STATE OF OHIO

DEPARTMENT OF TRANSPORTATION

SUPPLEMENT 1015

COMPACTION TESTING OF UNBOUND MATERIALS

APRIL 15, 2005

1015.01 General. Perform all compaction testing of soils, granular material, bases or backfill according to this supplement for Items 203, 204, 205, 206, 804, 304, 307, 411, 503, 603, select granular for MSE walls and other items when this supplement is specified.

The Department will perform the compaction tests unless specifically stated otherwise in the contract.

A pass is defined as one coverage over any given area with the compaction equipment.

Perform the in place density tests by utilizing a nuclear gauge according to AASHTO T-310. A nuclear gauge standard count will be required once a week.

Record all compaction tests on the Department supplied forms. Record all of the embankment construction inspections using the CA-EW-12, Daily Earthwork Inspection Sheet.

All compaction percentages will be calculated based on the dry densities of the material.

1015.02 Compaction Testing for Soils. Use the direct transmission method in section 9.5 in AASHTO T-310 when testing soils. Use a 12 inch (300 mm) depth when testing subgrade and an 8 inch (200 mm) depth when testing embankment. The depth will correspond to the compacted depth of the material.

Use forms CA-EW-5 or CA-EW-6 to record the compaction results.

To prepare the compaction testing location, have the Contractor remove the top 6 to 12 inches (150mm to 300mm) of material and to smooth it out.

A. Choose the moisture density curve according to AASHTO T-272 except for the following:

1. Perform a one point proctor test for every soil test.

2. Use a concrete block under the proctor mold while compacting the proctor soil.

3. Save the material retained during the sieving operation. Follow the procedure in 1015.03 if needed.

4. Use method C for the nuclear gauge testing.

5. Use the family of curves supplied by the Department. If required, make a new moisture density curve according to AASHTO T-99.

6. The compaction curve used will be determined by utilizing the results of the proctor testing and the moisture tests.

7. When the intersection is between two curves choose the next higher curve.

When the material or field conditions warrant in lieu of the above, a test section may be performed according to 1015.04, 1015.05, 1015.06 or 1015.07.

1015.03 Compaction Testing Requiring an Aggregate Correction. Prior to placing the soil in the proctor mold, the material is sieved through a ¾ inch (19 mm) sieve. The percent retained on the given sieve is divided by the total amount of soil obtained from under the nuclear gauge. This percent stone retained on the sieve is used to determine the need for an aggregate correction.

Perform the aggregate correction by utilizing the procedures, graph and form detailed in the Construction Inspection Manual of Procedures.

Use form CA-EW-6 to record the compaction results when an aggregate correction is needed.

When less than 10 percent by weight is retained on the ¾ inch (19 mm) an aggregate correction is not required. When 10 to 25 percent by weight is retained on the ¾" sieve, then an aggregate correction is required. When more than 25 percent is retained on the ¾ inch (19 mm) sieve then use a test section according to 1015.04, 1015.05, 1015.06 or 1015.07.

In lieu of performing the aggregate correction, a test section may be performed according to 1015.04, 1015.05, 1015.06 or 1015.07.

Fine granular material, such as sand, will be tested according to the test section methods in 1015.04, 1015.05, 1015.06 or 1015.07.

1015.04 Compaction Testing for Granular Material. Use the Backscatter method in section 9.4 in AASHTO T-310 when testing granular soil, sand, structural backfill type 1 or 2, 304, 411, select granular for MSE walls, granular material type A, B, C or F or any materials that requires a test section.

Use form CA-EW-5 to record the compaction results.

A moisture density curve will be made according to AASHTO T-99 Method C. This curve will define the optimum moisture to be initially utilized for the material. The maximum density will be determined by a test section method. The test section method will be performed according to 1015.05.

1015.05 Test Section Method A. Use test section method A, when the material has a definitive moisture density relationship. Conduct the test section as follows:

Initially, use an optimum moisture for the material that was found in 1015.04 for the compaction operations.

The test section maximum unit dry density will be determined as follows:

At the beginning of the compaction operation, the density requirement will be determined by compacting a short test section of approximately 400 square yards (350 square meters) for embankment or bases and 10 square yards (8 square meters) for pipe structural backfill and 40 square yards (35 square meters) for select granular for MSE walls.

An in place compaction test will be taken after two passes with the compaction equipment. The location of the test will be marked with paint. The test section will be compacted with one more pass. A compaction test will be taken at the same location.

This procedure will continue until no further increase in density is achieved or the density decreases. Once the maximum density is achieved take two additional passes and one additional test to verify that a maximum density is achieved. Record the number of passes to achieve this maximum density.

Use this number of passes and moisture content for the production areas on the project. Compact the remainder of the material to the percentage of the test section density specified in the item.

When vibration is used, the vibration may need modified to prevent instability or cracking.

A new test section density may be required if the aggregate material characteristics or the supporting materials change appreciably. Reduce the moisture content if the material becomes unstable.

1015.06 Test Section Method B. When the material does not have a definitive moisture density relationship as defined in 1015.04, then use test section method B as follows:

Compact the material at 0 to 3 percent moisture content by using the procedure described in method A, to find the maximum density in this moisture content range. Record the maximum density and number of passes.

Add water to another area to obtain a moisture content 2 percent more than the moisture content previously used. Obtain another maximum density and number of passes at this moisture content.

Repeat this method at higher moisture contents until a true field maximum density, optimum moisture and number of passes is achieved.

Once the addition of moisture makes the material unstable or two consecutive test sections obtain lower or the same densities, then this procedure is complete.

Use the moisture content and number of passes that obtains the maximum density for the production areas.

Compact the remainder of the material to the percentage of the test section maximum density specified in the item.

Use form CA-EW-5 to record the compaction results.

A new test section density will be required if the aggregate material characteristics or the supporting materials change appreciably. Reduce the moisture content if the material becomes unstable.

1015.07 Test Section Method C. This method will be used for Item 307, open graded material or highly variable material. Use form CA-EW-7 to record the compaction testing results.

One or more test sections will be constructed at the beginning of the work to determine project compaction requirements. An additional test section will be constructed when a change is made in the source of material or type of material from the same source. Each test section will consist of an area of at least 400 square yards (350 square meters) and will be of the same material as that specified on the remainder of the project.

Compaction of the test section will continue until the compaction begins to crush the aggregate or a maximum density is achieved using the testing sequences described in 1015.05. The average of three tests will be used between each pass not one as in 1015.05. The same testing locations will be used between passes and will be marked with paint.

The compaction shall be considered complete and density considered 100 percent, when the aggregate begins to break.

Upon the completion of the compaction, take a minimum of ten tests at random locations. This will determine the average in-place density of the test section. The value of this average will be a reference maximum density for the production areas.

Use the moisture content and number of passes that obtains the maximum density for the production areas.

Compact the remainder of the material to the percentage of the test section density specified in the item.

Apply water to the surface to maintain the moisture at least 1 ½ percent above saturated surface dry during the compaction operation for Item 307. Water from the rollers may be used.

A new test section density may be required if the aggregate material characteristics or the supporting materials change appreciably.

1015.08 Compaction Testing for Shale. Severely deteriorated, or weathered shale will be tested according to 1015.02.

Soft or hard shale will be tested according to 703.16.D.

If less than 25 percent of the material is retained on the ¾ inch (19 mm) sieve, then the compaction testing will be performed according to 1015.02. If 25 percent to 75 percent is retained on the ¾ inch (19 mm) sieve, then use a test section method in 1015.04, 1015.05, 1015.06 or 1015.07. All of the above shale materials will be considered soft shale.

If more than 75 percent of the shale is retained on the ¾ inch (19 mm) sieve or when the material does not deteriorate, then the shale will be field tested for hardness according to 703.16.D.

If more than 40 percent of the shale breaks down, by visual inspection, then the material will be considered soft shale. Use a test section method in 1015.04, 1015.05, 1015.06 or 1015.07 for acceptance.

If less than 40 percent of the shale breaks down, by visual inspection, then the material will be considered hard shale. Use the hard shale compaction procedure in 203.06.B for the compaction acceptance of this material.

A. Summary of Compaction Testing for Shale:

1. Perform initial test for hardness in 703.16.D (Water Bucket Test)

a. When less than 25 percent is retained on the ¾ inch (19 mm) sieve, then test like soil (1015.02).

b. When 25 to 75 percent is retained on the ¾ inch (19 mm) sieve, then use a test section method.

c. When greater than 75 percent is retained on ¾ inch (19 mm) sieve, then field test for hardness (703.16.D).

2. Use the rollers in 703.16 to field test for hardness.

a. If greater than 40 percent breaks down, then use test section method. (Soft Shale)

b. If less than 40 percent breaks down use the procedure in 203.06.B (Hard Shale)

1015.09 Compaction Acceptance. Once the initial testing is performed, the production area material will be checked for compaction.

The project will be divided into cubic yards (meters), square yards (meters) or linear feet (meter) as described in 1015.10. The minimum number of tests specified will be taken in the lots. When more than one test is required in the lot, the average density of the tests are required to be greater than the specified percentage in the item.

If a lot fails to meet the requirements, it shall be dried or wetted as needed, re-compacted and resubmitted for acceptance.

When a test section is used for acceptance and the density still fails again, then a new test section will be constructed.

1015.10 Minimum Number of Tests. The minimum number of compaction tests are listed below. The project pay items will be divided into the following lots and will consist of the following minimum compaction tests in said lots:

ITEM	NUMBER OF TESTS	LOT SIZE
203 Roadway Excavation and Embankment, 205 Chemically Stabilized Embankment and 205 Lime Modified Embankment (2002 Specifications)	One	2000 Cubic Yards (1530 Cubic Meters)
204 Subgrade Compaction and Proof Rolling, 206 Chemically Stabilized Subgrade, 206 Lime Stabilized Subgrade (2002 Specifications) and 804 Cement Stabilized Subgrade (2002 Specifications)	One	3000 Square Yards (2500 Square Meters)
304 Aggregate Base and 411 Stabilized Crushed Aggregate	Three	5000 Square Yards (4200 Square Meters)
307 Non Stabilized Drainage Base	Ten	5000 Square Yards (4200 Square Meters)
603 Pipe Bedding and Backfill	One	50 linear feet (17 Meters) of Pipe
Select Granular Embankment Material for MSE Walls	One	Per lift Per 300 feet (100 Meters) of Wall
503 Backfill	One	Every 5th lift

The amount of compaction tests in these lots may be more at the beginning of the work and less at the end of construction. If the compaction tests consistently pass a reduction in the amount testing can be considered. If the compaction tests consistently fail then increase the compaction testing frequency.