

Manual of Operation and Instruction

Model 2701-B PaveTracker™ Plus



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PN 113045
June 2020
Edition 6.2



SAFETY ALERT SYMBOL



The Safety Alert Symbol shall appear within this manual. Wherever it appears in this manual or on safety signs affixed to the machine, this is to make all aware of the potential for personal injury and to be cautious when these images are present.

Always observe all WARNING, CAUTION, and NOTE recommendations listed within this manual before operating the machine.



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HOW TO USE THIS MANUAL

Congratulations on the purchase of the **Troxler Model 2701-B PaveTracker™ Plus**. Troxler, the leader in density gauge technology, now offers the PaveTracker Plus, an electromagnetic sensing device that quickly gives an indication of the density of asphalt pavement.

The *Model 2701-B Manual of Operation and Instruction* contains information on safely using this gauge. Also included in this manual are safety warnings, gauge setup, troubleshooting, and general maintenance.

CONVENTIONS USED IN THIS MANUAL

Throughout this manual the following symbols and special formatting are used to reveal the purpose of the text.



WARNING

Warnings indicate conditions or procedures that, if not followed correctly, may cause personal injury.

CAUTION

Cautions indicate conditions or procedures that, if not followed correctly, may cause equipment damage.

NOTE

Notes indicate important information that must be read to ensure proper operation.

⟨KEY⟩ This style indicates a key or character to press on the keypad.

**DI SPLAY- Typest yl e an
d shadi ng used t o si m
ul at e t he cont r ol pan
el di spl ay**

1. Indicates a procedure with multiple steps.
- ◆ Indicates a list of things needed (such as equipment) or important points to know.
- ▶ Indicates that more than one option is available. Carefully select the option that applies.

ABOUT THIS MANUAL

The Model 2701-B *Manual of Operation and Instruction* provides detailed information about the PaveTracker Plus gauge. The manual includes product safety information, as well as instructions for the proper installation and use of the PaveTracker Plus.

This manual is organized as follows:

Chapter 1, Introduction – Provides a brief overview of the unit and its features; a list of parts and accessories; and instructions for unpacking and inspection.

Chapter 2, Getting Started – Describes the gauges keypad and provides instructions for setting up, starting, and operating the unit.

Chapter 3, Adjusting Measurements – Provides instructions for using offsets and mix calibration.

Chapter 4, Using the Gauge – Provides instructions for referencing the gauge and using offsets.

Chapter 5, Using the Gauge – Provides instructions for referencing using the Projects function.

Appendix A, Troubleshooting and Service – Provides maintenance and service information, as well as instructions for basic troubleshooting.

Appendix B, Menu Map – Shows a map of the gauge's Setup and Target menus.

Appendix C, Specifications – Contains the mechanical, electrical, and environmental performance specifications.

Appendix D, Global Positioning System (GPS) – Contains information and specifications for the GPS receiver.

EU DECLARATION OF CONFORMITY

Application of Council EMC Directive 89/336/EEC.

NOTE

The Low Voltage Directive 73/23/EEC does not apply to the Model 2701-B PaveTracker Plus gauge because there are no voltages greater than 75 V dc that are accessible by the operator.

Standards to which Conformity is Declared:

EN 55011:1998+A1:1999+A2:2002 – Industrial, Scientific, and Medical (ISM) Radio Frequency Equipment

EN 61326:1997+A1:1998+A2:2001+A3:2002 – Electrical Equipment for Measurement, Control, and Laboratory Use

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Apparatus: Model 2701-B PaveTracker Plus

Year of Declaration: 2006

FCC REGULATIONS

Troxler's Model 2701-B PaveTracker™ Plus has been tested and found to comply with the limits for Industrial, Scientific, and Medical Devices pursuant to Part 18 of Federal Communications Commission (FCC) Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not used in accordance with this instruction manual, may cause harmful interference to radio communications. Operation of the equipment in a residential area may cause harmful interference. It is advised that operation in residential areas be as brief as practicable to minimize the potential for interference.

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WARRANTY

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Chapter 1: Introduction

This chapter covers the following topics and tasks:

- ✓ An introduction to your new PaveTracker Plus
- ✓ Included parts and accessories
- ✓ Inspection and unpacking
- ✓ Assembly and first-time use

Introduction

The Model 2701-B PaveTracker Plus is an electromagnetic sensing device that quickly gives an indication of the density of asphalt pavement.

The advanced technology in the patented PaveTracker Plus allows rapid and reliable measurements. The PaveTracker Plus 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 Plus is a precision device that is designed to provide many years of trouble-free service. As any precision device, the PaveTracker Plus requires reasonable care and maintenance to ensure its accuracy and reliability. The user should:

- ◆ 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 unit. Opening the case will affect the integrity of the unit and therefore will void the warranty.

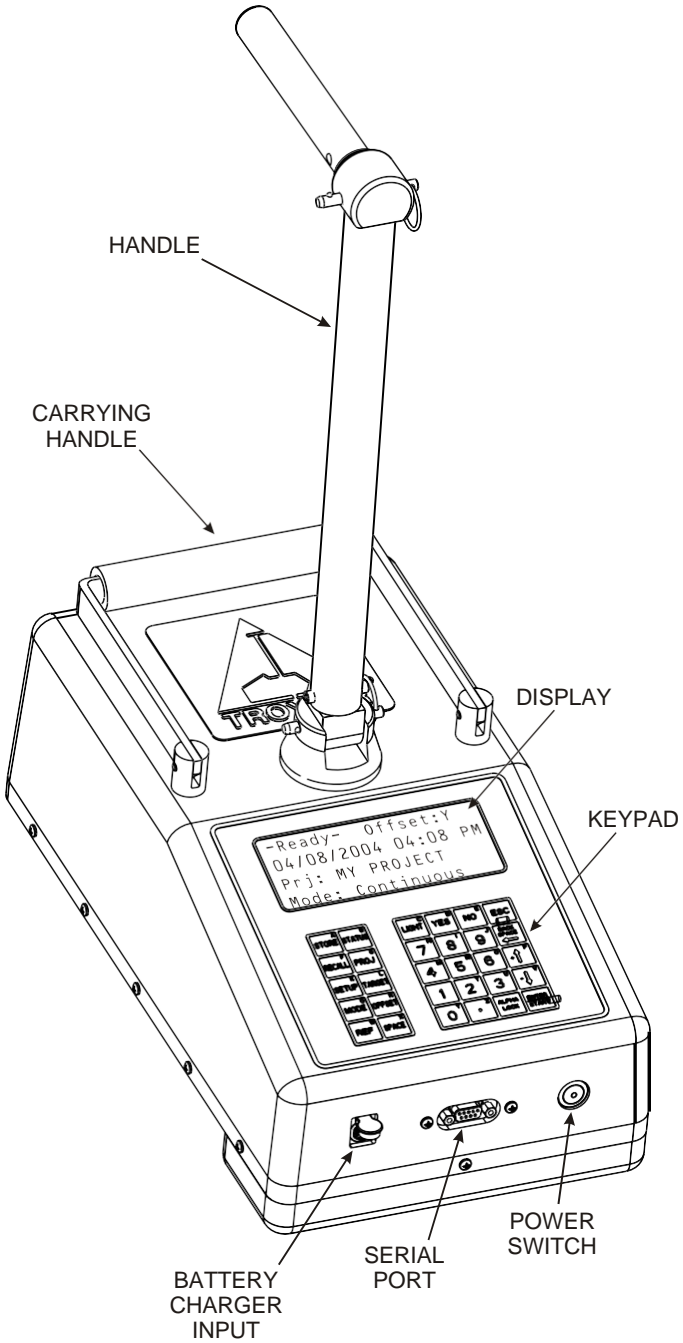


Figure 1-1. Model 2701-B PaveTracker Plus

Features

The PaveTracker Plus (see Figure 1–1) incorporates a number of features that provide unmatched efficiency, usability, and flexibility.

The PaveTracker Plus takes density measurements using *electromagnetic sensing technology*, eliminating the need for government licenses or special training. Measurements are completed within two seconds, saving time and money.

The unit's memory can **store approximately 1000 readings** for later viewing, printing, or downloading.

Both the 30-button **keypad** and 4 x 20 liquid crystal display (LCD) screen are *backlit*, making them easy to see, day or night.

The gauge includes a **replaceable, protective, adhesive-backed bottom cover disc** on its bottom surface. The protective cover provides thermal protection for the gauge's internal components and protects the bottom surface of the gauge against wear.

The **carrying case** for the Model 2701-B includes a built-in **reference standard**, which provides a density measurement standard for referencing the gauge.

The PaveTracker Plus's advanced software provides **three test modes** (*continuous, averaging, and segregation*) for greater flexibility and multiple applications. The software also provides **automatic calculations** (*average density, percent maximum density, percent air voids, and so on*) for greater ease of use.

The PaveTracker allows the operator to specify the **layer thickness**; the value entered is stored with other measurement data.

Measurements can be adjusted using a **density offset** or **mix calibration** (which includes slope and intercept values) to increase accuracy on specific materials.

Both an ac charger and a dc adapter are included with the PaveTracker Plus, enabling the unit to be recharged from an ac outlet or a 12 V dc system.

The gauge features **two audible indicators**, an internally mounted *beeper*, as well as a louder, external one mounted on its underside. The internal beeper emits a short tone in response to a valid keystroke on the keypad. It sounds a longer tone when the operator presses an invalid key or if the gauge displays an error message. The external beeper performs the same functions and can be enabled or disabled as desired by the operator.

A **serial communications port** is mounted on the front of the gauge. The serial port is used to output data to a serial device, such as a computer or printer.

The gauge can be equipped with an optional global positioning system (GPS) receiver. The GPS receiver enables the gauge to store precise GPS coordinates, along with the standard date and time stamp for each measurement.

The gauge features **two handles**. The right-angle handle is used to move and position the gauge while taking measurements. A second *carrying handle* is provided for ease of transporting and positioning the gauge. An optional *telescoping handle* (PN 113017) is also available.

Gauge Parts and Accessories

1. The **gauge** is the portable electromagnetic sensing device containing all electronic modules and a rechargeable battery pack.
2. The **carrying case** for the Model 2701-B includes a built-in **reference standard**, which provides a density measurement standard for taking reference readings.
3. The **ac charger** and **dc adapter** are used to charge the gauge batteries. The ac charger accepts 100 – 240 V ac, 47 – 63 Hz and supplies 12 V dc at 1.8 A. The dc adapter allows recharging from a 12 V dc system, such as a vehicle cigarette lighter.
4. A **printer** (optional) connects to the gauge for printing data.

Unpacking and Inspection

NOTE

To ensure the safe return of the PaveTracker Plus to Troxler for repair or maintenance, please keep the original shipping boxes and all packing materials.

Upon receipt of the gauge from the factory:

1. 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**.
2. Check the shipping case for the following:
 - ◆ Model 2701-B PaveTracker Plus
 - ◆ Carrying Case (PN 113034.1000)
 - ◆ Handle (PN 113210)
 - ◆ AC Charger (PN 110403)
 - ◆ DC Adapter (PN 104156)
 - ◆ 2701-B Cover Kit (PN 113107), containing replacement bottom covers and cleaning wipes
 - ◆ Manual of Operation and Instruction (PN 113045)
3. Lift the gauge from the carrying case and inspect the outside surface for damage

NOTES

Chapter 2:

Getting Started

This chapter covers the following topics and tasks:

- ✓ Getting started with the PaveTracker Plus
- ✓ Using the keypad
- ✓ Turning the gauge on
- ✓ Setting up the gauge
- ✓ Checking the Status of the gauge
- ✓ Using *Target* and *Mode*
- ✓ Using the optional GPS

Keypad

The Model 2701-B keypad (Figure 2–1) allows the operator to access the gauge software. Troxler designed the keypad for ease of use, with large keys and an anti-glare coating. Note that the function keys are available only when the **Ready** screen is displayed. Table 2–1 describes the function of each key.

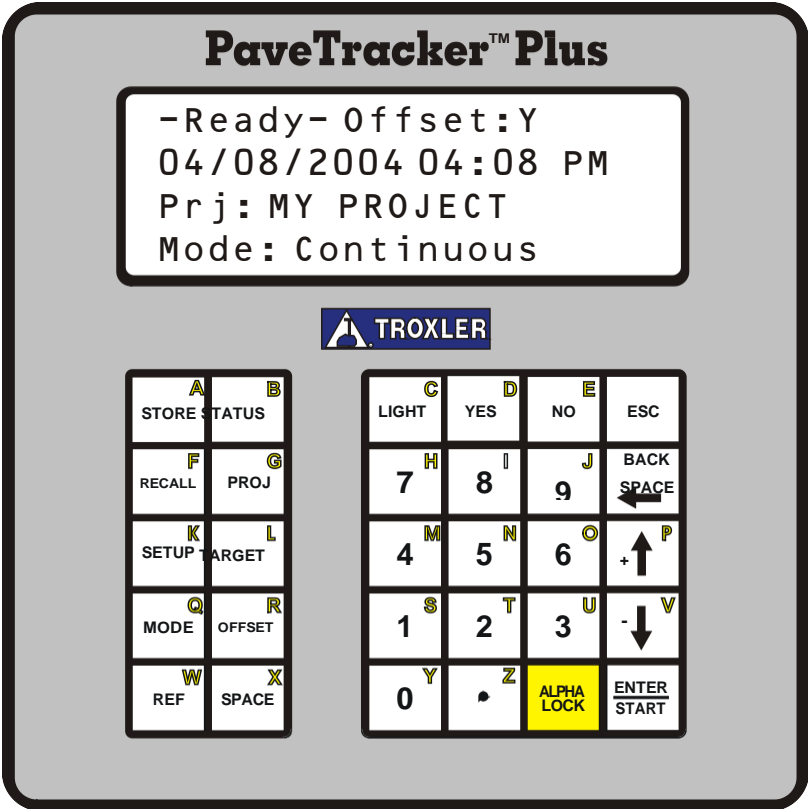


Figure 2–1. Model 2701-B Keypad

Table 2–1. Model 2701-B Keypad Functions

KEY	FUNCTION	PAGE
⟨STORE⟩	Store the most recent data in the current project file.	5-10
⟨STATUS⟩	Displays gauge status information.	2–6
⟨RECALL⟩	Display the most recent data.	4–12
⟨PROJ⟩	Select or create a project file and view, output, or erase project data file.	5-2
⟨SETUP⟩	Displays the gauge Setup menu.	2–7
⟨TARGET⟩	Select, enter, or disable a Gmb (Marshall) or Gmm (Voidless density) value.	2–15
⟨MODE⟩	Select the measurement mode, <i>Averaging</i> , <i>Continuous</i> , or <i>Segregation</i> .	2–18
⟨OFFSET⟩	Enable, disable, or change a density offset.	3–3
⟨REF⟩	Take a reference reading.	4–2
⟨SPACE⟩	Enter a space.	
⟨LIGHT⟩	Manually toggle the keypad and LCD backlights on and off.	2–5
⟨YES⟩	Respond <i>yes</i> to <i>yes/no</i> questions.	
⟨NO⟩	Respond <i>no</i> to <i>yes/no</i> questions.	
⟨ESC⟩	Return the display to the Ready screen without storing or updating the data.	
⟨0⟩ .. ⟨9⟩	Enter numbers and access menu options.	
⟨.⟩	Enter a decimal point.	
⟨ALPHA LOCK⟩	Access the letters.	
⟨BACK SPACE⟩	Moves cursor back one space.	
⟨↑⟩, ⟨↓⟩	Scroll through menu options or view screens.	
⟨ENTER/START⟩	Accept data entry or begin a measurement.	
⟨A⟩ .. ⟨Z⟩	Enter letters. Access these keys by first pressing ⟨ALPHA LOCK⟩.	

Turning the PaveTracker Plus On

To turn on the PaveTracker Plus, press the power switch located on the front panel next to the serial port (see Figure 1–1).

NOTE


To turn off the PaveTracker Plus, press *and hold* the power switch for two seconds.

The gauge displays the model number, battery voltage, software version, and unit serial number as shown below:


```
- Model 2701B-  
Battery Volts: X. X  
V#. ## SN: ###  
Press <ENTER>
```

Press the **<ENTER/START>** key to continue. The software performs two tests to ensure that the gauge is working properly. The gauge first performs a brief self-test, followed by a test of the display.

Following the test period, the gauge displays the **Ready** screen:

```
- Ready- Off set : YES   
mm/dd/ yyyy hh: mmAM  
Pr j : PROJECT NAME  
Mode: Continuous
```

The operator can access any gauge function from the **Ready** screen. On the first line, the **Ready** screen displays whether a density offset (see page 3–3) or mix calibration (see page 3–6) is enabled.

When the GPS option is installed, enabled, and receiving satellite signals, the symbol  appears in the upper-right of the display, as shown above.

The second line shows the current date and time. The third line shows the current project (see page 5-2), if any. The last line shows the measurement mode (see page 2-18).

The PaveTracker Plus features a backlit keypad and display. To toggle the backlights on and off, press the **<LIGHT>** key.

NOTE

The keypad and display backlights increase the power consumption of the unit. To conserve battery life, Troxler recommends that the backlights be used only when necessary.

To conserve power, the PaveTracker Plus provides a *sleep* mode, as well as an automatic shutdown. If no key is pressed for five minutes, the gauge enters *sleep* mode. In *sleep* mode, the display and keypad backlights, and most of the electronics are turned off, but all data and gauge settings are protected. To exit *sleep* mode, press any key. If no key is pressed for 60 minutes, the gauge shuts down automatically.

NOTE

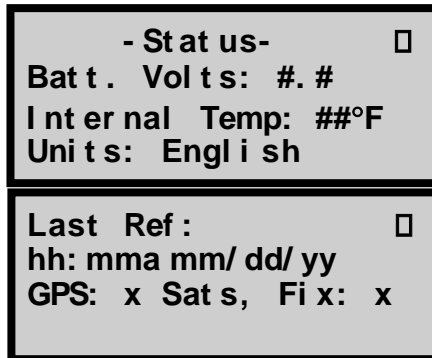
If the gauge goes into *sleep* mode while in the *continuous* measurement mode (see page 2-18), the display returns to the Ready screen. In *averaging* or *segregation* mode, the gauge maintains its current state when it enters *sleep* mode.

The gauge software monitors the battery voltage. If the voltage falls below 6.0 V dc, the gauge displays a low battery symbol (☐) in the upper right of the **Ready** screen. Recharge the batteries as described on page A-5. After charging, the battery voltage should be between 6.8 and 7.2 V dc. If the voltage falls below 5.5 V dc, the gauge powers down automatically after completing any memory store functions already in progress.

Status

The gauge **Status** display enables the operator to view gauge status information, including the battery voltage, internal temperature, selected measurement units (see page 2–8), the time and date of the last reference reading (see page 4–2), and GPS satellite and fix status.

To access this information, press the **(STATUS)** key. The gauge displays:



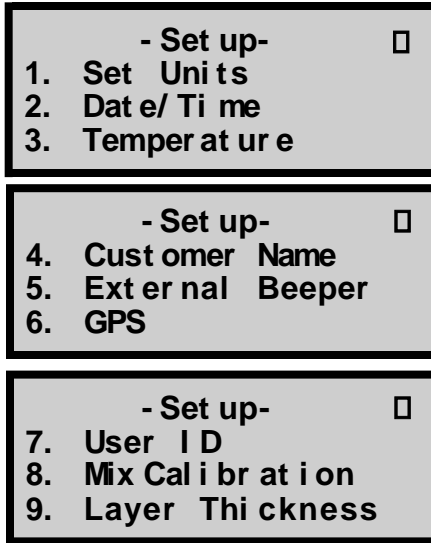
To scroll through the displays, use the up and down arrow keys. Return to the Ready screen by pressing the **(ESC)** key.

Setup Menu

After turning the gauge on for the first time, set up the software. The gauge stores the software setup, so the operator does not need to enter a new setup each time the gauge is turned on.

The gauge *setup* includes the measurement units (*Metric* or *English*), date and time, temperature, customer name, external beeper setup, GPS, user ID, mix calibration, and the layer thickness function.

To access the **Setup** menu, press the **<SETUP>** key. The gauge displays:

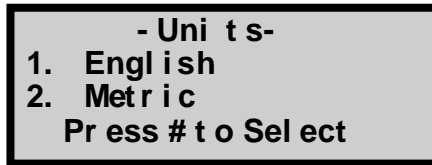


To scroll through the **Setup** menu, use the arrow keys (screens that have options the operator can scroll through are indicated with the up/down arrow symbol in the upper right corner of the screen). To select a menu option, use the numeric key that corresponds to the option. To return to the **Ready** screen, press the **<ESC>** key.

The remainder of this section provides details on the setup options.

Set Units

The gauge can display measurement results in either metric (SI) or English units. To set the units, press **<1>** at the **Setup** menu shown on page 2–7. The gauge displays:



Select the desired measurement units by pressing the corresponding numeric key. The gauge displays the new units, and then returns to the **Setup** menu.

Date/Time


The *Date/Time* function allows you to change the date and time, and to select the display format for each. To access the **Date/Time** menu, press **<2>** at the **Setup** menu shown on page 2–7. The gauge displays the **Date/Time** menu:



From this screen, the operator may change the time, date, or time/date display format. Use the up and down arrows to scroll between the menu options. To select a menu option, press the corresponding numeric key. To return to the **Setup** menu, press the **<ESC>** key.

Change Time

To change the time, press **<1>** at the **Date/Time** menu. The gauge displays:




hh: mm AM
Arrows toggle AM/PM
Input Time and
Press <ENTER>

(Note that in this example, the time is displayed in *AM/PM* format. To change the format, see the *Time Format* section on page 2–10.)

- ▶ To accept the displayed time, press **<ENTER/START>**.
- ▶ To change the time, use the numeric keys to enter the new time, and the arrow keys to toggle between *AM* and *PM*. Press **<ENTER/START>**. The gauge sets the time and returns to the **Date/Time** menu.

Change Date

To change the date, press **<2>** at the **Date/Time** menu. The gauge displays:



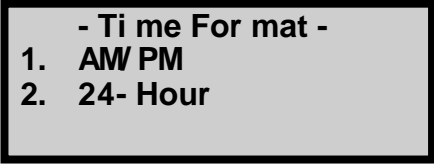
04/ 08/ 2004
mm/dd/yyyy
Input Date and
Press <ENTER>

(Note that in this example, the time is displayed in *mm/dd/yyyy* format. To change the date format, refer to the *Date Format* section on page 2–10.)

- ▶ To accept the displayed date, press **<ENTER/START>**.
- ▶ To change the date, use the numeric keys to enter the new date. When finished, press **<ENTER/START>**. The gauge sets the date and returns to the **Date/Time** menu.

Time Format

The gauge can display the time in either *AM/PM* or *24-hour* format. To select the desired time format, press **(3)** at the **Date/Time** menu. The gauge displays:

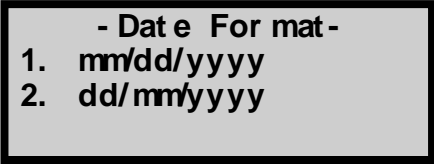


- Time Format -
1. AM/PM
2. 24-Hour

Use the numeric keys to select the desired time format. The gauge sets the time format and returns to the **Date/Time** menu.

Date Format

The gauge can display the date in either *mm/dd/yyyy* or *dd/mm/yyyy* format, where *mm* = month, *dd* = day, and *yyyy* = year. To select the desired date format, press **(4)** at the **Date/Time** menu. The gauge displays:



- Date Format -
1. mm/dd/yyyy
2. dd/mm/yyyy

Use the numeric keys to select the desired format. The gauge sets the date format and returns to the **Date/Time** menu.

Temperature Option

An infrared sensor that measures the temperature of the mat is available as an option for the gauge. If this option is installed, press **<3>** at the **Setup** menu shown on page 2–7 to display the temperature reading. Press the **<ESC>** key to return to the **Setup** menu.

Customer Name

The Model 2701-B can store a customer name of up to 12 characters. To enter a customer name, press **<4>** at the **Setup** menu shown on page 2–7. The gauge displays the current customer name on the second line.

Cust omer Name i s:
CUSTOMER
Change Name?
<YES> or <NO>

To change the customer name, press **<YES>**. The gauge displays:

Cust omer Name: **A**
Input Name and
Press <ENTER>

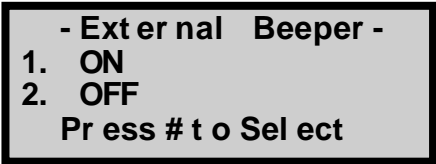
Press the **<ALPHA LOCK>** key to enable the alphabetic keys on the keypad. When the alphabetic keys are enabled, the symbol **A** appears in the upper-right of the display, as shown above.

Enter the new name and press the **<ENTER/START>** key. The gauge stores the new customer name, and then returns to the **Setup** menu.

External Beeper

The PaveTracker Plus is equipped with an external beeper mounted on its underside. The external beeper can be enabled or disabled as desired. To control the external beeper, press <5> from the **Setup** menu shown on page 2–7.

The gauge displays:

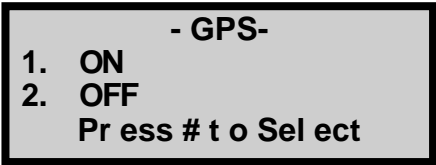


Press <1> to enable the external beeper or <2> to disable it. The gauge sets the external beeper function to the desired state, displays a brief confirmation message, and returns to the **Setup** menu.

GPS Option

The PaveTracker Plus can be equipped with an optional GPS receiver, which enables the gauge to store each measurement with precise coordinates and a standard date and time stamp.

To toggle the GPS function on or off, press <6> from the **Setup** menu shown on page 2–7. The gauge displays:



Press <1> to enable the GPS or <2> to disable it. The gauge sets the GPS function to the desired state, displays a brief confirmation message, and returns to the **Setup** menu.

User ID

The PaveTracker Plus stores a three-character *user ID* with each measurement. To enter or change the user ID, press **<7>** from the **Setup** menu shown on page 2–7. The gauge displays:

A rectangular display box with a black border containing the text: "User ID", "XXX", "Do You Want To", "Change User ID?".

User ID
XXX
Do You Want To
Change User ID?

To change the user ID, press **<YES>**. The gauge displays:

A rectangular display box with a black border containing the text: "Input User ID A", "<ALPHA> for Letters", "Press <ENTER>".

Input User ID A
<ALPHA> for Letters
Press <ENTER>

Press the **<ALPHA LOCK>** key to enable the alphabetic keys on the gauge. When the alphabetic keys are enabled, the symbol **A** appears in the upper right of the display, as shown above.

Enter the new user ID and press **<ENTER/START>**. The gauge stores the new user ID and returns to the **Setup** menu.

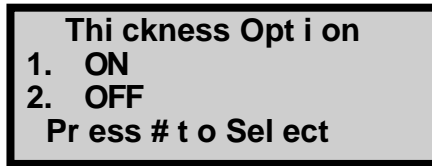
Mix Calibration

The *Mix Calibration* function is used to adjust gauge measurements, as described on page 3–7.

Layer Thickness

The *Layer Thickness* function enables the operator to enter the thickness of the material being measured. When this function is enabled, the gauge prompts the operator to enter a thickness value when creating a new *project* as described on page 5-3. The layer thickness value is then stored along with other measurement data in the active project.

To enable or disable the *Layer Thickness* function, press **<9>** from the **Setup** menu shown on page 2-7. The gauge displays:



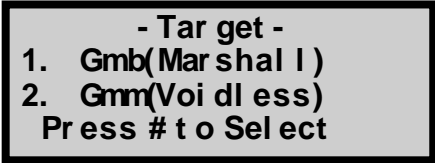
Press **<1>** to enable the *Layer Thickness* function or **<2>** to disable it. The gauge sets the function to the desired state, displays a brief confirmation message, and returns to the **Setup** menu.

Target

The Model 2701-B can store up to four *Gmb* (Marshall) and four *Gmm* (Voidless density) target values. A *Gmb* value is the bulk density of a material, often determined using the Marshall method. A *Gmm* value is the maximum theoretical density for a test material as obtained in laboratory tests.


The gauge uses target values to determine the percent compaction and/or percent voids (if a *Gmm* value is entered) as compared to the measured density of the test material.

With the *Target* function, the operator can enter a new target value, enable a stored target value, or disable a target value. To access the *Target* function, press the **<TARGET>** key. The gauge displays the **Target** menu:



- Tar get -
1. Gmb(Marshal l)
2. Gmm(Voi dl ess)
Pr ess # t o Sel ect

To enter, enable, or disable a value, press the corresponding numeric key. For example, to edit the *Gmb* (Marshall) value, press **<1>**. The gauge displays the menu shown below. The **Gmm(Void) Value**: menu is similar and operates the same.



Gmb(MA) Val ue:
1. #. # 2. #. #
3. #. # 4. #. #
5. New 6. Disabl e

The target value menu shows the four stored target values (if any) and the *New* and *Disable* options.

Enable or Disable a Target Value

To enable a displayed target value, press the corresponding numeric key on the target value menu. The gauge enables the target value and returns to the **Ready** screen.

Enter a New Target Value

To enter a new target value, press **<5>** at the target value menu. The gauge displays:

Gmb(Marshall) Value:
0.0 pcf
Press <ENTER>

Use the numeric and decimal keys to enter the target value. Press the **<ENTER/START>** key. The gauge displays:

Gmb(MA) = ##.#
Do You Want to
Save This Value
for Later Use?

- ▶ To store the value, press the **<YES>** key.
- ▶ To use the value now without storing it for later use, press the **<NO>** key.

If **<YES>** is pressed, the target value, the gauge displays:

Select Memory Cell
1. #.# 2. #.#
3. #.# 4. #.#
Press # To Select

The gauge can store the target value in one of four *memory cells*. Use the numeric keys to store the target value. Note that this will replace any target value that was previously stored. The gauge enables the target value, displays a brief confirmation message and returns to the **Ready** screen.

Disable a Target Value

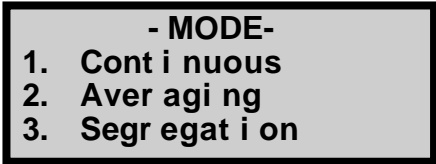
To disable the current target value, press **(6)** at the target value menu. The gauge disables the target value, displays a brief confirmation message, and returns to the **Ready** screen.

Mode

The Model 2701-B provides three measurement modes:

- ◆ In *continuous* mode, the gauge takes a measurement and updates the display every second. This mode is used for typical quality control measurements.
- ◆ In *averaging* mode, the operator can take up to 30 measurements at selected locations. The gauge then calculates the average of the measurements. This mode enables the operator to determine the average density over a selected area. The *Store* function (see page 5-13) records the most recent results screen when in this mode.
- ◆ In *segregation* mode, the operator can take up to 30 measurements at selected locations. The gauge then displays the high, low, and average density of the readings. This mode enables the operator to determine the degree of segregation in the area being measured. The *Store* function (see page 5-13) records the most recent results screen when in this mode.

Before taking a measurement, select the appropriate measurement mode. To select a measurement mode, press the **<MODE>** key. The gauge displays:



Press the numeric key that corresponds to the desired measurement mode. The gauge enables the selected mode, displays a brief confirmation message, and returns to the **Ready** display.

Chapter 3:

Adjusting Measurements

This chapter covers the following topics and tasks:

- ✓ Adjust gauge measurements using offsets
- ✓ Using mix calibration (slope and intercept)

Introduction

Troxler recommends referencing the gauge each day that the gauge is in use and periodically while taking measurements.

The reference reading consists of placing the gauge on the reference standard contained in the gauge carrying case and pressing the **⟨Ref⟩** key.

The density read by the gauge is then compared to the known density of the reference standard. The result of this comparison is used to automatically adjust gauge measurements.

For increased accuracy, measurements can be adjusted using *density offset* and *mix calibration* values described in the following sections.

To determine the density offset, take a gauge reading and compare the measured value to an *alternative density value*, as measured by another method (such as using a nuclear gauge or extraction and analysis of a road core).

For a given material, the slope and intercept values can also be determined using the *Mix Calibration* function (see page 3–6).

Offset

To improve the accuracy of the PaveTracker Plus for a specific material of known density, the unit can be calibrated using a density offset. A density offset is determined by taking in-place measurements using the PaveTracker Plus, then comparing the *measured density* to an *alternative density*, as determined using a nuclear gauge reading or road core extraction and analysis.

Determining the Density Offset

To determine the density offset for a given material:

1. Take a reference reading using the PaveTracker Plus as described on page 4–2.

NOTE

Before using the PaveTracker Plus, inspect the protective cover of the bottom surface of the gauge's sensor. Ensure that the cover is in good condition, and has no deep scratches or buildup of material. If necessary, replace the cover as described on page A–8.

2. Measure the in-place density of the material using the PaveTracker Plus to find the *measured density*. Mark the test site so that nuclear gauge readings or core extraction can be conducted in the same location. If the core has already been removed, take the measurement as close as possible to the core location.

NOTE

When taking PaveTracker Plus measurement *on* a core site, be sure to take measurements *before* the core is cut, as the water used during the core cutting process may affect PaveTracker Plus measurements.

3. Determine the *alternative density* of the material using a nuclear gauge reading or road core extraction and analysis. Be sure to conduct the gauge measurements or core extraction in the same location as the PaveTracker Plus reading.
4. Subtract the measured density from the alternative density to determine the density offset to be entered into the PaveTracker Plus software. For example, if the density as determined by a core analysis is *150 pcf*, and the density measured by PaveTracker Plus is *146 pcf*, the density offset is *+4 pcf*.

NOTE

For best results, repeat the above procedure to determine the density offset at each of several in-place locations. Then calculate the *average* density offset.

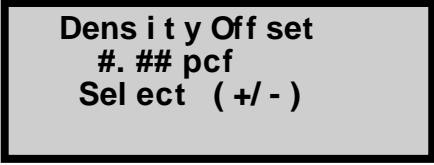
Managing Density Offsets

Density offsets are managed using the **Density Offset** menu. To access this menu, press **<OFFSET>**. The gauge displays:

```
Dens i t y Off set
# . ## pcf
1- Enabl e    2- Disabl e
3- Change Off set
```

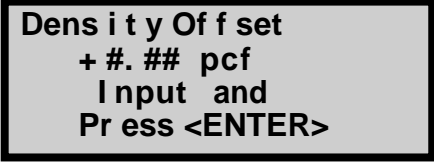
The gauge displays the current density offset on the second line. To enable the offset, press **<1>**. To disable the offset, press **<2>**.

To enter a new density offset, press **<3>**. The gauge prompts for the density offset as shown below:



Dens i t y O f f s e t
#. ## p c f
S e l e c t (+ / -)

To change the offset, use the arrow keys to select the offset sign (positive or negative). The gauge displays:



Dens i t y O f f s e t
+ #. ## p c f
I n p u t a n d
P r e s s <ENTER>

Enter the density offset as determined from the procedure on page 3–3 and press **<ENTER/START>**. The gauge enables the new offset and returns to the **Ready** screen.

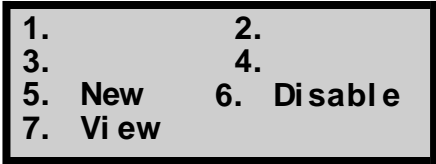
Mix Calibration

As noted earlier, the PaveTracker Plus can be calibrated for a specific mix using the *Mix Calibration* function. To use this function, the operator takes gauge measurements at three to ten locations across the material. The gauge compares these values to values obtained by core analysis or another method to determine a *slope* and *intercept* for that particular material. The gauge can store up to four mix calibrations.

NOTE

In order for the gauge to calculate both a slope and an intercept for the test material, measurements must be performed at a minimum of three locations. Also, the difference between the minimum and maximum reading must be at least 3 pcf. For best results, Troxler recommends taking measurements at seven to ten locations.

To access the *Mix Calibration* function, press **<8>** on the **Setup** menu shown on page 2–7. The gauge displays:



Selections **1** through **4** show the mix calibrations that have been stored previously. Use the numeric keys to enable an existing mix calibration, create a new calibration, disable an active calibration, or view a calibration.

Enable a Mix Calibration

To enable a displayed mix calibration, press the corresponding numeric key. The gauge enables the mix calibration and returns to the **Setup** menu.

New Mix Calibration

To determine a new mix calibration or to manually enter the slope and intercept values, press **<5>** on the menu shown on page 3–6. The gauge displays:

```
- Ent r y Method-  
1. Dat a Pai r s  
2. Slope/ I nt er cept
```

To determine a new mix calibration based on gauge measurements and values determined by an alternate method, press **<1>** to access the *Data Pairs* function. To enter slope and intercept values manually, press **<2>** to access the *Slope/Intercept* function. These functions are described in the following sections.

Data Pairs

To determine a new mix calibration based on gauge measurements and values determined by an alternate method, press **<1>** at the **Entry Method** menu shown above. The gauge displays:

```
Input Reading #: 1  
  0.0 pcf  
  
Press <ENTER>
```

Using the numeric and decimal keys, enter the *measured density* (the density as measured by the gauge) at the first test location. Press the **<ENTER/START>** key. The gauge displays:

I n p u t C o r e V a l u e 1 :
0. 0 p c f
P r e s s <ENTER>

Enter the *actual density* (the density as determined from an alternate method) and press the **<ENTER/START>** key. The gauge displays:

<STORE> f o r N e x t
<ENTER> t o C a l c u l a t e

Press the **<STORE>** key to store the values and to enter those for the next location. When the measured and actual densities for each location have been entered, press the **<ENTER/START>** key to calculate the mix calibration. The gauge displays:

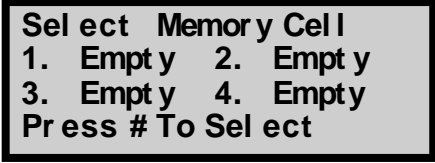
S l o p e = #. ##
I n t e r c e p t = ###. #
D o y o u w a n t t o
a c c e p t t h i s m i x ?

- ▶ To return to the **Setup** menu without saving the mix calibration, press the **<NO>** key.
- ▶ To save the mix calibration, press the **<YES>** key. The gauge requests a mix calibration ID as shown:

M i x C a l i b . I D
<ALPHA> f o r L e t t e r s
P r e s s <ENTER>

Press the **<ALPHA LOCK>** key to enable the alphabetic keys on the gauge. When the alphabetic keys are enabled, the symbol **A** appears in the upper right of the display, as shown above.

Enter a unique mix calibration ID and press **<ENTER/START>**. The gauge displays:



Select Memory Cell
1. Empty 2. Empty
3. Empty 4. Empty
Press # To Select

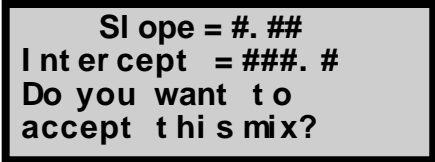
The gauge can store the mix calibration in one of four *memory cells*. Use the numeric keys to store the mix calibration. Note that this will replace any mix calibration that was previously stored in that cell.

The gauge enables the mix calibration, displays a brief confirmation message, and returns to the **Setup** menu.

Slope/Intercept

The *Slope/Intercept* function is used to manually enter the slope and/or intercept for a particular material. These values can be determined using the *Data Pairs* function described on page 3–7, or can be calculated manually.

To access the *Slope/Intercept* function, press **<2>** on the **Entry Method** menu shown on page 3–7. The gauge prompts for the slope and intercept values. Press **<ENTER/START>** after each value is entered. After both values have been entered, the gauge displays:



Slope = #. ##
Intercept = ###. #
Do you want to
accept this mix?

- ▶ To return to the **Setup** menu without saving the mix calibration, press the **<NO>** key.
- ▶ To save the mix calibration, press the **<YES>** key. The gauge requests a mix calibration ID as shown:

M i x C a l i b . I D
<ALPHA> f o r L e t t e r s
P r e s s <ENTER>

Press the **<ALPHA LOCK>** key to enable the alphabetic keys on the gauge. When the alphabetic keys are enabled, the symbol **A** appears in the upper right of the display, as shown above.

Enter a unique mix calibration ID and press **<ENTER/START>**. The gauge displays:

S e l e c t M e m o r y C e l l
1. E m p t y 2. E m p t y
3. E m p t y 4. E m p t y
P r e s s # T o S e l e c t

The gauge can store the mix calibration in one of four *memory cells*. Use the numeric keys to store the mix calibration. Note that this will replace any mix calibration that was previously stored in that cell.

The gauge enables the mix calibration, displays a brief confirmation message, and returns to the **Setup** menu.

Disable the Mix Calibration

To disable the current mix calibration, press **<6>** at the mix calibration menu. The gauge disables the mix calibration, displays a brief confirmation message, and returns to the **Setup** menu.

Chapter 4:

Using the Gauge

This chapter covers the following topics and tasks:

- ✓ Referencing the gauge
- ✓ Preparing measurement sites
- ✓ Setting measurement mode
- ✓ Taking measurements

Referencing the Gauge

To ensure the accuracy of gauge measurements, Troxler recommends referencing the gauge each time it is powered on and periodically while taking measurements.

Referencing the gauge consists of placing the gauge on material of known density located inside the case. The gauge then compares the reference check to a prior known value and uses the result of that comparison to adjust future gauge readings.

NOTE

A reference standard, built into the carrying case, is provided. Always reference the gauge using the reference standard provided with your unit. Each reference standard is unique; do not interchange gauges and cases.

1. Turn the gauge on as described on page 2–4. At the **Ready** screen, press the **<REF>** key. The gauge displays:

**Place Gauge on
Reference Standard
(Carrying Case)
Press <START>**

2. Place the gauge on the reference standard inside the carrying case. Ensure that the circular sensor on the bottom of the gauge is centered between the four locating pins inside the case, and that the sensor rests flat against the surface.
3. Press the **<ENTER/START>** key to begin referencing. Upon completion, the gauge displays:

**Reference Reading
Complete
Press <ENTER>**

4. Press the **⟨ENTER/START⟩** key to continue. The gauge stores the result of the reference and returns to the **Ready** screen. The result is then used to adjust all gauge readings.

NOTE

If the reference result is out of range and the gauge displays an error message, check the following:

- ✓ Ensure that the circular sensor cover is firmly in place on the gauge sensor (press firmly around the perimeter of the cover).
- ✓ Ensure that the cover and reference standard are totally clean and free of any asphalt residue, moisture, or debris. Clean with WD-40 or other suitable means.
- ✓ Ensure that the sensor cover is seated flat and flush on the reference standard, within the four locating pins, with the gauge in the case.
- ✓ Repeat the referencing process. If the reference result still does not pass, contact Troxler technical support (see the front of this manual for a list of service centers and their contact information).

Preparing a Test Site

To ensure measurement accuracy, properly prepare the test site before taking gauge measurements.

1. Locate a smooth site on the asphalt.
2. To ensure accurate readings, the gauge sensor must be completely in contact with the test material. If the gauge rocks, then find a more suitable test site. If taking a measurement around a core, the gauge may be moved a few inches away from the core to level it.

Taking Measurements

The *Status* feature (see page 2–6) allows the operator to view the current gauge status. This feature provides a quick overview of the battery voltage, sensor temperature, selected measurement units, the date and time of the last reference reading, and GPS status. If necessary, check the gauge's status before taking measurements.

NOTE


To ensure the accuracy of gauge measurements, take a reference reading each day the gauge is to be used (see page 4–2) and periodically while taking measurements.

As described on page 2–18, the PaveTracker Plus provides three measurement modes: *continuous*, *averaging*, and *segregation*. Before taking a measurement, select the appropriate measurement mode.

CAUTION

High internal temperatures may damage the gauge's electronic components. To reduce the risk of damage, DO NOT allow the gauge to sit on hot asphalt for extended periods.

If the internal temperature of the gauge reaches a level that is considered excessive, the beeper will sound and the warning message **Internal temp. high** will show on the display.

Allow the gauge to cool will be displayed. The gauge should be taken to a shady or air-conditioned environment and allowed to cool before continuing. If measurements are performed before the gauge is allowed to cool, the warning symbol  is displayed.

CAUTION

The gauge includes a replaceable protective cover that protects the bottom surface of the gauge's sensor assembly against wear and provides thermal protection for the gauge's internal components. To prevent damage to the gauge, DO NOT operate the gauge without the protective cover.

NOTE

Before using the gauge, inspect the protective cover of the bottom surface of the gauge's sensor. Ensure that the cover is in good condition, and has no deep scratches or buildup of material. If necessary, replace the cover as described on page A-8.

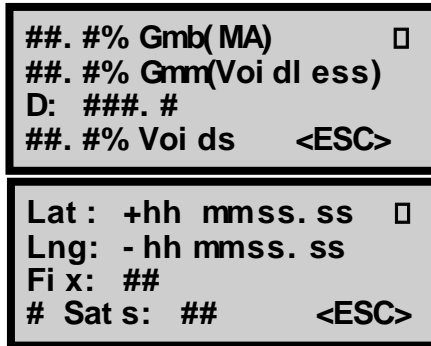
Continuous Mode

In *continuous* mode, the gauge takes a measurement and updates the display every second. This mode is used for typical quality control measurements.

Extend the telescoping handle (see Figure 1–1) to reduce the bending required while taking measurements.

1. To take a measurement in *continuous* mode, select the mode as described on page 2–18. Place the gauge on the test site and press **<ENTER/START>**.

The gauge displays the measurement results, updated every second, as shown:



2. Press **<ESC>** to return to the **Ready** screen.

For more information on storing measured data, see the *Storing Data* section on page 5-10.

NOTE

If the *Temperature* option (see page 2–11) is installed, the mat temperature is also shown in the upper right corner of the display.

NOTE

The latitude and longitude display, showing the location of the measurement, is available only on the PaveTracker Plus gauges equipped with the GPS option and is shown only when this option is enabled.

The latitude and longitude value denote the quality of the location fix. If WAAS information is available during a measurement, the latitude and longitude will be displayed to the nearest hundredth (1/100) of a second.

If a GPS location is determined, but the WAAS information is unavailable, the latitude and longitude will be displayed to the nearest tenth (1/10) of a second.

If the GPS receiver cannot determine a location, the latitude and longitude will be denoted as O. For more information on GPS accuracy, see Appendix D.

NOTE

If the gauge goes into *sleep* mode, the display returns to the *Ready* screen. To exit *sleep* mode and continue taking measurements, press the **⟨ENTER/START⟩** key.

Averaging Mode

In *averaging* mode, you can take up to 30 measurements at selected locations. The gauge will calculate the average of these measurements, allowing you to determine the average density over a larger area.

1. Extend the telescoping handle (see Figure 1–1) to reduce the bending required while taking measurements.
2. To take a measurement in averaging mode, select the mode as described on page 2–18.
3. Press the **<ENTER/START>** key. The gauge displays:

```
Averaging Mode
Reading #: 1
Press <START>
<STORE>/ <ESC> to End
```

4. Place the gauge on the first test site and press **<ENTER/START>**. The gauge takes a measurement, then displays the results:

```
##. #% Gmb(MA) □
##. #% Gmm(Voidless)
Avg of 1: ###. #
#. #% Voids <ENTER>
```

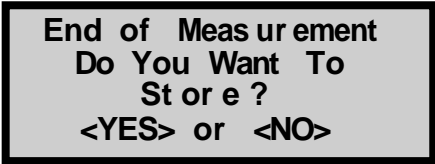
```
Lat: +hh mmss. ss □
Lng: -hh mmss. ss
Fix: ##
# Sat s: ## <ESC>
```

NOTE

If the *Temperature* option (see page 2–11) is installed, the mat temperature is also shown in the upper right corner of the display.

5. Press **<ENTER/START>** to continue. Repeat the steps above to take a measurement at up to 30 test locations. When all locations are complete, press the **<STORE>** or **<ESC>** key to continue.

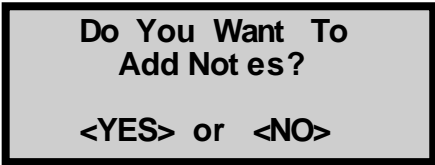
If the **<ESC>** key is pressed, the gauge displays:



End of Measurement
Do You Want To
Store?
<YES> or <NO>

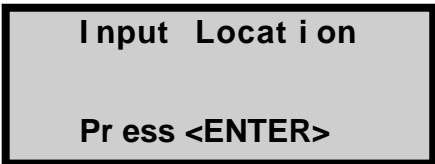
Press **<NO>** to return to the Ready screen without storing the results or **<YES>** to continue as described below.

If the **<STORE>** key is pressed at the end of the measurements (or if the operator presses **<ESC>** then **<YES>**), the gauge displays:



Do You Want To
Add Notes?
<YES> or <NO>

When storing test results, the gauge can also store project notes, such as location information, with the measurement data. To include project notes, press **<YES>**. The gauge displays:



Input Location
Press <ENTER>

Enter any desired information (up to eight characters) and press **<ENTER/START>**. The gauge stores the *last displayed* results and notes under the active project and returns to the **Ready** screen. For more information on storing measured data, see the *Storing Data* section on page 5-10.

NOTE

The gauge stores only the data shown in the *last display*. It does not store the results of each individual reading.

Segregation Mode

In *segregation* mode, the operator can take up to 30 measurements at selected locations. The gauge then displays the high, low, and average density of the readings. This mode enables the operator to determine if there is a large degree of segregation in the area being measured.

1. Extend the telescoping handle (see Figure 1–1) to reduce the bending required while taking measurements.
2. To take a measurement in *segregation* mode, select the mode as described on page 2–18.
3. Press the **<ENTER/START>** key. The gauge displays:

```
Segregation Mode
Reading #: 1
Press <START>
<STORE>/ <ESC> to End
```

4. Place the gauge on the first test site and press **<ENTER/START>**. The gauge takes a measurement, then displays the results:

```
Avg D: ##. #
Hi D: ##. #
Low D: ##. #
Den: ##. # <ENTER>
```

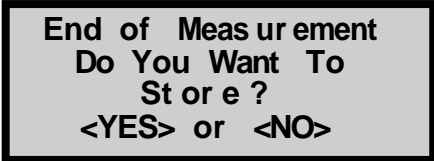
```
Lat : +hh mmss. ss □
Lng: - hh mmss. ss
Fix: ##
# Sat s: ## <ESC>
```

NOTE

If the *Temperature* option (see page 2–11) is installed, the mat temperature is also shown in the upper right corner of the display.

5. Press **<ENTER/START>** to continue. Repeat the previous steps to take a measurement at up to 30 test locations. When all locations are complete, press the **<STORE>** or **<ESC>** key to continue.

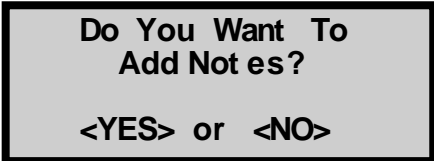
If the **<ESC>** key is pressed, the gauge displays:



End of Measurement
Do You Want To
Store?
<YES> or <NO>

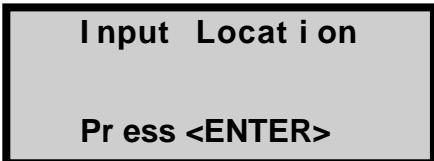
6. Press **<NO>** to return to the **Ready** screen without storing the results or **<YES>** to continue as described below.

If the **<STORE>** key is pressed at the end of the measurements (or if the operator presses **<ESC>** then **<YES>**), the gauge displays:



Do You Want To
Add Notes?
<YES> or <NO>

When storing test results, the gauge can also store project notes, such as location information, with the measurement data. To include project notes, press **<YES>**. The gauge displays:



Input Location
Press <ENTER>

Enter any desired information (up to eight characters) and press **(ENTER/START)**. The gauge stores the *last displayed* results and notes under the active project and returns to the **Ready** screen. For more information on storing measured data, see the *Storing Data* section on page 5-10.

NOTE

The gauge stores only the data shown in the *last display*. It does not store the results of each individual reading.

Checking the Gauge during Use

To verify that the gauge is reading properly during use, perform the following check:

1. Ensure that the gauge is turned on and in the correct measurement mode.
2. Turn off (disable) all operator-installed density offsets and mix calibrations. See Chapter 3 for more information.
3. Place the gauge on the reference standard and verify that it reads within ± 0.5 pcf (± 8 kg/m³) of the actual density value printed on the gray label located inside the case lid. If the reading is outside these limits, take a reference reading as described above to adjust the gauge.

Note that each reference standard is unique to that individual gauge. Use care to not intermix different gauges and cases.

Recall

To view the results of the most recent measurement, press the **(RECALL)** key from the **Ready** screen. The gauge displays the results of the most recent measurement. To return to the **Ready** screen, press the **(ENTER/START)** key.

Chapter 5:

Project Data

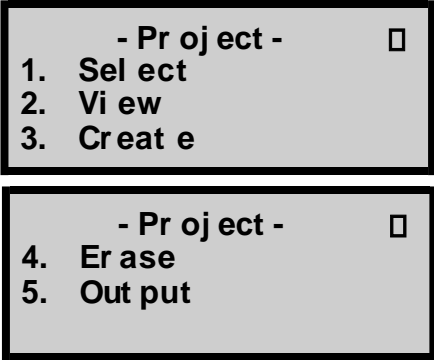
This chapter covers the following topics and tasks:

- ✓ Using the *Projects* function
- ✓ Storing data

Handling Project Data

The Model 2701-B can store approximately 1000 readings. The *Project* and *Store* functions allow handling of measurement data. Measurement results are stored in files (memory locations) called *projects*, which are named by the operator. The *Project* function allows the operator to create a new project, view project data, select a project (make an existing project active so that additional data may be added to it), output the data stored in the project, or erase projects. The *Store* function allows the operator to store measurement results and other test-identifying information in a selected project. Refer to page 5-10 for information on the *Store* function.

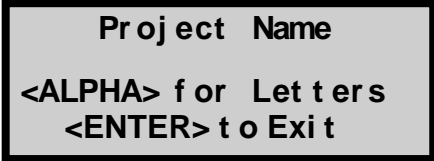
To access the *Project* function, press the **⟨PROJ⟩** key. The gauge displays the **Project** menu:



Use the arrow keys to scroll through the menu options. Use the numeric keys to select a menu option. Press **⟨ESC⟩** to return to the **Ready** screen.


Creating a Project

1. To create a new project, press **(3)** at the **Project** menu shown on page 5-2. The gauge displays:



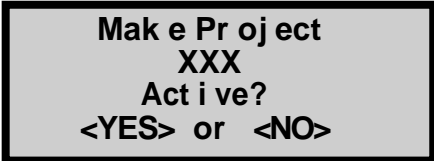
Project Name
<ALPHA> for Letters
<ENTER> to Exit

2. Press the **(ALPHA LOCK)** key to enable the alphabetic keys on the gauge. When the alphabetic keys are enabled, the symbol **A** appears in the upper right of the display, as shown above.
3. Enter the project name (up to twelve characters) and press the **(ENTER/START)** key.
4. If the *Layer Thickness* function (see page 2–14) is enabled, the gauge prompts for the layer thickness:



Input Layer
Thickness
51 mm
Press <ENTER>

5. Enter a layer thickness from 25 to 102 mm (2.0 to 4.0 in.) and press the **(ENTER/START)** key. The gauge displays:



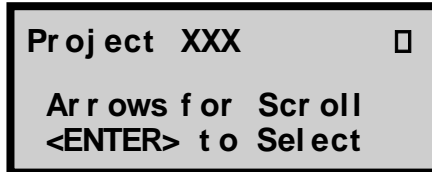
Make Project
XXX
Active?
<YES> or <NO>

6. To enable the new project, press the **(YES)** key. The gauge enables the new project, displays a brief confirmation message, and returns to the **Project** menu.

Selecting a Project

1. To select an existing project, press <1> at the **Project** menu shown above. If no projects have been created, the gauge displays the message **No Projects are stored.**

If a project has been created, the gauge displays:

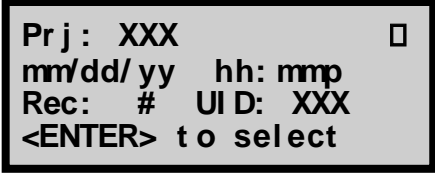


2. Use the arrow keys to scroll through the names of the existing projects.
3. Press <ENTER/START> when the desired project is displayed. The gauge sets the selected project as active, briefly displays a confirmation message, and returns to the **Project** menu.

Viewing Project Data

The Model 2701-B offers two methods of viewing data. You can view either the last measurement results using the *Recall* function described on page 4–12, or any measurement results, including project notes, stored in a project file using the *View* function available from the **Project** menu.

1. To view data stored in a project file, press **<2>** at the **Project** menu. The gauge displays:



Pr j : XXX □
mm/dd/yy hh: mmp
Rec: # UID: XXX
<ENTER> t o select

2. Use the arrow keys to scroll through the project names.
3. Press **<ENTER/START>**, when the gauge displays the desired project name.


If any measurement data has been stored in the selected project file, the gauge displays the data for the first measurement.

Five screens of information are displayed for each measurement. Use the up and down arrows to scroll through the project data.

4. Press the **<ESC>** key to return to the project selection screen shown above.

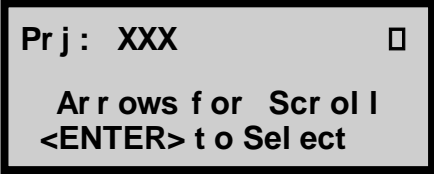
Erasing Projects

To erase either a selected project file or all project files, press **<4>** at the **Project** menu shown on page 5-2. The gauge displays:



Er ase:
1. One Pr o j e c t
2. All Pr o j e c t s
Pr e s s # t o S e l e c t

- ▶ To erase all projects, press **<2>** at the **Erase** menu. At the **Are You Sure?** prompt, press the **<YES>** key. The gauge erases all the projects and returns to the **Project** menu.
- ▶ To erase a single project, press **<1>**. If more than one project has been created, the gauge displays:



Pr j : XXX
Ar r o w s f o r S c r o l l
<ENTER> t o S e l e c t

Use the arrow keys to scroll through the project names displayed on the first line. When the gauge displays the desired project, press **<ENTER/START>**.

At the **Are you sure?** prompt, press the **<YES>** key. The gauge erases the project and returns to the **Project** menu.

Outputting Project Data

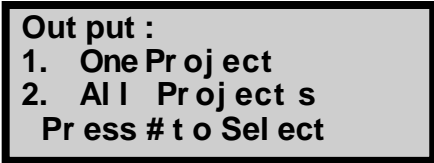
The *Output* function within the **Project** menu allows the operator to print (or upload) project data stored in the gauge to a printer or computer.

1. To output project data, connect a serial cable to the 9-pin serial port on the front of the gauge. Ensure that the serial cable meets the pinout shown on page C-3. An optional serial cable, PN 106514.0002, is available from Troxler.
2. Connect the serial cable to the printer (or computer) serial port.

NOTE

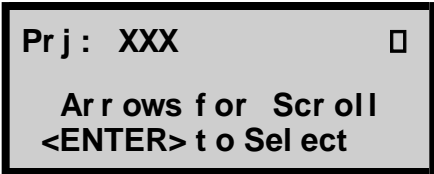
To upload data to a computer, use the HyperTerminal® application available from the Windows® Accessories menu. This application can be used to transfer data from the gauge to the computer.

3. At the **Project** menu shown on page 5-2, press **(5)**. The gauge displays the **Output** menu:



```
Out put :  
1. One Pr o j e c t  
2. A l l P r o j e c t s  
Pr e s s # t o S e l e c t
```

4. From this menu, the gauge can print (or upload) either a single project or all projects.
 - ▶ To output the data from all projects, press **(2)**.
 - ▶ To output a single project, press **(1)**. The gauge displays:



```
Pr j : XXX □  
  
A r r o w s f o r S c r o l l  
<ENTER> t o S e l e c t
```

Use the arrow keys to scroll through the project names displayed on the first line. When the gauge displays the desired project, press **(ENTER/START)**.

For either selection, the gauge displays:

Out put :
1. 32 Col umn Repor t
2. Spr eadsheet
Pr ess # t o Sel ect

The *32 Column Report* option is formatted for a standard printer width. This format is recommended when outputting the data to a printer. The *Spreadsheet* option is sent in a *comma-delimited* format, which can then be imported easily into a spreadsheet program, such as Microsoft Excel®. The information output using the *Spreadsheet* option is shown on page 5-10.

The gauge prints (or uploads) the project and returns to the *Project* menu shown on page 5-2. Press the **(ESC)** key to return to the *Ready* screen.

NOTE

The following information pertains ONLY to software versions 2.11 or later on page 5-9.

(SOFTWARE VERSIONS 2.11 OR LATER)

NOTE

The software version displays when you turn on the gauge.

```
-Model 2701B-  
Battery Volts: X.X  
V#.## SN: ###  
Press <ENTER>
```

NOTE

The **Project** menu now includes a *Print* option, and the *Output* option is renamed *Output (PC)*.

```
-Project-      ↓  
4. Erase  
5. Output (PC)  
6. Print
```

Printing Project Data

The Print function within the **Project** menu allows the operator to print project data stored in the gauge to a printer at the correct speed, ensuring that all the data is included in the hard copy.

To print project data, press **<6>** at the **Project** menu shown on page 5-2. The gauge displays the Output menu shown on page 5-7.

NOTE

From the **Output** menu, the steps to take are the same as those to upload project data stored in the gauge to a computer. Go to step 4 on page 5-7.

Storing Data

The Model 2701-B can store approximately 1000 readings. As described in the previous section, the gauge stores readings under the project name that has been enabled. For more information on selecting a project, see page 5-3.

Project data can be output as described on page 5-7. When using the *Spreadsheet* option, the gauge outputs the following information for each reading:

- ◆ Project name
- ◆ Layer Thickness – This value is displayed only if the Layer Thickness function is enabled.
- ◆ Record number
- ◆ Measurement time
- ◆ Measurement date
- ◆ Measurement mode
- ◆ Gmb (Marshall) – This value is 0.0 if the Gmb (Marshall) target is 0.0.
- ◆ Gmm (Voidless) – This value is 0.0 if the Gmm (Voidless) target is 0.0.
- ◆ Density measurement
- ◆ Low density – This value is 0.0 if not in segregation mode.
- ◆ High density – This value is 0.0 if not in segregation mode.
- ◆ Air voids – This value is 0.0 if Gmm (Voidless) target is 0.0.
- ◆ Slope
- ◆ Offset
- ◆ Gmb (Marshall) target
- ◆ Gmm (Voidless) target
- ◆ Mat temperature – This value is 0 if the Temperature option (see page 2-11) is not installed.
- ◆ Station ID

- ◆ User ID
 - ◆ Location (right or left) of centerline – This value is blank if not in continuous mode.
 - ◆ Distance from centerline – This value is 0.0 if not in continuous mode.
 - ◆ Latitude
 - ◆ Longitude
- ◆ GPS Fix

Note that the station number, distance from centerline, and location with respect to centerline fields are available only for *continuous* mode measurements.

Storing Data in Continuous Mode

When taking measurements in *continuous* mode, the operator can store the data in the selected project by pressing the **<STORE>** key at any time when the gauge is displaying measurement data, or after returning to the **Ready** screen. The gauge displays:

**Do You Want To
Add Notes?**

<YES> or <NO>

- ▶ Press **<NO>** to store only the measurement results under the active project and return to the previous screen.
- ▶ Press **<YES>** to store the station number, distance from centerline, and location with respect to centerline project notes along with the measurement. The gauge displays:

Input Station #

Press <ENTER>

Enter the station number (up to eight characters) and press **<ENTER/START>**. The gauge displays:

**St at i on Dist ance
Fr om Cent er Li ne?
. # f t
Pr ess <ENTER>**

Enter the distance from the centerline and press **<ENTER/START>**. The gauge displays:

**Lef t or Ri ght
of Cent er Li ne?
1. Lef t
2. Ri ght**

Press **<1>** if the station was to the left of the centerline or **<2>** if the station was to the right.

The gauge stores the measurement data and notes under the selected project and returns to the previous screen.

Storing Data in Averaging or Segregation Mode

After taking a measurement in *averaging* or *segregation* mode, the operator can store the data in the selected project by pressing the **<STORE>** key when the gauge displays the test results or after returning to the **Ready** screen. The gauge displays:

**Do You Want To
Add Notes?**
<YES> or <NO>

- ▶ Press **<NO>** to store only the measurement results under the active project and return to the previous screen.
- ▶ Press **<YES>** to include project notes along with the measurements results. The gauge displays:

Input Location
Press <ENTER>

Enter any desired information (up to eight characters) and press **<ENTER/START>**. The gauge stores the test results and notes under the active project and returns to the previous screen.

Appendix A: Troubleshooting and Service

This appendix provides details for troubleshooting and servicing the Model 2701-B PaveTracker Plus. For further details, contact the nearest Troxler Service Center or your Troxler representative.

Troubleshooting

GAUGE WILL NOT COMMUNICATE WITH PRINTER OR COMPUTER

1. Inspect the contents of the shipping case. If the shipping case or any other part or accessory appears damaged, notify the carrier and your Troxler representative immediately.
2. Check that the correct cable is being used.
3. Ensure that the printer/computer baud rate is 9,600 bps.
4. Ensure that all other parameters match:
 - ◆ Data bits = 8
 - ◆ Stop bits = 2
 - ◆ Parity = none
 - ◆ Protocol = DSR/DTR

GAUGE TURNS OFF AFTER IT IS TURNED ON

1. To conserve power, the gauge provides an automatic shutdown if no key is pressed for 60 minutes. To turn the gauge on, press the power switch.
2. If the rechargeable NiMH battery pack is below 5.5 V dc, the gauge shuts down. Recharge or replace the batteries (see page A-5).

SHORT BATTERY LIFE AFTER RECHARGING


- 1.** NiMH batteries may be charged up to 500 or more full charge/discharge cycles, and typically have a 4-year life. The batteries may be reaching the end of their life cycle, and should be replaced.
- 2.** Charger/adaptor may not be supplying full charge – check the ac outlet and the dc output (12 V dc) using a voltmeter on the proper setting.
- 3.** Check that you are using the correct charger.
- 4.** The ac charger may be defective. To check, use the dc adapter to charge the batteries.

Internal Gauge Temperature

High internal temperatures may damage the gauge's electronic components. **To reduce the risk of damage, DO NOT allow the gauge to sit on hot asphalt for extended periods.**

If the internal temperature of the gauge reaches a level that is considered excessive, the beeper will sound and the following warning message is displayed:

**I n t e r n a l t e m p . h i g h
A l l o w g a u g e t o c o o l
P r e s s E n t e r t o
r e s u m e**

The gauge should be taken to a shaded or air-conditioned environment and allowed to cool before continuing. If measurements are performed before the gauge is allowed to cool, the warning symbol  is displayed.

Batteries

The PaveTracker Plus is equipped with one set of rechargeable nickel-metal hydride (NiMH) batteries (pack of five C batteries). The gauge software monitors the NiMH battery voltage. When the batteries are fully charged, the battery voltage should be between 6.8 and 7.2 V dc. If the voltage falls below 6.0 V dc, the gauge displays a low battery symbol (☐) in the upper right of the **Ready** screen. Recharge the batteries as described below.

If the voltage falls below 5.5 V dc, the gauge powers down automatically after completing any memory store functions already in progress. Troxler recommends that the operator recharge the NiMH batteries. The NiMH batteries can be fully recharged in only 2.5 hours.

Charging

To charge the NiMH batteries, plug the charger into the round jack on the front of the gauge. Plug the other end of the ac charger into a standard 100–240 V ac outlet.

The dc adapter may be connected to any 12–14 V dc source (such as a vehicle's cigarette lighter). To ensure a full charge, charge the batteries for at least 2.5 hours. After charging, the battery voltage should be between 6.8 and 7.2 V dc.

After recharging the batteries, unplug the charger from both the wall outlet and the gauge. Store the charger for later use.

Replacing the Batteries

To replace the NiMH battery pack (PN 110374):

1. Turn the gauge off.
2. Using a 1/8-inch Allen wrench, remove the two screws that secure the battery cover to the base of the unit.
3. Clean the screws and set them aside.
4. Carefully lift the old NiMH battery pack from the gauge.
5. Unplug the battery cable from the battery connection on the top circuit board. Gently squeeze the connector to disconnect.
6. Plug the battery cable for the new NiMH battery pack into the battery connection on the top circuit board.
7. Slide the battery pack into the gauge.
8. Replace the battery cover and replace the two screws.

Cleaning the Base and Top Shell

To clean the gauge base, use a putty knife to scrape away any built-up accumulations of soil or asphalt.

CAUTION

Be careful not to scrape or scratch the round sensor, as damage to the sensor may cause erroneous readings.

Also be careful not to damage the gauge base.

After removing any large accumulations, wipe the gauge base with a cloth soaked in an adhesive remover (such as Goo Gone®), then wipe with alcohol to remove the remaining debris.

The keypad may be cleaned using a mild soap (such as 409™ or Fantastic™), followed by clean water.

The gauge's top shell is manufactured from an engineering thermoplastic designed specifically to provide high impact strength and to offer excellent compatibility with many industrial solvents and petro-chemicals. The top shell may be cleaned with mild (low alkaline) soap and water.

CAUTION

The use of any unapproved cleaning agents such as methyl-ethyl-ketones, amines, and methylene chloride will damage the top shell and void the warranty.

Other approved cleaning substances include: methyl, isopropyl, or isobutyl alcohols. A cloth dampened with kerosene or diesel fuel may be used to remove heavy soils.

Avoid prolonged exposure and do not soak.

Replacing the Protective Cover

The gauge includes a replaceable, adhesive-backed bottom cover disc that protects the bottom surface of the gauge's sensor assembly against wear and provides thermal protection for the gauge's internal components. The protective cover disc adheres to the rear base assembly. When the disc becomes worn, it should be replaced as described below.

CAUTION

To prevent damage to the gauge, **DO NOT** operate the gauge without the protective cover disc.

NOTE

Additional bottom cover discs can be purchased from Troxler by ordering PN 113103, Cover Replacement Kit, which includes three discs.

To remove the old protective cover disc:

1. Turn the gauge over so that its bottom surface is exposed. To prevent damage to the keypad or display, place the gauge on a soft surface.
2. Using a knife or other flat object, gently lift the edge of the disc. After loosening, peel the cover off by hand.

To install the replacement protective cover disc:

1. Clean the surface of the sensor with alcohol (used sparingly) and allow the surface to dry.
2. Peel the adhesive backing from the replacement protective cover disc.

3. Align the replacement cover disc with the sensor and press it into place. Smooth out the disc to eliminate air bubbles.

NOTE

Do not remove and re-install the same cover disc, as the adhesive will be weakened.

Replacement Parts

<u>PART #</u>	<u>DESCRIPTION</u>
113210	Handle assembly, L shaped
113006	Locking pin
113034.1000	Transit case assembly
113103	Bottom cover replacement kit (includes three replacement bottom cover discs)
110374	NiMH battery assembly

Accessories

<u>PART #</u>	<u>DESCRIPTION</u>
104156	DC charger
110403	AC adapter
106514.0002	Serial cable
113045	Model 2701-B <i>Manual of Operation and Instruction</i>

Options

<u>PART #</u>	<u>DESCRIPTION</u>
113017	Handle assembly, telescoping

Returning the Gauge for Service

All shipments within the United States to the factory must be accompanied by the following information. This information is used by Troxler shipping and service personnel to expedite the repair work.

- ◆ Gauge model and serial number.
- ◆ Part number/serial number (if applicable).
- ◆ Is the gauge still under warranty?
- ◆ Problem or difficulty you are having with the instrument.
- ◆ Shipment method to Troxler and for return shipment.
- ◆ Shipping and billing address (not P.O. Box) – street address and zip code.
- ◆ Telephone number and contact (for questions from Troxler).
- ◆ Will estimate be required before performing any work on the gauge?
- ◆ Payment method: credit card, account number, or purchase order number. All U.S. government agencies (city, county, state and federal) must send purchase order numbers.

NOTE

To prevent order duplication, if an order has been placed by telephone, please write "Confirming Order" on any follow-up written requests.

NOTES

Appendix B: Menu Map

This appendix provides a map of the various menus in the Model 2701-B PaveTracker Plus control software.

Menu Map Description

Figure 5–1 is a map of the menus of the PaveTracker Plus control software and each of its submenus.

The menu map shows the function key that accesses each menu. The map uses indentation to indicate submenus that result from selection of a menu item. For example, the first seven lines of Figure 5–1 are:

- ⟨PROJ⟩
- Pr o j e c t -
- 1. Sel e c t
- 2. Vi e w
- 3. Creat e
- 4. Er a s e
 - Er a s e
 - 1. O n e Pr o j e c t
 - 2. A l l Pr o j e c t s

This indicates that, by pressing the ⟨PROJ⟩ key, the operator accesses the **Pr o j e c t** menu. The first three items under the **Pr o j e c t** menu (1. **Sel e c t**, 2. **Vi e w**, and 3. **Creat e**) have no submenus. The fourth item (4. **Er a s e**) does have a submenu. Press ⟨4⟩ to access the **Er a s e** submenu.

NOTE

The menu map contains only the displays that allow or require a keypad selection from multiple choices. Other displays (such as status information, confirmation messages, data entry screens, or error displays) are not included.

Figure 5–1. Model 2701-B Menu Map

<PROJ>

- Pr o j e c t -

1. **Sel ect**
2. **Vi ew**
3. **Cr eat e**
4. **Er ase**
Er ase:
 1. **One Pr o j e c t**
 2. **All Pr o j e c t s**
5. **Out put**
Out put :
 1. **One Pr o j e c t**
 2. **All Pr o j e c t s**

<SETUP>

- Set up-

1. **Set Uni t s**
- Uni t s-
 1. **Engl ish**
 2. **Met ric**
2. **Dat e/ Ti me**
- Dat e/ Ti me-
 1. **Change Ti me**
 2. **Change Dat e**
 3. **Ti meFor mat**
- Ti me For mat -
 1. **AM/ PM**
 2. **24- Hour**
 4. **Dat e For mat**
- Dat e For mat -
 1. **mm/dd/yyyy**
 2. **dd/mm/yyyy**
3. **Temper at ur e**
4. **Cus t omer Name**
5. **Beeper**
Ext er nal Beeper
 1. **ON**
 2. **OFF**

Figure 5–1. Model 2701-B Menu Map (Continued)

- Set up-

- 6. GPS**
 1. ON
 2. OFF
- 7. User ID**
- 8. Mix Cal i br at i on**
 - 1.
 2. Items 1 through 4 represent memory
 3. cells used to store mix calibrations.
 - 4.
 5. **New**
 - Ent r y Met hod-**
 1. **Dat a Pai r s**
 2. **Sl ope/ I nt er cept**
 6. **Di sabl e**
 7. **Vi ew**
- 8. Layer Thi ckness**
Thi ckness Opt i on
 1. ON
 2. OFF

<TARGET>

- Tar get -

- 1. Gmb(Mar shal I)**
Gmb(MA)Val ue:
 - 1.
 2. Items 1 through 4 represent memory
 3. cells used to store Gmb(MA) values.
 - 4.
 5. **New**
 6. **Di sabl e**
- 2. Gmm(Voi dl ess)**
Gmm(Voi d) Value:
 - 1.
 2. Items 1 through 4 represent memory
 3. cells used to store Gmm(Void) values.
 - 4.
 5. **New**
 6. **Di sabl e**

Figure 5–1. Model 2701-B Menu Map (Continued)

<MODE>

- Mode-

- 1. Cont i nuous**
- 2. Aver agi ng**
- 3. Segr egat i on**

<OFFSET>

Dens i t y Of f set

- 1. Enabl e**
- 2. Disabl e**
- 3. Change Off set**

NOTES

Appendix C: Specifications

This appendix contains gauge and measurement specifications for the Model 2701-B PaveTracker Plus.

Measurement Specifications

Measurement capability	Pavement density in lb/ft ³ and kg/m ³
Precision	0.2 lb/ft ³ (3.2 kg/m ³) at 1-Sigma on reference standard
Probe	Non-nuclear, non-capacitance, measuring field
Probing depth	Up to 4.45 cm (1.75 in.)
Measurement time	1 second
Measurement modes	Continuous, averaging, and segregation

Electrical Specifications

Power Source	5 C NiMH (Rechargeable Pack) batteries
Charging Source	
Power Supply (AC charger)	100–240 V ac, 47–63 Hz, 0.7 A
PaveTracker Plus	12 V dc \pm 5%, 1.8 A minimum
Battery Recharge Time	2.5 hours maximum, automatic cutoff (may be charged incrementally without damaging the batteries)
Default Time Before Sleep Mode	5 minutes between keypresses, no loss of data or previous status
Time Before Automatic Shutdown	60 minutes of complete inactivity
Liquid Crystal Display	Alphanumeric, 4 line \times 20 characters, backlit
Keypad	30-key sealed membrane, backlit
Serial Data Format	8 data bits, 1 stop bit, No parity
Baud rate	9,600 bps

Serial Cable Pinout (PN 106514.0002)

<u>9 pin FEMALE</u>	<u>9 pin FEMALE</u>
Rx (pin 2)	Tx (pin 3)
Tx (pin 3).....	Rx (pin 2)
DTR (pin 4).....	DSR (pin 6)
DSR (pin 6).....	DTR (pin 4)
RTS (pin 7).....	CTS (pin 8)
CTS (pin 8)	RTS (pin 7)
Gnd (pin 5).....	Gnd (pin 5)

Mechanical Specifications

Gauge Size, Without Telescoping Handle	22.9 W × 40.6 D × 19.1 H cm (9.0 W × 16.0 D × 7.5 H in.)
Carrying Case Size	53.34 W × 44.45 D × 24.13 H cm (21.0 W × 17.5 D × 9.5 H in.)
Weight, Without Telescoping Handle	4.8 kg (10.5 lb)
Shipping Weight	13.7 kg (30.1 lb)
Operating Temperature (Ambient)	0 to 70 °C (32 to 158 °F)
Max Test Material Surface Temperature	150 °C (302 °F)
Storage Temperature	-55 to 85 °C (-67 to 185 °F)
Humidity	98%, noncondensing

Appendix D: Global Positioning System

This appendix gives an overview of how the optional GPS receiver operates and its accuracy.

GPS Accuracy

As described earlier, the PaveTracker Plus gauge can be equipped with an optional GPS receiver that determines the location (latitude and longitude) of the gauge. This information is stored with each gauge measurement. The GPS receiver used has *Wide Area Augmentation System (WAAS)* capabilities, which provides accuracy to within 3 m (10 ft). However, the accuracy is dependent upon the user's location and other factors as described below.

NOTE

The WAAS is currently functional only in the United States.

The GPS is a satellite-based navigation system that consists of 24 satellites and a network of ground stations that monitor and control those satellites. The satellites orbit the earth at an altitude of approximately 11,000 miles and constantly transmit signal information back to earth. A GPS receiver uses this information to determine its location.

To determine its latitude and longitude, a GPS receiver must receive the signals from at least three satellites.

On average, the receiver used in the gauge is accurate to within 15 m (approximately 50 ft) when receiving GPS data alone. However, the WAAS capabilities can increase the accuracy to within 3 m (10 ft), as shown in Table 1.

The accuracy of the GPS information can be affected by a number of atmospheric forces and other conditions. The WAAS corrects for these factors by placing the GPS receivers at 25 known, precisely surveyed locations, called reference stations, across the United States.

The reference stations determined a measured distance to each satellite using the signals received from the satellites. For each satellite, the stations compare the measured distance to the actual range (as calculated from its known position) to determine a differential correction for each satellite.

Two master stations, located on either coast, collect data from the reference stations to create a GPS correction message. This message is then broadcast through two geostationary satellites that are in fixed position over the equator. The GPS receiver applies the correction factors contained in the correction message to increase the accuracy of its measurements.

Note that the signals from the WAAS satellite may not be available to gauge users in locations where trees, mountains, and other large objects obstruct the view of the horizon. On other locations, the GPS receiver may not be able to access the signals from the three satellites required to determine a position. As noted earlier, the gauge stores location information with the results of each measurement. The measurement display also denotes the quality of the location fix as follows.

- ▶ If WAAS information is available during a gauge measurement, the latitude and longitude will be displayed to the nearest hundredth (1/100) of a second.
- ▶ If a GPS location is determined but the WAAS information is unavailable, the latitude and longitude will be displayed to the nearest tenth (1/10) of a second.
- ▶ If the GPS receiver cannot determine a location, the latitude and longitude will be denoted as 0.

Table D-1. GPS Position Accuracy

Quality of GPS Data	Accuracy	Fix Quality
GPS reading with WAAS	Within 3 m (10 ft)	Latitude and longitude displayed to nearest 1/100 second
GPS reading without WAAS	Within 15 m (50 ft)	Latitude and longitude displayed to nearest 1/10 second
No GPS reading	N/A	Latitude and longitude displayed as 0.

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