WSDOT Test Method T 807

Method of Operation of California Profilograph and Evaluation of Profiles

1. Scope

a. The operation of the California Profilograph, the procedure used for determining the Profile Index from profilograms of pavements made with the Profilograph, and the procedure used to locate individual high points in excess of 0.3 in are described in Parts I, II, and III, respectively, in this test method.

Part I
Operation of the California Profilograph

2. Procedure

a. Equipment – The California Profilograph consists of a frame 25 LF long supported upon multiple wheels at either end arranged in a staggered pattern, such that no two wheels cross the same bump at the same time. The profile is recorded from the vertical movement of a wheel attached to the frame at midpoint and is in reference to the mean elevation of the 12 points of contact with the road surface established by the support wheels (see Figure 1). The profilogram is recorded on a scale of 1 in = 25 LF longitudinally and the actual change in elevation vertically. Motive power is provided manually.

b. Operation – The instructions for assembling the Profilograph are contained in a booklet accompanying each unit. Particular attention should be paid to the listed precautions.

In operation, the Profilograph should be moved at a speed no greater than a walk so as to eliminate as much bounce as possible. Too high a speed will result in a profilogram that is difficult to evaluate.

Calibration of the Profilograph should be checked periodically. The horizontal scale can be checked by running a known distance and scaling the result on the profilogram. If the scale is off, the profile wheel should be changed to one of a proper diameter. The vertical scale is checked by putting a board of known thickness under the profile wheel and again scaling the result on the profilogram. If the scale is off, the cause of the incorrect height should be determined and corrected.

3. Procedure

a. Equipment – To determine the Profile Index, use a plastic scale 1.70 in wide and 1.76 LF long representing a pavement length of 528 LF at a scale of 1 in = 25 LF. A plastic scale for the Profilograph may be obtained by the regions from the State Materials Laboratory. Near the center of the scale is an opaque band 0.2 in wide extending the entire length of 21.12 in. On either side of this band are scribed lines 0.1 in apart, parallel to the opaque band. These lines serve as a convenient scale to measure deviations or excursions of the graph above or below the blanking band. These are called “scallops.”

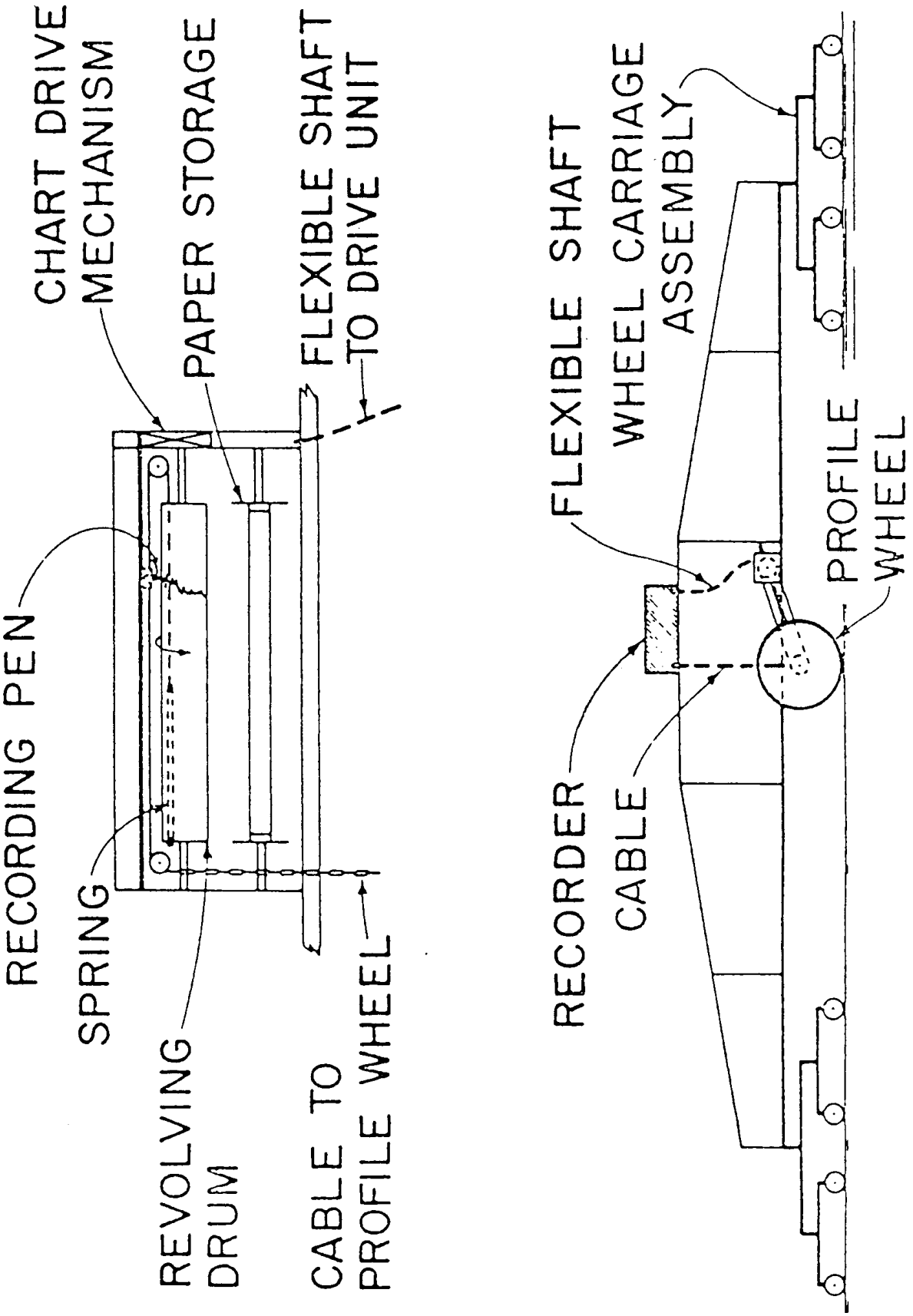
CHART DRIVE MECHANISM
PAPER STORAGE
FLEXIBLE SHAFT TO DRIVE UNIT
RECORDING PEN
SPRING
REVOLVING DRUM
CABLE TO PROFILE WHEEL
FLEXIBLE SHAFT
WHEEL CARRIAGE ASSEMBLY
PROFILE WHEEL
RECORDER CABLE

Figure 1

b. Method of Counting – 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, the scallops above and below the blanking band usually will be approximately balanced. See Figure 2.

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 a condition occurs, the profile should be broken into short sections and the blanking band repositioned on each section while counting as shown in the upper part of Figure 3.

Starting at the right end of the scale, measure and total the height of all the scallops appearing both above and below the blanking band, measuring each scallop to the nearest 0.05 in (half a tenth). Write this total on the profile sheet near the left end of the scale together with a small mark to align the scale when moving to the next section. Short portions of the profile line may be visible outside the blanking band but unless they project 0.03 in or more and extend longitudinally for 2 LF (0.08 in on the profilogram) or more, they are not included in the count. (See Figure 2 for illustration of these special conditions.)

When scallops occurring in the first 0.1 mile are totaled, slide the scale to the left, aligning the right end of the scale with the small mark previously made, and proceed with the counting in the same manner. The last section counted may or may not be an even 0.1 mile. If not, its length should be scaled. An example follows:

	Section Length, miles	Counts, tenth of an inch
	0.10	5.0
	0.10	4.0
	0.10	3.5
400 ft =	0.076	2.0
Total	0.376	14.5

The Profile Index is determined as "inches per mile in excess of the 0.2 in blanking band" but is simply called the Profile Index. The procedure for converting counts of Profile Index is as follows:

Using the figures from the above example:

Length = 0.376 mi., total count = 14.5 tenths of an inch

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

$$\text{Pr I} = \frac{1 \text{ mile}}{0.376 \text{ mile}} \times 1.45 = 3.9$$

(Note that the formula uses the count in inches rather than tenths of an inch and is obtained by dividing the count by ten.)

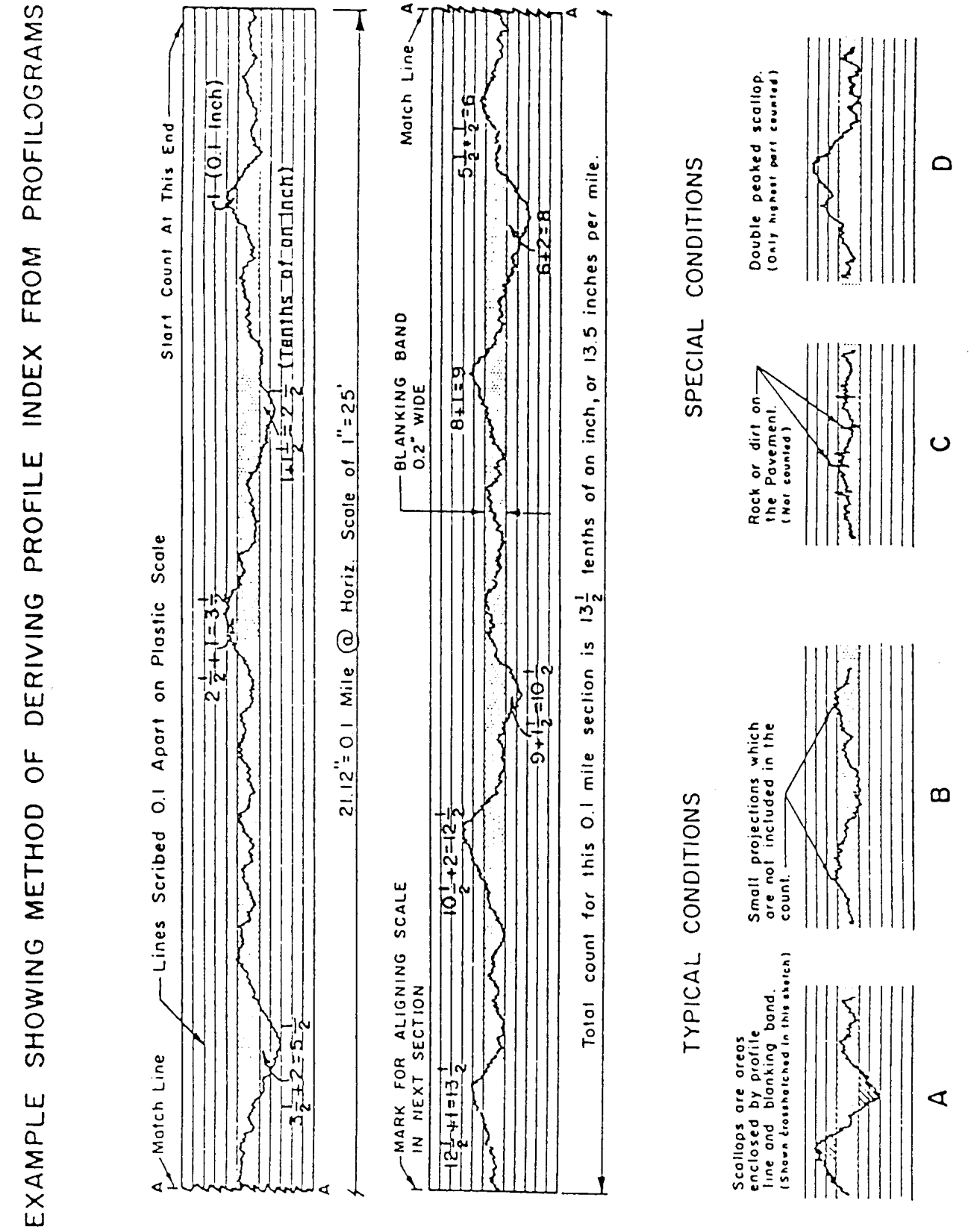
EXAMPLE SHOWING METHOD OF DERIVING PROFILE INDEX FROM PROFILOGRAMS
Match Line
Lines Scribed 0.1 Apart on Plastic Scale
Start Count At This End
21.12" = 0.1 Mile @ Horiz. Scale of 1" = 25'
(0.1-Inch)
(Tenths of an Inch)
MARK FOR ALIGNING SCALE IN NEXT SECTION
BLANKING BAND 0.2" WIDE
Match Line
Total count for this 0.1 mile section is 13½ tenths of an inch, or 13.5 inches per mile.
TYPICAL CONDITIONS
Scallops are areas enclosed by profile line and blanking band. (Shown crosshatched in this sketch)
Small projections which are not included in the count.
A
B
SPECIAL CONDITIONS
Rock or dirt on the Pavement. (Not counted)
Double peaked scallop. (Only highest part counted)
C
D

Figure 2

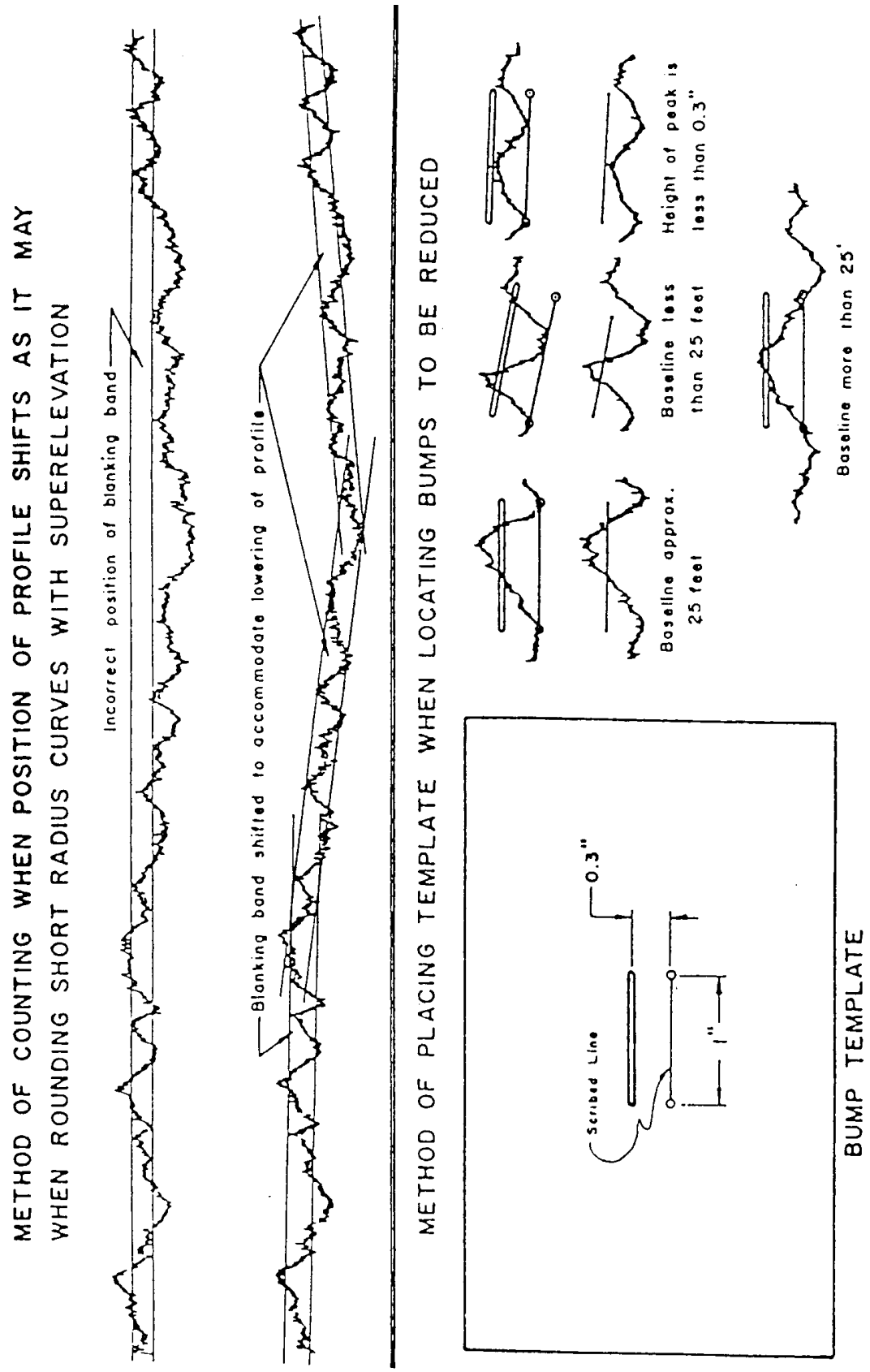
METHOD OF COUNTING WHEN POSITION OF PROFILE SHIFTS AS IT MAY
WHEN ROUNDING SHORT RADIUS CURVES WITH SUPERELEVATION
Incorrect position of blanking band
Blanking band shifted to accommodate lowering of profile
METHOD OF PLACING TEMPLATE WHEN LOCATING BUMPS TO BE REDUCED
Baseline approx. 25 feet
Baseline less than 25 feet
Height of peak is less than 0.3"
Baseline more than 25'
0.3"
Scribed Line
1"
BUMP TEMPLATE

Figure 3

The Profile Index is thus determined for the profile of any line called for in the specifications.

To determine the daily profile index to check the Contractors methods and procedures, profile indexes may be averaged for two or more profiles of the same section of road if the profiles are the same length.

Example:

		Counts, tenths of an inch	
	Section Length, miles	**Left wheel track**	**Right wheel track**
	0.10	5.0	4.5
	0.10	4.0	5.0
	0.10	3.5	3.0
400 LF =	0.076	2.0	1.5
Total	0.376	14.5	14.0
PrI (by formula)		3.9	3.7

$$\text{Averages} = \frac{3.9 + 3.7}{2} = 3.8$$

The specifications state which profiles to use when computing the average Profile Index for control of construction operations.

c. Limitations of Count in 0.1 Mile Sections – When the specifications limit the amount of roughness in "any one-tenth mile section," the scale is moved along the profile and counts made at various locations to find those sections if any, that do not conform to specifications. The limits are then noted on the profile and can be later located on the pavement preparatory to grinding.

d. Limits of Counts – Joints – When counting profiles, a day's paving is considered to include the last portion of the previous day's work, which includes the daily joint. The last 15 to 30 LF of a day's paving cannot usually be obtained until the following day. In general, the paving contractor is responsible for the smoothness of joints if he places the concrete pavement on both sides of the joint. On the other hand, the contractor is responsible only for the pavement placed by him if the work abuts a bridge or a pavement placed under another contract. Profilograph readings when approaching such joints should be taken in conformance with current specifications.

Part III
Determination of High Points in Excess of 0.3 in

4. Procedure

a. Equipment – Use a plastic template having a line 1 in long scribed on one face with a small hole or scribed mark at either end, and a slot 0.3 in from and parallel to the scribed line (see Figure 3). (The 1 in line corresponds to a horizontal distance of 0.3 in on the horizontal scale of the profilogram.) The plastic template may be obtained from the State Materials Laboratory.

b. Locating High Points in Excess of 0.3 in – At each prominent peak or high point on the profile trace, place the template so that the small holes or scribe marks at each end of the scribed line intersect the profile trace to form a chord across the base of the peak or indicated bump. The line on the template need not be horizontal. With a sharp pencil, draw a line using the narrow slot in the template as a guide. Any portion of the trace extending above this line will indicate the approximate length and height of the deviation in excess of 0.3 in.

There may be instances where the distance between easily recognizable low points is less than 1 in (25 LF). In such cases, a shorter chord length shall be used in making the scribed line on the template tangent to the trace at the low points. It is the intent, however, of this requirement that the baseline for measuring the height of bumps will be as near 25 LF as possible, but in no case to exceed this value. When the distance between prominent low points is greater than 25 LF, make the ends of the scribed line intersect the profile trace when the template is in a nearly horizontal position. A few examples of the procedure are shown in the lower portion of Figure 3.