

### 1. Background

The Federal Highway Administration (FHWA) conducted a stewardship review of TxDOT specifications and procedures in 2021. One finding from this review was soils and base specifications do not require density and moisture testing at predetermined random locations. Inspectors choose testing locations randomly from a given land or completed area, but they are not determining those locations using random numbers such as coring locations for hot mix asphalt pavements. FHWA requires acceptance testing at random locations determined from using random numbers.

Consequently, FHWA mandated TxDOT to require density and moisture testing at random locations for all applicable soils and base material items in the 2024 specification book. The 2024 specification book includes language requiring random density and moisture testing for Item 132 Embankment, Item 247 Flexible Base, and Items 247, 260, 275, 276, 290, and 291 for asphalt, cement, and lime treated materials. In addition to this, test procedure Tex-115-E required to measure density and moisture has been revised to include a new procedure Part IV for selecting random testing locations.

### 2. Compaction – Density Control

When specifications for soils and base materials require Density Control, the Engineer is required to test for density and moisture for acceptance at a frequency of testing established by TxDOT's Guide Schedule of Sampling & Testing. The frequency of testing in the Guide Schedule is a minimum and the Engineer may increase the number of tests at any time in addition to the random testing used for acceptance, such as when test results do not meet specifications or for testing areas with irregularities, such as depressions, segregation, weak or soft spots, and wet areas.

Testing is performed in accordance with test procedure Tex-115-E, Determining In-Place Density and Moisture of Soils and Base Materials. Part I, Nuclear Gauge Method is used for testing. However, prior to testing, 2024 specifications require the Engineer to determine random testing locations in accordance with Part IV, Random Selection of Testing Locations. The worksheet and random testing locations are not to be shared with the Contractor until the time of testing or afterwards.

### 3. In-Place Testing & Acceptance

Tex-115-E, Part IV is a procedure that produces random numbers and random testing locations. In conjunction with this procedure, a standalone excel worksheet is available. This worksheet generates random numbers and calculates the station and width offset for each random test assigned for the land or completed area that is ready for testing. The lateral offset is to be from the right side of the area or road, such as coring hot mix asphalt pavements and is at least 2 feet away from each compacted edge.

# Random Density Testing of Soils & Base Materials

## Guidance Document



The information required for entry into the worksheet by the Engineer must include the date of testing, controlling CSJ, beginning and ending station for the length of the area, width of the area, and the number of tests required for the area. When the width varies, the Engineer will determine the width that is most representative of the area. The Contractor is required to provide the Engineer the beginning and ending station numbers for the length of the area processed daily. This worksheet will be available in SiteManager as a test template. A screenshot of the template with example data entered is shown in Figure 1.

TEXAS DEPARTMENT OF TRANSPORTATION  
RANDOM DENSITY TESTING  
Tex-115-E

SAMPLE ID		SAMPLED DATE	
TEST NUMBER		LETTING DATE	
SAMPLE STATUS		CONTROLLING CSJ	
COUNTY		SPEC YEAR	
SAMPLED BY		SPEC ITEM	
SAMPLE LOCATION		SPECIAL PROVISION	
MATERIAL CODE		GRADE	
MATERIAL NAME			
PRODUCER			
AREA ENGINEER		PROJECT MANAGER	

  

COURSE/LIFT		STATION		DIST FROM CL:	
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*Note: Adjusted stations and width offsets are at least two feet away from compacted edges.*

Beginning Station	0+00.0
Ending Station	100+00.0
Width	12

Clear All

Clear Random Numbers

Generate Random Test Locations

Print

  

Test Number	Random Numbers		Random Station	Random Width Offset	Adjusted Station	Adjusted Width Offset
	Length	Width				
1	0.290	0.706	29+00.0	8.5	29+00.0	8.5
2	0.302	0.533	30+20.0	6.4	30+20.0	6.4
3	0.533	0.580	53+30.0	7.0	53+30.0	7.0
4	0.580	0.290	58+00.0	3.5	58+00.0	3.5
5	0.706	0.302	70+60.0	3.6	70+60.0	3.6

**Figure 1.**  
Screenshot of Excel Worksheet.

### *3.1. When to Determine Random Locations.*

The Engineer is required to determine the random testing locations for each area when the length and width of the area is known using the worksheet. This could be anticipated at the beginning of the project, but the length and width of the areas may change and the information from the worksheet won't be accurate. It is recommended to determine the random locations prior to testing such as at the start of the day or the day before. This process for selecting random samples should be discussed during the preconstruction meeting.

### *3.2. When Density and/or Moisture Do Not Meet Specification Requirements.*

Tex-115-E, Part I allowed the option of rotating the nuclear density gauge to 90 degrees and repeat testing. This option has been revised. When the density and/or moisture from the original test does not meet specification, the procedure requires the gauge to be rotated 90, 180, and 270 degrees and testing repeated after each rotation. This will produce four test results from the same location (pin hole). The four results are then averaged and the result will be used to determine if the testing results meets specification.

#### *3.2.1. Embankment and Flexible Base*

When the average test results do not meet specifications or does not meet reasonable tolerances, reference the worksheet and retest the area using the next random location. When test results at the second random location meet specification, accept the area. However, the initial failing test results should not be significantly lower than the required density and moisture of the specification. The Engineer will determine what may be deemed as acceptable for the failing initial test results and decide what to leave in place or what to rework and recompact.

When the second random test fails to meet specifications, perform additional density testing to determine the extent of the area that needs to be reworked and recompacted. The number of tests and distance from the random locations tested is at the discretion of the Engineer. An alternative to additional density testing is to have the Contractor proof-roll the area and correct any unstable or nonuniform areas. After correction of unstable areas, it is recommended for the Engineer to perform additional density testing by visually choosing a random location or using the worksheet.

The Engineer should consider the following when determining areas for reworking.

1. Areas with high moisture, wet areas.
2. Segregation
3. Soft subgrades and unsuitable materials in embankments.
4. Potential to reprocess cement stabilized materials to achieve satisfactory strength versus density.
5. Variable materials in subgrades using the appropriate proctors.

### *3.2.2. Asphalt, Cement, and Lime Treated Materials*

When two random tests fail to meet specification for asphalt, cement, or lime treated materials, a viable option for acceptance is for the Engineer to require the Contractor to proof-roll the area while observed by the Engineer and to correct any unstable or nonuniform areas and accept those areas that show to be stable. If areas are reworked after correction of unstable areas, it is recommended for the Engineer to perform additional testing by visually choosing a random location or using the worksheet.

The Engineer should consider the following when determining areas for reworking.

1. Areas with high moisture, wet areas.
2. Segregation
3. Soft subgrades and unsuitable materials in embankments.
4. Potential to reprocess cement stabilized materials to achieve satisfactory strength versus density.
5. Variable materials in subgrades using the appropriate proctors.