

Application Brief
TROXLER MODEL 2701B

PaveTracker™ Plus
Electromagnetic Sensing Device for Asphalt Quality Control

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Introduction

The Troxler Model 2701B, PaveTracker™ Plus, is a non-nuclear electromagnetic sensing device manufactured by Troxler Electronic Laboratories, Inc., the industry leader in field density measurement of asphalt. The PaveTracker Plus provides advanced technology in a patented[†] device designed for the asphalt industry that allows rapid and reliable pavement measurements. The PaveTracker Plus offers user friendly software to assist the operator in performing readings and storing data for later viewing or downloading. It is ideal for quick quality control measurements to check for segregation, areas of low density and overall pavement uniformity. The PaveTracker Plus complies with ASTM standard D7113, "Test Method for Density of Bituminous Paving Mixtures in Place by the Electromagnetic Surface Contact Methods."

Traditional Methods

The PaveTracker™ Plus device works in a very different way than the traditional nuclear density gauges in that they are not giving a direct density measurement. Instead, it gives a relative reading that can be offset to a representative core sample or a nuclear gauge reading to give actual density readings for the pavement being measured. The nuclear density gauges measure the actual density of the material; however, the PaveTracker Plus indicates the density of the material by detecting a component of the material density and relating that to a density value. This component is referred to as the dielectric property of the material. As the asphalt is compacted the air voids in the mix decrease and the dielectric properties change, and the PaveTracker Plus reports this change as an increase in the density.

Troxler Technology

The PaveTracker™ Plus's sensing technology (used to report pavement uniformity) relates to the "chemical composition per unit volume." For asphalt material that is relatively homogeneous, the change in the dielectric properties monotonically increases as the material condenses. The dielectric properties of asphalt include the composite chemical properties of the binder, aggregate, and air voids in the mix. As the asphalt is compacted, the air voids component of the mix is reduced. Because air has a lower dielectric constant than the other components, this change is reflected as an increase in the density of the asphalt. Non-uniformity in the asphalt

[†] US Patent #6677763 & 6400161

mix can also be reflected in a similar way, alerting the user of possible segregation of the asphalt.

PaveTracker™ Plus Operation

The operation of the PaveTracker™ Plus is quick and simple. Every second the display screen updates the measurement results. After the device is turned on and “referenced” on a test plate built into the PaveTracker Plus transport case, measurements can be performed immediately. If the device is not offset to match core samples or nuclear gauge measurement results, it can be used to indicate “relative density” values. In other words, the results can indicate if the maximum compaction level has been achieved or if a uniform compaction level has been achieved. If core values are available and the PaveTracker Plus is offset to match these, a direct density value can be measured.

Three operation modes are available for performing measurements on asphalt pavements: Continuous, Averaging, and Segregation.

Continuous mode: The density result, as well as the % Gmm, % Gmb, and/or % Air Voids (if desired), appear on the screen almost instantaneously after placing the device on the asphalt.

Averaging mode: Displays the average of a string of densities in addition to the percent compaction values as displayed in the continuous mode.

Segregation mode: Allows the operator to view the current density value, the average of the string of measurements, and the high and low values in the series. This information indicates when the readings show a higher variation than is typical. Usually this is due to segregation of the asphalt mix.

This device is non-nuclear and therefore requires no licensing or special training in order to possess, operate, or transport the equipment. It is also lightweight, weighing approximately 11 pounds. No moisture or temperature corrections are needed by the PaveTracker devices. The L-shaped handle allows for many measurements without bending. The PaveTracker Plus device is also supplied with sensor covers that protect the bottom surface of the sensor to prevent damage from hot asphalt, especially when the device is pulled across the mat to obtain a density profile. The reference standard or “test plate” contained in the transport case is always available for checking instrument stability. The Model 2701B, PaveTracker Plus, is designed for convenience and ease of use by the operator.

Features

The PaveTracker™ Plus offers many new features never seen in any other non-nuclear density measurement device. This gauge has memory capable of storing up to 999 measurement records, including information about the test location. This data can be viewed, printed, or uploaded to a computer. In addition, Target Density values can be stored for later use.

Three operation modes (Continuous, Averaging and Segregation) are offered to cover all testing needs. This device also displays the percent compaction and/or percent air voids automatically if given the appropriate target values.

An optional temperature sensor is also available on the PaveTracker Plus. With the temperature sensor on-board, the asphalt mat temperature displays on the screen with the measurement

results. The software allows the operator to enter a layer thickness for the material being measured. This information can be viewed later in the stored data record.

The optional Global Positioning System (GPS) can be included on the 2701B. Precise GPS coordinates are stored with each measurement record. The GPS receiver used in the Model 2701B has Wide Area Augmentation System (WAAS) capabilities, which improves the location accuracy. To determine latitude and longitude, a GPS receiver must receive signals from at least three satellites. The receiver in this gauge is accurate to within 15 m (approx. 50 ft.) when receiving GPS data alone. The WAAS capabilities increase the accuracy to within 3 m (10 ft.). The measurement display and stored record denotes the quality of the location fix according the number of digits displayed, information is displayed to the nearest 1/100 of a second if WAAS is available and the nearest 1/10 of a second if it is not available.

Keypad

The Model 2701B keypad consists of 30 keys. The keypad is designed to assist the user in simple navigation through the menus. Most functions can be accessed with 1 to 3 keystrokes. Above the keypad is a 4-line by 20-character Liquid Crystal Display (LCD) screen. The display has been enlarged for increased visibility. In addition, both the display screen and the keypad are backlit. This allows the operator to see the screen and keypad when performing measurements at night or in a dimly-lit area.

Data Storage and Output

This equipment is capable of storing 999 measurements as well as four Gmb (Marshall) target densities and four Gmm (voidless) density targets. Project numbers and measurement data can be stored and recalled later for viewing, printing, or uploading to a computer.

Batteries and Power Consumption

The PaveTracker™ Plus is powered by long-lasting, rechargeable Nickel Metal Hydride batteries. These last approximately 32 hours under typical operating conditions. The backlight and optional GPS features require the use of additional battery voltage; therefore, the batteries will need to be charged sooner if used often. The recharge time is typically 1.5 hours when the “Battery Low” warning is displayed. If the battery were to be completely drained, the recharge time would be approximately 2.3 hours. A 110 V AC and a 12 V DC (automobile) charger/adaptor are included as standard accessories.

Summary

The Model 2701B, PaveTracker™ Plus is a lightweight, non-nuclear, electromagnetic sensing device for measuring the uniformity of asphalt pavement. The measurements are practically instantaneous when the device is placed on the asphalt surface. Areas of segregation, low density, or other non-uniformity are easily detected by the PaveTracker Plus. This allows the operator to correct the problem before construction is complete. The advanced software, built-in reference plate, and enlarged display screen are some of the features that make the 2701B the most user-friendly, non-nuclear asphalt quality control device available today.

Specifications
Model 2701B PaveTracker™ Plus

Size (WxDxH)	9" x 16" x 6" (22.9 x 40.6 x 15.2 cm)
Size- transport case (WxDxH)	13.5" x 17.75" x 10" (34.3 x 45.1 x 25.4 cm)
Weight	approx. 11 lb (5 kg)
Shipping Weight	approx. 31 lb (14 kg)
Storage Temperature	-20° to 70° C (-4° to 158° F)
Operating temperature	Ambient 0° to 70° C (32° to 158° F) Surface 175° C (350° F) max.
Measure Units	US/ Imperial (lb/ft ³) or Metric (kg/m ³)
Display	4 lines x 20 characters, backlit
Data Storage	Up to 999 readings and notes
Probing depth	0.75 to 1.25 inches typical
Measurement time	under 2 seconds
Repeatability	+/-0.2 pcf (3.2 kg/m ³) on synthetic materials @ 95% level
Power	Rechargeable battery, run time 32 hours on full charge
Calibration	To asphalt cores
Handle	Carrying handle and detachable L shaped handle
Transport Case	Water resistant with built in reference standard (test plate)