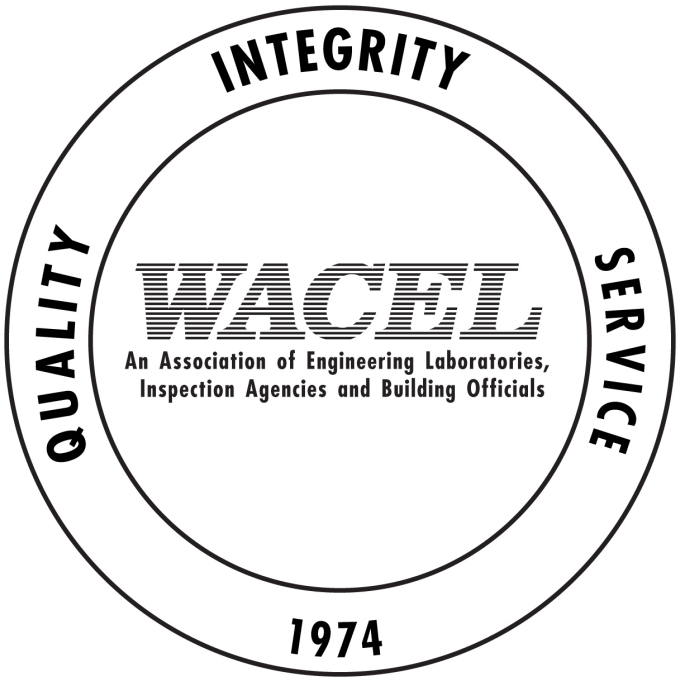

STUDY GUIDE

CONCRETE AGGREGATE LABORATORY TESTING TECHNICIAN

October 2023

Study Guide
Concrete Aggregate Laboratory Testing

General:

A Concrete Aggregate Laboratory Technician shall have sufficient training, education, and experience to conduct the testing of aggregate samples in the laboratory. ASTM C1077 gives guidance as to what standard test methods should be covered in this certification, and they are the following: ASTMs, C117, C127, C128, and C136. Technicians should be familiar with these standard test methods, how to properly perform the tests, and any calculations involved.

The WACEL Concrete Aggregate Laboratory Technician Certification is a two-part certification. A technician must successfully complete both a written examination and a hands-on "practical" examination. The written examination is 50 questions in length and covers the ASTM Standards listed above. A successful written examination score requires a technician to achieve at least 75 percent. The hands-on performance evaluation is to be administered to a technician by a WACEL approved practical evaluator. The 'practical' grading sheets are attached to this Study Guide. Instructions for administering the "practical" are included with the grading sheets.

Contact WACEL for arrangements to video tape evaluations.

Examinations:

Certification as a WACEL Aggregate Laboratory Testing Technician requires the successful completion of a 2-hour, written examination and a performance evaluation based on the referenced test methods.

This written examination is an open-book 50-question test that reasonably represents the learning objectives and references incorporated into this study guide. The references listed below can be used. Examination candidates should have copies of the listed refences with them, and the copies can contain no notes, markings, or highlighting. No other references are allowed. Simple calculators with no memory or printing capabilities are allowed. A grade of 75 percent is required for passing.

Mobile telephones are not allowed, and photo identification is required.

References:

A. ASTM C117-17, “Standard Test Method for Materials Finer Than 75µm (No. 200) Sieve in Mineral Aggregates By Washing.”

B. ASTM C127-15, “Standard Test Method for Relative Density (Specific Gravity) and Absorption of Coarse Aggregate.”

C. ASTM C128-22, “Standard Test Method for Relative Density (Specific Gravity) and Absorption of Fine Aggregate.”

D. ASTM C136-19, “Standard Test Method for Sieve Analysis of Fine and Coarse Aggregate.”

Learning Objectives:

I. Can determine and report the amount of material fine than a 75-µm (No. 200) sieve in mineral aggregate by washing in accordance with ASTM C117 (Procedure A).

A. Knows the two different procedures that are authorized and the differences between them.

B. Is aware of the differences in when conducting wet sieving rather than dry sieving.

C. Understands how the results from using this test method can be used with ASTM C136 results for the same sample.

D. Can determine the minimum size of the test sample based on the nominal, maximum aggregate size of the aggregate being evaluated.

E. Knows how to properly soak the test sample using plain water.

F. Can properly accomplish the wash to include pouring the wash water over the appropriate nested sieves.

G. After recombining all of the retained material and drying, can correctly compute the percentage of the material fine than the 75-µm (No. 200) sieve by washing.

II. Can properly determine the relative density (specific gravity) and absorption of coarse aggregate in accordance with ASTM C127.

A. Knows how to properly select and prepare a test sample of the coarse aggregate being evaluated.

B. Is aware that all material passing a 4.75-mm (No. 4) sieve is typically rejected from the test sample. Is aware of alternatives.

C. Knows that the remaining material is thoroughly washed to remove dust and other coatings.

D. Can determine the minimum mass of the test sample based on the nominal maximum aggregate size.

E. Knows that it is required for the test sample to be dried to a constant mass and allowed to cool prior to being immersed in water at room temperature for 24± 4 hours.

F. Knows how to roll the test sample in a large absorbent cloth to remove all visible water and without allowing pore water to evaporate in determining the saturated – surface dry (SSD) mass to the nearest 0.5g or 0.05% of the sample mass, whichever is greater.

G. Knows to immediately place the entire sample in an appropriate container and fully immerse it in water at 23± 2.0°C to determine its apparent mass in water to the same accuracy discussed in F above.

H. Knows to oven dry the sample to a constant mass. After cooling, determined the oven dry mass to the same accuracy discussed in F above.

I. Using the oven-dry mass in air, the SSD mass in air, and the apparent mass in water, can compute the relative density (specific gravity) (both OD and SSD) and absorption using the formulae in ASTM C127.

III. Can properly determine the relative density (specified gravity) and absorption of fine aggregate in accordance with ASTM C128.

A. Knows how to properly select and prepare a test sample of the fine aggregate being evaluated.

B. Knows that the test sample should be immersed in water or have at least 6 percent moisture added and allowed to stand for 24± 4 hours.

C. After water is decanted, is aware of the process of spreading the sample in a nonabsorbent surface, exposing it to a warm current, and the need for the sample to be stirred frequently.

D. When saturated-surface dry (SSD) condition is estimated, knows the process using cone and tamper to confirm if the SSD condition has been reached.

E. Knows the proper procedures to either add additional moisture or to continue the drying process.

F. Can determine the volume of a portion of the sample using either the gravimetric (pycnometer) or volumetric (Le Chatelier Flask) procedures.

G. Using the oven dry mass of the specimen, the mass of the saturated surface-dry specimen volumetric data from either the use of a pycnometer or a Le Chatelier Flask, can compute the relative density (specific gravity) (both OD and SSD) and the absorption using the formulae in ASTM C128.

IV. Can properly conduct a sieve analysis of fine and coarse aggregate in accordance with ASTM C136.

A. Is aware that this test method does not result in an accurate determination of material finer than the 75-µm (No. 200) sieve, and that the procedures described in ASTM C117 should be used.

B. Knows how to properly select and prepare a test sample of the aggregate being evaluated.

C. Knows the minimum test sample size of coarse and fine aggregate mixtures based on the nominal maximum aggregate size.

D. Is aware that if this test method is to be used on conjunction with ASTM C117 for material finer than the 75-µm (No. 200) sieve that the same test sample should be used and that the ASTM C117 procedure should be accomplished first.

E. Knows how to properly dry the selected test sample to a constant mass.

F. Knows how to properly select the sieved to be used to meet project specifications, to regulate the material retained on any sieve, and to allow for the determination of a fineness modulus if required.

G. Is aware of various options that can be used to prevent an overload of material on any individual sieve.

H. Knows how to properly conduct the required sieving by either hand sieving or use of a mechanical sieve shaker.

I. Knows the approximate maximum sieving time using a mechanical shaker to prevent degradation of the sample.

J. Knows to determine the mass of the material retained on each sieve and that the total of these masses should closely check with the original mass of the test sample.

K. Can calculate percentages passing, the percentages retained, and the total percentages retained to the nearest 0.1 percent based on the total mass of the initial dry sample.

L. Can compute, if required, the fineness modulus of the sample based on cumulative percent retained on the specific sieve sized listed in ASTM C136.

Enclosure: Skills Checklist for Practical Evaluation

Name (Technician): _____ Date(s): _____

Office / Location: _____ Final Rating (P or F): _____

Name of Examiner: _____

INSTRUCTIONS

All of the tests included in this set of worksheets must be performed by the technician and witnessed by an approved WACEL examiner. The examiner need not witness all steps for the sample preparation; this portion can be talked through. Not all of the tests need to be witnessed on the same date. If tests are spread out over several days, include the range of dates above on the date line and include the actual date of witness for each test method in the box requiring the signature of the examiner.

Arrangements can be made with WACEL for the submission of the performance evaluations by video tape.

Rate the performance appropriately and score the overall performance as either pass or fail. A failure of any individual test will result as a failure of the practical exam. The examiner shall sign as witnessing each individual test method.

ASTM C127-15 Coarse Aggregate Specific Gravity (Relative Density) and Absorption	**Pass**	**Fail**	**N/A**
1. Sample obtained by C702 (splitting, quartering, or mini-stockpile).			
2. Sample 'scalped' over No. 4 sieve (No. 8 if substantial minus No. 4 material).			
3. Sample washed to remove dust or other coatings from the surface.			
4. Sample mass meets the minimum sample mass required: Nominal Maximum Aggregate Size — Minimum Sample Mass, kg ½" or smaller — 2 ¾" — 3 1" — 4 1 ½" — 5 2" — 8			
5. Sample dried to constant mass in an oven at 110±5˚C and cooled for 1 to 3 hours. Note: Oven drying is not required if the aggregate is to be tested in their naturally moist condition.			
6. Immerse the sample in water (room temperature) for 20 to 28 hours.			
7. Sample removed from water and rolled in large absorbent cloth to remove visible films of water.			
8. Care taken to avoid evaporation from aggregate pores.			
9. Sample mass (SSD) determined to 0.5 g or 0.05% of sample mass, whichever is greater.			
10. Sample immediately placed in sample container.			
11. Sample immersed in water at 21 to 25°C and entrapped air removed by shaking.			
12. Apparent mass in water determined.			
13. Sample dried to constant mass in oven at 110°C and cooled for 1 to 3 hours.			
15. Sample mass determined.			
16. Specific gravities calculated as follows:			
a. Specific Gravity (OD) (to nearest 0.01) = Oven Dry Mass in Air / SSD Mass – Mass in Water			
b. Specific Gravity (SSD) (to nearest 0.01) = Mass of SSD Sample in Air / Mass of SSD Sample in Air – Mass in Water			
c. Specific Gravity (Apparent) (to nearest 0.01) = Oven Dry Mass in Air / Oven Dry Mass in Air – Mass in Water			
17. Calculate percentage of absorption: Absorption = (Mass of SSD Sample in Air – Oven Dry Mass in Air) / Oven Dry Mass in Air X100 (to nearest 0.1)			
Signature of examiner observing — OVERALL			

ASTM C117-17 Minus #200 By Washing (Procedure A)	Pass	Fail	N/A
1. Sample obtained by C702 (splitting, quartering, or mini-stockpile).			
2. Sample mass meets the minimum sample mass required. Nominal Maximum Aggregate Size — Minimum Sample Mass, g #4 or smaller — 300 > #4 to 3/8" — 1000 > 3/8" to ¾" — 2500 > ¾" — 5000			
3. Sample dried to constant mass at 110±5˚C.			
4. Drysample mass determined to 0.1%.			
5. Sample placed in container and covered with water.			
6. Sample agitated vigorously enough to separate fines from coarser particles.			
7. Wash water poured off through nest of sieves (No. 16 over No. 200).			
8. Care taken to avoid the decantation of coarser particles.			
9. Operation repeated until the wash water is clear.			
10. All material retained on nested sieves returned to washed sample.			
11. If decanting excess water, it must go through the No. 200 sieve.			
12. Washed aggregate dried in an oven at 110°C.			
13. Sample mass determined to nearest 0.1% of the original sample mass.			
14. Amount of material passing the No. 200 sieve calculated as follows: % Finer than No. 200 = $\frac{\text{Original Dry Mass – Dry Mass After Washing}}{\text{Original Dry Mass}}$ X 100			
Signature of examiner observing **OVERALL**			

ASTM C128-22 Fine Aggregate Relative Density (Specific Gravity and Absorption)	**Pass**	**Fail**	**N/A**
• **Sample preparation**			
1. Obtain approximately 1 kg sample of aggregate in accordance with ASTM C702.			
2. Oven dry at 110±5˚C and allow to cool. (Note: Optional if aggregate will be in naturally moist condition when used.)			
3. Immerse with water or add at least 6% moisture.			
4. Sample allowed to stand 24±4 hours.			
5. Decant excess water taking care to avoid the loss of fines.			
6. Spread sample on a flat, nonabsorbent surface.			
7. Uniformly dry the sample with a gently moving current of warm air, stirring frequently.			
8. Cone held firmly on a flat, nonabsorbent surface and filled to overflowing.			
9. Lightly tamp with 25 drops of the tamper, starting each drop approximately 5 mm above the surface.			
10. Loose sand removed from around base and cone lifted vertically. ***Slight*** slumping indicates SSD. ***Note:*** *If sample slumps on first test, add water and allow to stand for 30 minutes.*			
11. Continue drying and testing slump (frequently) until the sample slightly slumps.			
12. Test by ***Gravimetric Procedure*** or ***Volumetric Procedure***, making all mass determinations to 0.1 g.			
• ***Gravimetric (Pycnometer) Procedure***			
1. Pycnometer partially filled with water, and then 500 ± 10 g of SSD sample introduced.			
2. Pycnometer filled with additional water to approximately 90% of capacity.			
3. Agitate pycnometer to eliminate air bubbles by one of the following: – *Manually* – Roll, invert, and agitate for about 15 to 20 minutes. – *Mechanically* – In a manner that will not degrade the sample. ***Note:*** *Comparison testing for each 6-month period of use should fall within acceptable ranges listed in Table 1 of C128 if mechanical means are used*.			
4. Adjust the temperature of the pycnometer and contents to 21.0 to 25.0°C and then bring water level to calibration mark. ***Note:*** *A paper towel or isopropyl alcohol may be used to eliminate foam.*			
5. Total mass of pycnometer, sample, and water determined.			
6. Sample removed from pycnometer and dried to constant mass at 110°C.			
7. Sample cooled for ½ to 1 ½ hours and mass determined to 0.1 g.			
8. Pycnometer previously calibrated or mass determined filled with water at 21.0 to 25.0°C.			
9. Specific gravity (OD) calculated by: Specific Gravity (OD) = Oven Dry Mass of Sample / (Mass of pycnometer with water to calibration mark + Mass of SSD specimen – Mass of pycnometer with water and specimen to calibration mark).			
- OR-			

ASTM C128-22 Fine Aggregate Relative Density (Specific Gravity and Absorption) (Cont'd)	**Pass**	**Fail**	**N/A**
• ***Volumetric (Le Chatlier Flask) Procedure***			
1. Flask filled with water to point on stem between 0 and 1-mL mark and adjust to 21.0 to 25.0°C.			
2. Record this as the initial volume reading.			
3. 55 ± 5 g of SSD aggregate added (or, as necessary, other measured quantities are acceptable).			
4. Flask stoppered and agitated to eliminate air bubbles. ***Note:*** *A small amount of isopropyl alcohol (< 1 mL) may be used to eliminate foam. This amount of alcohol must be subtracted from the final reading.*			
5. Final reading taken, with flask and contents within 1°C of original temperature.			
6. For absorption, a separate 500 ± 10 g portion of SSD sample should be dried to constant mass.			
7. Specific gravity (OD) calculated by: Specific Gravity (OD) = $\frac{\text{Mass/Mass of SDD Specimen}}{0.9975\ (\text{final water level} - \text{Initial water level})}$			
Signature of examiner observing **OVERALL**			

ASTM C136-19 Sieve Analysis of Fine and Coarse Aggregates (CONT'D)	Pass	Fail	N/A
1. Sample obtained by C702 (splitting, quartering, or mini-stockpile).			
2. Sample size at least 300 g for ***fine aggregate***.			
3. Sample size conforms to the following for ***coarse aggregate*** (additional sizes are given in C136): Nominal Maximum Aggregate Size — Minimum Sample Mass, kg 3/8" — 1 ½" — 2 ¾" — 5 1" — 10 1 ½" — 15			
Fine Aggregate Initial Mass: _____ Final Mass:			
1. Sample mass determined to 0.1% of sample mass.			
2. Select sieves with suitable openings and will help prevent overloading (splitting sample if necessary).			
3. Sample placed in sieve stack and agitated.			
4. Sieving operation continued until not more than 1% on any individual sieve passes that sieve during one minute of continuous hand sieving. (Use 8" dia. sieves to check. Choose one sieve at random) Sieve Size: _____ Mass Retained: _____ Mass Passing: _____			
5. Mass of material retained on each sieve determined to 0.1% of total mass.			
6. Overloading of sieves avoided (sieves finer than #4: 227 g for 8", 511 g for 12")			
7. Total cumulative mass after sieving agrees within 0.3% of the mass before sieving. ***Note:*** *If not, the results should not be used for acceptance testing.*			
8. If sample was obtained from C117, the mass finer than No. 200 (from C117) should be included.			
9. Percentages (passing, retained, or various size fractions) calculated to ***0.1% of initial dry sample***.			
Coarse Aggregate Initial Mass: _____ Final Mass: _____			
1. Sample mass determined to 0.1% of sample mass.			
2. Select sieves with suitable openings and will help prevent overloading (splitting sample if necessary).			
3. Sample placed in sieve stack and agitated.			
4. If hand sieving, particles are not forced to pass through an opening.			
5. Sieving operation continued until not more than 1% on any individual sieve passes that sieve during one minute of continuous hand sieving. (Use 8" dia. sieves to check. Choose one sieve at random) Sieve Size: _____ Mass Retained: _____ Mass Passing: _____			
6. Mass of material retained on each sieve determined to 0.1% of total mass.			
7. Overloading of sieves avoided: – Sieves finer than #4: 227 g for 8", 511 g for 12" – 8" diameter sieves > #4: #4 – 330g, 3/8" – 670 g, ½" – 890 g, ¾" – 1400 g, 1" – 1800 g – 12" diameter sieves > #4: #4 – 800 g, 3/8" – 1600 g, ½" – 2100 g, ¾" – 3200 g, 1" – 4200 g			
8. Total cumulative mass after sieving agrees within 0.3% of the mass before sieving. ***Note:*** *If not, the results should not be used for acceptance testing.*			
9. Percentages (passing, retained, or various size fractions) calculated to ***0.1% of initial dry sample***.			
Signature of examiner observing **OVERALL**			