

## Section 989

# ESTABLISHING MAXIMUM FIELD DENSITY

### 989.01 SCOPE

This method establishes a maximum field density for use as a density standard to determine relative in-place density (percent compaction). This method is intended to be used on aggregate and soil/aggregate mixtures such as free-draining granular backfill or a material that is so rocky that a laboratory proctor cannot be run (30 percent or more retained on the ¾ inch sieve).

### 989.02 OVERVIEW

A section of roadway or fill is compacted. On each roller pass (a pass is defined as one time being from the start of the test strip to its end) the material is tested for density in three locations using the nuclear moisture/density gauge. A field density curve is developed and the maximum field density is established. The established maximum field density is used as a density standard to determine compaction on subsequent placements of the same material.

Re-establish the maximum field density when the source or material properties change.

### 989.03 REFERENCES

#### AASHTO STANDARDS

- AASHTO T 310; In-place Density and Moisture Content of Soil and Soil-aggregate by Nuclear Methods (Shallow Depth)

#### UDOT MINIMUM SAMPLING AND TESTING REQUIREMENTS

#### UDOT STANDARD SPECIFICATIONS

#### UDOT PROJECT SPECIAL PROVISIONS

### 989.04 APPARATUS

Equipment and nuclear density/moisture gauge required to perform a moisture/density determination according to AASHTO T 310.

Standardize the gauge according to AASHTO T 310.

### 989.05 TEST STRIP SELECTION

1. Choose a level, uniform section of the placement area large enough to perform a roller pattern. The test strip area needs to be representative of the placement area and approximately 100 feet long. Equipment other than that required to compact the material should be kept off the test strip location during testing.
2. Test the first lift of material at or near optimum moisture after performing two roller passes.
3. Select three test sites in the test strip; stratify test sites over the entire area. Ensure test sites are:
  - At least 30 ft. from other sources of radiation
  - 10 ft. away from large objects (structures)

- 12 in. from an unsupported edge
- Prepare the test site according to AASHTO T 310

### **989.06 PROCEDURE**

1. Take a one minute reading in each of the test locations in the Direct Transmission mode taken at a depth of ½ the lift thickness.
2. Record wet density results (lb/ft<sup>3</sup>) for each location.
3. The three determinations must be within 3 lb/ft<sup>3</sup> of each other; if the determinations are not within 3 lb/ft<sup>3</sup> of each other, one or more test locations may be 'reading' an oversize rock or void. Move to a new test site for suspect location(s).
4. Record the average of the density and moisture results with the number and type of passes (vibratory or static).
5. Clearly mark the test locations (if using paint, do not paint the gauge).
6. All subsequent density determinations must be in the same locations and the same gauge orientation as the first test.
7. Make two or more roller passes over the entire test strip.
8. Repeat density determinations.
9. Record density results and total number of passes.
10. Continue rolling and testing, maintaining moisture content, until the test results decrease or remain the same (within 1 lb/ft<sup>3</sup>). Perform one more roller pass, in static mode, and density determination. The final test should not show a decrease of more than 1.5 lb/ft<sup>3</sup>.

**Note:** A slight decrease in density may be observed before maximum density is achieved. If suspected, examine the material, and if no fracture of the material is visible, continue the rolling/density testing process until maximum density is achieved.

### **989.07 DETERMINING MAXIMUM FIELD DENSITY**

Creating field density / compactive effort curve

1. Plot the average field density on the vertical axis with the associated number of roller passes on the horizontal axis.
2. Connect plotted points with a smooth curve
3. The highest point of the curve is the maximum field density.

Perform random in-place density determinations according to Minimum Sampling and Testing Requirements using the determined maximum field density.

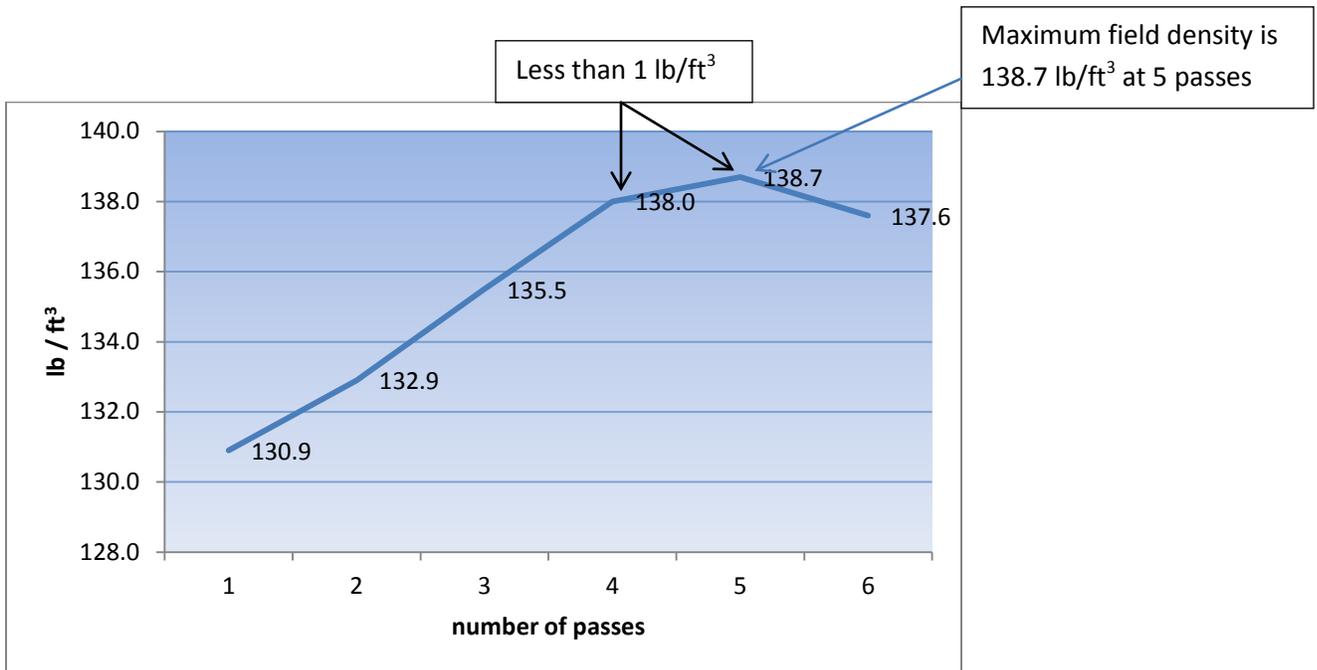
Note: The determined maximum field density is to be used as the field standard and input into the nuclear gauge for subsequent acceptance testing.

**989.08 REPORT**

1. Project number
2. Project location
3. Test Strip Stationing
4. Test location Stationing
5. Number of each vibratory and static passes needed to achieve density
6. Gauge information as required by AASHTO T 310
7. Individual and average in-place densities performed on the test strip
8. Average moisture content of each average field density
9. Field density / compactive effort curve
10. Maximum field density
11. Roller size, type, and description used to create the field density compactive effort curve

**989.09 EXAMPLE**

This will also include an example of the field density sheet.



Maximum field density is 138.7 lb/ft³ and was obtained in 5 passes.