

# Manual of Operation and Instruction

# Model 2701 PaveTracker™



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# NOTES

# INTRODUCTION TO THE PAVETRACKER

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Troxler, the leader in density gauge technology, now offers the Pavetracker™, an electromagnetic sensing device that quickly gives an indication of the density of asphalt pavement. The advanced technology in the patented Pavetracker allows rapid and reliable measurements. The Pavetracker can be used on existing asphalt pavements or on freshly placed mats. The unit is ideal for performing quick quality control measurements to check for segregation, areas of low density, and overall pavement uniformity.

The Pavetracker is a precision device that is designed to provide many years of trouble-free service. As any precision device, the Pavetracker requires reasonable care and maintenance to ensure its accuracy and reliability. The user must:

- ◆ Keep the unit clean and free of all road debris.
- ◆ Return the unit to Troxler for yearly re-calibration and inspection.
- ◆ Ensure that the unit remains sealed at all times. There are ***no field-serviceable components*** inside the gray case. Opening the case will affect the integrity of the unit and therefore will void the warranty.

The following features make the Pavetracker ideal for asphalt paving projects:

- ◆ The Pavetracker *display* is updated every second, allowing for rapid measurements.
- ◆ The Pavetracker is *lightweight*.
- ◆ Density measurements are displayed in *units of lb/ft<sup>3</sup>* for easy comparison to a nuclear gauge reading or core value.
- ◆ The Pavetracker requires *no moisture or temperature corrections*.
- ◆ The *telescoping handle* reduces bending for gauge operations.
- ◆ The Pavetracker's protective *transport case* has a *built-in reference standard* that provides a reference for instrument traceability to the factory standard.

# UNPACKING

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Upon receipt of the PaveTracker, perform a complete inspection and inventory. If the shipping case and/or any other part or accessory appears damaged, notify the carrier and your Troxler Representative **immediately**.

Check the shipping case for the following:

- ◆ Transport case with PaveTracker and reference standard (The standard not visible; it is sealed in the base of the large transport case.)
- ◆ Telescoping handle
- ◆ Manual of Operation and Instruction
- ◆ Slider gaskets, quantity of 3 (1 of the 3 slider gaskets is installed on the bottom of the reference case)
- ◆ Ac charger and 12 V dc car adapter

# OPERATING INSTRUCTIONS

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## HANDLE ASSEMBLY AND POWER UP

Before operating the PaveTracker:

1. Open the transport case and remove the PaveTracker.
2. Remove the telescoping handle from its cradle on the transport case. Fully extend the first (smallest) metallic section of the telescoping handle. Press the end buttons in and push them into the PaveTracker handle brackets. The relief angle at the end of the handle should be oriented upward. Extend the rest of the handle to a comfortable length.

### **NOTE**

**The handle must be installed so that it can tilt upward during use. If the handle will not tilt upward, remove it from the handle brackets, rotate it 180° so that the relief angle is oriented upward, and re-install it into the brackets.**

3. Place the PaveTracker in its transport case. Orient the handle vertically so that the unit rests flat on the reference standard in the bottom of the transport case.
4. Turn the **Power** switch on (see Figure 1).
5. Test the battery by pressing the **Battery** push button. Fully charged batteries will read 9.0 V dc or higher. The PaveTracker will operate properly with a battery voltage of 8.0 to 9.0 V dc. If the battery voltage is below 8.0 V dc, the PaveTracker will not function. Refer to page 16 for instructions on charging the batteries.

### **NOTE**

**Troxler recommends charging the batteries overnight before each use. A full charge will provide 8 hours of continuous operation.**

6. For normal operation, set the **Fast/Average** switch to **Fast**.

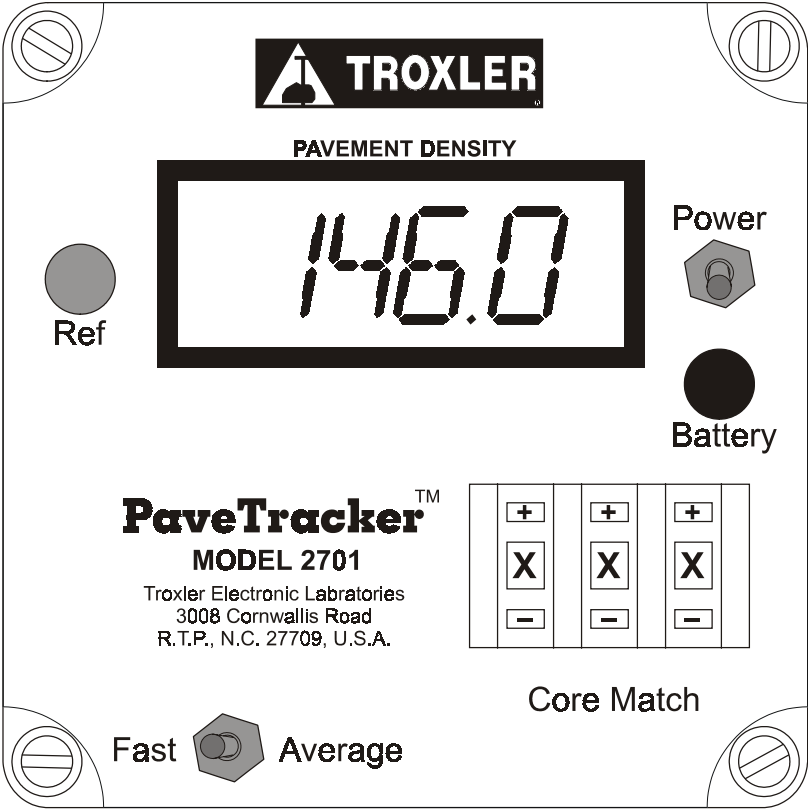


Figure 1. PaveTracker Control Panel



## VERIFYING/SETTING THE PAVETRACKER

To verify/set the PaveTracker:

1. Ensure that the PaveTracker rests snugly against the upper end of the transport case, with a small gap between the handle bracket and the lower end of the transport case. Orient the handle vertically so the unit rests flat in the case.
2. Turn the **Power** switch on (see Figure 1).
3. Allow the PaveTracker to warm up for one minute. Note the display reading and press the **Ref** button until a click is felt. Immediately remove your hand and pull it back 2 ft. The display flashes after 3 seconds. The displayed value should be within  $\pm 0.5 \text{ lb/ft}^3$  of the *displayed reference value*. (Units are shipped with a *set reference value* of 146, therefore, the initial display should be  $146.0 \pm 0.5 \text{ lb/ft}^3$ .)
4. If the displayed value is not  $146.0 \pm 0.5 \text{ lb/ft}^3$ , change the **Core Match** value and press the **Ref** button to take additional readings until a value of  $146.0 \pm 0.5 \text{ lb/ft}^3$  is achieved. To change the **Core Match** value, press the increment (+) and decrement (-) buttons as required.

## MATCHING TO CORES OR A NUCLEAR GAUGE

To further improve the accuracy of the PaveTracker for a specific application, the unit can be calibrated on a core of known density or a nuclear gauge reading, rather than the built-in reference standard.

After referencing the PaveTracker as described in the previous section, immediately remove the unit from the case and place it on pavement of known density, as determined (or to be determined) from core extractions and analysis. Place the PaveTracker directly over the center of a target core location and record the density value. Take four measurements in the same location, rotating the unit one-quarter turn ( $90^\circ$ ) after each measurement.

Take the average of the four readings. Note that this process can be repeated at several locations, however, before each measurement the PaveTracker must be placed in the transport case and referenced as described on page 5.

Due to variances in asphalt pavement mixtures, adjust the PaveTracker **Core Match** value (see Figure 1) to match the unit to “true highway densities”. To change the value of a **Core Match** digit, use the increment (+) and decrement (–) buttons for that digit.

For example, assume that the following data was recorded:

Factory Standard Reference Value: 146

<u>Location</u>	<u>1</u>	<u>2</u>	<u>3</u>
PaveTracker average reading	140	143	145
Actual core densities (lb/ft <sup>3</sup> )	144	146	150
Difference (PaveTracker – Core)	–4	–3	–5
Average difference –4 lb/ft <sup>3</sup>			

In this example, the PaveTracker is reading 4 lb/ft<sup>3</sup> low, as noted by the minus sign. Therefore, the **Core Match** value must be *increased* to compensate. Verify/set the unit as described on page 5. After the display flashes, increment the digital **Core Match** value to increase the prior reading from 146 to 150.

Record the **Core Match** value and the value displayed on the PaveTracker for future reference. The display value is the new *reference value*.



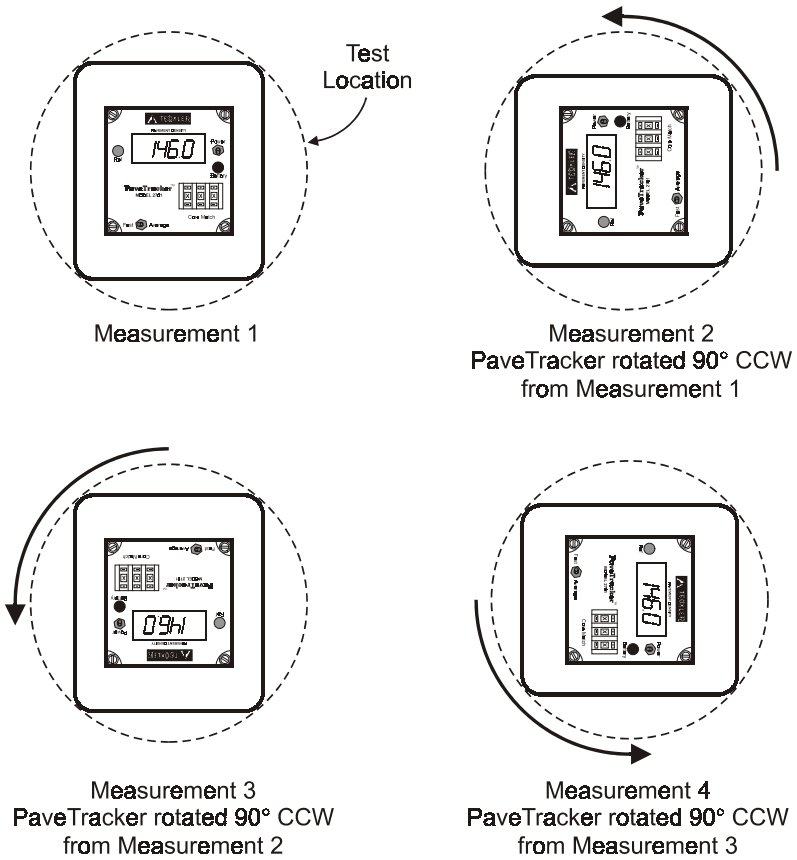
## **DENSITY MEASUREMENTS**

After the PaveTracker has been matched to cores or nuclear gauges as described in the previous sections, density measurements are simple and rapid. To measure density:

1. Verify/set the unit as described on page 5 using the most current *reference value*.
2. Place the PaveTracker on the asphalt test location and record a first value. Ensure that neither your hand nor any other object (except the extended handle) is within 2 ft of the PaveTracker while taking the measurement. Record four readings, rotating the unit one-quarter turn (90°) following each measurement, as shown in Figure 2.
3. Average the four measurements.

### **NOTE**

**Asphalt measurements should always be taken immediately after verifying/setting the unit to the standard. Verify/set the unit once per core location.**



*Figure 2. PaveTracker Density Measurements*

## **DENSITY PROFILE MODE**

In *density profile mode*, the PaveTracker is used to take profiles of selected pavement sections, such as across a lane or an area of suspected density variances or problems.

In this mode, a *slider gasket* must be used to avoid damage to the bottom sensor of the PaveTracker. With the power off, rest the unit face down on a soft surface. Align the slider gasket so that it is centered across the bottom sensor. Attach the Velcro ends of the slider gasket to the sides of the PaveTracker. Ensure that the slider gasket fits snugly over the bottom sensor. The gasket will lie relatively flat in the center of the bottom sensor, but will fit loose as it rounds the units corners.

To perform a density profile:

1. With the **Fast/Average** switch in the **Fast** position, verify/set the PaveTracker as described on page 5.
2. Change the **Fast/Average** switch to the **Average** position and remove the unit from the transport case.
3. Place the unit in one location and motionless for several seconds to allow the display to stabilize.
4. To take a profile of a selected area, grip the handle as if holding a small paint brush, and slowly pull the unit across the test area. Use a slight upward pull to ensure that the unit lies flat while encountering minimal friction.

### **NOTE**

**In *density profile mode*, several seconds are required for a reading to average out.**

### **NOTE**

**Always verify/set the unit as described on page 5 before performing successive measurements, Ensure that the **Fast/Average** switch is in the **Fast** position while verifying/setting the unit and in the **Average** position for profiling.**

## **LABORATORY SPECIMEN MEASUREMENTS**

The PaveTracker can also be used to measure the density of laboratory specimens. Density testing must be conducted on dry specimens. Testing must also be performed before the specimen is soaked during saturated surface dry (SSD) weight measurements, as air or low-temperature oven drying may be insufficient to remove hydrated moisture, which can alter accuracy.

To measure the density of a laboratory specimen, Troxler recommends removing the small PaveTracker electronics module from the field carrying case. With the assembled unit resting on a flat surface, press down on the cover and release both of the side latches. Lift the module from the case.

Before each measurement, the module must be verified/set as described on page 5. Place the module in the center of the white square locating marks while performing this procedure.

### **NOTE**

**Remove the telescoping handle from its cradle on the transport case while referencing the electronics module.**

When measuring a laboratory specimen, place the **Fast/Average** switch in the **Fast** position. Troxler recommends performing at least four top and four bottom measurements, with the PaveTracker module rotated one-quarter turn after each measurement, to achieve the best average. During measurements, the specimen should be placed on a non-metallic object and at least 2 feet away from adjacent metal objects. An empty cardboard box is an ideal measurement surface.

Note that values recorded on lab specimens are *relative* density values. The correlation of these values to true density values requires calibration similar to that discussed in the *Matching to Cores* section on page 5.

## **NOTE**

**The offset values determined for specimens surrounded by air may be different from that of the same identically compacted material in a roadway. The difference is due to device electromagnetic field variance. An additional correction factor may be necessary to equate “specimens in air” to “specimens in a mat.” The correction algorithm is currently under development. However, values can be determined experimentally by capable users.**

**The offset value may also be specific to the asphalt mix.**

To re-install the electronics module in the field carrying case, carefully align the base of the electronics module with the cutout in the bottom of the case. For best results, place the field case on a flat surface and align the module into the opening. Partially close the cover, then inspect the bottom of the assembly to be certain that centering is correct. Run a finger across the bottom surface to verify flatness. While keeping the cover partially closed to hold the module in place, again place the assembled unit on a flat surface. Fully close the cover by pressing on the cover area near the latching snaps to ease the closing force, then engaging the two latches.

## **SEGREGATION MODE (OPTIONAL FEATURE)**

The PaveTracker may also be used to test the segregation of an asphalt pavement. For this type of testing, the **Fast/Average** switch may be placed in either position.

When performing segregation testing on fresh, hot asphalt, a slider gasket must be used to avoid damage to the bottom sensor of the PaveTracker. Refer to the *Density Profile Mode* section on page 9 for instructions on installing a slider gasket.

The following procedure has proven to be an acceptable method for segregation determination. This procedure was developed by the Kansas and Texas departments of transportation.

1. Verify/set the PaveTracker as described on page 5.
2. A *profile section* is defined as a 50-ft length of asphalt mat, with measurements taken approximately every 5 ft. Additional longitudinal readings may be taken along the transverse offset where visible segregation is noticed.
3. If profiling a location where it is known that the paver stopped, perform the following steps. If it is not known if the paver stopped in this location, proceed to step 4.
  - ✓ Identify the location where the laydown machine stopped paving for some reason, such as sporadic delivery.
  - ✓ Mark and record this location as the beginning of the profile section, also called the *zero point*.
  - ✓ The first reading location should be 10 ft *behind* the zero point.
  - ✓ Proceed to step 5.
4. If profiling a location where it is not known if the paver stopped, randomly select an area. If possible, choose an area with visible segregation. Proceed to step 5.
5. Determine a point at least 2 ft from the pavement edge. Do not vary from this distance from the pavement edge.



6. From this point, measure back 5 ft and mark a second point.
7. Continue moving back away from the first point, marking a point every 5 ft until the last point is 50 ft from the zero point.
8. After the final rolling pattern is complete, position the PaveTracker at either end of the profile section and take readings at each marked location. Refer to the *Density Measurements* section on page 7 for instructions on taking the readings.

### **NOTE**

**In segregation mode, it is not necessary to offset the PaveTracker readings to a known density, as the readings are relative only to this specific location.**

9. After completing all readings:
  - ✓ Determine the average of the readings
  - ✓ Determine the difference between the highest and lowest readings from the population of all locations.
  - ✓ Determine the difference between the average of the readings and the lowest reading.

The actual determination of segregation should be established between the paving contractor and the purchasing agency. The following values have proven to be in useful in determining segregation:

- ◆ For surface or fine mixes, the pavement is segregated if the difference between the highest and lowest readings is greater than 6 and the difference between the average and the lowest reading is greater than 3.
- ◆ For coarse graded mixes, the pavement is segregated if the difference between the highest and lowest reading is greater than 8 and the difference between the average and the lowest reading is greater than 5.

## **POWER DOWN AND DISASSEMBLY**

When testing is complete:

1. Turn the **Power** switch off.
2. Remove the telescoping handle by pressing the end buttons with one hand while gently twisting the handle with the opposite hand. Retract the extension sections and place the handle in its cradle on the transport case.
3. Check the bottom of the PaveTracker for grit and stones. Clean the bottom surface carefully. Use WD-40® to remove any asphalt that has adhered to the base of the unit.
4. Place the PaveTracker in its transport case and close the cover by pressing down over each latch to ease the snapping force, then engaging the latches.

## GENERAL PROCEDURES

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- ◆ Do not touch the unit when recording a valid measurement.
- ◆ Before each measurement, reference the PaveTracker as described on page 5.
- ◆ The unit is water-resistant; protect the main unit and case/standard from excessive rain.
- ◆ Check the bottom of the PaveTracker for grit and stones before placing it back in its transport case.
- ◆ Use WD-40 to remove any asphalt that has adhered to base of unit.
- ◆ Use only a mild detergent or glass cleaner to clean all other surfaces of the PaveTracker.
- ◆ Always turn power off, if interval between measurements exceeds 10 minutes.
- ◆ Never store miscellaneous objects in the carrying case, as they may alter calibration.
- ◆ When measuring any surface, keep all objects at least 2 feet from the device.
- ◆ Never alter the **Core Match** value in the middle of a data set.
- ◆ Avoid close use of cell phones or similar devices while making measurements.
- ◆ Never leave the PaveTracker or its transport case resting on a hot asphalt surface.
- ◆ During measurements, always fully extend the non-metallic section of the telescoping handle.
- ◆ Turn off the **Power** switch when recharging the unit.

## BATTERY CHARGING

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Before using the Pavetracker, test the battery voltage as described in the *Handle Assembly and Power Up* section on page 3. The battery voltage should be greater than 9.0 V dc. If the battery voltage falls below 8.0 V dc, the Pavetracker will no longer function, and the batteries should be recharged.

To recharge the batteries, remove the electronics module from its field carrying case, as described in the *Laboratory Specimen Measurements* section on page 10. Ensure that the **Power** switch is turned off.

### NOTE

**The Power switch must be off when recharging the Pavetracker batteries.**

Connect the ac charger to the charging connector located on the upper front side of the electronics module, and plug the other end of the charger into a standard 110 V ac outlet. For a full charge, recharge the batteries for 15 hours. The battery voltage can be checked during charging. A battery voltage of over 9.0 V dc indicates a full charge, and will provide 8 hours of continuous operation.

If battery recharging is necessary in the field, a 12 V dc charger/adaptor is also provided. When using the dc charger/adaptor, the recharge time may be affected by the vehicle's battery voltage. The batteries will recharge most rapidly with the vehicle running. Monitor battery voltage to assess charging.

# SPECIFICATIONS

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<b>Size, electronics module</b>	3.5W x 4.5D x 2.25H in.
<b>Size, field case with electronics module</b>	6W x 8D x 3.5H in.
<b>Weight, electronics module</b>	1 lb
<b>Weight, field case with electronics module</b>	2 lb
<b>Measurement capability</b>	Pavement density in lb/ft <sup>3</sup> on warm pavement and battery level
<b>Probe</b>	Non-nuclear, non-capacitance, measuring field
<b>Probing depth</b>	1.75 in
<b>Measurement time</b>	1 second
<b>Repeatability</b>	± 0.5 units
<b>Power</b>	Rechargeable Battery, Run time 8 hours
<b>Calibration</b>	To asphalt cores, unit will sit on a 6-in. core or laboratory specimen
<b>Handle</b>	Telescoping, detachable
<b>Transport case</b>	Water-resistant with built-in reference standard

# NOTES

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# **TROXLER ELECTRONIC LABORATORIES, INC.**

## **LIMITED WARRANTY**

TROXLER ELECTRONIC LABORATORIES, INC., and subsidiary, TROXLER INTERNATIONAL, LTD., hereinafter referred to as "TROXLER," warrants this instrument, Model 2701 PaveTracker, Serial Number \_\_\_\_\_, against defects in material and workmanship for a period of 12 months from date of shipment. For gauges sold through authorized TROXLER representatives, the date of shipment will be as of the transfer from representative to purchaser. During the applicable warranty period, TROXLER's obligation under this warranty shall be limited exclusively to the repair at no charge, except for shipping to and from TROXLER'S plant, of any instrument which may prove defective under normal use and which TROXLER's examination shall disclose to its satisfaction to be thus defective. Normal use is defined for the purpose of this warranty as operation under normal load, usage, and conditions with proper care and maintenance and competent supervision. In no event shall TROXLER be held liable for damages, delays, or losses consequential, incidental, or otherwise attributable to the failure of this instrument or radioactive material contained therein. TROXLER's liability being specifically limited to repair as stated hereinabove. This warranty is automatically initiated except where modified by contractual or other written and signed agreement. This warranty is void if the user opens the gauge case.

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