

## **FDOT' Conceptual Features for Density Gauge**

### **Scope**

A system that obtains density measurements, records gps coordinates at the test location, determines acceptance, store test records, and transmits the data (wireless or usb universal series bus,) to PDA, personal data assistant, or laptop PC in excel format.(consider format i.e. text or rich text) Question for information systems.

- Provide a working system 90 working days from beginning of contract ready for pilot testing.

### **Tasks**

#### **Real time Data Acquisition**

A system where the technician can take a density measurement, calculate the percent maximum compaction, and determine if the test meets specifications

- Provide the option to enter log book data after the density test is run, including independent moisture content for calculating dry density.
- Perform calculations after all data is entered to determine acceptance of tests
- Automatic record for date and time with security to safeguard from tampering.
- Include feature to view probe depth prior to starting density test.

#### **Data Storage**

- A system that automatically stores test information. Provide security features that ensure all density tests taken with the gauge are stored and protected to prevent deletion or modification, prior to information being uploaded.
- After completion of uploading data from the gauge, provide option to “clear all” or “clear single” once the information has been successfully uploaded.

#### **Data Retrieval**

The system shall also be capable of transferring data (wireless or usb) to PDA or Laptop excel file.

- Data exported to individual columns
- Machine to tell us how many results to upload and include a feature that reports which tests are uploaded to make sure all tests are uploaded and avoid uploading duplicate data

#### **Notes**

- See logbook data on following sheets for Quality Control and Verification.

The current upload spreadsheet into LIMS (Laboratory Information Management System) database will be provided to vendors for information if requested.

# Quality Control - Earthwork Density Report

## CONTRACTOR - QC DENSITY RECORDS

### Earthwork Density Report

Project FIN: 1  
Type of Const: 2

Page: 3

FROM STATION 4 TO STATION 5

| Lot No. | RF | Date | Tech. ID. | Gauge Serial No. | STD. Dns./Mst. Count | Max. Dens. / Sample No. | Test No. | Station | Offset | Lift No. | Test Depth | Soil Dns./Mst. Count | Wet Dens. | % Moist. | Dry Dens. | % Max Dens. | Status / Disp. |  |
|---------|----|------|-----------|------------------|----------------------|-------------------------|----------|---------|--------|----------|------------|----------------------|-----------|----------|-----------|-------------|----------------|--|
| 6       | 7  | 8    | 9         | 10               | 11                   | 13                      | 15       | 16      | 17     | 18       | 19         | 20                   | 22        | 23       | 24        | 25          | 26             |  |
|         |    |      |           |                  | 12                   | 14                      |          |         |        |          |            | 21                   |           |          |           |             |                |  |
|         |    |      |           |                  |                      |                         |          |         |        |          |            |                      |           |          |           |             |                |  |
|         |    |      |           |                  |                      |                         |          |         |        |          |            |                      |           |          |           |             |                |  |
|         |    |      |           |                  |                      |                         |          |         |        |          |            |                      |           |          |           |             |                |  |
|         |    |      |           |                  |                      |                         |          |         |        |          |            |                      |           |          |           |             |                |  |
|         |    |      |           |                  |                      |                         |          |         |        |          |            |                      |           |          |           |             |                |  |
|         |    |      |           |                  |                      |                         |          |         |        |          |            |                      |           |          |           |             |                |  |
|         |    |      |           |                  |                      |                         |          |         |        |          |            |                      |           |          |           |             |                |  |
|         |    |      |           |                  |                      |                         |          |         |        |          |            |                      |           |          |           |             |                |  |
|         |    |      |           |                  |                      |                         |          |         |        |          |            |                      |           |          |           |             |                |  |
|         |    |      |           |                  |                      |                         |          |         |        |          |            |                      |           |          |           |             |                |  |
|         |    |      |           |                  |                      |                         |          |         |        |          |            |                      |           |          |           |             |                |  |
|         |    |      |           |                  |                      |                         |          |         |        |          |            |                      |           |          |           |             |                |  |
|         |    |      |           |                  |                      |                         |          |         |        |          |            |                      |           |          |           |             |                |  |
|         |    |      |           |                  |                      |                         |          |         |        |          |            |                      |           |          |           |             |                |  |
|         |    |      |           |                  |                      |                         |          |         |        |          |            |                      |           |          |           |             |                |  |
|         |    |      |           |                  |                      |                         |          |         |        |          |            |                      |           |          |           |             |                |  |
|         |    |      |           |                  |                      |                         |          |         |        |          |            |                      |           |          |           |             |                |  |

|                          |   |
|--------------------------|---|
| Disposition Letter Code: | V – Lots Verified by Verification Test    R – Lots Verified by Resolution Procedure    N – Lots Not Verified and Resolution initiated |
|--------------------------|---|

## General Notes & Instructions: Earthwork Density Report

All required information on the Density Report shall be current, legible and written in ink. No transcribed, rewritten, or otherwise copied Record Sheets shall be allowed or included. Dittos, arrows, white-out, and erasures shall be avoided. A correction shall be indicated with a single line striking through the original data and the corrected data written close to it. All corrections or other notes made on the plot or Record pages shall be initialed. Special Provisions or other issues effecting earthwork testing and sampling should be noted on the LOT INDEX PAGES. Retain a copy of the Calibration Parameter sheet in the Earthwork Record System for any gauge used on the project. Add a new Calibration Parameter sheet each time a Nuclear Gauge is recalibrated.

Lifts, Lots or partial lots affected by water and consequently not tested shall be identified on the DENSITY RECORD AND LOT INDEX sheets. Example: “Lifts 1-3 affected by water.”

1. **Project FIN:** Enter the project Financial Identification Number
2. **Type of Constr.:** Enter type of Construction. (Embankment, Subgrade, Base, etc.)
3. **Page:** Enter the page number corresponding to the number of the Plot page where the test will be plotted followed by a letter sequence for the page. (i.e. 1A, 1B etc. for successive density report pages)
4. **From Sta. -** Beginning station of section represented.
5. **To Sta. -** Ending station of section represented.
6. **Lot No.:** Enter LOT number. (i.e. Lot# - Corresponding Page #) Start a new set of numbers for each type of construction on each sheet. i.e Pipe Backfill, Embankment, Subgrade, Base, MSE Wall)
7. **RF:** Mark if lots were tested during reduced frequency by placing an “**X** or  $\sqrt{\phantom{x}}$ ”.
8. **Date:** Enter date of Test
9. **Tech. ID:** Enter the nine digit technician ID used for CTQP qualification.
10. **Gauge Serial No.:** - Serial number of gauge used.
11. **STD. Dns. Count:** - Record the daily standard density count of gauge used to perform the density test.
12. **STD. Mst. Count:** - Record the daily standard moisture count of gauge used to perform the moisture test.
13. **Max Density:** Enter Laboratory Maximum Density Value (Proctor) for the Test to the nearest whole number.
14. **Sample No.:** Enter sample number for the maximum density proctor.
15. **Test No.:** This is an alphanumeric value starting with Q for QC, V for Verification and R for Resolution and followed by sequential digits starting with 0001. (This may be N/A if not a district requirement.)
16. **Station:** Enter the station location of the test
17. **Offset:** Enter the Offset Distance in feet (meter) from an offset, with the direction ‘L’ or ‘R’ following the number.
18. **Lift Number:** Enter the lift number and total lifts at the test location (i.e. 2/10)
19. **Test Depth:** Write the test depth in inches (millimeter).
20. **Soil Dns. Count:** - Record the soil density count reading.
21. **Soil Mst. Count:** - Record the moisture count of gauge used to perform the moisture test.
22. **Wet Density:** Enter the wet density result from the test to the nearest 0.1 PCF.

23. **% Moisture:** Write the % moisture value to the nearest 0.1 percent as follows.

- Use Nuclear Gauge % moisture for approved Limerock, Shell rock, and Cemented Coquina Base materials.
- If the Speedy Moisture tester was used for the materials specified above, use the dial reading directly.
- For all other materials, use the moisture number from an appropriate chart, based on the Speedy dial reading.
- Microwave moisture as determined by the FM5-537 can also be used for all the materials.

24. **Dry Density:**  $\frac{\text{Wet Density}}{100 + \% \text{ Moisture}} \times 100$  Reporting Accuracy: nearest 0.1 PCF (1.0kg/m<sup>3</sup>)

25. **% Max Density:** The result of Dry Density divided by Proctor and multiplied by 100. Report to the nearest 1.0 percent.

26. **Status and Disposition:** Use the Disposition as described at the bottom of the form.

### Instructions: Earthwork Pavement Plot

- Use this plot for projects or sections of a project with ‘no Embankment’.
- Enter the beginning Station in the first row, first column. Enter the next station based on the frequency of the Density testing; thus each rectangle represents a lot.
- Enter the title for each bar in the second row, first column. Use the ‘Type of Constr.’ designations as specified below.  

|                  |                |                   |             |   |             |                  |                       |
|------------------|----------------|-------------------|-------------|---|-------------|------------------|-----------------------|
| Recommended Type | Rdwy Base: B   | Shoulder Base: SB | Curb Pad: C | Sidewalk Emb: SW  | Subgrade: S | Shoulder Sub: SS | Embankment Roadway: E |
| of Construction: | Traffic Sep: T | Pipe Backfill: PB |             | Add "L" for Left and "R" for Right to specify directions/roadways |             |                  |                       |
- Approach A: A group of bars can represent one Type of Construction from the beginning to the end of the project.
- Approach B: A group of bars can represent various Types of Construction for a set of Stations.
- When a successful density test is completed for an area, write an ‘X’ or the test number in the appropriate rectangle.
- A multiple lift construction can be represented by labeling two rows stacked over one another as Lift 1 of 2 and Lift 2 of 2. Record Resolution testing performed by the QC technician on the QC sheet.

### Instruction: Embankment and drainage Plot

- Use the Density Log Book Plot program for projects or sections of a project with Embankment and Drainage Pipe.
- Plot the test No., excluding the page number at the appropriate Station and lift location where the test was conducted.
- All failing test locations should be circle to indicate the failing status
- Groundwater elevations and the date of the observation should be noted on the plot sheet (▼ 07/01/03). The horizontal line represents the water table elevation. The symbol should be placed at the left or right side of the graph. Multiple water table elevations should be indicated, dated, and initialed.
- All lifts (LOTS) affected by water should also be noted on the LOT index sheet.

### QC Density Data

|                     | Filled in  | Number of |   |
|---------------------|------------|-----------|---|
|                     | User Entry | By Gauge  | Characters Notes  |
| Project FIN:        | x          |           | 11  |
| Test Level:         | x          |           | 1 See Pull Down in QC Density Record on "Main Menu" sheet                     |
| PAGE #:             | x          |           | 4   |
| Type Const.:        | x          |           | See Pull Down in QC Density Record on "Main Menu" sheet                       |
| STA From:           | x          |           | 7 3000+00   |
| STA To:             | x          |           | 7 3000+01   |
| Submitted By:       | x          |           | 20  |
| Of:                 | x          |           | 15  |
| Phone:              | x          |           | 12 352-955-2935   |
| Comments:           | x          |           | 256   |
| Lot No.             | x          |           | 7 100-101   |
| Date                |            | x         | 8 12/29/2008  |
| Technician ID       | x          |           | 13 w12345678-000  |
| Gauge Serial No.    |            | x         |   |
| Std. Density Count  |            | x         |   |
| Std. Moisture Count |            | x         |   |
| Maximum Density     |            | x         |   |
| Test No.            | x          |           | 4   |
| Station             | x          |           | 7 3000+01   |
| <b>Offset</b>       |            |           | This is a header in the QC Density Record (No Data Entry for this line)       |
| Distance            | x          |           | 3 123   |
| Direction           | x          |           | 1 See Pull Down in QC Density Record on "Main Menu" sheet                     |
| Ref Line            | x          |           | 11 See Pull Down in QC Density Record on "Main Menu" sheet                    |
| Lift No             | x          |           | 8 10/11/11  |
| Test Depth          |            | x         |   |
| Soil Density Count  |            | x         |   |
| Soil Moisture Count |            | x         |   |
| Wet Density         |            | x         |   |
| % Moisture          | x          |           | Option to manually enter % moisture for embankment and subgrade construction. |
| Dry Density         |            | x         |   |
| % Maximum Density   |            | x         |   |
| Status              |            | x         |   |
| Disposition         | x          |           | 1 Will be filled in later.  |
| Reduced Frequency   | x          |           | 1 See Pull Down in QC Density Record on "Main Menu" sheet                     |
| Resolution          | x          |           | 1 See Pull Down in QC Density Record on "Main Menu" sheet                     |



## General Notes & Instructions: Verification - Earthwork Density Report

All required information on the Density Report shall be current, legible and written in ink. No transcribed, rewritten, or otherwise copied Record Sheets shall be allowed or included. Dittos, arrows, white-out, and erasures shall be avoided. A correction shall be indicated with a single line striking through the original data and the corrected data written close to it. All corrections or other notes made on the plot or Record pages shall be initialed. Special Provisions or other issues effecting earthwork testing and sampling should be noted. Retain a copy of the Calibration Parameter sheet in the Earthwork Record System for any verification gauge used on the project. Add a new Calibration Parameter sheet each time a Nuclear Gauge is recalibrated.

1. **Project FIN:** Enter the project Financial Identification Number
2. **Page:** Enter the page number corresponding to the number of the Plot page where the test will be plotted followed by an Alphabetic letter sequence for the page. (i.e. 1A, 1B etc. for successive density report pages)
3. **Type of Const.:** Enter type of Construction. (Embankment, Subgrade, Base, etc.)
4. **From Sta.** - Beginning station of Lot represented.
5. **To Sta.** - Ending station of Lot represented. \* Get approval from the District Materials Earthwork Coordinator to write in “From Station” and “To Station” for the purpose of recording verification for multiple QC sheets on one page.
6. **Lot number:** Enter the Lot number using the following format (QC Lot# - Corresponding QC Page #)
7. **Date:** Enter date of Test
8. **Tech. ID:** Enter the nine digit technician ID used for CTQP qualification.
9. **Gauge Serial No.:** - Serial number of gauge used.
10. **STD. Dns. Count:** - Record the daily standard density count of gauge used to perform the density test.
11. **STD. Mst. Count:** - Record the daily standard moisture count of gauge used to perform the moisture test.
12. **Max Density:** Enter Laboratory Maximum Density Value (Proctor) for the Test to the nearest whole number.
13. **Sample No.:** Enter sample number for the maximum density proctor.
14. **Test No.:** This is an alphanumeric value starting with Q for QC, V for Verification and R for Resolution and followed by sequential digits starting with 0001. (Test No. may not be applicable in all districts.)
15. **Station:** Enter the station location of the test
16. **Offset:** Enter the Offset Distance in feet (meter) from an offset, with the direction ‘L’ or ‘R’ following the number.
17. **Lift Number:** Enter the lift number and total lifts at the test location (i.e. 2/10)
18. **Test Depth:** Write the test depth in inches (millimeter).
19. **Soil Dns. Count:** - Record the soil density count reading.
20. **Soil Mst. Count:** - Record the moisture count of gauge used to perform the moisture test.
21. **Wet Density:** Enter the wet density result from the test to the nearest 0.1 PCF.
22. **% Moisture:** Write the % moisture value to the nearest 0.1 percent as follows.
  - Use Nuclear Gauge % moisture for approved Limerock, Shell rock, and Cemented Coquina Base materials.
  - If the Speedy Moisture tester was used for the materials specified above, use the dial reading directly.
  - For all other materials, use the moisture number from an appropriate chart, based on the Speedy dial reading.
  - Microwave moisture as determined by the FM5-537 can also be used for all the materials.

23. **Dry Density:**  $\frac{\text{Wet Density}}{100 + \% \text{ Moisture}} \times 100$  Reporting Accuracy: nearest 0.1 PCF (1.0kg/m<sup>3</sup>)

24. **% Max Density:** The result of Dry Density divided by Proctor and multiplied by 100. Report to the nearest 1.0 percent.

25. **Lots Verified:** List lots verified by this test. (QC Lot#s - Corresponding QC Page #s)

### **Instructions: Verification/Resolution - Summary of Proctor Samples**

1. **Project FIN:** Enter the project Financial Identification Number.
2. **Page:** Enter the corresponding page number.
3. **Sample Number:** Enter the Five character QC sample number i.e. 00001Q
4. **Material Description:** Enter a description of material being sampled.
5. **QC Max Density:** Enter Laboratory Maximum Density Value (Proctor) for the sample.
6. **QC Opt Moist:** Enter Laboratory Optimum Moisture Value for the sample.
7. **Type of Constr.:** Enter the type of Construction. Use 'L' or 'R' to specify Left or Right roadway and/or side.
8. **Lots Represented:** Indicate the corresponding lot numbers represented by the Proctor results.
9. **Sample Number:** Enter the corresponding Verification sample number i.e. 00001V. (Make sure numbers match)
10. **Max Density:** Enter the corresponding Verification Maximum Density Value (Proctor).

### **Instructions: VERIFICATION STABILIZING MIXING DEPTH / VERIFICATION ROCK BASE THICKNESS**

These sheets may be used to record mixing depths and base thicknesses. Enter information as requested.

### VT Density Data

| Field               | User Entry | Filled in By Gauge | Number of Characters | Notes   |
|---------------------|------------|--------------------|----------------------|---|
| Project FIN         | x          |                    | 11                   |   |
| Test Level:         | x          |                    | 1                    | See Pull Down in VT Density Record on "Main Menu" sheet                       |
| PAGE #:             | x          |                    | 4                    |   |
| Type Const          | x          |                    |                      | See Pull Down in VT Density Record on "Main Menu" sheet                       |
| STA From:           | x          |                    | 7                    | 3000+00   |
| STA To:             | x          |                    | 7                    | 3000+01   |
| Submitted l         | x          |                    | 20                   |   |
| Of:                 | x          |                    | 15                   |   |
| Phone:              | x          |                    | 12                   | 352-955-2935  |
| Comments:           | x          |                    | 256                  |   |
| Lot No.             | x          |                    | 7                    | 100-101   |
| Date                |            | x                  | 8                    | 12/29/2008  |
| Technician          | x          |                    | 13                   | w12345678-000   |
| Gauge Serial No.    |            | x                  |                      |   |
| Std. Density Count  |            | x                  |                      |   |
| Std. Moisture Count |            | x                  |                      |   |
| Maximum Density     |            | x                  |                      |   |
| Test No.            | x          |                    | 4                    |   |
| Station             | x          |                    | 7                    | 3000+01   |
| Offset              |            |                    |                      | This is a header in the VT Density Record (No Data Entry for this line)       |
| Distance            | x          |                    | 3                    | 123   |
| Direction           | x          |                    | 1                    | See Pull Down in VT Density Record on "Main Menu" sheet                       |
| Ref Line            | x          |                    | 11                   | See Pull Down in VT Density Record on "Main Menu" sheet                       |
| Lift No             | x          |                    | 8                    | 10/11/11  |
| Test Depth          |            | x                  |                      |   |
| Soil Density Count  |            | x                  |                      |   |
| Soil Moisture Count |            | x                  |                      |   |
| Wet Density         |            | x                  |                      |   |
| % Moisture          | x          |                    |                      | Option to manually enter % moisture for embankment and subgrade construction. |
| Dry Density         |            | x                  |                      |   |
| % Maximum Density   |            | x                  |                      |   |
| Verified Lc         | x          |                    |                      | 4 fields with 3 characters each   |
| PAGE #:             | x          |                    |                      | 4 fields with 4 characters each   |