

**DEPARTMENT OF TRANSPORTATION**  
**DIVISION OF ENGINEERING SERVICES**  
Transportation Laboratory  
5900 Folsom Blvd.  
Sacramento, California 95819-4612



## METHOD OF TEST FOR SOIL AND AGGREGATE SAMPLE PREPARATION

### A. SCOPE

This method describes the processes for preparing untreated aggregate and disturbed soil samples, as received from the field, for the required tests. Separation by screening, weighing, removing soil coatings from coarse aggregate, breaking up clods, and splitting out representative test samples of specified size are described.

### B. REFERENCES

AASHTO M 92 - Standard Specification for Wire-Cloth Sieves for Testing Purposes  
California Test 105 - Calculations Pertaining to Gradings and Specific Gravities  
California Test 202 - Test for Sieve Analysis of Fine and Coarse Aggregates  
California Test 227 - Test for Evaluating Cleanness of Coarse Aggregate

### C. APPARATUS

1. Sieves: U. S. Standard sieves conforming to AASHTO Designation: M 92. The standard sieve series shall include the following sizes: 3 in., 2½ in., 2 in., 1½ in., 1 in., ¾ in., ½ in., 3/8 in., No. 4. Other U. S. Standard sieves may be added for special purposes.
2. Sieve shaker: Any mechanical sieve shaker, which accomplishes the thoroughness of sieving specified below:
  - a. Not more than 0.5 % of the sample mass shall pass any sieve during one minute of hand sieving.
  - b. Hand sieving shall be by means of a lateral and vertical motion of the sieve, accompanied by a jarring action, which keeps the sample moving continuously over the surface of the sieve. Do not turn or manipulate particles through the sieve by hand.
3. Crusher: A jaw crusher, which can be adjusted to produce material passing the No. 4 sieve. A sledgehammer may be used to reduce oversize particles enough to permit the material to be fed into the crusher.
4. Quartering canvas or sample splitters: If using splitters, a minimum of three riffle type splitters of different sizes are required. Sample splitters shall have an even number of equal-width chutes, but not less than a total of 8 for coarse aggregate and 12 for fine aggregate, which discharge alternately to each side of the splitter. The minimum width of the individual chutes shall be approximately 50 % larger than the largest particles in the sample to be split. 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.

5. Rock cleaning and clod-breaking device: A device for removing fines from coarse aggregate particles and for breaking up clods without appreciably reducing the natural individual particle sizes. The following devices may be used on most materials:
  - a. Stiff fiber brush.
  - b. Mortar and rubber-covered pestle.
  - c. Soil-pulverizing apparatus consisting of the following:<sup>1</sup>
    - (1) Containers: Steel drums approximately 11 in. in diameter, 15 in. in length, 6 gal capacity, and having positive seal covers with flowed-in rubber seals and lever-lock fastening devices.
    - (2) Rollers: Rubber-covered metal bars approximately 2 in. outside diameter and 1 to 3 in. shorter than the inside length of the container. Cold rolled steel bars, 1½ in. in diameter, 13 to 14 in. long, covered with fuel oil hose (U. S. Royal P5196 or equivalent) are satisfactory for use with the 6 gallon containers. The exact dimensions of the container and rollers are not critical provided adequate pulverizing can be accomplished without reducing the natural individual particle size.
    - (3) Rotating device: A motor-driven apparatus capable of rotating one or more containers at a rate of approximately 65 rpm.
6. Sample containers: Various-sized metal containers are required, some of which should have the following approximate capacities: 30,000 g, 7,000 g, 3,500 g, 300 g, and 100 g.
7. A facility to accommodate the removal of moisture from wet samples. When air drying is not practical, typical equipment may be fans with or without heating coils or a vented forced draft oven capable of maintaining a temperature of 140°F or less.

#### **D. SAMPLE IDENTIFICATION**

Each sample shall be given an identification number, which shall be written on suitable cards or tickets. One of these cards or tickets bearing the sample identification number shall accompany each portion of the sample throughout the processing and testing of the material.

#### **E. DRYING OF SAMPLES**

1. Dry wet samples sufficiently to permit a complete separation on the No. 4 sieve and to develop a free-flowing condition in the portion passing the No. 4 sieve. Drying may be performed by any means, which does not heat the aggregate in excess of 140°F or cause degradation of the particles. The use of sunlight, ovens, or forced drafts of warm air are the most common drying methods.

---

<sup>1</sup>For details of this soil-pulverizing apparatus see Suggested Mechanical Method for Breaking up Soil Aggregations by C. M. Johnson and J. R. Blystone, "Procedures for Testing Soils", ASTM 1958.

- a. Drying can be expedited by occasionally stirring the material during the drying process.
- b. Drying may be done at  $230^{\circ}\text{F} \pm 9^{\circ}\text{F}$  when all subsequent tests are required or permit drying at this temperature.

**F. SEPARATING COARSE AND FINE PORTIONS ON THE NO. 4 SIEVE**

1. Follow the sieving instructions in California Test 202 to separate the material on the No. 4 sieve.
2. Separation of the coarse portion into individual coarse-size fractions may be done simultaneously with the separation on the No. 4 sieve if desired.
3. Remove coatings from coarse aggregate and break up clods retained on the No. 4 sieve as prescribed in Section F.
4. Combine all of the passing No. 4 sieve material accumulated from the various steps of sieving, removing coatings, and clod breaking.
5. Retain the passing No. 4 sieve material and each separated coarse-size fraction in separate containers.

**G. REMOVAL OF COATINGS FROM COARSE AGGREGATES AND BREAKING UP OF CLOUDS**

1. Hard clods of material with a natural particle size smaller than the No. 4 sieve must be broken up to pass the No. 4 sieve. Coatings on coarse aggregate particles must also be removed and included with the passing No. 4 sieve material.
2. Any method, which does not appreciably reduce the natural individual particle sizes, may be used. Three approved methods are described below.
  - a. Mortar and rubber-covered pestle.
    - (1) Place a portion of the retained No. 4 sieve material in the mortar.
    - (2) Use a pushing and twisting motion with the pestle to apply a grinding action to the material.
    - (3) Do not pound the material in such a way as to cause fracturing of aggregate particles.
    - (4) Separate the material on the No. 4 sieve and add the passing No. 4 portion to the fine material previously separated.
    - (5) Repeat this procedure on all portions of the retained No. 4 material until the clods have been broken and the coarse particles appear to be free of coatings.
  - b. Soil pulverizing apparatus.
    - (1) Place a minimum of approximately 5 lb of the retained No. 4 sieve material in the steel drum.

- (2) Place two or three rollers in the drum with the material and secure the dust-proof cover in place.
- (3) Position the drum horizontally on the rotating device.
- (4) Start the device and rotate the drum and its contents as necessary to break up clay lumps and loosen coatings.

NOTE: When large quantities of fines are generated, the pulverizing process should be interrupted periodically to permit resieving and removal of the portion, which will pass the No. 4 sieve. Because of variations in materials, operator judgment is required to determine the number of rollers and the rotation time to be used.

c. Wash method.

- (1) Place the retained No. 4 sieve portion in a suitable container and cover with water.
- (2) Soak for sufficient time to soften the lumps and coatings.
- (3) Hand wash the individual particles and disperse the lumps.
- (4) Remove the cleaned retained No. 4 sieve particles from the wash water and dry to constant mass at  $230^{\circ}\text{F} \pm 9^{\circ}\text{F}$ .
- (5) Evaporate the water from the residual material. Do not heat to a temperature greater than  $140^{\circ}\text{F} \pm 9^{\circ}\text{F}$ .

#### H. ADJUSTING GRADING OF SAMPLES

1. When it is necessary to adjust the grading of a sample prior to testing in order to bring the material within a specified grading, the adjustments of scalping, wasting, or combining materials should be such that it can be duplicated under field conditions. See California Test 105 for information and instruction on aggregate grading adjustments.
2. When the sample submitted for preliminary tests represents aggregate which will require crushing on the job, crush the oversize aggregate to such a degree that a blend made with the crushed and uncrushed portions will conform to the proposed grading specifications. Perform a coarse sieve separation (California Test 202) on the crushed portion and record the mass on the appropriate work card.

#### I. SECURING REPRESENTATIVE PORTIONS FOR SPECIFIED TESTS

1. Refer to the respective test methods for grading requirements and quantity of materials needed.
2. Split or quarter the sample into representative portions for the various tests. The use of a sample splitting device is preferred. However, hand quartering is acceptable if carefully performed.
  - a. Splitting sample with mechanical device.

- (1) Thoroughly mix the sample and spread it evenly across the pan or hopper.
  - (2) Open the hopper gate or pour the material from the pan so that the material flows evenly through all of the chutes. Control the rate of discharge as necessary to maintain a continuous flow of material through the chutes.
  - (3) Continue to split or combine successive portions until the desired sample size is achieved.
- b. Hand quartering a sample mass exceeding 100 lb.
- (1) Mix and pile the sample on a quartering canvas. Shovel the material into the center to form a cone. Place each shovelful so that the material spills over the cone equally in all directions to mix the sample. Dampen samples, which tend to segregate before proceeding with the following steps.
  - (2) Flatten the cone with a shovel, spreading the material to a circular layer of uniform thickness.
  - (3) Insert a stick or pipe beneath the canvas and under the center of the pile, then lift both ends of the stick, dividing the sample into two equal parts. Remove the stick leaving a fold of canvas between the divided portions.
  - (4) Insert the stick under the center of the pile at right angles to the first division and again lift both ends of the stick, dividing the sample into four parts. In lieu of dividing by use of a stick, a shovel may be used to divide the sample into four equal parts.
  - (5) Remove two diagonally opposite quarters, being careful to clean the fines from the canvas.
  - (6) Remix the remaining material by taking alternate shovelfuls from each remaining quarter and placing it in the center so that a cone is formed as before. Repeat the quartering process until the sample is reduced to the desired size.
- c. Hand quartering a sample mass between 25 lb to 100 lb.
- (1) Pile the sample on the canvas and mix by alternately lifting each corner of the canvas and pulling it over the sample toward the diagonally opposite corner, causing the material to be rolled. Dampen material, which tends to segregate.
  - (2) Flatten and quarter as specified above.
- d. Hand quartering a sample mass less than 25 lb.
- (1) Place the sample on a canvas or a clean sheet of heavy paper. Mix thoroughly with a trowel and form the material into a conical pile. Dampen material, which tends to segregate.

- (2) Flatten the cone by pressing it down with a trowel.
  - (3) Divide the material into quarters with the trowel and remove diagonally opposite quarters.
  - (4) Repeat the above process until the sample is reduced to the desired size.
- e. Samples of coarse aggregates, which have been separated into basic sizes using the standard coarse sieve series, may be obtained by scooping the required amount from each size fraction. Do not scoop or pour out samples of passing No. 4 sieve material or samples of coarse aggregate, which has not been separated into basic sizes using the standard coarse sieve series.
3. After the required test samples have been prepared, save the remainder of the submitted sample for possible future check tests.

#### **J. PRECAUTIONS**

1. If the Test for Evaluating Cleanness of Coarse Aggregate, California Test 227, is to be performed on the submitted sample, prepare this test sample from the material in an "as received" condition. Samples, which have been subjected to any form of cleaning or any sieving action, other than that specified in California Test 227, may not be used for determining the cleanness of the aggregate.
2. When possible, attempt to duplicate field conditions when preparing test samples. For example, do not remove coatings from AC bin samples when the material is to be used in fabricating asphalt concrete test specimens.
3. Check sieves frequently for broken or distorted wires. Repair or replace defective sieves.
4. Periodically check splitters for accuracy by taking a dry sample of material, which tends to segregate, and dividing it into eight or more equal parts by use of the splitter. Then weigh and grade several of the parts and compare.
5. Review the test procedures for which the samples are being prepared frequently to make sure the samples are processed in accordance with these procedures.

#### **K. SAFETY AND HEALTH**

Soils and aggregates may contain bacteria and/or organisms, which can be harmful to one's health. The wearing of dust masks and protective gloves when handling materials is advised.

Dust, noise, lifting and the operation of equipment are encountered in this testing procedure. It is not possible to completely eliminate these risks, but steps should be taken to minimize them as much as possible.

The use of dust collection units and the spraying of workroom floors with dust palliatives are very effective methods of reducing dust conditions.

The use of earplugs or earmuffs is recommended when operating noisy equipment. Enclosures built around noisy equipment can eliminate much of the noise. The use of sound deadening material should be utilized when appropriate.

Guards or shields must be provided around dangerously exposed moving parts of machinery. Also, personnel will be instructed in the proper operation of each machine and in proper lifting methods. The use of back support braces and table-height carts to move materials can eliminate much of the lifting.

Caltrans Laboratory Safety Manual is available at:

[http://www.dot.ca.gov/hq/esc/ctms/pdf/lab\\_safety\\_manual.pdf](http://www.dot.ca.gov/hq/esc/ctms/pdf/lab_safety_manual.pdf)

**End of Text  
(California Test 201 contains 7 pages)**