

Method of Test for  
**DRY PREPARATION OF DISTURBED SAMPLES FOR TEST**  
DOTD Designation: TR 411-10

**Method A – Soil**  
**With Less Than 5% Aggregate**

**I. Scope**

- A. This procedure is designed to summarize the sample sizes needed and basic preparation for DOTD test procedures for soil with less than 5% aggregate.
- B. Reference Documents.
  - 1. DOTD TR 108 – Splitting and Quartering Samples
  - 2. AASHTO M 92 – Wire Cloth Sieves for Testing Purposes
  - 3. AASHTO M 231 – Weighing Devices Used in the Testing of Materials

**II. Apparatus**

- A. **Balance** – readable to 0.5% of the required sample size.
- B. **Drying apparatus**
  - 1. **Laboratory** – approved thermostatically controlled ventilated oven, capable of maintaining temperature within  $\pm 5^{\circ}\text{C}$ .
  - 2. **Field** electric or gas hot plate. Open flame hot plate must be equipped with a suitable shield to disperse heat and to prevent direct contact of the flame with the drying pan.
- C. **Sieves** – 4.75mm (No. 4), 2.00 mm (N. 10) and 425  $\mu\text{m}$  (No. 40); cover sieve (s) as necessary to prevent overload, catch pan and top – conforming to AASHTO M 92.

- D. **Pans** – sufficient to hold sample without spilling and large enough to spread the material for rapid drying.
- E. **Personal protective equipment** – thermal gloves, apron, tools, eye protection, dust mask or respirator.
- F. **Miscellaneous hand tools** – rubber mallet, brushes, spatula, stirrers, scoops as necessary to manipulate the material.
- G. **Feeler gauge** – capable of measuring 0.070 – 0.080 mm.
- H. **Pulverizing apparatus**
  - 1. **Power driven wedge crusher**
  - 2. **Drill press** – to drive a rubber-covered pestle with a mortar.
  - 3. **Mechanical open-type, flat disc pulverizer**
- I. **Splitters** – various sizes meeting the requirements of TR 108, including one with 6-mm ( $\frac{1}{4}$  inch) chutes.
- J. **No. 2 metal can(s)**

**III. Health Precautions**

When preparing soils, do not wear loose clothing, jewelry, or any other apparel or accessory which could be caught by rotating equipment. Hair that is long enough to be caught by equipment must be securely fastened or bound so that it cannot become entangled in the equipment. Be very careful not to catch body parts in the equipment. This equipment is dangerous if not properly used or if used without proper safety equipment and procedures. Be clean

shaven to ensure proper fit of the respirator. Use proper equipment and techniques to ensure safety in handling hot materials.

#### IV. Sample

For sample size, refer to the "Minimum Quantity" column of the Materials Sampling Manual.

#### V. Procedure

- A. Refer to test procedure to be performed to determine if it is necessary to dry material.
  - 1. If it is not necessary to dry material, prepare the material in accordance with the applicable test procedure. Refer to Table 1 for general preparation requirements and sample size requirements. (Table 1 is located at the end of Method B.
  - 2. If it is necessary to dry material, proceed to Step B.
- B. Place the sample in the oven and dry to constant weight with the oven set at a temperature of 60°C (140°F). Drying may be facilitated by reducing soil clods to smaller sizes by using the appropriate hand tools.

**Note A-1:** *The oven may be set at a higher temperature if previous experience has demonstrated that no change in soil characteristics will occur. In no case shall the drying temperature exceed 95°C (203°F).*

**Note A-2:** *Constant weight for drying purposes is defined as less than 0.1% weight loss between successive weighings no less than 15 minutes apart.*

- C. Turn on ventilation system and put on all protective equipment.
- D. Set wedge crusher to a 10-15 mm (approximately ½ in.) gap. Place catch pan beneath the wedge crusher. Remove the sample from the oven and allow to cool until it can be handled. Turn on the wedge crusher. Pour the dried sample gradually into the wedge crusher. After the sample has been collected, turn off the wedge crusher.
- E. Reduce the sample that has gone through the wedge crusher to the appropriate size for the test(s) to be performed using the sample splitter or by quartering in accordance with TR 108. (Refer to Table 1 or the individual test procedure for appropriate sample sizes.) Place the remaining material in the original sample container with the proper identification included.

**Note A-3:** *If multiple representative portions are required, identify each separately after preparation.*

- F. Nest the appropriate sieves with the catch pan.
- G. Pour the reduced sample over the appropriate sieve as indicated in Table 1 or the individual test procedure. Shake the nest of sleeves by hand vigorously while tapping them on a hard surface.
- H. Check the catch pan at regular intervals. Empty the material from the catch pan into a pan. Do not allow the catch pan to become too full.
- I. Process the material retained on the appropriate sieve by one of the following methods:

1. Drill press
  - a. Place a small quantity of the material retained on the sieve in the mortar (bowl of the drill press). Place the mortar on the drill press pedestal centered under the pestle. Turn on the drill press.
  - b. While holding the mortar tightly and ensuring that the mortar cover remains on the mortar, lower the pestle into the mortar by rotating the drill press handle.
  - c. Advance and release the pestle in short cycles until the material is pulverized to pass the appropriate sieve.
  - d. Repeat Steps a – c until only a negligible quantity of material is retained on the sieve. Turn off the drill press when finished.
  - e. If there are a significant number of aggregations that will not reduce using the drill press, use the pulverizer in accordance with Steps 2.a – e to reduce them.
- check the adjustment, insert a feeler gauge in the opening between each plate.
- b. Brush all soil particles from the internal parts of the pulverizer to prevent contamination of the sample. Put a catch pan beneath the pulverizer.
- c. Turn on the pulverizer. Slowly pour the material into the throat of the pulverizer only one time.
- d. When all material has passed through the pulverizer, turn off the device. Brush all soil particles from the internal parts of the device into the catch pan. Remove the catch pan with the samples.
- e. Pour the pulverized material over the sieve. Discard any particles retained on the sieve. Combine the pulverized material that passes the sieve with the rest of the sample.
- J. Stir the sample with the spatula. Thoroughly mix the material after sieving and before testing by pouring across the splitter with 6 mm (¼ in.) chutes. Divide and label the individual representative portions. Stir the individual representative portions with a spatula.

**Note A- 4:** Do not use the flat disc pulverizer on any sand or sandy type material. Perform this process of reducing material size carefully using minimum pressure to break up aggregations without fracturing the individual grains.

2. Mechanical open type, flat disc pulverizer.
  - a. Check the adjustment on the plates in the pulverizer to ensure that the soil particle sizes will not be reduced. To

## VI. Normal Test Reporting Time

Preparation time is dependent on the material. There is no standard time. Testing and the reporting of results are addressed in each applicable test procedure.

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**Method B – Soil – Aggregate Mixtures  
With 5% or More Aggregate**

**I. Scope**

- A. This procedure is designed to summarize the sample sizes needed and basic preparation for DOTD test procedures for soil-aggregate mixtures with 5% or more aggregate.
- B. Reference Documents
  - 1. DOTD TR 108 – Splitting and Quartering Samples
  - 2. AASHTO M 92 – Wire Cloth Sieves for Testing Purposes
  - 3. AASHTO M 231 – Weighing Devices Used in the Testing of Materials

**II. Apparatus**

- A. **Balance** – readable to 0.5% of the required sample size
- B. **Drying apparatus**
  - 1. **Laboratory** – approved thermostatically controlled ventilated oven, capable of maintaining temperature within  $\pm 5^{\circ}\text{C}$ .
  - 2. **Field** – electric or gas hot plate. Open flame hot plate must be equipped with a suitable shield to disperse heat and to prevent direct contact of the flame with the drying pan.
- C. **Sieves** – 50 mm (2 in.), 37.5 mm (1½ in.), 25.0 mm (1 in.), 19.0 mm (¾ in.), 12.5 mm (½ in.), 4.75 mm (No. 4), 2.00 mm (No. 10) the catch pan. Remove the catch pan with the 2.00 mm (No. 10) and 425  $\mu\text{m}$  (NO. 40), cover sieve(s) as necessary to prevent overload, catch pan and top – conforming to AASHTO M 92.
- D. **Shaker**

- E. **Pans** – sufficient to hold sample without spilling and large enough to spread the material for rapid drying.
- F. **Personal protective equipment** – thermal gloves, apron, tools, eye protection, dust mask or respirator.
- G. **Miscellaneous hand tools** – rubber mallet, brushes, spatula, stirrers, scoops necessary to manipulate the material.
- H. **Feeler gauge** – capable of measuring 0.070 – 0.080 mm.
- I. **Pulverizing apparatus**
  - 1. **Drill press** – to drive a rubber-covered pestle with a mortar.
  - 2. **Mechanical open-type, flat disc pulverizer.**
  - 3. **Drum pulverizer or rubber mallet.**
- J. **Splitters** – various sizes meeting the requirements of TR 108, including one with 6 mm (¼ in.) chutes.
- K. **No. 2 metal can(s)**

**III. Health Precautions**

When preparing soils, do not wear loose clothing, jewelry, or any other apparel or accessory which could be caught by rotating equipment. Hair that is long enough to be caught by equipment must be securely fastened or bound so that it cannot become entangled in the equipment. Be very careful not to catch body parts in the equipment. This equipment is dangerous if not properly used or if used without proper safety equipment and procedures. Be clean shaven to ensure proper fit of the respirator. Use proper equipment and

techniques to ensure safety in handling hot materials.

#### IV. Sample

For sample size, refer to the "Minimum Quantity" column of the Materials Sampling Manual.

#### V. Procedure

- A. Refer to test procedure to be performed to determine if it is necessary to dry the material.
  - 1. If it is not necessary to dry material, prepare the material in accordance with the applicable test procedure. Refer to Table 1 for general preparation requirements and sample size requirements.
  - 2. If it is necessary to dry material, proceed to Step B.
- B. Place the sample in the oven and dry to constant weight with the oven set at a temperature of 60°C (140°F). Drying may be facilitated by reducing soil clods to smaller sizes by using the hand or appropriate tools.

**Note B - 1:** For shell or sand-shell, continue preparation in accordance with the applicable test procedure.

**Note B - 2:** The oven may be set at a higher temperature if previous experience has demonstrated that no change in soil characteristics will occur. In no case shall the drying temperature exceed 95°C (203°F).

**Note B - 3:** Constant weight for drying purposes is defined as less than 0.1% weight loss between successive weighings no less than 15 minutes apart.

- C. Turn on the ventilation system and put on all protective equipment.
- D. Use the drum pulverizer or rubber mallet to break up clods.
  - 1. If you use the drum pulverizer, put the entire sample in drum. Turn on machine and allow to run until sample is separated into individual particles.
  - 2. If you use the rubber mallet, place the material in a large pan, cover the material with an opened sample sack to prevent material loss, and strike large particles with the mallet until they are reduced to approximately 13 mm (½ in.).
- E. If the entire sample is not needed for testing, reduce it to a smaller quantity (3.5 kg [7.5 lb.], minimum) using the sample splitter or by quartering in accordance with TR 108. Place the remaining material in the original sample container with the proper sample identification.
- F. Weigh the material to be prepared and record as total weight of sample on the appropriate worksheet.
- G. Nest the appropriate sieves with the catch pan.
- H. Pour the entire sample over the appropriate sieve(s) as indicated in the individual test procedure. Shake the sieves vigorously. Retain the material from the individual sieve sizes in separate containers.
- I. Check the catch pan at regular intervals. Empty the material from the catch pan into a pan. Do not allow the catch pan to become too full.
- J. Using the drill press, reduce material aggregations retained on the appropriate sieve to individual particle size.

**Note B - 4:** *Perform this process carefully using minimum pressure to reduce aggregation size without changing the original particle sizes.*

1. Place a small quantity of the material retained on the sieve in the mortar (bowl of the drill press). Place the mortar on the drill press pedestal centered under the pestle. Turn on the drill press.
  2. While holding the mortar tightly and ensuring that the mortar cover remains on the mortar, lower the pestle into the mortar by rotating the drill press handle.
  3. Advance and release the pestle in short cycles until the material is pulverized to pass the appropriate sieve.
  4. Repeat Steps 1 – 3 until only aggregate is retained on the appropriate sieve(s).
- K. Place the prepared aggregate in a separate pan for each individual particle size; weigh and record the weight of the material retained on each sieve on the appropriate worksheet.

- L. Reduce the soil portion of the sample to the appropriate size for the test(s) to be performed using the sample splitter or by quartering in accordance with TR 108. (Refer to Table 1 or the individual test procedure for appropriate sample sizes.) Place the remaining material in the original sample container with the proper sample identification included.

**Note B - 5:** *If multiple representative portions are required, identify each separately after preparation.*

- M. If the test(s) to be conducted on this material require the inclusion of the aggregate, recomposite the sample by weight returning the aggregate to the sample based on the sizes required in the appropriate test procedure.

## VI. Normal Preparation Time

Preparation time is dependent on the material. There is no standard time. Testing and the reporting of results are addressed in each applicable test procedure.

DOTD TR	Title	Prepared Material Needed For Test	Remarks
401 Method A	Determination of In-Place Density (All Nuclear Methods)	-----	Site Preparation Only Required
401 Method B	Determination of In-Place Density (Sand Cone)	Total Material	Site Preparation Required Dry total sample in acc. With TR 403
403 Method A	Determination of Moisture Content (Rapid Drying)	Soils-500 g Aggregates – 5 kg (10 lb) Soil-Agg.-2.55 kg (5lb) Total Material when required	
403 Method B	Determination of Moisture Content (Oven Drying)	Soils-500 g Aggregates – 5 kg (10 lb) Soil-Agg.-2.55 kg (5lb) Total Material when required	
407 Method A	Mechanical Analysis of Soils (Standard)	Sand (100 g) or Clay (50 g) Minus No. 10	Prepare total sample. Obtain approx. 225 g (½-lb) of material passing the No. 10 sieve.
407 Method B	Mechanical Analysis of Soils (24 Hours)	100 g Minus No. 10	Prepare total sample. Obtain approx. 225 g (½-lb) of material passing the No. 10 sieve.
413 Method A	Organic Material in Soil (Standard)	40 g, Minus No. 10	Prepare total sample. Obtain approx. 225 g (½-lb) of material passing the No. 10 sieve.
413 Method B	Organic Material in Soil (Quick Approximation)	10 g, Minus No. 40*	Prepare total sample. Obtain approx. 225 g (½-ob) of material passing the #40 sieve. *Minus #10 may be used, if not enough material passes No. 40.
415 Method A	Field Moisture Density Relationships (Family of Curves)	3 kg (6 lb), wet weight Minus No. 4	Field conditions, split total wet sample on No. 4 sieve.

## Preparation Summary

Table 1

DOTD TR	Title	Prepared Material Needed For Test	Remarks
415 Method B	Field Moisture Density Relationships (Average Proctor Values)	7 kg (15 lb), wet weight (<5% retained on No. 4)  *20 kg (45 lb), wet weight (5% or more retained on No. 4)	Field conditions, split total wet sample on No. 4 to determine % plus No. 4.  *Wet weight of total material under field condition
416	Determination of the % Lime for Treatment of Soils or Soil-Aggregate Mixtures	4.5 kg (10 lb) wet weight (soil) 13.6 kg (30 lb) wet weight (soil-agg.)	Broken to pass ½-in. sieve. Atterburg Limits to be determined on each test specimen.
417 Method A	Mixing Loss of Aggregate Material in Field Condition (Shell or Sand-Shell)	*100 kg (200 lb)	*Consists of the proper proportions of unmixed components
417 Method B	Mixing Loss of Aggregate Material in Field Condition (Other than Shell or Sand-Shell)	*100 kg (200 lb)	*Consists of the proper proportions of unmixed components
418 Method A	Moisture Density Relationships (5% agg. and raw soil)	5 kg (10 lb)	Dry material passing No. 4
418 Method B	Moisture Density Relationships (5% agg. and raw soil)	14 kg (30 lb)	Dry material passing No. 4
418 Method C	Moisture Density Relationships (shell and sand-shell)	55 kg (120 lb) each component	Dry total sample
418 Method D	Moisture Density Relationships (shell and sand-shell with cement additive)	55 kg (120 lb) each component	Dry total sample
418 Method E	Moisture Density Relationships (≥5% aggregate)	40 kg (85 lb)	Prepare on 1", ¾", ½", No. 4, and No. 10 sieves

Preparation Summary Continued  
 Table 1



DOTD TR	Title	Prepared Material Needed For Test	Remarks
418 Method F	Moisture Density Relationships (≥5% aggregate with cement or lime additive)	40 kg (85 lb)	Prepare on 1", ¾", ½", No. 4, and No. 10 sieves
418 Method G	Moisture Density Relationships (stone, crushed slag, recycled pcc, or other designated materials)	45 kg (90 lb)	Prepare on 1", ¾", ½", No. 4, and No. 10 sieves
418 Method H	Moisture Density Relationships (raw recycled in place materials)*	45 kg (90 lb)	*Refer to Procedure Scope for specific materials 95 – 100% passing 1" sieve
418 Method I	Moisture Density Relationships (recycled in-place materials with cement or lime additive)*	45 kg (90 lb)	*Refer to Procedure Scope for specific materials 95 – 100% passing 1" sieve
419	Determination of Compaction Factor of Base Material	-----	Refer to TR 417 and TR 418 for sample
423	Classification of Soils and Soil Aggregate Mixtures for Highway Construction	-----	Refer to TR 407, TR 413, and TR 428 for sample
425	Determination of Conversion Ratio of Soil	-----	Refer to TR 401 and 418 for sample
426	Determination of Muck Elevation	-----	On-Site Training
428	Determining Atterberg Limits of Soils and Soil-Aggregate Mixtures	500 g (1 lb) passing No. 40 sieve	
429	Resistivity Values of Soils and Water	soil; min. 1400 g, passing No. 10 sieve	water: 1 qt field conditions
430	Determination of pH Value of Water, Soils, or Lightweight Aggregate	soil: 225 g (½ lb) passing No. 10 sieve aggregate: 225 g (½ lb) passing ½" sieve	water: 1 qt field conditions

Preparation Summary Continued  
 Table 1

DOTD TR	Title	Prepared Material Needed For Test	Remarks
431	Determining Pulverization	min. 2000 g, field-condition material*	*as designated by specifications
432 Method A	Determining Minimum Cement Content for Incorporation into Soils, Soil-Aggregate or Aggregate Mixtures for Stabilization or Treatment (Naturally Occurring Soils or Soil-Aggregates)	-----	Chart Determination of Minimum Cement Content Using DOTD TR 423
432 Method B	Minimum Cement Content (Unconfined Compression Testing – Soils, < 5% agg.)	180 lb	Dry material passing No. 4
432 Method C	Minimum Cement Content (Unconfined Compression Testing – Soils, ≥ 5% agg.)	600 lb	Dry material passing 1", ¾", ½", and No. 4 sieves
432 Method D	Minimum Cement Content (Durability)	2 specimens made in accordance with TR 432 – Method B or C	
435	Identification of Collapsible Silt	0.5 lb, passing No. 10 sieve	
436 Method A	Determining the Percentage of Additive in Stabilization or Treatment (In-Place Mixing)	-----	On-Site Testing Weight of Cement per Unit Area
436 Method B	Determining the Percentage of Additive in Stabilization or Treatment (Central Plant Mixing)	cement: 100 lb min. soil: flow qty. in cement feed time	
436 Method C	Determining the Percentage of Additive in Stabilization or Treatment (Slurry)		

Preparation Summary Continued  
 Table 1