Mixture Aggregate Technician Course

LAKE LAND COLLEGE

2023-2024

Illinois Department of Transportation
Central Bureau of Materials

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*

*The calculations exam 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, calculations 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 16, 2023, the last date to retest is August 30, 2024).** 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:

			LEAD INSTR.	LAB INSTR. 1	LAB INSTR. 2
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:

			LEAD INSTR.	LAB INSTR. 1	LAB INSTR. 2
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.	______

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:

https://idot.illinois.gov/content/dam/soi/en/web/idot/documents/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 100% PFP, QCP or 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.

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 QMTP 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) *note 1*
ASPHALT	
Quality Control Manager	Hot-Mix Asphalt Level II (CET 023)
Aggregate Sampling and Gradation Testing	Hot-Mix Asphalt Level I (CET 029) *notes 1 & 3*
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) *note 2*
Concrete Plant	PCC Level II (CET 030, CET 024, and CET 020) *notes 1 & 3*
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.

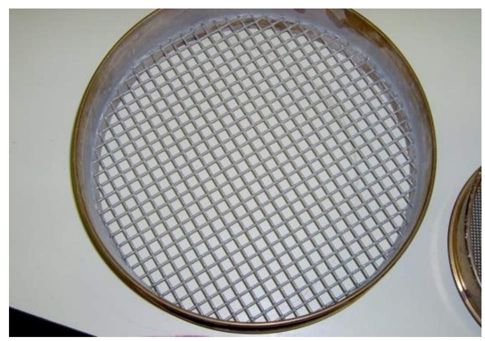
Note 2 A Concrete Tester must be supervised by a PCC Level I or a PCC Level II.

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.

Sieve Designations

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

SIEVE CONVERSIONS



ENGLISH	**METRIC**
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
#4	**4.75mm**
#8	2.36mm
#10	2.00mm
#16	1.18mm
#30	600µm (microns)
#40	425µm
#50	300µm
#80	180µm
#100	150µm
#200	**75µm**

Coarse Aggregate ↑ / Fine Aggregate ↓ (at #4 — 4.75mm)

Fine Aggregate ↑ / Dust ↓ (at #200 — 75µm)

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>	**<u>3</u>**	**<u>2</u>**	**<u>C</u>**	**<u>M</u>**	**<u>16</u>**
Aggregate	**'B' Quality**	**Crushed Stone**	**Coarse Aggregate**	**Modified Specification**	**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 A 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

Gradation	Critical Sieve*	Master Band (%)	Warning Band (%)
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".

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

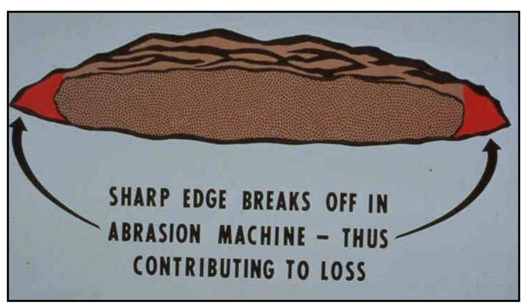
4.0 STOCKPILING AND HANDLING

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 pipe 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.

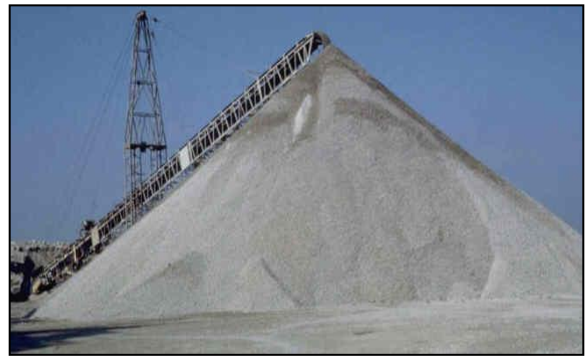


The following discussion will cover the types of stockpiling/handling, the effect of segregation and degradation on each type, and the methods normally used to eliminate or reduce their effects.

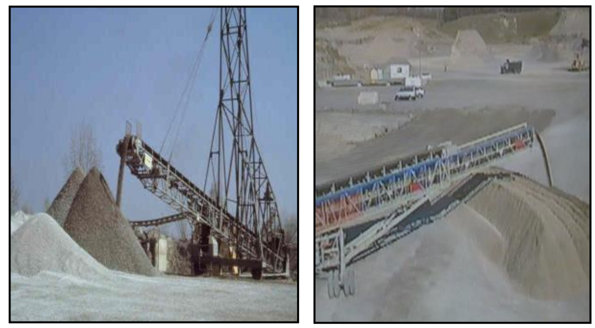
All stockpiling and handling for the Aggregate Gradation Control System shall conform to *Policy Memorandum 11-08.7 Aggregate Gradion Control System (AGCS)* (see Appendix A, page A-77 herein).

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



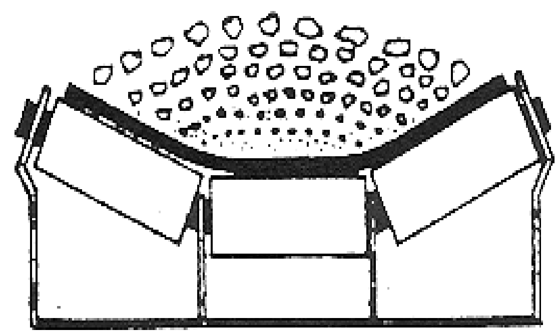
Cone Stockpile



Elongated Cone Stockpiles

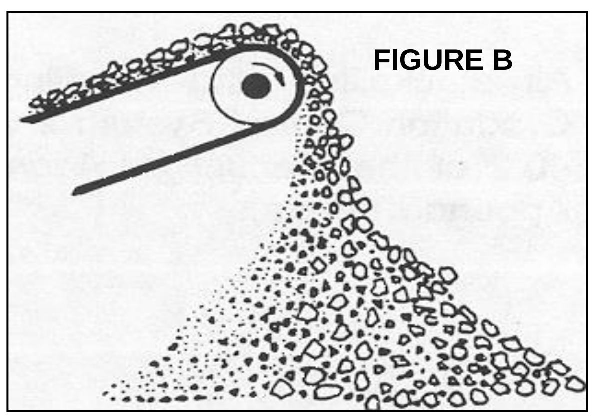
4.1.1 These two types of stockpiles create a high degree of segregation. A simple explanation can show the reason for segregation. As the aggregate stream is conveyed up the belt **(Figure A)**, vibration of the belt tends to layer the individual sizes and causes the fines to move to the bottom of the 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)**.

FIGURE A



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.

FIGURE B



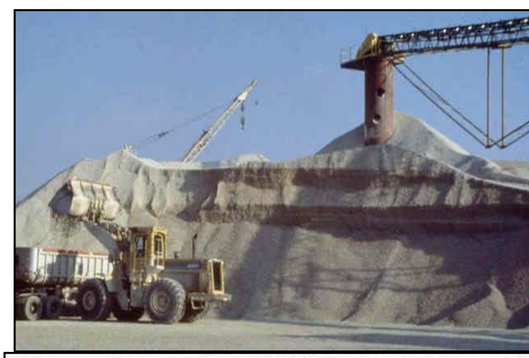
An adjustable radial stacker or an adjustable telescopic portable radial stacker can be used to build elongated tent-shaped piles. The adjustable radial stacker moves horizontally as well as vertically. The telescopic radial stacker not only moves horizonally and vertically, but also moves telescopically 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.

Adjustable Radial Stacker

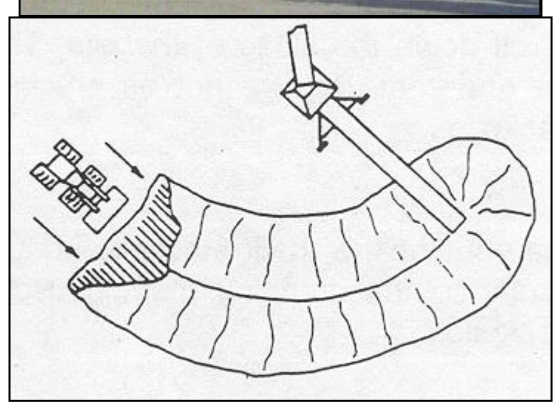
Telescopic Portable Radial Stacker

It should be pointed out that the fall distance from the conveyor/stacker to stockpile cannot be greater than 15 feet unless a change is approved by the Central Bureau of Materials, as specified in Section 5.1.2 of *Policy Memorandum 11-08.7* (See Appendix A, 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.



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.

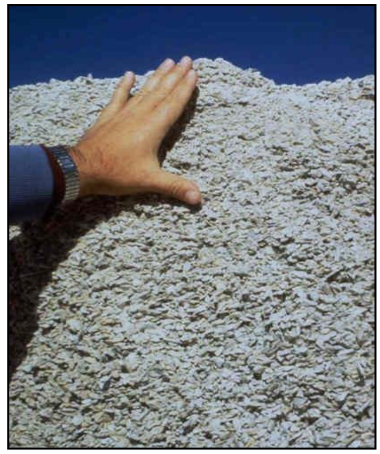
4.2 **Truck Stockpiles**. The second of the two most common stockpiling methods is using large off-road trucks. These trucks normally carry 25 to 100 metric tons per load. The method requires truck dumps to be placed next to each other, effectively building a layer of material. Material can be placed 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 µm) fines.

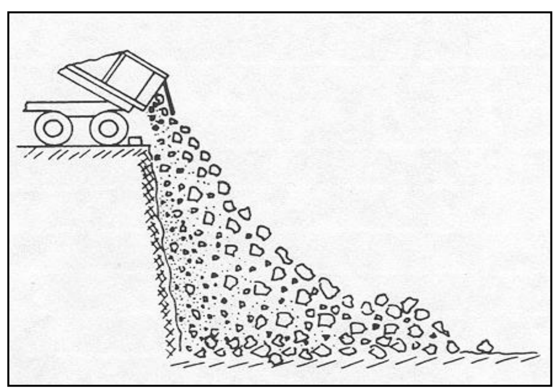


Care must be exercised when permitting trucks on a stockpile. Aggregate used where excessive fines can cause problems should not be truck-stockpiled. Stockpiles should be constantly monitored for a fines problem and, if necessary, corrective action initiated, even to the extent of halting truck-stockpiling.

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 current Illinois Modified AASHTO R90 Test Prodecure. **<u>No other sampling procedures will be allowed</u>**. 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 **<u>representative</u>** 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.

Automatic samplers may be used as long as the gradations compare to samples taken with the sample template.

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 <u>entire</u> (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 <u>entire</u> 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

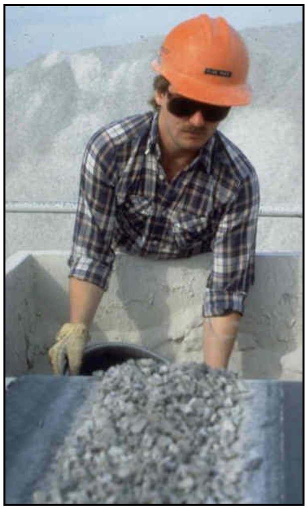
Step 1

Step 2

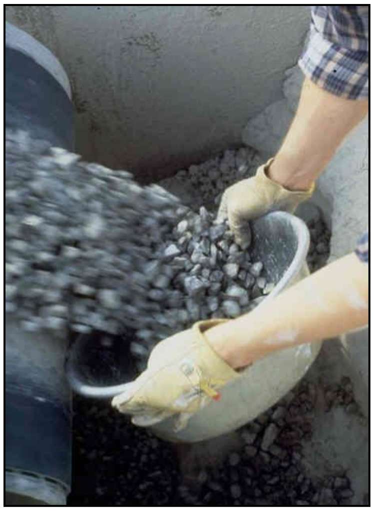
Step 3

Step 4

Belt-Stream Sampling

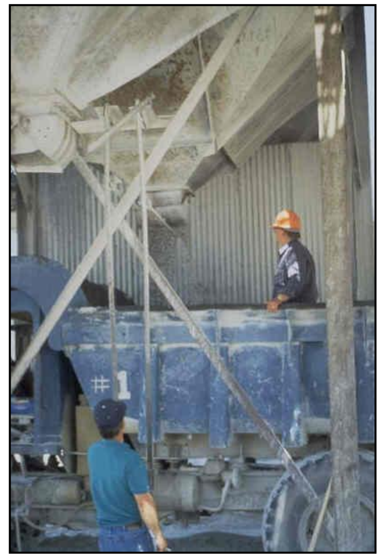


Step 1



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 bucketsloads 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 tip 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 a minimum of five 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.

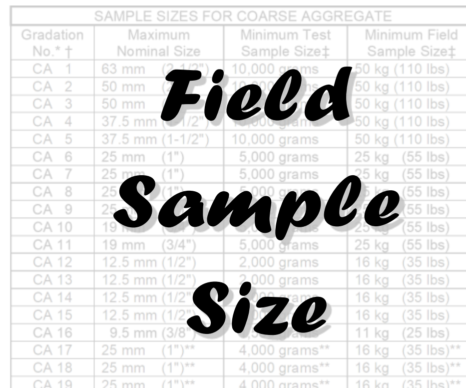
5.4.2 **Sampling Device** - The sampling device used to cut the flow stream from the end of the belt or the bin discharge must be strong enough to handle the force of the flow stream. The device must also be large and deep enough to cut the <u>entire</u> flow stream and not overflow when passing through 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 <u>**Sampling Frequency / Field Sample Size**</u>

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, 2021. A copy of the Aggregate Sample Size Table is located on pages 6-18 & 6-19 herein.

5.6 **Safety**. Gradation sampling can pose one of the greatest risks to the safety of the aggregate technician/inspector. <u>Extreme care</u> 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
  (Illinois Modified AASHTO R 76)
- Drying of the sample
  (Illinois Modified AASHTO T 255)
- Wash test
  (Illinois Modified AASHTO T 11)
- Dry sieve analysis
  (Illinois Modified AASHTO T 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 <u>Manual of Test Procedures for Materials</u> (See Appendix A, 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. The test sample size shall be as stated in Illinois Specification 201.

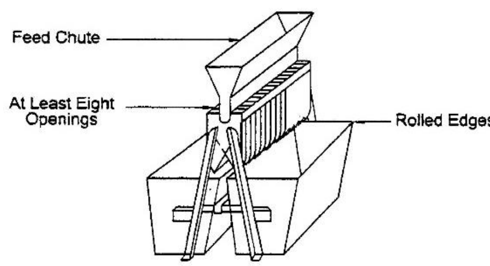
Reduction of field samples shall conform to AASHTO R 76 (see Appendix A, herein). Selection during splitting of an exact predetermined mass for the sample is not permitted.

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 AASHTO R 76, Method 'A' (see Appendix A herein).

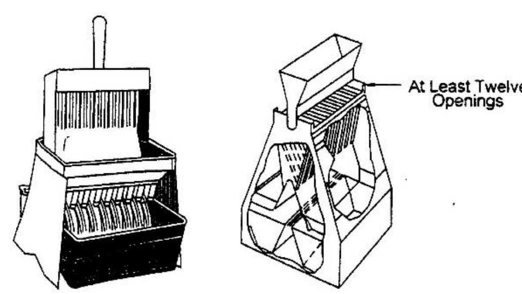
6.1.1 Method 'A' - Mechanical Splitters - As stated in the specification, the mechanical splitter shall have an even number of same-width chutes, directed alternately to different sides. There shall be a minimum of eight chutes for coarse aggregate and twelve chutes for fine aggregate. All chutes shall 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 AASHTO R 76.

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. 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.

<u>Mechanical Splitting</u>

<u>STEP 1</u>

<u>STEP 2</u>

<u>STEP 3</u>

<u>STEP 4</u>

<u>STEP 5</u>

6.1.2 Method 'B' - Quartering - Quartering, as described in AASHTO R 76, 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 IL Modified AASHTO R 76. Both split halves shall conform to the +/- 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 AASHTO T 255 utilizing an oven, specifically designed for drying, set at and capable of maintaining a uniform temperature of 230 +/- 9˚F (110 +/- 5˚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, AASHTO T 11, "Amount of Material Finer than No. 200 [75um] Sieve in Aggregate", requires the sample be placed in a sufficiently sized pan and covered with water. 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.

Manual Wash Method

Mechanical Wash Method

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 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 AASHTO T 27, "Sieve Analysis of Fine and Coarse Aggregates". All equipment used shall conform to AASHTO T 27

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 chance for a particle to pass a certain sized
orientations to the sieves. This allows every
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 AASHTO T 27 (See Appendix B herein). Shaking time shall be increased if necessary to comply with AASHTO T 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 AASHTO T 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 µm) sieves, while a soft china brush shall be used the No. 50 (300 µm) sieve through the No. 200 (75µm) 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. 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 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:

$$\textbf{\% -200 (-75µm) by Washing} = \frac{\textbf{TDW-TWW}}{\textbf{TDW}} \textbf{ X 100}$$

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:

Maximum Gain-Loss = 0.3% x TDW

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%.

$$\textbf{Cumulative \% Retained} = \frac{\textbf{CWR}}{\textbf{TDW}} \textbf{ X 100}$$

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:

% passing = 100 – 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 AASHTO R 76 and shall meet the minimum sample size requirements of Illinois Specification 201, Aggregate Gradation Sample Size Table and Quality Control Sieves (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 AASHTO T 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 AASHTO T 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:

$$P = \frac{(OSW - TDW)}{TDW} \times 100$$

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:

OSW = 5,165 g
TDW = 5,045 g

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

P = ____________

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	50,000 g	X	X	X	XC	X		XC	XC	X
CS02	50,000 g		X	X	XC	X		XC	XC	X
RR01	20,000 g				X	XC	X	XC	XC	X
RR02	20,000 g			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.

AGGREGATE GRADATION REPORT

MISTIC ID ____________

Inspector No.: ________ Name: ________ Date Sampled: ________ Seq No: ________

Mix Plant No.: ________ Name: ________ Contract No: ________ Job No.: ________

Responsible Loc: ________ Lab: ________ Lab Name: ________ Source Name: ________

SOURCE	MATL CODE	TYPE INSP	ORIGINAL ID	SPECIFICATION	SAMPLED FROM	WASH DRY	Load Out / Terminal	Ledge

SIEVE IN / MM	3 / 75	2.5 / 63	2 / 50	1.75 / 45	1.5 / 37.5	1 / 25	3/4 / 19	5/8 / 15.9	1/2 / 12.5	3/8 / 9.5	#4 / 4.75	#8 / 2.36	#16 / 1.18	#30 / 0.6	#40 / 0.425	#50 / 0.3	#100 / 0.15	#200 / 0.075
PASS %																		

%WASH - 200	PI RATIO	RESULT	REMARK

Insp. Quantity (tons)

SIEVE English	SIEVE Metric	Ind. Wt. Retain	Accum Wt.	Accum % Retain	% Passing	Spec Min	Spec Max	Out Flag	Rounded Passing
3	75.0								
2.5	63.0								
2	50.0								
1.75	45.0								
1.5	37.5								
1	25.0								
3/4	19.0								
5/8	15.9								
1/2	12.5								
3/8	9.5								
1/4	6.3								
#4	4.75								
#8	2.36								
#10	2.0								
#16	1.18								
#30	0.6								
#40	0.425								
#50	0.3								
#80	0.18								
#100	0.15								
#200	0.075								
Pan									
Tot Dry Wt.				% Washed - 200					
Tot Wash Wt.									
Diff (-.075)				#200 / #40					

Orig. Wet Weight: ________ Moisture %: ________

(Mix Plant Only)

Lot: ________

Bin: ________

Tech/Insp: ________

Tested By: ________

Agency: ________

Copies to: ________

Report Date: ________

/FOR DTY03504

MI504QC

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AGGREGATE GRADATION REPORT

MISTIC ID: ______

Inspector No.: ______ Name: ______ Date Sampled: ______ Seq No: ______

Mix Plant No.: ______ Name: ______ Contract No: ______ Job No.: ______

Responsible Loc: ______ Lab: ______ Lab Name: ______ Source Name: ______

SOURCE	MATL CODE	TYPE INSP	ORIGINAL ID	SPECIFICATION	SAMPLED FROM	WASH DRY	Load Out / Terminal	Ledge

SIEVE IN / MM	3 / 75	2.5 / 63	2 / 50	1.75 / 45	1.5 / 37.5	1 / 25	3/4 / 19	5/8 / 15.9	1/2 / 12.5	3/8 / 9.5	#4 / 4.75	#8 / 2.36	#16 / 1.18	#30 / 0.6	#40 / 0.425	#50 / 0.3	#100 / 0.15	#200 / 0.075
PASS %																		

%WASH - 200	PI RATIO	RESULT	REMARK

Insp. Quantity (tons)

SIEVE English	SIEVE Metric	Ind. Wt. Retain	Accum Wt.	Accum % Retain	% Passing	Spec Min	Spec Max	Out Flag	Rounded Passing
3	75.0								
2.5	63.0								
2	50.0								
1.75	45.0								
1.5	37.5								
1	25.0								
3/4	19.0								
5/8	15.9								
1/2	12.5								
3/8	9.5								
1/4	6.3								
#4	4.75								
#8	2.36								
#10	2.0								
#16	1.18								
#30	0.6								
#40	0.425								
#50	0.3								
#80	0.18								
#100	0.15								
#200	0.075								
Pan									
Tot Dry Wt.			% Washed - 200						
Tot Wash Wt.									
Diff (-.075)			#200 / #40						

Orig. Wet Weight: ______ Moisture %: ______

(Mix Plant Only)

Lot: ______

Bin: ______

Tech/Insp: ______

Tested By: ______

Agency: ______

Copies to: ______

Report Date: ______

/FOR DTY03504

MI504QC

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AGGREGATE GRADATION REPORT

MISTIC ID: (1)

Inspector No.: (2) Name: (3) Date Sampled: (4) Seq No: (5)

Mix Plant No.: (6) Name: (7) Contract No: (8) Job No.: (9)

Responsible Loc: (10) Lab: (11) Lab Name: (12) Source Name: (13)

SOURCE	MATL CODE	TYPE INSP	ORIGINAL ID	SPECIFICATION	SAMPLED FROM	WASH DRY	Load Out / Terminal	Ledge
(14)	(15)	(16)	(17)	(19)	(21)	(23)	(22)	(20)

SIEVE IN / MM	3 75	2.5 63	2 50	1.75 45	1.5 37.5	1 25	3/4 19	5/8 15.9	1/2 12.5	3/8 9.5	#4 4.75	#8 2.36	#16 1.18	#30 0.6	#40 0.425	#50 0.3	#100 0.15	#200 0.075
PASS %	(24)																	

%WASH - 200	PI RATIO	RESULT	REMARK
(25)	(26)	(27)	(28)

Insp. Quantity (tons)
(18)

SIEVE English	SIEVE Metric	Ind. Wt. Retain	Accum Wt.	Accum % Retain	% Passing	Spec Min	Spec Max	Out Flag	Rounded Passing
3	75.0	(29)	(30)	(31)	(32)	(33)	(34)		
2.5	63.0								
2	50.0								
1.75	45.0								
1.5	37.5								
1	25.0								
3/4	19.0								
5/8	15.9								
1/2	12.5								
3/8	9.5								
1/4	6.3								
#4	4.75								
#8	2.36								
#10	2.0								
#16	1.18								
#30	0.6								
#40	0.425								
#50	0.3								
#80	0.18								
#100	0.15								
#200	0.075								
Pan									
Tot Dry Wt.		(35)	% Washed - 200		(38)				
Tot Wash Wt.		(36)							
Diff (-.075)		(37)	#200 / #40		(39)				

Orig. Wet Weight: (40) Moisture %: (41)

(Mix Plant Only)

Lot: (42)

Bin: (43)

Tech/Insp: (44)

Tested By: (45)

Agency: (46)

Copies to: (47)

Report Date: (48)

/FOR DTY03504

MI504QC

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FIELD/LAB GRADATIONS

MI 504M

(Revised 11/9/22)

1. **MISTIC ID:** MISTIC test identification number. Leave blank, 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 the 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.
    Example: 96 for District 6

11. **<u>LAB:</u>** Enter the 2 letter MISTIC lab code.

Laboratory Locations	MISTIC Lab Codes
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. **<u>LAB NAME:</u>** Enter the name of the company which cannot exceed 20 characters.

13. **<u>SOURCE NAME:</u>** Enter the name of the aggregate producer.

14. **<u>SOURCE:</u>** Enter the MISTIC code number of the aggregate producer. Example: 50912-02

15. **<u>MAT. CODE NO.:</u>** 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. Coarse and fine aggregates

used in concrete are always “A” quality. Hot mix asphalt surface course and fine aggregates are generally “B” quality. Hot mix asphalt binder course aggregates are generally “C” quality and fine aggregate 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 **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	**TYPE OF MATERIAL**	**AGGREGATE TYPE**
0 & 1 Have No Quality	0 = Gravel	C = Coarse Aggregate
2 = A Quality	1 = Crushed Gravel	F = Fine Aggregate
3 = B Quality	2 = Crushed Stone	
4 = C Quality	3 = ACBF Slag	
5 = D Quality	7 = Natural Sand	
6 = D Quality Stabilized	8 = Stone Sand	
	9 = Special 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.

AGENCY	**QC/QA**	**NON QC/QA**
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. **LEDGE:** A five-digit code, provided by the District that correlates to the production method of the sampled material. Enter "99999" for all stockpile samples and material sampled at a Terminal or Supply Yard.

21. **SAMPLED FROM:** Enter the 2 character designation in the first two spaces. Refer to "Sampled From Codes".

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

22. **LOADOUT / TERMINAL:** Enter name of site for multiple samples from the same source

23. **WASH/DRY:** Enter "W" if the test was a washed gradation, or a "D" if it was a dry gradation.

24. **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 (#200) sieve, which shall be reported to the nearest 0.1%.

25. **WASH - 0.075 (-#200):** Enter the washed minus 0.075 mm (#200) value from the calculation table to the nearest 0.1%.

26. **PI RATIO:** Plasticity index ratio. Leave blank. IDOT personnel, when appropriate, should enter the PI ratio value.

27. **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.

28. <u>REMARKS:</u> 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
- Enter "ws" if the sample was witnessed by the "IND"

  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.
- Enter "ws" if the sample was witnessed by the "IND"
- Explain reason for unacceptable comparison.

  Examples: Contractor obtained sample incorrectly; IDOT equipment required repair; Contractor performed test method incorrectly; problem was not identified, will investigate further if problem continues.
- Enter "ws" if the sample was witnessed by the "IND"

  Example: X - 100297 TCS ws. Contractor obtained sample incorrectly.

29. <u>INDIV. WT. RETAINED:</u> 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).

30. <u>CUMUL. WT. RETAINED:</u> Cumulative Weight Retained. Add the weight on each sieve, to the weight on any larger sieve(s), and enter that value.

31. <u>CUMUL. % RETAINED:</u> 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.

32. <u>PERCENT % PASSING:</u> Subtract the cumulative percent retained, from 100, for each sieve. Record to nearest 0.1%, and enter that value

33. <u>MINIMUM % PASSING:</u> Enter the specification minimum for all appropriate sieves. These may be Standard Specifications, or modified Standard Specification, or master band limits.

34. **MAXIMUM % PASSING:** Enter the specification maximum for all appropriate sieves. These may be Standard Specifications, or modified Standard Specification, or master band limits

35. **TOTAL DRY Wt.:** 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.

36. **TOTAL WASHED WT.:** 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.

37. **DIFF. -0.075 (-200):** Subtract total washed weight from the total dry weight, and enter that value.

38. % 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.

39. **0.075 / 0.425:** Leave blank. IDOT personnel, when appropriate, enter the ratio of the percent passing the 0.075 mm (#200) sieve and the 0.425 mm (#40) sieve.

40. **ORIGINAL WET WT.:** Enter weight of the "as received" material before drying.

41. **MOISTURE %:** Percent difference between the "Original Wet Wt." and "Total Dry Wt."

42. **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.

43. **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.

44. **TECH / INSP.:** Leave blank. IDOT will enter initials of the person entering the test results into MISTIC.

45. **TESTED BY:** 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.

46. **AGENCY:** Enter testers employer

47. **COPIES TO:** 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.

48. **REPORT DATE:** Leave blank. IDOT will enter the date the results are entered into MISTIC as month, day, and year n mmddyy format.

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.
- Calculate % Moisture.

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.
- Calculate % Moisture

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.
- Calculate % Moisture

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.
- Calculate % Moisture.
- 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: **Sam Jones is the Quality Control Manager for Maine Construction Company (918-02). Sam took a sample of 022CM16 from a stockpile located at Maine Construction's asphalt plant site on June 20, 2023. Joyce Walker, a Mixture Aggregate Technician, who also works for Maine Construction, ran a washed gradation (Seq. No. 005) on this material the same day. The testing took place on site in the Maine Construction's laboratory. The stone came from Alta Materials. (50587-03). Maine Construction's plant and laboratory is located in District 3.**

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.
- Calculate % Moisture.

Problem 6 - Sample Comparison Problem

- Transfer the producer rounded 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)

AGGREGATE GRADATION REPORT

MISTIC ID ______

Inspector No.: ______ **Name:** ______ **Date Sampled:** ______ **Seq No:** ______

Mix Plant No.: ______ **Name:** ______ **Contract No:** ______ **Job No.:** ______

Responsible Loc: ______ **Lab:** ______ **Lab Name:** ______ **Source Name:** ______

SOURCE	MATL CODE	TYPE INSP	ORIGINAL ID	SPECIFICATION	SAMPLED FROM	WASH DRY	Load Out / Terminal	Ledge
	022CM11					D		

SIEVE IN / MM	3 / 75	2.5 / 63	2 / 50	1.75 / 45	1.5 / 37.5	1 / 25	3/4 / 19	5/8 / 15.9	1/2 / 12.5	3/8 / 9.5	#4 / 4.75	#8 / 2.36	#16 / 1.18	#30 / 0.6	#40 / 0.425	#50 / 0.3	#100 / 0.15	#200 / 0.075
PASS %																		

%WASH - 200	PI RATIO	RESULT	REMARK

Insp. Quantity (tons)

SIEVE English	SIEVE Metric	Ind. Wt. Retain	Accum Wt.	Accum % Retain	% Passing	Spec Min	Spec Max	Out Flag	Rounded Passing
3	75.0								
2.5	63.0								
2	50.0								
1.75	45.0								
1.5	37.5								
1	25.0	0					100		
3/4	19.0	570				80	96		
5/8	15.9	1001							
1/2	12.5	1508				34	50		
3/8	9.5	1305							
1/4	6.3	916							
#4	4.75	243				0	12		
#8	2.36								
#10	2.0								
#16	1.18	227				0	8		
#30	0.6	15							
#40	0.425								
#50	0.3								
#80	0.18								
#100	0.15								
#200	0.075	33				0	2.5		
Pan		21							
Tot Dry Wt.		5842	% Washed - 200						
Tot Wash Wt.									
Diff (-.075)			#200 / #40						

Orig. Wet Weight: 5929 Moisture %: ______

(Mix Plant Only)

Lot: ______

Bin: ______

Homework #1

Tech/Insp: ______

Tested By: ______

Agency: ______

Copies to: ______

Report Date: ______

/FOR DTY03504

MI504QC

Is this a valid test? ______

This Page Is Reserved

AGGREGATE GRADATION REPORT

MISTIC ID

Inspector No.: ______ Name: ______ Date Sampled: ______ Seq No: ______
Mix Plant No.: ______ Name: ______ Contract No: ______ Job No.: ______
Responsible Loc: ______ Lab: ______ Lab Name: ______ Source Name: ______

SOURCE	MATL CODE	TYPE INSP	ORIGINAL ID	SPECIFICATION	SAMPLED FROM	WASH DRY	Load Out / Terminal	Ledge
	038FM20					W		

SIEVE IN / MM	3 / 75	2.5 / 63	2 / 50	1.75 / 45	1.5 / 37.5	1 / 25	3/4 / 19	5/8 / 15.9	1/2 / 12.5	3/8 / 9.5	#4 / 4.75	#8 / 2.36	#16 / 1.18	#30 / 0.6	#40 / 0.425	#50 / 0.3	#100 / 0.15	#200 / 0.075
PASS %																		

%WASH - 200	PI RATIO	RESULT	REMARK

Insp. Quantity (tons)

SIEVE English	SIEVE Metric	Ind. Wt. Retain	Accum Wt.	Accum % Retain	% Passing	Spec Min	Spec Max	Out Flag	Rounded Passing
3	75.0								
2.5	63.0								
2	50.0								
1.75	45.0								
1.5	37.5								
1	25.0								
3/4	19.0								
5/8	15.9								
1/2	12.5								
3/8	9.5	0.0					100		
1/4	6.3								
#4	4.75								
#8	2.36	131.2				67	97		
#10	2.0								
#16	1.18	237.4				36	66		
#30	0.6	133.6				20	46		
#40	0.425								
#50	0.3	101.9				7	29		
#80	0.18								
#100	0.15	74.5				2	16		
#200	0.075	52.1				0	8		
Pan		3.0							
Tot Dry Wt.		760.2	% Washed - 200						
Tot Wash Wt.		734.9							
Diff (-.075)			#200 / #40						

Orig. Wet Weight: 778.9 Moisture %: ______

(Mix Plant Only)

Lot: ______

Bin: ______

Homework #2

Tech/Insp: ______

Tested By: ______

Agency: ______

Copies to: ______

Report Date: ______
/FOR DTY03504
MI504QC

Is this a valid test? ________

This Page Is Reserved

AGGREGATE GRADATION REPORT

MISTIC ID: ________

Inspector No.: ________ Name: ________ Date Sampled: ________ Seq No: ________

Mix Plant No.: ________ Name: ________ Contract No: ________ Job No.: ________

Responsible Loc: ________ Lab: ________ Lab Name: ________ Source Name: ________

SOURCE	MATL CODE	TYPE INSP	ORIGINAL ID	SPECIFICATION	SAMPLED FROM	WASH DRY	Load Out / Terminal	Ledge
	027FM02					W		

SIEVE IN / MM	3 / 75	2.5 / 63	2 / 50	1.75 / 45	1.5 / 37.5	1 / 25	3/4 / 19	5/8 / 15.9	1/2 / 12.5	3/8 / 9.5	#4 / 4.75	#8 / 2.36	#16 / 1.18	#30 / 0.6	#40 / 0.425	#50 / 0.3	#100 / 0.15	#200 / 0.075
PASS %																		

%WASH - 200	PI RATIO	RESULT	REMARK

Insp. Quantity (tons)

SIEVE English	SIEVE Metric	Ind. Wt. Retain	Accum Wt.	Accum % Retain	% Passing	Spec Min	Spec Max	Out Flag	Rounded Passing
3	75.0								
2.5	63.0								
2	50.0								
1.75	45.0								
1.5	37.5								
1	25.0								
3/4	19.0								
5/8	15.9								
1/2	12.5								
3/8	9.5	0.0					100		
1/4	6.3								
#4	4.75	31.0				94	100		
#8	2.36	95.8				70	100		
#10	2.0								
#16	1.18	104.6				45	85		
#30	0.6	156.7				41	67		
#40	0.425								
#50	0.3	294.5							
#80	0.18								
#100	0.15	119.0				0	10		
#200	0.075	7.6				0	6		
Pan		0.4							
Tot Dry Wt.		823.4	% Washed - 200						
Tot Wash Wt.		811.1							
Diff (-.075)			#200 / #40						

Orig. Wet Weight: 842.6 Moisture %: ________

(Mix Plant Only)

Lot: ________

Bin: ________

Homework #3

Tech/Insp: ________

Tested By: ________

Agency: ________

Copies to: ________

Report Date: ________

/FOR DTY03504

MI504QC

Is this a valid test? ________

This Page Is Reserved

AGGREGATE GRADATION REPORT

MISTIC ID: ________

Inspector No.: ________ Name: ________ Date Sampled: ________ Seq No: ________
Mix Plant No.: ________ Name: ________ Contract No: ________ Job No.: ________
Responsible Loc: ________ Lab: ________ Lab Name: ________ Source Name: ________

SOURCE	MATL CODE	TYPE INSP	ORIGINAL ID	SPECIFICATION	SAMPLED FROM	WASH DRY	Load Out / Terminal	Ledge

SIEVE IN / MM	3 / 75	2.5 / 63	2 / 50	1.75 / 45	1.5 / 37.5	1 / 25	3/4 / 19	5/8 / 15.9	1/2 / 12.5	3/8 / 9.5	#4 / 4.75	#8 / 2.36	#16 / 1.18	#30 / 0.6	#40 / 0.425	#50 / 0.3	#100 / 0.15	#200 / 0.075
PASS %																		

%WASH - 200	PI RATIO	RESULT	REMARK

Insp. Quantity (tons)

SIEVE English	SIEVE Metric	Ind. Wt. Retain	Accum Wt.	Accum % Retain	% Passing	Spec Min	Spec Max	Out Flag	Rounded Passing
3	75.0								
2.5	63.0								
2	50.0								
1.75	45.0								
1.5	37.5								
1	25.0								
3/4	19.0								
5/8	15.9								
1/2	12.5	0					100		
3/8	9.5	32				94	100		
1/4	6.3	763							
#4	4.75	567				32	48		
#8	2.36	739							
#10	2.0								
#16	1.18	30				0	8		
#30	0.6								
#40	0.425								
#50	0.3								
#80	0.18								
#100	0.15								
#200	0.075	27				0	2.5		
Pan		3							
Tot Dry Wt.		2206	% Washed - 200						
Tot Wash Wt.		2169							
Diff (-.075)			#200 / #40						

Orig. Wet Weight: 2265 Moisture %: ________

(Mix Plant Only)

Lot: ________

Bin: ________

Homework #4

Tech/Insp: ________

Tested By: ________

Agency: ________

Copies to: ________

Report Date: ________

/FOR DTY03504
MI504QC

Is this a valid test? ________

This Page Is Reserved

AGGREGATE GRADATION REPORT

MISTIC ID: ________

Inspector No.: ________ Name: ________ Date Sampled: ________ Seq No: ________
Mix Plant No.: ________ Name: ________ Contract No: ________ Job No.: ________
Responsible Loc: ________ Lab: ________ Lab Name: ________ Source Name: ________

SOURCE	MATL CODE	TYPE INSP	ORIGINAL ID	SPECIFICATION	SAMPLED FROM	WASH DRY	Load Out / Terminal	Ledge
	022CM16					W		

SIEVE IN / MM	3 / 75	2.5 / 63	2 / 50	1.75 / 45	1.5 / 37.5	1 / 25	3/4 / 19	5/8 / 15.9	1/2 / 12.5	3/8 / 9.5	#4 / 4.75	#8 / 2.36	#16 / 1.18	#30 / 0.6	#40 / 0.425	#50 / 0.3	#100 / 0.15	#200 / 0.075
PASS %																		

%WASH - 200	PI RATIO	RESULT	REMARK

Insp. Quantity (tons)

SIEVE English	SIEVE Metric	Ind. Wt. Retain	Accum Wt.	Accum % Retain	% Passing	Spec Min	Spec Max	Out Flag	Rounded Passing
3	75.0								
2.5	63.0								
2	50.0								
1.75	45.0								
1.5	37.5								
1	25.0								
3/4	19.0								
5/8	15.9								
1/2	12.5	0					100		
3/8	9.5	89				94	100		
1/4	6.3	460							
#4	4.75	920				34	48		
#8	2.36	737							
#10	2.0								
#16	1.18	80				0	8		
#30	0.6								
#40	0.425								
#50	0.3								
#80	0.18								
#100	0.15								
#200	0.075	36				0	2.5		
Pan		2							
Tot Dry Wt.		2380	% Washed - 200						
Tot Wash Wt.		2322							
Diff (-.075)			#200 / #40						

Orig. Wet Weight: 2451 Moisture %: ________

(Mix Plant Only)

Lot: ________

Bin: ________

Homework #5

Tech/Insp: ________

Tested By: ________

Agency: ________

Copies to: ________

Report Date: ________

/FOR DTY03504

MI504QC

Is this a valid test? ________

This Page Is Reserved

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)					

This Page Is Reserved

APPENDIX A – TABLE OF CONTENTS

PAGE

MTP = Manual of Test Procedures for Materials
IDOT = Illinois Department of Transportation

THIS PAGE IS RESERVED

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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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

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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	50,000 g	X	X	X	XC	X		XC	XC	X
CS02	50,000 g		X	X	XC	X		XC	XC	X
RR01	20,000 g				X	XC	X	XC	XC	X
RR02	20,000 g			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 Modified Test Procedure
Effective Date: December 1, 2021
Revised Date: December 1, 2023

Standard Test Method for
Sampling Aggregate Products

Reference AASHTO R 90-18 (2022)

AASHTO Section	***Illinois Modification***
1.1	Remove “of coarse, fine, or combinations” in the first paragraph. Remove “which the aggregate is furnished” and replace with “the AGCS Policy” in the first paragraph. Add “for the following purposes” to the end of the last sentence of the first paragraph.
1.1.1	Add: “Preliminary investigation of the potential source of supply.”
1.1.2	Add: “Control of the product at the source of supply.”
1.1.3	Add: “Control of the operations at the site of use.”
1.1.4	Add: “Acceptance or rejection of the materials.”
1.1.4 Note1	Add: “Sampling plans and acceptance and control tests vary with the type of construction in which the material is used.”
1.2	Replace with the following: “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	Replace with the following: “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	Replace with the following: “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.”
1.4 Note 2	Replace with the following: “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.”
2.1	Replace with the following: Illinois Modified AASHTO Standards • T11, Materials Finer Than No. 200 (75µm) Sieve in Mineral Aggregates by Washing • T27, Sieve Analysis of Fine and Coarse Aggregates
2.3	Insert the following: Illinois Specification: • Illinois Specification 201 Aggregate Gradation Sample Size Table
3	Replace with the following: “**3 TERMINOLOGY**”
3.1	Add: “Definitions:”
3.1.1	Add: “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	Add: “Maximum aggregate size, (Superpave) n—in specifications for, or descriptions of aggregate—one size larger than the nominal maximum aggregate size.”

Illinois Modified Test Procedure
Effective Date: December 1, 2021
Revised Date: December 1, 2023

Standard Test Method for
Sampling Aggregate Products

Reference AASHTO R 90-18 (2022)

AASHTO Section	***Illinois Modification***
3.1.3	Add: “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	Add: “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	Add: 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	Add: 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	Replace with the following: “**4 SIGNIFICANCE AND USE**”
4.1	Add: “Sampling is a critical step in determining the quality of the material being evaluated. Care shall be exercised to ensure that samples are representative of the material being evaluated.”
4.2	Add: “This practice is intended to provide standard requirements and procedures for sampling coarse and fine aggregate products. The detailed requirements as to materials, interpretation of results, and precision and bias are described in specific test methods.”
4.3	Add: “For sampling of potential aggregate sources and preliminary site investigation, refer to Central Bureau of Materials AGCS Policy Memo.”
5	Replace with the following: “**5 APPARATUS**”
5.1	Add: Template – The template shall be designed with two end plates and shall be adjustable. The distance between the two 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 template with a single end plate may be used in the sampling method, if care is exercised.
5.2	Add: 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 and not overflow when passing through the stream. The device may be a bucket, a pan, or a manufactured sampling container.

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Revised Date: December 1, 2023

Standard Test Method for
Sampling Aggregate Products

Reference AASHTO R 90-18 (2022)

AASHTO Section	***Illinois Modification***
5.2 Note 3	Add: “Shelby tubes are not allowed as sampling devices.”
5.3	Add: 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.
5.4	Add: Sampling Containers – 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. For moisture content samples, containers must prevent moisture loss.
6	Replace with the following: “**6 PROCEDURE**”
6.1	Add: 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	Add: Inspection – The material shall be inspected to determine discernible variations. The seller shall provide suitable equipment needed for proper inspection and sampling.
6.3	Add: Sampling – Aggregate production sampling shall be accomplished by one of the following methods: 1. Belt-stream sampling 2. Bin-discharge sampling (requires IDOT approval) 3. On-belt sampling 4. Truck-dump or stockpile sampling
6.3 Note 4	Add: “No other sampling methods will be permitted.”

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Effective Date: December 1, 2021
Revised Date: December 1, 2023

Standard Test Method for
Sampling Aggregate Products

Reference AASHTO R 90-18 (2022)

AASHTO Section	***Illinois Modification***
6.3.1	Add: 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 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, altering the bin-discharge stream gradation. The sampling method therefore shall be used only when approved by the District Engineer.

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Standard Test Method for
Sampling Aggregate Products

Reference AASHTO R 90-18 (2022)

AASHTO Section	***Illinois Modification***
6.3.2	Add: 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	Add: 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 only by the sampling methods 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 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.

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Standard Test Method for
Sampling Aggregate Products

Reference AASHTO R 90-18 (2022)

AASHTO Section	***Illinois Modification***
6.3.3 (cont'd)	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, RR1 and RR2 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 slope. Spanning the breadth of the vertical face 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 method shall follow the truck-dump sampling method 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	Add: "Masses of Field Samples:"
6.4.1	Add: Field Sample Sizes – The field sample size shall meet the minimum requirements as detailed in the Illinois Specification 201.
7	Replace with the following: "**7 SHIPPING SAMPLES**"
7.1	Add: "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."

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Effective Date: December 1, 2021
Revised Date: December 1, 2023

Standard Test Method for
Sampling Aggregate Products

Reference AASHTO R 90-18 (2022)

AASHTO Section	***Illinois Modification***
7.2	Add: "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."
7.3	Add: "Red Tag Samples – Used for Quality Samples only"
7.3.1	Add: "The Central Bureau of Materials has established a procedure which allows the producer the opportunity to deliver their quality samples directly to the Central Bureau of Materials, located at 126 E. Ash Street in Springfield. The 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 documentation has been completed the producer will then be allowed to deliver the samples to the Central Bureau of Materials.

Standard Practice for

Sampling Aggregate Products

AASHTO Designation: R 90-18 (2022)[1]

AASHTO

Reclassified: 2018 **Reviewed but Not Updated: 2022**

Technical Subcommittee: 1c, Aggregates

1. SCOPE

1.1. This practice covers the procedures for obtaining representative samples of coarse, fine, or combinations of coarse and fine aggregate (CA and FA) products to determine compliance with requirements of the specifications under which the aggregate is furnished. The method includes sampling from conveyor belts, transport units, roadways, and stockpiles.

1.2. *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 standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. REFERENCED STANDARDS

2.1. *AASHTO Standards*:
- M 323, Superpave Volumetric Mix Design
- T 11, Materials Finer Than 75-μm (No. 200) Sieve in Mineral Aggregates by Washing
- T 27, Sieve Analysis of Fine and Coarse Aggregates

2.2. *ASTM Standard*:
- D75/D75M, Standard Practice for Sampling Aggregates

3. SIGNIFICANCE AND USE

3.1. Sampling is a critical step in determining the quality of the material being evaluated. Care shall be exercised to ensure that samples are representative of the material being evaluated.

3.2. This practice is intended to provide standard requirements and procedures for sampling coarse, fine and combinations of coarse and fine aggregate products. The detailed requirements as to materials, interpretation of results, and precision and bias are described in specific test methods.

3.3. For sampling of potential aggregate sources and preliminary site investigation, refer to ASTM D75/D75M.

4. APPARATUS

4.1. *Shovels or Scoops, or Both*—Tools with which to gather the sample.

4.2. *Brooms, Brushes, and Scraping Tools*—Tools to assist in collecting the sample.

4.3. *Sampling Tube*—Plastic, aluminum, or similar tube whose diameter is at least three times the nominal maximum aggregate size; the end of the tube may be angled to assist in sampling.

4.4. *Mechanical Sampling Systems*—Normally, a permanently attached device that allows a sample container to pass perpendicularly through the entire stream of material or diverts the entire stream of material into the container by manual, hydraulic, or pneumatic operation.

4.5. *Belt Template*—A pair of templates, either joined to each other or separate, which are the shape and width of the aggregate stream belt. If the two templates are joined, enough space must be allowed between the templates to yield an increment of the required weight.

4.6. *Sampling Containers*—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. For moisture content samples, containers must prevent moisture loss.

5. PROCEDURE

5.1. Sampling is as important as testing. The technician shall use every precaution to obtain samples that are representative of the material. Record the sampling time or location, or both. When samples will be used as part of a statistical quality control or acceptance program, determine the time or location for sampling using a random sampling procedure.

5.1.1. Ensure sampling equipment and containers are clean and dry before sampling.

5.2. The field samples should meet or exceed the minimum mass in Table 1. The amounts specified in Table 1 will generally provide adequate material for routine grading and quality analysis (Note 1).

Note 1—Sample size is based upon the test(s) required. Generally, the field sample size should be such that, when split twice, it will provide a testing sample of proper size. For example, the sample size may be four times that shown in T 27, or in T 11 if that mass is more appropriate.

Table 1—Recommended Sample Sizes

Nominal Maximum Size		Minimum Mass	
mm	(in.)	kg	(lb)
90	(3$^1/_2$)	175	(385)
75	(3)	150	(330)
63	(2$^1/_2$)	125	(275)
50	(2)	100	(220)
37.5	(1$^1/_2$)	75	(165)
25.0	(1)	50	(110)
19.0	($^3/_4$)	25	(55)
12.5	($^1/_2$)	15	(35)
9.5	($^3/_8$)	10	(25)
4.75	(No. 4)	10	(25)
2.36	(No. 8)	10	(25)

Note 2—Nominal maximum size may be defined by aggregate type or usage; for example, as defined by M 323.

5.3. *Sampling from Conveyor Belt Using a Sampling Template*—Avoid sampling at the beginning or end of the aggregate run due to the potential for segregation. Be careful when sampling in the rain. Make sure to capture material that may stick to the belt or that the rain tends to wash away.

5.3.1. Stop the belt.

5.8. *Sampling from Stockpile for Coarse Aggregate and Mixtures of Coarse and Fine Aggregate Products*:

5.8.1. *Sampling from a Flat Surface Created by a Loader*:

5.8.1.1. Direct the loader operator to enter the stockpile with the bucket at least 0.3 m (1 ft) above ground level without contaminating the stockpile.

5.8.1.2. Discard the first bucketful.

5.8.1.3. Have the loader re-enter the stockpile, obtain a full loader bucket of the material, and tilt the bucket back and up.

5.8.1.4. Form a small sampling pile at the base of the stockpile by gently rolling the material out of the bucket with the bucket just high enough to permit free flow of the material. Repeat as necessary.

5.8.1.5. Create a flat surface by having the loader back drag the small pile.

5.8.1.6. Obtain increments from at least three randomly selected locations on the flat surface at least 1 ft (300 mm) from the edge.

5.8.1.7. Fully insert the shovel, exclude the underlying material, roll back the shovel, and lift the material slowly out of the pile to avoid material rolling off the shovel.

5.8.1.8. Combine the increments to form a sample.

5.8.2. *Sampling from a Horizontal Surface on the Stockpile Face*:

5.8.2.1. Create horizontal surfaces with vertical faces in the top, middle, and bottom third of the stockpile with a shovel, or with a loader if one is available.

5.8.2.2. Shove a flat board against the vertical face behind sampling location to prevent sloughing. Discard sloughed material to create the horizontal surface.

5.8.2.3. Obtain sample from the horizontal surface as close as possible to the intersection of the horizontal and vertical faces.

5.8.2.4. Obtain at least one increment of equal size from each of the top, middle, and bottom thirds of the pile.

5.8.2.5. Combine the increments to form a single sample.

5.9. *Sampling from a Stockpile for Fine Aggregate (Alternate Tube Method)*:

5.9.1. Remove the outer layer of material.

5.9.2. Using a sampling tube, obtain increments of equal size from a minimum of five random locations on the pile.

5.9.3. Combine the increments to form a single sample.

5.3.2. Set the sampling template in place on the belt avoiding intrusion by adjacent material.

5.3.3. Remove the material from inside the template; include all of the material adhering to the belt.

5.3.4. Obtain equal increments when one increment is insufficient for the required testing.

5.3.5. Combine the increments to form a single sample.

5.4. *Sampling from Conveyor Belt Discharge*—Avoid sampling from the beginning or end of an aggregate run due to the potential for segregation. To collect a representative sample the sampling device must pass through the full stream of material as it runs off the conveyor belt. A manually, semi-automatic, or automatically operated sampling device may be used to collect the sample.

5.4.1. Pass a sampling device, at a constant speed and perpendicular to the flow of material, through the full stream once in each direction without overfilling; include all material that may adhere to the sampling device when emptying into the container, or divert the full stream of material into container.

5.4.2. Obtain multiple equal increments when one increment is insufficient for the required testing.

5.4.3. Combine the increments to form a single sample.

5.5. *Sampling from Transport Units*:

5.5.1. Visually divide the unit into four quadrants.

5.5.2. Identify one sampling location in each quadrant.

5.5.3. Remove approximately 0.3 m (1 ft) of material from the sampling area. Obtain an increment from the exposed surface. Repeat in each of the remaining quadrants.

5.5.4. Combine the increments to form a single sample.

5.6. *Sampling from Roadway—Berm or Windrow*:

5.6.1. Do not take the sample or any increment from the beginning or end of the windrow or berm.

5.6.2. Remove the top one third of the windrow or berm before taking an increment.

5.6.3. Obtain a minimum of three approximately equal increments from random locations along the windrow or berm.

5.6.3.1. Fully insert the shovel into the location, exclude the underlying material, roll back the shovel, and lift the material slowly out of the pile to avoid material rolling off the shovel.

5.6.4. Combine the increments to form one single sample.

5.7. *Sampling from Roadway—In Place*:

5.7.1. Obtain representative sample after spreading and before compacting.

5.7.2. Insert the shovel to the full depth of the material, exclude the underlying material, roll back the shovel, and lift the material slowly to avoid material rolling off the shovel. Repeat as necessary.

6. SHIPPING SAMPLES

6.1. Use bags or containers to transport aggregate samples. Make sure the bags and containers are clean and undamaged to avoid contamination or loss of sample.

6.2. *Label each sample with unique identification labels that contain the following information*:

6.2.1. Date and time the sample was obtained;

6.2.2. Sampling location;

6.2.3. Quantity of material represented by the sample, if applicable;

6.2.4. Material type; and

6.2.5. Supplier.

7. KEYWORDS

7.1. Coarse aggregate; fine aggregate; samples.

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[1] Formerly T 2. First published as a practice in 2018.

Illinois Modified Test Procedure
Effective Date: December 1, 2022
Revised Date: December 1, 2023

Standard Test Method
for
Materials Finer Than 75-µm (No. 200) Sieve in Mineral Aggregates by Washing

Reference AASHTO T 11-23

AASHTO Section	***Illinois Modification***
1.1	Replace "method" with "procedure" in the first sentence of paragraph.
1.2	Replace with the following: "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-µm) sieve from the coarser material. A wetting agent such as detergent or dispersing solution is recommended."
1.4	Delete the first sentence of paragraph
2.1	Replace with "Illinois Modified AASHTO Standards": • R 76, Standard Practice for Reducing Samples of Aggregate to Testing Size • R 90, Sampling Aggregate Products • T 27, Sieve Analysis of Fine and Coarse Aggregates • T 30, Mechanical Analysis of Extracted Aggregate
2.2	Replace with the following: Illinois Specifications: ▪ Illinois Specifications 201, Aggregate Gradation Sample Size Table
2.3	Replace with the following: 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
2.4	Delete
3.1	Delete "or water containing a wetting agent, as specified" from the first sentence of paragraph.
4.2	Replace "in" with "with" in the first sentence of paragraph. Revise the second sentence to read: "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."
5.2	Add sentence to end of paragraph: "The sieve cloth shall be mounted on substantial frames constructed in a manner that will prevent loss of material during sieving."
5.5	Add sentences to end of paragraph: "The oven shall be specifically designed for drying. In addition, a gas burner or electric hot plate may be used. Microwave ovens are <u>not</u> permitted for drying aggregate gradations samples."
5.7 Note 1	Revise with the following: "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."
6.1	Replace with the following: "Field samples of aggregate shall be taken according to Illinois Modified AASHTO R90. The field sample size shall meet the minimum requirements in the Illinois Specifications 201."

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Effective Date: December 1, 2022
Revised Date: December 1, 2023

Standard Test Method
for
Materials Finer Than 75-µm (No. 200) Sieve in Mineral Aggregates by Washing

Reference AASHTO T 11-23

AASHTO Section	***Illinois Modification***
6.2	Replace with the following: “Field samples of aggregate shall be reduced to test sample size before testing according to Illinois Modified AASHTO R76.” Add and insert: “Test sample size for aggregate gradation samples shall meet the minimum requirements found in Illinois Specifications 201.” to the end of the paragraph.
8.1	Replace with the following: 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±9˚F(110±5˚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 <u>continually attend</u> 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.
8.2	Replace with the following: 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 (75µm) 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.
8.2 Note 3	Add: 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.

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Effective Date: December 1, 2022
Revised Date: December 1, 2023

Standard Test Method
for
Materials Finer Than 75-µm (No. 200) Sieve in Mineral Aggregates by Washing

Reference AASHTO T 11-23

AASHTO Section	***Illinois Modification***
7.3	Replace with the following: 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.
7.3 Note 4	Add: If mechanical washing equipment is used, the charging of water, agitating, and decanting may be a continuous operation.
7.3 Note 5	Add: 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.
8.4	Replace with the following: 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).
8.4 Note 6	Add: Following the washing of the sample and flushing any material retained on the No. 200 (75µm) 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 (75µm) sieve, to avoid loss of material. Excess water from flushing should be evaporated from the sample in the drying process.”
9	Delete
	“
10.1	Replace with the following: The “Percent Minus 75µm (No. 200) by Washing” shall be determined by using the following formula: % - No. 200 (-75µm) by Washing = $\frac{TDM-TW}{TDM} * 100$ TDM = Total Dry Mass, g. TWM = Total Wash Mass, g.”
11.1	Replace with the following: 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).”
12	Delete
13	Delete

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Standard Method of Test for

Materials Finer Than 75-µm (No. 200) Sieve in Mineral Aggregates by Washing

AASHTO Designation: T 11-23[1]

AASHTO

Technically Revised: 2023

Technical Subcommittee: 1c, Aggregates

ASTM Designation: C117-17

1. SCOPE

1.1. This test method covers determination of the amount of material finer than a 75-µm (No. 200) 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. Two procedures are included, one using only water for the washing operation, and the other including a wetting agent to assist the loosening of the material finer than the 75-µm (No. 200) sieve from the coarser material. Unless otherwise specified, Procedure A (water only) shall be used. Analysis of aggregate extracted from asphalt mixtures is conducted in accordance with T 30.

1.3. The values stated in SI units are to be regarded as the standard.

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

1.5. *The quality of the results produced by this standard are dependent on the competence of the personnel performing the procedure and the capability, calibration, and maintenance of the equipment used. Agencies that meet the criteria of R 18 are generally considered capable of competent and objective testing/sampling/inspection/etc. Users of this standard are cautioned that compliance with R 18 alone does not completely assure reliable results. Reliable results depend on many factors; following the suggestions of R 18 or some similar acceptable guideline provides a means of evaluating and controlling some of those factors.*

2. REFERENCED DOCUMENTS

2.1. *AASHTO Standards*:

- M 231, Weighing Devices Used in the Testing of Materials
- M 339M/M 339, Thermometers Used in the Testing of Construction Materials
- R 18, Establishing and Implementing a Quality Management System for Construction Materials Testing Laboratories
- R 76, Reducing Samples of Aggregate to Testing Size

- R 90, Sampling Aggregate Products
- T 27, Sieve Analysis of Fine and Coarse Aggregates
- T 30, Mechanical Analysis of Extracted Aggregate

2.2. *ASTM Standards*:

- C117, Standard Test Method for Materials Finer than 75-µm (No. 200) Sieve in Mineral Aggregates by Washing
- C670, Standard Practice for Preparing Precision and Bias Statements for Test Methods for Construction Materials
- E1, Standard Specification for ASTM Liquid-in-Glass Thermometers
- E11, Standard Specification for Woven Wire Test Sieve Cloth and Test Sieves
- E230/E230M, Standard Specification for Temperature-Electromotive Force (emf) Tables for Standardized Thermocouples
- E2877, Standard Guide for Digital Contact Thermometers

2.3. *International Electrotechnical Commission Standard*:

- IEC 60584-1:2013, Thermocouples - Part 1: EMF Specifications and Tolerances

2.4. *Other Document*:

- NCHRP Research Results Digest 389, Precision Estimates of AASHTO T 304, AASHTO T 96, and AASHTO T 11 and Investigation of the Effect of Manual and Mechanical Methods of Washing on Sieve Analysis of Aggregates, Transportation Research Board, National Research Council, Washington, DC, 2014.

3. SUMMARY OF METHOD

3.1. A sample of the aggregate is washed in a prescribed manner, using either plain water or water containing a wetting agent, as specified. The decanted wash water, containing suspended and dissolved material, is passed through a 75-µm (No. 200) 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 75-µm (No. 200) sieve by washing.

4. SIGNIFICANCE AND USE

4.1. Material finer than the 75-µm (No. 200) 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 75 µm in fine or coarse aggregate are desired, this test method is used on the sample prior to dry sieving in accordance with T 27. The results of this test method are included in the calculation in T 27, and the total amount of material finer than 75 µm by washing, plus that obtained by dry sieving the same sample, is reported with the results of T 27. Usually the additional amount of material finer than 75 µm 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 the degradation of the aggregate.

4.2. Plain water is adequate to separate the material finer than 75 µm from the coarser material in most aggregates. In some cases, the finer material is adhered to the larger particles, such as in some clay coatings and coatings on aggregates that have been extracted from bituminous mixtures. In these cases, the fine 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 75-µm (No. 200) sieve and the upper being a sieve with openings in the range of 2.36 mm (No. 8) to 1.18 mm (No. 16), both conforming to the requirement of ASTM E11.

5.3. *Container*—A pan or vessel of a size sufficient to contain the sample covered with water and to permit vigorous agitation without loss of any part of the sample or water.

5.4. *Spoon or Mixing Utensil*—Or similar device for agitating the sample during the washing procedure.

5.5. *Oven*—An oven of sufficient size, capable of maintaining a uniform temperature of 110 ± 5°C (230 ± 9°F). Oven(s) for heating and drying shall be capable of operation at the temperatures required, between 100 to 120°C (212 to 248°F), within ±5°C (±9°F), as corrected, if necessary, by standardization. More than one oven may be used, provided each is used within its proper operating temperature range. The thermometer for measuring the temperature shall meet the requirements of M 339M/M 339 with a temperature range of at least 90 to 130°C (194 to 266°F), and an accuracy of ±1.25°C (±2.25°F) (see Note 1).

Note 1—Thermometer types suitable for use include ASTM E1 mercury thermometers; ASTM E2877 digital metal stem thermometer; ASTM E230/E230M thermocouple thermometer, Type J or K, Special Class, Type T any Class; IEC 60584 thermocouple thermometer, Type J or K, Class 1, Type T any Class; or dial gauge metal stem (bi-metal) thermometer.

5.6. *Wetting Agent (Procedure B only)*—Any dispersing agent, such as liquid dishwashing detergent, powdered dishwashing detergent, or sodium hexametaphosphate that will promote separation of the fine materials without degrading the aggregate.

5.7. *Mechanical Washing Apparatus (Optional)*—A mechanical apparatus that aids in the washing process.

Note 2—A sample shall not be washed for more than 10 minutes when using a mechanical washing apparatus. Wash intervals greater than 10 minutes have been shown to cause significant amounts of degradation depending upon aggregate type (NCHRP RR Digest 389).

6. SAMPLING

6.1. Sample the aggregate in accordance with R 90. If the same test sample is to be tested for sieve analysis according to T 27, comply with the applicable requirements of that method.

6.2. Thoroughly mix the sample of aggregate to be tested and reduce the quantity to an amount suitable for testing using the applicable methods described in R 76. If the same test sample is to be tested according to T 27, the minimum mass shall be as described in the applicable sections of that method. Otherwise, the mass of the test sample, after drying, shall conform with the following:

Nominal Maximum Size	Minimum Mass, g
4.75 mm (No. 4) or smaller	300
9.5 mm ($^3/_8$ in.)	1000
19.0 mm ($^3/_4$ in.)	2500
37.5 mm ($1^1/_2$ in.) or larger	5000

temperature of 110 ± 5°C (230 ± 9°F). Determine and record the mass to the nearest 0.1 percent of the original mass of the sample.

9. PROCEDURE B—WASHING USING A WETTING AGENT

9.1. Prepare the sample in the same manner as for Procedure A.

9.2. After drying and determining the mass, place the test sample in the container. Add sufficient water to cover the sample, and add wetting agent to the water (Note 6). Agitate the sample with sufficient vigor to result in complete separation of all particles finer than the 75-µm (No. 200) sieve from the coarser particles, and to bring the fine material into suspension. The use of a large spoon or other similar tool to stir and agitate the aggregate in the wash water has been found satisfactory. Immediately pour the wash water containing the suspended and dissolved solids over the nested sieves described in Section 5.2, arranged with the coarser sieve on top. Take care to avoid, as much as feasible, the decantation of coarser particles of the sample. Do not overflow or overload the 75-µm (No. 200) sieve.

Note 6—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.

9.3. Add a second charge of water (without wetting agent) to the sample in the container, agitate, and decant as before. Repeat this operation until the wash water is clear.

9.4. Complete the test as for Procedure A.

10. CALCULATION

10.1. Calculate the amount of material passing a 75-µm (No. 200) sieve by washing as follows:

$$A = \left[(B - C) / B\right] \times 100 \qquad (1)$$

where:

A = percentage of material finer than a 75-µm (No. 200) sieve by washing;

B = original dry mass of sample, g; and

C = dry mass of sample after washing, g.

11. REPORT

11.1. Report the percentage of material finer than the 75-µm (No. 200) sieve by washing to the nearest 0.1 percent, except if the result is 10 percent or more, report the percentage to the nearest whole number.

11.2. Include a statement as to which procedure was used.

12. PRECISION AND BIAS

12.1. *Precision*—The estimates of precision of this test method listed in Table 1 are based on results from the AASHTO re:source Proficiency Sample Program, with testing conducted by this test method and ASTM C117. The significant differences between the methods at the time the data were acquired is that T 11 required, and ASTM C117 prohibited, the use of a wetting agent. The data are based on the analyses of more than 100 paired test results from 40 to 100 laboratories.

The test sample shall be the end result of the reduction. Reduction to an exact predetermined mass shall not be permitted. If the nominal maximum size of the aggregate to be tested is not listed above, the next larger size listed shall be used to determine sample size.

7. SELECTION OF PROCEDURE

7.1. Procedure A shall be used, unless otherwise specified by the specification with which the test results are to be compared, or when directed by the agency for which the work is performed.

8. PROCEDURE A—WASHING WITH PLAIN WATER

8.1. Dry the test sample to constant mass at a temperature of 110 ± 5°C (230 ± 9°F). Determine the mass to the nearest 0.1 percent of the mass of the test sample.

8.2. If the applicable specification requires that the amount passing the 75-µm (No. 200) sieve shall be determined on a portion of the sample passing a sieve smaller than the nominal maximum size of the aggregate, separate the sample on the designated sieve and determine the mass of the material passing the designated sieve to 0.1 percent of the mass of this portion of the test sample. Use this mass as the original dry mass of the test sample in Section 10.1.

Note 3—Some specifications for aggregates with a nominal maximum size of 50 mm (2 in.) or greater, for example, provide a limit for material passing the 75-µm (No. 200) sieve determined on that portion of the sample passing the 25.0-mm (1-in.) sieve. Such procedures are necessary because it is impractical to wash samples of the size required when the same test sample is to be used for sieve analysis by T 27.

8.3. After drying and determining the mass, place the test sample in the container and add sufficient water to cover it. No detergent, dispersing agent, or other substance shall be added to the water. Agitate the sample with sufficient vigor to result in complete separation of all particles finer than the 75-µm (No. 200) sieve from the coarser particles, and to bring the fine material into suspension. The use of a large spoon or other similar tool to stir and agitate the aggregate in the wash water has been found satisfactory. Immediately pour the wash water containing the suspended and dissolved solids over the nested sieves described in Section 5.2, arranged with the coarser sieve on top. Take care to avoid, as much as feasible, the decantation of coarser particles of the sample.

8.4. 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. Do not overflow or overload the 75-µm (No. 200) sieve. Limit agitation by mechanical washing equipment to a maximum of 10 min. Following the washing of the sample and the flushing of any materials retained on the 75-µm (No. 200) sieve back into the container, no water shall be decanted from the container except through the 75-µm (No. 200) sieve to avoid loss of material. Excess water from flushing should be evaporated from the sample in the drying process.

Note 4—If mechanical washing equipment is used, the charging of water, agitating, and decanting may be a continuous operation.

Note 5—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.

8.5. Return all material retained on the nested sieves by flushing into the container containing the washed sample. If a mechanical washing apparatus is used, transfer material on the nest of sieves and the washing apparatus to a drying container. Dry the washed aggregate to constant mass at a

Table 1—Precision

	Standard Deviation (1s),[a] %	Acceptable Range of Two Results (d2s),[a] %
Coarse aggregate:[b]		
Single-operator precision	0.10	0.28
Multilaboratory precision	0.22	0.62
Fine aggregate:[c]		
Single-operator precision	0.15	0.43
Multilaboratory precision	0.29	0.82

[a] These numbers represent the (1s) and (d2s) limits as described in ASTM C670.

[b] Precision estimates are based on aggregates having a nominal maximum size of 19.0 mm (3/4 in.) with less than 1.5 percent finer than the 75-µm (No. 200) sieve.

[c] Precision estimates are based on fine aggregates having 1.0 to 3.0 percent finer than the 75-µm (No. 200) sieve.

12.1.1. The precision values for fine aggregate in Table 1 are based on nominal 500-g test samples. Revision of this test method in 1996 permits the fine aggregate test sample size to be 300 g minimum. Analysis of results of testing of 300-g and 500-g test samples from Aggregate Proficiency Test Samples 99 and 100 (Samples 99 and 100 were essentially identical) produced the precision values in Table 2, which indicates only minor differences due to test sample size.

Table 2—Precision Data for 300-g and 500-g Test Samples

Fine Aggregate Proficiency Sample				Within Laboratory		Between Laboratory	
Test Result	Sample Size	No. Labs	Avg	1s	d2s	1s	d2s
AASHTO T 11/ASTM C117 (Total material passing the	500 g	270	1.23	0.08	0.24	0.23	0.66
No. 200 sieve by washing, %)	300 g	264	1.20	0.10	0.29	0.24	0.68

Note 7—The values for fine aggregate in Table 1 will be revised to reflect the 300-g test sample size when a sufficient number of Aggregate Proficiency Tests have been conducted using that sample size to provide reliable data.

12.2. *Bias*—Because there is no accepted reference material suitable for determining the bias for the procedure in this test method, no statement on bias is made.

13. KEYWORDS

13.1. Aggregate; size analysis; wash loss; 75-µm (No. 200) sieve.

[1] Similar but not identical to ASTM C117-17.

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Effective Date: December 1, 2022

Standard Test Method
for
Sieve Analysis of Fine and Coarse Aggregates

Reference AASHTO T 27-23

AASHTO Section	***Illinois Modification***
2.1	Replace “AASHTO Standards” with “Illinois Modified AASHTO Standards”
2.2	Replace with the following: Illinois Specifications: • Illinois Specifications 201, Aggregate Gradation Sample Size Table
2.3	Add and insert the following: 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
3.1	Replace “method” with “procedure” in the first sentence of paragraph.
4.2	Replace “T 11” with “T 11 (Illinois Modified)” in the second sentence of the paragraph.
5.2 Note 1	Replace with the following: “When running Coarse Aggregate samples 12in (305mm) are required, if running Fine Aggregate samples 12in (305mm) or 8in (203mm) sieves are acceptable.” Delete.
5.3	Delete: Note 2
5.4	Add sentences to end of paragraph: “The oven shall be specifically designed for drying. In addition, a gas burner or electric hot plate may be used. Microwave ovens are <u>not</u> permitted for drying aggregate gradations samples.”
6.1	Replace with the following: “Field samples of aggregate shall be taken according to Illinois Modified AASHTO Standards R90. The field sample size shall meet the minimum requirements in the Illinois Specifications 201.”
6.2	Replace with the following: “Field samples of aggregate shall be reduced to test sample size before testing according to Illinois Modified AASHTO Standards R76.” “Test sample size for aggregate gradation samples shall meet the minimum requirements found in Illinois Specifications 201.”

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Reference AASHTO T 27-23

AASHTO Section	***Illinois Modification***
6.3	Replace with the following: "In the event that the amount of material finer than No. 200 (75µm) sieve is to be determined by Illinois Modified AASHTO Standards T11, proceed as follows: use the procedure described in Section 7.3.1 or 7.3.2, whichever is applicable."
6.3.1	Add and insert the following: "Use the same test sample for testing by AASHTO Standards T 11 (Illinois Modified) and by this method. First test the sample according to T 11 (Illinois Modified) through the final drying operation, and then dry-sieve the sample as stipulated in Sections 8.2 through 8.6 of this method."
6.3.2	Add and insert the following: "If the test sample is not to be tested by Illinois Modified AASHTO Standards T 11, follow Section 8, "Procedure"."
6.4	Delete.
6.5	Delete.
6.6	Delete.
6.7	Delete.
6.7.1	Delete.
6.7.2	Delete.
6.7.3	Delete.
7.1	Replace with the following: "If the test sample has not been subject to testing by T 11 (Illinois Modified), 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±9˚F (110±5˚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. Microwave ovens are not permitted for drying gradation samples.

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Reference AASHTO T 27-23

AASHTO Section	***Illinois Modification***
7.1 (cont'd)	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."
7.2	Replace with the following: "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.

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Reference AASHTO T 27-23

AASHTO Section	***Illinois Modification***
7.2 (cont'd)	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 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."
7.3	Replace with the following: "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."
7.3.1	Delete.
7.3.1.1	Delete.
7.3.1.2	Delete.
7.3.1.3	Delete.
7.3.1.4	Delete.
7.3.1.5	Delete.
7.4	Add paragraph to beginning: "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."

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for
Sieve Analysis of Fine and Coarse Aggregates

Reference AASHTO T 27-23

AASHTO Section	***Illinois Modification***
7.5	Replace with the following: “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.”
7.5 Note	Add: “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.”
7.6	Add and insert the following: “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.”

Illinois Modified Test Procedure
Effective Date: December 1, 2022

Standard Test Method
for
Sieve Analysis of Fine and Coarse Aggregates

Reference AASHTO T 27-23

AASHTO Section	***Illinois Modification***
8.1	Replace with the following: "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: Cumulative % Retained = $\frac{CMR}{TDM} * 100$ where CMR = Cumulative Mass Retained and TDM = Total Dry Mass Calculated the percent passing each sieve by using the following formula: % = 100 – Cumulative % Retained These results shall be recorded to the nearest 0.1 percent."
8.1.1	Delete.
9.2	Replace with the following: "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 competed with all required information."
9.3	Delete
9.4	Add and insert the following: "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."
10	Replace **PRECISION AND BIAS** with the following: "**COMPARISON PROCEDURE**"
10.1	Replace with the following: "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)."
10.2	Delete
12	Delete.

Standard Method of Test for

Sieve Analysis of Fine and Coarse Aggregates

AASHTO Designation: T 27-23[1]

Technically Revised: 2023

Technical Subcommittee: 1c, Aggregates

ASTM Designation: C136/C136M-19

1. SCOPE

1.1. This method 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. Analysis of aggregate extracted from asphalt mixtures is conducted in accordance with T 30.

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 may involve hazardous materials, operations, and equipment. This standard does not purport to address all of the safety concerns associated with its use. It is the responsibility of the user of this procedure to consult and establish appropriate safety and health practices and to determine the applicability of regulatory regulations prior to its use.*

1.5. *The quality of the results produced by this standard are dependent on the competence of the personnel performing the procedure and the capability, calibration, and maintenance of the equipment used. Agencies that meet the criteria of R 18 are generally considered capable of competent and objective testing/sampling/inspection/etc. Users of this standard are cautioned that compliance with R 18 alone does not completely assure reliable results. Reliable results depend on many factors; following the suggestions of R 18 or some similar acceptable guideline provides a means of evaluating and controlling some of those factors.*

2. REFERENCED DOCUMENTS

2.1. *AASHTO Standards*:

- M 231, Weighing Devices Used in the Testing of Materials
- M 339M/M 339, Thermometers Used in the Testing of Construction Materials
- R 18, Establishing and Implementing a Quality Management System for Construction Materials Testing Laboratories
- R 76, Reducing Samples of Aggregate to Testing Size
- R 90, Sampling Aggregate Products
- T 11, Materials Finer Than 75-µm (No. 200) Sieve in Mineral Aggregates by Washing
- T 30, Mechanical Analysis of Extracted Aggregate

2.2. *ASTM Standards*:

- C670, Standard Practice for Preparing Precision and Bias Statements for Test Methods for Construction Materials
- E1, Standard Specification for ASTM Liquid-in-Glass Thermometers
- E11, Standard Specification for Woven Wire Test Sieve Cloth and Test Sieves
- E230/E230M, Standard Specification for Temperature-Electromotive Force (emf) Tables for Standardized Thermocouples
- E2877, Standard Guide for Digital Contact Thermometers

2.3. *International Electrotechnical Commission Standard*:

- IEC 60584-1: 2013 Thermocouples - Part 1: EMF Specifications and Tolerances

3. SUMMARY OF METHOD

3.1. 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.

4. SIGNIFICANCE AND USE

4.1. This method 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.

4.2. Accurate determination of material finer than the 75-µm (No. 200) sieve cannot be achieved by use of this method alone. T 11 for material finer than the 75-µm (No. 200) sieve by washing should be employed.

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 M 231.

5.2. *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 E11. Nonstandard sieve frames shall conform to the requirements of ASTM E11 as applicable.

Note 1—It is recommended that sieves mounted in frames larger than standard 203.2 mm (8 in.) diameter be used for testing coarse aggregate to reduce the possibility of overloading the sieves. See Section 7.3.

5.3. *Mechanical Sieve Shaker*—A mechanical sieving device, if used, shall create motion of the sieves to cause the particles to bounce, tumble, or otherwise turn so as to present different orientations to the sieving surface. The sieving action shall be such that the criterion for adequacy of sieving described in Section A2 is met in a reasonable time period.

Note 2—Use of a mechanical sieve shaker is recommended when the size of the sample is 20 kg (44 lb) or greater, and may be used for smaller samples, including fine aggregate. Excessive time (more than approximately 10 min) to achieve adequate sieving may result in degradation of the sample. The same mechanical sieve shaker may not be practical for all sizes of samples because the large sieving area needed for practical sieving of a large nominal size coarse aggregate very likely could result in loss of a portion of the sample if used for a smaller sample of coarse aggregate or fine aggregate.

5.4. *Oven*—An oven of appropriate size capable of maintaining a uniform temperature of 110 ± 5°C (230 ± 9°F). Oven(s) for heating and drying shall be capable of operation at the temperatures required, between 100 to 120°C (212 to 248°F), within ±5°C (±9°F), as corrected, if necessary, by standardization. More than one oven may be used, provided each is used within its proper operating temperature range. The thermometer for measuring the temperature, regardless of drying apparatus used, shall meet the requirements of M 339M/M 339 with a temperature range of at least 90 to 130°C (194 to 266°F), and an accuracy of ±1.25°C (±2.25°F) (see Note 3).

Note 3—Thermometer types suitable for use include ASTM E1 mercury thermometers; ASTM E2877 digital metal stem thermometer; ASTM E230/E230M thermocouple thermometer, Type J or K, Special Class, Type T any Class; IEC 60584 thermocouple thermometer, Type J or K, Class 1, Type T any Class; or dial gauge metal stem (bi-metal) thermometer.

6. SAMPLING

6.1. Sample the aggregate in accordance with R 90. The mass of the field sample shall be the mass shown in R 90 or four times the mass required in Sections 6.4 and 6.5 (except as modified in Section 6.6), whichever is greater.

6.2. Thoroughly mix the sample and reduce it to an amount suitable for testing using the applicable procedures described in R 76. The sample for test shall be the approximate mass desired when dry and shall be the end result of the reduction. Reduction to an exact predetermined mass shall not be permitted.

Note 4—Where sieve analysis, including determination of material finer than the 75-µm (No. 200) sieve, is the only testing proposed, the size of the sample may be reduced in the field to avoid shipping excessive quantities of extra material to the laboratory.

6.3. *Fine Aggregate*—The size of the test sample of aggregate, after drying, shall be 300 g minimum (Note 5).

6.4. *Coarse Aggregate*—The mass of the test sample of coarse aggregate shall conform with the following (Note 5):

Nominal Maximum Size Square Openings, mm (in.)	Minimum Mass of Test Sample, kg (lb)
9.5 ($^3/_8$)	1 (2)
12.5 ($^1/_2$)	2 (4)
19.0 ($^3/_4$)	5 (11)
25.0 (1)	10 (22)
37.5 (1$^1/_2$)	15 (33)
50 (2)	20 (44)
63 (2$^1/_2$)	35 (77)
75 (3)	60 (130)
90 (3$^1/_2$)	100 (220)
100 (4)	150 (330)
125 (5)	300 (660)

Note 5—If washing is performed in accordance with T 11 prior to sieve analysis by this test method, it is acceptable for the sample to be less than the minimum required mass after washing,

as long as the minimum sample mass is met prior to performing the washing procedure. The initial sample mass for analysis by this method should be the same as the final sample mass for T 11.

6.5. *Coarse and Fine Aggregates Mixtures*—The mass of the test sample of coarse and fine aggregate mixtures shall be the same as for coarse aggregate in Section 6.4.

6.6. *Samples of Large-Size Coarse Aggregate*—The size of sample required for aggregate with 50-mm (2-in.) nominal maximum size or larger is such as to preclude convenient sample reduction and testing as a unit except with large mechanical splitters and sieve shakers. As an option when such equipment is not available, instead of combining and mixing sample increments and then reducing the field sample to testing size, conduct the sieve analysis on a number of approximately equal sample increments such that the total mass tested conforms to the requirements of Section 6.4.

6.7. In the event that the amount of material finer than the 75-µm (No. 200) sieve is to be determined by T 11, use the procedure described in Section 6.7.1 or 6.7.2, whichever is applicable.

6.7.1. For aggregates with a nominal maximum size of 12.5 mm ($^1/_2$ in.) or less, use the same test sample for testing by T 11 and this method. First test the sample in accordance with T 11 through the final drying operation, then dry sieve the sample as stipulated in Sections 7.2 through 7.5 of this method.

6.7.2. For aggregates with a nominal maximum size greater than 12.5 mm ($^1/_2$ in.), a single test sample may be used as described in Section 6.7.1 or separate test samples may be used for T 11 and this method.

6.7.3. Where the specification requires determination of the total amount of material finer than the 75-µm (No. 200) sieve by washing and dry sieving, use the procedure described in Section 6.7.1.

7. PROCEDURE

7.1. If the test sample has not been subjected to testing by T 11, dry it to constant mass at a temperature of 110 ± 5°C (230 ± 9°F). Determine and record the mass of material that will be placed on the sieves to the accuracy of the balance as defined in Section 5.1.

Note 6—For control purposes, particularly where rapid results are desired, it is generally not necessary to dry coarse aggregate for the sieve analysis test. The results are little affected by the moisture content unless (1) the nominal maximum size is smaller than about 12.5 mm ($^1/_2$ in.), (2) the coarse aggregate contains appreciable material finer than 4.75 mm (No. 4), or (3) the coarse aggregate is highly absorptive (a lightweight aggregate, for example). Also, samples may be dried at the higher temperature associated with the use of hot plates without affecting results, provided steam escapes without generating pressures sufficient to fracture the particles, and temperatures are not so great as to cause chemical breakdown of the aggregate.

7.2. Select sieves with suitable openings to furnish the information required by the specifications covering the material to be tested. Use additional sieves as desired or necessary to provide other information, such as fineness modulus, or to regulate the amount of material on a sieve to meet the requirements of Annex A1. If the sample was washed in accordance with T 11, the 75-µm (No. 200) sieve shall be included in the sieve set. Nest the sieves in order of decreasing size of opening from top to bottom and place the sample, or portion of the sample if it is to be sieved in more than one increment, on the top sieve. Agitate the sieves by hand or by mechanical apparatus for a sufficient period, established by trial or checked by measurement on the actual test sample, to meet the criterion for adequacy of sieving described in Annex A2.

7.3. Limit the quantity of material on a given sieve so that all particles have opportunity to reach sieve openings a number of times during the sieving operation.

7.3.1. *Prevent an overload of material on an individual sieve as described in Table A1 by one or a combination of the following methods*:

7.3.1.1. Insert an additional sieve with opening size intermediate between the sieve that may be overloaded and the sieve immediately above that sieve in the original set of sieves.

7.3.1.2. Split the sample into two or more portions, sieving each portion individually. Combine the masses of the several portions retained on a specific sieve before calculating the percentage of the sample on the sieve.

7.3.1.3. Use sieves having a larger frame size and providing greater sieving area.

7.3.1.4. In the case of coarse and fine aggregate mixtures, the portion of the sample finer than the 4.75-mm (No. 4) sieve may be distributed among two or more sets of sieves to prevent overloading of individual sieves.

7.3.1.5. Alternatively, the portion finer than the 4.75-mm (No. 4) sieve may be reduced in size using a mechanical splitter according to R 76. If this procedure is followed, compute the mass of each size increment of the original sample as follows:

$$A = \frac{W_1}{W_2} \times B \quad (1)$$

where:

A = mass of size increment on total sample basis;

W_1 = mass of fraction finer than 4.75-mm (No. 4) sieve in total sample;

W_2 = mass of reduced portion of material finer than 4.75-mm (No. 4) sieve actually sieved; and

B = mass of size increment in reduced portion sieved.

7.4. Unless a mechanical sieve shaker is used, hand sieve particles retained on the 75 mm (3 in.) by determining the smallest sieve opening through which each particle will pass by rotating the particles, if necessary, in order to determine whether they will pass through a particular opening; however, do not force particles to pass through an opening.

7.5. Determine the mass of each size increment on a scale or balance conforming to the requirements specified in Section 5.1 to the nearest 0.1 percent of the total original dry sample mass. The total mass of the material after sieving should check closely with the total original dry mass of the sample placed on the sieves. If the two amounts differ by more than 0.3 percent, based on the total original dry sample mass placed on the sieves, the results should not be used for acceptance purposes.

8. CALCULATION

8.1. Calculate percentages passing, total percentages retained, or percentages in various size fractions to the nearest 0.1 percent on the basis of the total mass of the initial dry sample. If the same test sample was first tested by T 11, include the mass of material finer than 75-µm (No. 200) sieve by washing in the sieve analysis calculation; and use the total dry sample mass prior to washing in T 11 as the basis for calculating all the percentages.

8.1.1. When sample increments are tested as provided in Section 6.6, total the masses of the portion of the increments retained on each sieve, and use these masses to calculate the percentage as in Section 8.1.

8.2. Calculate the fineness modulus, when required, by adding the total percentages of material in the sample that are coarser than each of the following sieves (cumulative percentages retained), and dividing the sum by 100; 150 µm (No. 100), 300 µm (No. 50), 600 µm (No. 30), 1.18 mm (No. 16), 2.36 mm (No. 8), 4.75 mm (No. 4), 9.5 mm ($^3/_8$ in.), 19.0 mm ($^3/_4$ in.), 37.5 mm ($1^1/_2$ in.), and larger, increasing the ratio of 2 to 1.

9. REPORT

9.1. *Depending on the form of the specifications for use of the material under test, the report shall include one of the following*:

9.1.1. Total percentage of material passing each sieve, or

9.1.2. Total percentage of material retained on each sieve, or

9.1.3. Percentage of material retained between consecutive sieves.

9.2. Report percentages to the nearest whole number, except if the percentage passing the 75-µm (No. 200) sieve is less than 10 percent, it shall be reported to the nearest 0.1 percent.

9.3. Report the fineness modulus, when required, to the nearest 0.01.

10. PRECISION AND BIAS

10.1. *Precision*—The estimates of precision for this test method are listed in Table 1. The estimates are based on the results from the AASHTO re:source Proficiency Sample Program, with testing conducted by T 27 and ASTM C136/C136M. The data are based on the analyses of test results from 65 to 233 laboratories that tested 18 pairs of coarse aggregate proficiency test samples, and test results from 74 to 222 laboratories that tested 17 pairs of fine aggregate proficiency test samples (Samples No. 21 through 90). The values in the table are given for different ranges of total percentage of aggregate passing a sieve.

Table 2—Precision Data for 300-g and 500-g Fine Aggregate Test Samples

Fine Aggregate Proficiency Sample Test Result	Sample Size	Number of Labs	Average	Within Laboratory 1s	Within Laboratory d2s	Among Laboratories 1s	Among Laboratories d2s
AASHTO T 27/ASTM C136/C136M:							
Total material passing the 4.75-mm (No. 4) sieve (%)	500 g	285	99.992	0.027	0.066	0.037	0.104
	300 g	276	99.990	0.021	0.060	0.042	0.117
Total material passing the 2.36-mm (No. 8) sieve (%)	500 g	281	84.10	0.43	1.21	0.63	1.76
	300 g	274	84.32	0.39	1.09	0.69	1.92
Total material passing the 1.18-mm (No. 16) sieve (%)	500 g	286	70.11	0.53	1.49	0.75	2.10
	300 g	272	70.00	0.62	1.74	0.76	2.12
Total material passing the 600-µm (No. 30) sieve (%)	500 g	287	48.54	0.75	2.10	1.33	3.73
	300 g	276	48.44	0.87	2.44	1.36	3.79
Total material passing the 300-µm (No. 50) sieve (%)	500 g	286	13.52	0.42	1.17	0.98	2.73
	300 g	275	13.51	0.45	1.25	0.99	2.76
Total material passing the 150-µm (No. 100) sieve (%)	500 g	287	2.55	0.15	0.42	0.37	1.03
	300 g	270	2.52	0.18	0.52	0.32	0.89
Total material passing the 75-µm (No. 200) sieve (%)	500 g	278	1.32	0.11	0.32	0.31	0.85
	300 g	266	1.30	0.14	0.39	0.31	0.85

10.2. *Bias*—Because there is no accepted reference material suitable for determining the bias in this test method, no statement on bias is made.

11. KEYWORDS

11.1. Aggregate gradation; fineness modulus.

ANNEX A

(Mandatory Information)

A1. OVERLOAD DETERMINATION

A1.1. Do not exceed a mass of 7 kg/m^2 (4 g/in^2) of sieving surface for sieves with openings smaller than 4.75 mm (No. 4) at the completion of the sieving operation.

A1.2. Do not exceed a mass in kilograms of the product of 2.5 × (sieve opening in mm) × (effective sieving area) for sieves with openings 4.75 mm (No. 4) and larger. This mass is shown in Table A1.1 for five sieve-frame dimensions in common use. Do not cause permanent deformation of the sieve cloth due to overloading.

Note A1—The 7 kg/m^2 (4 g/in.^{2}) amounts to 200 g for the usual 203-mm (8-in.) diameter sieve [with effective or clear sieving surface diameter of 190.5 mm (7 $^1/_2$ in.)] or 450 g for a 305-mm (12-in.) diameter sieve [with effective or clear sieving surface diameter of 292.1 mm (11 $^1/_2$ in.)].

Table 1—Estimates of Precision

	Total Percentage of Material Passing		Standard Deviation (1s),[a] %	Acceptable Range of Two Results (d2s),[a] %
Coarse Aggregate:[b]	100	≥95	0.32	0.9
Single-operator precision	<95	≥85	0.81	2.3
	<85	≥80	1.34	3.8
	<80	≥60	2.25	6.4
	<60	≥20	1.32	3.7
	<20	≥15	0.95	2.7
	<15	≥10	1.00	2.8
	<10	≥5	0.75	2.1
	<5	≥2	0.53	1.5
	<2	0	0.27	0.8
Multilaboratory precision	100	≥95	0.35	1.0
	<95	≥85	1.37	3.9
	<85	≥80	1.92	5.4
	<80	≥60	2.82	8.0
	<60	≥20	1.97	5.6
	<20	≥15	1.60	4.5
	<15	≥10	1.48	4.2
	<10	≥5	1.22	3.4
	<5	≥2	1.04	3.0
	<2	0	0.45	1.3
Fine Aggregate:				
Single-operator precision	100	≥95	0.26	0.7
	<95	≥60	0.55	1.6
	<60	≥20	0.83	2.4
	<20	≥15	0.54	1.5
	<15	≥10	0.36	1.0
	<10	≥2	0.37	1.1
	<2	0	0.14	0.4
Multilaboratory precision	100	≥95	0.23	0.6
	<95	≥60	0.77	2.2
	<60	≥20	1.41	4.0
	<20	≥15	1.10	3.1
	<15	≥10	0.73	2.1
	<10	≥2	0.65	1.8
	<2	0	0.31	0.9

[a] These numbers represent, respectively, the (1s) and (d2s) limits as described in ASTM C670.

[b] The precision estimates are based on aggregates with nominal maximum size of 19.0 mm (3/4 in.).

10.1.1. The precision values for Fine Aggregate in Table 2 are based on nominal 500-g test samples. Revision of ASTM C136 in 1994 permitted the fine aggregate test sample size to be 300 g minimum. Analysis of results of testing of 300-g and 500-g test samples from Aggregate Proficiency Test Samples 99 and 100 (Samples 99 and 100 were essentially identical) produced the precision values in Table 2, which indicate only minor differences due to test sample size.

Note 7—The values for Fine Aggregate in Table 1 will be revised to reflect the 300-g test sample size when a sufficient number of Aggregate Proficiency Tests have been conducted using that sample size to provide reliable data.

Table 2—Precision Data for 300-g and 500-g Fine Aggregate Test Samples

Fine Aggregate Proficiency Sample Test Result	Sample Size	Number of Labs	Average	Within Laboratory 1s	Within Laboratory d2s	Among Laboratories 1s	Among Laboratories d2s
AASHTO T 27/ASTM C136/C136M:							
Total material passing the 4.75-mm (No. 4) sieve (%)	500 g	285	99.992	0.027	0.066	0.037	0.104
	300 g	276	99.990	0.021	0.060	0.042	0.117
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Total material passing the 1.18-mm (No. 16) sieve (%)	500 g	286	70.11	0.53	1.49	0.75	2.10
	300 g	272	70.00	0.62	1.74	0.76	2.12
Total material passing the 600-µm (No. 30) sieve (%)	500 g	287	48.54	0.75	2.10	1.33	3.73
	300 g	276	48.44	0.87	2.44	1.36	3.79
Total material passing the 300-µm (No. 50) sieve (%)	500 g	286	13.52	0.42	1.17	0.98	2.73
	300 g	275	13.51	0.45	1.25	0.99	2.76
Total material passing the 150-µm (No. 100) sieve (%)	500 g	287	2.55	0.15	0.42	0.37	1.03
	300 g	270	2.52	0.18	0.52	0.32	0.89
Total material passing the 75-µm (No. 200) sieve (%)	500 g	278	1.32	0.11	0.32	0.31	0.85
	300 g	266	1.30	0.14	0.39	0.31	0.85

10.2. *Bias*—Because there is no accepted reference material suitable for determining the bias in this test method, no statement on bias is made.

11. KEYWORDS

11.1. Aggregate gradation; fineness modulus.

ANNEX A

(Mandatory Information)

A1. OVERLOAD DETERMINATION

A1.1. Do not exceed a mass of 7 kg/m^2 (4 g/in^2) of sieving surface for sieves with openings smaller than 4.75 mm (No. 4) at the completion of the sieving operation.

A1.2. Do not exceed a mass in kilograms of the product of 2.5 × (sieve opening in mm) × (effective sieving area) for sieves with openings 4.75 mm (No. 4) and larger. This mass is shown in Table A1.1 for five sieve-frame dimensions in common use. Do not cause permanent deformation of the sieve cloth due to overloading.

Note A1—The 7 kg/m^2 (4 g/in.^{2}) amounts to 200 g for the usual 203-mm (8-in.) diameter sieve [with effective or clear sieving surface diameter of 190.5 mm (7 $^1/_2$ in.)] or 450 g for a 305-mm (12-in.) diameter sieve [with effective or clear sieving surface diameter of 292.1 mm (11 $^1/_2$ in.)].

A1.3. As provided below, the amount of material retained on a sieve may be regulated by (1) the introduction of a sieve with larger openings immediately above the given sieve, (2) testing the sample in multiple increments, or (3) testing the sample over a nest of sieves with a larger sieve-frame dimension.

A1.3.1. Insert an additional sieve with opening size intermediate between the sieve that may be overloaded and the sieve immediately above that sieve in the original set of sieves.

A1.3.2. Split the sample into two or more portions, sieving each portion individually. Combine the masses of the several portions retained on a specific sieve before calculating the percentage of the sample on the sieve.

A1.3.2.1. Alternatively, the portion finer than the 4.75-mm (No. 4) sieve may be reduced in size using a mechanical splitter according to R 76. If this procedure is followed, compute the mass of each size increment of the original sample as follows:

$$A = \frac{W_1}{W_2} \times B \quad (1)$$

where:

A = mass of size increment on total sample basis;

W_1 = mass of fraction finer than 4.75-mm (No. 4) sieve in total sample;

W_2 = mass of reduced portion of material finer than 4.75-mm (No. 4) sieve actually sieved; and

B = mass of size increment in reduced portion sieved.

A1.4. Use sieves having a larger frame size and providing greater sieving area.

Table A3.1—Maximum Allowable Mass of Material Retained on a Sieve, kg

Sieve Opening Size	Nominal Dimensions of Sieve[a]				
	203.2 mm, dia[b]	254 mm, dia[b]	304.8 mm, dia[b]	350 by 350, mm	372 by 580, mm
	Sieving Area, m^2				
	0.0285	0.0457	0.0670	0.1225	0.2158
125 mm (5 in.)	[c]	[c]	[c]	[c]	67.4
100 mm (4 in.)	[c]	[c]	[c]	30.6	53.9
90 mm (3 1/2 in.)	[c]	[c]	15.1	27.6	48.5
75 mm (3 in.)	[c]	8.6	12.6	23.0	40.5
63 mm (2 1/2 in.)	[c]	7.2	10.6	19.3	34.0
50 mm (2 in.)	3.6	5.7	8.4	15.3	27.0
37.5 mm (1 1/2 in.)	2.7	4.3	6.3	11.5	20.2
25.0 mm (1 in.)	1.8	2.9	4.2	7.7	13.5
19.0 mm (3/4 in.)	1.4	2.2	3.2	5.8	10.2
12.5 mm (1/2 in.)	0.89	1.4	2.1	3.8	6.7
9.5 mm (3/8 in.)	0.67	1.1	1.6	2.9	5.1
4.75 mm (No. 4)	0.33	0.54	0.80	1.5	2.6

[a] Sieve-frame dimensions in inch units: 8.0-in. diameter; 10.0-in. diameter; 12.0-in. diameter; 13.8 by 13.8 in. (14 by 14 in. nominal); 14.6 by 22.8 in. (16 by 24 in. nominal).

[b] The sieve area for round sieves is based on an effective or clear diameter of 12.7 mm (1/2 in.) less than the nominal frame diameter because ASTM E11 permits the sealer between the sieve cloth and the frame to extend 6.35 mm (1/4 in.) over the sieve cloth. Thus, the effective or clear sieving diameter for a 203.2-mm (8.0-in.) diameter sieve frame is 190.5 mm (7 1/2 in.). Sieves produced by some manufacturers do not infringe on the sieve cloth by the full 6.35 mm (1/4 in.).

[c] Sieves indicated have less than five full openings and should not be used for sieve testing.

A2. TIME EVALUATION

A2.1. The minimum time requirement shall be evaluated for each shaker at least annually by the following method:

A2.1.1. Shake the sample over nested sieves for approximately 10 min.

Note A2—If the sample material may be prone to degradation, reduce the initial shaking time in Section A2.1.1 to 5 min, and begin each recheck with a new sample.

A2.1.2. Provide a snug-fitting pan and cover for each sieve and hold the items in a slightly inclined position in one hand.

A2.1.3. Hand-shake each sieve continuously for 60 s by striking the side of the sieve sharply and with an upward motion against the heel of the other hand at the rate of about 150 times per min, turning the sieve about one sixth of a revolution at intervals of about 25 strokes.

A2.2. If more than 0.5 percent by mass of the total sample before sieving passes any sieve after one minute of continuous hand sieving, adjust the shaker time and repeat Section A2.1.

A2.3. In determining sieving time for sieve sizes larger than 4.75 mm (No. 4), limit the material on the sieve to a single layer of particles.

A2.4. If the size of the mounted testing sieves makes the described sieving motion impractical, use 203-mm (8-in.) diameter sieves to verify the adequacy of sieving.

A2.5. If the mass retained on any sieve exceeds the maximum allowable mass per Table A1.1, select a different sample and repeat Section A2.

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[1] Similar but not identical to ASTM C136/C136M-19.

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Illinois Modified Test Procedure
Effective Date: December 1, 2021
Revised Date: December 1, 2023

Standard Test Method
for
Reducing Samples of Aggregate to Testing Size

Reference AASH
TO R 76-23

AASHTO Section	***Illinois Modification***
2.1	Replace with the following: Illinois Modified AASHTO Standards: • R90, Sampling Aggregate Products • T11, Materials Finer Than No. 200 (75µm) Sieve in Mineral Aggregates by Washing
2.2	Replace with the following: Illinois Specification: • Illinois Specification 201 Aggregate Gradation Sample Size Table.
2.3	Insert the following: ASTM Standard: • C125, Standard Terminology Relating to Concrete and Concrete Aggregates
5.1	Replace with the following: "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 Note 1	Replace with the following: "As a quick approximation of free moisture; if the fine aggregate will retain its shape when molded in the hand, it may be considered to be wetter than saturated surface-dry."
5.1.2	Replace "38 mm (1 ½ in.)" with "1 1/2in. (37.5mm)" in the second sentence of the paragraph
5.2	Replace with the following: "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."
5.3	Delete
6.1	Replace with the following: "Field samples of aggregate shall be taken according to Illinois Modified AASHTO R90. The field sample size shall meet the minimum requirements in the Illinois Specifications 201."

Illinois Modified Test Procedure
Effective Date: December 1, 2021
Revised Date: December 1, 2023

Standard Test Method
for
Reducing Samples of Aggregate to Testing Size

Reference AASHTO R 76-23

AASHTO Section	***Illinois Modification***
7.1	Replace with the following: "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 twelve 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).
7.1 Note 2	Replace with the following: "Mechanical splitters are commonly available in sizes adequate for coarse aggregate having the largest particles not larger than 1 1/2in. (37.5mm)."
7.1 Note 3	Delete
8.1	Replace with the following: "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. Upon the final split, the mass of the two halves (after splitting) shall be within ±10 percent of each other. This is determined by multiplying mass of the smaller split by (1.10 or 110%); 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."
9.1	Replace "2 by 2.5 m (6 by 8 ft.)" with "6 by 8ft (2 by 2.5m)"

Illinois Modified Test Procedure
Effective Date: December 1, 2021
Revised Date: December 1, 2023

Standard Test Method
for
Reducing Samples of Aggregate to Testing Size

Reference AASHTO R 76-23

AASHTO Section	***Illinois Modification***
10.1.1	Replace with the following: "Mix the material thoroughly on a hard, clean, level surface by turning the entire sample over four times using a 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. 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 and/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 of section 8.1 herein."
10.1.2	Replace with the following: "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 of section 8.1 herein."
12.1	Revise with the following: "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. 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 Illinois Modified AASHTO T11, 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 of section 8.1 herein."
13	Delete

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Standard Practice for

Reducing Samples of Aggregate to Testing Size

AASHTO Designation: R 76-23[1]

Technically Revised: 2023

Technical Subcommittee: 1c, Aggregates

ASTM Designation: C702/C702M-18

1. SCOPE

1.1. These methods cover 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 associated with its use. It is the responsibility of the user of this procedure to establish appropriate safety and health practices and to determine the applicability of regulatory limitations prior to its use.*

2. REFERENCED DOCUMENTS

2.1. *AASHTO Standards*:
- R 90, Sampling Aggregate Products
- T 84, Specific Gravity and Absorption of Fine Aggregate

2.2. *ASTM Standard*:
- C125, Standard Terminology Relating to Concrete and Concrete Aggregates

3. TERMINOLOGY

3.1. *Definitions*—the terms used in this standard are defined in ASTM C125.

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, use caution 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, test the entire original sample.

4.3. Failure to carefully follow the procedures in these methods could result in providing a nonrepresentative sample to be used in subsequent testing.

5. SELECTION OF METHOD

5.1. *Fine Aggregate*—Reduce samples of fine aggregate that are drier than the saturated surface-dry condition (Note 1) using a mechanical splitter according to Method A. Samples having free moisture on the particle surfaces may be reduced in size by quartering according to Method B, or by treating as a miniature stockpile as described in Method C.

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—The method of determining the saturated surface-dry condition is described in T 84. As a quick approximation, if the fine aggregate will retain its shape when molded in the hand, it may be considered to be wetter than saturated surface-dry.

5.1.2. If 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 38 mm ($1^1/_2$ in.) or more to reduce the sample to not less than 5000 g. The portion so obtained is then dried, and reduction to test sample size is completed using Method A.

5.2. *Coarse Aggregates*—Reduce the sample using a mechanical splitter in accordance with Method A (preferred method) in Section 8 or by quartering in accordance with Method B in Sections 10.1.1 or 10.1.2. Do not use the sectoring Method B in Section 10.1.3 or the miniature stockpile Method C in Section 12 for coarse aggregates.

5.3. *Combined Coarse and Fine Aggregate*—Samples that are in a dry condition may be reduced in size by either Method A in Section 8 or Method B in Sections 10.1.1 or 10.1.2. Samples having free moisture on the particle surfaces may be reduced in size by quartering according to Method B Sections 10.1.1 or 10.1.2. When Method A is desired and the sample is damp or shows free water, dry the sample until it appears dry or until clumps can be easily broken by hand (Note 2). Dry the entire sample to this condition, using temperatures that do not exceed those specified for any of the tests contemplated, and then reduce the sample. Do not use the sectoring Method B in Section 10.1.3 or the miniature stockpile Method C in Section 12 for combined aggregates.

Note 2—The dryness of the sample can be tested by tightly squeezing a small portion of the sample in the palm of the hand. If the cast crumbles readily, the correct moisture range has been obtained.

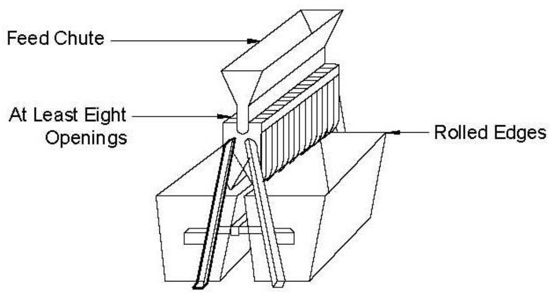
6. SAMPLING

6.1. Obtain samples of aggregate in accordance with R 90, or as required by individual test methods.

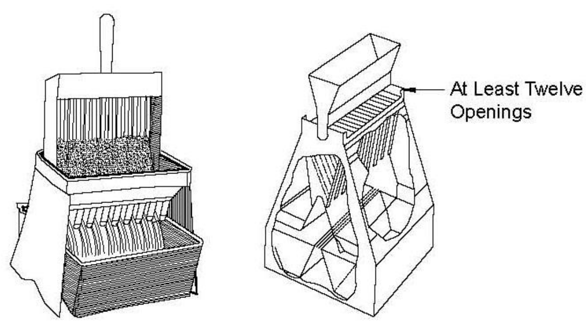
METHOD A—MECHANICAL SPLITTER

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 twelve 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 3). For dry fine aggregate in which the entire sample will pass the 9.5-mm ($^3/_8$-in.) 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 19 mm ($^3/_4$ in.). 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 straightedged 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 Figures 1 and 2).



(a) Large Sample Splitter for Coarse Aggregate



(b) Small Sample Splitters for Fine Aggregate

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

Figure 1—Sample Splitters (Riffles)

(a) Side View (b) Top View

Figure 2—Sample Splitter (Adjustable)

Note 3—Mechanical splitters are commonly available in sizes adequate for coarse aggregate having the largest particle not over 37.5 mm ($1^1/_2$ in.).

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 into the chutes, approximately equal amounts will flow through each chute. Introduce the sample at a rate that allows the material to flow freely through the chutes into the receptacles below.

8.2. 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.

METHOD B—QUARTERING

9. APPARATUS

9.1. Straightedge; straightedged scoop or shovel.

9.2. Spatulas, trowels, or drywall taping knives.

9.3. Stick or pipe.

9.4. Broom or brush.

9.5. Tear-resistant rectangular tarp, appropriate for the amount and size of the material being reduced.

9.6. *Quartering Template*—Formed in the shape of a 90-degree cross with equal length sides that exceed the diameter of the flattened cone of material sufficient to allow complete separation of the quartered sample. The height of the sides must be sufficient to extend above the thickness of the flattened cone of the sample to be quartered (see Figure 3).

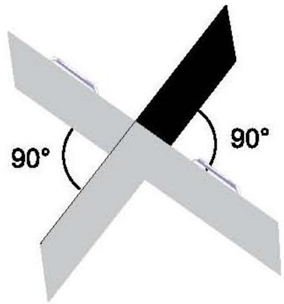


Figure 3—Quartering Template

10. PROCEDURE

10.1. Use the procedure described in Section 10.1.1, 10.1.2, 10.1.3, or a combination thereof.

10.1.1. *Quartering on a Clean, Hard, Level Surface*:

10.1.1.1. Place the original sample on a clean, hard, level surface where there will be neither loss of material nor the accidental addition of foreign material.

10.1.1.2. Mix the material by turning the entire sample over at least three times until the material is thoroughly mixed. With the last turning, form the entire sample into a conical pile by depositing individual lifts on top of the preceding lift.

10.1.1.3. Carefully flatten the conical pile to a uniform thickness with a diameter approximately four to eight times the thickness by pressing down the top with a shovel or trowel so that each quarter sector of the resulting pile will contain the material originally in it.

10.1.1.4. Divide the flattened mass into four approximately equal quarters with a quartering template, shovel, or trowel.

10.1.1.5. 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.

10.1.1.6. If necessary, repeat Sections 10.1.1.2 through 10.1.1.5 until the required sample size is obtained (see Figure 4).

10.1.1.7. The reduced sample consists of two diagonally opposite quarters.

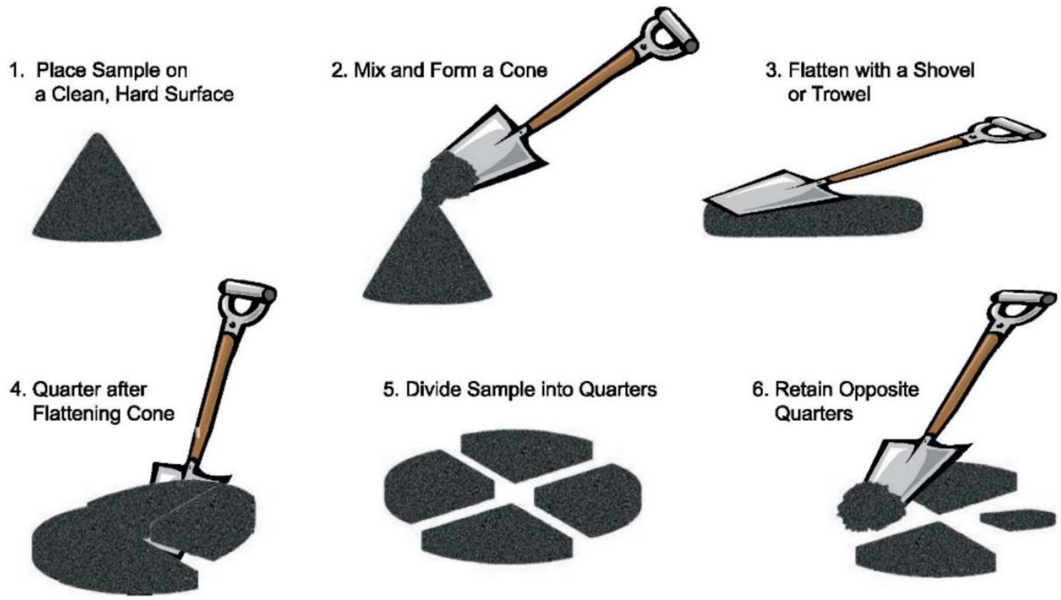


Figure 4—Quartering on a Hard, Clean, Level Surface

10.1.2. *Quartering on a Tarp*:

10.1.2.1. As an alternative to the procedure in Section 10.1.1 or when the floor surface is uneven, place the sample on a tarp and mix with a shovel or trowel as described in Section 10.1.1.2, leaving the sample in a conical pile.

10.1.2.2. As an alternative to mixing with the shovel or trowel, lift each corner of the tarp and pull it over the sample toward the diagonally opposite corner, causing the material to be rolled. Roll the material at least four times until it is thoroughly mixed.

10.1.2.3. Pull each corner of the tarp toward the center of the pile so the material will be left in a conical pile.

10.1.2.4. Flatten the pile as described in Section 10.1.1.3.

10.1.2.5. Divide the sample as described in Section 10.1.1.4 or insert a stick or pipe beneath the tarp and under the center of the pile, then lift both ends of the stick or pipe, dividing the sample into two approximately equal parts.

10.1.2.6. Remove the stick or pipe, leaving a fold of the tarp between the divided portions.

10.1.2.7. Insert the stick or pipe under the center of the pile at right angles to the first division and again lift both ends of the stick or pipe, dividing the sample into four approximately equal parts.

10.1.2.8. Remove two diagonally opposite quarters, being careful to clean the fines from the tarp. The two unused quarters may be set aside for later use or testing.

10.1.2.9. If necessary, repeat Sections 10.1.2.1 through 10.1.2.8 until the required sample size is obtained (see Figure 5).

10.1.2.10. The reduced sample consists of two diagonally opposite quarters.

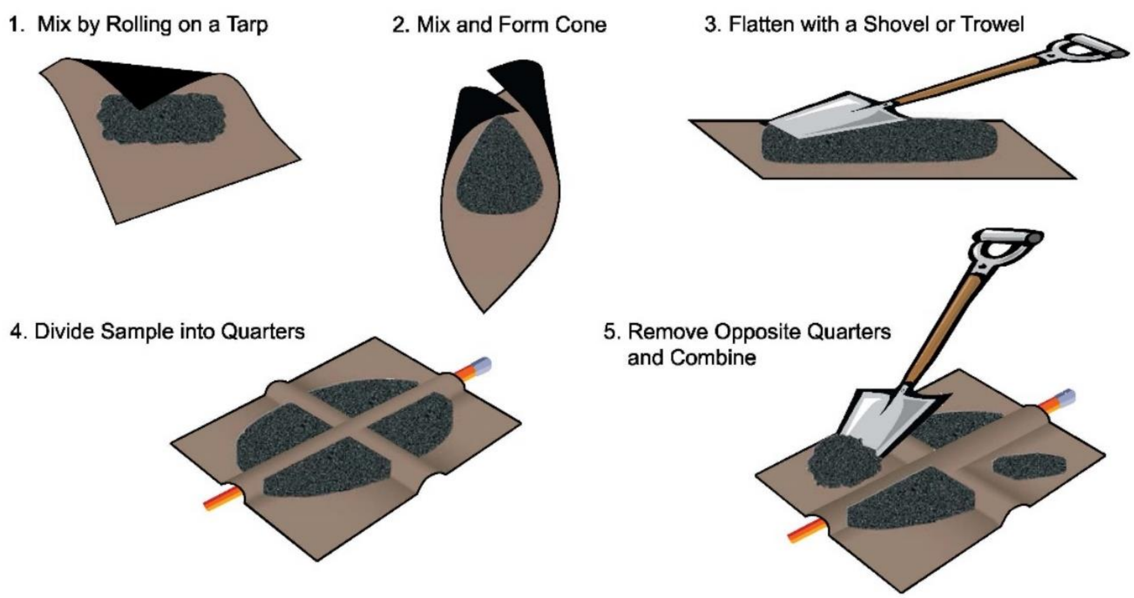


Figure 5—Quartering on a Tarp

10.1.3. *Sectoring*:

10.1.3.1. This method may be used in conjunction with Section 10.1.1, 10.1.2, or a combination of both.

Note 4—The sectoring method may be used for reducing samples of fine aggregate to a target sample size with minimal manipulation.

10.1.3.2. Mix the material as described in Section 10.1.1.2.

10.1.3.3. Flatten the conical pile as described in Section 10.1.1.3.

10.1.3.4. Divide the flattened cone into four approximately equal quarters using a quartering template, straightedge, shovel, or trowel, assuring complete separation.

10.1.3.5. Using a straightedge, obtain a sector by slicing through a quarter of the material from the center point to the outer edge of the quarter.

10.1.3.6. Pull or drag the sector from the quarter with two straightedges or hold one edge of the straightedge in contact with a quartering device.

10.1.3.7. Remove an approximately equal sector from the diagonally opposite quarter and combine.

10.1.3.8. If necessary, repeat Sections 10.1.3.5 through 10.1.3.7 until the required sample size is obtained (see Figure 6).

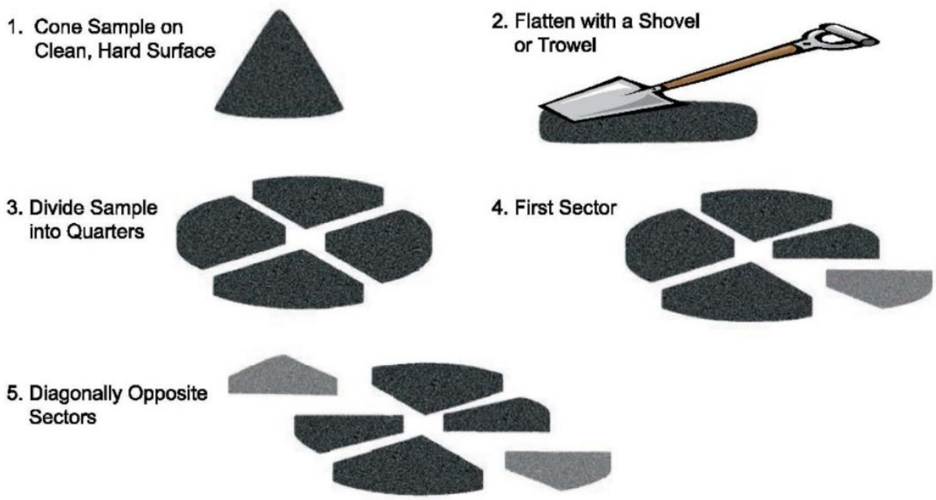


Figure 6—Reduction by Sectoring

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

11. APPARATUS

11.1. Straightedge, flat bottom scoop, square point shovel, or trowel for mixing the aggregate.

11.2. A small sampling thief, small scoop, or spoon for sampling.

12. PROCEDURE

12.1. Place the original sample of damp fine aggregate on a hard, clean, level surface where there will be neither loss of material nor the accidental addition of foreign material.

12.2. Mix the material by turning the entire sample over at least three times until the material is thoroughly mixed.

12.3. With the last turning, form the entire sample into a conical pile by depositing individual lifts on top of the preceding lift. If desired, the conical pile may be flattened to a uniform thickness and diameter by pressing the top with a shovel or trowel so that each quarter sector of the resulting pile will contain the material originally in it.

12.4. Obtain a sample for each test by selecting at least five increments of material at random locations from the miniature stockpile, using any of the sampling devices described in Section 11.2.

13. KEYWORDS

13.1. Aggregate; aggregate sample; mechanical splitter; quartering.

[1] Formerly T 248. First published as a practice in 2016. Similar but not identical to ASTM C702/C702M-18.

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Illinois Modified Test Procedure
Effective Date: December 1, 2023

Standard Method of Test
For
Total Evaporable Moisture Content of Aggregates by Drying

Reference AASHTO T 255-22

AASHTO Section	***Illinois Modification***
1.1	Add the following: Aggregate moisture content may be run on a gradation sample prior to gradation testing or on a separate test sample.
2.1	Revise the individual Standards as follows: AASHTO R 76 (Illinois Modified) AASHTO R 90 (Illinois Modified) AASHTO T 19/T 19M (Illinois Modified) AASHTO T 84 (Illinois Modified) AASHTO T 85 (Illinois Modified)
2.2	Delete the individual Standard as follows: ASTM C 670
5.2	Add the following: The oven shall be specifically designed for drying. All the other specified sources of heat may be used for drying except for a microwave oven or an electric heat lamp. A microwave oven or an electric heat lamp may be used only when drying a non-gradation test sample.
6.1	Replace with the following: Field samples of aggregate shall be taken according to AASHTO R 90 (Illinois Modified). The field sample size shall meet the minimum requirements in the IDOT Aggregate Gradation Sample Size Table. Field samples shall be stored in sealable, nonabsorbent bags or containers prior to splitting to prevent moisture loss.
6.2	Replace with the following: Field samples of aggregate shall be reduced to test sample size before testing according to AASHTO R 76 (Illinois Modified). Test sample size for non-gradation samples shall meet the minimum test sample size in Table 1. Test sample size for gradation samples also having aggregate moisture content performed shall meet the minimum requirements in the IDOT Aggregate Gradation Sample Size Table. Test samples shall be stored in sealable, nonabsorbent bags or containers prior to determining mass to start the test.
7.1	Replace with the following: 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	Replace with the following: The test sample shall be dried back to constant mass by the selected source of heat as specified herein.

Illinois Modified Test Procedure
Effective Date: December 1, 2021

Standard Method of Test
For
Total Evaporable Moisture Content of Aggregates by Drying
(continued)
Reference AASHTO T 255-00 (2021)

AASHTO Section	***Illinois Modification***
7.2.1	Add the following: 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	Delete.
7.3.1	Delete.
7.4	Replace with the following: Constant mass is defined as the sample mass at which there has not been more than a 0.5-gram mass loss during 1 hour of drying.
7.5	Replace with the following: After the test sample has been dried to constant mass and cooled sufficiently so as not to damage the balance or scale, determine the mass of the test sample to the nearest 0.1 gram for fine aggregate. 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. This procedure provides the “Total Dry Mass, g” (TDM). The TDM will also be used for calculation of gradation samples.
8.1	Replace with the following: The “Aggregate Moisture Content” shall be determined by using the following formula: $P = \frac{100(OSM - TDM)}{TDM}$ 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).

Standard Method of Test for

Total Evaporable Moisture Content of Aggregate by Drying

AASHTO Designation: T 255-22[1]

Technically Revised: 2022

Technical Subcommittee: 1c, Aggregates

ASTM Designation: C566-13

1. SCOPE

1.1. This test method 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.

1.2. The values stated in SI units are to be regarded as the standard. The values stated in parentheses are provided for information only.

1.3. *This standard does not purport to address all of the safety concerns associated with its use. It is the responsibility of the user of this procedure to establish appropriate safety and health practices and to determine the applicability of regulatory limitations prior to its use.* For specific precautionary statements, see Sections 5.3.1, 7.2.1, and 7.3.1.

1.4. *The quality of the results produced by this standard are dependent on the competence of the personnel performing the procedure and the capability, calibration, and maintenance of the equipment used. Agencies that meet the criteria of R 18 are generally considered capable of competent and objective testing/sampling/inspection/etc. Users of this standard are cautioned that compliance with R 18 alone does not completely assure reliable results. Reliable results depend on many factors; following the suggestions of R 18 or some similar acceptable guideline provides a means of evaluating and controlling some of those factors.*

2. REFERENCED DOCUMENTS

2.1. *AASHTO Standards*:
- M 231, Weighing Devices Used in the Testing of Materials
- M 339M/M 339, Thermometers Used in the Testing of Construction Materials
- R 18, Establishing and Implementing a Quality Management System for Construction Materials Testing Laboratories
- R 90, Sampling Aggregate Products
- T 19M/T 19, Bulk Density ("Unit Weight") and Voids in Aggregate
- T 84, Specific Gravity and Absorption of Fine Aggregate
- T 85, Specific Gravity and Absorption of Coarse Aggregate

2.2. *ASTM Standards*:

- C125, Standard Terminology Relating to Concrete and Concrete Aggregates
- C670, Standard Practice for Preparing Precision and Bias Statements for Test Methods for Construction Materials
- E1, Standard Specification for ASTM Liquid-in-Glass Thermometers
- E11, Standard Specification for Woven Wire Test Sieve Cloth and Test Sieves
- E230/E230M, Standard Specification for Temperature-Electromotive Force (emf) Tables for Standardized Thermocouples
- E2877, Standard Guide for Digital Contact Thermometers

2.3. *International Electrotechnical Commission* Standard:

- IEC 60584-1:2013, Thermocouples - Part 1: EMF Specifications and Tolerances

2.4. *Other Document*:

- Strategic Highway Research Program. National Research Council Report SHRP-P-619, Soil Moisture Proficiency Sample Program, 1993. Available from https://onlinepubs.trb.org/onlinepubs/shrp/SHRP-P-619.pdf

3. TERMINOLOGY

3.1. *Definitions*—For definitions of terms used in this test method, refer to ASTM C125.

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 50 mm (2 in.), 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 M 231.

5.2. *Source of Heat*—A ventilated oven capable of maintaining the temperature surrounding the sample at 110 ± 5°C (230 ± 9°F). Oven(s) for heating and drying shall be capable of operation at the temperatures required, between 100 to 120°C (212 to 248°F), within ±5°C (±9°F), as corrected, if necessary, by standardization. More than one oven may be used, provided each is used within its proper operating temperature range. The thermometer for measuring the temperature, regardless of drying apparatus used, shall meet the requirements of M 339M/M 339 with a temperature range of at least 90 to 130°C (194 to 266°F), and an accuracy of ±1.25°C (±2.25°F) (see Note 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.

Note 1—Thermometer types suitable for use include ASTM E1 mercury thermometers; ASTM E2877 digital metal stem thermometer; ASTM E230/E230M thermocouple thermometer, Type J or K, Special Class, Type T any Class; IEC 60584 thermocouple thermometer, Type J or K, Class 1, Type T any Class; or dial gauge metal stem (bi-metal) thermometer.

5.3. *Sample Container*—A container not affected by the heat, and of sufficient volume to contain the sample without danger of spilling, and of such shape that the depth of sample will not exceed one-fifth of the least lateral dimension.

5.3.1. **Precaution**—When a microwave oven is used, the container shall be nonmetallic.

Note 2—Except for testing large samples, an ordinary frying pan is suitable for use with a hot plate, or any shallow flat-bottomed metal pan with heat lamps or oven. Note precaution in Section 5.3.1.

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

6. SAMPLE

6.1. Sampling shall generally be accomplished in accordance with R 90, except the sample size may be as stated in Table 1.

Table 1—Sample Size for Aggregate

Nominal Maximum Size of Aggregate, mm (in.)[a]	Mass of Normal Weight Aggregate Sample, Min., kg[b]
4.75 (0.187) (No. 4)	0.5
9.5 ($^3/_8$)	1.5
12.5 ($^1/_2$)	2
19.0 ($^3/_4$)	3
25.0 (1)	4
37.5 ($1^1/_2$)	6
50 (2)	8
63 ($2^1/_2$)	10
75 (3)	13
90 ($3^1/_2$)	16
100 (4)	25
150 (6)	50

[a] Based on sieves meeting ASTM E11.

[b] Determine the minimum sample mass for lightweight aggregate by multiplying the value listed by the dry–loose unit mass of the aggregate in kg/m^3 (determined using T 19M/T 19) and dividing by 1600.

6.2. Secure a sample of the aggregate representative of the moisture content in the supply being tested and having a mass not less than the amount listed in Table 1. Protect the sample against loss of moisture prior to determining the mass.

7. PROCEDURE

7.1. Determine the mass of the sample to the nearest 0.1 percent.

7.2. Dry the sample thoroughly in the sample container by means of the selected source of heat, exercising care to avoid loss of any particles. Very rapid heating may cause some particles to explode, resulting in loss of particles. Use a controlled temperature oven when excessive heat may alter the character of the aggregate, or where more precise measurement is required. If a source of heat other than the controlled temperature oven is used, stir the sample during drying to accelerate the operation and avoid localized overheating. When using a microwave oven, stirring of the sample is optional.

7.2.1. **Caution**: When using a microwave oven, occasionally minerals are present in aggregates that may cause the material to overheat and explode. If this occurs, it can damage the microwave oven.

7.3. When a hot plate is used, drying can be expedited by the following procedure. Add sufficient anhydrous denatured alcohol to cover the moist sample. Stir and allow suspended material to settle. Decant as much of the alcohol as possible without losing any of the sample. Ignite the remaining alcohol and allow it to burn off during drying over the hot plate.

7.3.1. **Warning**: Exercise care to control the ignition operation to prevent injury or damage from the burning alcohol.

7.4. The sample is thoroughly dry when further heating causes, or would cause, less than 0.1 percent additional loss in mass.

7.5. Determine the mass of the dried sample to the nearest 0.1 percent after it has cooled sufficiently not to damage the balance.

8. CALCULATION

8.1. Calculate total evaporable moisture content as follows:

$$p = 100(W - D)/D \qquad (1)$$

where:

p = total evaporable moisture content of sample, percent;
W = mass of original sample, g; and
D = mass of dried sample, g.

8.2. Surface moisture content is equal to the difference between the total evaporable moisture content and the absorption, with all values based on the mass of a dry sample. Absorption may be determined in accordance with T 85, Test for Specific Gravity and Absorption of Coarse Aggregate, or T 84, Test for Specific Gravity and Absorption of Fine Aggregate.

9. PRECISION AND BIAS

9.1. *Precision*:

9.1.1. The within-laboratory single-operator standard deviation for moisture content of aggregates has been found to be 0.28 percent (Note 3). Therefore, results of two properly conducted tests by the same operator in the same laboratory on the same type of aggregate sample should not differ by more than 0.79 percent (Note 3) from each other.

9.1.2. The between-laboratory standard deviation for moisture content of aggregates has been found to be 0.28 percent (Note 3). Therefore, results of properly conducted tests from two laboratories on the same aggregate sample should not differ by more than 0.79 percent (Note 3) from each other.

9.1.3. Test data used to derive the above precision indices were obtained from samples dried to a constant mass in a drying oven maintained at 110 ± 5°C. When other drying procedures are used, the precision of the results may be significantly different than that indicated above.

Note 3—These numbers represent, respectively, the 1s and d2s limits as described in ASTM C670.

9.2. *Bias*:

9.2.1. When experimental results are compared with known values from accurately compounded specimens, the following has been derived.

9.2.1.1. The bias of moisture tests on one aggregate material has been found to have a mean of +0.06 percent. The bias of individual test values from the same aggregate material has been found with 95 percent confidence to lie between –0.07 percent and +0.20 percent.

9.2.1.2. The bias of moisture tests on a second aggregate material has been found to have a mean of less than +0.01 percent. The bias of individual test values from the same aggregate material has been found with 95 percent confidence to lie between –0.14 percent and +0.14 percent.

9.2.1.3. The bias of moisture tests overall on both aggregate materials has been found to have a mean of +0.03 percent. The bias of individual test values overall from both aggregate materials has been found with 95 percent confidence to lie between –0.12 percent and +0.18 percent.

9.2.2. Test data used to derive the above bias statement were obtained from samples dried to a constant mass in a drying oven maintained at 110 ± 5°C. When other drying procedures are used, the bias of the results may be significantly different than that indicated above.

Note 4—These precision and bias statements were derived from aggregate moisture data provided by 17 laboratories participating in the SHRP Soil Moisture Proficiency Sample Program, which is fully described in the National Research Council Report SHRP-P-619. The samples tested that relate to these statements were well-graded mixtures of fine and coarse aggregate with moisture contents ranging from air dry to saturated surface-dry.

10. KEYWORDS

10.1. Aggregate; drying; moisture content.

[1] This method is technically equivalent to ASTM C566-13, except for the balance statement in Section 5.1.

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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:

ASTM Section	***Illinois Modification***
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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Designation: E29 – 13 (Reapproved 2019)

An American National Standard

Standard Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications[1]

This standard is issued under the fixed designation E29; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

This standard has been approved for use by agencies of the U.S. Department of Defense.

1. Scope

1.1 This practice is intended to assist the various technical committees in the use of uniform methods of indicating the number of digits which are to be considered significant in specification limits, for example, specified maximum values and specified minimum values. Its aim is to outline methods which should aid in clarifying the intended meaning of specification limits with which observed values or calculated test results are compared in determining conformance with specifications.

1.2 This practice is intended to be used in determining conformance with specifications when the applicable ASTM specifications or standards make direct reference to this practice.

1.3 Reference to this practice is valid only when a choice of method has been indicated, that is, either *absolute method or rounding method.*

1.4 The system of units for this practice is not specified. Dimensional quantities in the practice are presented only as illustrations of calculation methods. The examples are not binding on products or test methods treated.

1.5 *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 standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.6 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

E177 Practice for Use of the Terms Precision and Bias in ASTM Test Methods

E456 Terminology Relating to Quality and Statistics

E2282 Guide for Defining the Test Result of a Test Method

IEEE/ASTM SI 10 Standard for Use of the International System of Units (SI): The Modern Metric System

3. Terminology

3.1 *Definitions*—Terminology E456 provides a more extensive list of terms in E11 standards.

3.1.1 *observed value, n*—the value obtained by making an observation. **E2282**

3.1.2 *repeatability conditions, n*—conditions where independent test results are obtained with the same method on identical test items in the same laboratory by the same operator using the same equipment within short intervals of time. **E177**

3.1.3 *repeatability standard deviation (s_r), n*—the standard deviation of test results obtained under repeatability conditions. **E177**

3.1.4 *significant digit*—any of the figures 0 through 9 that is used with its place value to denote a numerical quantity to some desired approximation, excepting all leading zeros and some trailing zeros in numbers not represented with a decimal point.

3.1.4.1 *Discussion*—This definition of significant digits relates to how the number is represented as a decimal. It should not be inferred that a measurement value is precise to the number of significant digits used to represent it.

3.1.4.2 *Discussion*—The digit zero may either indicate a specific value or indicate place only. Zeros leading the first nonzero digit of a number indicate order of magnitude only and are not significant digits. For example, the number 0.0034 has two significant digits. Zeros trailing the last nonzero digit for

[1] This practice is under the jurisdiction of ASTM Committee E11 on Quality and Statistics and is the direct responsibility of Subcommittee E11.30 on Statistical Quality Control.

Current edition approved Jan. 1, 2019. Published January 2019. Originally approved in 1940. Last previous edition approved in 2013 as E29 – 13. DOI: 10.1520/E0029-13R19.

[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

numbers represented with a decimal point are significant digits. For example, the numbers 1270. and 32.00 each have four significant digits. The significance of trailing zeros for numbers represented without use of a decimal point can only be identified from knowledge of the source of the value. For example, a modulus strength, stated as 140 000 Pa, may have as few as two or as many as six significant digits.

3.1.4.3 *Discussion*—To eliminate ambiguity, the exponential notation may be used. Thus, 1.40×10^5 indicates that the modulus is reported to the nearest 0.01×10^5 or 1000 Pa.

3.1.4.4 *Discussion*—Use of appropriate SI prefixes is recommended for metric units to reduce the need for trailing zeros of uncertain significance. Thus, 140 kPa (without the decimal point) indicates that the modulus is reported either to the nearest 10 or 1 kPa, which is ambiguous with respect to the number of significant digits. However, 0.140 MPa clearly indicates that the modulus is reported to the nearest 1 kPa, and 0.14 MPa clearly indicates that the modulus is reported to the nearest 10 kPa.

3.1.5 *test result, n*—the value of a characteristic obtained by carrying out a specified test method. **E2282**

4. Significance and Use

4.1 This practice describes two commonly accepted methods of rounding data, identified as the Absolute Method and the Rounding Method. In the applications of this practice to a specific material or materials it is essential to specify which method is intended to apply. In the absence of such specification, reference to this practice, which expresses no preference as to which method should apply, would be meaningless. The choice of method depends upon the current practice of the particular branch of industry or technology concerned, and should therefore be specified in the prime publication.

4.1.1 The unqualified statement of a numerical limit, such as "2.50 in. max," cannot, in view of different established practices and customs, be regarded as carrying a definite operational meaning concerning the number of digits to be retained in an observed or a calculated value for purposes of determining conformance with specifications.

4.1.2 *Absolute Method*—In some fields, specification limits of 2.5 in. max, 2.50 in. max, and 2.500 in. max are all taken to imply the same absolute limit of exactly two and a half inches and for purposes of determining conformance with specifications, an observed value or a calculated value is to be compared directly with the specified limit. Thus, any deviation, however small, outside the specification limit signifies nonconformance with the specifications. This will be referred to as the *absolute method*, which is discussed in Section 5.

4.1.3 *Rounding Method*—In other fields, specification limits of 2.5 in. max, 2.50 in. max, 2.500 in. max are taken to imply that, for the purposes of determining conformance with specifications, an observed value or a calculated value should be rounded to the nearest 0.1 in., 0.01 in., 0.001 in., respectively, and then compared with the specification limit. This will be referred to as the *rounding method*, which is discussed in Section 6.

4.2 Section 7 of this practice gives guidelines for use in recording, calculating, and reporting the final result for test data.

5. Absolute Method

5.1 *Where Applicable*—The absolute method applies where it is the intent that all digits in an observed value or a calculated value are to be considered significant for purposes of determining conformance with specifications. Under these conditions, the specified limits are referred to as absolute limits.

5.2 *How Applied*—With the absolute method, an observed value or a calculated value is not to be rounded, but is to be compared directly with the specified limiting value. Conformance or nonconformance with the specification is based on this comparison.

5.3 *How Expressed*—This intent may be expressed in the standard in one of the following forms:

5.3.1 If the absolute method is to apply to all specified limits in the standard, this may be indicated by including the following sentence in the standard:

> For purposes of determining conformance with these specifications, all specified limits in this standard are absolute limits, as defined in ASTM Practice E29, for Using Significant Digits in Test Data to Determine Conformance with Specifications.

5.3.2 If the absolute method is to apply to all specified limits of some general type in the standard (such as dimensional tolerance limits), this may be indicated by including the following sentence in the standard:

> For purposes of determining conformance with these specifications, all specified (dimensional tolerance) limits are absolute limits, as defined in ASTM Practice E29, for Using Significant Digits in Test Data to Determine Conformance with Specifications.

5.3.3 If the absolute method is to apply to all specified limits given in a table, this may be indicated by including a footnote with the table as follows:

Capacity mL	Volumetric Tolerance[A] ± mL
10	0.02
25	0.03
50	0.05
100	0.10

[A] Tolerance limits specified are absolute limits as defined in Practice E29, for Using Significant Digits in Test Data to Determine Conformance with Specifications.

6. Rounding Method

6.1 *Where Applicable*—The rounding method applies where it is the intent that a limited number of digits in an observed value or a calculated value are to be considered significant for purposes of determining conformance with specifications.

6.2 *How Applied*—With the rounding method, an observed value or a calculated value should be rounded by the procedure prescribed in 4.1.3 to the nearest unit in the designated place of figures stated in the standard, as, for example, "to the nearest kPa," "to the nearest 10 ohms," "to the nearest 0.1 percent," etc. The rounded value should then be compared with the specified limit, and conformance or nonconformance with the specification based on this comparison.

6.3 *How Expressed*—This intent may be expressed in the standard in one of the following forms:

6.3.1 If the rounding method is to apply to all specified limits in the standard, and if all digits expressed in the specification limit are to be considered significant, this may be indicated by including the following statement in the standard:

The following applies to all specified limits in this standard: For purposes of determining conformance with these specifications, an observed value or a calculated value shall be rounded "to the nearest unit" in the last right-hand digit used in expressing the specification limit, in accordance with the rounding method of ASTM Practice E29, for Using Significant Digits in Test Data to Determine Conformance with Specifications.

6.3.2 If the rounding method is to apply only to the specified limits for certain selected requirements, this may be indicated by including the following statement in the standard:

The following applies to specified limits for requirements on (tensile strength), (elongation), and (...) given in ..., (applicable section number and title) and (...) of this standard: For purposes of determining conformance with these specifications, an observed value or a calculated value shall be rounded to the nearest 1 kPa for (tensile strength), to the nearest (1 percent) for (elongation), and to the nearest (...) for (...) in accordance with the rounding method of ASTM Practice E29 Using Significant Digits in Test Data to Determine Conformance with Specifications.

6.3.3 If the rounding method is to apply to all specified limits in a table, this may be indicated by a note in the manner shown in the following examples:

6.3.3.1 *Example 1*—Same significant digits for all items:

	Chemical Composition, % mass
Copper	4.5 ± 0.5
Iron	1.0 max
Silicon	2.5 ± 0.5
Other constituents (magnesium + zinc + manganese)	0.5 max
Aluminum	remainder

For purposes of determining conformance with these specifications, an observed value or a calculated value shall be rounded to the nearest 0.1 percent, in accordance with the rounding method of ASTM Practice E29 Using Significant Digits in Test Data to Determine Conformance with Specifications.

6.3.3.2 *Example 2*—Significant digits not the same for all items; similar requirements:

	Chemical Composition, % mass min	Chemical Composition, % mass max
Nickel	57	...
Chromium	14	18
Manganese	...	3
Silicon	...	0.40
Carbon	...	0.25
Sulfur	...	0.03
Iron	remainder	

For purposes of determining conformance with these specifications, an observed value or a calculated value shall be rounded "to the nearest unit" in the last right-hand significant digit used in expressing the limiting value, in accordance with the rounding method of ASTM Practice E29 Using Significant Digits in Test Data to Determine Conformance with Specifications.

6.3.3.3 *Example 3*—Significant digits not the same for all items; dissimilar requirements:

	Tensile Requirements
Tensile strength, psi	60 000 to 72 000
Yield point, min, psi	33 000
Elongation in 2 in., min %	22

For purposes of determination of conformance with these specifications, an observed value or a calculated value shall be rounded to the nearest 1000 psi for tensile strength and yield point and to the nearest 1 percent for elongation, in accordance with the rounding method of ASTM Practice E29 Using Significant Digits in Test Data to Determine Conformance with Specifications.

6.4 *Rounding Procedure*—The actual rounding procedure[3] shall be as follows:

6.4.1 When the digit next beyond the last place to be retained is less than 5, retain unchanged the digit in the last place retained.

6.4.2 When the digit next beyond the last place to be retained is greater than 5, increase by 1 the digit in the last place retained.

6.4.3 When the digit next beyond the last place to be retained is 5, and there are no digits beyond this 5, or only zeros, increase by 1 the digit in the last place retained if it is odd, leave the digit unchanged if it is even. Increase by 1 the digit in the last place retained, if there are non-zero digits beyond this 5.

NOTE 1—This method for rounding 5's is not universally used by software packages.

6.4.4 This rounding procedure may be restated simply as follows: When rounding a number to one having a specified number of significant digits, choose that which is nearest. If two choices are possible, as when the digits dropped are exactly a 5 or a 5 followed only by zeros, choose that ending in an even digit. Table 1 gives examples of applying this rounding procedure.

6.5 The rounded value should be obtained in one step by direct rounding of the most precise value available and not in two or more successive roundings. For example: 89 490 rounded to the nearest 1000 is at once 89 000; it would be incorrect to round first to the nearest 100, giving 89 500 and then to the nearest 1000, giving 90 000.

6.6 *Special Case, Rounding to the Nearest 50, 5, 0.5, 0.05, etc.*—If in special cases it is desired to specify rounding to the nearest 50, 5, 0.5, 0.05, etc., this may be done by so indicating

[3] The rounding procedure given in this practice is the same as the one given in the *ASTM Manual 7 on Presentation of Data and Control Chart Analysis.*

TABLE 1 Examples[A] of Rounding

Specified Limit	Observed Value or Calculated Value	To Be Rounded to Nearest	Rounded Value to be Used for Purposes of Determining Conformance	Conforms with Specified Limit
Yield point, 36 000 psi, min	35 940	100 psi	35 900	no
	35 950	100 psi	36 000	yes
	35 960	100 psi	36 000	yes
Nickel, 57 %, mass, min	56.4	1 %	56	no
	56.5	1 %	56	no
	56.6	1 %	57	yes
Water extract conductivity, 40 ms/m, max	40.4	1 ms/m	40	yes
	40.5	1 ms/m	40	yes
	40.6	1 ms/m	41	no
Sodium bicarbonate 0.5 %, max, dry mass basis	0.54	0.1 %	0.5	yes
	0.55	0.1 %	0.6	no
	0.56	0.1 %	0.6	no

[A] These examples are meant to illustrate rounding rules and do not necessarily reflect the usual number of digits associated with these test methods.

in the standard. In order to round to the nearest 50, 5, 0.5, 0.05, etc., double the observed or calculated value, round to the nearest 100, 10, 1.0, 0.10, etc., in accordance with the procedure in 6.4, and divide by 2. For example, in rounding 6025 to the nearest 50, 6 025 is doubled giving 12 050 which becomes 12 000 when rounded to the nearest 100 (6.4.3). When 12 000 is divided by 2, the resulting number, 6000, is the rounded value of 6025. In rounding 6075 to the nearest 50, 6075 is doubled giving 12 150 which becomes 12 200 when rounded to the nearest 100 (6.4.3). When 12 200 is divided by 2, the resulting number, 6100, is the rounded value of 6075.

6.7 *Special Case, Rounding to the Nearest Interval Not Covered in 6.4 or 6.6*—In some test methods, there may be a requirement to round a value to an interval that does not align with the specific requirements in 6.4 or 6.6, such as to the nearest 0.02, 0.25, 0.3, etc. In such cases, the following procedure can be used for rounding to any interval:

NOTE 2—Using a calculation subroutine that has been programmed to perform the rounding procedure described in 6.7.1, 6.7.2, and 6.7.3 can be advantageous in evaluating laboratory data.

6.7.1 Divide the result by the desired rounding increment or interval.

6.7.2 Round the result obtained in 6.7.1 to the nearest whole number following the conventions in 6.4, 6.4.1, 6.4.2, and 6.4.3 as appropriate.

6.7.3 Multiply the result obtained in 6.7.2 by the desired rounding increment or interval.

6.7.4 For example, in rounding 0.07 to the nearest 0.02, dividing 0.07 by 0.02 gives a value of 3.5. Rounding this value to the nearest whole number gives a value of 4, based on the information in 6.4.3. Multiplying 4 by 0.02 yields 0.08. In rounding 0.09 to the nearest 0.02, dividing 0.09 by 0.02 gives a value of 4.5. Rounding this value to the nearest whole number gives a value of 4, based on the information in 6.4.3. Multiplying 4 by 0.02 yields 0.08.

7. Guidelines for Retaining Significant Figures in Calculation and Reporting of Test Results

7.1 *General Discussion*—Rounding test results avoids a misleading impression of precision while preventing loss of information due to coarse resolution. Any approach to retention of significant digits of necessity involves some loss of information; therefore, the level of rounding should be carefully selected considering both planned and potential uses for the data. The number of significant digits must, first, be adequate for comparison against specification limits (see 6.2). The following guidelines are intended to preserve the data for statistical summaries. For certain purposes, such as where calculations involve differences of measurements close in magnitude, and for some statistical calculations, such as paired t-tests, autocorrelations, and nonparametric tests, reporting data to a greater number of significant digits may be advisable.

7.2 *Recording Observed Values*—When recording direct measurements, as in reading marks on a buret, ruler, or dial, all digits known exactly, plus one digit which may be uncertain due to estimation, should be recorded. For example, if a buret is graduated in units of 0.1 mL, then an observed value would be recorded as 9.76 mL where it is observed between 9.7 and 9.8 marks on the buret, and estimated about six tenths of the way between those marks. When the measuring device has a vernier scale, the last digit recorded is the one from the vernier.

7.2.1 The number of significant digits given by a digital display or printout from an instrument should be greater than or equal to those given by the rule for reporting test results in 7.4 below.

7.3 *Calculation of Test Result from Observed Values*—When calculating a test result from observed values, avoid rounding of intermediate quantities. As far as is practicable with the calculating device or form used, carry out calculations with the observed values exactly and round only the final result.

7.4 *Reporting Test Results*—A suggested rule relates the significant digits of the test result to the precision of the measurement expressed as the standard deviation σ. The applicable standard deviation is the repeatability standard deviation. The rounding interval for test results should not be greater than 0.5 σ nor less than 0.05 σ, but not greater than the unit in the specification (see 6.2). When only an estimate, s, is available for σ, s may be used in place of σ in the preceding sentence. An alternative statement of the suggested rule is: Write down the standard deviation. Round test results to the place of the first significant digit in the standard deviation if the digit is two or higher, to the next place if it is a one.

Example:
A test result is calculated as 1.45729. The standard deviation of the test method is estimated to be, 0.0052. Round to 1.457 or the nearest 0.001 since this rounding unit, 0.001, is between 0.05 σ = 0.00026 and 0.5 σ = 0.0026.

NOTE 3—A rationale for this rule is derived from Sheppard's adjustment for grouping, which represents the standard deviation of a rounded test result by $\sqrt{\sigma^2 + w^2/12}$ where σ is the standard deviation of the unrounded test result and w is the rounding interval. The quantity $w/\sqrt{12}$ is the standard deviation of an error uniformly distributed over the range w. Rounding so that w is below 0.5 σ ensures that the standard deviation is increased by at most 1 %.

7.4.1 When no estimate of the standard deviation σ is known, then rules for retention of significant digits of computed quantities may be used to derive a number of significant digits to be reported, based on significant digits of test data.

7.4.1.1 The rule when adding or subtracting test data is that the result contains no significant digits beyond the place of the last significant digit of any datum.

Examples:
(*1*) 11.24 + 9.3 + 6.32 = 26.9, since the last significant digit of 9.3 is the first following the decimal place, 26.9 is obtained by rounding the exact sum, 26.86, to this place of digits.
(*2*) 926 − 923.4 = 3
(*3*) 140 000 + 91 460 = 231 000 when the first value was recorded to the nearest thousand.

7.4.1.2 The rule when multiplying or dividing is that the result contains no more significant digits than the value with the smaller number of significant digits.

Examples:
(*1*) 11.38 × 4.3 = 49, since the factor 4.3 has two significant digits.
(*2*) (926 − 923.4) ⁄4.3 = 0.6 Only one figure is significant since the numerator difference has only one significant digit.

7.4.1.3 The rules for logarithms and exponentials are: Digits of $ln(x)$ or $\log_{10}(x)$ are significant through the n-th place after the decimal when x has n significant digits. The number of significant digits of e^x or 10^x is equal to the place of the last significant digit in x after the decimal.

Examples:
ln(3.46) = 1.241 to three places after the decimal, since 3.46 has three significant digits. $10^{3.46}$ = 2900 has two significant digits, since 3.46 is given to two places after the decimal.

7.4.1.4 The rule for numbers representing exact counts or mathematical constants is that they are to be treated as having an infinite number of significant digits.

Examples:
(*1*) 1 – 0.23/2 = 0.88 where the numbers 1 and 2 are exact and 0.23 is an approximate quantity.
(*2*) A count of 50 pieces times a measured thickness 0.124 mm is 50 × 0.124 = 6.20 mm, having three significant figures.
(*3*) A measurement of 1.634 in. to the nearest thousandth, is converted to mm. The result, 1.634 × 25.4 = 41.50 mm, has four significant digits. The conversion constant, 25.4, is exact.

NOTE 4—More extensive discussion of dimensional conversion can be found in IEEE/ASTM SI 10.

7.5 *Specification Limits*—When the rounding method is to apply to given specified limits, it is desirable that the significant digits of the specified limits should conform to the precision of the test following the rule of 7.4. That is, the rounding unit for the specification limits should be between 0.05 and 0.5 times the standard deviation of the test.

7.6 *Averages and Standard Deviations*—When reporting the average and standard deviation of replicated measurements or repeated samplings of a material, a suggested rule for most cases is to round the standard deviation to two significant digits and round the average to the same last place of significant digits. When the number of observations is large (more than 15 when the lead digit of the standard deviation is 1, more than 50 with lead digit 2, more than 100 in other cases), an additional digit may be advisable.

7.6.1 Alternative approaches for averages include reporting $\bar{x}$ to within 0.05 to 0.5 times the standard deviation of the average $\sigma/\sqrt{n}$, or applying rules for retaining significant digits to the calculation of $\bar{x}$. ASTM Manual 7 provides methods for reporting $\bar{x}$ and s for these applications.[3]

NOTE 5—A rationale for the suggested rule comes from the uncertainty of a calculated standard deviation s. The standard deviation of s based on sampling from a normal distribution with n observations is approximately $\sigma/\sqrt{2n}$. Reporting s to within 0.05 to 0.5 of this value, following the rule of 7.4, leads to two significant digits for most values of σ when the number of observations n is 100 or fewer.

Example: Analyses on six specimens give values of 3.56, 3.88, 3.95, 4.07, 4.21, and 4.47 for a constituent. The average and standard deviation, unrounded, are $\bar{x}$ = 4.0233... and s = 0.3089... . The suggested rule would report $\bar{x}$ and s as 4.02 and 0.31.

8. Keywords

8.1 absolute method; conformance; rounding; significant digits; specifications; test data

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Illinois Department of Transportation

Development of Gradation Bands on Incoming Aggregate at Hot-Mix Asphalt and Portland Cement Concrete Plants
Appendix A.1

Effective: January 1, 1994
Revised: December 1, 2021

A. Scope

Quality Control Plans for Hot-Mix Asphalt (HMA) and Portland Cement Concrete (PCC) contracts normally require incoming aggregate to be checked for gradation compliance before use in HMA and PCC 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 a 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 PCC plants, the Contractor may increase the specification limit for the minus No. 200 (75-µm) Illinois Modified AASHTO T 11 sieve material upwards one half percent (0.5%) if the No. 200 (75-µm) material consists of dust from fracture, or degradation from abrasion and attrition, during

Illinois Department of Transportation

Development of Gradation Bands on Incoming Aggregate at Hot-Mix Asphalt and Portland Cement Concrete Plants
Appendix A.1
(continued)
Effective: January 1, 1994
Revised: December 1, 2021

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 A.5

Effective Date: November 10, 1997
Revised Date: December 1, 2023

Precision Comparison Table*
State Monitor vs. Producer

	Size Fraction Between Consecutive Sieves (%) †	*Tolerance (%)*
Coarse Aggregate:	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
Fine Aggregate:	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 A.5
(continued)
Effective Date: November 10, 1997
Revised Date: December 1, 2023

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 Differenc	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 111.18mm)	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 (9.5 mm and 4.75 mm)					
#4 and #16 (4.75 mm and 1.18mm)					
#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 ± 5 °C (230 ± 9 °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 °C (0 – 300 °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 D.5

Effective Date: April 1, 1999
Revised Date: December 1, 2021

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.

Note: Units—The values stated in metric units are to be regarded as standard. Within the text, English units are shown when commonly used and may not be an exact equivalent.

Minimum Requirements for Laboratory Balances

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	8 kg	0.1 g
20Coarse Aggregate CA/CM 1 through 5	12 kg	0.1 g
HOT- MIX ASPHALT 1/		
Volumetric Analysis		
Mix Design Labs	15 kg	0.1 g
QC, QA Labs	8 kg	0.1 g
Asphalt Content		
(Nuclear AB Gauge, Approved Solvent Extraction, or Ignition Furnace)	12 kg	0.1 g
PORTLAND CEMENT CONCRETE 1/		
Aggregate Moisture Content 2/	8 kg	0.1 g
Unit Weight 2/	4/	5/
Cylinder Strength Specimens 3/	4/	50 g

1/ Also requires Aggregate Balances
2/ The weighing equipment may be a balance or scale, and it does not have to be electronic.
3/ The weighing of the cylinder strength specimens prior to compressive strength testing is optional.
4/ Sufficient capacity
5/ A 20 g (0.05 lb) or smaller readability shall be required for unit weight measures and air meter measuring bowls which have a capacity less than 0.3 cu ft. A 50 g (0.1 lb) or smaller readability shall be required for unit weight measures which have a capacity greater than or equal to 0.3 cu ft.

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State of Illinois
Department of Transportation
Bureau of Materials
Springfield

POLICY MEMORANDUM

Revised: July 27, 2023	6-08.8
This Policy Memorandum supersedes number 6-08.7 dated February 7, 2023	

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 30º C (68-86º 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:

<u>Sieves</u>
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**. The **Bureau** is responsible for updating the database with the approval status of **District Laboratories** and for entering the initial approval of **Private Laboratories**. The **District** shall be responsible for updating the approval status of **Private Laboratories** based on subsequent re-inspections. The **District** shall also be responsible for initial recording and updating the approval status of **Local Agency Laboratories**, Aggregate Only **Private Laboratories** and PCC Jobsite **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**.

TABLE 1
PRIVATE QUALITY CONTROL LABORATORY TESTS

	PROCEDURE	PRIVATE QC LAB TYPE					
	Illinois Modified AASHTO (IL Mod.)	AGG	HMA QC	HMA DESIGN	PCC QC	Jobsite PCC QC	TITLE
AGGREGATE TESTS	IL Mod. R 90	✓	✓	✓	✓		Sampling of Aggregates
	IL Mod. T 11	✓	✓	✓	✓		Materials Finer Than 75-µm (No. 200) Sieve in Mineral Aggregates by Washing
	IL Mod. T 19	✓[1]					Bulk Density ("Unit Weight") and Voids in Aggregate
	IL Mod. T 27	✓	✓	✓	✓		Sieve Analysis of Fine and Coarse Aggregate
	IL Mod. T 84	✓[2]					Specific Gravity and Absorption of Fine Aggregate
	IL Mod. T 85	✓[2]					Specific Gravity and Absorption of Coarse Aggregate
	IL Mod. R 76	✓	✓	✓	✓		Reducing Samples of Aggregate to Testing Size
	IL Mod. T 255	✓	✓	✓	✓		Total Evaporable Moisture Content of Aggregate by Drying

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

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

	PROCEDURE		PRIVATE QC LAB TYPE		
	Illinois Modified AASHTO (IL Mod.)	Illinois Modified ASTM (IL Mod.)	HMA QC	HMA DESIGN	TITLE
HOT-MIX ASPHALT TESTS	IL Mod. T 30	-	✓	✓	Mechanical Analysis of Extracted Aggregate
	IL Mod. T 164	-	✓[3] or IL Mod. T 287 or IL Mod. T 308[4]	✓[3]	Quantitative Extraction of Asphalt Binder from Hot Mix Asphalt (HMA)
	IL Mod. T 166	-	✓	✓	Bulk Specific Gravity (Gmb) of Compacted Hot Mix Asphalt (HMA) Using Saturated Surface-Dry Specimens
	IL Mod. T 209	-	✓	✓	Theoretical Maximum Specific Gravity (Gmm) and Density of Hot Mix Asphalt Paving Mixtures
	IL Mod. T 283	-		✓	Resistance of Compacted Hot Mix Asphalt (HMA) to Moisture-Induced Damage
	IL Mod. T 287	-	✓ or IL Mod. T 164 or IL Mod. T 308[4]		Asphalt Binder Content of Asphalt Mixtures by the Nuclear Method
	IL Mod. T 308	-	✓ or IL Mod. T 164 or IL Mod. T 287[4]		Determining the Asphalt Binder Content of Hot Mix Asphalt (HMA) by the Ignition Method
	IL Mod. T 312	-	✓	✓	Preparing and Determining the Density of Hot Mix Asphalt (HMA) Specimens by Means of the Superpave Gyratory Compactor
	-	IL Mod. D 2950	✓		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

	PROCEDURE		PRIVATE QC LAB TYPE		TITLE
	Illinois Modified AASHTO (IL Mod.)	Illinois Modified ASTM (IL Mod.)	PCC QC	Jobsite PCC QC	
PORTLAND CEMENT CONCRETE TESTS	IL Mod. R 39	-	Required if developing mix designs.		Making and Curing Concrete Test Specimens in the Laboratory
	IL Mod. R 60	-	✓	✓	Sampling Freshly Mixed Concrete
	IL Mod. R 100	-	✓	✓	Making and Curing Concrete Test Specimens in the Field
	IL Mod. T 22	-	✓[5] or IL Mod. T 177		Compressive Strength of Cylindrical Concrete Specimens
	IL Mod. T 119	-	✓	✓	Slump of Hydraulic Cement Concrete
	IL Mod. T 121	-			Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete
	IL Mod. T 152	-	✓	✓	Air Content of Freshly Mixed Concrete by the Pressure Method - Type A or B Air Meter
	IL Mod. T 177	-	✓[5] or IL Mod. T 22		Flexural Strength of Concrete (Using Simple Beam with Center-Point Loading)
	IL Mod. T 196	-			Air Content of Freshly Mixed Concrete by the Volumetric Method
	IL Mod. T 231	-	✓ or IL Mod. C 1231		Capping Cylindrical Concrete Specimens
	-	IL Mod. C 1064	✓	✓	Temperature of Freshly Mixed Hydraulic Cement Concrete
	-	IL Mod. C 1231	✓ or IL Mod. T 231		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.

TABLE 2
REQUIRED TESTS – QUALITY ASSURANCE TESTING CONSULTANTS [1,2]

	PROCEDURE		REQUIRED FOR PREQUALIFICATION Private QA Lab Type: HMA/Agg and PCC/Agg			TITLE
	Illinois Modified AASHTO/ AASHTO	ASTM	IDOT QA	AAP On-Site Assessment	AAP Proficiency Sample Program	
AGGREGATE	Mod. R 90 R 90	-	✓			Sampling of Aggregates
AGGREGATE	Mod. T 11	-	✓			Materials Finer Than 75-µm (No. 200)Sieve in Mineral Aggregates by Washing
AGGREGATE	T 11	-		✓	✓	
AGGREGATE	Mod. T 19	-	✓			Bulk Density ("Unit Weight") and Voids in Aggregate
AGGREGATE	T 19	-		✓		
AGGREGATE	Mod. T 27	-	✓			Sieve Analysis of Fine and Coarse Aggregates
AGGREGATE	T 27	-		✓	✓	
AGGREGATE	Mod. T 84[3]	-	✓			Specific Gravity and Absorption of Fine Aggregate
AGGREGATE	T 84[3]	-		✓	✓	
AGGREGATE	Mod. T 85[3]	-	✓			Specific Gravity and Absorption of Coarse Aggregate
AGGREGATE	T 85[3]	-		✓	✓	
AGGREGATE	Mod. R 76	-	✓			Reducing Samples of Aggregate to Testing Size
AGGREGATE	R76	-		✓		
AGGREGATE	Mod. T 255	-	✓			Total Evaporable Moisture Content of Aggregate by Drying
AGGREGATE	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 – Private QA Lab Type: HMA/Agg			TITLE
	Illinois Modified AASHTO/ AASHTO	Illinois Modified ASTM	IDOT QA	AAP On-Site Assessment	AAP Proficiency Sample Program	
HOT-MIX ASPHALT	Mod. T 30	-	✓	✓		Mechanical Analysis of Extracted Aggregate
	T 30	-		✓	✓	
	Mod. T 164	-	✓			Quantitative Extraction of Asphalt Binder from Hot Mix Asphalt (HMA)
	T 164	-		✓	✓	
	Mod. T 166	-	✓			Bulk Specific Gravity (Gmb) of Compacted Hot Mix Asphalt (HMA) Using Saturated Surface-Dry Specimens
	T 166	-		✓	✓	
	Mod. T 209	-	✓			Theoretical Maximum Specific Gravity (Gmm) and Density of Hot Mix Asphalt Paving Mixtures
	T 209	-		✓	✓	
	Mod. T 283	-	✓			Resistance of Compacted Hot Mix Asphalt (HMA) to Moisture-Induced Damage
	T 283	-		✓		
	Mod. T 287	-	✓[4]			Asphalt Binder Content of Asphalt Mixtures by the Nuclear Method
	Mod. T 308	-	✓[4]			Determining the Asphalt Binder Content of Hot Mix Asphalt (HMA) by the Ignition Method
	T 308	-		✓[4]	✓	
	Mod. T 312	-	✓			Preparing and Determining the Density of Hot Mix Asphalt (HMA) Specimens by Means of the Superpave Gyratory Compactor
	T 312	-		✓	✓	
	-	IL Mod. D 2950	✓			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.

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/ AASHTO/ Illinois Test Procedure (ITP)	Illinois Modified ASTM/ ASTM	IDOT QA	AAP On-Site Assessment	AAP Proficiency Sample Program	
PORTLAND CEMENT CONCRETE	-	C 192			✓	Making and Curing Concrete Test Specimens in the Laboratory
	Mod. R 60	-	✓			Sampling Freshly Mixed Concrete
	-	C 172		✓		
	Mod. R 100	-	✓			Making and Curing Concrete Test Specimens in the Field
	-	C 31		✓		
	Mod. T 22	-	✓			Compressive Strength of-Cylindrical Concrete Specimens
	-	C 39		✓	✓	
	Mod. T 119	-	✓			Slump of Hydraulic Cement Concrete
	-	C 143		✓	✓	
	Mod. T 121	-	✓			Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete
	-	C 138		✓	✓	
	Mod. T 152	-	✓			Air Content of Freshly Mixed Concrete by the Pressure Method-Type A or B Air Meters
	-	C 231		✓	✓	
	Mod. T 177	-	✓			Flexural Strength of Concrete (Using Simple Beam with Center-Point Loading)
	-	C 293		✓[5]		
	Mod. T 196	-	[6]			Air Content of Freshly Mixed Concrete by the Volumetric Method
	-	C 173		[6]	[7]	
	Mod. T 231	-	[6]			Capping Cylindrical Concrete Specimens
	-	C 617		[6]		
	-	Mod. C 1064	✓			Temperature of Freshly Mixed Hydraulic Cement Concrete
		C 1064		✓		
	-	Mod. C 1231	✓			Use of Unbonded Caps in Determination of Compressive Strength of Hardened Concrete Cylinders
		C 1231		✓		
	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

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 shall be performed if consultant lab has the ability to perform the test.

TABLE 3
EQUIPMENT CALIBRATION, STANDARDIZATION, VERIFICATION AND CHECK SCHEDULE[1]

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

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	CBM 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:			BMPR QCD18
Water Temperature	Verification	6	
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 QCD34 Unit Weight Bucket BMPR QCD35 Air Meter Bowl
Air Meter (Pressure Type)	Standardize	12 (Type A)	BMPR QCD36
	Standardize	3 (Type B)	BMPR QCD37
Air Meter (Volumetric Type)	Standardize	12	BMPR QCD38
Compression & Flexural Testing Machine	Verification	12	ASTM E4
Capping Material	Check Strength	3 or New Shipment	BMPR QCD39
Slump Cone	Check Critical Dimensions	12	BMPR QCD40
Beam Molds	Check Critical Dimensions	12	BMPR QCD41
Plastic Cylinder Mold 4 x 8	Check Dimensions	Each Shipment	BMPR QCD42
Plastic Cylinder Mold 6 x 12	Check Dimensions	Each Shipment	BMPR QCD43
Retaining Rings and Neoprene Pads	Check Critical Dimensions and Neoprene Pad Usage	12	BMPR QCD44
Metal Stem Thermometer	Standardize with Calibrated NIST Traceable Reference Thermometer	12	BMPR QCD45
Moist Room/Storage Tank Recording Thermometer or Max/Min Thermometer	Standardize with Calibrated NIST Traceable Reference Thermometer	12	BMPR QCD46

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.

Instructions for Providing Departmental Access to Results of Participation in the AASHTO Proficiency Sample Program for Quality Assurance Testing Consultants

Consultants seeking to become prequalified as a **Quality Assurance Testing Consultant** shall be accredited by **AASHTO**. Participation in the **AASHTO** Proficiency Sample Program is one of the requirements for accreditation. **Consultants** who are accredited by **AASHTO** shall also allow the **Department** access to their Proficiency Sample Ratings as part of the prequalification process.

To allow the **Department** access to these data from **AASHTO re:source** provided proficiency samples, **Consultants** should go to the **AASHTO re:source** website (http://www.aashtoresource.org) and follow the instructions given below:

1. Log into your account and navigate to your home page.
2. Using the green vertical menu on the left side of the page, click “My Specifiers”
3. Click “Search for Specifiers” at the top of the page
4. Using the drop-down menu, select “Illinois” as the State, or type in “Illinois Dept. of Transportation”. A list of results should populate including the ILDOT option. It is important to type in the specifier name EXACTLY as shown or it won’t find the Illinois Department of Transportation.
5. Click the green “Request” button. Confirm that you want to send a request.
6. The samples to be made available to the **Department** (with unlimited time periods) for evaluation shall be taken from Attachment A Table 2 and need only correspond to the QA Lab Type(s) a **Consultant** is seeking prequalification for.

To allow the **Department** access to these data from **CCRL** provided proficiency samples, **Consultants** should contact **CCRL** directly for assistance.

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State of Illinois
Department of Transportation
Bureau of Materials
Springfield

POLICY MEMORANDUM

Revised: April 14, 2022 This Policy Memorandum supersedes number 7-08.3 dated June 1, 2018	7-08.4

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 Bureau of Materials 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 4.0 herein. Acceptance of returned Ready-Mix Concrete shall be according to 5.0 herein.

4.0 ACCEPTANCE AT JOBSITE OR CENTRAL RECYCLER

4.1 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. The plant area, haul roads, and stockpile pads shall be properly maintained to assure that acceptable material is not contaminated prior to use.

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

4.3 Quality testing, when specified shall consist of one quality sample per every 10,000 tons (9,072 Metric tons) per specific gradation. The quality samples shall be taken from stockpiled material. Quality testing limits by use are specified below:

Aggregate Use	Illinois Modified AASHTO T 327* (% Loss)	Illinois Modified AASHTO T 96* (% Loss)
HMA Surface and Binder	15	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.

5.0 RECYCLED RETURNED READY-MIX CONCRETE

5.1 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:

5.1.1 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.

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

5.1.3 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.

5.1.4 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.

5.2 **Quality**. IDOT reserves the right to test this material for quality, as outlined in Section 4.3 herein, if contamination is present in the stockpile.

5.3 **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.

5.4 **Stockpiling**. Stockpiling, hauling, and loading shall comply with the Aggregate Gradation Control System. The plant area, haul roads and stockpile pads shall be properly maintained to assure that acceptable material is not contaminated prior to use.

6.0 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: April 14, 2022	11-08.7
This Policy Memorandum supersedes number 11-08.6 dated December 4, 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

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.

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.

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/idot-training-schedule/

Bureau – Bureau of Materials, Illinois Department of Transportation, Springfield, Illinois.

Department – Illinois Department of Transportation.

District – Materials Office located at each Illinois Department of Transportation highway district office.

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.

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.

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.

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/idot-training-schedule/

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.

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.

Qualified Products List (QPL) – The current Approved/Qualified Producer List of Aggregate Sources, maintained by the Department identifying aggregate sources certified to supply aggregate to Department/Local Agency projects.

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.

Source – Individual aggregate source, i.e., a specific quarry or pit location supplying a specific product or products.

Source Classification – Under this program, a **Source** will be classified as Certified, De-Certified, or Non-Certified.

Certified Source – A **Source** that has met the requirements for certification and is allowed to supply aggregate for Department/Local Agency projects.

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.

Non-Certified Source – A **Source** that does not initially meet certification requirements or has not applied for certification.

Source QC Plan – A QC Plan detailing how an **Outlying Source** will comply with the AGCS.

Standard Specifications – Current edition of the Illinois Department of Transportation Standard Specifications for Road and Bridge Construction.

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).

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.

5.1.2.1 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.

5.1.2.2 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.

5.1.4.1 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.

5.1.4.2 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.

5.1.4.3 The Aggregate Technician, Gradation Technician or Mixture Aggregate Technician, shall demonstrate gradation testing proficiency to the Aggregate Inspector on a quarterly basis.

5.1.4.4 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.

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

6.3 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.

6.4 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.

6.5 **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.

6.5.1 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.

6.5.2 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.

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

6.6 **Sampling and Testing**. Gradation samples shall be reduced to testing size by Illinois Modified AASHTO R 76. 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 Modified AASHTO R 90, Illinois Modified AASHTO R 76, Illinois Modified AASHTO T 11, and Illinois Modified AASHTO T 27. The Illinois Test Procedures noted above are located in the current Manual of Test Procedures for Materials.

6.6.1 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:

6.6.1.1 **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.

6.6.1.2 **Normal-Production Frequency**. During normal production, the minimum production sampling and testing frequency/requirements as noted in Table 1 shall be maintained.

6.6.1.3 **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.

6.6.1.4 **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.

6.7 **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.

6.7.1 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.

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

6.8 **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.

6.8.1 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.

6.8.2 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.

6.8.3 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.

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

6.8.5 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.

6.8.6 The Aggregate Technician or the AGCS Technician shall monitor the corrective action. Failure to comply with Section 6.8 herein shall cause the **Source** to be removed from the **QPL** as per Section 11.0 herein.

6.9 **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 Section 6.8 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 current 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.

8.1.1 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.

8.3.1 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.

8.4.1 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.

10.4.1 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**.

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

11.7 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**.

11.8 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 Erosion and Sediment Control Rip-Rap Bedding Ice Control Abrasives Trench Backfill	Department Testing				

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.

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 ($Si0_2$).

(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

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 µm) 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 µm) sieve requirements.

FINE AGGREGATE QUALITY			
QUALITY TEST	CLASS		
	A	B	C
Na_2SO_4 Soundness 5 Cycle, Illinois Modified AASHTO T 104, % Loss max.	10	15	20
Minus No. 200 (75 µm) 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.

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

Art. 1003.01 Fine Aggregates

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/	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 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

(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.

(b) Quality. The fine aggregate for portland cement concrete shall meet Class A Quality, except the minus No. 200 (75 µm) 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 (Na_2O + $0.658K_2O$) 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 (Na_2O + $0.658K_2O$) 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 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 Ndesign = 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, Ndesign = 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, Ndesign = 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.

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 µm) sieve shall be 2±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.

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 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

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 alumino-silicates 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.

(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_2SO_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 11/, % 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.

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.

Art. 1004.01 Coarse Aggregates

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		

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/ 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.

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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.

(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 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) in.	mm	Gradation Permitted
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 (Na_2O + $0.658K_2O$) 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

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.

Coarse Aggregates Art. 1004.03

<table>
<tr><th>Use</th><th>Mixture</th><th colspan="2">Aggregates Allowed</th></tr>
<tr><td>Class A</td><td>Seal or Cover</td><td colspan="2"><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</td></tr>
<tr><td>HMA
Low ESAL</td><td>Stabilized Subbase or Shoulders</td><td colspan="2"><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</td></tr>
<tr><td>HMA
High ESAL
Low ESAL</td><td>Binder
IL-19.0
or IL-19.0L

SMA Binder</td><td colspan="2"><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/]</td></tr>
<tr><td>HMA
High ESAL
Low ESAL</td><td>C Surface and Binder
IL-9.5
IL-9.5FG
or IL-9.5L

SMA
Ndesign 50 Surface</td><td colspan="2"><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/]</td></tr>
<tr><td rowspan="6">HMA
High ESAL</td><td rowspan="6">D Surface and Binder
IL-9.5
or IL-9.5FG

SMA
Ndesign 50
Surface</td><td colspan="2"><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/]</td></tr>
<tr><td colspan="2"><u>Other Combinations Allowed:</u></td></tr>
<tr><td>Up to...</td><td>With...</td></tr>
<tr><td>25% Limestone</td><td>Dolomite</td></tr>
<tr><td>50% Limestone</td><td>Any Mixture D aggregate other than Dolomite</td></tr>
<tr><td>75% Limestone</td><td>Crushed Slag (ACBF) or Crushed Sandstone</td></tr>
</table>

Art. 1004.03 Coarse Aggregates

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 Crushed Concrete[3/] No Limestone.	
		<u>Other Combinations Allowed:</u>	
		Up to...	*With...*
		50% Dolomite[2/]	Any Mixture E aggregate
		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
HMA High ESAL	F Surface IL-9.5 or IL-9.5FG SMA Ndesign 80 Surface	<u>Allowed Alone or in Combination</u> [5/]: Crystalline Crushed Stone Crushed Sandstone Crushed Slag (ACBF) Crushed Steel Slag No Limestone.	
		<u>Other Combinations Allowed</u>:	
		Up to...	*With...*
		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.

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 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.

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.

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.