

## **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<sup>1</sup> 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. A relative reading is given 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. The 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; therefore the PaveTracker™ Plus reports this change as an increase in the density.

#### **Troxler Technology**

The sensing technology employed by the PaveTracker™ Plus to report pavement uniformity is related 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 densifies. 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 will be reduced. Since air has a lower dielectric constant than the other components, this change will be reflected as an increase in the density of the asphalt. Non-uniformity in the asphalt 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. Measurement results are updated on the display screen every second. 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. In the continuous mode the density result, as well as the % Gmm , % Gmb and / or % Air Voids (if desired), appear on the screen almost instantaneously as the device is placed on the asphalt. The averaging mode displays the average of a string of densities in addition to the percent compaction values as displayed in the continuous mode. The 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 will indicate 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 the user to perform 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 was 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 downloaded to a computer. In addition, Target Density values can be stored for later use. Three test 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 the operator enters the appropriate target values. An optional temperature sensor is also available on the 2701B if desired. With the temperature sensor on-board, the asphalt mat temperature is displayed 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.

## **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 screen. The display has been enlarged for increased visibility. In addition, the display and the keypad are backlit. This allows the operator to see the screen as well as the keypad when performing quality control 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. If a project number is entered into the software and the readings are stored, the measurement data can be recalled at a later time for viewing, printing or downloading to a computer.

## **Batteries and Power Consumption**

The PaveTracker™ Plus is powered by long-lasting Nickel Metal Hydride rechargeable batteries. These will last approximately 32 hours under typical operating conditions. The backlight feature requires the use of additional battery voltage, therefore the batteries will need to be charged sooner if this is 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, which 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 <sup>3</sup> ) or Metric (kg/m <sup>3</sup> )
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 <sup>3</sup> ) on synthetic materials @ 95% level
Power	Rechargeable battery, run time 32 hours on full charge
Calibration	To asphalt cores, unit will sit on a 6" core or puck
Handle	Carrying handle and detachable L shaped handle
Transport Case	Water resistant with built in reference standard "test plate"