



Iowa Department of Transportation

DEVELOPMENTAL SPECIFICATIONS FOR COMPACTION WITH MOISTURE AND DENSITY CONTROL

Effective Date
January 19, 2011

THE STANDARD SPECIFICATIONS, SERIES 2009, ARE AMENDED BY THE FOLLOWING MODIFICATIONS AND ADDITIONS. THESE ARE DEVELOPMENTAL SPECIFICATIONS AND THEY SHALL PREVAIL OVER THOSE PUBLISHED IN THE STANDARD SPECIFICATIONS.

09056.01 DESCRIPTION.

Place and compact embankment materials at the required moisture content and density as shown in the contract documents. Test and ensure moisture content of soil being placed is within specified range and in-place density meets minimum requirements.

09056.02 MATERIAL.

Soils placed with compaction with moisture and density control may be select, Class 10, or unsuitable.

09056.03 CONSTRUCTION.

A. Quality Control Program (Embankment Construction).

1. Provide and maintain a Quality Control Program (Embankment Construction), defined as all activities of sampling, testing, process control inspection, and necessary adjustments for construction of embankments to meet the requirements of this specification.
2. Provide a Quality Control Technician as part of the Quality Control Program (Embankment Construction), to perform testing on all embankment soils placed with Compaction with Moisture and Density Control. As a minimum, the Quality Control Technician shall have a high school education and shall obtain 'Soils Technician Lab Certification' through a two day course held at Des Moines Area Community College (DMACC) in Boone through the Technical Training and Certification Program (TTCP) of the Department. Arrange training through the Iowa DOT's Office of Construction (telephone 515.239.1280). TTCP requirements of Materials I.M. 213 apply.
3. Ensure the Quality Control Technician is present on the project when embankment is being placed with Compaction with Moisture and Density Control.
4. Provide a laboratory facility and necessary calibrated equipment to perform required tests.

B. Test Procedures.

1. Use test procedures and equipment complying with applicable Materials I.M.'s, Iowa DOT Materials Laboratory Test Methods, or equivalent standards of AASHTO or ASTM.

2. Allow the Engineer to review equivalent standards. Use equivalent standards only if approved by the Engineer.
3. Acceptable test methods for determining moisture content and density are:
 - Oven drying AASHTO T 265
 - Pan drying AASHTO T 265 modified to use an open burner
 - Microwave ASTM D 4643
 - Nuclear gauge Materials I.M. 334
 - Density of soil cores Materials I.M. 326
 - Sand Cone Test ASTM D 1556
4. Use AASHTO T 265 oven drying method for the reference method for calibration.

C. Embankment Construction.

1. General.

Apply Section 2107 of the Standard Specifications, except when amended by requirements of this specification. Verify embankment placed with moisture and density control meets the requirements of Article 2107.03, H of the Standard Specifications.

2. Moisture and Density Control.

- a. Determine optimum moisture content and maximum density by Proctor testing of soil being placed. Determine optimum moisture and maximum density for each type of excavated or mixed soil which varies as to change the expected AASHTO classification, or if directed by the Engineer.
- b. With Engineer's approval, and for soils that can be identified during excavation, the Contractor may use the optimum moisture content and maximum density as shown on the soils 'Q' sheets in the contract documents. In lieu of using values from the 'Q' sheets, the Contractor may choose to determine optimum moisture and maximum density from a field sample.
- c. If the Engineer deems the optimum moisture and maximum density of material being excavated and/or mixed is not represented by that shown on the 'Q' sheets, determine optimum moisture and maximum density from a field sample.
- d. When determined from a field sample at the option of the Contractor or at the Engineer's request, the optimum moisture and maximum density values from the field sample prevail over that shown on the 'Q' sheets.
- e. Test and verify that moisture content of material placed under the item 'Compaction with Moisture and Density Control' is within optimum moisture content range and greater than or equal to required minimum density. Upper and lower control limits for field moisture content of embankment material will be shown in the contract documents.
- f. Disk to reduce moisture if, after initial disking to break down lumps greater than 12 inches (0.3 m) as required by Article 2107.03, D, 2, d, of the Standard Specifications, the deposited soil material contains moisture in excess of the specified moisture limits.
- g. If, after initial disking as required by Article 2107.03, D, 2, d, of the Standard Specifications, the material is dry to the extent that it is not within the range of the optimum moisture of the soil to allow satisfactory compaction by rolling, uniformly moisten the material to the required limits before it is compacted.
- h. Proceed with aeration, watering, and compaction operations in an orderly fashion without unreasonable and unnecessary delay. Compensation will not be allowed for delays resulting from the ordering of moistening or disking.
- i. Verify soil accepted for final placement is within the specified moisture control limits and meets the in-place density requirements.

3. Compaction.

Apply Article 2107.03, E, of the Standard Specifications.

4. Equipment.

Apply Article 2107.03, B of the Standard Specifications, except that for compaction of granular sand soils classified as AASHTO M 145 Group A-1, A-2, or A-3 and having 15% or less combined silt/clay content (percent passing the No. 200 (75 µm sieve) use:

- Pneumatic tired rollers as described in Articles 2001.05, C and 2001.05, D of the Standard Specifications, or
- Self-propelled vibratory rollers as described in Article 2001.05, F of the Standard Specifications.

D. Test Frequency during Embankment Construction.

1. Test for proctor optimum moisture content and embankment moisture content and density at minimum frequencies in Materials I.M. 204. Samples will be randomly selected.
2. If source of excavation and moisture have been consistent and within moisture control limits, moisture and density testing of each lift by Article 2107.03, H of the Standard Specifications will be waived for areas less than 1300 cubic yards (1000 m³), or for embankment placed as median dikes (Standard Road Plan RL-4) or safety dikes (Standard Road Plan RL-7). Where testing per lift is waived, test randomly selected samples at a minimum frequency of one test per compacted volume of 1300 cubic yards (1000 m³).

E. Field Records.

Document observations, records and inspection, changes in soil type, soil moisture and density, fill placement procedures, and test results on a weekly basis. Note results of observations and records of inspection in a permanent field record as they occur. Submit copies of field moisture and density tests to the Engineer weekly. Submit original testing records (raw field and lab data sheets) and control charts to the Engineer in a neat and orderly manner within five calendar days after completion of the project.

F. Corrective Action.

Notify Engineer when a moisture content falls outside the specified control limits or density falls below required minimum. If a single moisture content falls outside of control limits, fill material in this area will be considered unacceptable for compaction. Perform corrective action(s) to bring uncompacted fill material, after a retest, within specified moisture control limits. If material has been compacted, disk it, bring to within moisture control limits, and recompact. If a single density does not meet the requirements, compacted fill material in this area will be considered unacceptable. Perform corrective action(s) to material to meet density requirements.

G. Quality Assurance.**1. Required Testing.**

- a. Contractor's Quality Control Technician shall perform field testing and data analysis. Quality Control Technician shall retain split samples of Materials I.M. 309 testing when requested by the Engineer. The Engineer may select any or all Contractor-retained split samples for independent assurance testing.
- b. The Engineer will determine the random location of moisture and density verification tests and will test at the minimum frequencies in Materials I.M. 204. Contractor's Quality Control Technician shall obtain a sample at the same location as directed by the Engineer and provide results to the Engineer. Verification test results will be provided to the Contractor within one working day after the Contractor's quality control test results have been reported.
- c. The Engineer will periodically witness field testing being performed by the Contractor. If the Engineer observes quality control field tests are not being performed according to the applicable test procedures, the Engineer may stop production until corrective action is taken. The Engineer will notify the Contractor of observed deficiencies, promptly, both verbally and in writing. The Engineer will document witnessed testing.

d. Quality control test results become part of project files.

2. Verification and Independent Assurance Testing.

- a. Contractor's quality control test results will be validated by the Engineer's verification test results using the criteria in Materials I.M. 216. If Engineer's verification test results validate Contractor's test results, Contractor's results will be used for material acceptance.
- b. In the event that the Contractor's results cannot be validated, Engineer will investigate the reason immediately. Engineer's investigation may include:
 - Testing of other locations,
 - Observations of Contractor's testing procedures and equipment, and
 - Comparison of test results of Contractor with those of the Engineer.
- c. Personnel and laboratories performing tests used in acceptance of material shall participate in the independent assurance program covered in Materials I.M. 205.

3. Referee Testing.

If a difference in procedures for sampling and testing and/or test results exists between the Contractor and the Engineer which they cannot resolve, the Iowa DOT's Central Materials Laboratory will provide referee testing. The Engineer and Contractor will abide by results of referee testing.

H. Acceptance.

The Engineer will base final acceptance of tests and materials on results of the Contractor's quality control testing as verified by Engineer's quality assurance.

09056.04 METHOD OF MEASUREMENT.

- A. The quantity of embankment requiring Compaction with Moisture and Density Control, in cubic yards (cubic meters), will be the quantity shown in the contract documents as determined by the template fill volume. Shrinkage will not be included in moisture and density control quantity.
- B. Excavation in preparation for and construction of embankment with moisture and density control will be included in Class 10 Excavation according to Article 2102.04 of the Standard Specifications.

09056.05 BASIS OF PAYMENT.

- A. Payment for Compaction with Moisture and Density Control will be the contract unit price in cubic yards (cubic meters) for the quantity of embankment placed with moisture and density control.
- B. Payment is full compensation for furnishing a Quality Control Technician, sampling and testing, process control inspection, working of drying material, furnishing and applying water, controlling moisture content of the materials, and compacting the materials to the required density, as specified.