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FINE AGGREGATE GRADATIONS (Metric)											
Grad No.	Sieve Size and Percent Passing										
	9.5 mm	4.75 mm	2.36 mm ^{4/}	2.00 mm	1.18 mm	600 μm ^{5/}	425 μm	300 μm	180 μm	150 μm	75 μm ^{1/}
FA 1	100	97±3			65±20			16±13		5±5	
FA 2	100	97±3			65±20			20±10		5±5	
FA 3	100	97±3		80±15			50±20		25±15		3±3
FA 4 ^{7/}	100				5±5						
FA 5	100	92±8								20±20	15±15
FA 6		92±8 ^{2/}								20±20	6±6
FA 7		100		97±3			75±15		35±10		3±3
FA 8			100				60±20			3±3	2±2
FA 9			100					30±15		5±5	
FA 10				100			90±10		60±30		7±7
FA 20	100	97±3	80±20		50±15			19±11		10±7	4±4
FA 21 ^{3/}	100	97±3	80±20		57±18			30±10		20±10	9±9
FA 22	100	^{6/}	^{5/}		8±8						2±2
FA 23	100	80±10	57±13		39±11	26±8		18±7		12±6	10±5
FA 24	100	95±5	77±13		57±13	35±10		19±6		15±6	10±5

- 1/ Subject to maximum percent allowed in Fine Aggregate Quality Table.
- 2/ 100 percent shall pass the 1 in. (25 mm) sieve, except that for bedding material 100 percent shall pass the 3/8 in. (9.5 mm) sieve. If 100 percent passes the 1/2 in. (12.5 mm) sieve, the No. 4 (4.75 mm) sieve may be 75 ± 25.
- 3/ For all HMA mixtures. When used, either singly or in combination with other sands, the amount of material passing the No. 200 (75 μm) sieve (washed basis) in the total sand fraction for mix design shall not exceed ten percent.
- 4/ For each gradation used in HMA, the aggregate producer shall set the midpoint percent passing, and the Department will apply a range of ±15 percent. The midpoint shall not be changed without Department approval.
- 5/ For each gradation used in HMA, the aggregate producer shall set the midpoint percent passing, and the Department will apply a range of ±13 percent. The midpoint shall not be changed without Department approval.
- 6/ For fine aggregate gradation FA 22, the aggregate producer shall set the midpoint percent passing, and the Department will apply a range of ±10 percent. The midpoint shall not be changed without Department approval.
- 7/ When used as backfill for pipe underdrains, Type 3, the fine aggregate shall meet one of the modified FA 4 gradations shown in the following table.

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FA 4 Modified		
Sieve Size	Percent Passing	
	Option 1	Option 2
3/8 in. (9.5 mm)	100	100
No. 4 (4.75 mm)		97 ± 3
No. 8 (2.36 mm)		5 ± 5
No. 10 (2 mm)	10 ± 10	
No. 16 (1.18 mm)	5 ± 5	2 ± 2
No. 200 (75 µm)	1 ± 1	1 ± 1

- (d) Incompatibility. Incompatibility of any of the gradations or combinations of gradations permitted resulting in unworkable mixtures, nonadherence to the final mix gradation limits, or any other indication of incompatibility shall be just cause for rejection of one or both of the sizes.
- (e) Storage of Fine Aggregate. Sites for storage of all fine aggregates shall be grubbed and cleaned prior to storing the material.

Stockpiles shall be built according to the Bureau of Materials Policy Memorandum, "Aggregate Gradation Control System (AGCS)" and the following.

- (1) Fine aggregate of various gradations and from different sources shall be stockpiled separately.
- (2) Stockpiles shall be separated to prevent intermingling at the base. If partitions are used, they shall be of sufficient heights to prevent intermingling.
- (3) Fine aggregates for portland cement concrete and HMA shall be handled in and out of the stockpiles in such a manner that will prevent contamination, segregation, and degradation.

At the time of use, the fine aggregate shall be free from frozen material, material used to caulk rail cars, and all foreign materials which may have become mixed during transportation and handling.

- (f) Shipping Tickets. Shipping tickets for the material shall be according to the Bureau of Materials Policy Memorandum, "Designation of Aggregate Information on Shipping Tickets".

1003.02 Fine Aggregate for Portland Cement Concrete and Mortar. The aggregate shall be according to Article 1003.01 and the following.

- (a) Description. The fine aggregate shall consist of washed sand, washed stone sand, or a blend of washed sand and washed stone sand approved by the Engineer. Stone sand produced through an air separation system approved by the Engineer may be used in place of washed stone sand.

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- (b) Quality. The fine aggregate for portland cement concrete shall meet Class A Quality, except the minus No. 200 (75 μ m) sieve Illinois Modified AASHTO T 11 requirement in the Fine Aggregate Quality Table shall not apply to washed stone sand or any blend of washed stone sand and washed sand approved by the Engineer. The fine aggregate for masonry mortar shall meet Class A Quality.
- (c) Gradation. The washed sand for portland cement concrete shall be Gradation FA 1 or FA 2. Washed stone sand for portland cement concrete, which includes any blend with washed sand, shall be Gradation FA 1, FA 2, or FA 20. Fine aggregate for masonry mortar shall be Gradation FA 9.
- (d) Use of Fine Aggregates. The blending, alternate use, and/or substitution of fine aggregates from different sources for use in portland cement concrete will not be permitted without the approval of the Engineer. Any blending shall be by interlocked mechanical feeders at the aggregate source or concrete plant. The blending shall be uniform, and the equipment shall be approved by the Engineer.
- (e) Alkali Reaction.
- (1) ASTM C 1260. Each fine aggregate will be tested by the Department for alkali reaction according to ASTM C 1260. The test will be performed with Type I or II portland cement having a total equivalent alkali content ($\text{Na}_2\text{O} + 0.658\text{K}_2\text{O}$) of 0.90 percent or greater. The Engineer will determine the assigned expansion value for each aggregate, and these values will be made available on the Department's Alkali-Silica Potential Reactivity Rating List. The Engineer may differentiate aggregate based on ledge, production method, gradation number, or other factors. An expansion value of 0.03 percent will be assigned to limestone or dolomite fine aggregates (manufactured stone sand). However, the Department reserves the right to perform the ASTM C 1260 test.
- (2) ASTM C 1293 by Department. In some instances, such as chert natural sand or other fine aggregates, testing according to ASTM C 1260 may not provide accurate test results. In this case, the Department may only test according to ASTM C 1293.
- (3) ASTM C 1293 by Contractor. If an individual aggregate has an ASTM C 1260 expansion value that is unacceptable to the Contractor, an ASTM C 1293 test may be performed by the Contractor to evaluate the Department's ASTM C 1260 test result. The laboratory performing the ASTM C 1293 test shall be approved by the Department according to the Bureau of Materials Policy Memorandum "Minimum Laboratory Requirements for Alkali-Silica Reactivity (ASR) Testing".

The ASTM C 1293 test shall be performed with Type I or II portland cement having a total equivalent alkali content ($\text{Na}_2\text{O} + 0.658\text{K}_2\text{O}$) of 0.80 percent or greater. The interior vertical wall of the ASTM C 1293 recommended container (pail) shall be half covered with a wick of absorbent material consisting of blotting paper. If the testing laboratory

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desires to use an alternate container, wick of absorbent material, or amount of coverage inside the container with blotting paper, ASTM C 1293 test results with an alkali-reactive aggregate of known expansion characteristics shall be provided to the Engineer for review and approval. If the expansion is less than 0.040 percent after one year, the aggregate will be assigned an ASTM C 1260 expansion value of 0.08 percent that will be valid for two years, unless the Engineer determines the aggregate has changed significantly. If the aggregate is manufactured into multiple gradation numbers, and the other gradation numbers have the same or lower ASTM C 1260 value, the ASTM C 1293 test result may apply to multiple gradation numbers.

The Engineer reserves the right to verify a Contractor's ASTM C 1293 test result. When the Contractor performs the test, a split sample shall be provided to the Engineer. The Engineer may also independently obtain a sample at any time. The aggregate will be considered reactive if the Contractor or Engineer obtains an expansion value of 0.040 percent or greater.

1003.03 Fine Aggregate for Hot-Mix Asphalt (HMA). The aggregate shall be according to Article 1003.01 and the following.

- (a) Description. Fine aggregate for HMA shall consist of sand, stone sand, chats, slag sand, or steel slag sand. For gradation FA 22, uncrushed material will not be permitted. Fine aggregate for SMA shall consist of stone sand, slag sand, or steel slag sand.
- (b) Quality. The fine aggregate for all HMA shall be Class B Quality or better.
- (c) Gradation. The fine aggregate gradation for all HMA shall be FA 1, FA 2, FA 20, FA 21, or FA 22. The fine aggregate gradation for SMA shall be FA/FM 20 or FA/FM 22.

For mixture IL-4.75 and surface mixtures with an $N_{design} = 90$, at least 50 percent of the required fine aggregate fraction shall consist of either stone sand, slag sand, or steel slag meeting the FA 20 gradation.

For mixture IL-9.5FG, at least 67 percent of the required fine aggregate fraction shall consist of either stone sand, slag sand, steel slag sand, or combinations thereof meeting FA 20 gradation.

For mixture IL-19.0, $N_{design} = 90$ the fine aggregate fraction shall consist of at least 67 percent manufactured sand meeting FA 20 or FA 22 gradation. For mixture IL-19.0, $N_{design} = 50$ or 70 the fine aggregate fraction shall consist of at least 50 percent manufactured sand meeting FA 20 or FA 22 gradation. The manufactured sand shall be stone sand, slag sand, steel slag sand, or combinations thereof.

Gradation FA 1, FA 2, or FA 3 shall be used when required for prime coat aggregate application for HMA.

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1003.04 Fine Aggregate for Bedding, Backfill, Trench Backfill, Embankment, Porous Granular Backfill, and French Drains. The aggregate shall be according to Article 1003.01 and the following.

- (a) Description. The fine aggregate shall consist of sand, stone sand, chats, wet bottom boiler slag, slag sand, or granulated slag sand. Crushed concrete sand, construction and demolition debris sand, and steel slag sand produced from an electric arc furnace may be used in lieu of the above for trench backfill.
- (b) Quality. The fine aggregate shall be reasonably free from an excess of soft and unsound particles and other objectionable matter.
- (c) Gradation. The fine aggregate gradations shall be as follows.

Application	Gradation
Granular Embankment, Granular Backfill, Trench Backfill, and Bedding and Backfill for Pipe Culverts and Storm Sewers	FA 1, FA 2, or FA 6 through FA 21
Porous Granular Embankment, Porous Granular Backfill, French Drains, and Bedding and Backfill for Pipe Underdrains, Type 1	FA 1, FA 2, or FA 20, except the percent passing the No. 200 (75 μ m) sieve shall be 2 \pm 2
Backfill for Pipe Underdrains, Type 3	FA 4 Modified (see Article 1003.01(c))

1003.05 Fine Aggregate for Membrane Waterproofing. The aggregate shall be according to Article 1003.01 and the following.

- (a) Description. The fine aggregate shall consist of sand, stone sand, wet bottom boiler slag, slag sand, or chats.
- (b) Quality. The fine aggregate shall meet the Class B Quality Deleterious Count, and when subjected to Illinois Modified AASHTO T 104, the weighted average loss shall not be more than ten percent.
- (c) Gradation. The fine aggregate shall be Gradation FA 8.

1003.06 Fine Aggregate for Controlled Low-Strength Material (CLSM). The aggregate shall be according to Article 1003.01 and the following.

- (a) Description. The fine aggregate shall consist of sand.
- (b) Quality. The fine aggregate shall be reasonably free from an excess of soft and unsound particles and other objectionable matter.
- (c) Gradation. The fine aggregate gradation shall be FA 1 or FA 2. Blending of fine aggregate will not be permitted.

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1003.07 Fine Aggregate for Select Fill Used for Retaining Wall Applications Utilizing Soil Reinforcement. The aggregate shall be according to Article 1003.01 and the following.

- (a) Description. The fine aggregate shall consist of sand or stone sand.
- (b) Quality. The fine aggregate shall have a maximum sodium sulfate (Na_2SO_4) loss of 15 percent according to Illinois Modified AASHTO T 104.
- (c) Gradation. The fine aggregate shall be FA 1, FA 2, or FA 20.
- (d) Internal Friction Angle. The effective internal friction angle for the fine aggregate shall be a minimum 34 degrees according to AASHTO T 236 on samples compacted to 95 percent density according to Illinois Modified AASHTO T 99. The AASHTO T 296 test with pore pressure measurement may be used in lieu of AASHTO T 236. If the Contractor's design uses a friction angle greater than 34 degrees this greater value shall be taken as the minimum required.
- (e) pH. The pH shall be determined according to Illinois Modified AASHTO T 289.
 - (1) When geosynthetic soil reinforcement is used, the fine aggregate pH shall be 4.5 to 9.0 for permanent applications, and 3.0 to 10.0 for temporary applications.
 - (2) When steel reinforcement is used, the fine aggregate pH shall be 5.0 to 10.0.
- (f) Corrosion Mitigation. The fine aggregates shall also meet the following when used in conjunction with steel soil reinforcement in non-temporary wall applications.
 - (1) Resistivity. The resistivity according to Illinois Modified AASHTO T 288 shall be greater than 3000 ohm centimeters for galvanized reinforcement, and 1500 ohm centimeters for aluminized Type 2 reinforcement.
 - (2) The chlorides shall be less than 100 parts per million according to Illinois Modified AASHTO T 291 or ASTM D 4327. For either test, the sample shall be prepared according to Illinois Modified AASHTO T 291.
 - (3) The sulfates shall be less than 200 parts per million according to Illinois Modified AASHTO T 290 or ASTM D 4327. For either test, the sample shall be prepared according to Illinois Modified AASHTO T 290.
 - (4) The organic content shall be a maximum of 1.0 percent according to Illinois Modified AASHTO T 267.
- (g) Test Frequency. Prior to the start of construction, the Contractor shall provide internal friction angle and pH test results to demonstrate the select

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fill material meets the specification requirements. Resistivity, chlorides, sulfates, and organic content test results shall also be provided if steel reinforcement is used. The laboratory performing the Illinois Modified AASHTO T 288 test shall be approved by the Department according to the Bureau of Materials Policy Memorandum "Minimum Laboratory Requirements for Resistivity Testing". These test results shall be no more than 12 months old. In addition, a sample of select fill material will be obtained by the Engineer for testing and approval before construction begins. Thereafter, the minimum frequency of subsequent sampling and testing at the jobsite will be one per 40,000 tons (36,300 metric tons) of select fill.

1003.08 Fine Aggregate for Micro-Surfacing and Slurry Sealing. The aggregate shall be according to Article 1003.01 and the following.

- (a) Description. The fine aggregate shall consist of stone sand, wet bottom boiler slag, slag sand, granulated slag sand, steel slag sand, or crushed concrete sand.
- (b) Quality. The fine aggregate shall be Class B Quality.
- (c) Gradation. Rut filling mixes shall be FA 23. Surface mixes shall be FA 24.
- (d) Use of Fine Aggregates. The blending, alternate use, and/or substitutions of aggregates from different sources for use in this work will not be permitted without the approval of the Engineer. Any blending shall be by interlocked mechanical feeders. The blending shall be uniform, compatible with the other components of the mix, and the equipment shall be approved by the Engineer.

If blending aggregates, the blend shall have a washed gradation preformed every other day or a minimum of three tests per week. Testing shall be completed before the aggregate receives final acceptance for use in the mix.

Aggregates shall be screened at the stockpile prior to delivery to the paving machine to remove oversized material or contaminants.

SECTION 1004. COARSE AGGREGATES

1004.01 Materials. Coarse aggregate materials shall be according to the following.

- (a) Description. The natural and manufactured materials used as coarse aggregate are defined as follows.
 - (1) Gravel. Gravel shall be the coarse granular material resulting from the reduction of rock by the action of the elements and having subangular to rounded surfaces. It may be partially crushed.
 - (2) Chert Gravel. Chert gravel shall be the coarse granular material occurring in alluvial deposits resulting from reworking by weathering and

SECTION 1004. COARSE AGGREGATES

1004.01 Materials. Coarse aggregate materials shall be according to the following.

- (a) Description. The natural and manufactured materials used as coarse aggregate are defined as follows.
 - (1) Gravel. Gravel shall be the coarse granular material resulting from the reduction of rock by the action of the elements and having subangular to rounded surfaces. It may be partially crushed.
 - (2) Chert Gravel. Chert gravel shall be the coarse granular material occurring in alluvial deposits resulting from reworking by weathering and

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erosion of chert bearing geological formations and containing a minimum of 80 percent chert or similar siliceous material.

- (3) Crushed Gravel. Crushed gravel shall be the product resulting from crushing, by mechanical means, and shall consist entirely of particles obtained by crushing gravel. The acceptance and use of crushed gravel shall be according to the Bureau of Materials Policy Memorandum, "Crushed Gravel Producer Self-Testing Program".
- (4) Crushed Stone. Crushed stone shall be the angular fragments resulting from crushing undisturbed, consolidated deposits of rock by mechanical means. Crushed stone shall be divided into the following, when specified.
 - a. Carbonate Crushed Stone. Carbonate crushed stone shall be either dolomite or limestone. Dolomite shall contain 11.0 percent or more magnesium oxide (MgO). Limestone shall contain less than 11.0 percent magnesium oxide (MgO).
 - b. Crystalline Crushed Stone. Crystalline crushed stone shall be either metamorphic or igneous stone, including but is not limited to, quartzite, granite, rhyolite and diabase.
- (5) Wet Bottom Boiler Slag. Wet bottom boiler slag shall be the hard, angular by-product of the combustion of coal in wet bottom boilers.
- (6) Crushed Slag. Crushed slag shall be the graded product resulting from the processing of air-cooled blast furnace slag. Air-cooled blast furnace slag shall be the nonmetallic product, consisting essentially of silicates and aluminosilicates of lime and other bases, which is developed in a molten condition simultaneously with iron in a blast furnace. It shall be air-cooled and shall have a compact weight (Illinois Modified AASHTO T 19) of not less than 70 lb/cu ft (1100 kg/cu m). The acceptance and use of air-cooled blast furnace slag shall be according to the Bureau of Materials Policy Memorandum, "Crushed Slag Producer Certification and Self-Testing Program".
- (7) Crushed Sandstone. Crushed sandstone shall be the angular fragments resulting from crushing, by mechanical means, a cemented sand composed predominantly of quartz grains. Sandstone shall have an Insoluble Residue of 50.0 percent or higher.
- (8) Crushed Concrete. Crushed concrete shall be the angular fragments resulting from crushing portland cement concrete by mechanical means. The acceptance and use of crushed concrete shall be according to the Bureau of Materials Policy Memorandum, "Recycling Portland Cement Concrete Into Aggregate".
- (9) Chats. Chats shall be the tailings resulting from the separation of metals from the rocks in which they occur.

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(10) Crushed Steel Slag. Crushed steel slag shall be the graded product resulting from the processing of steel slag. Steel slag shall be the nonmetallic product which is developed in a molten condition simultaneously with steel in an open hearth, basic oxygen, or electric furnace. The acceptance and use of crushed steel slag shall be according to the Bureau of Materials Policy Memorandum, "Slag Producer Self-Testing Program".

- (b) Quality. The coarse aggregate shall be according to the quality standards listed in the following table.

COARSE AGGREGATE QUALITY				
QUALITY TEST	CLASS			
	A	B	C	D
Na ₂ SO ₄ Soundness 5 Cycle, Illinois Modified AASHTO T 104 ^{1/} , % Loss max.	15	15	20	25 ^{2/}
Los Angeles Abrasion, Illinois Modified AASHTO T 96 ^{1 1/} , % Loss max.	40 ^{3/}	40 ^{4/}	40 ^{5/}	45
Minus No. 200 (75 µm) Sieve Material, Illinois Modified AASHTO T 11	1.0 ^{6/}	---	2.5 ^{7/}	---
Deleterious Materials ^{10/}				
Shale, % max.	1.0	2.0	4.0 ^{8/}	---
Clay Lumps, % max.	0.25	0.5	0.5 ^{8/}	---
Coal & Lignite, % max.	0.25	---	---	---
Soft & Unsound Fragments, % max.	4.0	6.0	8.0 ^{8/}	---
Other Deleterious, % max.	4.0 ^{9/}	2.0	2.0 ^{8/}	---
Total Deleterious, % max.	5.0	6.0	10.0 ^{8/}	---
Oil-Stained Aggregate ^{10/} , % max.	5.0	---	---	---

1/ Does not apply to crushed concrete.

2/ For aggregate surface course and aggregate shoulders, the maximum percent loss shall be 30.

3/ For portland cement concrete, the maximum percent loss shall be 45.

4/ Does not apply to crushed slag or crushed steel slag.

5/ For hot-mix asphalt (HMA) binder mixtures, except when used as surface course, the maximum percent loss shall be 45.

6/ For crushed aggregate, if the material finer than the No. 200 (75 µm) sieve consists of the dust from fracture, essentially free from clay or silt, this percentage may be increased to 2.5.

7/ Does not apply to aggregates for HMA binder mixtures.

8/ Does not apply to Class A seal and cover coats.

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9/ Includes deleterious chert. In gravel and crushed gravel aggregate, deleterious chert shall be the lightweight fraction separated in a 2.35 heavy media separation. In crushed stone aggregate, deleterious chert shall be the lightweight fraction separated in a 2.55 heavy media separation. Tests shall be run according to Illinois Modified AASHTO T 113.

10/ Test shall be run according to ITP 203.

11/ Does not apply to crushed slag.

All varieties of chert contained in gravel coarse aggregate for portland cement concrete, whether crushed or uncrushed, pure or impure, and irrespective of color, will be classed as chert and shall not be present in the total aggregate in excess of 25 percent by weight (mass).

Aggregates used in Class BS concrete (except when poured on subgrade), Class PS concrete, and Class PC concrete (bridge superstructure products only, excluding the approach slab) shall contain no more than two percent by weight (mass) of deleterious materials. Deleterious materials shall include substances whose disintegration is accompanied by an increase in volume which may cause spalling of the concrete.

- (c) Gradation. All aggregates shall be produced according to the Bureau of Materials Policy Memorandum, "Aggregate Gradation Control System (AGCS)".

The sizes prescribed may be manufactured by any suitable commercial process and by the use of any sizes or shapes of plant screen openings necessary to produce the sizes within the limits of the sieve analysis specified.

The gradation of the material from any one source shall be reasonably close to the gradation specified and shall not be subject to the extreme percentages of gradation represented by the tolerance limits for the various sieve sizes. The gradation numbers and corresponding gradation limits are listed in the following table.

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Grad No.	COARSE AGGREGATE GRADATIONS												
	Sieve Size and Percent Passing												
	3 in.	2 1/2 in.	2 in.	1 1/2 in.	1 in.	3/4 in.	1/2 in.	3/8 in.	No. 4	No. 8	No. 16	No. 50	No. 200 ^{1/}
CA 1	100	95±5	60±15	15±15	3±3								
CA 2		100	95±5		75±15		50±15		30±10		20±15		8±4
CA 3		100	93±7	55±20	8±8		3±3						
CA 4			100	95±5	85±10		60±15		40±10		20±15		8±4
CA 5				97±3 ^{2/}	40±25		5±5		3±3				
CA 6				100	95±5		75±15		43±13		25±15		8±4
CA 7				100	95±5		45±15 ^{7/}		5±5				
CA 8				100	97±3	85±10	55±10		10±5		3±3 ^{3/}		
CA 9				100	97±3		60±15		30±15		10±10		6±6
CA 10					100	95±5	80±15		50±10		30±15		9±4
CA 11					100	92±8	45±15 ^{4/ 7/}		6±6		3±3 ^{3/ 6/}		
CA 12						100	95±5	85±10	60±10		35±10		9±4
CA 13						100	97±3	80±10	30±15		3±3 ^{3/}		
CA 14							90±10 ^{6/}	45±20	3±3				
CA 15							100	75±15	7±7		2±2		
CA 16							100	97±3	30±15		2±2 ^{3/}		
CA 17	100								65±20		45±20	20±10	10±5
CA 18	100				95±5				75±25		55±25	10±10	2±2
CA 19	100				95±5				60±15		40±15	20±10	10±5
CA 20							100	92±8	20±10	5±5	3±3		

Grad No.	COARSE AGGREGATE GRADATIONS (metric)												
	Sieve Size and Percent Passing												
	75 mm	63 mm	50 mm	37.5 mm	25 mm	19 mm	12.5 mm	9.5 mm	4.75 mm	2.36 mm	1.18 mm	300 µm	75 µm ^{1/}
CA 1	100	95±5	60±15	15±15	3±3								
CA 2		100	95±5		75±15		50±15		30±10		20±15		8±4
CA 3		100	93±7	55±20	8±8		3±3						
CA 4			100	95±5	85±10		60±15		40±10		20±15		8±4
CA 5				97±3 ^{2/}	40±25		5±5		3±3				
CA 6				100	95±5		75±15		43±13		25±15		8±4
CA 7				100	95±5		45±15 ^{7/}		5±5				
CA 8				100	97±3	85±10	55±10		10±5		3±3 ^{3/}		
CA 9				100	97±3		60±15		30±15		10±10		6±6
CA 10					100	95±5	80±15		50±10		30±15		9±4
CA 11					100	92±8	45±15 ^{4/ 7/}		6±6		3±3 ^{3/ 6/}		
CA 12						100	95±5	85±10	60±10		35±10		9±4
CA 13						100	97±3	80±10	30±15		3±3 ^{3/}		
CA 14							90±10 ^{6/}	45±20	3±3				
CA 15							100	75±15	7±7		2±2		
CA 16							100	97±3	30±15		2±2 ^{3/}		
CA 17	100								65±20		45±20	20±10	10±5
CA 18	100				95±5				75±25		55±25	10±10	2±2
CA 19	100				95±5				60±15		40±15	20±10	10±5
CA 20							100	92±8	20±10	5±5	3±3		

1/ Subject to maximum percent allowed in Coarse Aggregate Quality table.

2/ Shall be 100 percent passing the 1 3/4 in. (45 mm) sieve.

3/ When used in HMA (High and Low ESAL) mixtures, the percent passing the No. 16 (1.18 mm) sieve for gradations CA 11, CA 13, or CA 16 shall be 4±4 percent.

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- 4/ When using gradation CA 11 for IL-19.0 and IL-19.0L binder, the percent passing the 1/2 in. (12.5 mm) sieve may also be 15±10 percent. |
- 5/ The No. 16 (1.18 mm) requirement will be waived when CA 11 is used in the manufacture of portland cement concrete.
- 6/ Shall be 100 percent passing the 5/8 in. (16 mm) sieve.
- 7/ When Class BS concrete is to be pumped, the coarse aggregate gradation shall have a minimum of 45 percent passing the 1/2 in. (12.5 mm) sieve. The Contractor may combine two or more coarse aggregate sizes, consisting of CA 7, CA 11, CA 13, CA 14, and CA 16, provided a CA 7 or CA 11 is included in the blend.

Note: When CA 7, CA 8, CA 11, CA 13, CA 14, CA 15, or CA 16 are used under paved median, Notes 3, 4, 5, and 6 shall apply.

- (d) Incompatibility. Incompatibility of any of the gradations or combinations of gradations permitted resulting in unworkable mixtures, nonadherence to the final mix gradation limits, or any other indication of incompatibility shall be just cause for rejection of one or both of the sizes.
- (e) Storage. Sites for stockpiles shall be grubbed and cleaned prior to storing the aggregates.

The stockpiles shall be built according to the Bureau of Materials Policy Memorandum, "Aggregate Gradation Control System (AGCS)" and the following. |

- (1) Segregation or degradation due to improper stockpiling or loading out of stockpiles shall be just cause for rejecting the material.
- (2) Separate stockpiles shall be provided for the various kinds of aggregates.
- (3) Stockpiles shall be separated to prevent intermingling at the base. If partitions are used, they shall be of sufficient heights to prevent intermingling.
- (4) Coarse aggregates shall be handled in and out of the stockpiles in such a manner that will prevent contamination and degradation.
- (5) Crushed concrete, crushed slag, or lightweight aggregate for portland cement concrete shall be stockpiled in a moist condition (saturated surface dry or greater) and the moisture content shall be maintained uniformly throughout the stockpile by periodic sprinkling.

At the time of use, the coarse aggregate shall be free from frozen material, material used to caulk rail cars, and all foreign material which may have become mixed during transportation and handling.

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- (f) Shipping Tickets. Shipping tickets for the material shall be according to the Bureau of Materials Policy Memorandum, "Designation of Aggregate Information on Shipping Tickets".

1004.02 Coarse Aggregate for Portland Cement Concrete. The aggregate shall be according to Article 1004.01 and the following.

- (a) Description. The coarse aggregate shall be gravel, crushed gravel, crushed stone, crushed concrete, crushed slag, or crushed sandstone.
- (b) Quality. The coarse aggregate shall be Class A quality.
- (c) Gradation. The gradations of coarse aggregate used in the production of portland cement concrete for pavements and structures shall be according to Table 1 of Article 1020.04. Washing equipment will be required where producing conditions warrant.
- (d) Combining Sizes. Each size shall be stored separately and care shall be taken to prevent them from being mixed until they are ready to be proportioned. Separate compartments shall be provided to proportion each size.
- (1) When Class BS concrete is to be pumped, the coarse aggregate gradation shall have a minimum of 45 percent passing the 1/2 in. (12.5 mm) sieve. The Contractor may combine two or more coarse aggregate sizes, consisting of CA 7, CA 11, CA 13, CA 14, or CA 16, provided a CA 7 or CA 11 is included in the blend.
- (2) If the coarse aggregate is furnished in separate sizes, they shall be combined in proportions to provide a uniformly graded coarse aggregate grading within the following limits.

Class of Concrete ^{1/}	Combined Sizes	Sieve Size, in. (mm), and Percent Passing						
		2 1/2 (63)	2 (50)	1 3/4 (45)	1 1/2 (37.5)	1 (25)	1/2 (12.5)	No. 4 (4.75)
PV ^{2/}	CA 5 & CA 7	---	---	100	98±2	72±22	22±12	3±3
	CA 5 & CA 11	---	---	100	98±2	72±22	22±12	3±3
SI and SC ^{2/}	CA 3 & CA 7	100	95±5	---	---	55±25	20±10	3±3
	CA 3 & CA 11	100	95±5	---	---	55±25	20±10	3±3
	CA 5 & CA 7	---	---	100	98±2	72±22	22±12	3±3
	CA 5 & CA 11	---	---	100	98±2	72±22	22±12	3±3

1/ See Table 1 of Article 1020.04.

2/ Any of the listed combination of sizes may be used.

- (e) Mixing Gravel, Crushed Gravel, Crushed Stone, and Crushed Slag Coarse Aggregates. Two different specified sizes of crushed stone, gravel, and crushed gravel from one source or any two sources may be combined in any

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consistent ratio in a mix; but the use of alternate batches of crushed stone, gravel, or crushed gravel of any one size or combination of sizes will not be permitted. Coarse aggregates of any one size from different sources shall not be mixed without permission from the Engineer. Crushed slag shall not be combined or mixed with gravel, crushed gravel, or crushed stone aggregates.

- (f) Freeze-Thaw Rating. When coarse aggregate is used to produce portland cement concrete for base course, base course widening, pavement (including precast), driveway pavement, sidewalk, shoulders, curb, gutter, combination curb and gutter, median, paved ditch, concrete superstructures on subgrade such as bridge approach slabs (excluding precast), concrete structures on subgrade such as bridge approach footings, or their repair using concrete, the gradation permitted will be determined from the results of the Department's Freeze-Thaw Test (Illinois Modified AASHTO T 161). A list of freeze-thaw ratings for all Class A quality coarse aggregate sources will be available. The gradations permitted for each rating shall be as follows.

Freeze-Thaw Rating (Top Size)		Gradation Permitted
in.	mm	
1 1/2 in.	(37.5 mm)	Combined CA 5 & CA 7, Combined CA 5 & CA 11, CA 7, or CA 11
1 in.	(25 mm)	CA 7 or CA 11
3/4 in.	(19 mm)	CA 11
1/2 in.	(12.5 mm)	CA 13, CA 14, or CA 16
NON-ACC		Not Acceptable

Additional requirements may be placed on coarse aggregates when used in continuously reinforced concrete pavement. Such requirements will be stipulated on the most recent Freeze-Thaw Rating List.

- (g) Alkali Reaction.

- (1) ASTM C 1260. Each coarse aggregate will be tested by the Department for alkali reaction according to ASTM C 1260. The test will be performed with Type I or II portland cement having a total equivalent alkali content ($\text{Na}_2\text{O} + 0.658\text{K}_2\text{O}$) of 0.90 percent or greater. The Engineer will determine the assigned expansion value for each aggregate, and these values will be made available on the Department's Alkali-Silica Potential Reactivity Rating List. The Engineer may differentiate aggregate based on ledge, production method, gradation number, or other factors. An expansion value of 0.05 percent will be assigned to limestone or dolomite coarse aggregates. However, the Department reserves the right to perform the ASTM C 1260 test.
- (2) ASTM C 1293 by Department. In some instances testing a coarse aggregate according to ASTM C 1260 may not provide accurate test

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results. In this case, the Department may only test according to ASTM C 1293.

- (3) ASTM C 1293 by Contractor. If an individual aggregate has an ASTM C 1260 expansion value that is unacceptable to the Contractor, an ASTM C 1293 test may be performed by the Contractor according to Article 1003.02(e)(3).

If lightweight aggregate is specified for structures, it shall be according to ASTM C 330, the second paragraph of Article 1004.01(c), and Articles 1004.01(d) and 1004.01(e). Lightweight aggregate of any one size from different sources shall not be mixed without permission of the Engineer. Lightweight aggregate may be combined or mixed with gravel, crushed gravel, or crushed stone.

1004.03 Coarse Aggregate for Hot-Mix Asphalt (HMA). The aggregate shall be according to Article 1004.01 and the following.

- (a) Description. The coarse aggregate for HMA shall be according to the following table.

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Use	Mixture	Aggregates Allowed	
Class A	Seal or Cover	<u>Allowed Alone or in Combination</u> ^{5/} : Gravel Crushed Gravel Carbonate Crushed Stone Crystalline Crushed Stone Crushed Sandstone Crushed Slag (ACBF) Crushed Steel Slag Crushed Concrete	
HMA Low ESAL	Stabilized Subbase or Shoulders	<u>Allowed Alone or in Combination</u> ^{5/} : Gravel Crushed Gravel Carbonate Crushed Stone Crystalline Crushed Stone Crushed Sandstone Crushed Slag (ACBF) Crushed Steel Slag ^{1/} Crushed Concrete	
HMA High ESAL Low ESAL	Binder IL-19.0 or IL-19.0L SMA Binder	<u>Allowed Alone or in Combination</u> ^{5/} : Crushed Gravel Carbonate Crushed Stone ^{2/} Crystalline Crushed Stone Crushed Sandstone Crushed Slag (ACBF) Crushed Concrete ^{3/}	
HMA High ESAL Low ESAL	C Surface and Binder IL-9.5 IL-9.5FG or IL-9.5L SMA Ndesign 50 Surface	<u>Allowed Alone or in Combination</u> ^{5/} : Crushed Gravel Carbonate Crushed Stone ^{2/} Crystalline Crushed Stone Crushed Sandstone Crushed Slag (ACBF) Crushed Steel Slag ^{4/} Crushed Concrete ^{3/}	
HMA High ESAL	D Surface and Binder IL-9.5 or IL-9.5FG SMA Ndesign 50 Surface	<u>Allowed Alone or in Combination</u> ^{5/} : Crushed Gravel Carbonate Crushed Stone (other than Limestone) ^{2/} Crystalline Crushed Stone Crushed Sandstone Crushed Slag (ACBF) Crushed Steel Slag ^{4/} Crushed Concrete ^{3/}	
		<u>Other Combinations Allowed:</u>	
		<u>Up to...</u>	<u>With...</u>
		25% Limestone	Dolomite
		50% Limestone	Any Mixture D aggregate other than Dolomite
75% Limestone	Crushed Slag (ACBF) or Crushed Sandstone		

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Use	Mixture	Aggregates Allowed	
HMA High ESAL	E Surface IL-9.5 or IL-9.5FG SMA Ndesign 80 Surface	<u>Allowed Alone or in Combination</u> ^{5/} :	
		Crushed Gravel Crystalline Crushed Stone Crushed Sandstone Crushed Slag (ACBF) Crushed Steel Slag ^{1/} Crushed Concrete ^{3/} No Limestone.	
		<u>Other Combinations Allowed:</u>	
		<u>Up to...</u>	<u>With...</u>
		50% Dolomite ^{2/}	Any Mixture E aggregate
HMA High ESAL	F Surface IL-9.5 or IL-9.5FG SMA Ndesign 80 Surface	75% Dolomite ^{2/}	Crushed Sandstone, Crushed Slag (ACBF), Crushed Steel Slag, or Crystalline Crushed Stone
		75% Crushed Gravel or Crushed Concrete ^{3/}	Crushed Sandstone, Crystalline Crushed Stone, Crushed Slag (ACBF), or Crushed Steel Slag
		<u>Allowed Alone or in Combination</u> ^{5/} :	
HMA High ESAL	F Surface IL-9.5 or IL-9.5FG SMA Ndesign 80 Surface	Crystalline Crushed Stone Crushed Sandstone Crushed Slag (ACBF) Crushed Steel Slag No Limestone.	
		<u>Other Combinations Allowed:</u>	
		<u>Up to...</u>	<u>With...</u>
		50% Crushed Gravel, Crushed Concrete ^{3/} , or Dolomite ^{2/}	Crushed Sandstone, Crushed Slag (ACBF), Crushed Steel Slag, or Crystalline Crushed Stone

1/ Crushed steel slag allowed in shoulder surface only.

2/ Carbonate crushed stone shall not be used in SMA Ndesign 80. In SMA Ndesign 50, carbonate crushed stone shall not be blended with any of the other aggregates allowed alone in Ndesign 50 SMA binder or Ndesign 50 SMA surface.

3/ Crushed concrete will not be permitted in SMA mixes.

4/ Crushed steel slag shall not be used as binder.

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5/ When combinations of aggregates are used, the blend percent measurements shall be by volume.

- (b) Quality. For surface courses, the coarse aggregate shall be Class B quality or better. For SMA surface and binder courses the coarse aggregate shall be Class B Quality or better. For Class A (seal or cover coat), and other binder courses, the coarse aggregate shall be Class C quality or better.
- (c) Gradation. The coarse aggregate gradations shall be as listed in the following table.

Use	Size/Application	Gradation No.
Class A-1, A-2, & A-3	3/8 in. (10 mm) Seal	CA 16 or CA 20
Class A-1	1/2 in. (13 mm) Seal	CA 15
Class A-2 & A-3	Cover Coat	CA 14
HMA High ESAL	IL-19.0	CA 11 ^{1/}
	SMA 12.5 ^{2/}	CA 13, CA 14, or CA 16 ^{3/}
	SMA 9.5 ^{2/}	CA 13, CA 14, or CA 16 ^{3/}
	IL-9.5	CA 16
	IL-9.5FG	CA 16
HMA Low ESAL	IL-19.0L	CA 11 ^{1/}
	IL-9.5L	CA 16

1/ CA 16 or CA 13 may be blended with CA 11.

2/ The coarse aggregates shall be capable of being combined with the fine aggregates and mineral filler to meet the approved mix design and the mix requirements noted herein.

3/ The specified coarse aggregate gradations may be blended.

- (d) Flat and Elongated Particles. For SMA the coarse aggregate shall meet the criteria for Flat and Elongated Particles listed in Illinois Modified AASHTO M 325.

- (e) Absorption. For SMA the coarse aggregate shall also have water absorption ≤ 2.5 percent.

1004.04 Coarse Aggregate for Granular Embankment Special; Granular Subbase; and Aggregate Base, Surface, and Shoulder Courses. The aggregate shall be according to Article 1004.01 and the following.

- (a) Description. The coarse aggregate shall be gravel, crushed gravel, crushed stone, crushed concrete, crushed slag, or crushed sandstone, except gravel shall not be used for subbase granular material, Type C.

The coarse aggregate for aggregate base course and aggregate shoulders, if approved by the Engineer, may be produced by blending aggregates from

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more than one source, provided the method of blending results in a uniform product. The components of a blend need not be of the same kind of material. The source of material or blending proportions shall not be changed during the progress of the work without written permission from the Engineer. Where a natural aggregate is deficient in fines, the material added to make up deficiencies shall be a fine aggregate of Class C quality or higher according to Section 1003 and/or mineral filler meeting the requirements of Article 1011.01.

- (b) Quality. The coarse aggregate shall be Class D Quality or better.
- (c) Gradation. The coarse aggregate gradation shall be used as follows.

Use	Gradation
Granular Embankment, Special	CA 6 or CA 10 ^{1/}
Granular Subbase:	
Subbase Granular Material, Ty. A	CA 6 or CA 10 ^{2/}
Subbase Granular Material, Ty. B	CA 6, CA 10, CA 12, or CA 19 ^{2/}
Subbase Granular Material, Ty. C	CA 7, CA 11, or CA 5 & CA 7 ^{3/}
Aggregate Base Course	CA 6 or CA 10 ^{2/}
Aggregate Surface Course:	
Type A	CA 6 or CA 10 ^{1/}
Type B	CA 6, CA 9, or CA 10 ^{4/}
Aggregate Shoulders	CA 6 or CA 10 ^{2/}

1/ Gradation CA 2, CA 4, CA 9, or CA 12 may be used if approved by the Engineer.

2/ Gradation CA 2 or CA 4 may be used if approved by the Engineer.

3/ If the CA 5 and CA 7 blend is furnished, proper mixing will be required either at the source or at the jobsite according to Article 1004.02(d).

4/ Gradation CA 4 or CA 12 may be used if approved by the Engineer.

- (d) Plasticity. All material shall comply with the plasticity index requirements listed below. The plasticity index requirement for crushed gravel, crushed stone, and crushed slag may be waived if the ratio of the percent passing the No. 200 (75 µm) sieve to that passing the No. 40 (425 µm) sieve is 0.60 or less.

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Use	Plasticity Index - Percent ^{1/}	
	Gravel	Crushed Gravel, Stone, & Slag
Granular Embankment, Special	0 to 6	0 to 4
Granular Subbase:		
Subbase Granular Material, Type A	0 to 9	---
Subbase Granular Material, Type B	0 to 9	---
Aggregate Base Course	0 to 6	0 to 4
Aggregate Surface Course:		
Type A	2 to 9	---
Type B ^{2/}	2 to 9	---
Aggregate Shoulders	2 to 9	---

1/ Plasticity Index shall be determined by the method given in AASHTO T 90. Where shale in any form exists in the producing ledges, crushed stone samples shall be soaked a minimum of 18 hours before processing for plasticity index or minus No. 40 (425 µm) material. When clay material is added to adjust the plasticity index, the clay material shall be in a minus No. 4 (4.75 mm) sieve size.

2/ When Gradation CA 9 is used, the plasticity index requirement will not apply.

1004.05 Coarse Aggregate for Blotter, Embankment, Backfill, Trench Backfill, Bedding, and French Drains. The aggregate shall be according to Article 1004.01 and the following.

- (a) Description. The coarse aggregate shall be gravel, crushed gravel, crushed stone, crushed concrete, crushed slag, chats, crushed sandstone, or wet bottom boiler slag.

For pipe underdrains, Type 2, the crushed stone shall be a crystalline crushed stone.

- (b) Quality. The coarse aggregate shall consist of sound durable particles reasonably free of objectionable deleterious material.
- (c) Gradation. The coarse aggregate gradations shall be as follows.

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Application	Gradation
Blotter	CA 15
Granular Embankment, Granular Backfill, Trench Backfill, and Bedding and Backfill for Pipe Culverts and Storm Sewers	CA 6, CA 9, CA 10, CA 12, CA 17, CA 18, and CA 19
Porous Granular Embankment, Porous Granular Backfill, and French Drains	CA 7, CA 8, CA 11, CA 15, CA 16 and CA 18
Bedding and Backfill for Pipe Underdrains, Type 2	CA 16, except the percent passing the No. 16 (1.18 mm) sieve shall be 4 ± 4 percent.

1004.06 Coarse Aggregate for Select Fill Used for Retaining Wall Applications Utilizing Soil Reinforcement. The aggregate shall be according to Article 1004.01 and the following.

- (a) Description. The coarse aggregate shall be crushed gravel or crushed stone.
- (b) Quality. The coarse aggregate shall have a maximum sodium sulfate (Na_2SO_4) loss of 15 percent according to Illinois Modified AASHTO T 104.
- (c) Gradation. The coarse aggregate shall be CA 6 thru CA 16, except when geosynthetic or geotextile soil reinforcement is utilized the coarse aggregate shall be CA 12 thru CA 16.
- (d) Internal Friction Angle. The effective internal friction angle for the coarse aggregate shall be a minimum 34 degrees according to AASHTO T 236 on samples compacted to 95 percent density according to Illinois Modified AASHTO T 99. The AASHTO T 296 test with pore pressure measurement may be used in lieu of AASHTO T 236. If the Contractor's design uses a friction angle greater than 34 degrees, this greater value shall be taken as the minimum required.
- (e) pH. pH shall be determined according to Illinois Modified AASHTO T 289.
 - (1) When geosynthetic soil reinforcement is used, the coarse aggregate pH shall be 4.5 to 9.0 for permanent applications, and 3.0 to 10.0 for temporary applications.
 - (2) When steel reinforcement is used, the coarse aggregate pH shall be 5.0 to 10.0 according to Illinois Modified AASHTO T 289.
- (f) Corrosion Mitigation. The coarse aggregates shall also meet the following when used in conjunction with steel soil reinforcement in non-temporary wall applications:

- (1) Resistivity. The resistivity according to Illinois Modified AASHTO T 288 shall be greater than 3000 ohm centimeters for galvanized reinforcement, and 1500 ohm centimeters for aluminized Type 2 reinforcement. However, the resistivity requirement is not applicable to CA 7, CA 8, CA 11, CA 13, CA 14, CA 15, and CA 16.
- (2) The chlorides shall be less than 100 parts per million according to Illinois Modified AASHTO T 291 or ASTM D 4327. For either test, the sample shall be prepared according to Illinois Modified AASHTO T 291.
- (3) The sulfates shall be less than 200 parts per million according to Illinois Modified AASHTO T 290 or ASTM D 4327. For either test, the sample shall be prepared according to Illinois Modified AASHTO T 290.
- (4) The organic content shall be a maximum of 1.0 percent according to Illinois Modified AASHTO T 267.
- (g) Test Frequency. Prior to the start of construction, the Contractor shall provide internal friction angle and pH test results demonstrating the select fill material meets the specification requirements. Resistivity, chlorides, sulfates, and organic content test results shall also be provided if steel reinforcement is used. The laboratory performing the Illinois Modified AASHTO T 288 test shall be approved by the Department according to the Bureau of Materials Policy Memorandum "Minimum Laboratory Requirements for Resistivity Testing". These test results shall be no more than 12 months old. In addition, a sample of select fill material will be obtained by the Engineer for testing and approval before construction begins. Thereafter, the minimum frequency of subsequent sampling and testing at the jobsite will be one per 40,000 tons (36,300 metric tons) of select fill. Testing to verify the internal friction angle will only be required when the wall design utilizes a minimum effective internal friction angle greater than 34 degrees.