SECTION 01452

PROFILOGRAPH AND PAVEMENT SMOOTHNESS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Materials and procedures for smoothness testing of (HMA) Hot Mix Asphalt, Open Graded Surface Course (OGSC), Stone Matrix Asphalt (SMA), and Portland Cement Concrete Pavement (PCCP).

B. Requirements for 25-foot wheel base, California type profilograph with electronic data recording, storing, data reduction, and printing capabilities.

1.2 RELATED SECTIONS

A. Section 02741: Hot Mix Asphalt (HMA)

B. Section 02748: Prime Coat/Tack Coat

C. Section 02752: Portland Cement Concrete Pavement

D. Section 02786: Open-graded Surface Course (OGSC)

1.3 REFERENCES

A. UDOT Materials Manual of Instruction

1.4 GENERAL REQUIREMENTS

A. Certify profilograph operators and equipment through the Department. Engineer verifies certifications.

B. Comply with project Traffic Control Plan and all applicable safety requirements when performing profilograph testing.

C. Contractor Quality Control
   1. Comply with requirements identified in Section 02741 and Section 02752.
   2. Address the following minimum items in the QCP:

a. Identify person(s) responsible for managing smoothness issues and monitoring compliance with requirements.
b. Identify equipment used to measure and monitor smoothness along with calibration and correlation information.
c. Identify personnel responsible for operation of equipment and their qualifications.
d. Identify construction methods employed to obtain smoothness, including:
    1) Method of grade control for rotomilling and paving operations.
    2) Actions taken to prevent paver from stopping and starting, including any use of additional equipment.
    3) Placement of manholes outside of projected wheel paths and methods of matching surface elevations and slopes
e. Identify potential problems that could interfere with meeting pavement surface requirements.
f. Describe grinding process and operation:
    1) Equipment and operators
    2) Must-grind layout, grade control, sealing process, etc.
    3) Schedule

1.5 ACCEPTANCE

A. Notify the Engineer in writing a minimum of two working days prior to scheduling Department inspection of acceptance testing on the final pavement surface, after all corrective work has been performed.
    1. Clearly define the areas to be tested for acceptance in the written notification.
    2. Do not perform any work on the final surface after acceptance testing, except as directed by the Engineer.

B. The Department evaluates the surface by section, defined as:
    1. Traffic lane, 0.1 mile in length, including adjacent shoulder with a design width 8.0 ft or less, meeting the Class I description. (See Table 1)
        a. Testing consists of a single trace measurement of each wheel path, defined as a continuous parallel line 2.5 ft inside the projected lane lines, of the traffic lane.
        b. Testing of adjacent shoulder consists of a single trace measurement approximately centered in the shoulder when the design width is 6.0 ft or greater. Do not test shoulders having design widths less than 6.0 ft.
        c. Determine the Profile Index (PI) by taking the average of all profile traces taken on the section.
    2. Shoulder, 0.1 mile in length, with a design width greater than 8.0 ft, meeting the Class I description.

a. Testing consists of two profile traces, 2.0 ft inside each edge.
b. Determine the Profile Index (PI) by taking the average of profile traces taken on the section.

C. Begin the initial section(s) at the start of the project. Lay out subsequent sections consecutively to the end of the project.

D. The Department does not measure the PI for Class II surfaces.

E. The Department evaluates longitudinal and transverse deviations for both Class I and Class II surfaces.

F. If the final lift of pavement cannot be completed due to seasonal limitations, the Department evaluates all roadway sections paved through the final lift and evaluates the remaining final lift of pavement upon completion.

1.6 MEASUREMENT AND PAYMENT PROCEDURE

A. All work necessary to prepare the pavement for testing, such as but not limited to sweeping, is incidental to the work and is not measured for payment. Include all costs and resources for smoothness testing, preparation and correction in the surfacing bid items.

PART 2 PRODUCTS

2.1 FRAME

A. Construction:
1. All welded of light-weight square aluminum tubing in three separate units of the same dimensions in width and within 6 inches in length of each other.
2. Design: reinforced truss.

B. Length:
1. Effective wheel base of the frame assembly: 25 ft.
2. Overall length with multiple wheel assemblies attached: not to exceed 35 ft.

C. Frame Connections:
   1. Indexed with steel location pins or dowels to prevent misalignment of frame assembly.
   2. Secured with quick acting clamps rated at a minimum of 800 lbs each.

D. Parts: Each of the three frame units manufactured to allow interchangeable replacement of individual units.

2.2 WHEEL SUPPORT ASSEMBLIES

A. Tubing: All welded, light-weight square aluminum.

B. Connections: All connection points between wheel assemblies and frame sections secured with quick-acting clamps.

C. Support wheels: Cast aluminum hubs with ball bearing supported steel axles and cushion rubber tires. Caster wheel assemblies: Ball bearing supported.

D. Front Wheels: Steerable from the center of the machine.

E. Rear Wheels: Quick setting manual adjustment to allow for short radius turning, moving laterally, and for trimming to avoid crabbing on superelevations.

2.3 RECORDING WHEEL

A. Light weight, 24 inch to 26 inch nominal diameter, and heavy duty spokes.
   1. Tire: pneumatic tube type with non-aggressive tread design.
   2. Frame: all welded of light-weight square aluminum tubing. Frame pivot points and rotating shafts supported by sealed ball bearings.

2.4 GENERAL MECHANICAL

A. All exposed steel components anodized, nickel plated, or zinc plated for corrosion protection.

B. Interchangeable parts.

C. Capable of being broken down in segments that can fit into the back of a standard pickup truck or van for ease of transport.

D. Constructed to allow complete assembly in less than 15 minutes without tools.

2.5 AC POWER GENERATING UNIT

A. Self-contained, capable of delivering 120 VAC at 60Hz.

B. Mount on the frame with appropriate vibration and shock control hardware.

2.6 MICROCOMPUTER

A. Control the system by a dedicated on-board microcomputer.

B. The microcomputer components replaceable and interchangeable with like items from the manufacturer's stock to facilitate controller repairs and provide the following minimum operation characteristics:

1. Processor:
   a. Minimal 16 bit microprocessor capable of running at a nominal 8 MHz processing speed.
   b. On-board memory sufficient to store Profile Index (PI) and bump Discrimination software.
   c. RAM memory sufficient to input control parameters and process project documentation variables at the test site.
2. Displacement Transducer Interface:
   a. Contains an analog to digital converter compatible with the operating characteristics of the microprocessor.
   b. Include signal conditioning for analog filtering and scaling.
   c. Overall resolution for displacement transducer less than or equal to 0.004 inches.
3. Odometer Transducer Interface: Provides digital logic to encode positive or negative signals to microprocessor.
4. Clock:
   a. Provides time and calendar functions to microprocessor unit automatically.
   b. Independent battery power required to avoid documentation errors and input data losses caused by on-board power shut downs.

2.7 TRANSDUCERS

A. Rated to withstand shock, vibration, dust, and extremes of humidity. Operational from -30 degrees C to 100 degrees C.

1. Vertical Displacement Transducer: Resolution of 0.01 inches.
2. Odometer: horizontal resolution of 0.39 inches and operational in either an incrementing or decrementing mode.
3. Temperature transducer: Accurate to " 1 degree C.

2.8 PRINTER/PLOTTER

A. Compatible with and provide suitable interfaces with the microprocessor.

B. The data acceptance (baud rate) and buffer storage capacity: adequate to fully register, plot, and accept data from a 4 mph operational run without excessive wait states.

C. Dot matrix mechanism (if applicable): print bar resolution of 100 dots per inch with a row resolution of 200 rows per inch.

2.9 OPERATOR CONTROL PANEL

A. Located within easy access of the operator and in a location on the profilograph that does not hinder other operational functions or line of sight to testing path.

B. Control panel with a digital display, data input keyboard, observable indicators, (video or screen) and operator actuated control switches.

C. Parameters entered, displayed, and printed as follows (all numeric):
   1. Time
   2. Date
   3. Region, route and pavement
   4. Pass number
   5. Beginning Station
   6. Ending Station
   7. Odometer
   8. Blanking band width
   9. Bump height
   10. Bump width
   11. Event marker

2.10 REPORTING REQUIREMENTS

A. Determine Profile Index, documentation, reports, outputs, or example, as specified. UDOT Materials Manual, 8-995.

B. Set preprogrammed or operator entered scaling or sensitivity factors at a sensitivity level that to correlate with Department profilographs.

C. Include the following documentation supplied with the Profilograph system:
   1. Operator's Manual.
   2. Wiring Diagrams.
   3. Industry standard part number or name and model numbers for complete subsystems.

PART 3 EXECUTION

3.1 HMA, SMA, AND OGSC

A. Construction Requirements
   1. Construct finished pavement to meet the surface requirements in Table 1.
   2. Identify defects exceeding the limits in Table 1 and correct prior to acceptance testing.
      a. Analyze the profile using 0.2 inch blanking band.
      b. Correct defects across the entire width of the traffic lane or shoulder either by grinding with a device approved by the Engineer, or by milling and filling as directed by the Engineer.
      c. Re-profile for correction verification prior to acceptance testing.
   3. Correct transverse defects where the pavement surface varies more than 1/8 inch from the lower edge of a 10 foot straightedge placed perpendicular to the centerline of the roadway.
   4. Seal ground areas with asphalt tack coat and blotter material.
      a. Use a tack coat application rate between 0.07 and 0.14 gal/yd^2.
      b. Meet blotter material requirements in Section 02748.
   5. The Department inspects acceptance testing prior to the placement of Chip Seal Coat, when applicable.

B. Incentive/Disincentive - HMA
   1. Incentive/Disincentive applies only to Class I surfaces for each pavement section defined in this Section, Article 1.5, paragraph B.
      a. Incentive/Disincentive is calculated according to Table 2, with partial sections prorated based on length.
      b. Incentive/Disincentive does not apply to HMA surfaces on projects requiring OGSC or SMA.
      c. Any section requiring grinding exceeding 20 yd^2 does not qualify for incentive. Disincentive remains applicable for sections where grinding exceeds 20 yd^2.
   2. Any section still requiring corrective work that is identified at the time of acceptance testing results in loss of incentive for the section. Disincentives remain applicable and are based on PI obtained at the time of acceptance testing.

3. Failure to correct defects, identified at the time of acceptance testing, within 14 calendar days after notification by the Engineer results in liquidated damages assessed at $100.00 per day after 14 calendar days per each section needing corrective work.
    a. Liquidated damages may be waived by the Engineer if it is determined to be in the best interests of the Department to defer corrective work.

C. Incentive/Disincentive - OGSC and SMA Surfaces
1. Incentive/Disincentive applies only to Class I surfaces for each pavement section defined in this Section, article 1.5, Acceptance.
    a. Incentive/Disincentive is calculated according to Table 3, with partial sections prorated based on length.
2. Any section requiring grinding exceeding 20 yd^2 or any section still requiring corrective work that is identified at the time of acceptance testing results in a disincentive of $1000.00 per section.
3. Failure to correct defects, identified at the time of acceptance testing, within 14 calendar days after notification by the Engineer results in liquidated damages assessed at $100.00 per day per each section needing corrective work.
    a. Liquidated damages may be waived by the Engineer if it is determined to be in the best interests of the Department to defer corrective work.

3.2 PORTLAND CEMENT CONCRETE PAVEMENT (PCCP)

A. Construction Requirements
1. Construct finished pavement to meet surface requirements listed in Table 1.
2. Identify defects exceeding the limits in Table 1 and correct prior to acceptance testing.
    a. Analyze the profile using 0.2 inch blanking band.
3. Correct defects across the entire width of the traffic lane or shoulder by grinding with a device approved by the Engineer.
    a. Re-profile for correction verification prior to acceptance testing.
4. Correct transverse defects where the pavement surface varies more than 1/8 inch from the lower edge of a 10 foot straightedge placed perpendicular to the centerline of the roadway.

B. Incentive/Disincentive - PCCP
1. Incentive/Disincentive applies only to Class I surfaces for each pavement section defined in this Section, article 1.5, Acceptance, paragraph B.
    a. Incentive/Disincentive is calculated according to Table 4, with partial sections prorated based on length.

2. Any section requiring grinding exceeding 20 yd^2 does not qualify for incentive.
3. Any section still requiring corrective work that is identified at the time of acceptance testing results in loss of incentive for the section. Disincentives remain applicable and are based on PI obtained at the time of acceptance testing.
4. Failure to correct defects, identified at the time of acceptance testing, within 14 calendar days after notification by the Engineer results in liquidated damages assessed at $100.00 per day per each section needing corrective work.
    a. Liquidated damages may be waived by the Engineer if it is determined to be in the best interests of the Department to defer corrective work.

Table 1 Surface Requirements				
Pavement Category	**Class 1 Surface**		**Class II Surface**	
	Section PI	**Profile Deviation**	**Section PI**	**Profile Deviation**
Category	**in/mi**	**in/25ft**	**in/mi**	**in/25ft**
1	5	0.3	N/A	0.3
2	7	0.3	N/A	0.3
Category 1	National Highway System and Truck Routes (See Section 02741, Table 11) and all other routes with surfaces having three or more opportunities for improving the ride.*			
Category 2	All other routes incorporating single lift overlays with not more than two opportunities for improving the ride.*			
Class I	Surfaces consist of all through traffic and climbing lanes, passing lanes, acceleration and deceleration lanes, shoulders, ramps and turn lanes longer than 1000 ft, including bridges and bridge approach slabs with final riding surfaces placed on the contract. Excluded are horizontal curves having a centerline radius of curvature less than 900 ft and areas within the superelevation transitions to these short radius curves.			
Class II	Surfaces consist of all tapers, road approaches, mainline pavement sections with posted regulatory speeds less than 35 MPH, pavement within 15 ft of bridge decks and approach slabs not paved as part of the project, pavement to a point 50 ft beyond the paving limits of the project and all other surfaces not included in Class 1 and surfaces excluded due to horizontal curves.			

* Each opportunity to improve the ride is one of the following: Placing a gravel or treated base course, OGSC, SMA, rotomilling, cold recycling, and each lift of paving. Leveling is not considered as an opportunity to improve the ride.

Table 2 HMA	
Category	**Incentive/Disincentive per Section**
1	**$60 x [(Required in/mi) - (PI)]**
2	**$30 x [(Required in/mi) - (PI)]**

Table 3 OGSC & SMA	
Category	**Incentive/Disincentive per Section**
1	**$150 x [(Required in/mi) - (PI)]**
2	**$100 x [(Required in/mi) - (PI)]**

Table 4 PCCP	
Category	**Incentive/Disincentive per Section**
1	**$200 x [(Required in/mi) - (PI)]**
2	**$125 x [(Required in/mi) - (PI)]**

END OF SECTION