

State of Nevada
Department of Transportation
Materials and Testing Division

METHOD OF TEST FOR SOIL AND AGGREGATE SAMPLE
PREPARATION

SCOPE

This method describes the process for preparing untreated aggregate and disturbed soil samples, as received from the field, for the required tests. Separation by sieving, weighing, removing soil coatings from aggregate, breaking up clods, and splitting out representative test samples of specified size are some of the more important phases of sample preparation.

A. APPARATUS

1. Sieves. Woven wire cloth sieves with 75 mm (3 in.), 63 mm (2 1/2 in.), 50 mm (2 in.), 37.5 mm (1 1/2 in.), 25 mm (1 in.), 19 mm (3/4 in.), 12.5 mm (1/2 in.), 9.5 mm (3/8 in.), 4.75 mm (No. 4), 2.00 mm (No.10), and 0.425 mm (No. 40) sieves with square openings conforming to AASHTO Designation M92.
2. Sieve shaker. Any mechanical sieve shaker may be used which produces the thoroughness of sieving required, i.e., not more than 1 percent by weight of the residue retained on any sieve after mechanical sieving is completed shall pass that sieve during one minute of continuous hand sieving as described under Sieving Procedure of Test Method Nev. T206.
3. Crusher. A jaw crusher which can be adjusted to produce material passing the 4.75 mm (No. 4) sieve. A sledge hammer may be used to reduce oversize particles enough to permit the material to be fed into the crusher.
4. Heavy duty scale. A scale with a minimum of 20 000 g capacity and sensitive to 20 g.
5. Scale or balance. A scale or balance with 5000 g capacity and sensitive to 1 g.
6. Splitter. Any device may be used which will divide the sample into representative portions. However, the riffle-type splitter is preferable to hand quartering. When riffle splitters are used, three are required; one with

chutes approximately 37.5 mm (1-1/2 inches) wide for coarse aggregates up to 25 mm (1 inch) maximum in size, one with chutes approximately 19 mm (3/4 inch) wide for samples passing 4.75 mm (No. 4) sieve for material weighing 5000 g or more, and one with chutes approximately 9.5 mm (3/8 inch) wide for samples passing 4.75 mm (No. 4) sieve for material weighing less than 5000 g.

7. Pulverizing apparatus. Either a mortar and rubber-covered pestle or a mechanical device consisting of a power-driven rubber-covered muller suitable for breaking up the aggregations of soil particles without reducing the size of the individual grains.

NOTE 1: Other types of apparatus, such as a revolving drum into which the soil sample and rubber-covered rollers are placed and tumbled until soil aggregations are pulverized, are satisfactory if the aggregations of soil particles are broken up without reducing the size of the individual grains.

8. Sample containers. Various sized metal containers are required, some of which have the following approximate capacities: 50 000 g, 7000 g, 3500 g, 300 g, and 100 g.

B. 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.

C. TEST RECORD FORM

Record the test data on the appropriate work sheet.

D. INITIAL PREPARATION OF TEST SAMPLES FOR LIQUID LIMIT AND/OR PLASTIC LIMIT

1. The soil or aggregate sample shall be dried thoroughly in air or a drying apparatus at a temperature not exceeding 60°C (140° F). A representative test sample shall then be obtained with the sampler, or by splitting or quartering as per section G. of this test method.

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This sample shall be approximately 6000 g for coarse material (retained on the 4.75 mm (No. 4) sieve and approximately 1000 g for fine material (passing the 4.75 mm (No. 4) sieve). Split the sample in half and perform the following procedures on one half of each sample (either 3000 g or 500 g). The aggregations of soil particles shall then be broken up in the pulverizing apparatus in such a way as to avoid reducing the natural size of individual particles.

NOTE 2: Samples dried in an oven or other drying apparatus at a temperature not exceeding 60°C (140° F) are considered to be air dried.

2. The dried sample shall first be separated into two fractions using a 2.00 mm (No. 10) sieve. The fraction retained on this sieve shall be ground thoroughly with the pulverizing apparatus, and/or thoroughly cleaned with a stiff brush, if coatings exist, until the aggregation of soil particles are broken into separate grains. This process of grinding, brushing, and sieving over the 2.00 mm (No. 10) sieve shall be repeated until the material is visibly free of clay lumps, clods, and coatings, and until no appreciable amount of material passes the 2.00 mm sieve, and the material retained on the 2.00 mm sieve consists only of individual sand and gravel grains. The ground soil shall then be separated into two fractions using the 2.00 mm sieve, and the material now retained on the 2.00 mm sieve shall be discarded.
3. The portion of the material passing the 2.00 mm (No. 10) sieve shall then be separated into two parts by means of a 0.425 mm (No. 40) sieve. The fraction retained on the 0.425 mm sieve shall be ground with the pulverizing apparatus in such a manner as to break up the aggregations without fracturing the individual grains. If the sample contains brittle particles, such as flakes of mica, fragments of sea shells, etc., the pulverizing operation shall be done carefully and with just enough pressure to free the finer material that adheres to the

coarser particles. The ground soil shall then be separated into two fractions by means of the 0.425 mm sieve, and the material shall be reground as before.

This process of grinding and sieving over the 0.425 mm sieve shall be repeated until no appreciable amount of material passes the 0.425 mm sieve, and the material retained on the 0.425 mm sieve consists only of individual sand and gravel grains. At this point, the material retained on the 0.425 mm sieve shall be discarded. The several fractions passing the 0.425 mm sieve obtained from the grinding and sieving operations just described, shall be thoroughly mixed together and set aside for use in performing the physical tests.

If unable to obtain specified material quantity required in performing physical tests, reserve material obtained and repeat steps 2 through 3 on remaining half of split sample. If material quantity obtained by completing steps 2 through 3 on first half of split sample combined with quantity obtained on second half of split sample does not generate specified material quantity to perform the physical tests, physical tests shall be documented as "unable to obtain required amount of material".

E. SIEVING OF SAMPLES - COARSE AGGREGATE

1. If the coarse aggregate particles contained in a sample are clean or are only lightly coated with fines which can be easily removed by sieving it will not be necessary to subject the coarse portion to a cleaning process prior to performing the coarse sieve analysis.
2. Perform the coarse aggregate sieve analysis by separating the sample on the following sieves: 75 mm (3 in.), 63 mm (2 1/2 in.), 50 mm (2 in.), 37.5 mm (1 1/2 in.), 25 mm (1 in.), 19 mm (3/4 inch), 9.5 mm (3/8 inch), and 4.75 mm (No. 4). Include the 12.5 mm (1/2 in.) sieve for bituminous mix aggregates and screenings when required. The sieving may be performed either by hand or mechanical sieving. Place each size fraction in a separate container and combine all of the portions passing the 4.75 mm (No. 4) sieve (more than one portion when necessary to remove coatings and/or breakdown lumps). Weigh each size fraction and the passing 4.75 mm (No. 4) portion, and record these weights on the appropriate work sheet.

3. Crushing of samples. If the sample is submitted for preliminary tests and 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 analysis on the crushed portion and record the weight on the same card used for recording the as-received coarse sieve analysis.

F. ADJUSTING GRADING OF SAMPLES

If 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 they can be duplicated under field conditions.

G. SECURING REPRESENTATIVE PORTIONS FOR SPECIFIED TESTS

1. Refer to the respective test methods for grading requirements and quantity of material 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) Make sure that the device is checked regularly for accuracy by taking a dry sample of material which tends to segregate and dividing it into four or more equal parts by use of the splitter. Then weigh and grade several of the parts and compare.
 - 2) The splitting device should have openings sufficiently wide to permit easy passage of the largest particles in the sample and yet not so wide that a nonrepresentative separation is obtained. Generally, the width of openings should be approximately 50 percent larger than the largest particles in the sample to be split.

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- 3) Thoroughly mix the sample and spread it evenly across the pan or hopper. The pan or hopper used with a riffle-type splitter shall be equal in width to the overall width of the chutes so that the material will pour in equal amounts into each chute. Do not pour samples directly into chutes from anything other than the pan described above.
 - 4) To increase the accuracy of the splitting method so as to insure a more representative sample for testing, "double split" all samples. This procedure involves quartering the original sample into four equal parts, then combining opposite quarters. Repeat this procedure until the desired sample size is obtained for the various tests.
- b) Hand quartering of samples weighing over 45 kg (100 lbs).
- 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 of samples weighing 11 kg to 45 kg (25 to 100 lbs.)
 - 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 of samples weighing less than 11 kg (25 lbs.)
 - 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) Separate into quarters with the trowel and remove diagonally opposite quarters.
 - 4) Repeat the above process until the sample is reduced to the desired size.
3. After the required test samples have been removed, save the remainder of the sample for possible future check tests.

H. PRECAUTIONS

1. When possible, attempt to duplicate field conditions in preparation of a sample; for example, do not remove coatings from coated PMS bin samples.
2. Always use either a sample splitter or the quartering method to obtain test samples. Do not scoop or pour material for testing.

3. Check sieves frequently for broken or distorted wires, and repair or replace defective sieves.
4. Sample preparation shall be subject to controls specified by the individual test methods.

I. CALCULATIONS - COARSE AGGREGATE GRADING ANALYSIS

1. Calculate the coarse grading from the weights recorded on the work sheet (see Section E, Paragraph 2) as follows:
 - a) Compute the percentage by weight of material retained on each sieve by the following formula.

$$P_r = \frac{100 W_r}{W_t}$$

Where:

- P_r = Percentage of test sample retained on each sieve size individually.
- W_r = Weight of test sample retained on each sieve individually.
- W_t = Total dry weight of sample.

- b) Compute the total percentage of material passing each sieve.
 - 1) Starting with the 4.75 mm (No. 4) sieve, add the percent passing that sieve to the percent retained on the same sieve, to give the total percent passing the next larger sieve 9.5 mm (3/8").
 - (2) Continue in this manner for each sieve until the largest size is reached, at which time the "percent passing" figure will be 100%.

c. Example:

Sieve Size	W_r Weight Retained (g)	P_r Percent Retained	Percent Passing
75 mm (3")	0	0	100
63 mm (2-1/2)	405	1	99
50 mm (2")	1510	3	96
37.5 mm (1-1/2)	2375	5	91
25 mm (1")	3560	7	84
19 mm (3/4")	5215	10	74
9.5 mm (3/8")	7155	14	60
4.75 mm (No. 4)	7550	16	44
Minus 4.75 mm (No. 4)	22 230	44	--

Total weight of Sample, $W_t = 50\ 000\ g$

HAZARDS

Dust, noise, improper lifting, and the operation of equipment are the most various health and accident hazard sources encountered in sample preparation. It is not possible to completely eliminate these hazards, 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.

Enclosures built around noisy equipment can eliminate much of the noise. The use of sound deadening materials should be utilized when possible to increase the efficiency of an enclosure.

Guards or shields should be provided around dangerously exposed moving parts of machinery. Also, personnel should be instructed in the proper operation of each machine and cautioned of the existing hazards.

Instruction and enforcement of proper lifting methods is important in reducing the hazards of strain or rupture. The use of table-high carts to move materials can eliminate much of the lifting.

REPORTING OF RESULTS

Report the percent passing each of the sieves used along with other test data on the appropriate test report forms.

REFERENCE: AASHTO Designation M 92 and T 87