APPENDIX J

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 & 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 ¼ 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^3) 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 $w,\% = \frac{(W\ wet - W\ dry)}{(W\ dry - W\ con)} \times 100$

  Where:
  w,% = percent moisture
  w wet = weight of wet soil/aggregate and container
  w dry = weight of dry soil/aggregate and container
  w con = weight of container

SAND CONE

Equipment Needed: Sand cone apparatus, base plate, drying equipment, scales, and miscellaneous equipment such as knife, chisel, small trowel, screwdriver, spoon, large nails or spikes, containers with lids, small paint brush, calculator and TL-125.

PRETEST CALIBRATIONS

UNIT WEIGHT OF SAND

- Record empty weight of proctor mold and base plate. Invert and support sand cone apparatus over a 4 inch proctor mold. Open valve and allow mold to fill until it overflows, then close valve.

- Strike off top with a straightedge being careful to cause no vibration. Clean excess sand off mold. Weigh mold, base plate and sand.

- Subtract weight of mold to obtain weight of sand in mold. Calculate unit weight of sand in mold by multiplying weight of sand in mold by 30.

- Repeat 3 times and average results. Record on Line A of TL-125. There should be no more than 1% variation between any one determination and the average.

WEIGHT OF SAND IN CONE AND BASE PLATE

- Fill sand cone apparatus with clean, dry sand. Weight the apparatus and record the weight.

- Place base plate on a clean, level surface. Invert sand cone apparatus and place cone in flanged hole in base plate. Mark apparatus and base plate so they can be matched and reseated in same position during testing.

- Open valve fully. When sand stops running, close the valve.

- Weigh sand cone apparatus and remaining sand. Subtract this weight from the weight of the sand cone apparatus when full of sand. This is the weight of the sand that fills the cone and base plate.

- Repeat 3 times and average results. Record on Line D of TL-125. There should be no more than 1% variation between any one determination and the average.

TEST PROCEDURE

WEIGHT OF SOIL IN TEST HOLE

- Prepare a flat area on the compacted lift about a foot square. Seat base plate on leveled site, making sure edge of center hole is in contact with ground surface. Mark outline of base plate to check for movement during test or secure plate by pushing nails in soil adjacent to the edge of base plate.

- Weigh and record empty weight of water tight container on Line I. Dig test hole through hole in base plate. Test hole should approximate the thickness of the lift being tested. Sides of test hole should be straight or taper slightly inward to a flat or conical bottom.

- Place all disturbed soil in water tight container as it is dug to avoid moisture loss. Weigh soil removed and record on Line H. Protect sample from moisture loss until a sample can be taken and an oversize correction is determined if needed.

VOLUME OF HOLE

- Fill jar with sand and weigh the sand cone apparatus and record weight on Line B.

- Invert sand cone apparatus over hole in base plate. Place bottom of cone in flanged hole in same position used during calibration. Eliminate or minimize vibrations in the test area.

- Open valve and let sand run into the hole. When sand stops running close the valve. Weigh apparatus with remaining sand and record on Line C. Add this weight to the weight of the sand in cone and base plate from Line D. Record on Line E.

- Determine the weight of the sand required to fill the test hole by subtracting Line E from Line B. Record on Line F.

- Determine volume of hole by dividing weight of sand in hole (Line F) by weight per cubic foot of sand (Line A). Record on Line G.

$$\text{Volume of test hole (Line G)} = \frac{\text{weight of sand (Line F)}}{\text{weight per cubic foot of sand (Line A)}}$$

WET UNIT WEIGHT OF SOIL

- Find the weight of wet soil from test hole by subracting the weight of the pan (Line I) from the weight of the soil and pan (Line H) and record on Line J.

- Calculate wet unit weight per cubic foot of wet soil by dividing the weight of the wet soil (Line J) by the volume of the hole (Line G) and record on Line K.

$$\text{Wet density (Line K)} = \frac{\text{weight of wet soil (Line J)}}{\text{volume of hole (Line G)}}$$

DRY UNIT WEIGHT OF SOIL

- Mix material thoroughly and obtain a representative sample for moisture content determination or use the entire sample. Determine the moisture content by drying over a hotplate or by using the Speedy Moisture Tester. Record on Line T.

- Find the dry unit weight per cubic foot of soil by dividing the wet weight per cubic foot of soil (Line K) by 1 plus the moisture content (Line T) expressed as a decimal. Record on Line L.

$$\text{Dry unit weight (Line L)} = \frac{\text{wet unit weight of soil (Line K)}}{\{1 + [\text{moisture content (T)} \div 100]\}}$$

PERCENT COMPACTION

- Maximum dry density and Optimum moisture content are determined by One Point Proctor or Laboratory Proctor. Record Maximum dry density on Line M and Optimum moisture content on Line N.

- Find the percent compaction by dividing the Dry Density of soil (Line L) by the Maximum Dry Density (Line M) and multiply by 100. record on Line R.

$$\text{Percent Compaction (Line R)} = \frac{\text{dry density of soil (Line L)}}{\text{maximum dry density (Line M)}} \times 100$$

TEST RESULTS

- Determine passing or failing density by comparing the percent compaction (Line R) to the minimum required density (Line S) from the specifications.

- Determine if moisture content (Line T) is within ±20% of optimum moisture content (Line N) for soil and is within ±2 whole percentage points of optimum moisture content for aggregate.

NUCLEAR TESTING

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

GAUGE WARM UP AND STANDARD COUNT PROCEDURE

- Wear TLD. Warm gauge up.
- Place reference block on flat surface with a minimum density of 100 lb/ft^3 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. (Gauge flush on surface. 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 lb/ft^3 or until mat shows distress (cracking of aggregate).

  When the dry density is less than 1 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 lb/ft^3 make one more pass with the roller.
- ☐ Graph the results on the roller pattern curve. To be acceptable each moisture must fall within Optimum Moisture Range and the break should not be over 1.5 lb/ft^3.
- ☐ A new roller pattern 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^3 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 and 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 test section readings are above or below the target values by more than 8 lb/ft^3 establish a new control strip.