

PROFILOGRAPH OPERATOR CERTIFICATION

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**Georgia Department of Transportation
Office of Materials and Research**

Standard Operating Procedure (SOP) 34

**Certification of Contractor Personnel and Equipment for Smoothness Testing of
Portland Cement Concrete Pavement With The Rainhart Profilograph**

I. General

The Concrete Technical Services Unit of the [Office of Materials and Research](#) at Forest Park, Georgia will be responsible for the certification of personnel and equipment used for the smoothness testing on Portland cement concrete pavement. A list of certified personnel will be maintained by the Concrete Branch. Certification will remain in force for one year unless revoked for performance deficiencies of either equipment or operator.

Certification evaluation will be based on the following:

A. Profilograph: (Rainhart Model 860)

1. Calibration (static)
2. Successful operation through test pattern

B. Operator:

1. Written Examination
2. Proficiency of operation through test pattern

II. Request for Certification

Contractors desiring certification of their equipment and operator may direct their request to:

State Materials and Research Engineer

Office of Materials and Research

15 Kennedy Drive, Forest Park, Georgia 30297

Upon notification of personnel and equipment to be considered for certification, an equipment operation and examination session will be scheduled.

III. Calibration and Certification

A. Calibration of Equipment (Profilograph) will involve the following:

1. A static calibration of the profilograph utilizing 0.5 in (12.7 mm) and 1.0 in (25.4 mm) spacer blocks for calibration of vertical displacement of the recording wheel as recorded on the recording chart. Vertical displacement will be within $\pm .03$ in (0.762 mm) of the test blocks.
2. A static check of the eccentricity of the recording wheel made through one revolution of the wheel on a stationary roller assembly. The tracing from this test shall have no areas that exceed 0.03 in (0.762 mm) from the zero baseline.
3. A check of the horizontal distance counter will be made on a 500 ft (150 m) test pattern. The distance recorded shall be within $\pm 0.2\%$ of the predetermined length.
4. A static check of the truss system will be made while equipment is lowered to the test configuration. This will be accomplished by inserting the 0.1 in (2.54 mm) test block under each of the twelve averaging wheels. No individual wheel shall show more than 0.1 in (2.54 mm) of vertical movement on the recording chart.

B. Certification of operator will involve the following:

1. An operator proficiency test will be conducted on the pre-selected test pattern. The operator must demonstrate his ability to set up the equipment in the proper test configuration mode and to maintain proper steering control through the test pattern.
2. A written examination covering all of the following procedures:
 - a. Equipment Setup
 - b. Equipment Operation
 - c. Trace Reduction and Calculations
 - d. Reporting of Results

Satisfactory completion of both equipment calibration and the operator's written examination and proficiency demonstration is required. Equipment and operators that satisfactorily meet these requirements will be added to the list of certified equipment and operators list.

Upon expiration of certification, re-examination is required. Re-certification will normally be limited to equipment calibration and operator proficiency test, but may include all activities listed above. Equipment must be checked for calibration prior to startup of each project and at other times if a problem is suspected. Equipment may be certified for several projects if paving is taking place concurrently.

IV. Revocation of Certification

When incidents occur which may cast doubt on the accuracy or capability of the certified equipment or operator to perform, evaluate and report results of profile test to the Department, comparison tests performed by and with Department equipment will be obtained. If comparison tests indicate just cause, equipment and/or operator certifications may be revoked, with remaining tests obtained by the Department and charged to the contractor at the rate specified in the Specifications.

Reinstatement may be considered only after all discrepancies have been corrected to the satisfaction of the Department and all requirements of [Section III](#) are met.

V. Records

The Concrete Branch of the [Office of Materials and Research](#) will maintain records of certified equipment and operators. Records will include all information shown in [Section III](#). A letter of certification for equipment and operator will be transmitted to the contractor upon satisfactory performance of all procedures. Operator certifications will remain in effect until expiration of the one-year period or removal for cause.

PROFILOGRAPH OPERATOR TRAINING GUIDE

A. Scope: To describe test procedures and operation of the Rainhart Model 860 Profilograph and related equipment.

B. Apparatus:

1. Profilograph – A device for measuring pavement surface deviations by the vertical movement between a center mounted measuring wheel to the reference plane created by a 25 foot wheel truss system. These vertical deviations are recorded on a continuous graph for determination of pavement smoothness. This equipment shall also record all longitudinal distances traversed.
2. Blanking Band – A clear plastic scale 1.50 inches wide and 11.0 inches long. Near the center of the scale is an opaque band 0.1 inch wide extending the entire length of 11.0 inches. On either side of this band are scribed lines 0.1 inch apart, parallel to the opaque band. These lines serve as a scale to measure deviations of the graph above or below the blanking band.

C. Procedure:

1. Prior to testing, check to see that all averaging wheels and truss system are in good condition and check for any damage to the recording wheel. Attach recording head to truss system in the prescribed location. Attach chain and secure head into position with toggle clamps.
2. Install chart recorder paper into the forward chart receptacle ensuring an adequate supply is available to complete tests. Thread paper into drive sprockets and insert recording pen into pen carriage.
3. Align profilograph with the area of pavement to be tested. Remove both truss lock pins and lower the profilograph from the trailering to the testing position by rotating the lowering lever in a clockwise direction.
4. Position the chart drive selector lever into the proper gear to obtain the desired chart paper feed rate. Pavements are tested at one (1) inch equals twenty-five (25) feet in the horizontal plane. The vertical scale remains constant at one (1) inch equals one (1) inch.
5. Tighten the pen carriage to the drive cord. The zero location is arbitrary, but should be located so that multiple tracings can be recorded in an adjacent manner so that the width of individual bumps can be evaluated as discussed in Section G calculations. Engage and zero the horizontal distance counter.
6. Testing may now begin. Pavement segments will be typically recorded on preselected 0.25 mile segments. Therefore, a beginning point should be selected to correspond with these and the station number noted on the chart. Begin testing in a steady forward motion at a speed not to exceed two miles per hour. The operator should be able to maintain steering control within one foot of the desired longitudinal test locations.

7. During testing the operator will stop and note on the chart the following intersect points:
 - a. Beginning station number
 - b. Every 500 ft. station number cast in slab
 - c. All paving construction joints (headers)
 - d. Ending station number

Any additional reference information required by Specifications will also be noted on the respective chart. All multiple tracings on additional lanes will be aligned so that all intercept points will correspond for all tracings on this test chart.

D. Special Conditions:

1. Special care must be taken if testing is performed on damp or windy days to ensure proper feed of chart paper and a non-binding movement of the pen carriage.
2. The surface to be tested must be free of all debris and obstructions and if the micro texture produces too much chatter in the recording pen, a slower operating speed may be required.
3. Early testing of concrete pavement may produce a build-up of curing compound on all wheels of the profilograph. This build-up should be removed daily.

E. Determination of Test Segment Limits:

The segments to be tested will normally be 0.25 miles in length, but not less than 700 feet.

1. Pavement profiles shall be taken four (4) feet from and parallel to the new pavement edges for pavements greater than sixteen (16) feet in width, and up to twenty-four (24) feet in width. Pavement six (6) to sixteen (16) feet in width shall be tested parallel to and at the centerline of the pavement section. The 0.25 mile record segments will begin at the first day's placement and continue until project completion except as noted herein. Pavement sections less than 700 feet in length approaching a bridge will be combined with the previous 0.25 mile segment for determination of profile index. Sections 700 feet or greater approaching a bridge will be calculated as a separate record segment. This exception also applies to sections at project limits.
2. A separate profile index value will be determined for the one hundred feet (100') of the joint with the approach slab. The profile index from the right and left wheel paths will be averaged for each 100' ft. segment for each lane for each approach. The average profile index value shall not exceed 30.

F. Trace Reduction and Calculations

Place the plastic scale over the profile in such a way as to "blank out" as much of the profile as possible. When this is done, scallops above and below the blanking band will be approximately balanced. See Figure I.

The profile trace will move from a generally horizontal position when going around super-elevated curves, making it impossible to blank out the central portion of the trace without shifting the scale. When such conditions occur the profile should be broken into short sections and the blanking band repositioned on each section. See Figure II.

Beginning at the end of the scale, measure and total the height of all the scallops appearing both above and below the blanking band. Each scallop is to be measured to the nearest 0.05 inch (half a tenth). Short portions of the profile line may be visible outside the blanking band, but unless they project 0.03 inch or more and extend longitudinally for two feet or more, they are not included in the count. See Figure I for special conditions.

When scallops occurring in the first scale length are totaled, slide the scale to the left aligning the right end of the scale with a small mark made at the end of the first scale length.

The Profile Index is determined as “inches per mile in excess of the 0.1 inch blanking band”. The formula for calculating Profile Index is as follows:

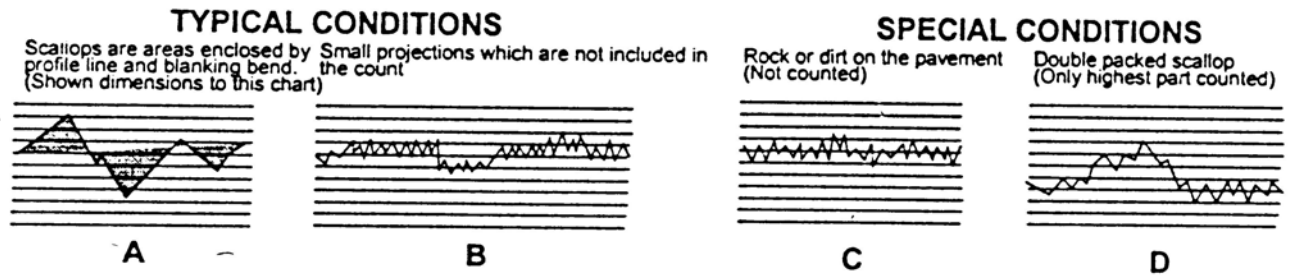
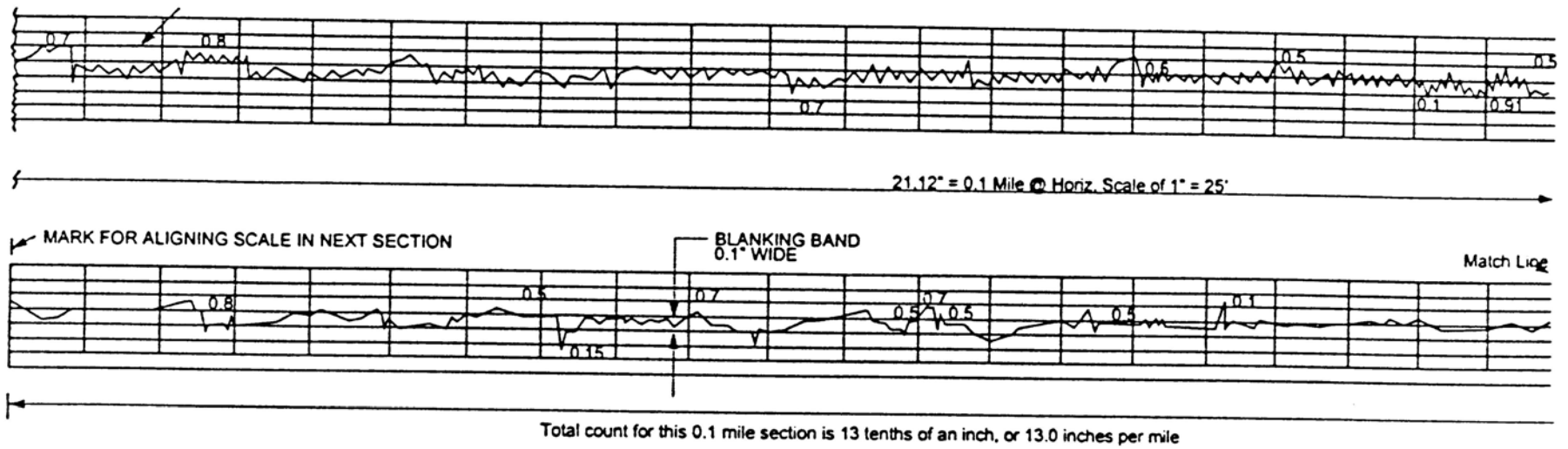
$$\text{Profile Index} = \frac{1 \text{ mile}}{\text{length of section in miles}} \times \text{total count in inches}$$

G. Reporting

A report form (Figure III) shall be completed and attached to each days profilograph tracings. Each trace shall include the following information:

1. Project number
2. Beginning and ending station numbers
3. 500 foot paving stations
4. Traffic direction
5. Lane number
6. Date paved and tested
7. All construction joint locations

The certified operator shall obtain and evaluate traces to be submitted to the Engineer and provide results no later than the end of the second work day following placement.



EXAMPLE SHOWING METHOD OF DERIVING PROFILE INDEX FROM PROFILOGRAMS

Figure I

METHOD OF COUNTING WHEN POSITION OF PROFILE SHIFTS AS IT MAY WHEN ROUNDING SHORT RADIUS CURVES WITH SUPERELEVATION

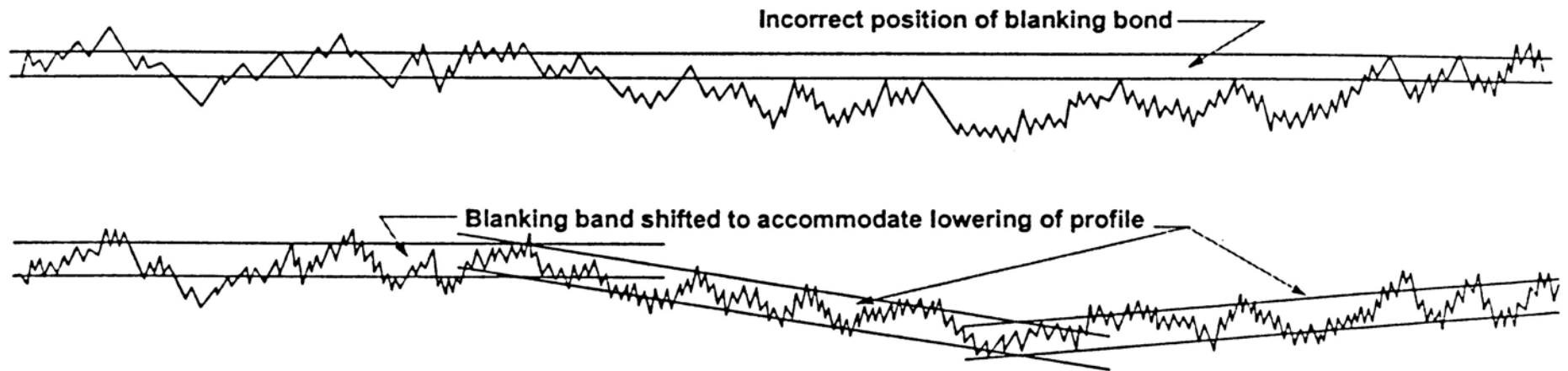


Figure II

GDT 78

A. Scope

For a complete list of GDTs, see the [Table of Contents](#).

Use this test method to determine the Profile Index from profilograms of pavements, made with the Rainhart-type profilograph.

For pavements, the profilogram is recorded on a scale of 1 in (25 mm) equals 25 ft (7.6 m) longitudinally and a vertical scale of 1:1.

Determining the Profile Index involves measuring “scallops” that appear outside a blanking band.

B. Apparatus

The apparatus consists of only the following:

5. Scale: Use a clear plastic scale, 1.50 in (37.5 mm) wide and 11.0 in (280 mm) long. Near the center of the scale is an opaque band, 0.1 in (2.5 mm) wide, extending the entire length of 11.0 in (280 mm). On either side of this band are lines scribed 0.1 in (2.5 mm) apart, parallel to the opaque band. These lines serve as a convenient scale to measure deviations, or scallops of the graph above or below the blanking band.

C. Sample Size and Preparation

No special sample preparation is needed.

D. Procedures

6. Place the plastic scale over the profile so it blanks out as much of the profile as possible. The scallops above and below the blanking band will be approximately balanced. (See [Figure 78-1](#))
 - e. The profile trace will move from a generally horizontal position when going around super-elevated curves, making it impossible to blank out the central portion of the trace without shifting the scale.
 - f. In this case, break the profile into short sections and reposition the blanking band on each section. (See [Figure 78-2](#).)
7. Beginning at the right end of the scale, measure and total the height of all the scallops appearing both above and below the blanking band.
 - g. Measure each scallop to the nearest 0.05 in (1.27 mm).
 - h. Short portions of the profile line may be visible outside the blanking band, but unless they project 0.03 in (0.75 mm) or more and extend longitudinally for 2 ft (600 mm) or more, do not include them in the count. (See [Figure 78-1](#) for special conditions.)
8. After totalling the scallops in the first scale length, slide the scale to the left. Align the right end of the scale with a small mark made at the end of the first scale length.

E. Calculations

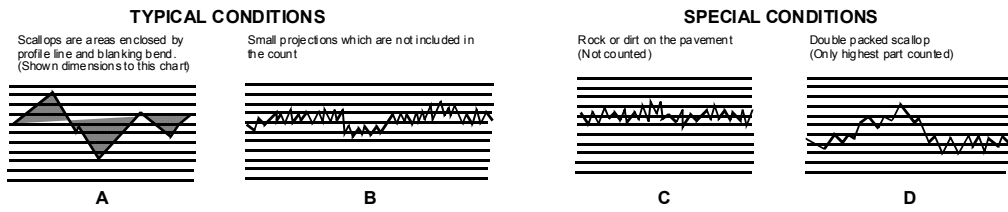
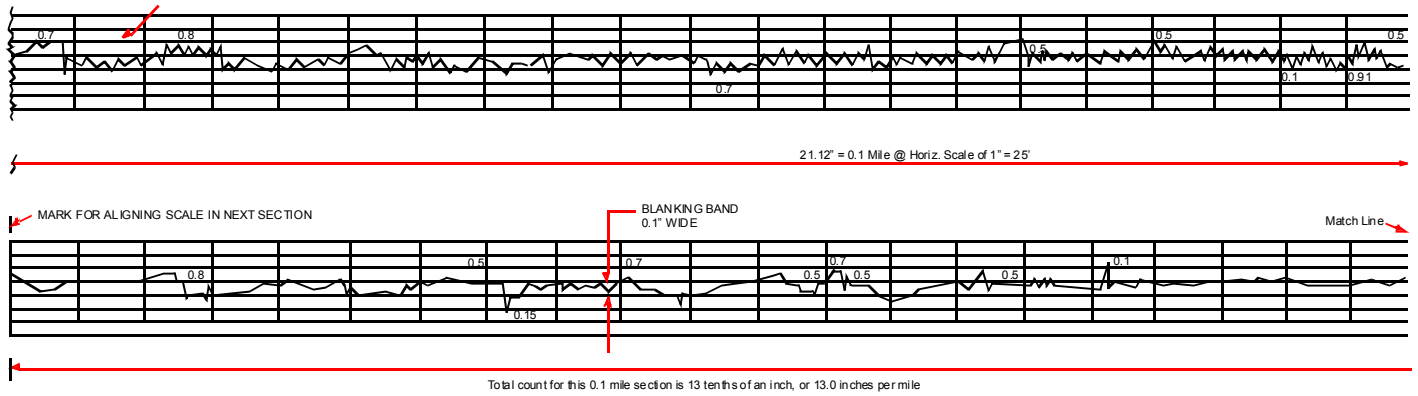
The Profile Index is determined as “inches per mile (millimeters per kilometer) in excess of the 0.1 in (2.5 mm) blanking band.” The formula for calculating Profile Index is:

$$\text{PROFILE INDEX} = \frac{1 \text{ MILE}}{\text{LENGTH OF SECTION IN MILES}} \times \text{TOTAL COUNT IN INCHES}$$

$$\text{PROFILE INDEX} = \frac{1 \text{ KILOMETER}}{\text{LENGTH OF SECTION IN KILOMETERS}} \times \text{TOTAL COUNT IN MILLIMETERS}$$

F. Report

Report the profile index in “inches per mile (millimeters per kilometer) in excess of the 0.1 in (2.5 mm) blanking band” on the [Profilograph Report Form](#).



EXAMPLE SHOWING METHOD OF DERIVING PROFILE INDEX FROM PROFILOGRAMS

Figure 78-1

METHOD OF COUNTING WHEN POSITION OF PROFILE SHIFTS AS IT MAY WHEN ROUNDING SHORT RADIUS CURVES WITH SUPERELEVATION

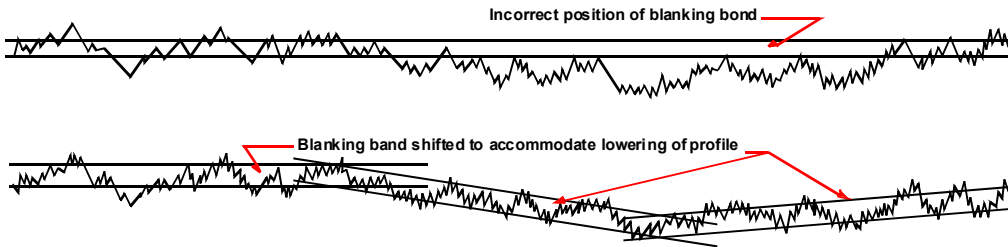


Figure 78-2

GDT 78 Form 1

Profilograph Report Form

Project No.:

Date:

Contractor:

Operator:

Profilograph No.:

Segment No.	Location From - To	Direction	Lane No.	Profile Index	Corrections Required
	-				
	-				
	-				
	-				
	-				
	-				
	-				
	-				
	-				
	-				
	-				
	-				
	-				
	-				
	-				
	-				

Required Individual Bump Corrections

Segment No.	Station No.

Profilograph Form