

## FOP for AASHTO T 255

### ***Total Evaporable Moisture Content of Aggregate by Drying***

WAQTC FOP for AASHTO T 255 has been adopted by WSDOT with the following changes:

#### **Sample Preparation**

**TABLE 1 Sample Sizes for Moisture Content of Aggregate** – *Shall conform to the following nominal maximum size definition and include the note below.*

\*For Aggregate, the nominal maximum size sieve is the largest standard sieve opening listed in the applicable specification upon which more than 1-percent of the material by weight is permitted to be retained. For concrete aggregate, the nominal maximum size sieve is the smallest standard sieve opening through which the entire amount of aggregate is permitted to pass.

**Note:** For an aggregate specification having a generally unrestrictive gradation (i.e., wide range of permissible upper sizes), where the source consistently fully passes a screen substantially smaller than the maximum specified size, the nominal maximum size, for the purpose of defining sampling and test specimen size requirements may be adjusted to the screen, found by experience to retain no more than 5 percent of the materials.



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## TOTAL EVAPORABLE MOISTURE CONTENT OF AGGREGATE BY DRYING FOP FOR AASHTO T 255

### Scope

This procedure covers the determination of moisture content of aggregate in accordance with AASHTO T 255-00. It may also be used for other construction materials.

### Overview

Moisture content is determined by comparing the wet mass of a sample and the mass of the sample after drying to constant mass. The term constant mass is used to define when a sample is dry.

*Constant mass* – the state at which a mass does not change more than a given percent, after additional drying for a defined time interval, at a required temperature.

### Apparatus

- Balance or scale: Capacity sufficient for the principle sample mass, accurate to 0.1 percent of sample mass or readable to 0.1 g, meeting the requirements of AASHTO M 231.
- Containers: clean, dry and capable of being sealed
- Suitable drying containers
- Microwave safe container with ventilated lids
- Heat source, controlled
  - Forced draft oven
  - Ventilated oven
  - Convection oven
- Heat source, uncontrolled
  - Infrared heater, hot plate, fry pan, or any other device/method that will dry the sample without altering the material being dried
  - Microwave oven (900 watts minimum)

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- Hot pads or gloves
- Utensils such as spoons

### Sample Preparation

In accordance with the FOP for AASHTO R 90 obtain a representative sample in its existing condition. The representative sample size is based on Table 1 or other information that may be specified by the agency.

**TABLE 1**  
**Sample Sizes for Moisture Content of Aggregate**

Nominal Maximum Size* mm (in.)	Minimum Sample Mass g (lb)
150 (6)	50,000 (110)
100 (4)	25,000 (55)
90 (3 1/2)	16,000 (35)
75 (3)	13,000 (29)
63 (2 1/2)	10,000 (22)
50 (2)	8000 (18)
37.5 (1 1/2)	6000 (13)
25.0 (1)	4000 (9)
19.0 (3/4)	3000 (7)
12.5 (1/2)	2000 (4)
9.5 (3/8)	1500 (3.3)
4.75 (No. 4)	500 (1.1)

\* One sieve larger than the first sieve to retain more than 10 percent of the material using an agency specified set of sieves based on cumulative percent retained. Where large gaps in specification sieves exist, intermediate sieve(s) may be inserted to determine nominal maximum size.

Immediately seal or cover samples to prevent any change in moisture content or follow the steps in "Procedure."

### Procedure

Determine all masses to the nearest 0.1 percent of the sample mass or to the nearest 0.1 g.

When determining the mass of hot samples or containers or both, place and tare a buffer between the sample container and the balance. This will eliminate damage to or interference with the operation of the balance or scale.

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1. Determine and record the mass of the container (and lid for microwave drying).
  2. Place the wet sample in the container.
    - a. For oven(s), hot plates, infrared heaters, etc.: Spread the sample in the container.
    - b. For microwave oven: Heap sample in the container; cover with ventilated lid.
  3. Determine and record the total mass of the container and wet sample.
  4. Determine and record the wet mass of the sample by subtracting the container mass determined in Step 1 from the mass of the container and sample determined in Step 3.
  5. Place the sample in one of the following drying apparatus :
    - a. Controlled heat source (oven): at  $110 \pm 5^{\circ}\text{C}$  ( $230 \pm 9^{\circ}\text{F}$ ).
    - b. Uncontrolled heat source (Hot plate, infrared heater, etc.): Stir frequently to avoid localized overheating.
  6. Dry until sample appears moisture free.
  7. Determine mass of sample and container.
  8. Determine and record the mass of the sample by subtracting the container mass determined in Step 1 from the mass of the container and sample determined in Step 7.
  9. Return sample and container to the heat source for additional drying.
    - a. Controlled (oven): 30 minutes
    - b. Uncontrolled (Hot plate, infrared heater, etc.): 10 minutes
    - c. Uncontrolled (Microwave oven): 2 minutes
- Caution:** Some minerals in the sample may cause the aggregate to overheat, altering the aggregate gradation.
10. Determine mass of sample and container.
  11. Determine and record the mass of the sample by subtracting the container mass determined in Step 1 from the mass of the container and sample determined in Step 10.
  12. Determine percent change by subtracting the new mass determination ( $M_n$ ) from the previous mass determination ( $M_p$ ) divide by the previous mass determination ( $M_p$ ) multiply by 100.

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13. Continue drying, performing steps 9 through 12, until there is less than a 0.10 percent change after additional drying time.
14. Constant mass has been achieved, sample is defined as dry.
15. Allow the sample to cool. Determine and record the total mass of the container and dry sample.
16. Determine and record the dry mass of the sample by subtracting the mass of the container determined in Step 1 from the mass of the container and sample determined in Step 15.
17. Determine and record percent moisture by subtracting the final dry mass determination ( $M_D$ ) from the initial wet mass determination ( $M_W$ ) divide by the final dry mass determination ( $M_D$ ) multiply by 100.

**Table 2**  
**Methods of Drying**

Heat Source	Specific Instructions	Drying intervals to achieve constant mass (minutes)
<b>Controlled:</b> Forced Draft Oven (preferred), Ventilated Oven, or Convection Oven	$110 \pm 5^\circ\text{C}$ ( $230 \pm 9^\circ\text{F}$ )	30
<b>Uncontrolled:</b>		
Hot plate, Infrared heater, etc.	Stir frequently	10
Microwave	Heap sample and cover with ventilated lid	2

### Calculation

#### Constant Mass:

Calculate constant mass using the following formula:

$$\frac{M_p - M_n}{M_p} \times 100 = \% \text{ Change}$$

Where:

$M_p$  = previous mass measurement

$M_n$  = new mass measurement

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Example:

Mass of container: 1232.1 g

Mass of container after first drying cycle: 2637.2 g

Mass,  $M_p$ , of possibly dry sample: 2637.2 g - 1232.1 g = 1405.1 g

Mass of container and dry sample after second drying cycle: 2634.1 g

Mass,  $M_n$ , of dry sample: 2634.1 g - 1232.1 g = 1402.0 g

$$\frac{1405.1 \text{ g} - 1402.0 \text{ g}}{1405.1 \text{ g}} \times 100 = 0.22\%$$

*0.22 percent is not less than 0.10 percent, so continue drying*

Mass of container and dry sample after third drying cycle: 2633.0 g

Mass,  $M_n$ , of dry sample: 2633.0 g - 1232.1 g = 1400.9 g

$$\frac{1402.0 \text{ g} - 1400.9 \text{ g}}{1402.0 \text{ g}} \times 100 = 0.08\%$$

*0.08 percent is less than 0.10 percent, so constant mass has been reached***Moisture Content:**Calculate the moisture content,  $w$ , as a percent, using the following formula:

$$\frac{M_W - M_D}{M_D} \times 100 = \% \text{ Moisture Content}$$

where:

 $M_W$  = wet mass $M_D$  = dry mass

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Example:

Mass of container: 1232.1 g

Mass of container and wet sample: 2764.7 g

Mass,  $M_W$ , of wet sample: 2764.7 g - 1232.1 g = 1532.6 g

Mass of container and dry sample (COOLED): 2633.0 g

Mass,  $M_D$ , of dry sample: 2633.0 g - 1232.1 g = 1400.9 g

$$w = \frac{1532.6\text{g} - 1400.9\text{g}}{1400.9\text{g}} \times 100 = \frac{131.7\text{g}}{1400.9\text{g}} = 9.40\% \text{ rounded to } 9.4\%$$

## Report

- Results on forms approved by the agency
- Sample ID
- $M_W$ , wet mass
- $M_D$ , dry mass
- $w$ , moisture content to nearest 0.1 percent



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**PERFORMANCE EXAM CHECKLIST**

**TOTAL MOISTURE CONTENT OF AGGREGATE BY DRYING  
FOP FOR AASHTO T 255**

Participant Name \_\_\_\_\_ Exam Date \_\_\_\_\_

Record the symbols "P" for passing or "F" for failing on each step of the checklist.

Procedure Element	Trial 1	Trial 2
1. Representative sample of appropriate mass obtained?	_____	_____
2. Mass of container determined to 0.1 percent or 0.1 g?	_____	_____
3. Sample placed in container and wet mass determined to 0.1 percent or 0.1 g?	_____	_____
4. Test sample mass conforms to the required mass?	_____	_____
5. Loss of moisture avoided prior to mass determination?	_____	_____
6. Sample dried by a suitable heat source?	_____	_____
7. If aggregate heated by means other than a controlled oven, is sample stirred to avoid localized overheating?	_____	_____
8. If heated in a microwave, heaped and covered with a ventilated lid	_____	_____
9. Is aggregate heated for the additional, specified time?	_____	_____
a. Forced draft, ventilated, convection ovens – 30 minutes;		
b. Microwave – 2 minutes		
c. Other – 10 minutes		
10. Mass determined and compared to previous mass – showing less than 0.10 percent loss?	_____	_____
11. Sample cooled before dry mass determination to 0.1 percent or 0.1 g?	_____	_____
12. Calculations performed properly, and results reported to the nearest 0.1 percent?	_____	_____

Comments: First attempt: Pass\_\_\_\_\_Fail\_\_\_\_\_ Second attempt: Pass\_\_\_\_\_Fail\_\_\_\_\_

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Examiner Signature \_\_\_\_\_ WAQTC #: \_\_\_\_\_

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