Mixture Aggregate Technician Course

LAKE LAND COLLEGE

2015-2016

Illinois Department of Transportation
Bureau of Materials & Physical Research

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

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

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

MIXTURE AGGREGATE TECHNICIAN COURSE

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

Prerequisite Course:

None.

Written Test (Part 1) (Closed book test)
Time limit is 1 hour.
Minimum grade of 70 is required.

Calculation Test (Part 2) (Closed book test)
Time limit is 1 ½ hrs.
Minimum grade of 70 is required.

Practical Test (Part 3) (Closed book test)
No time limit is specified.
Minimum grade of pass is required.

Retest:

If the student fails the written test (Part 1), calculation test (Part 2), or practical test (Part 3), a retest can be performed. A retest must be taken by the end of the academic year that the initial test was taken. The academic year runs from September 1st to August 31st**. (For example, if the test was taken November 18, 2015, the last date to retest is August 31, 2016)** 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 Tech. Course** Section__________ Date_________________

Lead Instructors Name:_______________________ **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 Program

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

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

Philosophy of QC/QA:

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

Aggregates:

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

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

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

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

Effective July 1, 2000

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

Effective July 1, 2001

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

Hot Mix Asphalt

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

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

Portland Cement Concrete

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

Training

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

CET 020 Mixture Aggregate Technician (3 days)

CET 021 Aggregate Technician (5 days)

CET 027 Mixture Aggregate Technician Upgrade (2 days)

CET 029 Level I Hot Mix Asphalt (5 days)

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

CET 023 Level II Hot Mix Asphalt (5 days)

Prerequisite: CET 029 Level I Hot Mix Asphalt

CET 031 Level III Hot Mix Asphalt (5 days)

Prerequisite: CET 023 Level II Hot Mix Asphalt

CET 026 Half-Day Nuclear Density

CET 030 Level I Portland Cement Concrete

CET 024 Level II Portland Cement Concrete

CET 039 Level III Portland Cement Concrete

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

and CET 030 Level I Portland Cement Concrete

and CET 024 Level II Portland Cement Concrete

Concrete Tester Course

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

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

AGGREGATES	
Task	***Required Training Course***
Quality Control Manager	Aggregate Technician (CET 021 or CET 027)
Visual Inspections	Aggregate Technician (CET 021 or CET 027)
Aggregate Sampling	Aggregate Technician (CET 021) ***or*** Mixture Aggregate Technician (CET 020)
Splitting and Gradation Testing	Aggregate Technician (CET 021) ***or*** Mixture Aggregate Technician (CET 020) ***or*** Gradation Technician (IDOT) *note 1*
ASPHALT	
Quality Control Manager	Bituminous Concrete Level II (CET 023)
Aggregate Sampling and Gradation Testing	Bituminous Concrete Level I (CET 029) *notes 1 & 3*
HMA Sampling and Testing	Bituminous Concrete Level I (CET 029)
HMA Mix Design	Bituminous Concrete 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.

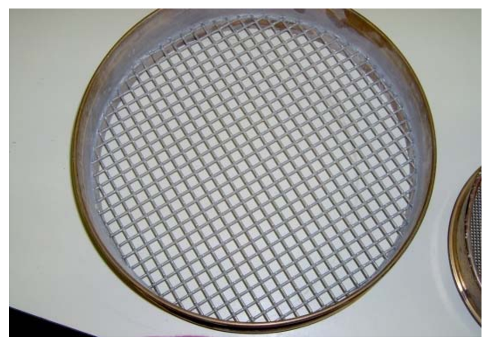
Note 2 A Concrete Tester must be supervised by a PCC Level I.

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

Metrification

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

Sieve Designations



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

SIEVE CONVERSIONS

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 Coarse Aggregate

#4----------------------------4.75mm

#8----------------------------2.36mm Fine Aggregate

#10-------------------------- 2.00mm

#16-------------------------- 1.18mm

#30--------------------------600µm (microns)

#40----------------------------425µm

#50----------------------------300µm

#80----------------------------180µm

#100---------------------------150µm Fine Aggregate

#200----------------------------75µm

Dust

Gradation:

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

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

These terms are used in conjunction with numerical codes which indicate specific gradations and uses of material as shown in the following example. The following information is obtained in part from the Standard Specifications for Road and Bridge Construction, adopted on January 1, 2012.

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**

0	3	2	C	M	16
Aggregate	**'B' Quality**	**Crushed Stone**	**Coarse Aggregate**	**Modified Specification**	**Gradation**

A modified 'B' quality crushed stone coarse aggregate 16 gradation

Class Example:

<u>Pages 7 & 8 are excerpts from the 2016 Standard Specifications for Road and Bridge Construction, Adopted April 1, 2016:</u>

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

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 8, 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.

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

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

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

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

Gradation of Standard Specifications versus AGCS gradations

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

The following are excerpts from the AGCS Policy Memorandum:

Gradation Specifications

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

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

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

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

Development of Gradation Bands on Incoming Aggregate at Mix Plants

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

Master Band/Warning Band and Critical Sieve Designations

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 (page 1).

AGGREGATE GRADATION CONTROL SYSTEM

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

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

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

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

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

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

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

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

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4.0 STOCKPILING AND HANDLING

Stockpiling
&
Handling

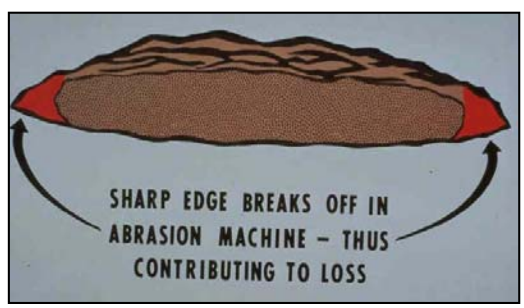
Stockpiling and handling are two of the most important aspects in the aggregate production process. Material being produced to a uniform in-specification gradation can become out-of-specification material through poor stockpiling and handling. Several factors affecting aggregate gradation in this manner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

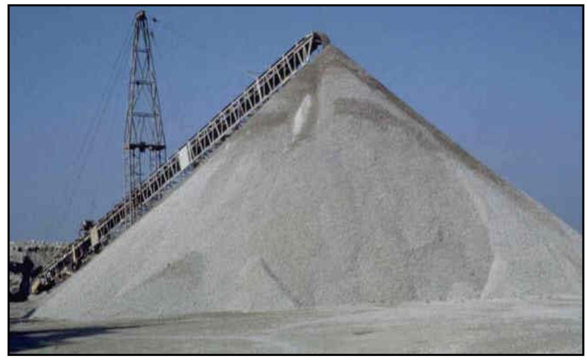
The following discussion will cover the types of stockpiling/handling, the effect of segregation and degradation on each type, and the methods normally used to eliminate or reduce their effects.



All stockpiling and handling for the Aggregate Gradation Control System shall conform to Section 40.2 of the *Manual for Aggregate Inspection* (see Appendix A, page A-3 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

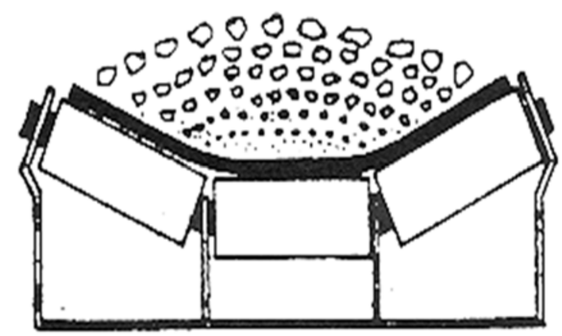


Cone Stockpile

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.

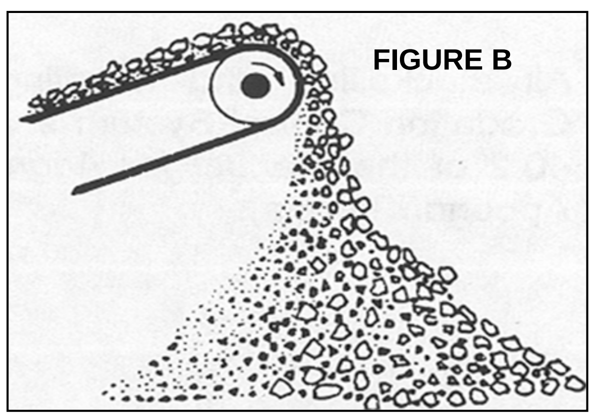


FIGURE B

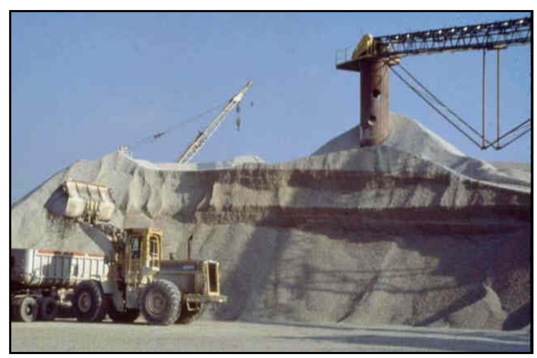
An adjustable radial stacker or an adjustable telescopic portable radial stacker can be used to build elongated tent-shaped piles. The adjustable radial stacker moves horizontally as well as vertically. The telescopic radial stacker not only moves horizonally and vertically, but also moves telescopically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

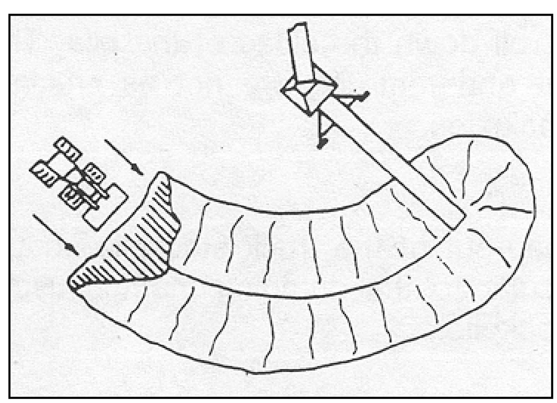
Telescopic Portable Radial Stacker

It should be pointed out that the fall distance from the conveyor/stacker to stockpile cannot be greater than 15 feet for IDOT Class A, B, or C Quality aggregate, unless a change is approved by the Bureau of Materials and Physical Research, as specified in Section 40.2 of the Department's *Manual for Aggregate Inspection* (See Appendix A, page A-3 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.



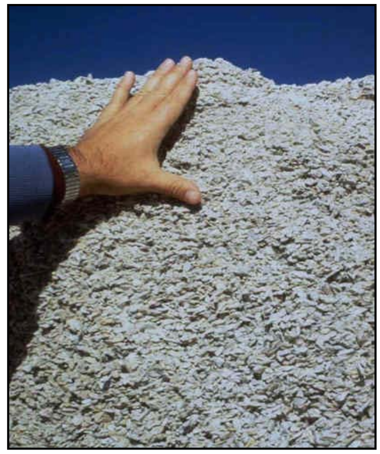
4.1.2 Degradation in cone/elongated cone stockpiles normally does not become a major problem. The main abrading action, which is minimum, is in the load-out of the stockpile.

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.

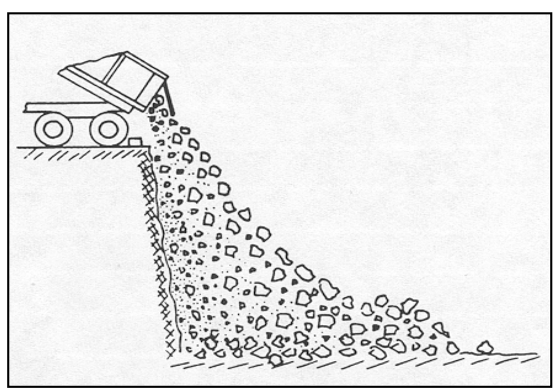


4.2.2 Degradation does become a factor when building a multilayered truck stockpile. The movement of trucks on the layered material can cause sufficient abrading and attrition of the aggregate particles to produce an unacceptable amount of minus minus No. 200 (75 µm) fines.

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 Illinois Test Procedure 2. **No other sampling procedures will be allowed**. Both production and stockpile sampling methods will be covered in this chapter.

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

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

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

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

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

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

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

On-Belt Sampling

Step 1

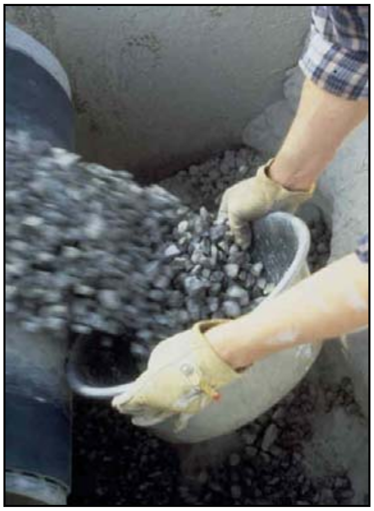
Step 2

Step 3

Step 4

Belt-Stream Sampling

Step 1



Step 2

Step 3

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

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

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

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

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

This sampling method requires taking a field sample from one or two truck dumps which are placed during the building of a stockpile or feeding of a plant. The truck dump(s) shall be cut with an endloader and two or more 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 parallel to the direction of flow used to build the stockpile. Stockpiles having not 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.

<u>Stockpile Sampling Procedure</u>

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

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

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

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

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

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

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

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

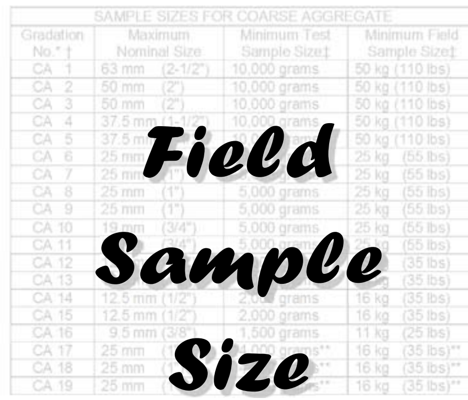
****Shelby tubes are not allowed as sampling devices.**

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 February 1, 2014. A copy of the Aggregate Sample Size Table is located on page 6-18 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 (ITP-248)

Drying of the sample (ITP 255)

Wash test (ITP-11)

Dry sieve analysis (ITP-27)

Calculation / Reporting

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

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

The necessary laboratory equipment to run a gradation or aggregate moisture content is noted in Section 7.0 of the Department Policy Memorandum, “Aggregate Gradation Control System”. 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 an annual basis thereafter.

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

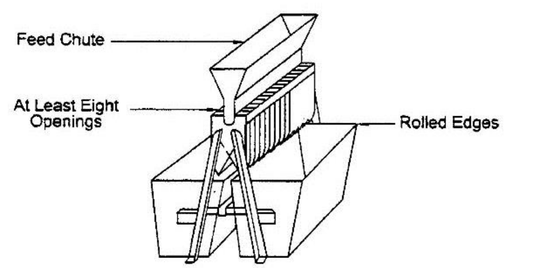
Reduction of field samples shall conform to Illinois Test Procedure 248 (see Appendix B, herein). Selection during splitting of an exact predetermined mass for the sample is not permitted.

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

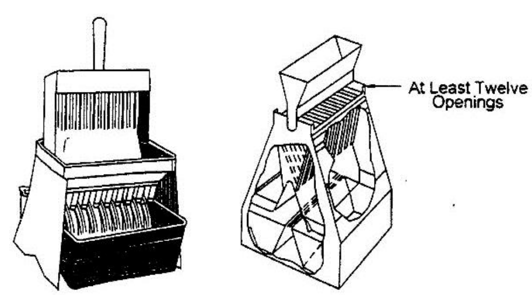
6.1.1 Method 'A' - Mechanical Splitters - As stated in the specification, the mechanical splitter shall have an even number of same-width chutes, directed alternately to different sides. There shall be a minimum of eight chutes for coarse aggregate and twelve chutes for fine aggregate. All chutes shall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

Mechanical Splitters
Hopper Style

Mechanical Splitters
Straightedge Pan Style



Riffle Sample Splitter
(a) Large Sample Splitter for Coarse Aggregate



(b) Small Sample Splitters for Fine Aggregate

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

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

On the <u>final</u> 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 <u>final</u> split calculation:

Weight of 1st half is 5325 g
Weight of 2nd half is 5609 g

(Smaller split) _______ g x 10% = _________ g

(Add to smaller split) _______g + _________g = _________g

The mass of the larger split half (5609 g) cannot be larger than the calculated mass in order to be a valid split.

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

Mechanical Splitting

STEP 1

STEP 2

STEP 3

STEP 4

STEP 5

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

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

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

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

Quartering

Step 1

Step 2

Step 3

Step 4

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

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

6.2 Drying of Test Sample – The test sample shall be dried back to constant weight in conformance to the Illinois Test Procedure 255 utilizing an oven, specifically designed for drying, set at and capable of maintaining a uniform temperature of 230 +/- 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 one hour". This shall be verified occasionally.

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

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

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

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

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

Manual Wash Method

Mechanical Wash Method

After completing the washing, the test sample is dried back to constant weight and its weight determined. This weight is recorded as the Total Wash Weight to the nearest 1 gram for coarse aggregate and the nearest 0.1 gram for fine aggregate.

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

Wash Test

STEP 1

STEP 2

STEP 3

STEP 4

STEP 5

STEP 6

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

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

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

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

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

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

After hand-shaking, any retained material shall be removed from the sieve. Particles shall not be forced through the sieves. The sieve shall be inverted and lightly tapped on the sides to facilitate removal for weighing. A dowel rod or putty knife may be used to gently remove wedged particles from all sieves down through and including the No. 10 (2.00mm). A soft brass-wired brush shall be used on the No. 16 (1.18mm) through the No. 40 (425 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. (See page 6-21 herein.) Individual source forms may be used if approved by the District Materials Engineer. The procedure for test calculation and reporting is as follows:

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

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

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

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

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 TDM

where TDM = Total Dry Mass (weight)

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

$$\textbf{Cumulative \% Retained} = \frac{\textbf{CMR}}{\textbf{TDM}} \textbf{ X 100}$$

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 Illinois Test Procedure 248 and shall meet the minimum sample size requirements of Illinois Specification 201, Aggregate Gradation Sample Size Table and Quality Control Sieves, effective February 1, 2014 (See Appendix A, herein).

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

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

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

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

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

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

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

Where P = Aggregate Moisture Content (%),

OSM = Original Sample Mass (weight), g,

and TDM = Dried Sample Mass (weight), g

Test results shall be rounded to the nearest 0.1%.

Example:

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

OSM = 3,200 g
TDM = 3,095 g

$$P = \frac{(3{,}200-3{,}095)}{3{,}095} \times 100$$

P = ____________

Illinois Specification 201

Illinois Department of Transportation (IDOT)

AGGREGATE GRADATION SAMPLE SIZE TABLE & QUALITY CONTROL SIEVES

Effective: February 1, 2014

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: February 1, 2014

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}

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 & II 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: February 1, 2014

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	20,000 g	X	X	X	XC	X		XC	XC	X
CS02	15,000 g		X	X	XC	X		XC	XC	X
RR01	10,000 g				X	XC	X	XC	XC	X
RR02	10,000 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 by be used for the gradation
6 = Test sample size shall be taken in the field. No splitting is required.

Illinois Department of Transportation

Field / Lab Gradations

I.D. Number(1) ____

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

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

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

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

(23)

CA FA	75 (3) or 6.3 (1/4)	63 (2.5)	50 (2) 25 (1)	45 (1.75) 9.5 (3/8)	37.5 (1.5) 4.75 (4)	25 (1) 2.36 (8)	19 (3/4) 2 (10)	16 (5/8) 1.18 (16)	12.5 (1/2) 0.6 (30)	9.5 (3/8) 0.425 (40)	4.75 (4) 0.3 (50)	2.36 (8)	1.18 (16) 0.18 (80)	0.6 (30)	0.3 (50) 0.15 (100)	0.15 (100)	.075 (200) .075 (200)

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

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

Max Gain/Loss= ____

% Washed - #200(36) ____

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

$\frac{0.075}{(37)0.425}$ ____

(Mix Plant Only)

Lot(38) ____
Bin(39) ____

Copies(40): ____ Tester(41) ____

____ Agency(42) ____

MISTIC INPUT
Date Entered(43) ____
Initials(44) ____

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BMPR MI504 (Rev. 11/20/12)

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Field / Lab Gradations

I.D. Number(1) ________

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

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

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

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

(23)

CA FA	75 (3) or 6.3 (1/4)	63 (2.5)	50 (2) 25 (1)	45 (1.75) 9.5 (3/8)	37.5 (1.5) 4.75 (4)	25 (1) 2.36 (8)	19 (3/4) 2 (10)	16 (5/8) 1.18 (16)	12.5 (1/2) 0.6 (30)	9.5 (3/8) 0.425 (40)	4.75 (4) 0.3 (50)	2.36 (8)	1.18 (16) 0.18 (80)	0.6 (30)	0.3 (50) 0.15 (100)	0.15 (100)	.075 (200) .075 (200)

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

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

Max Gain/Loss= ________

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

0.075 / (37)0.425 ________

(Mix Plant Only)
Lot(38) ________
Bin(39) ________

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

MISTIC INPUT
Date Entered(43) ________
Initials(44) ________

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Field / Lab Gradations

I.D. Number(1) (1)

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

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

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

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

(23)

CA FA	75 (3) or 6.3 (1/4)	63 (2.5)	50 (2) 25 (1)	45 (1.75) 9.5 (3/8)	37.5 (1.5) 4.75 (4)	25 (1) 2.36 (8)	19 (3/4) 2 (10)	16 (5/8) 1.18 (16)	12.5 (1/2) 0.6 (30)	9.5 (3/8) 0.425 (40)	4.75 (4) 0.3 (50)	2.36 (8)	1.18 (16) 0.18 (80)	0.6 (30)	0.3 (50) 0.15 (100)	0.15 (100)	.075 (200) .075 (200)
	(23)																

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

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

Max Gain/Loss= ______

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

0.075 / (37)0.425 ______

(Mix Plant Only)

Lot(38) ______
Bin(39) ______

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

Agency(42) (42)

MISTIC INPUT
Date Entered(43) (43)
Initials(44) (44)

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BMPR MI504 (Rev. 11/20/12)

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FIELD/LAB GRADATIONS

MI 504M

(Revised 11/20/12)

1. **I.D. NUMBER:** MISTIC test identification number. Leave blank, because the MISTIC system will generate the test identification number.

2. **INSPECTOR NO.:** Identify the individual who took the sample. For split samples, the same inspector number should be used for both halves of the sample**.**

   a) IDOT personnel should enter their MISTIC inspector number.

   b) Contractor, Subcontractor, Producer, should use a "9", the District number, and seven zeroes (0's).
   Example: (960000000) for District 6.

   c) Consultant personnel enter their company's MISTIC inspector number.

   d) Local agency personnel are to enter a "9"; followed by the District number, which is repeated until field is filled.
   Example: (966666666) for District 6 local agency.

3. **INSPECTOR NAME:** Enter the name of the inspector who took the sample.

4. **DATE SAMPLED:** Enter the date the sample was taken as month, day, and year in mmddyy format. Example: (103112)

5. **SEQ. NO.:** Sequence number. May be any combination of letters and/or numbers up to 6 characters in length. It is used to differentiate multiple samples of the same gradation, taken on the same day. For a split sample, both halves of the split shall have "**SPLIT**" in this field.

6. **MIX PLANT NO.:** The MISTIC code number for the P.C. Concrete or Hot Mix Asphalt Producer. Only one plant may be shown on one report.

7. **MIX PLANT NAME:** Name of mix plant.

8. **CONTRACT NO.:** Leave blank unless the gradation has been sampled at a jobsite for a specific contract. Enter the 5 digit contract number. If it is a local agency contract without a 5 digit number, then enter the 16 or 17 character MFT (Motor Fuel Tax) contract number.

9. **JOB NO.:** Leave blank unless gradation sampled at the jobsite for a specific contract. Enter the 8 character number that corresponds with the 5 digit contract number. If the contract number is not 5 digits, leave this field blank.

10. **RESPONSIBLE LOC.:** Enter the District identification number as a "9" followed by the District number. Example: 96 for District 6

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

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. LAB NAME: Enter the name of the company which cannot exceed 20 characters.

13. SOURCE NAME: Enter the name of the aggregate producer.

14. SOURCE: Enter the MISTIC code number of the aggregate producer.
Example: 50912-02

15. MAT. CODE NO.: Material code for the aggregate product. Enter the 8 to 10 character code number of the material being tested.

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

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

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

QUALITY LEVEL	**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. ARTICLE: Leave blank. IDOT aggregate personnel should enter the warning band ranges under a "PRE" test at the beginning of each production season. Example: WB2234

21. SAMPLED FROM: Enter the 2 character designation in the first two spaces. Refer to "Sampled From Codes" box, which is on the form.

22. WASH/DRY: Enter if the test was a "W" for a washed gradation, or "D" for a dry gradation.

23. GRADATION RESULTS INPUT TABLE: Enter the percent passing test results, "percent % passing", from the calculation table for all sieves. All test results shall be reported to the nearest 1%, except for the 0.075 mm (or 75µm)(-#200) sieve, which shall be reported to the nearest 0.1%.

24. WASH - 0.075 (-#200): Enter the washed minus .075 mm (#200) value from the calculation table to the nearest 0.1%.

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

26. TEST RESULTS: Enter "APPR" for results meeting specifications or "FAIL" for failure to meet specifications. Show under "Remarks" action taken for samples not meeting specifications. For example, retest, checked equipment, test method incorrect, will monitor.

27. REMARKS: This space should be used to record any comments about the aggregates, or the stockpiling and handling methods used.

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

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

For an unacceptable comparison, enter the following:

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

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

28. <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).

29. <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.

30. <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.

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

32. <u>SPEC. RANGE % PASSING:</u> Enter the specification range for all appropriate sieves. These may be Standard Specifications, or modified Standard Specification, or master band limits.

33. <u>TOTAL DRY MASS:</u> Enter the weight of the sample after it has been dried to a constant weight. Weigh coarse aggregate to the nearest 1 gram, and fine aggregate to the nearest 0.1 gram.

34. <u>TOTAL WASHED MASS:</u> Enter the weight of the sample after it has been washed, and dried back to a constant weight. Weigh coarse aggregate to the nearest 1 gram, and fine aggregate to the nearest 0.1 gram.

35. <u>DIFF. -0.075 (-200):</u> Subtract total washed weight from the total dry weight, and enter that value.

36. <u>% WASHED -0.075:</u> Divide the “Diff. - 0.075” by the “Total Dry Wt.” and multiply by 100. Round to the nearest 0.1%, and enter that value.

37. <u>0.075 / 4.25:</u> Leave blank. IDOT personnel, when appropriate, enter the ratio of the percent passing the .075 mm (#200) sieve and the .425 mm (#40) sieve.

38. <u>LOT:</u> Leave blank. IDOT mix plant personnel use if performing individual hot bin “IND” tests. Enter the lot corresponding to the Daily Plant Output (MI 305). Also, enter this in the remarks.

39. **BIN:** Leave blank. IDOT mix plant personnel use if performing individual hot bin “IND” tests. Enter the appropriate hot bin number. Also, enter this in remarks.

40. **COPIES:** Enter the distribution of this report. The normal distribution for mix plant results is the **original** goes to the District Engineer, a copy goes to the Resident Engineer(s), and a copy goes to the QC Manager(s). The distribution for aggregate source tests is the original goes to the District Engineer and a copy goes to the source’s QC manager. Non-QC/QA – Same as above, except that the file copy stays with the tester or the individual who completed the report.

41. **TESTER:** Print the name of the individual who tested the aggregate. The individual’s signature is also required. If the test is run by a Gradation Technician, then the supervisor should sign here also.

42. **AGENCY:** Enter the tester’s employer.

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

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

CHAPTER 6 – HOMEWORK

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

Problem No. 1

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

Problem No. 2

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

Problem No. 3

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

OVER – (HOMEWORK CONTINUED)

CHAPTER 6 – HOMEWORK (Cont'd)

Problem No. 4

- Calculate the percent passing
- Show all weights and percents calculated.
- Report Percent % Passing on the Report line.
- Calculate the % Washed -200.
- Calculate Max Loss.
- Use given information below and complete as much of the form as possible. (Directions for filling out the form are located in Chapter 6 on pages 6-23 thru 6-31.)

GIVEN: **Matt Sparks is the Quality Control Manager for Miller Construction Company (923-02). Matt took a sample of 032CM16 from a stockpile located at Miller Construction's asphalt plant site on August 10, 2015. Josie Peters, a Mixture Aggregate Technician, who also works for Miller Construction, ran a washed gradation (Seq. No. 003) on this material the same day. The testing took place on site in the Miller Construction's laboratory. The stone came from Cleary Materials. (50612-01). Miller Construction's plant and laboratory is located in District 5.**

Problem No. 5

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

Problem 6 - Sample Comparison Problem

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

Illinois Department of Transportation

HOMEWORK - PROBLEM 1

Field / Lab Gradations

I.D. Number ______

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

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

Responsible Loc. ______ Lab. ______ Lab Name ______ Source Name ______

Source	Mat. Code #	Type Insp.	Orig I.D. #	Insp. Qty.	Spec.	Article	Sampled From	Wash/Dry
	042CM11							D

CA FA	75 (3) or 6.3 (1/4)	63 (2.5)	50 (2) 25 (1)	45 (1.75) 9.5 (3/8)	37.5 (1.5) 4.75 (4)	25 (1) 2.36 (8)	19 (3/4) 2 (10)	16 (5/8) 1.18 (16)	12.5 (1/2) 0.6 (30)	9.5 (3/8) 0.425 (40)	4.75 (4) 0.3 (50)	2.36 (8)	1.18 (16) 0.18 (80)	0.6 (30)	0.3 (50) 0.15 (100)	0.15 (100)	.075 (200) .075 (200)

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

Sieve CA	Sieve FA	Indiv. Wt. Retained	Cumul. Wt. Retained	Cumul. % Retained	Percent % Passing	Spec. Range % Passing
63 (2.5)						
50 (2)	25 (1)					
45 (1.75)	9.5 (3/8)					
37.5 (1.5)	4.75 (#4)					
25 (1)	2.36 (#8)	**0**				
19 (3/4)	2 (#10)	**565**				
16 (5/8)	1.18 (#16)	**762**				
12.5 (1/2)	0.6 (#30)	**1448**				
9.5 (3/8)	0.425 (#40)	**1146**				
6.3 (1/4)		**525**				
4.75 (#4)	0.3 (#50)	**318**				
2.36 (#8)						
1.18 (#16)	0.18 (#80)	**195**				
0.6 (#30)						
0.425 (#40)						
0.3 (#50)	0.15 (#100)					
0.15 (#100)						
0.075 (#200)	0.075 (#200)	**68**				
Pan		**8**				
Total Dry Mass		**5034**				
Total Washed Mass						
Diff. -0.075(- #200)						

Max Gain/Loss = ______

% Washed - #200 ______

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

0.075 / 0.425 ______

(Mix Plant Only)
Lot ______
Bin ______

Copies: ______ Tester ______
______
______ Agency ______

MISTIC INPUT
Date Entered ______
Initials ______

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

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Illinois Department of Transportation

HOMEWORK - PROBLEM 2

Field / Lab Gradations

I.D. Number ______

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

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

Responsible Loc. ______ Lab. ______ Lab Name ______ Source Name ______

Source	Mat. Code #	Type Insp.	Orig I.D. #	Insp. Qty.	Spec.	Article	Sampled From	Wash/Dry
	038FM20							**W**

CA FA	75 (3) or 6.3 (1/4)	63 (2.5)	50 (2) 25 (1)	45 (1.75) 9.5 (3/8)	37.5 (1.5) 4.75 (4)	25 (1) 2.36 (8)	19 (3/4) 2 (10)	16 (5/8) 1.18 (16)	12.5 (1/2) 0.6 (30)	9.5 (3/8) 0.425 (40)	4.75 (4) 0.3 (50)	2.36 (8)	1.18 (16) 0.18 (80)	0.6 (30)	0.3 (50) 0.15 (100)	0.15 (100)	.075 (200) .075 (200)

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

Sieve CA	Sieve FA	Indiv. Wt. Retained	Cumul. Wt. Retained	Cumul. % Retained	Percent % Passing	Spec. Range % Passing
63 (2.5)						
50 (2)	25 (1)					
45 (1.75)	9.5 (3/8)	**0.0**				
37.5 (1.5)	4.75 (#4)	**5.6**				
25 (1)	2.36 (#8)	**248.2**				
19 (3/4)	2 (#10)					
16 (5/8)	1.18 (#16)	**358.6**				
12.5 (1/2)	0.6 (#30)	**231.3**				
9.5 (3/8)	0.425 (#40)					
6.3 (1/4)						
4.75 (#4)	0.3 (#50)	**141.8**				
2.36 (#8)						
1.18 (#16)	0.18 (#80)					
0.6 (#30)						
0.425 (#40)						
0.3 (#50)	0.15 (#100)	**81.3**				
0.15 (#100)						
0.075 (#200)	0.075 (#200)	**35.4**				
Pan		**2.3**				
Total Dry Mass		**1144.9**				
Total Washed Mass		**1097.5**				
/Diff. -0.075(- #200)						

Max Gain/Loss = ______

% Washed - #200 ______

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

0.075 / 0.425 ______

(Mix Plant Only)
Lot ______
Bin ______

Copies: ______ Tester ______
______
______ Agency ______

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Date Entered ______
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MI 504M (Rev. 11/20/12)

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HOMEWORK - PROBLEM 3

Field / Lab Gradations

I.D. Number ____

Inspector No. ____ Inspector Name ____ Date Sampled ____ Seq. No. ____

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

Responsible Loc. ____ Lab. ____ Lab Name ____ Source Name ____

Source	Mat. Code #	Type Insp.	Orig I.D. #	Insp. Qty.	Spec.	Article	Sampled From	Wash/Dry
	038FM20							W

CA / FA	75 (3) or 6.3 (1/4)	63 (2.5)	50 (2) / 25 (1)	45 (1.75) / 9.5 (3/8)	37.5 (1.5) / 4.75 (4)	25 (1) / 2.36 (8)	19 (3/4) / 2 (10)	16 (5/8) / 1.18 (16)	12.5 (1/2) / 0.6 (30)	9.5 (3/8) / 0.425 (40)	4.75 (4) / 0.3 (50)	2.36 (8)	1.18 (16) / 0.18 (80)	0.6 (30)	0.3 (50) / 0.15 (100)	0.15 (100)	.075 (200) / .075 (200)

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

Sieve CA	Sieve FA	Indiv. Wt. Retained	Cumul. Wt. Retained	Cumul. % Retained	Percent % Passing	Spec. Range % Passing
63 (2.5)						
50 (2)	25 (1)					
45 (1.75)	9.5 (3/8)	**0.0**				
37.5 (1.5)	4.75 (#4)	**4.4**				
25 (1)	2.36 (#8)	**179.9**				
19 (3/4)	2 (#10)					
16 (5/8)	1.18 (#16)	**287.3**				
12.5 (1/2)	0.6 (#30)	**188.2**				
9.5 (3/8)	0.425 (#40)					
6.3 (1/4)						
4.75 (#4)	0.3 (#50)	**116.8**				
2.36 (#8)						
1.18 (#16)	0.18 (#80)					
0.6 (#30)						
0.425 (#40)						
0.3 (#50)	0.15 (#100)	**67.4**				
0.15 (#100)						
0.075 (#200)	0.075 (#200)	**28.5**				
Pan		**1.9**				
Total Dry Mass		**911.2**				
Total Washed Mass		**871.9**				
Diff. -0.075(- #200)			% Washed - #200			

Max Gain/Loss = ____

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

0.075 / 0.425 ____

(Mix Plant Only)
Lot ____
Bin ____

Copies: ____ Tester ____
____ Agency ____

MISTIC INPUT
Date Entered ____
Initials ____

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HOMEWORK - PROBLEM 4

Field / Lab Gradations

I.D. Number ______

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

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

Responsible Loc. ______ Lab. ______ Lab Name ______ Source Name ______

Source	Mat. Code #	Type Insp.	Orig I.D. #	Insp. Qty.	Spec.	Article	Sampled From	Wash/Dry
	032CM16							W

CA / FA	75 (3) or / 6.3 (1/4)	63 (2.5)	50 (2) / 25 (1)	45 (1.75) / 9.5 (3/8)	37.5 (1.5) / 4.75 (4)	25 (1) / 2.36 (8)	19 (3/4) / 2 (10)	16 (5/8) / 1.18 (16)	12.5 (1/2) / 0.6 (30)	9.5 (3/8) / 0.425 (40)	4.75 (4) / 0.3 (50)	2.36 (8)	1.18 (16) / 0.18 (80)	0.6 (30)	0.3 (50) / 0.15 (100)	0.15 (100)	.075 (200) / .075 (200)

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

Sieve CA	Sieve FA	Indiv. Wt. Retained	Cumul. Wt. Retained	Cumul. % Retained	Percent % Passing	Spec. Range % Passing
63 (2.5)						
50 (2)	25 (1)					
45 (1.75)	9.5 (3/8)					
37.5 (1.5)	4.75 (#4)					
25 (1)	2.36 (#8)					
19 (3/4)	2 (#10)					
16 (5/8)	1.18 (#16)					
12.5 (1/2)	0.6 (#30)	**0**				
9.5 (3/8)	0.425 (#40)	**72**				
6.3 (1/4)		**427**				
4.75 (#4)	0.3 (#50)	**789**				
2.36 (#8)		**578**				
1.18 (#16)	0.18 (#80)	**47**				
0.6 (#30)						
0.425 (#40)						
0.3 (#50)	0.15 (#100)					
0.15 (#100)						
0.075 (#200)	0.075 (#200)	**34**				
Pan		**2**				
Total Dry Mass		**2015**				
Total Washed Mass		**1952**				
Diff. -0.075(- #200)						

Max Gain/Loss = ______

% Washed - #200 ______

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

0.075 / 0.425 ______

(Mix Plant Only)
Lot ______
Bin ______

Copies: ______ Tester ______
______
______ Agency ______

MISTIC INPUT
Date Entered ______
Initials ______

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

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Illinois Department of Transportation

HOMEWORK - PROBLEM 5

Field / Lab Gradations

I.D. Number ______

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

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

Responsible Loc. ______ Lab. ______ Lab Name ______ Source Name ______

Source	Mat. Code #	Type Insp.	Orig I.D. #	Insp. Qty.	Spec.	Article	Sampled From	Wash/Dry
	032CM16							W

CA / FA	75 (3) or / 6.3 (1/4)	63 (2.5)	50 (2) / 25 (1)	45 (1.75) / 9.5 (3/8)	37.5 (1.5) / 4.75 (4)	25 (1) / 2.36 (8)	19 (3/4) / 2 (10)	16 (5/8) / 1.18 (16)	12.5 (1/2) / 0.6 (30)	9.5 (3/8) / 0.425 (40)	4.75 (4) / 0.3 (50)	2.36 (8)	1.18 (16) / 0.18 (80)	0.6 (30)	0.3 (50) / 0.15 (100)	0.15 (100)	.075 (200) / .075 (200)

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

Sieve CA	Sieve FA	Indiv. Wt. Retained	Cumul. Wt. Retained	Cumul. % Retained	Percent % Passing	Spec. Range % Passing
63 (2.5)						
50 (2)	25 (1)					
45 (1.75)	9.5 (3/8)					
37.5 (1.5)	4.75 (#4)					
25 (1)	2.36 (#8)					
19 (3/4)	2 (#10)					
16 (5/8)	1.18 (#16)					
12.5 (1/2)	0.6 (#30)	**0**				
9.5 (3/8)	0.425 (#40)	**89**				
6.3 (1/4)		**460**				
4.75 (#4)	0.3 (#50)	**920**				
2.36 (#8)		**737**				
1.18 (#16)	0.18 (#80)	**80**				
0.6 (#30)						
0.425 (#40)						
0.3 (#50)	0.15 (#100)					
0.15 (#100)						
0.075 (#200)	0.075 (#200)	**36**				
Pan		**2**				
Total Dry Mass		**2380**				
Total Washed Mass		**2323**				
Diff. -0.075(- #200)			% Washed - #200			

Max Gain/Loss = ______

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

$\frac{0.075}{0.425}$ ______

(Mix Plant Only)

Lot ______
Bin ______

Copies: ______ Tester ______
______
______ Agency ______

MISTIC INPUT
Date Entered ______
Initials ______

/FOR DTY03504
MI 504M (Rev. 11/20/12)

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HOMEWORK PROBLEM 6

SAMPLE COMPARISON DATA

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

032CM16	1/2" (12.5 mm)	3/8" (9.5 mm)	1/4" (6.3 mm)	#4 (4.75 mm)	#8 (2.36 mm)	#16 (1.18 mm)	#200 (75 µm)
Monitor, % Passing	100	97	73	33	10	5	2.0
Producer, % Passing							

Comparison Data

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

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APPENDIX A – TABLE OF CONTENTS

PAGE

MTP = Manual of Test Procedures for Materials
IDOT = Illinois Department of Transportation
BMPR = Bureau of Materials and Physical Research

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Illinois Department of Transportation

Stockpiling and Handling of Aggregate
(Section 40.2, *Manual for Aggregate Inspection*)
Appendix A4

Effective Date: March 4, 1980
Revised: November 25, 1996

40.2 **Classes A, B, and C Quality Coarse Aggregate and Manufactured Sand**
Degradation is of primary concern in handling Classes A, B, and C Quality coarse aggregates (and manufactured sand). Steel-tracked equipment shall not be permitted on stockpiles of Classes A, B, and C Quality (Class I binder and seal/cover coat) aggregate (and manufactured sand). 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 a special remixing procedure or device approved by the Bureau of Materials and Physical Research. A comparison of a series of samples taken during the reclaiming or loading-out operation to those taken from the production belt should be made to estimate the effect of the aggregate-handling method on degradation.

Stockpiling and handling methods of Classes A Quality, B Quality, and C Quality (Class I binder and seal/cover coat) aggregate should be designed to hold segregation to a minimum. Coned stockpiles built with stationary or movable conveyor equipment shall not be permitted unless the reclaiming method is such that the loaded-out material will meet the requirements of Article 30.3(b)1. 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 endloader 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 should be checked for consistency of gradation. Consistency of the gradation should be checked according to the procedures and requirements described in Article 30.3(b) for checking uninspected stockpiles during loading-out procedures. 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 loading-out point, meets the gradation requirements described in Article 30.3(b)1.

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State of Illinois
Department of Transportation
Bureau of Materials and Physical Research

POLICY MEMORANDUM

Revised: July 1, 2015	6-08.2
This Policy Memorandum supersedes number 6-08.1 dated June 6, 2014	

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 DEFINITIONS

AASHTO R 18 - The American Association of State Highway and Transportation Officials (AASHTO) Standard for "Establishing and Implementing a Quality System for Construction Materials Laboratories." The principles of AASHTO R 18 are used by the Bureau of Materials and Physical Research (BMPR) to administer the qualified laboratory program for **District** and **Private Laboratories**.

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

BMPR LABORATORY - The Department's central laboratory maintained and operated by the Bureau of Materials and Physical Research (BMPR). The BMPR Laboratory administers the qualified laboratory program for **District** and **Private Laboratories**.

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

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.

HMA MIX DESIGN LABORATORY – Any **Private Laboratory** that has a **Department** approved HMA mix design lab. Consultants that are prequalified with the **Department** for HMA Mix Design must be capable of performing the tests listed in Table 1 under HMA Design.

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

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

QUALIFIED LABORATORIES – Laboratories that are inspected and approved by the **Department**. FHWA's Construction 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 (HMA) or Portland cement concrete (PCC) testing is successful completion of the prescribed **Department** Quality Control/Quality Assurance (QC/QA) Trained Technician 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 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 Table 2.

QUALITY ASSURANCE LABORATORY - Any laboratory used for Quality Assurance (QA) testing (**Department** tests) required by the **Department**. Required tests for quality assurance laboratories are listed in Table 2.

QUALITY CONTROL LABORATORY - Any laboratory used for Quality Control (QC) testing (**Contractor** or **Producer** tests) required by the **Department**. Required tests for quality control laboratories are listed in Table 1.

QUALITY CONTROL (QC) MANAGER – An employee (or **Consultant**) of a **Contractor** or **Producer** who is responsible for compliance with the QC/QA requirements in a **Department** contract or policy.

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 (QC) testing requirements and the specified equipment.

2.0 SCOPE

This policy governs the minimum qualifications for materials **Quality Control** and **Quality Assurance Laboratories** operated by **Contractors**, **Producers** and **Consultants**. It applies to aggregate, hot-mix asphalt (HMA) and Portland cement concrete (PCC) testing laboratories.

3.0 PURPOSE

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

4.0 AUTHORITY

Federal regulations (23 CFR Part 637) require the **Department** to establish a program for "qualifying" construction laboratories involved in tests which are used for acceptance. Under the **Department's** QC/QA specifications, **Contractor**/**Producer** test results are used in the acceptance process.

5.0 REFERENCE DOCUMENTS

- IDOT *Standard Specifications for Road and Bridge Construction.*
- IDOT *Manual of Test Procedures for Materials.*
- IDOT QC/QA Specifications for Hot-Mix Asphalt and Portland Cement Concrete.
- AASHTO, ASTM, and IDOT Test Procedures.
- Code of Federal Regulations (23 CFR Part 637).
- **Department** Policy MAT-15, "Quality Assurance Procedures for Construction."

6.0 PRIVATE LABORATORY REQUIREMENTS

6.1 Personnel Qualifications/Responsibilities

6.1.1 All testing for **Department** contracts shall be performed by **Qualified Personnel** as specified in the contract.

6.1.2 The **Department** will maintain a computer database of **Qualified Personnel** who have successfully passed the appropriate QC/QA classes.

6.2 Facilities and Equipment

6.2.1 The **Department** shall approve all **Private Laboratories** used on **Department** projects.

6.2.2 Each **Private Laboratory** shall maintain the equipment and facilities necessary to perform the tests as appropriate for the product to be tested. A list of required **Private Laboratory** tests is provided in Tables 1 and 2.

6.2.3 Each **Private Laboratory** shall have adequate floor space to efficiently conduct required tests. Suggested minimum floor space is provided under "Model Quality Control Plans" in the Manual of Test Procedures for Materials.

6.2.4 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.

6.2.5 All equipment shall be as specified in the current Manual of Test Procedures for Materials.

7.0 QUALITY SYSTEM CRITERIA

7.1 AASHTO R 18

Each **Quality Assurance Private Laboratory** shall establish and implement a quality system which meets the criteria from **AASHTO R 18**. Accredited Laboratories shall comply with all of **AASHTO R 18** for AMRL and ASTM C 1077 for CCRL, with the exception of Sections 6.1.7.4 and Section 6.1.7.5 of ASTM C 1077. The **Quality Assurance Private Laboratory** shall document staff technical proficiency in line with the requirements of AASHTO R 18 section 5.5.2.

7.2 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 and calibration, 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.

7.3 Equipment Calibration and Verification

The **Quality Control Private Laboratory** shall calibrate or verify all testing equipment associated with tests performed by the **Quality Control Private Laboratory** according to Table 3 which includes the maximum interval for calibrating most laboratory equipment. Heavy use or specific test requirements may justify more frequent checks. **Department** verification of **Quality Control Private Laboratory** equipment shall not be construed as part of, or substitute for, the equipment calibration requirement, except for **Department** verification of the gyratory compactor using the DAV-2 and **Department** verification of the gyratory molds using the bore gauge.

The **Quality Assurance Private Laboratory** shall calibrate, standardize, and check all significant equipment associated with tests the laboratory performs according to AASHTO R 18 for AMRL and ASTM C 1077 for CCRL in addition to Table 3 which may include equipment required for Illinois Modified Tests or Illinois Test Procedures.

7.4 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.

7.5 Records

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

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

- Documentation of assignment of personnel responsible for internal quality controls.
- Documentation of equipment calibration.
- Logs of sample pick-up shall be maintained for a minimum period of three years.
- All documentation shall be maintained and available to **Department** inspection for a period of three years.

7.5.3 Equipment Calibration and Verification Records - Calibration records shall include the minimum information listed below. **AASHTO R 18** and ASTM Standard C 1077 provide additional guidance for calibration of most testing equipment.

1. Description
2. Model & Serial Number
3. Name of person calibrating
4. Calibration equipment used
   (e.g., standard weights, proving rings, thermometers)
5. Date calibrated & next due date
6. Reference procedure used
7. Results of calibration / verification

7.5.4 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.

7.6 Publications

Each **Approved Private Laboratory** shall maintain current copies or electronic access to all test procedures performed and the Manual of Test Procedures for Materials.

8.0 <u>LABORATORY INSPECTIONS</u>

8.1 General

The **Department** will approve **Private Laboratories** by inspection.

- AGGREGATE LABORATORIES - Initial inspections and re-inspections will be performed by the District.

- OTHER LABORATORIES - Initial inspections are performed by the **Bureau of Materials and Physical Research**. Re-inspections are performed by the District.

8.2 AASHTO Accredited Private Laboratories

8.2.1 Current AASHTO accreditation of the **private** laboratory is a prerequisite for **Consultant** prequalification as a **Quality Assurance Testing Consultant**. Conditions for prequalification may be found in the prequalification instructions and forms.

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

AASHTO accreditation is required for **Quality Assurance Testing Consultants** prior to initial **BMPR** inspection. AMRL (AASHTO Material Reference Laboratory) shall provide assessment for HMA and Aggregates. CCRL (Cement and Concrete Reference Laboratory) shall provide assessment for Portland Cement Concrete.

8.3 Initial Inspection

- Facilities - Physical and environmental conditions.
- Equipment - Test apparatus for specification compliance.
- Documentation - Calibration and verification records.
- Personnel - A review of qualified personnel credentials.
- 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.
- Report - The **Private Laboratory** will be provided with a report listing those tests for which it is approved. The report will note deficiencies.

8.4 Initial HMA and PCC Laboratory Inspections

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

- The location of the **Private Laboratory**.
- The type of **Private Laboratory**, i.e., QC, QA or HMA Mix Design; aggregate, HMA, PCC.
- The name of the **Technical Manager**, who will be present for the inspection.
- The date the **Private Laboratory** will be ready for inspection.

8.4.2 The District will notify the **BMPR Laboratory** of the inspection request. **BMPR** personnel will establish a tentative date to perform the inspection.

8.4.3 The District will perform an inspection approximately seven calendar days before the **BMPR** inspection. The District will verify that the **Private Laboratory** is ready for inspection and notify **BMPR**.

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

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

Sieves
e.g., IL07 -1418-01
where: IL = State
07 = inspection year
1418-01 = Producer/Supplier Number
Sieves are engraved on the inside of the bottom lip directly beneath the label.

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

*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.

8.4.6 **BMPR** 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.

8.4.7 If a review of the preliminary report indicates there are no deficiencies, **BMPR** will provide written notification to the **Private Laboratory** indicating the **Private Laboratory** is now an approved **Quality Control** or **Quality Assurance Private Laboratory**. The notification will include an equipment list. A copy of the notification will be provided to the District.

8.4.8 If the preliminary report indicates there are deficiencies, **BMPR** 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.

8.4.9 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 **BMPR** in writing.

8.4.10 **BMPR** will provide written notification to the **Private Laboratory**, indicating the private laboratory is now an approved **Quality Control** or **Quality Assurance Private Laboratory**. The notification will include an equipment list. A copy of the written notification will be provided to the District.

8.4.11 Uncorrected deficiencies will not be waived. Equivalent equipment specifications may be approved only with the written approval of BMPR's Engineer of Tests.

8.5 Initial Aggregate Laboratory Inspection

For an aggregate **Private Laboratory**, the procedures outlined in 8.4 shall be followed, except District personnel will perform the inspection instead of personnel from **BMPR**.

8.6 Re-Approval of Approved Private Laboratories

8.6.1 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:

- Physical inspection of the laboratory facility and equipment.
- Review of the **Private Laboratory's** internal quality plan and documentation in accordance with this policy and those parts of **AASHTO R 18** incorporated by this policy.
- Observations of tests performed by qualified personnel.
- Results of split sample testing between the **Private Laboratory** and the District.
- Results of proficiency sample testing programs conducted by the **Department**.
- Overall past performance and experience.

8.6.2 The District may not waive any requirements for **Private Laboratories** or test equipment for **Required Tests**.

8.6.3 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.

8.6.4 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.

9.0 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** must 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.

10.0 LABORATORY DATABASE

The **Department** will maintain a computer database to monitor the approval status of **Private Laboratories**. The database will include the following information:

- Laboratory Codes (Department, Producer, etc.)
- Responsible District
- Type Laboratory (Aggregate, HMA, PCC, Other)
- Demographics (Address, etc.)
- Date Inspected
- Approval Status

Laura R. Mlacnik, P.E.
Acting, Engineer of Materials
and Physical Research

Attachments

TABLE1
QUALITY CONTROL PRIVATE LABORATORY TESTS

	PROCEDURE		PRIVATE LAB TYPE				
	Illinois Test Procedure	**ASTM**	**AGG**	**HMA QC**	**HMA DESIGN**	**PCC QC**	**TITLE**
AGGREGATE TESTS	ITP 2	___	√	√	√	√	Sampling of Aggregates
	ITP 11	___	√	√	√	√	Materials Finer Than 75-µm (No. 200) Sieve in Mineral Aggregates by Washing
	ITP 19	___	√[1]			√	Bulk Density ("Unit Weight") and Voids in Aggregate
	ITP 27	___	√	√	√	√	Sieve Analysis of Fine and Coarse Aggregate
	ITP 84	___	√[2]				Specific Gravity and Absorption of Fine Aggregate
	ITP 85	___	√[2]				Specific Gravity and Absorption of Coarse Aggregate
	ITP 248	___	√	√	√	√	Reducing Samples of Aggregate to Testing Size
	ITP 255	___	√	√	√	√	Total Evaporable Moisture Content of Aggregate by Drying

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

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

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TABLE1 (CONT'D)
QUALITY CONTROL PRIVATE LABORATORY TESTS

	PROCEDURE		PRIVATE LAB TYPE				
	AASHTO (Illinois Modified)	ASTM (Illinois Modified)	AGG	HMA QC	HMA DESIGN	PCC QC	TITLE
HOT-MIX ASPHALT TESTS	T 30 (IL)			√	√		Mechanical Analysis of Extracted Aggregate
	T 164 (IL)			√[3] Or T 287 or T 308[4]	√[3]		Quantitative Extraction of Asphalt Binder from Hot Mix Asphalt (HMA)
	T 166 (IL)			√	√		Bulk Specific Gravity (Gmb) of Compacted Hot Mix Asphalt (HMA) Using Saturated Surface-Dry Specimens
	T 209 (IL)			√	√		Theoretical Maximum Specific Gravity (Gmm) and Density of Hot Mix Asphalt Paving Mixtures
	T 245 (IL)						Resistance to Plastic Flow of Asphalt Mixtures Using Marshall Apparatus
	T 283 (IL)				√		Resistance of Compacted Hot Mix Asphalt (HMA) to Moisture-Induced Damage
	T 287 (IL)			√ Or T 164 or T 308[4]			Asphalt Binder Content of Asphalt Mixtures by the Nuclear Method
	T 308 (IL)			√ Or T 164 or T 287[4]	√		Determining the Asphalt Binder Content of Hot Mix Asphalt (HMA) by the Ignition Method
	T 312 (IL)			√	√		Preparing and Determining the Density of Hot Mix Asphalt (HMA) Specimens by Means of the Superpave Gyratory Compactor
	______	D 2950 (IL)		√			Determination of Density of Bituminous Concrete in Place by Nuclear Methods – Field Test; not observed during Lab Inspection

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

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

TABLE1 (CONT'D)
QUALITY CONTROL PRIVATE LABORATORY TESTS

	PROCEDURE		PRIVATE LAB TYPE				TITLE
	AASHTO (Illinois Modified)/Illinois Test Procedure	ASTM (Illinois Modified)	AGG	HMA QC	HMA DESIGN	PCC QC	
PORTLAND CEMENT CONCRETE TESTS	R 39 (IL)					Required if developing mix designs.	Making and Curing Concrete Test Specimens in the Laboratory
	R 60 (IL)					√	Sampling Freshly Mixed Concrete
	T 22 (IL)					√[5]Either T 22 or T 177	Compressive Strength of Cylindrical Concrete Specimens
	T 23 (IL)					√	Making and Curing Concrete Test Specimens in the Field
	T 119 (IL)					√	Slump of Hydraulic Cement Concrete
	T 121 (IL)					√	Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete
	T 152 (IL)					√	Air Content of Freshly Mixed Concrete by the Pressure Method - Type A or B Air Meter
	T 177 (IL)					√[5]Either T 22 or T 177	Flexural Strength of Concrete (Using Simple Beam with Center-Point Loading)
	T 196 (IL)						Air Content of Freshly Mixed Concrete by the Volumetric Method
	T 231 (IL)					Either T 231 or C 1231	Capping Cylindrical Concrete Specimens
		C 1064 (IL)				√	Temperature of Freshly Mixed Hydraulic Cement Concrete
		C 1231 (IL)				Either T 231 or C 1231	Use of Unbonded Caps in Determination of Compressive Strength of Hardened Concrete Cylinders
	ITP 301	____					Fine Aggregate Moisture Content by the Flask Method
	ITP 302	____					Aggregate Specific Gravity and Moisture Content by the Dunagan Method
	ITP 303	____					Fine or Coarse Aggregate Moisture Content by Pycnometer Jar Method
	ITP 306	____				Required if developing mix designs.	Voids Test of Coarse Aggregate for Concrete Mixtures

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

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

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

Note 1: Compliance with IDOT test methods will be required for IDOT QA lab inspections. However, AMRL 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 or PCC/AGG approved.

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

TABLE 2 (CON'T)
REQUIRED TESTS – QUALITY ASSURANCE TESTING CONSULTANTS [1, 2]

	PROCEDURE		REQUIRED FOR PREQUALIFICATION			TITLE
	Illinois Modified/A AASHTO	ASTM Illinois Modified	IDOT QA	AAP On-Site Assessment	AAP Proficiency Assessment	
HOT-MIX ASPHALT	T 30 (IL)		√			Mechanical Analysis of Extracted Aggregate
	T 164 (IL) T 164		√	 √		Quantitative Extraction of Asphalt Binder from Hot Mix Asphalt (HMA)
	T 166 (IL) T 166		√	 √	 √	Bulk Specific Gravity (Gmb) of Compacted Hot Mix Asphalt (HMA) Using Saturated Surface-Dry Specimens
	T 209 (IL) T 209		√	 √	 √	Theoretical Maximum Specific Gravity (Gmm) and Density of Hot Mix Asphalt Paving Mixtures
	T 245 (IL)					Resistance of Plastic flow of Asphalt mixtures Using Marshall Apparatus
	T 283 (IL) T 283		√	 √		Resistance of Compacted Hot Mix Asphalt (HMA) to Moisture-Induced Damage
	T 287 (IL)		√[4]			Asphalt Binder Content of Asphalt Mixtures by the Nuclear Method
	T 308 (IL) T 308		√	 √	 √	Determining the Asphalt Binder Content of Hot Mix Asphalt (HMA) by the Ignition Method
	T 312 (IL) T 312		√	 √	 √	Preparing and Determining the Density of Hot Mix Asphalt (HMA) Specimens by Means of the Superpave Gyratory Compactor
		D 2950 (IL)	√			Density of Bituminous Concrete in Place by Nuclear Method – Field Test

Note 1: Compliance with IDOT test methods will be required for IDOT QA lab inspections. However, AMRL 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 or PCC/AGG approved.

Note 4: Requirement determined on case to case basis by district in which lab is located.

TABLE 2 (CON'T)
REQUIRED TESTS – QUALITY ASSURANCE TESTING CONSULTANTS [1, 2]

	PROCEDURE		REQUIRED FOR PREQUALIFICATION			TITLE
	Illinois Modified/ AASHTO/Illinois Test Procedure	ASTM/Illinois Modified	IDOT QA	AAP On-Site Assessment	AAP Proficiency Assessment	
PORTLAND CEMENT CONCRETE		C 192			√	Making and Curing Concrete Test Specimens in the Laboratory
	R 60 (IL)	C 172	√	√		Sampling Freshly Mixed Concrete
	T 22 (IL)	C 39	√	√	√	Compressive Strength of Cylindrical Concrete Specimens
	T 23 (IL)	C 31	√	√	√	Making and Curing Concrete Test Specimens in the Field
	T 119 (IL)	C 143	√	√	√	Slump of Hydraulic Cement Concrete
	T 121 (IL)	C 138	√	√	√	Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete
	T 152 (IL)	C 231	√	√	√	Air Content of Freshly Mixed Concrete by the Pressure Method-Type A or B Air Meters
	T 177 (IL)	C 78	√	√[5]		Flexural Strength of Concrete (Using Simple Beam with Center-Point Loading)
	T 196 (IL)	C 173	[6]	[6]	[8]	Air Content of Freshly Mixed Concrete by the Volumetric Method
	T 231 (IL)	C 617	[6]	[6]		Capping Cylindrical Concrete Specimens
		C 1064 (IL) C 1064	√	√		Temperature of Freshly Mixed Hydraulic Cement Concrete
		C 1231 (IL) C 1231	√	√		Use of Unbonded Caps in Determination of Compressive Strength of Hardened Concrete Cylinders
	ITP 301		[6]			Fine Aggregate Moisture Content by the Flask Method
	ITP 302		[6]			Aggregate Specific Gravity and Moisture Content by the Dunagan Method
	ITP 303		[6]			Fine or Coarse Aggregate Moisture Content by Pycnometer Jar Method
	ITP 306		[7]			Voids Test of Coarse Aggregate for Concrete Mixtures

Note 1: Compliance with IDOT test methods will be required for IDOT QA lab inspections. However, AMRL 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 or 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 must be presented during an inspection if the consultant lab has the ability to perform the test.

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

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

TABLE 3[1]
EQUIPMENT CALIBRATION SCHEDULE

EQUIPMENT	REQUIREMENT	MAXIMUM INTERVAL (MONTHS)
AGGREGATE & GENERAL		
Unit Weight Measures	Standardize	12
General Purpose Balances, Scales	Commercial Service or Verification using standardized NIST traceable Masses	12
Standard Masses	Standardize	12
Mechanical Shakers	Check Sieving Thoroughness	12
Ovens	Standardize Thermometric Device	12
Coarse Sieves (Openings ≥ 4.75 mm)	Check Physical Condition and Dimensions of Openings	12
Fine Sieves (Openings <4.75 mm)	Check Physical Condition	12
Working Thermometers	Standardize with calibrated NIST traceable Reference Thermometer	12
Reference Thermometer	Calibrate	60
Timers	Check Accuracy	12
Calipers and Micrometers	Standardize	12
Caliper Checker (Gauge Blocks or Caliper Master)	Calibrate	60
HOT MIX ASPHALT		
Gyratory Compactor	Verify Angle, Pressure, Height	Once a month during use
	Verify Angle using a DAV-2	12
Plates, Ram Face, Molds	Check Critical Dimensions	12
Marshall Hammer	Check Physical Condition	12
	Standardize	36
Ignition Furnace	Standardize	Each Mix
Vacuum Pump	Check Pressure	12
Tensile Strength Machine	Standardize	12
Breaking Heads	Check Critical Dimensions	12
Pycnometers	Standardize Volume	12
Mixers	Check Physical Condition	12
Water Baths	Standardize	12
Extraction Equipment	Check Physical Condition	12
Residual Pressure Manometer	Standardize	12
Bore Gauge	Standardize	Each Use
Master Ring	Calibrate	60
Hamburg Wheel-Track		
Water Temperature	Verify	12
Speed	Verify	12
Wheel Weight	Verify	12
LVDT'S	Verify	12

Note 1: See AASHTO R18 for equipment calibration terminology definitions.

EQUIPMENT	REQUIREMENT	MAXIMUM INTERVAL (MONTHS)
PORTLAND CEMENT CONCRETE		
Air Meters (Pressure Type)	Standardize During Use	3 (Type B)
	Standardize	12 (Type A)
Air Meters (Volumetric Type)	Standardize	12
Compression & Flexural Testing Machine	Calibrate	12
Capping Material	Check Strength	3 or New Shipment
Slump Cones	Check Critical Dimensions	12
Reusable Molds	Check Critical Dimensions	12
Single Use Molds	Check Dimension	Each Shipment
Neoprene Pads	Check Physical Condition	Track Usage
Metal Retainers	Check Critical Dimensions	3
Metal Stem Thermometers	Standardize with calibrated NIST traceable Reference Thermometer	12
Moist Room/Storage Tanks Recording Thermometer or Max/Min Thermometer	Standardize with calibrated NIST traceable Reference Thermometer	12

Note 1: See AASHTO R 18 for equipment calibration terminology definitions.

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Illinois Department of Transportation

Aggregate Laboratory Equipment
Appendix D3

Effective Date: October 1, 1995
Revised: June 1, 2012

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 – 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, 8,000-gram capacity, 0.1-gram readability
15	Sample Pans, (constructed to minimize loss of material during testing)
5	Pans, holding, typical round – 12 in. minimum diameter
2	Spoon, stainless steel, 15 in. minimum
1	Brush, stencil
1	Brush, brass
1	Knife, putty
2	Thermometers, - 18 to 150 ˚C (0 to 300 ˚F), readable to 0.5 ˚C (1.0 ˚F) to verify oven temperature.
1	Set (11) Fine Aggregate Sieves, brass, 8 in. 12 in. diameter, with brass or stainless cloth, -- 9.5 mm, 4.75 mm, 2.36 mm, 2.00 mm, 1.18 mm, 600 µm, 425 µm, 300 µm, 180 µm, 150 µm, 75 µm (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.
1	Lid for 12 in. sieve
1	Pan, catch, bottom, 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 µm (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 CA05 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.

Aggregate Laboratory Equipment
Appendix D3
(continued)

Effective Date: October 1, 1995
Revised: June 1, 2012

VENDOR LIST – For information only

Baxter Healthcare Corp.
One Baxter Parkway
Deerfield, IL 60015-4625
Phone: 800-422-9837

Curtin Matheson Scientific, Inc. (CMS)
1225 North Michael Drive
Wood Dale, IL 60191
Phone: 800-323-6572

Gilson Company, Inc.
P.O. Box 200
Lewis Center, OH 43035-200
Phone: 800-444-1508

Greco Sales, Inc.
901 East Adams Street
Springfield, IL 62708
Phone: 800-252-8522
217-528-2548

Humboldt Scientific, Inc.
3801 North 25th Avenue
Schiller Park, IL 60176
Phone: 800-544-7220

Rainhart Co.
604 William Street
P.O. Box 4533
Austin, TX 78765
Phone: 800-628-0021

VWR Scientific
3850 North Wilke Road
Suite 300
Arlington Heights, IL 60004
Phone: 847-463-1233

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

Effective Date: November 10, 1997
Revised Date: June 1, 2012

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 A5
(continued)
Effective Date: November 10, 1997
Revised Date: June 12, 2012

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

Example:

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

Comparison Data

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

GUIDELINE FOR COMPARISON

Example:

CM 11

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

Example:

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

Comparison Data

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

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Illinois Specification 201

Illinois Department of Transportation (IDOT)

AGGREGATE GRADATION SAMPLE SIZE TABLE & QUALITY CONTROL SIEVES

Effective: February 1, 2014

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
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AGGREGATE GRADATION SAMPLE SIZE TABLE & QUALITY CONTROL SIEVES
Effective: February 1, 2014

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}

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 for Category I & II 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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AGGREGATE GRADATION SAMPLE SIZE TABLE & QUALITY CONTROL SIEVES
Effective: February 1, 2014

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	20,000 g	X	X	X	XC	X		XC	XC	X
CS02	15,000 g		X	X	XC	X		XC	XC	X
RR01	10,000 g				X	XC	X	XC	XC	X
RR02	10,000 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 by be used for the gradation
6 = Test sample size shall be taken in the field. No splitting is required.

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APPENDIX B – TABLE OF CONTENTS

PAGE

MTP = Manual of Test Procedures for Materials
IDOT = Illinois Department of Transportation
BMPR = Bureau of Materials and Physical Research

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ILLINOIS TEST PROCEDURE 2

SAMPLING OF AGGREGATES

Effective Date: April 1, 2012
Revised Date: February 1, 2014

1 SCOPE

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

1.1.1 Preliminary investigation of the potential source of supply.

1.1.2 Control of the product at the source of supply.

1.1.3 Control of the operations at the site of use.

1.1.4 Acceptance or rejection of the materials.

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

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

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

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

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

2 REFERENCED DOCUMENTS

2.1 Illinois Specification:

- Illinois Specification 201 Aggregate Gradation Sample Size Table

3 TERMINOLOGY

3.1 *Definitions*:

3.1.1 *maximum size of aggregate, n*—in specifications for, or descriptions of aggregate—the smallest sieve opening through which the entire amount of aggregate is required to pass.

ILLINOIS TEST PROCEDURE 2

SAMPLING OF AGGREGATES

Effective Date: April 1, 2012
Revised Date: February 1, 2014

3.1.2 *maximum aggregate size, (Superpave) n*—in specifications for , or descriptions of aggregate—one size larger than the nominal maximum aggregate size.

3.1.3 *nominal maximum aggregate size (of aggregate), n*—in specifications for, or descriptions of aggregate—smallest sieve opening through which the entire amount of the aggregate is permitted to pass.

3.1.4 *nominal maximum aggregate size (Superpave), n*—in specifications for, or descriptions of aggregate—one size larger than the first sieve that retains more than 10% aggregate.

3.1.4.1 *Discussion*—These definitions in 3.1.2 and 3.1.4 apply to hot mix asphalt (HMA) mixtures designed using the Superpave system only.

3.1.4.2 *Discussion* -Specifications on aggregates usually stipulate a sieve opening through which all the aggregate may, but need not, pass so that a slated maximum portion of the aggregate may be retained on that sieve. A sieve opening so designated is the nominal maximum size.

4 SIGNIFICANCE AND USE

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

5 APPARATUS

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

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

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

Shelby tubes are not allowed as sampling devices.

ILLINOIS TEST PROCEDURE 2

SAMPLING OF AGGREGATES

Effective Date: April 1, 2012
Revised Date: February 1, 2014

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

6 SECURING SAMPLES

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

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

6.3 *Sampling Procedure* – Aggregate production sampling shall be accomplished by one of the following procedures:

1. belt-stream sampling
2. bin-discharge sampling (requires IDOT approval)
3. on-belt sampling
4. truck-dump or stockpile sampling

Aggregate stockpile sampling shall be accomplished by any of the procedures notes above.

No other sampling procedures will be permitted.

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

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

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

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

ILLINOIS TEST PROCEDURE 2

SAMPLING OF AGGREGATES

Effective Date: April 1, 2012
Revised Date: February 1, 2014

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

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

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

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

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

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

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

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

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SAMPLING OF AGGREGATES

Effective Date: April 1, 2012
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After mixing twice, the end loader shall drop the angle of its bucket downward on one side of the pile and back drag the pile into a layer not less than 1 foot thick.

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

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

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

6.4 *Number and Masses of Field Samples*:

6.4.1 The number of field samples (obtained by one of the methods described in 5.3) required depends on the criticality of, and variation in, the properties to be measured. Designate each unit from which a field sample is be obtained prior to sampling. The number of field samples from the production should be sufficient to give the desired confidence in test results.

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

7 Shipping Samples

7.1 Transport aggregates in bags or other containers so constructed as to preclude loss or contamination of any part of the sample, or damage to the contents from mishandling during shipment.

7.2 Shipping containers for aggregate samples shall have a LM-5 envelope attached to the container. Written on the outside of the LM-5 shall be the following information: producer number, test id# (including suffix), material code, ledge description. The required information to be written on the outside of the LM-5 shall also be written on the outside of the sample container. Inside the LM-5 shall contain a fully completed LM-6 form. The LM-6 form shall be the most recent version of the Bureau of

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Materials and Physical Research online template (no other LM-6 forms will be accepted).

8 Red Tag Samples – Used for Quality Samples only.

8.1 The Bureau of Materials and Physical Research has established a procedure which allows the producer the opportunity to delivering their quality samples directly to the Springfield testing facility.

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

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

9 Keywords

9.1 aggregates; exploration of potential sources; aggregates; number and sizes needed to estimate character; aggregates; sampling

ILLINOIS TEST PROCEDURE 11

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

Effective Date: April 1, 2012
Revised Date: February 1, 2014

1 SCOPE

1.1 This test procedure covers the determination of the amount of material finer than a No. 200 (75µm) sieve in aggregate by washing. Clay particles and other aggregate particles that are dispersed by the wash water, as well as water-soluble materials, will be removed from the aggregate during the test.

1.2 There are two methods. Method A uses only water for the operation. Method B includes the use of a wetting agent to assist in the loosening of the material finer than the No. 200 (75µm) sieve from the coarser material. A wetting agent such as detergent or dispersing solution is recommended.

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

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

2 REFERENCED DOCUMENTS

2.1 Illinois Test Procedures (ITP):

- ITP 2, Sampling of Aggregates
- ITP 27, Sieve Analysis of Fine and Coarse Aggregates
- ITP 248, Reducing Samples of Aggregate to Testing Sizes

2.2 Illinois Specifications:

- Illinois Specification 201, Aggregate Gradation Sample Size Table

2.3 *AASHTO Standards*:

- M 231, Weighing Devices Used in the Testing of Materials

2.4 ASTM Standards:

- E 11, Woven Wire Test Sieve Cloth and Test Sieves
- E 29 (Illinois Modified), Using Significant Digits in Test Data to Determine Conformance with Specifications

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

Effective Date: April 1, 2012
Revised Date: February 1, 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 No. 200 (75µm) sieve. The loss in mass resulting from the wash treatment is calculated as mass percent of the original sample and is reported as the percentage of material finer than a No. 200 (75µm) sieve by washing.

4 SIGNIFICANCE AND USE

4.1 Material finer than the No. 200 (75µm) sieve can be separated from larger particles much more efficiently and completely by wet sieving than through the use of dry sieving. Therefore, when accurate determinations of material finer than No. 200 (75µm) in fine or coarse aggregate are desired, this test method is used on the sample prior to dry sieving in accordance with ITP 27. The results of this test method are included in the calculation in ITP 27, and the total amount of material finer than the No. 200 (75µm) by washing, plus that obtained by dry sieving the same sample, is reported with the results of ITP 27. Usually the additional amount of material finer than No. 200 (75µm) obtained in the dry-sieving process is a small amount. If it is large, the efficiency of the washing operation should be checked. A large amount of material could also be an indication of degradation of the aggregate.

4.2 Plain water is adequate to separate the material finer than No. 200 (75µm) from the coarser material with most aggregates. In some cases, the finer material is adhering to the larger particles, such as some clay coatings and coatings on aggregates that have been extracted from bituminous mixtures. In these cases, the 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 No. 200 (75µm) sieve and the upper being a sieve with openings in the range of No. 8 (2.36mm) to No. 16 (1.18mm), both conforming to the requirement of ASTM E 11.

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

5.4 *Oven* – An oven of sufficient size, capable of maintaining a uniform temperature of 230±9˚F (110±5˚C). 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 gradation samples.

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

Effective Date: April 1, 2012
Revised Date: February 1, 2014

5.5 *Wetting Agent* – Any dispersing agent, such as liquid dishwashing detergents, that will promote separation of the fine materials

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

6 SAMPLING

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

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

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

7 PROCEDURE

7.1 The test sample shall be dried back to constant mass in an oven specifically designed for drying, set at and capable of maintaining a uniform temperature of 230±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 1 hour of drying. This should be verified occasionally.

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

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

ILLINOIS TEST PROCEDURE 11

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

Effective Date: April 1, 2012
Revised Date: February 1, 2014

7.2 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 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.

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

Note 2 – If mechanical washing equipment is used, the charging of water, agitating, and decanting may be a continuous operation.

Note 3 – A spray nozzle or a piece of rubber tubing attached to a water faucet may be used to rinse any of the material that may have fallen onto the sieves. The velocity of water, which may be increased by pinching the tubing or by use of a nozzle, should not be sufficient to cause any splashing of the sample over the sides of the sieve.

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

Note 4 – 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.

8 CALCULATION

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

% - No. 200 (-75µm) by Washing = $\frac{TDM-TWM}{TDM} X\ 100$

where TDM = Total Dry Mass, g
and TWM = Total Wash Mass, g.

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ILLINOIS TEST PROCEDURE 11

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

Effective Date: April 1, 2012
Revised Date: February 1, 2014

9 REPORT

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

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ILLINOIS TEST PROCEDURE 27

SIEVE ANALYSIS OF FINE AND COARSE AGGREGATE

Effective Date: March 1, 2013

1. SCOPE

1.1 This procedure covers the determination of the particle size distribution of fine and coarse aggregates by sieving.

1.2 Some specifications for aggregates, which reference this method, contain grading requirements including both coarse and fine fractions. Instructions are included for sieve analysis of such aggregates.

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

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

2. REFERENCED DOCUMENTS

2.1 Illinois Test Procedures (ITP):

- ITP 2, Sampling of Aggregates
- ITP 11, Materials Finer Than 75µm (No. 200) Sieve in Mineral Aggregates by Washing
- ITP 248, Reducing Samples of Aggregate to Testing Size

2.2 Illinois Specifications:

- Illinois Specification 201, Aggregate Gradation Sample Size Table

2.3 AASHTO Standards:

- M 231, Weighing Devices Used in the Testing of Materials

2.4 ASTM Standards:

- C 125, Standard Terminology Relating to Concrete and Concrete Aggregates
- E 11, Woven Wire Test Sieve Cloth and Test Sieves

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SIEVE ANALYSIS OF FINE AND COARSE AGGREGATE

Effective Date: March 1, 2013

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

3 TERMINOLOGY

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

4 SUMMARY OF METHOD

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

5 SIGNIFICANCE AND USE

5.1 This procedure is used primarily to determine the grading of materials proposed for use as aggregates or being used as aggregates. The results are used to determine compliance of the particle size distribution with applicable specification requirements and to provide necessary data for control of the production of various aggregate products and mixtures containing aggregates. The data may also be useful in developing relationships concerning porosity and packing.

5.2 Accurate determination of material finer than the 75μm (No. 200) sieve cannot be achieved by used of this method alone. ITP 11 for material finer than the 75μm (No. 200) sieve by washing should be employed.

6 APPARATUS

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

6.2 *Sieves* – The sieve cloth shall be mounted on substantial frames constructed in a manner that will prevent loss of material during sieving. The sieve cloth and standard sieve frames shall conform to the requirements of ASTM E 11. Nonstandard sieve frames shall conform to requirements of ASTM E 11 as applicable.

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

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SIEVE ANALYSIS OF FINE AND COARSE AGGREGATE

Effective Date: March 1, 2013

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

6.4 *Oven* – An oven of appropriate size capable of maintaining a uniform temperature of 110±5˚C (230±9˚F). The oven shall be specifically designed for drying.

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

7 SAMPLING

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

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

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

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

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

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

8 PROCEDURE

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

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

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

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

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

8.2 A nested set of sieves (203mm [8 inch] or 305mm [12 inch]) 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 75µm (No. 200) sieve is required to be part of all nested sets when running a gradation test. It is also required that 203mm (8 inch) and 305mm (12 inch) 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 16.0mm (5/8 inch), 9.5mm (3/8 inch), and 6.3mm (1/4 inch) sieves as cutter sieves, while the gradations CA/CM 13, 14, and 16 require the 6.3mm (1/4 inch) and the 2.38mm (No. 8) sieves. Cutter sieves for other gradations can be found in Illinois Specification 201.

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

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

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

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

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

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

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Effective Date: March 1, 2013

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

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

9 CALCULATION

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

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

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

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

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

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

% = 100 – Cumulative % Retained

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These results shall be recorded to the nearest 0.1 percent.

9.2 Calculate the fineness modulus, when required, by adding the total percentages of material in the sample that is coarser than each of the following sieves (cumulative percentages retained), and dividing the sum by 100; 150µm (No. 100), 300µm (No. 50), 600µm (No. 30), 1.18mm (No. 16), 2.36mm (No. 8), 4.75mm (No. 4), 9.5mm (3/8 in.), 19.0mm (¾ in.), 37.5mm (1 ½ in.), and larger, increasing the ratio of 2 to 1.

10 **REPORT**

10.1 Depending upon the form of the specifications for used of the material under test, the report shall include one of the following:

10.1.1 Total percentage of material passing each sieve, or

10.1.2 Total percentage of material retained on each sieve, or

10.1.3 Percentage of material retained between consecutive sieves.

10.2 All percent passing results except the washed minus 75µm (minus No. 200) and minus 75µm (minus No. 200) shall be reported on the gradation form as whole numbers. The washed minus 75µm (minus No. 200) and minus 75µm (minus No. 200) 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.

10.3 Rounding shall be according to ASTM E 29 (Illinois Modified).

10.4 For all sieves that are considered overloaded and split in more than one increment. An "S" next to the sieve must be notated on the worksheet.

11 **COMPARISON PROCEDURE**

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

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ILLINOIS TEST PROCEDURE 248

REDUCING SAMPLES OF AGGREGATE TO TESTING SIZE

Effective: June 1, 2012

1. SCOPE

1.1 This procedure covers the reduction of large samples of aggregate to the appropriate size for testing, employing techniques that are intended to minimize variations in measured characteristics between the test samples so selected and the large sample.

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

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

2. REFERENCED DOCUMENTS

2.1 Illinois Test Procedures (ITP):

- ITP 2, Sampling of Aggregates
- ITP 11, Materials Finer Than 75µm (No. 200) Sieve in Mineral Aggregates by Washing
- ITP 84, Specific Gravity and Absorption of Fine Aggregate

2.2 ASTM Standards:

- *C 125, Standard Terminology Relating to Concrete and Concrete Aggregates*

3. TERMINOLOGY

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

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

ILLINOIS TEST PROCEDURE 248

REDUCING SAMPLES OF AGGREGATE TO TESTING SIZE

Effective: June 1, 2012

representative of the larger sample and, thus, of the total supply. The individual test methods provide for minimum masses of material to be tested.

4.2 Under certain circumstances, reduction in size of the large sample prior to testing is not recommended. Substantial differences between the selected test samples sometimes cannot be avoided, as for example, in the case of an aggregate having relatively few large-sized particles in the sample. The laws of chance dictate that these few particles may be unequally distributed among the reduced-size test samples. Similarly, if the test sample is being examined for certain contaminants occurring as a few discrete fragments in only small percentages, caution should be used in interpreting results from the reduced-size test sample. Chance inclusion or exclusion of only one or two particles in the selected test sample may importantly influence interpretation of the characteristics of the original sample. In these cases, the entire original sample should be tested.

4.3 Failure to carefully follow the procedures in these methods could result in providing a non-representative sample to be used in subsequent testing. Selection during splitting of an exact, predetermined mass for the sample is not permitted.

5. SELECTION OF METHOD

5.1 *Fine Aggregate* – The preferred splitting method for fine aggregate shall be a fine aggregate mechanical splitter (Method A). However, quartering (Method B) and miniature stockpile sampling (Method C) may be used.

5.1.1 If the use of Method B or Method C is desired, and the sample does not have free moisture on the particle surfaces, the sample may be moistened to achieve this condition, thoroughly mixed, and then the sample reduction performed.

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

5.1.2 If the use of Method A is desired and the sample has free moisture on the particle surfaces, the entire sample may be dried to at least the surface-dry condition, using temperatures that do not exceed those specified for any of the tests contemplated, and then the sample reduction performed. Alternatively, if the moist sample is very large, a preliminary split may be made using a mechanical splitter having wide chute openings 37.5mm (1 ½ in.) or more to reduce the sample to not less than 5000g. The

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Effective: June 1, 2012

portion so obtained is then dried, and reduction to test sample size is completed using Method A.

5.2 *Coarse Aggregate and Mixtures of Coarse and Fine Aggregate* – The required splitting method for coarse aggregate and mixtures of coarse and fine aggregate shall be a coarse aggregate mechanical splitter (Method A). However, quartering (Method B) may be used for coarse aggregate moisture tests to proportion Portland cement concrete, cement aggregate mixture II, and controlled low-strength material mixtures.

6. SAMPLING

6.1 Field samples of aggregate shall be taken according to ITP 2.

METHOD A – MECHANICAL SPLITTER

7. APPARATUS

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

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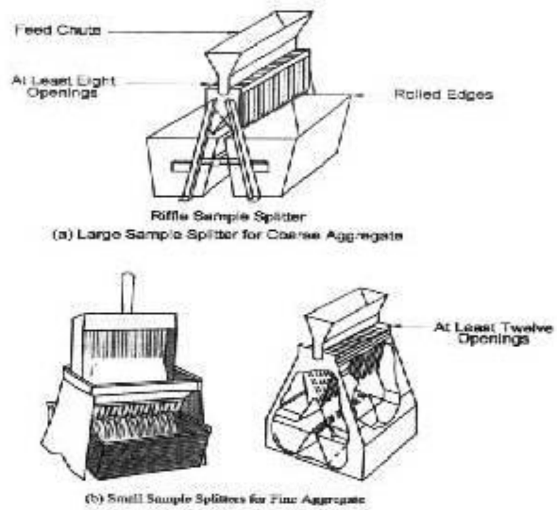

Note: (a) may be constructed as either closed or open type. Closed type is preferred.

Figure 1—Sample Splitters (Riffles)

Note 2 – Mechanical splitters are commonly available in sizes adequate for coarse aggregate having the largest particles not larger than 37.5mm (1 ½ 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 in the chutes, approximately equal amounts will flow through each chute. The rate at which the sample is introduced shall be such as to allow free flowing through the chutes into the receptacles below. Reintroduce the portion of the sample in one of the receptacles into the splitter as many times as necessary to reduce the sample to the size specified for the intended test. The portion of the material collected in the other receptacle may be reserved for reduction in size for other tests.

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

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METHOD B – QUARTERING

9. APPARATUS

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

10. PROCEDURE

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

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

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

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

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Effective: June 1, 2012

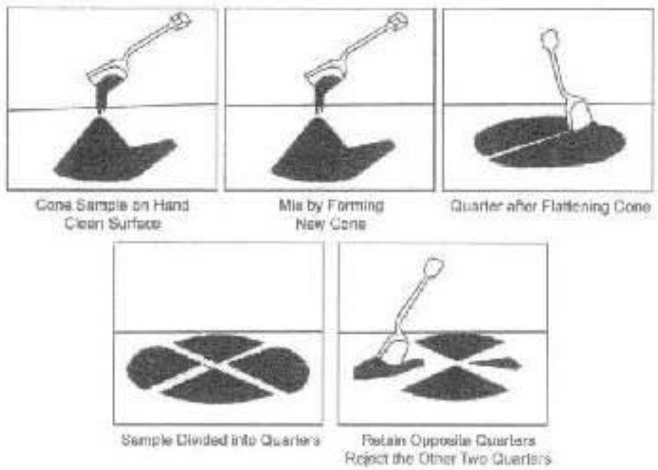

Figure 2—Quartering on a Hard, Clean, Level Surface

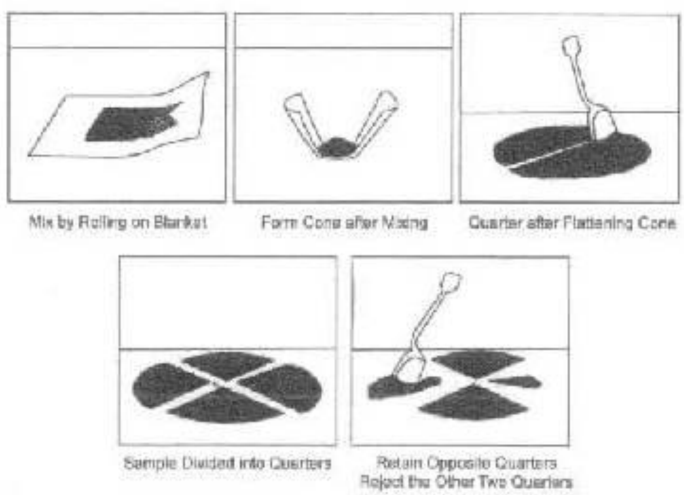

Figure 3—Quartering on a Canvas Blanket or Tear-Resistant Tarp

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

11. APPARATUS

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

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12. PROCEDURE

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

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

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

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

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

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ILLINOIS TEST PROCEDURE 255

TOTAL EVAPORABLE MOISTURE CONTENT OF AGGREGATE BY DRYING

Effective Date: March 1, 2013

1 SCOPE

1.1 This test procedure covers the determination of the percentage of evaporable moisture in a sample of aggregate by drying both surface moisture and moisture in the pores of the aggregate. Some aggregate may contain water that is chemically combined with the minerals in the aggregate. Such water is not evaporable and is not included in the percentage determined by this test method. Aggregate moisture content may be run on a gradation sample prior to gradation testing or on a separate test sample.

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

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

2 REFERENCED DOCUMENTS

2.1 Illinois Test Procedures (ITP):

- ITP 2, Sampling of Aggregates
- ITP 84, Specific Gravity and Absorption of Fine Aggregate
- ITP 85, Specific Gravity and Absorption of Coarse Aggregate
- ITP 248, Reducing Samples of Aggregate to Testing Size

2.2 Illinois Specifications:

- Illinois Specification 201, Aggregate Gradation Samples Size Table

2.3 AASHTO Standards:

- M 231, Weighing Devices Used in the Testing of Materials

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TOTAL EVAPORABLE MOISTURE CONTENT OF AGGREGATE BY DRYING

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2.4 *ASTM Standards:*

- C 125, Standard Terminology Relating to Concrete and Concrete Aggregates
- E 29 (Illinois Modified), Using Significant Digits in Test Data to Determine Conformance with Specifications

3 TERMINOLOGY

3.1 *Definitions:*

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

4 SIGNIFICANCE AND USE

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

4.2 Large particles of coarse aggregate, especially those larger than 50mm (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 AASHTO 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). The oven shall be specifically designed for drying.

5.2.1 Where close control of the temperature is not required (see Section 4.1), other suitable sources of heat may be used such as an electric or gas hot plate, electric

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TOTAL EVAPORABLE MOISTURE CONTENT OF AGGREGATE BY DRYING

Effective Date: March 1, 2013

heat lamps, or a ventilated microwave oven. A microwave oven or an electric or gas hot plate may be used only when drying a non-gradation test sample.

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

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

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

6 SAMPLE

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

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

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

7 PROCEDURE

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

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

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

ILLINOIS TEST PROCEDURE 255

TOTAL EVAPORABLE MOISTURE CONTENT OF AGGREGATE BY DRYING

Effective Date: March 1, 2013

must be turned down and/or the sample must be constantly stirred during drying to prevent potential aggregate particle breakdown.

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

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

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

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

8 CALCULATION

8.1 The "Aggregate Moisture Content" shall be determined by using the following formula:

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

where:

P = Aggregate Moisture Content (%)
OSM = Original Sample Mass, g.

and:

TDM = Dried Sample Mass g.

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

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

ILLINOIS TEST PROCEDURE 255

TOTAL EVAPORABLE MOISTURE CONTENT OF AGGREGATE BY DRYING

Effective Date: March 1, 2013

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 ITP 85, Test for Specific Gravity and Absorption of Coarse Aggregate, or ITP 84, Test for Specific Gravity and Absorption of Fine Aggregate.

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Illinois Department of Transportation

Illinois Specification 101
Minimum Requirements for Electronic Balances
Appendix D5

Effective Date: April 1, 1999
Revised February 1, 2014

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

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

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

Minimum Requirements for Laboratory Balances

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

* A maximum 50-gram (0.1 lb.) readability is permitted to calibrate the unit weight measure (Illinois Modified AASHTO T 121) and the air meter measuring bowl (Illinois Modified AASHTO T 152). However, if the capacity of the unit weight measure and the air meter measuring bowl is less than 0.009 cubic meter (0.3 cu.ft.), a 20-gram (0.05 lb.) or smaller readability is preferable for calibration.

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

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

† Sufficient capacity.

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

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Illinois Modified Test Procedure
Effective Date: February 1, 2014

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

Reference ASTM E 29-13

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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State of Illinois
Department of Transportation
Bureau of Materials and Physical Research
Springfield

POLICY MEMORANDUM

Revised: March 1, 2014	7-08.2
This Policy Memorandum supersedes 7-08.1 dated June 1, 2012	

TO: REGIONAL ENGINEERS AND HIGHWAY BUREAU CHIEFS

SUBJECT: RECYCLING PORTLAND CEMENT CONCRETE INTO AGGREGATE

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. Freeze-thaw, ASR and Chloride Content tests are required if the crushed concrete is to be recycled as Portland cement concrete. 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.

Acceptance of crushed concrete shall be determined using one of the following methods:

I. Project Acceptance
Recycling Portland cement concrete may be specified by special provision for appropriate projects. The crushed concrete shall be recycled from IDOT-specified concrete in the project. The Engineer shall approve the concrete removal method prior to crushing and continually monitor the method during crushing for unacceptable contamination.

Quality. The fact that the original aggregate in the concrete met “Class A” quality does not mean that the product resulting from the crushing of the concrete will meet “Class A” quality. Preliminary samples of existing concrete from a number of locations (minimum 3) in any potential recycling project shall be submitted to the Central Laboratory for quality testing. A period of three months is required for freeze-thaw testing if the material is to be recycled into any uses covered under 1004.02 (f) in the Standard Specifications for Road and Bridge Construction. This work shall be completed prior to advertising the project for bidding.

Quality testing shall include Illinois Test Procedures 96 “Resistance to Degradation of Small-size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine” and Illinois Test Procedure 203 “Deleterious Particles in Coarse Aggregate”. Standard “Class A” quality limits shall apply but Recycled Asphalt Pavement (RAP) shall be counted as Other Deleterious and shall not exceed 2.0%. RAP shall not be considered as Other Deleterious when Crushed Concrete is used as Aggregate Wedge Shoulders, Type B.

A. Gradation. Gradation sampling and testing shall conform to the Aggregate Gradation Control System (AGCS.

B. Stockpiling. Contamination in the stockpile area is as detrimental as contamination when picking up the broken concrete. Stockpile pads shall be provided and haul roads/plant area properly maintained to assure that acceptable material is not contaminated prior to use.

Stockpiling, hauling, and loading shall conform to the Aggregate Gradation Control System.

II. Central Recycling Plant

Portland Cement Concrete may be recycled by crushing at a central recycling plant.

Concrete used as raw feed at a central recycling plant 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 or aggregate, bricks, slabs of HMA pavement or washout from concrete trucks.

Acceptance for quality and gradation shall be on a stockpile-by-stockpile basis.

A. Quality. Each stockpile shall have one quality sample per each 10,000 tons per specific gradation submitted for quality testing. The quality samples shall be taken from stockpiled material. Since non-IDOT specified concrete may be included in recycling at central recycling plants, the crushed concrete produced at the central recycling plant is not acceptable for Class A quality use, Class B quality use, or Class C quality hot-mix asphalt mixture use, except as specified herein.

For HMA Surface courses and HMA Binder courses: Quality testing shall include Illinois Test Procedure 96 “Resistance to Degradation of Small-size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine”, and Illinois Test Procedure 203 “Deleterious Particles in Coarse Aggregate”. Standard “Class B” quality limits shall apply but there will be no limit on RAP from the Deleterious Count. Illinois Test Procedure 327 “Resistance to Coarse Aggregate to Degradation by Abrasion in the Micro-Deval Apparatus” shall also be performed and a 15.0% limit shall be applied.

For Granular Embankment Special, Granular Subbase, Stabilized Subbase, Aggregate Base, Aggregate Surface and Aggregate Shoulders: Quality testing shall include Illinois Test Procedure 96 “Resistance to Degradation of Small-size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine” with standard “Class D” quality limits applied. Illinois Test Procedure 203 “Deleterious Particles in Coarse Aggregate” shall also be performed but standard “Class C” quality limits shall apply except the Other Deleterious maximum percent limit shall be 7.0%, with no more than 5.0% RAP allowed, nor more than 2.0% other material defined as Other Deleterious. RAP shall not be considered as Other Deleterious when Crushed Concrete is used as Aggregate Wedge Shoulders, Type B.

B. Gradation. Gradation sampling and testing shall comply with the Aggregate Gradation Control System.

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

III. Recycled Returned Ready-Mix Concrete

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

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

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

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

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

A. Quality. IDOT reserves the right to test this material for quality, as outlined in Section II (A), herein, if contamination is present in the stockpile.

B. 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.

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

Aaron A. Weatherholt, P.E.
Acting, Engineer of Materials
and Physical Research

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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 current Bureau of Materials and Physical Research 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 current Bureau of Materials and Physical Research

Policy Memoranda, "Crushed Slag Producer Certification and Self-Testing Program" and "Slag Producer 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 furnace. The acceptance and use of steel slag sand shall be according to the current Bureau of Materials and Physical Research 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 current Bureau of Materials and Physical Research 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 current Bureau of Materials and Physical Research 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, ITP 104, % Loss max.	10	15	20
Minus No. 200 (75 µm) Sieve Material, ITP 11, % max. 4/	3	6 1/	10 1/
Organic Impurities Check, ITP 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 (ITP 21) will be checked for mortar making properties according to ITP 71, 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 current Bureau of Materials and Physical Research 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.

Art. 1003.01 Fine Aggregates

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

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

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

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±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 ± ten 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 current Bureau of Materials and Physical Research Policy Memorandum, “Aggregate Gradation Control System” 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 current Bureau of Materials and Physical Research 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 that the minus No. 200 (75 µm) sieve ITP 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 current Bureau of Materials and Physical Research 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.

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-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.

For trench backfill, crushed concrete sand and construction and demolition debris sand may be used in lieu of the above.

For pipe underdrains, Type 3, the fine aggregate shall consist of sand or crushed gravel 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 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 1003.02(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 ITP 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 ITP 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 current Bureau of Materials and Physical Research 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.

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 current Bureau of Materials and

Physical Research 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 (ITP 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 current Bureau of Materials and Physical Research Policy Memoranda, "Crushed Slag Producer Certification and Self-Testing Program" and "Slag Producer 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 current Bureau of Materials and Physical Research 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 current Bureau of Materials and Physical Research 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, ITP 104 1/, % Loss max.	15	15	20	25 2/
Los Angeles Abrasion, ITP 96, % Loss max.	40 3/	40 4/	40 5/	45
Minus No. 200 (75 µm) Sieve Material, ITP 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/	---

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, 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 ITP 113.

10/ Test shall be run according to ITP 203.

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 current Bureau of Materials and Physical Research Policy Memorandum, "Aggregate Gradation Control System".

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.

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3/ When used in HMA (High and Low ESAL) mixtures, the percent passing the No. 16 (1.18 mm) sieve for gradations CA 8, 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.

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 current Bureau of Materials and Physical Research Policy Memorandum, "Aggregate Gradation Control System" 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 current Bureau of Materials and Physical Research 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, and 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 and Percent Passing						
		2 1/2 in.	2 in.	1 3/4 in.	1 1/2 in.	1 in.	1/2 in.	No. 4
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

Coarse Aggregates Art. 1004.02

Class of Concrete 1/	Combined Sizes	Sieve Size (metric) and Percent Passing						
		63 mm	50 mm	45 mm	37.5 mm	25 mm	12.5 mm	4.75 mm
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 (ITP 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

Use	Mixture	Aggregates Allowed	
Class A	Seal or Cover	<u>Allowed Alone or in Combination</u> [5/]: Gravel Crushed Gravel Carbonate Crushed Stone Crystalline Crushed Stone Crushed Sandstone Crushed Slag (ACBF) Crushed Steel Slag Crushed Concrete	
HMA Low ESAL	Stabilized Subbase or Shoulders	<u>Allowed Alone or in Combination</u> [5/]: Gravel Crushed Gravel Carbonate Crushed Stone Crystalline Crushed Stone Crushed Sandstone Crushed Slag (ACBF) Crushed Steel Slag[1/] Crushed Concrete	
HMA High ESAL Low ESAL	Binder IL-19.0 or IL-19.0L SMA Binder	<u>Allowed Alone or in Combination</u> [5/]: Crushed Gravel Carbonate Crushed Stone[2/] Crystalline Crushed Stone Crushed Sandstone Crushed Slag (ACBF) Crushed Concrete[3/]	
HMA High ESAL Low ESAL	C Surface and Leveling Binder IL-9.5 or IL-9.5L SMA Ndesign 50 Surface	<u>Allowed Alone or in Combination</u> [5/]: Crushed Gravel Carbonate Crushed Stone[2/] Crystalline Crushed Stone Crushed Sandstone Crushed Slag (ACBF) Crushed Steel Slag[4/] Crushed Concrete[3/]	
HMA High ESAL	D Surface and Leveling Binder IL-9.5 SMA Ndesign 50 Surface	<u>Allowed Alone or in Combination</u> [5/]: Crushed Gravel Carbonate Crushed Stone (other than Limestone)[2/] Crystalline Crushed Stone Crushed Sandstone Crushed Slag (ACBF) Crushed Steel Slag[4/] Crushed Concrete[3/]	
		<u>Other Combinations Allowed:</u>	
		Up to...	*With...*
		25% Limestone	Dolomite
		50% Limestone	Any Mixture D aggregate other than Dolomite
		75% Limestone	Crushed Slag (ACBF) or Crushed Sandstone

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Art. 1004.03 Coarse Aggregates

Use	Mixture	Aggregates Allowed	
HMA High ESAL	E Surface IL-9.5 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 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 leveling 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), other binder courses, and surface course IL-9.5L (Low ESAL), 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, 2, & 3	3/8 in. (10 mm) Seal	CA 16
Class A-1	1/2 in. (13 mm) Seal	CA 15
Class A-2 & 3	Cover	CA 14
HMA High ESAL	IL-19.0 IL-9.5	CA 11 1/ CA 16 and/or CA 13 CA 16
HMA Low ESAL	IL-19.0L IL-9.5L Stabilized Subbase or Shoulders	CA 11 1/ CA 16

1/ CA 16 or CA 13 may be blended with the gradations listed.

(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; Stabilized 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 stabilized subbase, 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/
Stabilized Subbase	CA 6 or CA 10 4/
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 5/
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 2, CA 4, or CA 12 may be used if approved by the Engineer.
5/ 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	---
Stabilized Subbase	0 to 9	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.

Art. 1004.05 Coarse Aggregates

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 ITP 104.

(c) Gradation. The coarse aggregate shall be CA 6 thru CA 16, except when epoxy coated steel, 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 current Bureau of Materials and Physical Research 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.

Illinois Department of Transportation

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

Effective: January 1, 1994
Revised: June 1, 2012

A. Scope

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

B. Purpose

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

C. Aggregate Source Gradation Bands

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

D. General Procedure

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

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

   At portland cement concrete plants, the Contractor may increase the specification limit for the minus 75-µm (No. 200) Illinois Test Procedure 11 sieve material upwards one half percent (0.5%) if the 75-µm (No. 200) material consists of dust from fracture, or degradation from abrasion and attrition, during stockpiling and handling (reference Article 1004.01[b] of the Department's *Standard Specifications for Road and Bridge Construction*.

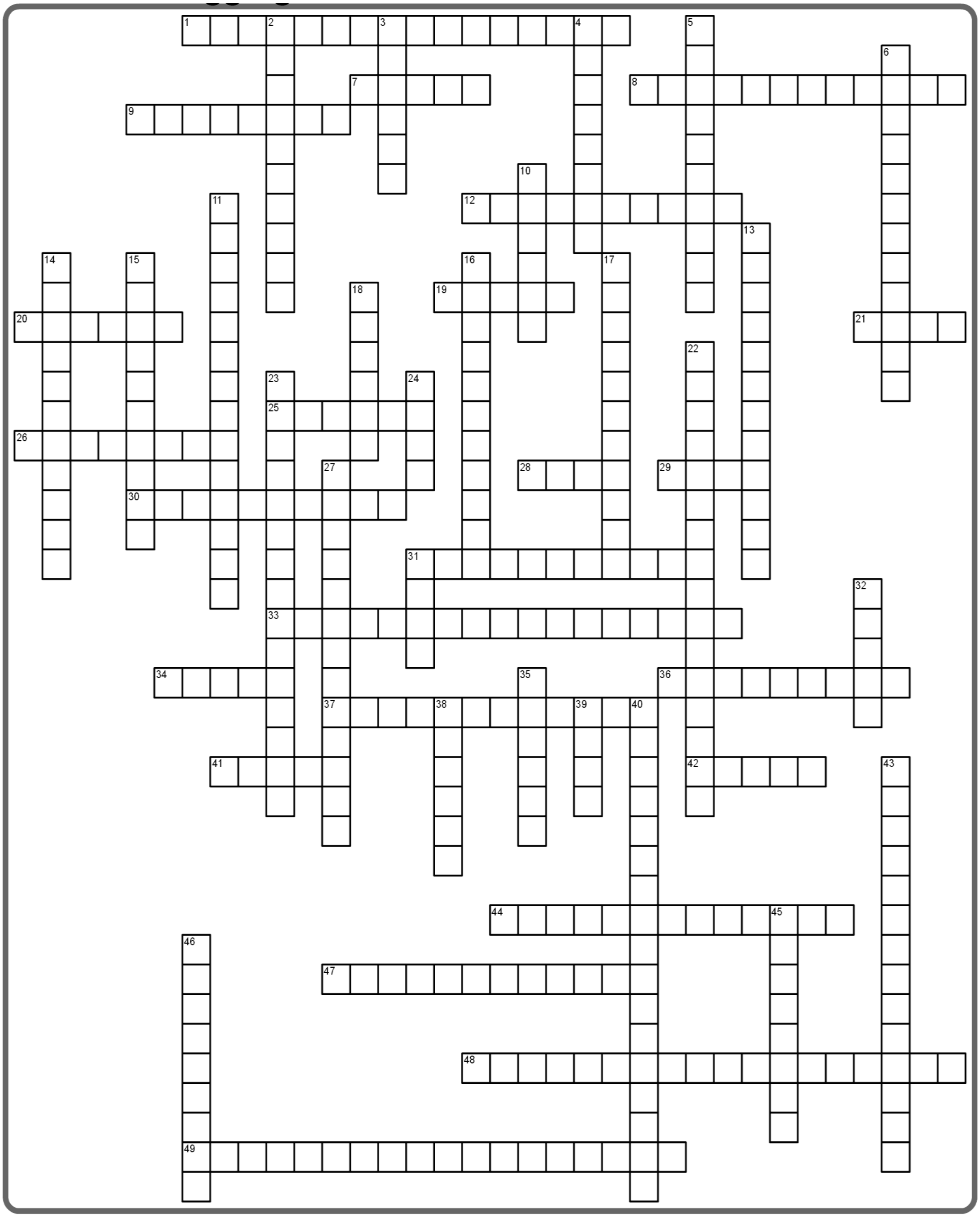
2. Manufactured Sand—All aggregate source gradation bands, except the top sieve and bottom sieve bands in the gradation specification, for each certified manufactured sand may be shifted upwards a maximum of three percent (3%). The top sieve and bottom sieve bands shall not be changed.

3. Natural Sand—The gradation bands obtained from the Department for each natural sand shall not be changed.

E. Department Approval

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

Mixture Aggregate Technician Crossword Review



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Mixture Aggregate Technician Crossword Review

Across:

1 Samples my be prepared or dried using an oven, ______________ or gas burner.

7 What is the test procedure following when performing the wash test?

8 When calculating the Minus #200 by washing we always divide by the ___________.

9 After submerging the sample during the wash test, the sample needs to be _________ to bring the fines into suspension in the water.

12 After the fine aggregate sample has been blended, the small conical pile is then flattened and divided into four approximate equal quarters with a shovel or trowel. Two diagonally opposite corners shall be removed, including all fine material. What reduction method uses this procedure?

19 Cumulative % retained is recorded to the nearest ________ of a percent.

20 The splitter shall be equipped with a ________ (preferred type) or a straightedge pan, either of which shall have a width equal to or slightly less than the overall width of the chutes.

21 When building a multi-layered stockpile, the material should not be dumped closer than two to _______ feet from the layer edge on all subsequent lifts.

25 This is one of four production sampling methods and requires production to be shut down in order to obtain a sample.

26 When completing this test procedure a nested set of sieves consisting of the #200 sieve; as well as, a protectant sieve from the #8 through the #16 must be used.

28 Under the QC/QA Program, who is responsible for quality assurance?

29 How many parts to the procedure are there for determining the gradation or particle size distribution of an aggregate?

30 A sampling device is passed uniformly through the entire (width and depth) stream or flow of material during this production sampling method. A minimum of three increments must be taken in a 10 to 15 minute period.

Down:

2 Who is responsible for quality control under the QC/QA Program?

3 These sieves are added to the nested set to help alleviate overloading of individual sieves.

4 This type of sampling device has two end plates and shall be designed to be adjustable. The end plates shall also be machined or cut to the approximate belt size and shape. This device can also be designed as a single end plate to be used in the sampling procedure if care is excercised.

5 This equipment can be used to remove wedged particles from all sieves, down through and including the #10 sieve.

6 The following formula will give you this result. (0.3% x Total Dry Mass)

10 This is everyone's responsibility?

11 Unless gradation samples are truly __________ of the material being produced and shipped, the test results are worthless for plan control or material acceptance.

13 With this type of stockpile, a ramp of material is constructed to allow the trucks to drive up onto the just-completed layer and dump material to build subsequent lifts.

14 A mechanical washing device, such as the _________, may be used for coarse aggregat samples providing the results match the manual procedure.

15 This type of device is not allowed for sampling.

16 This is the major problem associated with multi-layered stockpiles.

17 This is the major problem associated with conveyor built stockpiles.

18 This sampling equipment must be squared-nosed and have built-up back and sides of approximately 1 1/2 inches.

22 What is the fourth step in completing a gradation test?

23 The aggregate ___________ shall be determined by using the following formula: ((OSM-TDM) x 100).

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Mixture Aggregate Technician Crossword Review

Across:

31 Care shall be exercised to avoid cutting below the base of the stockpile, so as to not __________ the material being sampled or shipped.

33 The aggregate technician shall ___________ the sample on a gas burner or electric hot plate.

34 The sample must be placed into a mechanical shaker for a minimum of how many minutes?

36 This type of stockpile method is not used as often because the main problems associated with it is high cost and slow process.

37 The sample mass, at which there has not been more than 0.5 gram mass loss during one hour.

41 On the _______ split, the masses of the two halves, after splitting, shall be with +/- 10% of each other.

42 What test procedure would you follow when completing a dry sieve analysis?

44 A tent-shaped stockpile built using a radial or movable stacker.

47 This production sampling method requires approval from IDOT before it can be used.

48 This fine aggregate reduction method removes material from a sampling pad in a random "X" pattern, obtaining a minimum of five increments.

49 This is the splitting method required for most coarse aggregates.

Down:

24 What test procedure is followed when obtaining a field gradation sample?

27 When loading out from a fixed cone or elongated cone stockpile, the endloader operator should load out ___________ to belt flow.

31 This is the type of stockpile formed under a fixed or adjustable stacker.

32 After being cooled to room temperature, coarse aggregates are weighed to the nearest ________ gram.

35 This is the test procedure followed to reduce the field sample.

38 A fine aggregate mechanical splitter must have a minimum of how many chute openings?

39 The control system where the aggregate producer is reponsible for gradation control of the aggregate products produced and shipped for QC/QA projects.

40 Material is placed alongside the first layer and is pushed up by an endloader. This is considered a ______________ stockpile.

43 One of the five factors that dermine the amount of segregation in a conveyor built stockpile.

45 What is it called when a sieve has several layers of particles, one on top of the other, which do not permit the top layers to access the sieve openings?

46 When using this production sampling method, a small pile is mixed from two directions perpendicular to each other before being back dragged into a sampling pad of about a foot thick.

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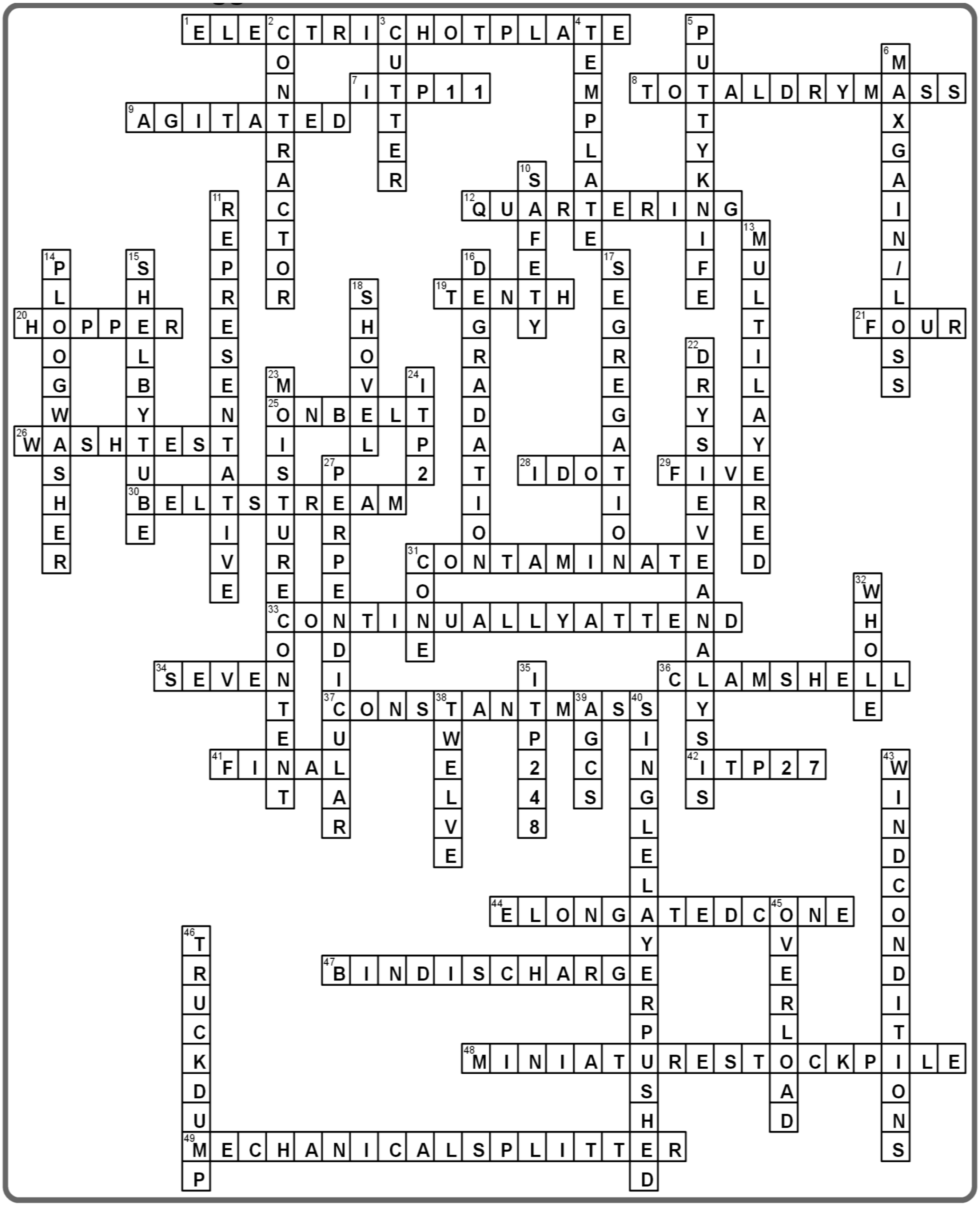
Mixture Aggregate Technician Crossword Review Solutions



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