

# **APPENDIX E**

## **PROFICIENCY CHECKLISTS**



## SPEEDY MOISTURE TEST

**Equipment Needed: Complete speedy kit, No. 4 sieve, speedy chart, and sample of soil.**

- Make sure moisture tester is clean and in good working order. Place three measures of calcium carbide and two steel balls in the large part of the moisture tester. Do not let the steel balls fall against the dial.
- Sieve sample of soil through the No. 4 sieve.
- Weigh soil sample on tared balance in kit and place in the cap. Holding tester horizontally, insert cap and tighten clamps.
- Holding tester vertically, tap top to allow soil to fall into large chamber.
- Holding tester horizontally, rotate it so that the steel balls are put into orbit around the inside.
- Rotate for 10 seconds, rest for 20 seconds. Repeat for a total of three (3) minutes.
- Holding tester horizontally, read the pressure dial. Determine the moisture content of the soil from the speedy moisture chart by finding the dial reading and next to it reading the moisture content.
- Carefully remove the cap making sure to point the instrument away from the operator to avoid breathing the fumes, and away from any potential source of ignition of acetylene gas. Empty the contents and examine the material for lumps. If sample is not completely pulverized repeat the test with a new sample.

Half sample procedure:

- If the moisture content exceeds the limit of the pressure gauge (more than 20 on the dial) a half sample must be used.
- Hang weight off balance.
- Weigh out sample of soil.
- All other steps are the same; except, double the dial reading before going to speedy chart.

## ONE POINT PROCTOR

**Equipment Needed: No. 4 sieve, proctor mold, 5.5 lb. drop hammer, beveled straightedge, knife, scales, scoop, TL-125A, and set of “Ohio Curves”.**

- Information obtained from this test: Maximum Dry Density and Optimum Moisture.
- Weigh the mold (without collar) and base plate and record. Attach collar.
- Sieve a sample of soil through a No. 4 sieve.
- Place mold on a stable surface (concrete block weighing at least 200 lbs., concrete floor, concrete box culvert, bridge abutment).
- Compact the soil into the Proctor mold in three approximately equal layers, compacting each layer 25 blows with the hand held 5.5 lb. drop hammer dropped 12 inches. Distribute the blows evenly around the surface of each layer.
- Soil should be at least  $\frac{1}{4}$  inch inside the collar when compaction is finished. If sample is shy in the mold or you have too much start over.
- Cut around edge of mold before collar is removed to prevent shearing. If sample shears below top of mold start over.
- Remove the collar, and using a beveled straightedge strike off the surface evenly.
- If surface voids are present, use soil trimmings to fill in and apply finger pressure.
- Trim the sample again.
- Clean off the mold and base plate and weigh mold and base plate and wet sample.
- Subtract empty weight from full weight and multiply by 30 (molds per ft<sup>3</sup>) to determine the Wet Density.
- Use a field hot plate or “Speedy” Moisture Test to determine Moisture Content.
- Plot the wet density and moisture content on the “Ohio Curves” chart to determine the optimum moisture and maximum dry density. The point should fall within “Moisture Limit Lines” on graph. If the point falls to the right, let the soil dry out or start over and use less water. If the point falls to the left of moisture limit lines add more water.

## FIELD MOISTURE CONTENT

**Equipment Needed: Electric hot plate or gas burner, scale, metal container, large spoon, and 1.1 lbs. (500 grams) of soil.**

- 500 grams is the minimum sample required for soils and for aggregate the sample size depends on the Nominal Maximum Size Aggregate.
- Weigh clean dry container and record weight.
- Place sample in container and weigh.
- Place container on stove or hot plate. Mix sample continuously to expedite drying. Use low flame or heat.
- When sample looks dry, remove from stove, cool and weigh.
- Place sample back on stove or hot plate. Continue to dry for 2 to 3 minutes. Cool and reweigh.
- When constant weight is achieved, sample is dry. Record the weight.
- To determine the moisture content, use the following formula:

$$W\% = \frac{(W_{\text{wet}} - W_{\text{dry}})}{(W_{\text{dry}} - W_{\text{con}})} \times 100$$

Where:

W% = Percent Moisture

Wwet = Weight of Wet Aggregate and Container (g or lb)

Wdry = Weight of Dry Aggregate and Container (g or lb)

Wcon = Weight of the Container (g or lb)

## NUCLEAR DENSITY TESTING

**Equipment Needed:** Nuclear gauge, reference block, drill rod guide, extraction tool, drill rod, hammer and safety glasses.

### Gauge Warm Up and Standard County Procedure

- Wear TLD. Warm gauge up.
- Place reference block on flat surface with a minimum density of 100 lb/ft<sup>3</sup> and a minimum distance of 10 feet from any structure and 33 feet from any other radioactive source.
- Place gauge on reference block (seated flat, within raised edges, proper side of gauge against metal butt plate).
- Take Standard Counts.

### Direct Transmission Procedure

- Prepare a smooth flat test area free of surface voids.
- Place drill rod guide on test site. Insert drill rod into guide sleeve. Place foot on drill rod guide. Drive rod 2" deeper than depth of test. Carefully remove drill rod and drill rod guide.
- Select one minute count and soils mode on gauge.
- Place gauge over hole. Extend source rod into hole the required test depth.
- Source rod should not disturb hole.
- Gently pull on gauge housing so source rod is tight against hole. (Make sure the gauge is flush on the surface, with the source rod locked in correct depth position.)
- Retract handle to safe position and record gauge readings.

## ROLLER PATTERN

**Equipment Needed: Nuclear gauge, reference block, drill rod guide/ leveling plate, extraction tool, drill rod, hammer and compaction equipment that is typical for the rest of the project.**

- Gauge has been warmed up and standard counts have been taken.
- 75 feet plus additional space to accommodate roller positioning (50 feet on each end).
- Roller will make 2 passes (this varies) over the entire 75' section.
- Position gauge parallel with the roadway, with the source end toward the direction of the paver. Backscatter position in 15-second (fast) mode
- Take 3 readings for density and moisture spread out over most of the 75' section and record on TL-53. Mark locations. Do not test any closer than 18 inches to an unsupported edge or in areas that have been overlapped (such as the center).
- Add and average readings.
- Make 2 more passes over the entire 75' section.
- Take 3 readings for density and moisture in the same locations as before. Add and average them.
- Continue until increase in dry density is less than  $1 \text{ lb/ft}^3$  or until mat shows distress (cracking of aggregate).
- When the dry density is less than  $1 \text{ lb/ft}^3$ , cut vibrator off and make 1 additional pass to be certain there is a sufficient degree of compaction. If the dry density increases by more than  $1 \text{ lb/ft}^3$ , make one more pass with the roller.
- Graph the results on the roller pattern curve. To be acceptable, each moisture reading must fall within the Optimum Moisture Range and the break should not be over  $1.5 \text{ lb/ft}^3$ .
- A new roller pattern should be established when there is a change in: source of material, compaction equipment, gradation or type of material, or a visual change in subsurface or subgrade.

## CONTROL STRIP

**Equipment Needed: Nuclear gauge, reference block, drill rod guide/ leveling plate, extraction tool, drill rod, hammer and compaction equipment that is typical for the rest of the project.**

- Gauge has been warmed up and standard counts have been taken.
- 300 feet plus additional space to accommodate roller positioning (50 feet on each end).
- Backscatter position in 1-minute mode.
- Roller will make number of passes established by the Roller Pattern over entire 300' section.
- Take 10 readings for density and moisture spread out over most of the 300' section and record on TL-54. Do not test any closer than 18 inches to an unsupported edge.
- Add and average density readings.
- To be an acceptable Control Strip - all moisture readings must fall within optimum moisture range and the average dry density must be within 3 lb/ft<sup>3</sup> of the roller pattern's peak density. If moisture is below optimum moisture range, add water. If moisture is above optimum moisture range, wait for it to dry out and retest that area.
- Calculate individual dry density and average dry density requirements to be used for the test section.
- At the completion of the Control Strip, run a Direct Transmission test on aggregate and compare density results to theoretical maximum density (VTM- 1).

## TEST SECTION

**Equipment Needed: Nuclear gauge, reference block, drill rod guide/leveling plate, extraction tool, drill rod, hammer and compaction equipment that is typical for the rest of the project.**

- Gauge has been warmed up and standard counts have been taken.
- Half-mile (2640 feet) per application width.
- Backscatter position in 1-minute mode.
- Roller will make number of passes established by the Roller Pattern and Control Strip over entire half-mile section.
- Take 5 readings for density and moisture spread out over most of the half-mile section and record on TL-55. Do not test any closer than 18 inches to an unsupported edge.
- Add and average density readings.
- To be an acceptable Test Section, all moisture readings must fall within optimum moisture range, each individual dry density must be at least 95% of the Control Strip Average Dry Density, and the average of the 5 dry density readings must be at least 98% of the Control Strip Average Dry Density.
- If one test fails, roll that area again. If the test section readings are above or below the target values by more than  $8 \text{ lb/ft}^3$ , establish a new control strip.

