

GDT 13

A. Scope

For a complete list of GDTs, see the Table of Contents.

Use this test method to determine the quantitative particle size in soil aggregate blends and to calibrate and control the gradation of soil aggregate mixtures mixed in a central plant.

B. Apparatus

The apparatus consists of the following:

1. Balance: Use a balance of at least 1 lb (2 kg) capacity with 0.0022 lb (1.0 g) sensitivity.
2. Scales: Use scales with at least a 100 lb (45 kg) capacity and a 0.1 lb (0.045 kg) sensitivity.
3. Sieve Shaker: Use a Gilson shaker for mechanically agitating the sieves in separating coarse aggregate particles (WS-09).
4. Sieves: The woven-wire cloth sieves shall conform to the “Standard Specifications for Sieves for Testing Purposes,” AASHTO M 92 (WS-08).
Mount sieves with square openings on substantial frames constructed to prevent material loss during sieving. Select suitable sieve sizes to furnish the information required by the Specifications covering the material to be tested.
5. Drying Device: Use a stove or oven capable of rapidly drying the sample.
6. Pie Pans (WP-01).
7. Templates: Use two metal or wood templates shaped to fit the contour of the belt.
8. Containers: Use two No. 2 wash tubs or equivalent to collect sample.
9. Spoons (WS-14).
10. Sample Splitter or Quartering Device (WQ-1).

C. Sample Size and Preparation

1. Sample from the Roadway
 - a. Take all the material within a 1 to 2 ft (300 mm to 600 mm) square area from the full depth of the course.
 - b. Carefully collect all the course material from the area, but do not include any underlying material.
2. Sample from the Conveyor Belt
 - a. Stop the plant while the conveyor belt is loaded.
 - b. Push the two templates through the material on the conveyor belt. Place the templates far enough apart to yield a sample weighing from 60 to 80 lbs (27 to 36 kg) between them.
 - c. For maximum accuracy, remove all the material from between two templates.
 - d. Collect the sample with a shovel.
 - e. Spoon the sample into a wash tub placed on the belt adjacent to the sample area.

D. Procedures

Use Alternate No. 1 to quickly determine the moisture content of the soil. However, if you need more detailed information, use [Alternate No. 2](#).

1. Alternate No. 1
 - a. From the whole sample, take a small portion weighing approximately 2,000 g.
 - b. Dry the 1 lb (2000 g) sample in the oven at 240 °F (116 °C).
 - c. Weigh the dried sample.
 - d. Test the small portion for moisture content as follows:

$$\text{Percent Moisture (M)} = 100\frac{(A-B)}{B}$$

B

A = wet weight of sample

B = dry weight of sample

- e. Carefully sift the dried 1 lb (2000 g) sample over the No.10 (2 mm) sieve. Ensure that all clay balls and soil coatings on the plus No.10 (2 mm) material are broken down, without destroying material that should be retained on the No.10 (2 mm) sieve.
 - f. Thoroughly mix the material passing the No.10 (2 mm) sieve.
 - g. Use GDT 4, “Test for Determining Gradation of Soils,” to test a representative sample for gradation.
 - h. Weigh the initial portion of the moist sample and record the weight as the wet weight of total sample.
 - i. Place the sample in a Gilson shaker equipped with the proper sieves.
 - j. Run the Gilson shaker for one minute.
 - k. Break down any visible clay or mortar lumps remaining on the sieves by hand or with a wooden mallet.
 - l. Start the Gilson shaker again and let it shake while you direct a moderate stream of water over the material to wash the sample.
 - m. Continue washing the sample until the material passing the No.10 (2 mm) sieve is washed out of the sample. Be careful not to wash material over the sides of the sieves.
 - n. Let the material retained on the sieves drain for approximately three minutes or until the free moisture is gone.
 - o. Remove the material from the Gilson shaker.
 - p. Starting with the coarsest sieve, record the accumulated weights on each sieve.
 - q. After obtaining the weights, thoroughly mix the sample again.
 - r. Take a sample weighing approximately 1 lb (2000 g) of the plus No.10 (2 mm) material and test it for moisture content.
 - s. Conduct three tests and calculate the moisture content for each one. Use the formula in [Procedures, step 1.d](#) to calculate moisture percent.
 - t. Average the results of the tests and record the average as the moisture content of the soil sample.
2. Alternate No. 2
 - a. Thoroughly dry the total sample to a constant weight and record the weight as total weight of the dry sample.
 - b. Place the sample in a Gilson shaker equipped with the proper sieves.
 - c. Run the Gilson shaker for three minutes.
 - d. Stop the Gilson shaker and break down all visible clay balls and soil coatings on the No.10 (2 mm) and coarser sieves by hand or with a wooden mallet. Do not break down any material that should be retained on the No.10 (2 mm) sieve.
 - e. Start the Gilson shaker again and run it until you cannot feel material passing any sieve when you place your hand between the sieves.
 - f. Thoroughly mix the material that passed the No.10 (2 mm) sieve.
 - g. Take a 0.125 lb (50 g) sample and use GDT 4, “Test for Determining Gradation of Soils,” to test for gradation.
 - h. Start the Gilson shaker again and let it shake while you direct a moderate stream of water over the material to wash the sample.
 - i. Continue washing the sample until all minus No.10 (2 mm) material is washed out of the sample.
 - j. Dry all material retained on the No.10 (2 mm) and coarser sieves to a constant weight.
 - k. Place the material again in the Gilson shaker equipped with the proper sieves.
 - l. Start the Gilson shaker again and run it until you cannot feel material passing any sieve when you place your hand between the sieves.
 - m. Remove the material from the Gilson shaker.
 - n. Starting with the coarsest sieve, record the accumulated weights from each sieve.

E. Calculations

1. Alternate No. 1

Calculate the percent retained on each sieve.

$$\text{Percent Retained} = 1 + 0.01 \frac{W_r}{M_1} \quad \text{and}$$

$$= 1 + 0.01 \frac{W_t}{M_2}$$

Where:

W_r = wet weight retained on sieve ([Procedures, step 1.p](#))

M_1 = percent moisture of plus No.10 (2 mm) material ([Procedures, step 1.r](#))

W_T = wet weight of total sample ([Procedures, step 1.h](#))

M_2 = percent moisture of total sample ([Procedures, step 1.d](#))

2. Alternate No. 2

Calculate the percent retained on each sieve as follows:

$$\text{Percent Retained} = W_{td} \times \frac{W_{rd}}{W_{td}}$$

Where:

W_{rd} = dry weight retained on sieve ([Procedures, step 2.n](#))

W_{Td} = dry weight of total sample ([Procedures, step 2.a](#))

Use GDT 4 to measure the gradation of the material passing the No.10 (2 mm) sieve.

F. Report

1. Report the gradation of the percent retained for each alternate on Form 658.
2. Send the original report to the Office of Materials and Research in Forest Park.
3. Send a copy of the report to the Area Engineer.