

April 10, 2002

**MEMORANDUM
02-02**

TO: District Directors
District Construction Engineers
Toll Road Operations Engineer
District Material & Tests Engineers
District Area Engineers
Project Engineers/Supervisors

From: Timothy D. Bertram, Chief
Contracts and Construction Division

RE: **Field Density of Soil, Soil-Aggregate, and Aggregate**

Recent revisions to AASHTO T 310 concerning the density and moisture content of soils and soil-aggregates will result in revised acceptance procedures for these tests. Included below is a summary of these procedures for determining the maximum dry density, wet density, moisture content, and dry density of soils, soil-aggregates, and aggregates.

AASHTO T 99 -- Moisture-Density Relations of Soils Using a 2.5-kg (5.5-lb)
Rammer and a 305-mm (12-in) Drop
AASHTO T 191 -- Density of Soil In-Place by Sand-Cone Method
AASHTO T 217 -- Determination of Moisture in Soils by Means of a Calcium Carbide
Gas Pressure Moisture Tester
AASHTO T 272 -- Family or Curves - One Point Method
AASHTO T 310 -- In-Place Density and Moisture Content of Soil and Soil-Aggregate
by Nuclear Methods
ITM 506 -- Field Determination of Moisture Content of Soils

Soils -- Cohesive Material (Option 1 or 2 is used for each)

Maximum Dry Density

1. AASHTO T 99 (Method A)
2. AASHTO T 272

Wet Density

1. AASHTO T 191
2. AASHTO T 310 -- Direct Transmission (except soil stabilization lifts)

Moisture Content

1. ITM 506
2. AASHTO T 217

Soil-Aggregate -- Granular Soil that is Non-Cohesive (Option 1 or 2 (if available) is used)

Maximum Dry Density

1. AASHTO T 99 (Method A or C)

Wet Density

1. AASHTO T 191
2. AASHTO T 310 (Backscatter)

Moisture Content

1. ITM 506

Aggregate -- Compacted Aggregate (Option 1 or 2 (if available) is used)

Maximum Dry Density

1. AASHTO T 99 (Method C)

Wet Density

1. AASHTO T 191
2. AASHTO T 310 (Backscatter)

Moisture Content

1. ITM 506

Dry Density -- The dry density of the material is determined as follows:

$$d = \frac{100}{100+w} (m)$$

Where:

- d = Dry density in lbm/ft³ (kg/m³)
m = Wet density in lbm/ft³ (kg/m³)
w = Water as a percent of dry mass

The dry density and wet density are reported to the nearest 0.1 lbm/ft³ (0.1 kg/m³)
And the moisture content is reported to the nearest 0.1%.

Nuclear Gauges -- The nuclear gauge is to be used in the direct transmission method for soil and the backscatter method for soil-aggregate materials. If the nuclear gauge is used on a soil stabilization lift then the backscatter method will be used. Direct transmission method tests require 1-minute readings and backscatter method tests require 4 minutes readings. The gauge is only used for wet density measurement. No calibration adjustment, such as correlating the value to a sand cone density, is required.

Moisture Content -- The moisture content may be determined by either the procedure requiring drying of the sample in accordance with ITM 506 or the procedure using the Speedy Moisture Tester. One moisture determination is required for each day that the wet density measurements are taken. The sample for moisture content should be taken adjacent to the nuclear gauge test site and be representative of the entire depth of the compaction lift being tested. Additional moisture content tests may be required during the day if there is an obvious change in the material.

TDB:SAT:sat