



**INDIANA DEPARTMENT OF TRANSPORTATION
DIVISION OF MATERIALS AND TESTS**

**TEST SECTIONS FOR AGGREGATES
AND RECYCLED MATERIALS**

ITM No. 514-25

1.0 SCOPE.

- 1.1 This test method describes the construction of an aggregate or recycled materials test section using a Light Weight Deflectometer (LWD) or Dynamic Cone Penetrometer (DCP). LWD shall be used for aggregate, recycled concrete, or *reclaimed* asphalt pavement (RAP) test sections. DCP shall be used for foundry sand or coal ash test sections.
- 1.2 The fundamental requirement for this *section is to achieve the maximum stiffness with adequate compaction effort.*
- 1.3 Test sections shall be constructed in the presence of a representative of the Department with the available equipment of the Contractor.
- 1.4 This ITM may involve hazardous materials, operations, and equipment and may not address all of the safety problems associated with the use of the test method. The user of the ITM is responsible for establishing appropriate safety and health practices and determining the applicability of regulatory limitations prior to use.

2.0 REFERENCES.

2.1 AASHTO Standards.

- T 27 Sieve Analysis of Fine and Coarse Aggregate
- T 88 Particle Size Analysis of Soils
- T 89 Determining the Liquid Limit of Soils
- T 90 Determining the Plastic limit and Plasticity Index of Soils
- T 99 Moisture-Density Relations of Soils Using a 2.5-kg (5.5-lb) Rammer and a 305-mm (12 in.) Drop
- T 255 Total Evaporative Moisture Content of Aggregates by Drying

2.2 ITM Standards.

ITM 506 Field Determination of Moisture Content of Soil, Stove or Hot Plate

ITM 508 Field Determination of Deflection Using Light Weight Deflectometer

ITM 509 Field Determination of Strength Using Dynamic Cone Penetrometer

3.0 TERMINOLOGY. Definitions for terms and abbreviations shall be in accordance with the Department's Standard Specification, Section 101 and as follows:

3.1 Recycled Materials. Foundry sand, coal ash, recycled concrete, RAP, or other recycled materials for similar use as determined by the Department.

4.0 SIGNIFICANCE AND USE. This ITM shall be used to obtain the maximum allowable deflection of aggregates or recycled materials using an LWD. LWD shall be used for aggregate, recycled concrete, or RAP test sections. DCP shall be used to determine the blow counts, roller type, pattern and number of passes. DCP shall be used for foundry sand or coal ash test sections.

5.0 APPARATUS.

5.1 Force-Generating Device, 10 kg \pm 0.1kg falling weight with a guide system, lock pin and spring assembly. The mass of the guide rod is 5 kg \pm 0.25 kg and the maximum impact force is 7.07 kN. The fixed drop height shall be in accordance with the manufacturer recommendation.

5.2 Loading Plate, made of steel, having dimensions of 300 mm in diameter and 20 mm in thickness. The plate shall have two handles and weigh 15 kg \pm 0.25 kg.

5.3 Deflection Sensor, capable of measuring the maximum vertical movement with an accelerometer. The accelerometer is required to be attached to the center of the plate.

5.4 Data Processing and Storage System, capable of displaying and recording the loading data, deflection data, and the test location for each test.

5.5 Dynamic Cone Penetrometer, with a 17.6 lbm steel drop hammer located between the handle and coupler assembly on a 0.625 in. diameter steel rod. The steel rod is required to be a minimum of 24 in. in length and be threaded on both ends to allow the attachment of a cone on one end and an anvil on the other end. The distance from the bottom of the hammer to the coupler assembly is 22.6 in. On the bottom of the rod is a replaceable hard sharp conical tip with an included angle of 60° and a diameter at the base of 0.79 in. The rod shall have 0.5 in. graduations. A ruler may be used to indicate the required penetration of the DCP on the steel rod.

5.6 Miscellaneous equipment such as a spade, broom, and trowel.

6.0 ROLLER EQUIPMENT

- 6.1 The roller used for the test section for aggregates, recycled concrete or **reclaimed** asphalt pavement (RAP) test sections shall be in accordance with 409.03(d)4 or 409.03(d)5.
- 6.2 The roller used for the test section for foundry sand or coal ash test sections materials shall be in accordance with 409.03 (d)1 or other approved compacting equipment capable of providing a smooth and even surface.
- 6.3 The roller shall be operated at speeds not to exceed 2.5 mph.

7.0 TEST SECTIONS

- 7.1 The test section shall be an area approximately **100** ft long by 24 ft wide. The depth shall be the lift thickness for aggregates, and 1 ft for recycled materials. Areas not meeting these minimum criteria will be considered.
- 7.2 The subgrade shall be proofrolled in accordance with 203.26 prior to construction of the test section. **Moisture content of the grade shall be in accordance with 203.23.**
- 7.3 One moisture test shall be performed in accordance with AASHTO T 255 for aggregates, recycled concrete, or RAP and ITM 506, stove or hot plate for foundry sand or coal ash prior to compaction of the test section. The moisture content shall be within -3 percentage points of optimum moisture content and the optimum moisture content.
- 7.4 The maximum allowable deflection for a 6 in. lift shall be determined for aggregates, recycled concrete or RAP. Prior to compaction of the test section the sieve analysis, and maximum density in accordance with AASHTO T 27 and T 99 shall be performed respectively on representative samples.
- 7.5 The number of required blow counts for a 6-inch lift or two 6-inch lifts shall be determined in accordance with 203.23 for foundry sand or coal ash. Prior to compaction of the test section the sieve analysis, liquid limit, plastic limit and optimum moisture and maximum density in accordance with AASHTO T 88, T 89, T 90 and T 99 shall be performed respectively on representative samples.

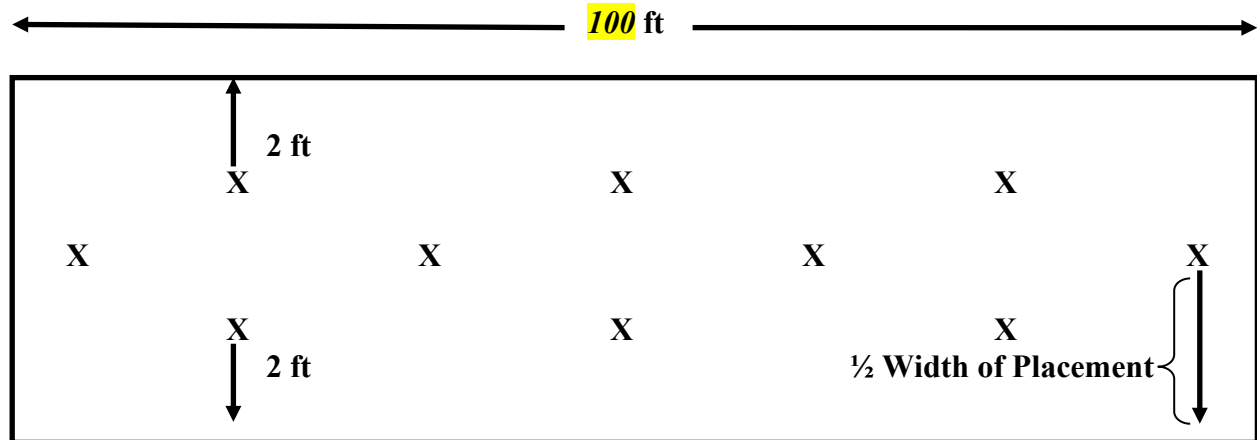
8.0 PROCEDURE – AGGREGATES, RECYCLED CONCRETE OR RAP

- 8.1 Mark the test section as described in 7.1.

- 8.2** Compact the test section with a roller operated in the vibratory mode and initially compact the test section with **5** roller applications (Note 1). There shall be no stopping or turning within the test section.

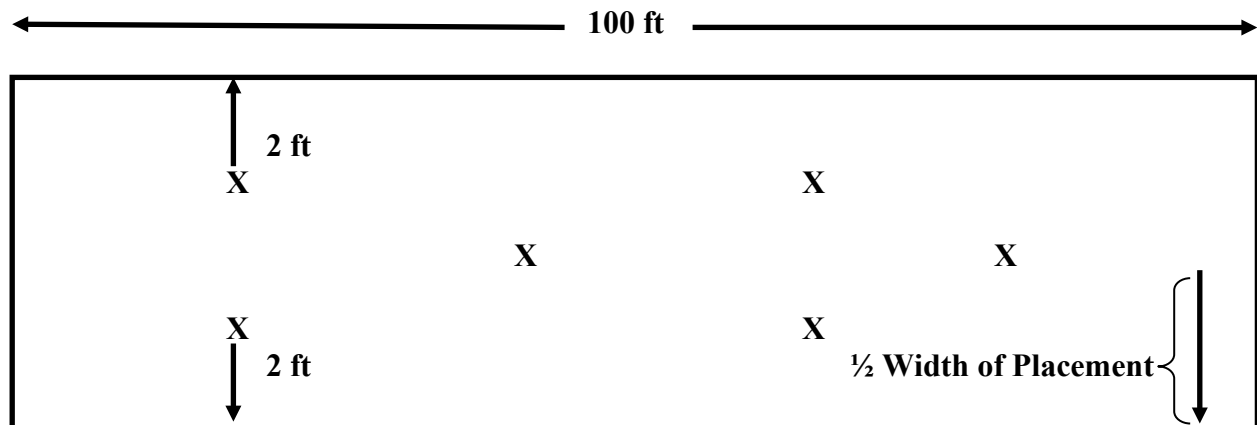
Note 1: A roller application is defined as one pass of the roller over the entire test section.

- 8.3** Obtain 10 LWD tests on the test section at the following approximate locations and mark the locations of the 10 LWD tests. Average the 10 LWD test results.



- 8.4** Compact the test section with one additional roller application in the vibratory mode, obtain 10 LWD tests at the same locations, and average the 10 LWD test results.
- 8.5** If the difference between the average LWD test values obtained from **5 and 6** roller applications is equal to or less than 0.02 mm, the compaction will be considered to have peaked and the test section procedure is finished.
- 8.6** If the difference between the average LWD test values obtained from **5 and 6** roller applications is greater than 0.02 mm, an additional roller application in the vibratory mode shall be made. Ten LWD tests shall be obtained at the same locations and the 10 LWD test results shall be averaged. This procedure shall continue until the difference of the average of the 10 LWD tests between consecutive roller applications is equal to or less than 0.02 mm.
- 8.7** The maximum allowable deflection shall be the lowest average of the 10 LWD test values.
- 8.8** Proofrooling shall be in accordance with 203.26.
- 9.0** **PROCEDURE – FOUNDRY SAND OR COAL ASH**
- 9.1** Place in two 6 in. successive lifts in accordance with 203.23.

- 9.2** Compact the test section with the required roller with 5 roller applications (Note 1). There shall be no stopping or turning within the test section.
- 9.3** After rolling is completed, three sand cone tests shall be performed in accordance with AASHTO T 191 in top six inches when the material is 35% greater than passing # 200 sieve or 6 inches below when the material is 35% less than passing # 200 sieve. The test locations shall be spaced uniformly throughout the test section. Determine the average of the three density values obtained from the sand cone tests.
- 9.4** Compare the average of the three density tests determined by sand cone to the maximum dry density of the soil. When the average test density is equal to 95% of the maximum dry density, the compaction is 95% and the test section is complete.
- 9.5** Mark the test section as described in 7.1
- 9.6** Obtain 10 DCP tests on the test section at the following approximate locations and mark the locations of the 10 DCP tests as shown in Figure 1.



- 9.7** Blow counts greater than 10 or less than 6 for each 6 inches or 12 inches will be discarded, and a new random test location will be selected in the test section so that 10 DCP tests shall be obtained. The 10 DCP test results for the top 6 in. shall be averaged and blow counts for 95% compaction are achieved, then the test section procedure is complete for clay soils. The 10 DCP test results for 12 in. shall be averaged and blow counts for 95% compaction are achieved. Then the test section procedure is complete for silty, sandy and granular soils.

10.0 REPORT.

- 10.1** The maximum allowable deflection shall be reported for aggregate, recycled concrete or RAP to the nearest hundredth (0.00).

- 10.2** The roller type, pattern, number of passes, and DCP value for foundry sand and coal ash shall be reported for a 6 inch lift or two 6 inch lifts.