STATE OF OHIO

DEPARTMENT OF TRANSPORTATION

SUPPLEMENT 1015

COMPACTION TESTING OF UNBOUND MATERIALS

APRIL 21, 2006

1015.01 General. Perform all compaction testing of soils, granular material, bases or backfill according to this supplement for Items 203, 204, 205, 206, 304, 307, 411, 503, 603, select granular embankment 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 according to 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 approximately 6 inches (150mm) of material and to smooth out the surface.

A. Use AASHTO T-272 to choose the moisture density curve. Modify AASHTO T-272 according to 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, develop a new moisture density curve according to AASHTO T-99.
6. Use the results of the proctor testing and the moisture tests to select the curve.

7. When the intersection is between two curves choose the higher of the two curves.

B. A test section may be performed according to 1015.04, 1015.05, 1015.06 or 1015.07, in lieu of proctor and moisture testing (1015.02.A), if warranted by the material or field conditions.

1015.03 Compaction Testing Requiring an Aggregate Correction. Use the aggregate correction method for clays and silts with significant material retained on the ¾ inch (19 mm) sieve not granular material. Test fine granular material, such as sand, according to the test section methods in 1015.04, 1015.05, 1015.06 or 1015.07.

Prior to placing the material in the proctor mold, sieve the material through a ¾ inch (19 mm) sieve. The weight retained on the ¾ inch sieve is divided by the total weight of material obtained from under the nuclear gauge. This percent stone retained on the ¾ inch (19 mm) 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) sieve an aggregate correction is not required. When 10 to 25 percent by weight is retained on the ¾ inch (19 mm) 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.

A test section performed according to 1015.04, 1015.05, 1015.06 or 1015.07 may be used for materials requiring an aggregate correction.

1015.04 Compaction Testing for Granular Material. Use the backscatter method according to AASHTO T-310 when testing granular soil, sand, structural backfill type 1 or 2, 304, 411, select granular embankment 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.

Create a moisture density curve according to AASHTO T-99 Method C. Use the moisture density curve to define the initial optimum moisture for the material. Determine the maximum dry density by a test section method. Conduct the test section method according to 1015.05.

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

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

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

At the beginning of the compaction operation, determine the density requirement 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 embankment for MSE walls.

Take an in place compaction test after two passes with the compaction equipment. Mark the location of the test with paint. Compact the test section with one more pass of the compaction equipment. Take an in place compaction test at the marked location.

Continue this procedure until no further increase in dry density is achieved or the dry density decreases. Once the maximum dry density is achieved compact the area with two additional passes of the compaction equipment and perform one additional in place compaction test. Verify that a maximum dry density is achieved. Record the number of passes to achieve this maximum dry 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 maximum dry density specified in the item.

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

Conduct a new test section and determine the new maximum dry density if the 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 laboratory 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 dry density in this moisture content range. Record the maximum dry density, moisture content and number of passes.

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

Repeat this procedure at higher moisture contents until a field maximum dry density 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 dry density for the production areas.

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

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

Conduct a new test section and determine the new maximum density if the material characteristics or the supporting materials change appreciably. Reduce the moisture content if the material becomes unstable.

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

Construct one or more test sections at the beginning of the work to determine project compaction requirements. Construction an additional test section when a change is made in the source of material or type of material from the same source. Use an area of at least 400 square yards (350 square meters) for each test section. Use the same material as that specified on the remainder of the project.

Continue the compaction during the test section until the compaction begins to crush the aggregate or a maximum dry density is achieved using the testing sequences described in 1015.05 except as follows:

Perform three in place density tests after each pass of the compaction equipment.

Use the average of the three density tests to calculate the dry density of the test.

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

Upon the completion of the test section compaction, take a minimum of ten tests at random locations. Determine the average in-place dry density of the test section. Use the average in-place density as a reference maximum dry density for the production areas.

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

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

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.

Conduct a new test section and determine the new maximum dry density if the 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.

Test soft or hard shale according to 703.16.D.

If less than 25 percent of the shale is retained on the ¾ inch (19 mm) sieve, perform compaction testing according to 1015.02. If 25 percent to 75 percent of the shale 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. Consider all of the above shale materials as soft shale.

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

If more than 40 percent of the shale breaks down, by visual inspection, the shale is 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, the shale is 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 the 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, 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, check the production area material for compaction.

Divide the work into cubic yards (meters), square yards (meters) or linear feet (meter) as detailed in 1015.10. Perform the minimum number of tests specified in the lots. When more than one test is required in the lot, the average dry 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 fails twice, then construct a new test section.

1015.10 Minimum Number of Tests. Use Table 1015.10-1 for the different materials, minimum testing frequencies and the appropriate test or method for controlling each material.

TABLE 1015.10-1			
Material	**Test or Method**	**Maximum Lot Size***	**Minimum Number of Tests**
Item 203 and 204 Rock, Hard Shale, and Granular Material Types D and E	Roller Passes	2000 Cubic Yards (1530 Cubic Meters)	One per lot with at least one per lift
All Item 203 and 205 Materials except for: Rock, Hard Shale, and Granular Material Types D and E	Compaction and Moisture	2000 Cubic Yards (1530 Cubic Meters)	One per lot
All Item 204 and 206 Materials except for: Rock, Hard Shale, and Granular Material Types D and E	Subgrade Compaction and Moisture	3000 Square Yards (2500 Square Meters)	One per lot with at least one per lift
As Required in S-1015	Test Section**	2000 Cubic Yards (1530 Cubic Meters)	One for each type of material
Item 203 and 204 Shale Materials	Shale Tests 203.06.B,703.16.D and 1015.08	2000 Cubic Yards (1530 Cubic Meters)	Each Shale Type with at least one every 5th lot
Items 203 and 204 Granular Embankment and Granular Material Types A, B and C; Item 304; Item 411; Item 603 Structural Backfill 703.11 Type 1 and 2; and Select Granular Embankment for MSE Walls	Moisture Density Curve AASHTO T-99	Each Material Type	One
All materials	Lift Thickness, Roller Passes and Type of Compaction Equipment	2000 Cubic Yards (1530 Cubic Meters)	One per lot with at least one per lift
Items 304 and 411	Compaction and Moisture	5000 Square Yards (4200 Square Meters)	Three with at least one per lift
Item 307	Compaction and Moisture	5000 Square Yards (4200 Square Meters)	Ten with at least one per lift
Item 603	Compaction and Moisture	Every 50 linear feet (17 meters) of pipe or every 5th lift which ever is more	One
Select Granular Embankment for MSE Walls	Compaction and Moisture	Per lift per 300 feet (100 meters) of Wall	One
Item 503 Backfill	Compaction and Moisture	Every 5th lift	One

*During construction, lot sizes may be modified if warranted to maintain a workable system. For example, two or more areas containing small quantities of embankment material might be combined into one lot.
**Notify the Engineer at least 24 hours in advance of performing a Test Section.