

# Soil Density

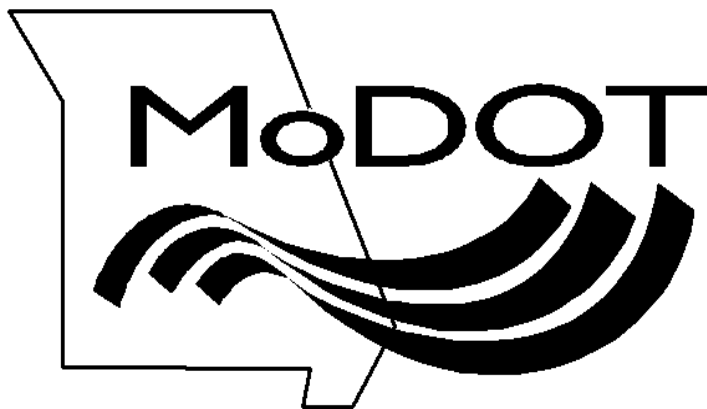
## 2023

### Proficiency Pack

Date: \_\_\_\_\_

Name: \_\_\_\_\_

Employer: \_\_\_\_\_





# AASHTO T 265: Laboratory Determination of Moisture Content of Soils PROFICIENCY CHECKLIST

Rev: 10/22/2019

Applicant: \_\_\_\_\_

Employer: \_\_\_\_\_

	Trial #	1	2
<b>Procedure</b>			
1. Preheat oven to 230 ±9°F (110 ± 5°C)			
2. Mass of clean, dry container plus lid determined			
3. Sample placed in container, lid immediately placed, and weighed. <b>(Wet Weight)</b> <b>Note:</b> Soils containing organic material can be air dried or oven-dried at approximately 140°F (60°C).			
4. Lid removed and placed container with the moist sample and lid in the drying oven at 230 ± 9°F (110 ± 5°C).			
5. Dried overnight (15 hours minimum) or until the mass loss of the sample after 1 hour of additional drying is less than 0.1% (Constant Mass).			
6. Lid replaced immediately and sample cooled to room temperature.			
7. Container, including lid and dried sample, weighed. <b>(Dry Weight)</b>			
8. Percent moisture calculated to the nearest 0.1% by:  $w = \left[ \frac{(W_1 - W_2)}{(W_2 - W_c)} \right] \times 100$			

PASS PASS

FAIL FAIL

Examiner: \_\_\_\_\_ Date: \_\_\_\_\_



# AASHTO T 99: Moisture-Density Relations of Soils PROFICIENCY CHECKLIST

Rev: 10/30/2019

Applicant: \_\_\_\_\_

Employer: \_\_\_\_\_

Trial #	1	2
<b>Sample Preparation</b>		
1. If damp, sample dried in air or drying apparatus not exceeding 140°F (60°C).		
2. Thoroughly broke up sample and adequate amount sieved over #4 (4.75mm) sieve (Method A) or ¾" (19.0mm) sieve (Method C).		
3. Material retained on No. 4 sieve, discarded if less than 5.0% (Method A). If 5.1% or more retained on No. 4, revert to Method C and see Annex A1 for oversize particles.		
4. Sample passing #4 sieve weighs 7 lb. (3 kg) or more (Method A). Sample passing ¾" sieve weighs 11 lb. (5 kg) or more (Method C).		
5. Sample mixed with water to approximately 4% to 8% below optimum moisture. <b>Clayey Soils:</b> Samples mixed with water varying by approx. 2% to 2.5% max 4% for increments of moisture, samples placed in covered containers and allowed to stand for at least 12 hours.		
<b>Procedure for Method A (4 inch mold)</b>		
1. Weighed the mold and base plate (w/o the collar), <u>recorded to the nearest 0.005 lb. (1g)</u>		
2. Attached collar to the mold and placed on a stable foundation.		
3. Layer of soil placed in mold distributed evenly to yield approximately 1/3 full after compaction (2/3 or 3/3 full).		
4. Soil lightly tamped with manual rammer of 2-inch diameter until it is not in a loose state.		
5. Applied 25 blows for 4 inch mold, with a 5.5 lb. rammer, 12 inch drop.		
6. Following compaction trimmed away any excess soil on mold walls evenly on top of layer (trimmed soil may be included with additional soil for next layer).		
7. Repeat steps 3 – 6, for 3 equal layers, last lift is slightly above the top of the mold.		
8. Removed the collar, soil sample trimmed to top of the mold with a straight edge, filled coarse aggregate holes on surface, patched with smaller sized material.		
9. Cleaned off the mold and base plate before weighing.		
10. Weighed the mold, base, and contents, <u>recorded to nearest 0.005 lb. (1g)</u> .		
11. Sample extracted from the mold.		
12. Sliced vertically through the center for moisture content sample.		
13. Moisture content sample removed from the slice, placed in a pre-weighed sample container, and weighed immediately, <u>recorded wet weight to nearest 0.1g</u> . Need approximately: <b>Method A</b> 100g, <b>Method C</b> 500g		
14. Sample dried and % moisture determined according to AASHTO T 265 , <u>reported w to 0.1%</u> .		
15. Remainder of material from mold broken up to pass a #4 size sieve and added to the remainder of original test sample. Samples mixed with water varying by 1-2% (2.5% max) increments of moisture and mixed thoroughly.		



## AASHTO T 99: Moisture-Density Relations of Soils PROFICIENCY CHECKLIST (cont.)

	Trial #	1	2
16. Repeat the compaction process: (Steps 2 through 15) for each increment of water added and the process continued until wet density either decreases or stabilizes, need 2 points pass Optimum Density <b>Note:</b> Non-cohesive drainable soils, only one additional determination over optimum moisture is sufficient.			
17. Calculated: Wet Density, Dry Density and Percent Moisture calculated for each sample.  <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="border: 1px solid black; padding: 5px; text-align: center;"> <math display="block">W_1 = (M_{ms} - M_m) \times \text{Constant}</math> <p>Wet Density</p> </div> <div style="border: 1px solid black; padding: 5px; text-align: center;"> <math display="block">W = \frac{W_1}{w + 100} \times 100</math> <p>Dry Density</p> </div> </div> <p style="text-align: center;">Percent Moisture</p>			
18. Dry density mass plotted on y-axis, % Moisture plotted on x-axis and points connected with curve either manually or by computer program. <b>Note:</b> (Method C): Calculate adjusted density for oversized particles on each point prior to plotting curve.			
19. Report: * <b>Percent Moisture</b> at peak of curve taken as Optimum Moisture reported to nearest 0.1%. * <b>Dry Density</b> mass at Optimum percent moisture reported as maximum dry density to the nearest 0.1 lb./ft <sup>3</sup> . * <b>Method Used</b> A, B, C, D. *Information on oversized particles and adjusted Max DD, Corrected Optimum MC and Gsb to 0.001.			

PASS	PASS
FAIL	FAIL

Examiner: \_\_\_\_\_ Date: \_\_\_\_\_





# MoDOT TM 40: A One-Point Method for Determining Maximum Dry Density and Optimum Moisture

## PROFICIENCY CHECKLIST

Rev: 12/28/2018

Applicant: \_\_\_\_\_

Employer: \_\_\_\_\_

	Trial #	1	2
1. One-point determination of dry density and corresponding moisture content made in accordance with AASHTO T 99 or AASHTO T 180, and moisture content determined in accordance with AASHTO T 265.			
2. Optimum Moisture and Maximum Dry Density calculated for the one-point.			
3. A Current MoDOT Family of Curves for specific sample on hand.			
4. Used the correct Method A, B, C, or D as described on the Current MoDOT Family of Curves.			
5. A One-Point plotted on the family of curves, was in the OM-4 area of the MoDOT graph, counted as VALID and Maximum Dry Density and Optimum Moisture Content determined.			
6. OR A One-Point plotted on the family of curves, was not in the OM-4 area of the MoDOT graph, was counted as NOT VALID, made another one-point determined with adjusted water content and plotted for a valid test.			
7. Report Method used, optimum moisture content as a percentage to the nearest whole number, maximum density to the nearest 0.1 lb./ft <sup>3</sup> (1 kg/m <sup>3</sup> ).			

PASS    PASS

FAIL    FAIL

Examiner: \_\_\_\_\_ Date: \_\_\_\_\_



# AASHTO T 310: In-Place Density and Moisture Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth) PROFICIENCY CHECKLIST

Rev: 12/28/2018

Applicant: \_\_\_\_\_

Employer: \_\_\_\_\_

Trial#	1	2
Make sure gauge is calibrated, charged, lab data, or offsets entered if any.		
<b>Standardization</b>		
1. Performed at start of each day's use.		
2. Permanent records of data retained.		
3. Performed with equipment at least 10 m (30 ft.) from other radioactive sources, and clear of large masses of water or other items which may affect reference count.		
4. Using reference standard, at least four repetitive readings taken at normal measurement period, and mean obtained.		
5. Procedure recommended by gauge manufacturer used to determine compliance with gauge calibration curves or – AASHTO Equation 1 used to determine standardization.		
<b>Preparing the test site</b>		
1. All loose, disturbed and additional material removed as necessary to expose top of material to be tested.		
2. Prepared a horizontal area sufficient in size to accommodate the gauge, planed the area smooth with plate or suitable tool to obtain maximum contact between gauge and material tested.		
3. Native fines or fine sand used to fill voids as necessary, for surface area less than 10% beneath the gauge.		
4. The depth of filler does not exceed approximately 1/8" (3 mm).		



**AASHTO T 310: Density and Moisture Content of Soils and  
Soils-Aggregate by Nuclear Methods  
PROFICIENCY CHECKLIST  
(CONT.)**

<b>Direct Transmission Procedure</b>		
1. Gauge turned on allowed to warm up.		
2. Drilling the Hole. <ul style="list-style-type: none"> <li>a. Placed scraper plate on prepared test site.</li> <li>b. Attached extraction tool and inserted drill rod.</li> <li>c. Stepped firmly on center of plate and hammered drill rod perpendicular to the surface 2" deeper than test depth.</li> <li>d. Removed drill rod with upward and twisting motion.</li> <li>e. After drill rod removed, marked around the scraper plate.</li> </ul>		
3. Removed all equipment from the test area except the gauge.		
4. Placed the gauge on marked area, ensuring maximum surface contact.		
5. Source rod lowered into hole to same depth of the lift being tested.		
6. Snugged the probe to contact the soil leaving no gap between the probe and soil.		
6. One or more 1-minute readings secured and % Compaction, Dry Density, % Moisture recorded by the gauge.		
8. Returned source rod to safe position.		
<b>Backscatter Procedure</b>		
1. Cleared the area of people and equipment.		
2. Turned the gauge on, allowed to warm up.		
3. Set the gauge to backscatter mode.		
4. Found a smooth location 30 feet (10 m) from other radioactive sources.		
5. Prepared the site.		
6. Gauge seated firmly on prepared test site.		
7. One or more 1-minute readings.		
8. In-place wet density determined and recorded by the gauge.		

PASS PASS

FAIL FAIL

Examiner: \_\_\_\_\_ Date: \_\_\_\_\_



# MoDOT TM 35: Moisture Offset Factor for A Nuclear Gauge PROFICIENCY CHECKLIST

12/28/2018

Applicant: \_\_\_\_\_

Employer: \_\_\_\_\_

	Trial#	1	2
1. Select at least 4 testing sites for each aggregate type.			
2. Ensure that moisture offset is disabled or turned off in the machine.			
3. Perform field nuclear wet density and moisture tests.			
4. Record readings obtained and Avg. (%M <sub>gauge</sub> ).			
5. At each test site obtain sample for moisture, retrieving material between source and detectors 2.2 lb. (1,000 g) for ≤ 1/4", 3.3 lb. (1,500 g) > 1/4".			
6. Dry sample per AASHTO T 265.			
7. Record and Avg. (%M <sub>lab</sub> ).			
8. Calculate "K" factor:  $K = \frac{(\%M_{lab} - \%M_{gauge})}{(100 + \%M_{gauge})} \times 1,000$			

PASS    PASS

FAIL    FAIL

Examiner: \_\_\_\_\_ Date: \_\_\_\_\_