

Manual of Operation and Instruction

Model 3430 Plus & 3440 Plus Surface Moisture-Density Gauge



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NOTE

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HOW TO USE THIS MANUAL

Congratulations on the purchase of a **Troxler Model 3430 Plus or 3440 Plus Surface Moisture-Density Gauge**. Troxler continues the proven technology of its 3400 Series surface moisture-density gauges with the Troxler Model 3430 Plus and 3440 Plus.

The *Model 3430 Plus & 3440 Plus 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.

NOTE

Before operating the gauge, read this manual carefully. If you do not completely understand the sections that cover radiation safety, contact your company radiation safety officer (RSO) or the nearest Troxler representative.

CONVENTIONS USED IN THIS MANUAL

Throughout this manual, symbols and special formatting are used to reveal the purpose of the text as follows:



WARNING

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

CAUTION

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

NOTE

Indicates important information that must be read to ensure proper operation.

<KEY>

Angle brackets and a different typestyle indicate a key or character (number or letter) to press on the gauge keypad. For example, “Press <START>” means to press the key labeled *START*.

DISPLAY

A different typestyle is used in text to indicate information or messages displayed on the gauge.

**DISPLAY - Typestyle
and shading used to
simulate the gauge
display**



Diamonds indicate a list of things needed (such as equipment) or things to know.



Check marks indicate the performance of an action. With lists of check marks, follow the instructions in the order of the check marks.



Triangles indicate that more than one option is available. Carefully select the option that applies.

NOTES

TABLE OF CONTENTS

CHAPTER 1. INTRODUCTION

Introduction.....	1-2
Gauge Parts and Accessories	1-5
Unpacking and Inspection	1-7

CHAPTER 2. THEORY OF OPERATION

Density	2-2
Moisture	2-3
Calibration	2-5

CHAPTER 3. GETTING STARTED

Gauge Illustration	3-2
Control Panel	3-3
Source Rod Positions	3-5
Daily Inspection.....	3-6
Turning the Gauge On	3-7
Setup	3-9

CHAPTER 4. USING THE GAUGE

Taking a Standard Count	4-2
Preparing a Test Site	4-7
Taking Measurements.....	4-10
Recall	4-17

CHAPTER 5. SETUP MENU

Setup Menu	5-3
Count Time	5-4
Set Units.....	5-4
Depth Mode	5-4
Stat Test	5-5
Drift Test.....	5-7
Nomograph	5-10
Precision	5-15
Options.....	5-17
Battery Status.....	5-18
Percent Air Voids (Soil Mode)	5-19

TABLE OF CONTENTS (Continued)

CHAPTER 6. TARGET MENU

Target Menu	6-2
Target Values	6-3

CHAPTER 7. CALIBRATION OFFSETS

Offset Menu.....	7-2
Density Offset.....	7-3
Moisture Offset.....	7-4
Trench Offset.....	7-8

CHAPTER 8. PROJECT DATA

Project Menu	8-2
Select	8-3
View	8-4
Create a Project	8-5
Erase Projects	8-6
Output Project.....	8-7
Set Output Destination	8-10
Deactivate.....	8-11
Auto-Store	8-12
Manual Store	8-14

CHAPTER 9. EXTENDED MENU

Extended Menu.....	9-2
Clock/Calendar	9-3
User ID	9-3
Customer Name	9-3
Language	9-4
Source Decay.....	9-5
Erase Standard Counts.....	9-6
Low Battery Warning	9-7
Software Reset.....	9-8
Test Menu.....	9-9

APPENDIX A. RADIATION THEORY AND SAFETY

Radiation Theory	A-2
Radiation Safety	A-5
Regulatory Requirements	A-14
Gauge Use Precautions.....	A-17
Radiation Profile.....	A-18

TABLE OF CONTENTS (Continued)

APPENDIX B. TRANSPORTATION AND SHIPPING

U.S. Shipping Requirements.....	B-2
Canadian Shipping Requirements.....	B-4

APPENDIX C. TROUBLESHOOTING AND SERVICE

Troubleshooting.....	C-2
Display Contrast.....	C-9
Batteries.....	C-10
Mechanical Maintenance.....	C-15
Replacement Parts.....	C-18
Returning the Gauge for Service.....	C-30

APPENDIX D. STANDARD COUNT LOG

APPENDIX E. UNIT CONVERSION

Measurement Units.....	E-2
Radiological Units.....	E-2

APPENDIX F. GAUGE SPECIFICATIONS

Measurement Specifications.....	F-2
Radiological Specifications.....	F-4
Electrical Specifications.....	F-5
Mechanical Specifications.....	F-7

APPENDIX G. SPECIAL EUROPEAN CONSIDERATIONS

Declaration of Conformity.....	G-2
Safety Warnings.....	G-3

APPENDIX H. PRINTING (UPLOADING) PROJECT DATA

Windows Hyperterminal.....	H-2
Viewing Project Data.....	H-5

APPENDIX I. GLOBAL POSITIONING SYSTEM (GPS)

GPS Accuracy.....	I-2
-------------------	-----

INDEX

WARRANTY

LIST OF FIGURES

<u>Figure</u>	<u>Title</u>	<u>Page</u>
1-1	Gauge Parts and Accessories	1-5
2-1	Effect of Moisture on Depth of Measurement	2-4
3-1	Gauge Illustration	3-2
3-2	Control Panel	3-3
3-3	Source Rod Positions	3-5
4-1	Standard Count Position	4-3
4-2	Drill Rod Assembly	4-8
4-3	Marking the Test Area	4-8
8-1	Spreadsheet Column Definitions	8-9
A-1	Diagram of an Atom	A-2
A-2	Effect of Distance on Exposure	A-7
A-3	Cleaning the Tungsten Sliding Block	A-12
A-4	Gauge and Transport Case	A-18
C-1	Adjusting the Display Contrast.....	C-9
C-2	NiMH Battery Pack and AA Batteries.....	C-11
C-3	Final Assembly, Part Numbers 110795_XXXX (3430 Plus) and 110800_XXXX (3440 Plus)	C-19
C-4	Base Assembly, Part Number 110015_XXXX.....	C-21
C-5	Scaler Assembly, Part Numbers 110791 (3430 Plus) and 110876 (3440 Plus).....	C-23
C-6	Baseboard Assembly, Part Numbers 110790 (3430 Plus) and 110877 (3440 Plus).....	C-26

LIST OF TABLES

<u>Table</u>	<u>Title</u>	<u>Page</u>
3-1	Keypad Functions.....	3-4
A-1	Radiation Profile for Gauge	A-19
C-1	Error Messages.....	C-6
C-2	Typical Battery Operating Life	C-11
I-1	GPS Position Accuracy	I-4

NOTES

**ATTENTION
MODEL 3430 PLUS OR 3440 PLUS
GAUGE OWNER**

*This unit contains functions that require an ACCESS CODE.
This code must be entered before these functions may be used.
For more information on using the access code, refer to
Chapter 9.*

The ACCESS CODE for this gauge is:

4708

*This page should be removed if the access code is not to be
distributed to other parties or users of this gauge.*

NOTES

CHAPTER 1

INTRODUCTION

This chapter provides a brief overview of the Troxler Model 3430 Plus and 3440 Plus Surface Moisture-Density Gauges, and includes a list of the gauge parts and accessories, as well as instructions for unpacking and inspecting the gauge.

CONTENTS

Introduction.....	1-2
Gauge Parts and Accessories	1-5
Unpacking and Inspection	1-7

INTRODUCTION

Since 1958, Troxler has been the worldwide leader in precision quality control and measurement equipment for the highway and construction industry. Troxler's Model 3430 and 3440 Surface Moisture-Density Gauges have become the industry standard for measuring the moisture content and density of construction materials. With the Model 3430 Plus and 3440 Plus gauges, Troxler has added a number of new features to the proven technology of the company's earlier products to provide increased performance, flexibility, ease of use, and operator safety.

Using the Model 3430 Plus and 3440 Plus gauges, the operator can quickly and precisely measure the moisture content and density of construction materials. Both gauges feature:

- ◆ Two measurement modes (*Soil* and *Asphalt*) for precise compaction control readings in most construction materials:
 - Soil Mode:* For moisture/density determinations in soil and soil-stone materials in layers of 4 inches or greater.
 - Asphalt Mode:* For density determinations in asphalt or hardened concrete layers of 4 inches or greater.
- ◆ A *Nomograph* function for density determinations in asphalt layers of less than 4 inches.
- ◆ Calibration offsets (*density, moisture, and trench*) to expand measurement possibilities, and to enhance gauge readings on materials that may fall outside the range of factory calibration.
- ◆ Over 30 functions to facilitate all phases of testing compaction on construction materials.
- ◆ A *backlit liquid crystal display (LCD)* to help the operator read the display during night construction.
- ◆ Easy-to-use *keypad* and user-friendly menus to reduce training time to increase productivity.
- ◆ An internally mounted *beeper*, which emits a short tone in response to a valid keystroke on the keypad. The beeper sounds a longer tone if the operator presses an invalid key, if the gauge displays an error message, or to signal the conclusion of a measurement.

- ◆ A *serial port* used to connect the gauge to an RS-232 device, such as a computer or printer.

In addition to the items listed above, the Model 3440 Plus gauge includes the following features:

- ◆ A *backlit keypad* for greater ease of use in low-light conditions.
- ◆ A *remote keypad*, including a **⟨START⟩** and **⟨ESC⟩** key, at the top of its source rod housing. The remote keypad reduces the amount of bending and stooping the operator must do while operating the gauge.
- ◆ A *USB port*, which can be used to output data to a USB printer or flash drive. A list of compatible USB devices is available at: www.troxlerlabs.com/PRODUCTS/PRODLIT/otherlit.shtml.
- ◆ In addition to its internal beeper, a louder, *external beeper* is included on the Model 3440 Plus. The external beeper performs the same functions as the internal one, and can be enabled or disabled as desired by the operator.

The Model 3440 Plus can also 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. For more information on the GPS option, refer to Appendix I.

The Model 3430 Plus and 3440 Plus gauges meet or exceed all applicable American Society of Testing and Materials (ASTM) standards (or corresponding equivalent), including:

- ◆ ASTM D-2950: *Standard Test Method for Density of Bituminous Concrete in Place by Nuclear Method*.
- ◆ ASTM D-6938-06: *Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)*

NOTE

As of November 2006, ASTM D-6938-06 replaces ASTM D-2922: *Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)* and ASTM D-3017: *Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)*.

Any licensing issues discussed in this manual are for the United States. To purchase a Model 3430 Plus or 3440 Plus in Canada, owners must obtain a radioisotope license from the Canadian Nuclear Safety Commission (CNSC). The owner should obtain copies of the CNSC Regulations and the *Transportation of Dangerous Goods Act and Regulations* (TDG). For other countries, please consult your local regulatory agency.

Owners are encouraged to require study of this manual before allowing anyone to use the gauge. ***A potential hazard does exist if improperly used.*** Appendices A and B, which cover radiological safety and transportation requirements, should be required reading for all users and potential users. **If these appendices are not completely understood, users should seek assistance from Troxler, an appointed Troxler representative, or others designated within the user's organization.**

Additional radiation safety information is available by attending a Troxler Nuclear Gauge Safety Training Course. For pricing and availability of these courses, visit the Troxler website at www.troxlerlabs.com/TRAINING/training.shtml or contact your Troxler representative.

Before operating the gauge, users in European countries must refer to Appendix G for special considerations, additional safety warnings, and the Declaration of Conformity.

Since changes are made to local, state, and federal regulations on a continuing basis, the owner/operator must maintain awareness of current requirements. *The responsibility for compliance ultimately falls on the owner.* An owner in the United States may also wish to purchase and subscribe to Titles 10 and 49 of the *Code of Federal Regulations* (CFR) in addition to applicable local/state regulations.

GAUGE PARTS AND ACCESSORIES

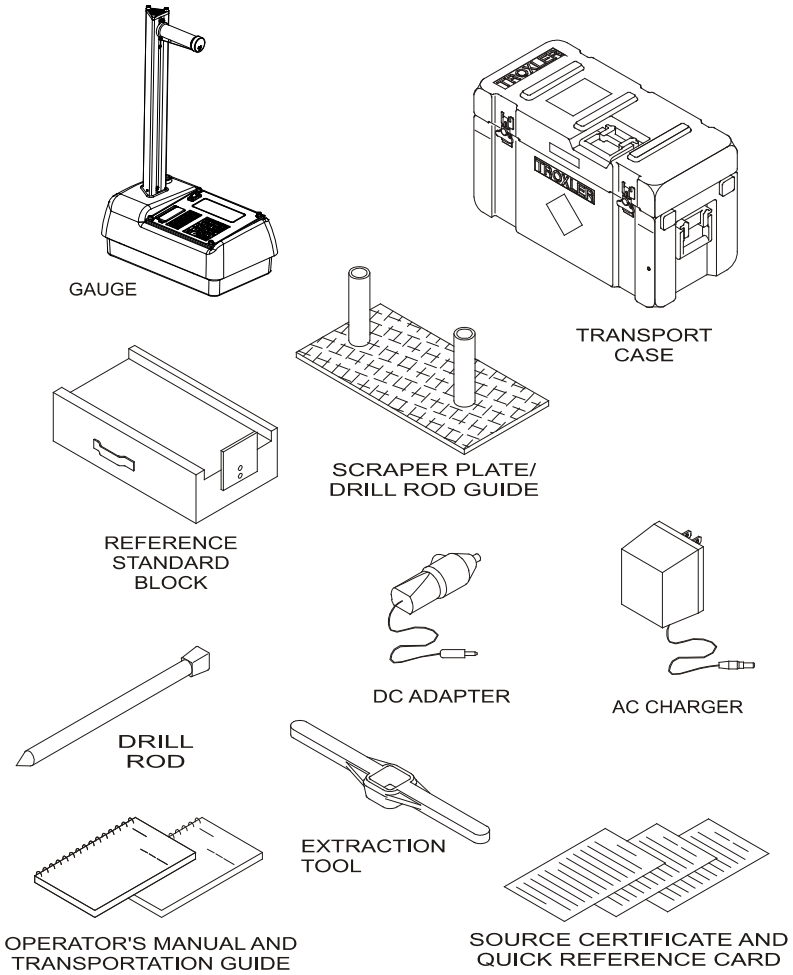


Figure 1–1. Gauge Parts and Accessories

1. The **Gauge** is the portable instrument containing all electronic modules, the rechargeable battery pack, detectors, and the radioactive sources.
2. The **Reference Standard Block** provides a measurement standard for standard counts. It is also used during stability and drift tests.
3. The **Drill Rod** is used to drill holes for direct transmission measurements. *Do not use the source rod of the gauge to drill holes.*
4. The **Scraper Plate/Drill Rod Guide** is used to prepare the test site and to guide the drill rod when preparing the source rod hole for direct transmission measurements.
5. The **Extraction Tool** provides leverage to remove the drill rod from soil materials.
6. The **AC Charger** and **DC Adapter** are used to charge the gauge batteries. The ac charger accepts 90 – 220 V ac, 50/60 Hz and supplies 12 V dc. The dc adapter allows recharging from an automobile cigarette lighter.
7. The **Transport Case** provided with the gauge has been approved as a Type A package. Always use this transport case when transporting or shipping the gauge.
8. The **Manual** details how to use the gauge. Both the manual and the **Transportation Guide** discuss radiation safety and gauge shipping concerns.
9. A **Printer** (optional, not shown) connects to the gauge for printing data.
10. A **Printer Cable** (optional, not shown) is used to connect the gauge to a serial printer or computer.

UNPACKING AND INSPECTION

Troxler recommends that the operator wear a dosimeter while working with the gauge. Upon receipt of the gauge from the factory, 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**.

For shipping to another location or back to the factory, save the box and any packing material. For shipping instructions and regulations, please see Appendix B.

Check the shipping case for the following:

- ◆ Gauge
- ◆ Reference Standard Block
- ◆ Drill Rod
- ◆ Scraper Plate/Drill Rod Guide
- ◆ Extraction Tool
- ◆ AC Charger
- ◆ DC Adapter (for a vehicle cigarette lighter)
- ◆ Manual of Operation and Instruction
- ◆ Gauge Warranty
- ◆ Source Certificate
- ◆ Transportation Guide (This guide refers to U.S. standards. All other countries please refer to local regulations. In the absence of local regulations, please use this guide as a reference only)



WARNING

The source rod should always be in the SAFE position when the gauge is not in use.

NOTE

Charge the batteries for four hours prior to initial use.

Lift the gauge from the transport case and inspect the outside surface for damage. Check the lock on the source rod handle and make sure the keys fit. Remove the lock, release the trigger, and check the source rod operation. It should move up and down with little effort. Return the gauge to the transport case.

CHAPTER 2

THEORY OF OPERATION

This chapter provides a brief description of the theory of operation of the Troxler Model 3430 Plus and 3440 Plus Surface Moisture-Density Gauges. The *direct transmission* and *backscatter* modes of operation are illustrated, along with an explanation of the cesium-137 source, americium-241:beryllium source, and detector geometry.

CONTENTS

Density	2-2
Moisture	2-3
Calibration	2-5
Offsets	2-5

DENSITY

The Troxler Model 3430 Plus and 3440 Plus Surface Moisture-Density Gauges use two modes of operation: *direct transmission mode* (with the source rod extended into the material to be measured) and *backscatter mode* (with the source rod in the backscatter position, just above the surface of the material). Source rod positions are described in Chapter 3.



WARNING

The source rod should always be in the SAFE position when the gauge is not in use.

In the direct transmission position, the source rod extends through the base of the gauge into a pre-drilled hole to a desired depth. Photons from the cesium-137 (Cs-137) source in the source rod pass through the test material. While passing through the test material, the photons collide with electrons and lose energy. A high material density increases the probability of these photon collisions. This decreases the number of photons that reach the Geiger-Mueller (G-M) detectors in the base of the gauge. Thus, the number of photons reaching the detectors is inversely related to the density of the material: the higher the density of the material, the fewer the photons that reach the detectors. Using the gauge calibration, the gauge software converts the G-M detector counts to a density value.

In the backscatter position, the source rod is lowered to the first notch below the **SAFE** (shielded) position. This places the source and the detectors in the same plane, with the source just above the surface of the material. Shielding between the source and detectors greatly reduces the number of photons reaching the detectors in a direct path from the source. Thus, the photons from the Cs-137 source must travel into the test material and scatter (or reflect) at least once to reach the G-M detectors. The detectors in the gauge base count these scattered photons.

MOISTURE

The gauge uses the principle of neutron *thermalization* to monitor the moisture content of a material. The gauge includes an americium-241:beryllium (Am-241:Be) source that is fixed in the gauge's base. Fast neutrons emitted by the Am-241:Be source pass into the test material. Multiple collisions between the fast neutrons and a similarly sized mass (such as the nuclei of hydrogen atoms) cause the neutrons to slow to the point where further collisions with hydrogen or other materials will not continue to reduce the neutron energy further. These neutrons are said to have been *thermalized*.

The gauge contains a helium-3 detector that is sensitive only to thermalized, or “slow,” neutrons. As a result, the moisture counts relate directly to the amount of hydrogen in the material. Using the gauge calibration, the gauge software converts the helium-3 detector counts to a moisture content. (Note that the helium-3 detector is in the same plane as the Am-241:Be source. Therefore, moisture measurement is similar to a density measurement taken in backscatter mode, as described earlier in this chapter.)

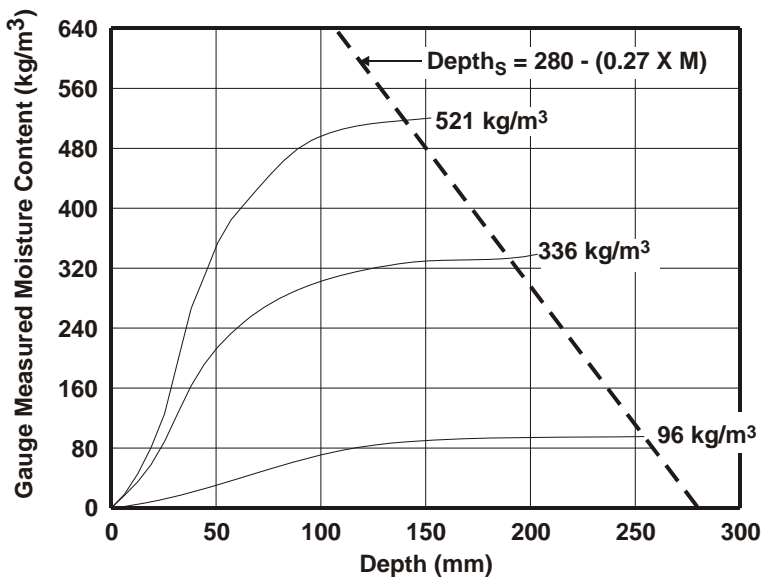
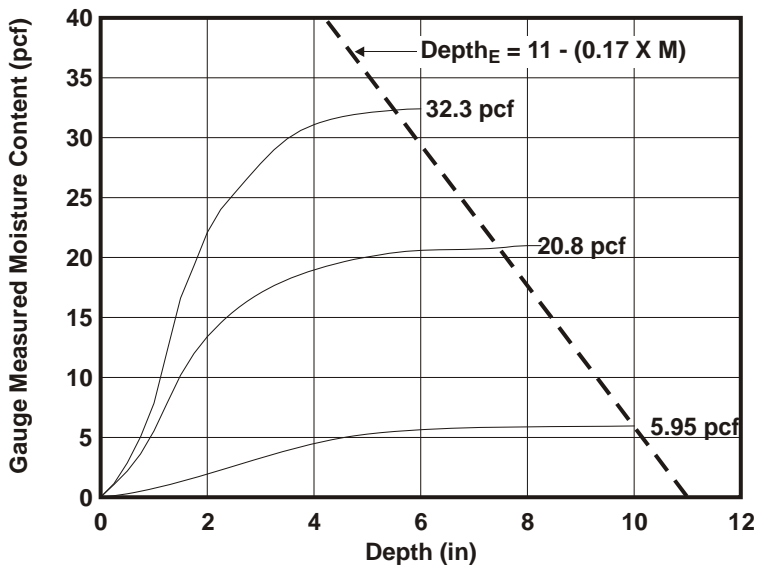
The *depth of measurement* is defined in terms of a maximum depth beneath the surface of the material being measured. Of the neutrons counted by the gauge, 98 percent will penetrate no deeper than the depth of measurement. The depth of measurement is a function of moisture content. The following equations can be used to determine the approximate depth of measurement.

$$\text{Depth (inches)} = 11 - (0.17 \times M), \text{ where: } M = \text{moisture in pcf}$$

or

$$\text{Depth (mm)} = 280 - (0.27 \times M), \text{ where: } M = \text{moisture in kg/m}^3$$

The normalized curve set shown in Figure 2–1 illustrates the effects of moisture content on the depth of measurement.



The dotted lines indicate the maximum depth of gauge measurement at a given soil moisture content.

Figure 2–1. Effect of Moisture on Depth of Measurement

CALIBRATION

Troxler calibrates the gauge at the factory and recommends that it always be calibrated by an authorized Troxler service center. For a list of Troxler and authorized Troxler service centers, refer to page iii of this manual or visit the Troxler website at www.troxlerlabs.com/SERVICES/services.shtml.

The operating range of the gauge is from 1100 to 2700 kg/m³ (approximately 70 to 170 pcf).

OFFSETS

The factory calibration provides accurate results for the majority of materials encountered in construction. If the gauge is to be used to test materials not covered by the factory calibration, the readings can be adjusted using an *offset*.

Perform a *density offset* if the test material is outside the density range for average soil or if the material composition varies from average soil/asphalt. Perform a *moisture offset* if the test material contains hydrogenous materials (other than water) or materials that absorb neutrons. Materials such as cement, gypsum, coal, mica, and lime all contain chemically bound hydrogen that will cause the gauge to display a moisture content that is higher than actual. Material such as boron and cadmium are neutron absorbers and will cause the gauge to display a moisture count that is lower than actual.

Vertical structures scatter neutrons and gamma photons back to the gauge. This could result in inaccurate moisture and density readings. To take readings in a trench or within 0.6 m (2 ft) of a large vertical structure, perform a *trench offset*.

NOTES

CHAPTER 3

GETTING STARTED

This chapter provides details on getting started with the Model 3430 Plus and 3440 Plus Surface Moisture-Density Gauges. It describes the gauge keypad, and provides instructions for conducting daily gauge inspections, turning the gauge on, and setting up the gauge.

CONTENTS

Gauge Illustration	3-2
Control Panel	3-3
Source Rod Positions	3-5
Daily Inspection.....	3-6
Turning the Gauge On	3-7
Setup	3-9
Setup Menu	3-9
Extended Menu	3-11
Measurement Mode.....	3-15
Project Function	3-16
Display Backlight.....	3-16

GAUGE ILLUSTRATION

Figure 3–1 illustrates various components of the gauge referred to throughout this chapter and the remainder of the manual.

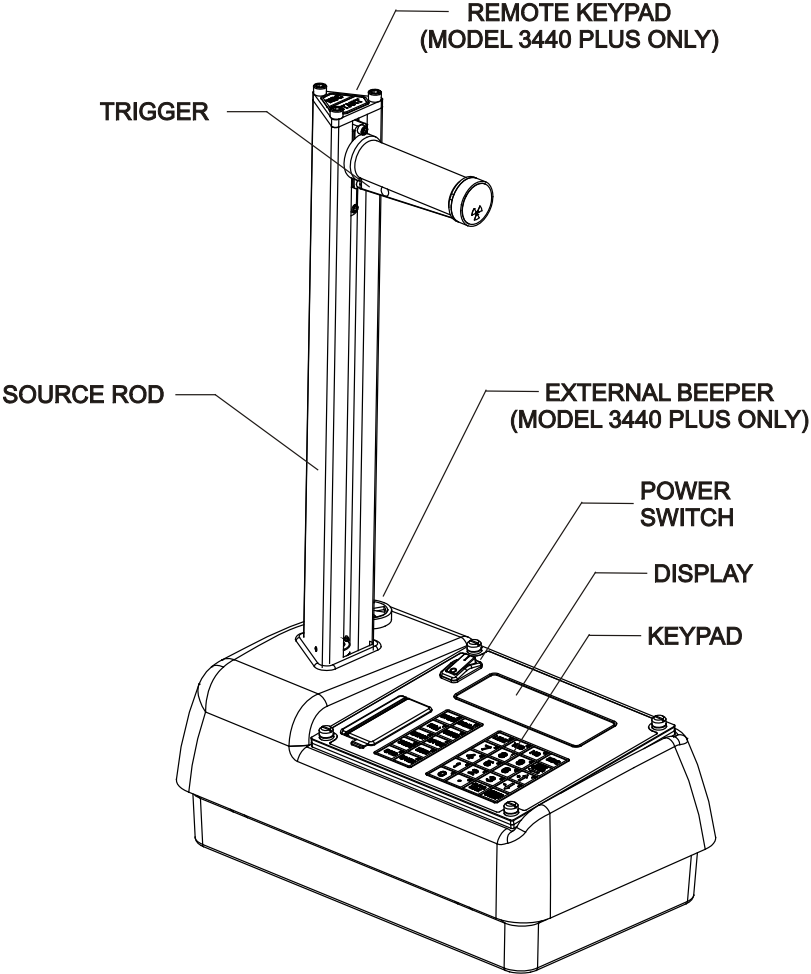
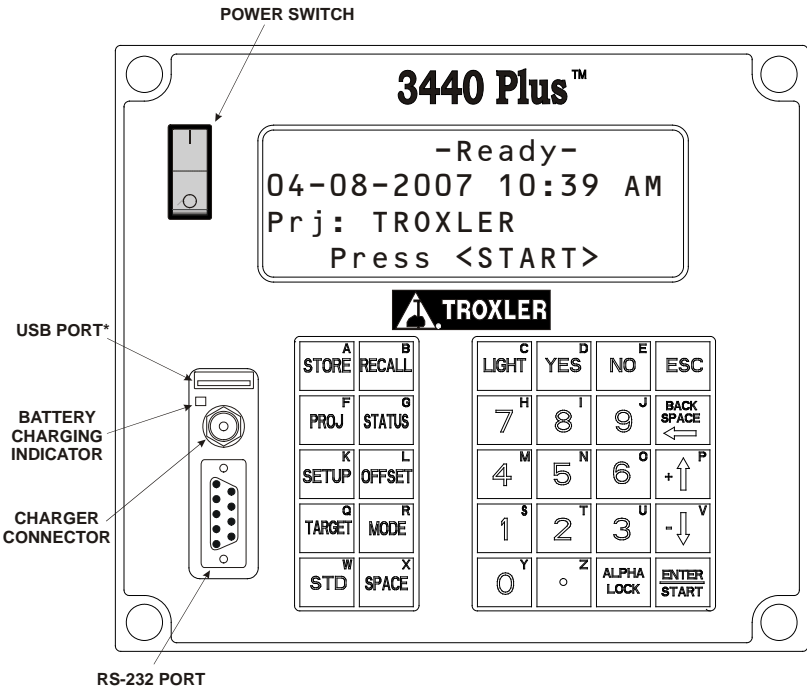


Figure 3–1. Gauge Illustration

CONTROL PANEL

The gauge control panel (see Figure 3–2) contains the power switch, display, USB port (only on the Model 3440 Plus), battery charging indicator, charger connector, RS-232 port, and keypad.

The keypad allows the operator to access the gauge software. Troxler designed the keypad for ease of use, with large keys and an anti-glare coating. Pressing a function key activates the function only when the **Ready** screen is displayed. Table 3–1 describes the function of each key.



3. GETTING STARTED

* The USB port is included only on the Model 3440 Plus.

Figure 3–2. Control Panel

Table 3–1. Keypad Functions

KEY	FUNCTION	PAGE
⟨STORE⟩	Store the most recent data in the current project file.	4–13, 4–16, 8–14
⟨RECALL⟩	Display the most recent data.	4–17
⟨PROJ⟩	Select or create a project file and view, output, or erase project data file.	8–2
⟨STATUS⟩	Displays gauge status information.	3–9
⟨SETUP⟩	Displays the gauge Setup menu.	5–3
⟨OFFSET⟩	Enable, disable, or change a density, moisture, or trench offset.	7–2
⟨TARGET⟩	Select, enter, or disable a Gmb (Marshall), Proctor, or Gmm (Voidless density) value.	6–2
⟨MODE⟩	Select the measurement mode, <i>Asphalt</i> or <i>Soil</i> .	3–15
⟨STD⟩	Take a standard count.	4–2
⟨SPACE⟩	Enter a space.	
⟨LIGHT⟩	Manually toggle the LCD and keypad backlights on and off.	3–16
⟨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 <i>Ready</i> 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⟩.	

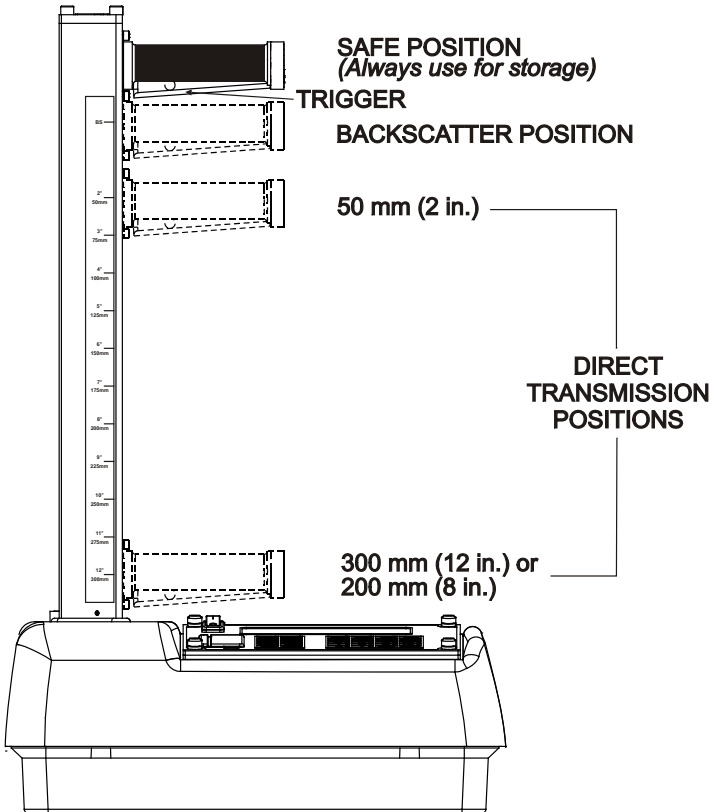
SOURCE ROD POSITIONS

As shown in Figure 3–3, the source rod can be placed in the **SAFE**, backscatter, or direct transmission positions. When not taking measurements, keep the source rod in the **SAFE** position. When measuring thin layer or other materials through which you cannot drill a hole, use the backscatter position. In the direct transmission positions, the source rod extends into a pre-drilled hole.



WARNING

The source rod should always be in the **SAFE** position when the gauge is not in use.



3. GETTING STARTED

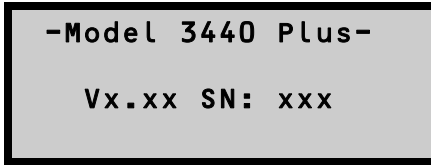
Figure 3–3. Source Rod Positions
(Maximum Depth of 300 mm in Increments of 50 mm)

DAILY INSPECTION

The gauge should be inspected daily before use to ensure proper operation of all safety features. Refer to page A-10 for the daily inspection procedure.

TURNING THE GAUGE ON

To turn on the gauge, press the power switch. Upon power-up, the gauge briefly displays the model number, software version, and serial number as shown below.



The software then performs a brief self-test, followed by a display test to ensure that the gauge is working properly. Following the two tests, the gauge enters a 300-second warmup period.

NOTE

To bypass the warmup period, press <ESC>.

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



NOTE

The symbol **g** in the upper right of the display indicates that the GPS option (see page 5–17) is installed, the option is enabled, and the gauge is receiving GPS satellite signals. This option is available only on the Model 3440 Plus.

The operator can access any gauge function from the **Ready** screen. The **Ready** screen displays the current date and time, as well as the current project (see Chapter 8), if any.

NOTE

If the gauge display is difficult to read in bright light, adjust the contrast as described in the *Display Contrast* section on page C-9.

After 5 hours of no activity, the gauge automatically performs a total power shutdown.

NOTE

If the charge calibration (see page C-11) is *BAD*, the gauge will not perform an automatic shutdown.

SETUP

After turning the gauge on for the first time, set up the software parameters described in the following sections. Several of these parameters accessed from the gauge's **Setup** and **Extended** menus. Other parameters are accessed via dedicated function keys. 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 setup may be changed at any time, however.

The gauge offers a *Status* function that enables the operator to view selected information concerning the current gauge status and setup. To access the *Status* function, press the **<STATUS>** key. The gauge displays two screens of information, including the measurement units, count time, measurement mode, battery status, Gmb (Marshall) value, Proctor value, Gmm (Voidless density) value, and measurement depth. Use the arrow keys to scroll between the two screens.

SETUP MENU

The gauge provides three different count times to be used in taking measurements. The gauge can also display measurement results in either U.S. units (pcf) or metric (SI) units (kg/m^3 or g/cm^3). The Model 3440 Plus gauge offers two depth modes: *automatic* and *manual*. These settings are accessed from the gauge's **Setup** menu. To display this menu, press the **<SETUP>** key. For information on all of the functions available from the **Setup** menu, see Chapter 5.

Count Time

The *count time* defines how long the gauge reads (15 seconds, 1 minute, or 4 minutes). Longer count times produce better measurement precision. Troxler recommends a count time of 1 minute for most sample measurements.

To change the count time, press **<1>** at the **Setup** menu. The gauge displays:

```
Time: 1 m
1. 15 sec
2. 1 min
3. 4 min
```

The gauge displays the current count time on the first line and options on subsequent lines. To select the desired count time, press the corresponding number key. The gauge sets the new count time, then returns to the **Setup** menu.

Set Units

The gauge can display measurement results in either U.S. units (pcf) or metric (SI) units (kg/m^3 or g/cm^3). To select the units, press **<2>** at the **Setup** menu. The gauge displays:

```
-Units-
1. pcf
2. kg/m3
3. g/cm3
```

Select the new units using the corresponding number key. The gauge displays the new units, then returns to the **Setup** menu.

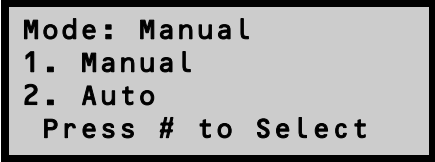
Depth Mode

The Model 3440 Plus gauge offers two depth modes: *Automatic* and *Manual*. In the *Automatic* mode, the gauge software determines the source rod depth automatically. In the *Manual* mode, the operator must enter the source rod depth at a gauge prompt whenever taking a measurement.

NOTE

The *Automatic* depth mode is not available on the Model 3430 Plus gauge.

The *Depth Mode* function allows the operator to set the depth mode. To access this function, press <2> at the **Setup** menu shown on page 5–3. The gauge displays:



```
Mode: Manual
1. Manual
2. Auto
Press # to Select
```

Select the desired depth mode using the corresponding number key. After the depth mode is selected, the gauge sets the mode and returns to the **Setup** menu.

EXTENDED MENU

The gauge is shipped with the current date and time (Eastern Standard Time) stored in its memory. In addition, the gauge can store a *user ID* and *customer name*. These settings are accessed from the **Extended** menu. This menu includes functions that are intended for use by authorized personnel only, and requires the use of the *access code* shown on page xiii.

To access the **Extended** menu, press <.> (9) at the **Setup** menu. The gauge requests an access code:



```
Input Access Code
—
Press <ENTER>
```

Enter the access code shown on page xiii and press the <ENTER/START> key. The gauge displays the **Extended** menu.

After setting the date and time, user ID, and/or customer name as described in the following sections, press <ESC> to return to the **Setup** menu.

For information on all of the functions available from the **Extended** menu, refer to Chapter 9.

Clock/Calendar

The *Clock/Calendar* function allows the operator to change the date and time, and to select the display format for each. To access the **Clock/Calendar** menu, press **<1>** at the **Extended** menu. The gauge displays the **Clock/Calendar** menu:

```
-Clock/Calendar-  ↑↓
1. Change Time
2. Change Date
3. Time Format
```

```
-Clock/Calendar-  ↑↓
4. Date 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 **Extended** menu, press the **<ESC>** key.

CHANGE TIME. To change the time, press **<1>** at the **Clock/Calendar** 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 the following page.) 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 **Clock/Calendar** menu.

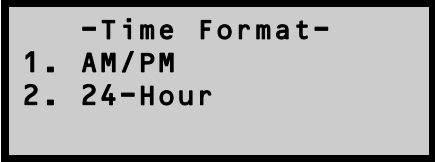
CHANGE DATE. To change the date, press **(2)** at the **Clock/Calendar** menu. The gauge displays:



04/08/2006
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 below.) 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 **Clock/Calendar** 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 **Clock/Calendar** 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 **Clock/Calendar** 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 **Clock/Calendar** menu. The gauge displays:

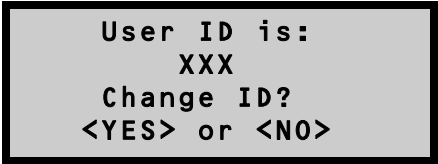


-Date Format-
1. mm/dd/yyyy
2. dd/mm/yyyy

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

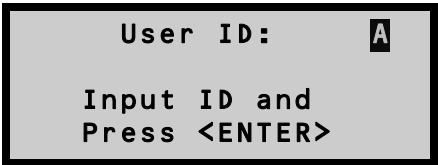
User ID

The gauge can store a three-character alphanumeric *user ID* with each measurement. To enter or change the user ID, press **<2>** at the **Extended** menu. The gauge displays:



User ID is:
XXX
Change ID?
<YES> or <NO>

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



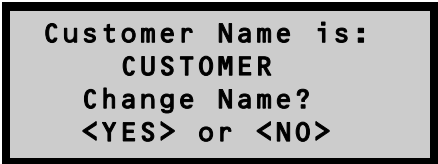
User ID: **A**
Input ID and
Press <ENTER>

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 **Extended** menu.

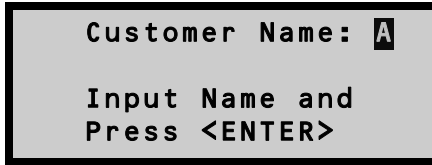
Customer Name

The gauge can store a customer name of up to 12 alphanumeric characters. To enter a customer name, press **<3>** at the **Extended** menu. The gauge displays the current customer name on the second line.



Customer Name is:
CUSTOMER
Change Name?
<YES> or <NO>

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



Customer Name: A
Input Name and
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 name and press the **<ENTER/START>** key. The gauge stores the new customer name, then returns to the **Extended** menu.

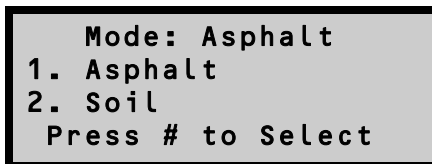
Press **<ESC>** twice to return to the **Ready** screen.

MEASUREMENT MODE

The gauge provides two measurement modes (*Soil* and *Asphalt*) for precise readings on base asphalt, concrete, soil, soil-stone aggregate, and similar materials. The gauge can also be used to determine the density of thin-layer overlays using the *Nomograph* function described on page 5–10.

Before taking a measurement, select the appropriate measurement mode.

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



Mode: Asphalt
1. Asphalt
2. Soil
Press # to Select

NOTE

The **<MODE>** key is active only when the **Ready** screen is displayed.

The current mode (*Asphalt*, *Soil*, or *Nomograph*) is displayed on the top line of the display. Use the *Soil* mode when measuring soil or a soil-stone aggregate. Use *Asphalt* mode when measuring concrete or asphalt layers of 4 inches or greater. Use the number keys to select either *Asphalt* or *Soil* mode, or refer to page 5–10 for instructions on enabling the *Nomograph* function for taking thin-layer measurements. The gauge enables the selected measurement mode and returns to the **Ready** display.

PROJECT FUNCTION

The gauge allows unique *project names* to be entered into the gauge memory. Subsequent measurements can then be stored under these project names. To access the *Project* function, press the **<PROJ>** key.

NOTE

The <PROJ> key is active only when the Ready screen is displayed.

Chapter 8 provides detailed instructions on the *Project* function.

DISPLAY BACKLIGHT

Both the Model 3430 Plus and 3440 Plus gauges provide a *backlight* for the liquid crystal display (LCD). The backlight can help the operator read the display at night. The Model 3440 Plus also features a backlit keypad; this feature is not available on the Model 3430 Plus gauge. To activate the backlight, press the **<LIGHT>** key.

NOTE

Using the display backlight reduces the battery life. To conserve battery life, turn the backlight off when it is not needed. Also note that the backlight turns off automatically after 3 minutes to conserve power.

NOTE

The gauge also features a hardware adjustment for the display contrast. If the gauge display is difficult to read in bright light, adjust the contrast as described in the *Display Contrast* section on page C-9.

NOTES

CHAPTER 4

USING THE GAUGE

This chapter explains the basic use of the Troxler Model 3430 Plus and 3440 Plus Surface Moisture-Density Gauges. Basic use includes taking the daily standard count, preparing measurement sites, setting the measurement mode, and taking measurements.

CONTENTS

Taking a Standard Count	4-2
New Standard Count	4-3
View Standard Counts.....	4-6
Preparing a Test Site	4-7
Soil Site	4-7
Asphalt Site	4-9
Taking Measurements.....	4-10
Soil Mode	4-11
Asphalt Mode.....	4-14
Recall	4-17

TAKING A STANDARD COUNT

To adjust readings for source decay (see Appendix A) and natural background radiation, take a daily *standard count*. A four-minute daily standard count helps ensure the highest measurement accuracy.

Locate the reference standard block shipped with the gauge.

NOTE

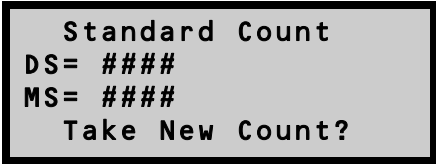
Always take standard counts using the reference standard block provided with the gauge.

Before taking a standard count, ensure that the gauge base and reference standard block are dry and free of debris.

Choose a standard count site that meets the following criteria:

- ◆ A smooth surface such that the reference standard block does not rock
- ◆ At least 3 meters (10 ft) from any large vertical surface
- ◆ At least 10 meters (33 ft) from any other radioactive source
- ◆ On asphalt, concrete, or compacted soil at least 10 centimeters (4 in.) thick

Turn the gauge on. At the **Ready** display, press the **<STD>** key. The gauge displays the last standard counts for density (DS) and moisture (MS).



Standard Count
DS= ####
MS= ####
Take New Count?

NOTE

The <STD> key is active only when the Ready screen is displayed.

- ▶ To take a new standard count, press **<YES>** and follow the instructions in the *New Standard Count* section that follows.
- ▶ To view the last four standard counts, press **<NO>** and follow the instructions in the *View Standard Counts* section on page 4–6.

NEW STANDARD COUNT

When taking a new standard count, the gauge displays:

Place Gauge on
Std. Block & Source
Rod in SAFE Pos.
Press <ENTER>

Place the reference standard block on the standard count site. As shown in Figure 4-1, place the gauge on the reference standard block, with the right side (keypad side) of the gauge against the metal butt plate.

NOTE

Ensure that the source rod is in the standard (SAFE) position and is securely seated by *firmly* tapping down on the handle of the source rod.

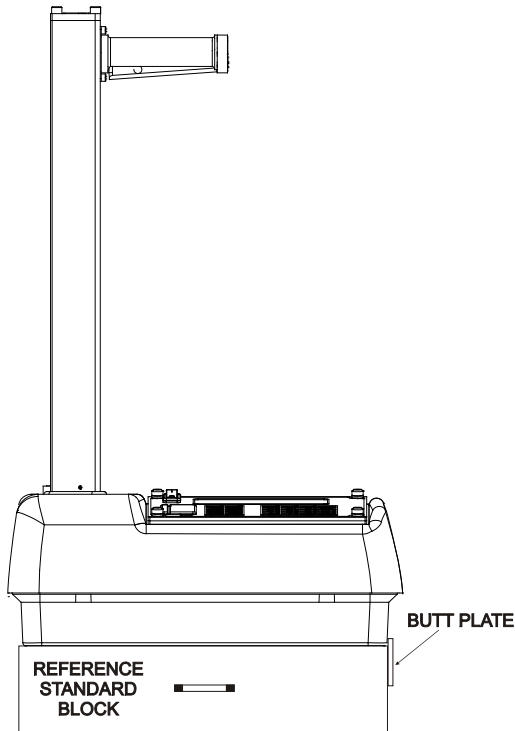


Figure 4-1. Standard Count Position

Begin the standard count by pressing the **<ENTER/START>** key.
The gauge displays:

**Taking
Standard Count
s
Remaining**

After taking the standard count, the gauge displays the results:

**DS= #### ##.##% P
MS= #### ##.##% P
Do You Want to
Use the New Std.?**

Troxler recommends that the operator keep a daily log of the moisture and density standard counts (see Appendix D). To verify gauge stability, compare the daily standard count to a reliable reference as follows:

- ◆ During the first four days of operation of a new or recalibrated gauge, compare the daily standard count to the factory-calibrated values (which are shown on the calibration report sent with the gauge).
- ◆ After the first four days of operation (or after taking four standard counts), compare the daily standard count to the average of the last four counts. Acceptable standard count limits are:

$\pm 1.0\%$ for DS (density standard) and
 $\pm 2.0\%$ for MS (moisture standard).

If the standard count *passes*, record the standard counts, then press the **<YES>** key. The gauge returns to the **Ready** screen.

NOTE

The factory standard count values should be used as a reference if the daily standard counts are ever in question. Be sure to refer to the most recent calibration report for the gauge in question.

- ▶ If the standard count *fails* and it has been *more than* a month since the last standard count, then accept the standard count by pressing the **⟨YES⟩** key. At the **Do You Want To Erase Last Four Standard Counts?** prompt, press the **⟨YES⟩** key. The gauge displays:

**Depth Calibration
Set Rod To BS.

And Press ENTER**

Follow the displayed instructions, and take four additional standard counts. The last of these counts will be compared to the previous four, and the standard counts should pass. If not, repeat the procedure. If it still fails, perform a stat test (see page 5–5) and a drift test (see page 5–7), then contact your Troxler representative.

- ▶ If the standard count *fails* and it has been *less than* a month since the last standard count, but the count was performed correctly and the failure is less than 5%, press the **⟨YES⟩** key. If the failure is more than 5%, press the **⟨NO⟩** key. Ensure that the gauge is properly positioned on the reference standard block (Figure 4–1). Verify that the standard count site meets the criteria listed on page 4–2. Take another standard count and accept it if it fails by less than 5%. If the standard count fails four times, perform a stat test (see page 5–5) and a drift test (see page 5–7), then contact your Troxler representative.

After the standard count passes, the operator can take measurements with the gauge. When not taking readings, always keep the source rod in the **SAFE** position. For added user safety, the source rod automatically retracts to the **SAFE** position when the gauge is lifted using the handle.

VIEW STANDARD COUNTS

To view the last four standard counts, press **<NO>** at the display shown at the bottom of page 4-2. The gauge displays:

Standard Count
Want to View
Last Four Counts?
<YES> or **<NO>**

- ▶ Press **<YES>** to view the last four standard counts. The gauge displays the last four density standard counts. Press **<YES>** to view the last four moisture standard counts. Press **<ENTER/START>** to return to the **Ready** screen.
- ▶ Press **<NO>** to return to the **Ready** screen.

PREPARING A TEST SITE

To ensure measurement accuracy, properly prepare the test site before taking gauge measurements. This section describes how to prepare test sites properly for soil and asphalt measurements.

SOIL SITE

- ✓ Locate a smooth site on the soil that is free from any large holes, cracks, or debris.
- ✓ If necessary, smooth the surface by moving the scraper plate in a back and forth motion.
- ✓ Fill any voids or depressions with fine sand or soil particles. Strike off any excess fill.
- ✓ Place the scraper plate back on the surface and press down slightly to level the surface.



WARNING

Under no circumstances should the source rod of the gauge be used to drill holes.

- ✓ For direct transmission measurements:
 - ✓ Put the drill rod through the extraction tool and then through one of the guides on the scraper plate (Figure 4–2).
 - ✓ Wear safety glasses and a radiation dosimeter.
 - ✓ Place the drill rod assembly on the test site.
 - ✓ Step on the scraper plate.
 - ✓ Hammer the drill rod at least 50 mm (2 in.) deeper than the desired test depth. The drill rod increments include the additional depth.
- ✓ Before removing the drill rod, mark the outline of the scraper plate as shown in Figure 4–3 to ensure the gauge is placed over the same area as the scraper plate.

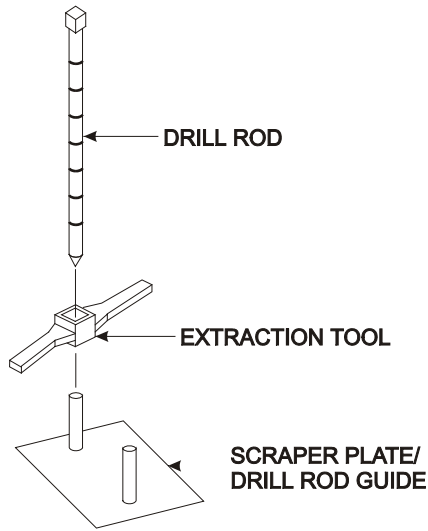


Figure 4-2. Drill Rod Assembly

- ✓ Remove the drill rod by pulling straight up and twisting the extraction tool. *Do not loosen the drill rod by tapping from side to side with a hammer.* Also, do not rock the extraction tool from side to side. This will distort the hole or cause loose material to fall into the hole.
- ✓ Carefully pick up the scraper plate.

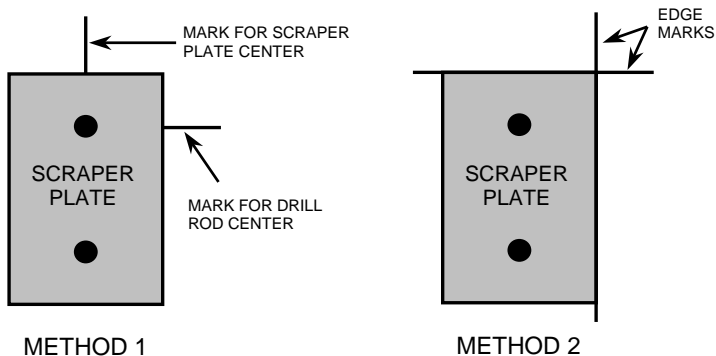


Figure 4-3. Marking the Test Area

ASPHALT SITE

This also applies to hardened concrete sites and soil.

NOTE

These directions also apply to taking a backscatter measurement on soil.

- ✓ Locate a smooth site on the asphalt.
- ✓ Fill the voids on open mixes with sand or cement. **The gauge base must rest on the asphalt, not the fill material!**
- ✓ Ensure that the gauge does not rock. To ensure accurate readings, the gauge base 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



WARNING

When not taking readings, always keep the source rod in the SAFE (shielded) position. For added user safety, the source rod automatically retracts to the SAFE position when the gauge is lifted by the handle.

If you do not hear a *click* when the gauge is raised to the **SAFE** position, look at the bottom of the gauge to verify that the tungsten sliding block is completely closed. If the gauge base opening is not completely closed by the sliding block, the block may require cleaning. Refer to page A-11 for cleaning instructions.



WARNING

Do not store or transport the gauge unless the sliding block is completely closed. Increased radiation levels may cause excessive personnel radiation exposure and may violate transportation regulations.

The *Status* function (see page 3-9) allows the operator to view selected information concerning the current gauge status and setup. To access the *Status* function, press the **<STATUS>** key. Check the gauge's current status before taking measurements.

Remember to take a standard count at least once each day the gauge is to be used (see page 4-2). Note that some states may require that a standard count be taken more frequently than once per day.

The gauge can store measurement results in files (memory locations) called *projects*. For information on creating and activating project files, refer to Chapter 8. Upon completion of a measurement, the results can be stored either automatically by enabling the *Auto-Store* function (see page 8-12) or manually by using the *Store* function (see page 8-14).

SOIL MODE

To measure the moisture and density of soil, soil-stone aggregate, and similar materials, follow the steps below:

- ✓ Select the *Soil* mode (see page 3–15).
- ✓ If desired, enter, change, or enable the Proctor value as described in Chapter 6.
- ✓ Prepare the test site as described on page 4–7.
- ✓ Place the gauge on the test area.
- ✓ Insert the source rod into the hole made by the drill rod. *Use care when inserting the source rod. Try not to disturb the soil around the hole.*
- ✓ Lower the source rod to the measurement depth. Release the trigger. Gently push the handle down to lock the source rod into position. You should hear a *click* when the source rod locks into position.
- ✓ Gently slide the gauge to the right (towards the keypad) so the source rod makes contact with the wall of the hole.
- ✓ Press the **<ENTER/START>** key.
 - ▶ In the *Manual* depth mode (see page 5–4), the gauge prompts for the source rod depth. Enter the source rod depth using the number keys. For example, with the source rod in the backscatter position, press **<0>**. Then press **<ENTER/START>**.
 - ▶ In the *Automatic* depth mode (available only on the Model 3440 Plus), the gauge software determines the source rod depth automatically.
 - ▶ Note that the Proctor value is based on soil particles 3/8 inches or less in diameter (or those passing a #4 sieve). If an unusual reading is obtained and oversize particles are suspected, rotate the gauge 90°. Use the same drill hole to take a second reading.

- ✓ The gauge displays the time remaining while taking a measurement.
- ✓ After the count time, the gauge displays the measurement results:

```

%PR= ###.#           ↑↓
DD=  ##.#
WD=  ###.#
M=   ##.#   %M=  ##.#
  
```

```

Lat:  +hh mm ss.ss  ↑↓
Lng:  -hh mm ss.ss
  
```

where: *%PR* = percent Proctor *%M* = percent moisture
 DD = dry density *Lat* = latitude
 WD = wet density *Lng* = longitude
 M = moisture

NOTE

The latitude and longitude display, showing the location of the measurement, is available only on Model 3440 Plus gauges equipped with the GPS option and is shown only when this option is enabled.

The latitude and longitude values denote the quality of the location fix. 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. For more information on GPS accuracy, see Appendix I.

- ▶ If a project is active (see Chapter 8) and the *Auto-Store* function (see page 8–12) is enabled, press **<ESC>** or **<ENTER/START>** to continue. For each measurement, the gauge can store a location description of up to 12 characters, as well as a note of up to 15 characters. Follow the prompts to enter location information and/or a note.
- ▶ If a project is active but the *Auto-Store* function is not enabled:
 - ▶ Press **<STORE>** to store the results. Follow the prompts to enter location information and/or notes. For more information on storing results manually, see page 8–14.
 - ▶ Press **<ESC>** to return to the **Ready** screen without storing the results. Note that, until another measurement has been taken, the results can be recalled as described on page 4–17 and stored later.
- ✓ Lift the gauge from the test site by the source rod handle. This returns the source rod to the **SAFE** position. When not taking readings, always keep the source rod in the **SAFE** position.

ASPHALT MODE

To measure the density of asphalt (and hardened concrete of 4 inches or more) follow the steps below:

- ✓ Select the *Asphalt* mode (see page 3–15).
- ✓ If desired, enter or enable the Marshall value and/or voidless density value as described in Chapter 6.
- ✓ Prepare the test site as described on page 4–9.
- ✓ Place the gauge on the test area.
- ✓ Lower the source rod to the backscatter position (just below the **SAFE** position). Release the trigger. Gently push the handle down to lock the source rod into position. You should hear a *click* when the source rod locks into position.
- ✓ Press the **<START>** key.
 - ▶ In the *Manual* depth mode (see page 5–4), the gauge prompts for the source rod depth. Enter the source rod depth using the number keys. For example, with the source rod in the backscatter position, press **<0>**. Then, press **<ENTER/START>**.
 - ▶ In the *Automatic* depth mode (available only on the Model 3440 Plus), the gauge software determines the source rod depth automatically.
- ✓ The gauge displays the time remaining while taking a measurement.

- ✓ After the count time, the gauge displays the measurement results:

```
%Gmb= ###.#
WD= ###.#
M= ##.# %M= ##.#
%Voids= ###.#
```

```
Lat: +hh mm ss.ss
Lng: -hh mm ss.ss
```

where:

%Gmb = percent of laboratory bulk density

WD = wet density

M = moisture value

%M = percent moisture

$$\%Voids = 100 \times \left(1 - \frac{WD}{Voidless} \right)$$

(displayed only when enabled)

Lat = latitude

Lng = longitude

NOTE

The latitude and longitude display, showing the location of the measurement, is available only on Model 3440 Plus gauges equipped with the GPS option and is shown only when this option is enabled.

The latitude and longitude values denote the quality of the location fix. 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. For more information on GPS accuracy, see Appendix I.

- ▶ If a project is active (see Chapter 8) and the *Auto-Store* function (see page 8–12) is enabled, press **⟨ESC⟩** or **⟨ENTER/START⟩** to continue. For each measurement, the gauge can store a location description of up to 12 characters, as well as a note of up to 15 characters. For an *Asphalt* mode measurement, the gauge can also store location with respect to the centerline (left, right, or neither), and the distance from the centerline. Follow the prompts to enter location information and/or a note.
- ▶ If a project is active but the *Auto-Store* function is not enabled:
 - ▶ Press **⟨STORE⟩** to store the results. Follow the prompts to enter location information and/or notes. For more information on storing results manually, see page 8–14.
 - ▶ Press **⟨ESC⟩** to return to the **Ready** screen without storing the results. Note that, until another measurement has been taken, the results can be recalled as described on page 4–17.
- ✓ Lift the gauge from the test site using the source rod handle. This returns the source rod to the **SAFE** position. When not taking readings, always keep the source rod in the **SAFE** position.

RECALL

To view the results of the most recent measurement, press the **<RECALL>** key from the **Ready** screen. To return to the **Ready** screen, press the **<ENTER/START>** key.

NOTE

The **<RECALL>** key is active only when the **Ready** screen is displayed.

NOTE

The *Recall* function can also be used to view the gauge *counts* from the most recent measurement.

NOTES

CHAPTER 5

SETUP MENU

The gauge software includes a **Setup** menu that allows the operator to manually set or change operating parameters of the gauge. This chapter describes these parameters.

CONTENTS

Setup Menu	5-3
Count Time	5-4
Set Units.....	5-4
Depth Mode	5-4
Stat Test	5-5
Taking a Stat Test.....	5-5
Reviewing the Stat Test.....	5-6
Printing the Stat Test.....	5-6
Drift Test.....	5-7
Taking a Drift Test	5-8
Reviewing the Drift Test	5-9
Printing the Drift Test	5-9
Nomograph	5-10
Enable Nomograph.....	5-11
Disable Nomograph.....	5-11
Change/View Nomograph Data	5-11
Taking Nomograph Measurements	5-14

CONTENTS (Continued)

Precision5-15

Options5-17

 External Beeper.....5-17

 GPS Option5-17

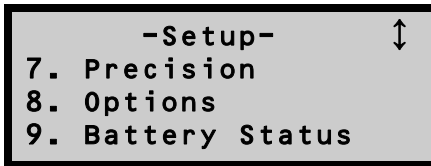
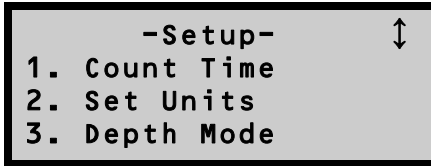
Battery Status5-18

Percent Air Voids (Soil Mode).....5-19



SETUP MENU

The gauge software groups most of the setup features into one menu. To access the **Setup** menu, press the **<SETUP>** key. The gauge displays:



NOTE

The **<SETUP>** key is active only when the **Ready** screen is displayed.

Use the arrows keys to scroll through the menu screens. To select a menu option, use the number key that corresponds to that option. The remainder of this section provides details on the functions available from the **Setup** menu.

COUNT TIME

The gauge provides three different count times for taking measurements. The *Count Time* function is described on page 3–9.

SET UNITS

The gauge can display measurement results in either U.S. units (pcf) or metric (SI) units (kg/m^3 or g/cm^3). The *Set Units* function is described on page 3–10.

DEPTH MODE

The Model 3440 Plus gauge offers two depth modes: *Automatic* and *Manual*. The *Depth Mode* function allows the operator to set the depth mode, as described on page 3–10.

STAT TEST

Erratic readings, or readings that seem to fluctuate, may indicate a problem with the gauge. If the readings are suspect, perform a *stat test*, or statistical stability test, to validate the normal operation of the gauge.

A stat test consists of twenty 1-minute counts. From the twenty counts, the gauge calculates the standard deviation. This standard deviation is compared to a theoretical standard deviation value. Ideally, this ratio should be 0.25, with acceptable limits from 0.17 to 0.33. The gauge is considered unstable if the ratio is outside these limits and the stat test will fail. If the stat test fails, ensure that the gauge setup and testing was conducted correctly, and take an additional test. If the second test fails, contact the nearest Troxler service center for assistance. For a list of Troxler and authorized Troxler service centers, refer to page iii of this manual or visit the Troxler website at www.troxlerlabs.com/SERVICES/services.shtml.

To access the *Stat Test* function, press **<4>** at the **Setup** menu. The gauge displays the **Stat Test** menu:

- 
1. Take STAT Test
 2. Review STAT Test
 3. Print STAT Test
- <ESC> to Exit**

To select a menu option, press the corresponding numeric key or press **<ESC>** to return to the **Setup** menu.

TAKING A STAT TEST

Choose an area free of other nuclear gauges or radioactive sources. Place the gauge on the reference standard block as shown in **Figure 4-1** on page 4-3.

To take a new stat test, press **<1>** at the **Stat Test** menu shown above. The gauge prompts the operator to place the gauge on the reference standard block with the source rod in the **SAFE** (shielded) position. Ensure that the gauge is properly positioned and press the **<ENTER/START>** key.

The gauge displays the progress of the stat test (twenty 1-minute counts). Upon completion of the counts, the gauge displays the results of the density stat test, including an indication of whether the test passed or failed:

```
Density Stat Test
Avg. Counts: ####
R: #.### (PASS)
<ENTER> for Moist.
```

Press **<ENTER/START>** to view the results of the moisture stat test. Follow the prompts to scroll through the results.

REVIEWING THE STAT TEST

To review the results of the last stat test, press **<2>** at the **Stat Test** menu shown on page 5–5. The gauge displays the results of the density stat test as shown above. Press **<ENTER/START>** to view the results of the moisture stat test. Follow the prompts to scroll through the results.

PRINTING THE STAT TEST

To print the results of the last stat test to a serial printer or computer via the gauge's 9-pin serial port, press **<3>** at the **Stat Test** menu shown on page 5–5. The gauge prompts the operator to connect the printer to the gauge.

Connect a serial cable to the gauge's serial port. Ensure that the serial cable meets the pinout shown on page F–6. An optional serial cable, PN 113128, is available from Troxler. Connect the serial cable to the printer or computer serial port.

Press **<ENTER/START>**. The gauge prints or uploads the stat test data and returns to the **Stat Test** menu.

DRIFT TEST

If the gauge passes the stat test, but shows long-term drift between measurements, perform a *drift test* to check the long-term drift of the gauge. A drift test consists of five counts taken three to eight hours after a stat test **with no movement of the gauge between tests**. The gauge sets the pass/fail limits based on the percent difference between the average of the stat test and drift test results. If the percent difference exceeds 0.5 percent for density counts or 1 percent for moisture counts, then the drift test fails. If the drift test fails, ensure that the gauge setup and testing were conducted correctly, and take an additional test. If the second test fails, contact the nearest Troxler service center for assistance. For a list of Troxler and authorized Troxler service centers, refer to page iii of this manual or visit the Troxler website at www.troxlerlabs.com/SERVICES/services.shtml.

NOTE

The drift test consists of five 4-minute counts, whereas the stat test consists of twenty 1-minute counts. Therefore, each test takes approximately 20 minutes to conduct.

DO NOT turn the gauge off between a stat test and a drift test.

DO NOT move the gauge between the stat and drift tests to eliminate possible failure due to positioning changes.

To access the *Drift Test* function, press **<5>** at the **Setup** menu. The gauge displays the **Drift Test** menu:

1. Take Drift Test
 2. Review Drift Test
 3. Print Drift Test
- <ESC> to Exit**

To select a menu option, press the corresponding numeric key or press **<ESC>** to return to the **Setup** menu.

TAKING A DRIFT TEST

To take a new drift test, press **<1>** at the **Drift Test** menu shown on page 5–7. The gauge prompts the operator to place the gauge on the reference standard block with the source rod in the **SAFE** (shielded) position. Ensure that the gauge is properly positioned and press the **<ENTER/START>** key.

NOTE

If it has been less than three hours or more than eight hours since the last stat test, the gauge displays an error message. Press **<ENTER/START> to return to the **Setup** menu.**

The gauge displays the progress of the drift test (five 4-minute counts). Upon completion of the counts, the gauge displays the results of the density drift test, including an indication of whether the test passed or failed:

```
Density Drift Test
Avg. Counts: ####
R: #.###      (PASS)
<ENTER> for Moist.
```

Press **<ENTER/START>** to view the results of the moisture drift test. Follow the prompts to scroll through the results.

REVIEWING THE DRIFT TEST

To review the results of the drift stat test, press **<2>** at the **Drift Test** menu shown on page 5–7. The gauge displays the results of the density drift test as shown on page 5–8. Press **<ENTER/START>** to view the results of the moisture drift test. Follow the prompts to scroll through the results.

PRINTING THE DRIFT TEST

To print the results of the last drift test to a serial printer or computer via the gauge's 9-pin serial port, press **<3>** at the **Drift Test** menu shown on page 5–7. The gauge prompts the operator to connect the printer to the gauge.

Connect a serial cable to the gauge's serial port. Ensure that the serial cable meets the pinout shown on page F–6. An optional serial cable, PN 113128, is available from Troxler. Connect the serial cable to the printer or computer serial port.

Press **<ENTER/START>**. The gauge prints or uploads the drift test data and returns to the **Drift Test** menu.

NOMOGRAPH

In some cases, the gauge may be used to determine the density of thin asphalt overlays. This measurement may be performed with the gauge in backscatter mode and using the *Nomograph* method of density measurement. It should be noted that this method is not as accurate as a true thin-layer gauge. However, this method may produce satisfactory results under many conditions.

When a nuclear gauge is used in backscatter mode on overlays under 3 in. (7.5 cm), several effects must be overcome to produce an accurate reading. With most gauges, the primary problem is the result of photons from the source penetrating deeper than 3 in. (7.5 cm) and scattering back to the gauge. These backscattered photons from the underlying material will adversely influence the reading.

Obtaining an accurate overlay density with the Nomograph method requires that the density of the bottom layer and the thickness of the top layer be determined. The simplest method of determining the density of the bottom layer is to take a nuclear gauge measurement prior to applying the top layer or overlay. With the overlay applied and compacted, the depth of the layer should be determined. At this time, the gauge may be used to calculate the overlay layer density.

To access the *Nomograph* function, press **(6)** at the **Setup** menu shown on page 5-3. The gauge displays:



```
Nomograph: OFF
1. Enable
2. Disable
3. Chg/View Data
```

From this menu, the operator may enable, disable, or change the *Nomograph* function, as described in the following sections.

ENABLE NOMOGRAPH

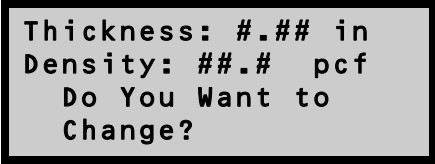
To enable the *Nomograph* function, press **<1>** at the **Nomograph** menu shown on page 5–10. The gauge enables the function, displays a brief confirmation message, and returns to the **Setup** menu.

DISABLE NOMOGRAPH

To disable the *Nomograph* function, press **<2>** at the **Nomograph** menu shown on page 5–10. The gauge disables the function, displays a brief confirmation message, and returns to the **Setup** menu.

CHANGE/VIEW NOMOGRAPH DATA

To change or view the Nomograph data, press **<3>** at the **Nomograph** menu shown on page 5–10. The gauge displays:



Thickness: #.## in
Density: ##.# pcf
Do You Want to
Change?

To return to the **Setup** menu without changing the Nomograph data, press **<NO>**.

To change the Nomograph data, press **<YES>**. The gauge displays:



Select Method of
Entering Density
1. Keypad
2. Measure

The wet density of the underlying or base material may be entered either manually using the keypad or by using the gauge to record actual measurements.

Entering Density Using the Keypad

To enter the density using the keypad, press (1) at the **Select Method of Entering Density** display shown on page 5–11. The gauge displays:

```
Overlay Thickness
  #.## in
Input and <ENTER>
```

Enter the thickness of the overlay (from 0 to 10 in.) and press (ENTER/START). The gauge displays:

```
Bottom Density
  #.# pcf
Input and <ENTER>
```

Enter the wet density of the bottom layer. The gauge enables the *Nomograph* function using the entered values, displays a brief confirmation message, and returns to the **Setup** menu.

Entering Density Using Gauge Measurements

Bottom density values may be obtained by using the gauge to record up to 20 actual measurements. To enter the density using this method, press (2) at the **Select Method of Entering Density** menu shown on page 5–11. The gauge displays:

```
# of Readings to
Average (1-20)?
  #
Input and <ENTER>
```

Enter the number of readings to be taken and averaged, then press **<ENTER/START>**. The gauge displays:

```

Readings: #
Time: # m
Place Rod to BS &
Press <START>
  
```

Prepare the site for measurement as described on page 4–9. Position the gauge and press **<ENTER/START>**. The gauge displays:

```

Nomograph
Reading: 1
Depth: BS
Time: ## s
  
```

After counting down to zero, the gauge displays:

```

Reading: 1
WD= ### pcf
Move Gauge and
Press <START>
  
```

If more than one reading is to be taken, move the gauge to the next location and press **<ENTER/START>**. The gauge will repeat the above sequence for each reading. When all the readings are completed, the display will be:

```

Average of #
Readings
### pcf
Press <ENTER>
  
```

Press **<ENTER/START>** to continue. The gauge enables the *Nomograph* function, displays a brief confirmation message, and returns to the **Setup** menu.

TAKING NOMOGRAPH MEASUREMENTS

When the *Nomograph* function is enabled, the gauge can be used to take thin-layer overlay measurements. Press **(ENTER/START)** to begin the test. The gauge displays:

```
Depth: BS  in
      ( Nomograph )
Time: xx  s
```

After counting down to zero, the display is:

```
%Gmb= ####
WD=   ##
      ( Nomograph )
```

This test may be stored as any other test measurement. The recall function and/or printout will show that the *Nomograph* function was used.

NOTE

The *Nomograph* function should be disabled before taking any measurements not requiring this function.

PRECISION

The gauge can produce test results with precision limits as low as 0.1 pcf (1.6 kg/m³) under certain conditions. The *Precision* function is used to determine the count time required to achieve the precision entered by the operator. If the precision requested is within range and the time required to calculate the required result does not exceed 60 minutes, the following procedure can usually produce the required results.

To execute the *Precision* function, first ensure that the gauge is in the correct mode: *Soil* or *Asphalt*. Press **(7)** from the **Setup** menu shown on page 5–3. The gauge displays:

```
Precision
#.#      pcf
<ENTER> to Continue
```

Enter the desired precision and press **(ENTER/START)**. The gauge displays:

```
Index: 0   in
<ENTER> to Select
<0> for BS
```

If the gauge is in the correct position, press **(ENTER/START)**. The gauge displays:

```
Depth: #   in
       1 min. count
<ENTER> to Continue
```

Press **<ENTER/START>**. The gauge displays:

```
Precision Mode
Depth: # in
Time: ## s
# min. count
```

After counting down to zero, the display will be:

```
## min. to
reach precision.
<ESC> to Abort
<ENTER> to Continue
```

To abort this operation and return to the **Setup** menu, press **<ESC>**.

To continue with the *Precision* function, press **<ENTER/START>**.

After counting down, the display will be:

(For *Soil* mode)

```
%PR= ###.#
DD= ###.#
WD= ###.#
M= ##.# %M= ##.#
```

(For *Asphalt* mode)

```
%Gmb= ###.#
WD= ###.#
M= ##.# %M= ##.#
%Voids= ###.#
```

NOTE

If the required precision cannot be reached in 60 minutes, the gauge halts the count and displays a warning message.

OPTIONS

The Model 3440 Plus gauge offers an *external beeper* and an optional *global positioning system (GPS) unit*. These features can be toggled on and off from the **Options** menu. To access this menu, press **<8>** from the **Setup** menu (see page 5–3). The gauge displays:

```
-Options-  
1. Ext. Beeper - OFF  
2. GPS - OFF
```

EXTERNAL BEEPER


The Model 3440 Plus gauge is equipped with an external beeper. The external beeper can be enabled or disabled as desired. To toggle the external beeper on or off, press **<1>** on the **Options** menu shown above.

GPS OPTION

The Model 3440 Plus gauge can also 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.

To toggle the *GPS* function on or off, press **<2>** on the **Options** menu shown above.

NOTE

When the *GPS* option is installed and enabled, the symbol  appears in the upper right of the **Ready** screen (see page 3–7) when the gauge is receiving GPS satellite signals.

BATTERY STATUS

The *Battery Status* function displays the voltage of the NiMH batteries, the charge percentage, and the status of the charge calibration. To access this function, press **(9)** at the **Setup** menu shown on page 5-3.

For more information, see the *Battery Status* section on page C-10.
For more information on the charge calibration, see page C-12.

PERCENT AIR VOIDS (SOIL MODE)

The gauge uses the specific gravity function to calculate percent air voids and void ratio in *Soil* mode only. The % Voids function allows the operator to enter the specific gravity of a material and disable or enable the percent air voids display.

NOTE

To display percent air voids in *Asphalt* mode, enter a voidless density target value (see the *Target Values* section that begins on page 6–3.

To access the % Voids function, press $\langle \cdot \rangle$ $\langle 0 \rangle$ at the **Setup** menu shown on page 5–3. The gauge displays:

```
% Voids (soil): OFF
SG: #.# #
1. Enable 2. Disable
3. Change Target
```

The current specific gravity (default 2.70) is shown on the second line of the display. For optimum results, use a specific gravity value that is appropriate for the material being measured.

- ▶ To enable the current specific gravity value, press $\langle 1 \rangle$. The gauge enables the value, displays a brief confirmation message, and returns to the **Setup** menu.
- ▶ To disable the current specific gravity, press $\langle 2 \rangle$. The gauge disables the value, displays a brief confirmation message, and returns to the **Setup** menu.
- ▶ To enter a new specific gravity value, press $\langle 3 \rangle$. The gauge prompts the operator for a new specific gravity. If the displayed specific gravity is acceptable, press the $\langle \text{ENTER/START} \rangle$ key. To change the value, use the numeric keys to do so, then press the $\langle \text{ENTER/START} \rangle$ key. In either case, the gauge enables the value, displays a brief confirmation message, and returns to the **Setup** menu.

NOTES

CHAPTER 6

TARGET MENU

The Model 3430 Plus and 3440 Plus Surface Moisture-Density Gauges can store up to four Marshall values, four different Proctor values, and four voidless density target values. The gauge uses the target values to determine the percent compaction after it has determined the density of the test material.

CONTENTS

Target Menu.....	6-2
Target Values.....	6-3
Enable a Target Value.....	6-3
Store a New Target Value.....	6-4
Disable the Target Value.....	6-4

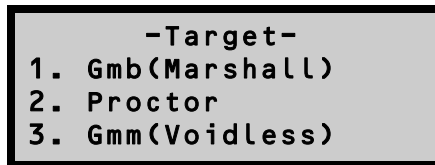
TARGET MENU

The gauge uses operator-specified *target values* to determine the percent compaction after it has determined the density of the test material. Target values include *Gmb (Marshall)*, *Proctor*, and *Gmm (Voidless density)* values.

The gauge uses the Marshall and/or voidless density values to calculate the compaction level in the *Asphalt* mode. The *voidless density* is the maximum theoretical density for the test material as obtained in laboratory tests. When enabled, the voidless density is used to determine the percent air voids.

The gauge uses the Proctor value to calculate the compaction level when taking measurements in the *Soil* mode.

The *Target* function enables the operator to enter and store a new target value, as well as to enable or disable a target value stored in memory. To access the Target menu, press the **<TARGET>** key. The gauge displays:



NOTE

The **<TARGET> key is active only when the Ready screen is displayed.**

To edit a Marshall, Proctor, or voidless density value, press the number key that corresponds to that target value. For example, to edit the Gmb (Marshall) value, press **<1>**.

TARGET VALUES

NOTE

Because the menus for managing the Gmb (Marshall), Proctor, and Gmm (Voidless density) values are essentially the same, the following sections describe only the **Gmb (Marshall)** menu.

To edit a Marshall, Proctor, or voidless density value, press the number key that corresponds to that target value, as shown on the **Target** menu (see page 6–2). For example, to edit the Gmb (Marshall) value, press **1**.

The gauge displays the selected *Target Value* menu. The menu for the Gmb (Marshall) value is:

Gmb: ##.#	pcf
1: ##.#	2: ##.#
3: ##.#	4: ##.#
5: New	6: Disable

The *Target Value* menu shows the target values stored in memory (if any) and the *New* and *Disable* options.

ENABLE A TARGET VALUE

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

STORE A NEW TARGET VALUE

To store a new target value, press **<5>** at the *Target Value* menu. At the prompt, use the number keys to enter the target value (between 20.0 and 200.0). Press the **<ENTER/START>** key. The gauge displays:

```
Gmb: ##.# pcf
Save This Value
for Later Use?
```

- ▶ To enable and use this value without storing it for later use, press **<NO>** key. The gauge enables the value and returns to the **Ready** screen.
- ▶ To enable the value and store it for later use, press the **<YES>** key. The gauge displays:

```
Select Memory Cell:
1: ##.#    2: ##.#
3: ##.#    4: ##.#
Press # to Select
```

The gauge can store the value in one of four *memory cells*. Storing a new value in a cell erases the old value. Use the number keys to store the value. This will replace any stored values that were previously associated with the memory cell. The gauge stores the target value, enables it for use, and returns to the **Ready** screen.

DISABLE THE TARGET VALUE

To disable the target value, press **<6>** at the *Target Value* menu. The gauge disables the target value and returns to the **Ready** screen.

NOTE

The gauge can be used with the target value disabled. In this case, no percent compaction value will be displayed.

CHAPTER 7

CALIBRATION OFFSETS

Troxler calibrates the Model 3430 Plus and 3440 Plus Surface Moisture-Density Gauges for use on soils, asphalt, and concrete. If the gauge is to be used on materials outside of the typical operating range, the operator can adjust the gauge using an *offset*. This chapter explains how to adjust gauge readings using offsets.

CONTENTS

Offset Menu	7-2
Density Offset	7-3
Moisture Offset	7-4
Enable a Stored Moisture Offset	7-4
Enter a New Moisture Offset	7-4
Disable the Moisture Offset	7-7
Trench Offset	7-8

OFFSET MENU

Troxler calibrates each gauge at the factory for use on soils, asphalt, and concrete. The operating range of the gauge is 1100 to 2700 kg/m³ (approximately 70 to 170 pcf). If the gauge is to be used on materials outside of this range, the operator can adjust the gauge using an offset.

The gauge provides three offsets: *density*, *moisture*, and *trench*.

Use a *density offset* if the test material is outside the range of material composition and/or texture used during factory calibration.

Use a *moisture offset* if the test material contains hydrogen in forms other than water, or is high in neutron absorbers. Examples of hydrogen-rich materials are cement, gypsum, coal, mica, and lime. The moisture offset for soils containing these materials is a *negative* value. If the material is high in neutron-absorbing material, such as boron, cadmium, or chlorine, the offset must be a *positive* value.

Perform a *trench offset* before taking measurements inside a trench or close vertical structures. Vertical structures scatter neutrons and gamma photons back to the gauge. This scattering could result in inaccurate moisture and density readings.

NOTE

When the gauge is turned off, all offsets are disabled.

To access the **Offset** menu, press <OFFSET>. The gauge displays:

-Offset-	
1. Density	OFF
2. Moisture	OFF
3. Trench	OFF

NOTE

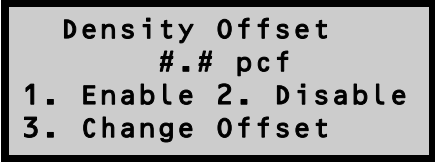
The <OFFSET> key is active only when the Ready screen is displayed.

To select a menu option, press the corresponding number key. The remainder of this chapter details the functions available from the **Offset** menu.

DENSITY OFFSET

The density offset is the difference between the gauge reading and the density as measured by an alternate method. Wet density values should always be used for this comparison.

To access the **Density Offset** menu, press **<1>** at the **Offset** menu shown above. The gauge displays:



```
Density Offset
#.# pcf
1. Enable 2. Disable
3. Change Offset
```

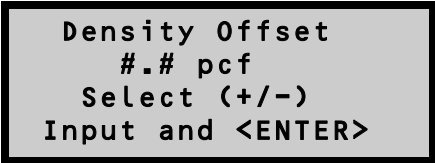
The gauge displays the current density offset on the second line.

- ▶ To enable the displayed density offset, press **<1>**. The gauge enables the offset, displays a brief confirmation message, and returns to the **Ready** screen.
- ▶ To disable the density offset, press **<2>**. The gauge disables the offset, displays a brief confirmation message, and returns to the **Ready** screen.

NOTE

The density offset is also disabled when the gauge is turned off.

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



```
Density Offset
#.# pcf
Select (+/-)
Input and <ENTER>
```

To change the offset, select the offset sign (positive or negative), enter the density offset, and press **<ENTER/START>**. The gauge enables the new density offset and returns to the **Ready** screen.

MOISTURE OFFSET

The moisture offset (*k*) is determined by comparing the moisture of a laboratory sample with the gauge moisture reading. The gauge allows the operator to enter the moisture offset manually, or to have the gauge derive the moisture offset. The gauge can store up to four moisture offsets.

To access the **Moisture Offset** menu, press **<2>** at the **Offset** menu shown on page 7-2. The gauge displays:

Moisture Offset	
1: #.##	2: #.##
3: #.##	4: #.##
5: New	6: Disable

The **Moisture Offset** menu shows the moisture offset values stored in memory (if any) and the *New* and *Disable* options.

ENABLE A STORED MOISTURE OFFSET

To enable a moisture offset value displayed on the **Moisture Offset** menu, press the number key that corresponds to that value. The gauge enables the moisture offset value and returns to the **Ready** screen.

ENTER A NEW MOISTURE OFFSET

A new moisture offset may be entered either manually using the keypad or by using the gauge to record actual measurements, then entering the true moisture value as determined by an alternate method. To enter and enable a new moisture offset value, press **<5>** at the **Moisture Offset** menu shown above. The gauge displays:

Select Offset Source
1. Manual Entry
2. Gauge Derived

Enter Moisture Offset (Manual Entry)

To enter a new moisture value manually via the keypad, first determine the *true moisture content* of a sample taken at the measurement site using standard laboratory methods (for example, oven drying, and so on).

Take multiple readings at or near the location where the sample was removed and record the moisture measurements. Calculate the average moisture of the readings to determine the *gauge moisture content*.

To enter the moisture offset manually, press **<1>** at the **Select Offset Source** menu shown on page 7-4. The gauge request the *true moisture value* as shown:

```
True Moisture %
#.# #
Press <ENTER>
```

Enter the *true moisture value* and press **<ENTER/START>**. The gauge requests the *gauge moisture value* as shown:

```
Gauge Moisture %
#.# #
Press <ENTER>
```

Enter the *gauge moisture value* and press **<ENTER/START>**. The gauge calculates and displays the moisture offset (*K*) as shown:

```
K: #.# #
Save This Value
for Later Use?
```

- ▶ To enable and use this moisture offset without storing it for later use, press **<NO>**. The gauge enables the offset and returns to the **Ready** screen.

- ▶ To enable the moisture offset and store it for later use, press **<YES>**. The gauge displays:

```
Select Memory Cell:
1: ##.#    2: ##.#
3: ##.#    4: ##.#
Press # to Select
```

The gauge can store the value in one of four *memory cells*. Storing a new value in a cell erases the old value. Use the number keys to store the value. This will replace any stored values that were previously associated with the memory cell. The gauge stores the moisture offset, enables it for use, and returns to the **Ready** screen.

Gauge-Derived Moisture Offset

To allow the gauge to derive the moisture offset, the operator must determine the *true moisture content* of a sample taken at the measurement site using standard laboratory methods (for example, oven drying, and so on), then take readings with the gauge.

To use this method of determining the moisture offset, press **<2>** at the **Select Offset Source** menu shown on page 7–4. The gauge request the *true moisture value* as shown:

```
True Moisture %
#.##
Press <ENTER>
```

Enter the *true moisture value* and press **<ENTER/START>**. The gauge displays:

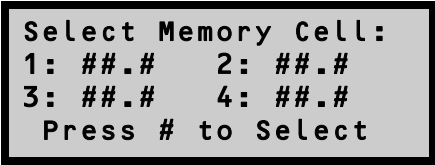
```
Place gauge on soil,
lower rod and
press any key
```

As prompted, place the gauge on the measurement site and press any key. The gauge takes a 240-second count, during which it displays the progress of the count. Upon completion, the gauge calculates and displays the moisture offset (K) as shown:



```
K: ##.##  
Save This Value  
for Later Use?
```

- ▶ To enable and use this moisture offset without storing it for later use, press **(NO)**. The gauge enables the offset and returns to the **Ready** screen.
- ▶ To enable the moisture offset and store it for later use, press **(YES)**. The gauge displays:



```
Select Memory Cell:  
1: ##.#    2: ##.#  
3: ##.#    4: ##.#  
Press # to Select
```

The gauge can store the value in one of four *memory cells*. Storing a new value in a cell erases the old value. Use the number keys to store the value. This will replace any stored values that were previously associated with the memory cell. The gauge stores the moisture offset, enables it for use, and returns to the **Ready** screen.

DISABLE THE MOISTURE OFFSET

To disable the moisture offset value, press **(6)** at the **Moisture Offset** menu shown on page 7–4. The gauge disables the moisture offset and returns to the **Ready** screen.

NOTE

The moisture offset is also disabled when the gauge is turned off.

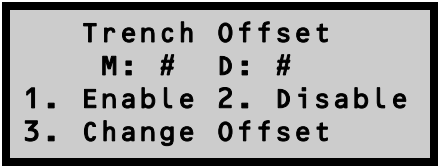
TRENCH OFFSET

To use the gauge in a trench or within 0.6 m (2 ft) of a large vertical surface, first perform a *trench offset*. The trench offset adjusts all moisture measurements and density measurements from backscatter to 4 inches. For direct transmission measurements over 4 inches deep, the gauge will only adjust the moisture measurements. In the displays shown below, *M* refers to *trench moisture offset*; *D* refers to *trench density offset* values.

NOTE

Before determining a new trench offset, ensure that a standard count has been performed recently *outside* the trench.

To access the **Trench Offset** menu, press **<3>** at the **Offset** menu shown on page 7–2. The gauge displays:



```
Trench Offset
M: #   D: #
1. Enable 2. Disable
3. Change Offset
```

The gauge displays the current offset values on the second line.

- ▶ To enable the displayed trench offset, press **<1>**. The gauge enables the offset, displays a brief confirmation message, and returns to the **Ready** screen.
- ▶ To disable the trench offset, press **<2>**. The gauge disables the offset, displays a brief confirmation message, and returns to the **Ready** screen.

NOTE

The trench offset is also disabled when the gauge is turned off.

- ▶ To enter a new trench offset, press **<3>**. The gauge displays:



Place Gauge in
trench on Std.
block in **SAFE** Pos.
Press **<START>**

Select a position inside the trench and the same distance from the wall as the test measurements. Place the gauge on the standard block in this position, set the source rod to the **SAFE** position, and press **<ENTER/START>**. The gauge performs a trench count, calculates the trench moisture and density offset values, enables the trench offset, and returns to the **Ready** screen.

NOTES

CHAPTER 8

PROJECT DATA

The Model 3430 Plus and 3440 Plus Surface Moisture-Density Gauges allow unique project names to be entered into the gauge memory. Subsequent measurements can then be stored under these project names. This chapter describes how to handle project data.

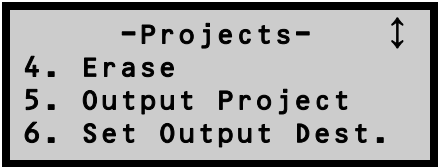
CONTENTS

Project Menu.....	8-2
Select.....	8-3
View.....	8-4
Create a Project.....	8-5
Erase Projects.....	8-6
Output Project.....	8-7
Set Output Destination.....	8-10
Deactivate	8-11
Auto-Store.....	8-12
Active Project Selected	8-12
No Project Data	8-13
No Project Selected	8-13
Manual Store.....	8-14

PROJECT MENU

The gauge can store approximately 750 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. Projects are managed using the **Projects** menu. From this menu, the operator can select a project (make an existing project active so that additional data may be added to it), view project data, create a new project, erase projects, output project data to the selected destination (via the serial or USB port), deactivate a project, and enable the *Auto-Store* function.

To access the **Projects** menu, press **<PROJ>**. The gauge displays:



NOTE

The **<PROJ>** key is active only when the **Ready** screen is displayed.

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.

SELECT

To select an existing project, press <1> at the **Projects** menu shown on page 8–2.

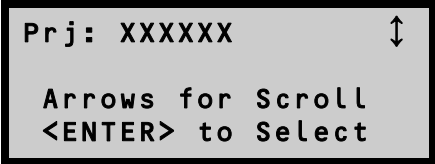
- ▶ If no projects have been created, the gauge displays the error message:



```
No projects are
stored.
Press any key to
continue
```

Press any key to return to the **Projects** menu, and create a project as described on page 8–5.

- ▶ If a project has been created, the gauge displays:



```
Prj: XXXXXX      ↑↓
Arrows for Scroll
<ENTER> to Select
```

Use the arrow keys to scroll through the names of the existing projects. When the desired project is displayed, press <ENTER/START> to select it as active. The gauge sets the selected project as active, briefly displays a confirmation message, and returns to the **Projects** menu.

VIEW

The gauge offers two methods of viewing data. The operator can either view the last measurement results using the *Recall* function described on page 4–17, or any measurement results, including project notes, stored in a project file using the *View* function available from the **Projects** menu.

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



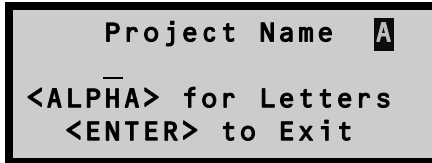
Prj: XXX ↕
04/08/06 04:08p
Rec: # UID: XXX
<ENTER> to select

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

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

CREATE A PROJECT

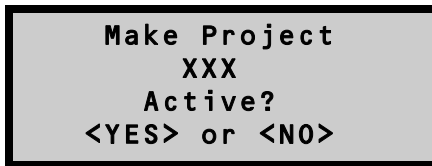
To create a new project, press **<3>** at the **Projects** menu shown on page 8–2. The gauge displays:



```
Project Name  A
—
<ALPHA> for Letters
<ENTER> to Exit
```

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 project name (up to twelve alphanumeric characters) and press the **<ENTER/START>** key. The gauge displays:



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

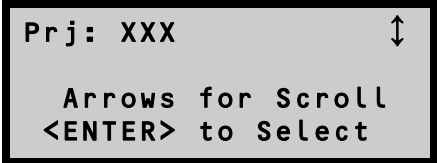
- ▶ To save the new project name without activating it, press **<NO>**. The gauge saves the new project, briefly displays the name of the active project (if any), and returns to the **Projects** menu.
- ▶ To save the new project name and activate the project, press **<YES>**. The gauge enables the new project, displays a brief confirmation message, and returns to the **Projects** menu.

ERASE PROJECTS

To erase either a selected project file or all project files, press **<4>** at the **Projects** menu shown on page 8–2. The gauge displays the **Erase** menu:



- ▶ To erase a single project, press **<1>**. If more than one project has been created, the gauge displays:



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 **Projects** menu.

- ▶ 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 **Projects** menu.

OUTPUT PROJECT

The *Output Project* function within the **Projects** menu allows the operator to print (or upload) project data stored in the gauge to a computer or serial printer connected to the serial port, or to a USB printer or flash drive connected to the USB port. To select the output destination, see page 8–10.

NOTE

The USB port is included only on Model 3440 Plus gauges.

To output project data via the 9-pin serial port, connect a serial cable to the port. Ensure that the serial cable meets the pinout shown on page F–6. An optional serial cable, PN 113128, is available from Troxler. 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. For more information on setting up HyperTerminal to communicate with the gauge, see Appendix H.

To output project data to a USB printer via the USB port, connect a USB cable to the USB port and connect the cable to the USB printer. To output project data to a USB flash drive, connect the flash drive directly to the USB port.

NOTE

The opening for the USB port will accept a device with maximum dimensions of 10 mm (0.40 in.) high by 29 mm (0.79 in.) wide.

NOTE

A list of compatible USB devices is available at: www.troxlerlabs.com/PRODUCTS/PRODLIT/otherlit.shtml

At the **Projects** menu shown on page 8–2, press **(5)**. The gauge request the output format as shown:

```
Output:
1. 32 Column Report
2. Spreadsheet
Press # to Select
```

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®. Figure 8–1 defines the information contained in each column of the spreadsheet.

Press **(1)** or **(2)** to select the desired output format. The gauge displays:

```
Output:
1. One Project
2. All Projects
Press # to Select
```

From this menu, the gauge can print (or upload) either a single project or all projects.

- ▶ To output a single project, press **(1)**. The gauge displays:

```
Prj: XXX ↑
Arrows for Scroll
<ENTER> to Select
```

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)**.

- ▶ To output the data from all projects, press **(2)**.

The gauge prints (or uploads) the selected project(s) and returns to the **Projects** menu shown on page 8–2. Press the **(ESC)** key to return to the **Ready** screen.

Figure 8–1. Spreadsheet Column Definitions

A	Record Number
B	Time and Date
C	Project Name
D	User
E	Mode:
F	Units
G	Location
H	Notes
I	Wet Density
J	Dry Density
K	Moisture
L	% Moisture
M	%Gmb
N	%Voids
O	%Proctor
P	%Voids – Soil
Q	Voids Ratio
R	Latitude
S	Longitude
T	Center Line Side
U	Center Line Distance
V	Gmb Target
W	Gmm Target
X	Proctor Target
Y	Specific Gravity
Z	Bottom Layer Density
AA	Top Layer Thickness
AB	Density Offset
AC	Moisture Offset
AD	Trench Density Offset
AE	Trench Moisture Offset
AF	Model Number:
AG	Serial Number
AH	Depth
AI	Time (Count Time)
AJ	Density Standard Count
AK	Moisture Standard Count
AL	Density Count
AM	Moisture Count

SET OUTPUT DESTINATION

As described on page 8–7, the gauge can print (or upload) project data to a computer or serial printer connected to the serial port, or to a USB printer or flash drive (also referred to as a “thumb drive”) connected to the USB port.

NOTE

The USB port is included only on Model 3440 Plus gauges.

NOTE

The opening for the USB port will accept a device with maximum dimensions of 10 mm (0.40 in.) high by 29 mm (0.79 in.) wide.

NOTE

A list of USB devices that are compatible with the gauge is available on the following page of the Troxler website: www.troxlerlabs.com/PRODUCTS/PRODLIT/otherlit.shtml

To select the output destination, press **<6>** at the **Projects** menu shown on page 8–2. The gauge displays:



```
Output Destination:  
1. Serial Port  
2. USB Printer- 3440  
3. Thumb Drive- 3440
```

Use the numeric keys to select the desired output destination. The gauge enables the selected option, displays a brief confirmation message, and returns to the **Projects** menu. Press **<ESC>** to return to the **Ready** screen.

DEACTIVATE

To deactivate the current project without selecting a different one as active, press **(7)** at the **Projects** menu shown on page 8–2. The gauge deactivates the current project, displays a brief confirmation message, and returns to the **Projects** menu. Press **(ESC)** to return to the **Ready** screen.

AUTO-STORE

The *Auto-Store* function automatically stores sample data upon completion of a measurement. The data is stored under the active project, using a sequential sample ID number. When a new project is created, the sample ID number for the *Auto-Store* function starts at 1 and is incremented each time a new measurement is stored automatically or manually.

To access the *Auto-Store* function, press **<8>** at the **Projects** menu shown on page 8-2. The gauge displays:

```
Auto-Storage
1. ON
2. OFF
Press # to Select
```

- ▶ To return to the **Projects** menu without changing the *Auto-Store* status, press **<ESC>**.
- ▶ To turn the *Auto-Store* function on, press **<1>**.
- ▶ To turn the *Auto-Store* function off, press **<2>**. The gauge updates the *Auto-Store* status, displays a brief confirmation message, and returns to the **Projects** menu.

ACTIVE PROJECT SELECTED

If the operator attempts to enable the *Auto-Store* function and a project has been selected as active, the gauge enables the *Auto-Store* function, briefly displays the confirmation message shown below, and then returns to the **Projects** menu.

```
Auto-Storage
Is Now ON
Prj:      XXX
Next Sample # X
```

NO PROJECT DATA

If the operator attempts to enable the *Auto-Store* function but no project has been created, the gauge displays:

No Project Data
Do You Want To
Enable Auto-Store by
Creating a Project?

- ▶ To return to the **Projects** menu without enabling the *Auto-Store* function, press **(NO)**.
- ▶ To create a project and enable the *Auto-Store* function, press **(YES)**. The gauge displays the screens required to create a project as described on page 8–5. When the project name is complete, the gauge sets the project as active, displays the confirmation message shown on page 8–12, and returns to the **Projects** menu.

NO PROJECT SELECTED

If the operator attempts to enable the *Auto-Store* function and one or more projects have been created, but no project has been selected as active, the gauge displays:

Auto-Store Requires
An Active Project:
1. Select Project
2. Create Project

- ▶ To select an existing project, press **(1)**. The gauge displays the screens required to select a project as described on page 8–3. After the project is selected, the gauge sets the project as active, briefly displays the confirmation shown on page 8–12, and returns to the **Projects** menu.
- ▶ To create a new project, press **(2)**. The gauge displays the screens required to create a project as described on page 8–5. After the project is created, the gauge sets the project as active, briefly displays the confirmation shown on page 8–12, and returns to the **Projects** menu.

MANUAL STORE

After completing a measurement and before taking another one, sample data can be stored manually under the active project. Refer to pages 8–3 through 8–5 for instructions on creating and selecting the active project.

To manually store measurement data, press the **⟨STORE⟩** key while data is being displayed. If no project is active when the **⟨STORE⟩** key is pressed, the gauge displays the error message **No active project!**, then returns to the **Ready** screen.

NOTE

The **⟨STORE⟩ key is active only when measurement data is displayed. Measurement data is displayed at the end of a reading, or the most recent test results can be displayed using the **⟨RECALL⟩** key (see page 4–17).**

For each measurement, the gauge can store a location description of up to 12 characters, as well as a note of up to 15 characters. For an *Asphalt* mode measurement, the gauge can also store the location with respect to the centerline (left, right, or neither), and the distance from the centerline. Follow the prompts to enter location information and/or a note.

CHAPTER 9

EXTENDED MENU

The gauge software includes an **Extended** menu, which contains functions that are intended for use by authorized personnel only. This chapter describes these functions.

CONTENTS

Extended Menu	9-2
Clock/Calendar	9-3
User ID.....	9-3
Customer Name	9-3
Language.....	9-4
Source Decay	9-5
Erase Standard Counts	9-6
Low Battery Warning	9-7
Software Reset	9-8
Test Menu	9-9

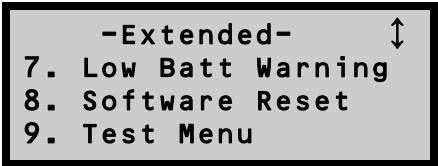
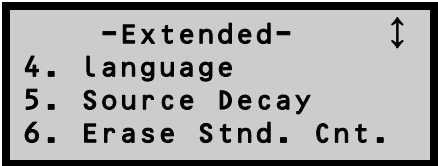
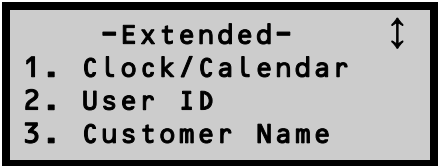
EXTENDED MENU

The **Extended** menu requires the use of the *access code* shown on page xiii.

To access the **Extended** menu, press **<SETUP>** to display the **Setup** menu, then press **<.>** **<9>**. The gauge requests an access code:



Enter the access code shown on page xiii and press the **<ENTER/START>** key. The gauge displays the **Extended** menu:



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.

CLOCK/CALENDAR

The *Clock/Calendar* function allows the operator to change the date and time, and to select the display format for each. This function is described on page 3–12.

USER ID

The gauge can store a three-character *user ID* with each measurement. To enter or change the user ID, refer to page 3–14.

CUSTOMER NAME

The gauge can store a customer name of up to 12 characters. To enter or change the customer name, refer to page 3–14.

LANGUAGE

NOTE

The *Language* function has not yet been implemented.

The gauge supports four languages (English, Spanish, German, and French). To access the *Language* function, press <4> at the **Extended** menu shown on page 9-1. The gauge displays:



Use the up and down arrows to scroll between the menu options. To select the desired language, press the corresponding numeric key. To return to the **Extended** menu, press the <ESC> key.

SOURCE DECAY

The strength of radioactive material is measured by its activity, or rate of decay. This activity decreases with time. The length of time it takes a given amount of radioactive material to decay to half of its original strength is referred to as the *half-life*. The half-life of the Am-241:Be source is 432 years. The half-life of the Cs-137 source is 30 years.

The *Source Decay* function allows the operator to view how the decrease in the radiation intensity of the source affects gauge density measurements. It displays the actual density standard count, the predicted standard count, and the percent difference between the two sets of counts. The gauge calculates the predicted standard count based upon the density standard count at the time the gauge was calibrated and the number of days that have elapsed since calibration.

To access the *Source Decay* function, press **<5>** at the **Extended** menu shown on page 9-1. The gauge displays:

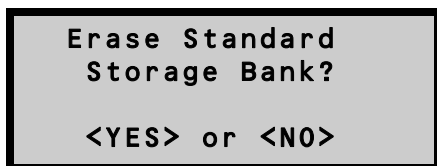
```
Standard After Decay
Current: ###
Predicted: ###
%Diff: ###
```

To return to the **Extended** menu, press the **<ENTER/START>** or **<ESC>** key.

ERASE STANDARD COUNTS

The *Erase Standard Counts* function allows the operator or service technician to remove all (four) standard counts from gauge memory.

To execute the *Erase Standard Counts* function, press **<6>** at the **Extended** menu shown on page 9-1. The gauge displays:



- ▶ To return to the **Extended** menu without erasing the standard counts stored in memory, press **<NO>**.
- ▶ To erase all the standard counts, press **<YES>**. The gauge erases the standard counts stored in memory and returns to the **Extended** menu.

LOW BATTERY WARNING

As described on pages 5–18 and C–10, the gauge constantly monitors the voltage and charge status of the NiMH batteries. The *Battery Status* function enables the operator to view the status of the NiMH batteries, as well as the status (*GOOD* or *BAD*) of the charge calibration.

In addition, if the battery voltage falls below a pre-determined threshold, the gauge displays a low-battery warning symbol (⏻) in the upper right corner of the **Ready** display.

By default (*Normal* setting), the low-battery warning is displayed when the battery voltage falls below 6.2 V dc. At that point, the gauge has approximately three hours of battery operating life left, or less if the backlight is used. If the gauge is equipped with a GPS unit (available only on Model 3440 Plus gauges), the remaining battery operating life will be approximately one hour.

The *Low Battery Warning* function enables the operator to select how early or late the low-battery warning is displayed. An early setting provides more time between when the warning is displayed and when the gauge shuts down. A later setting provides less warning time.

To access this function, press <7> at the **Extended** menu shown on page 9–1. The gauge displays:

```
-Low Batt Warning- ↑↓  
1. Earliest  
2. Early  
3. Normal
```

```
-Low Batt Warning- ↑↓  
4. Later  
5. Latest
```

Use the up and down arrows to scroll between the menu options. To select the desired low battery warning option, press the corresponding numeric key. To return to the **Extended** menu, press the <ESC> key.

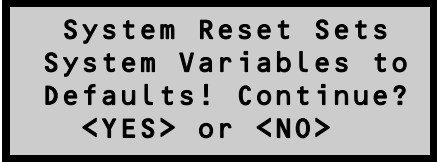
SOFTWARE RESET

The *Software Reset* function sets selected user setup values (count time, measurement units, depth mode, user ID, customer name, etc.) to their factory default values.

NOTE

The *Software Reset* function does *not* affect the calibration constants, gauge serial number, clock and calendar settings, or projects stored in the gauge memory.

To access this function, press **<7>** at the **Extended** menu shown on page 9–1. The gauge displays:



System Reset Sets
System Variables to
Defaults! Continue?
<YES> or <NO>

- ▶ To return to the **Extended** menu without resetting system variables, press **<NO>**.
- ▶ To reset system variables to default values, press **<YES>**. The gauge resets the system variables and returns to the **Extended** menu.

TEST MENU

NOTE

The functions available from the **Test Menu** are to be used by qualified service personnel only!

NOTES

APPENDIX A

RADIATION THEORY AND SAFETY

This appendix is required reading for anyone who will use the Troxler Model 3430 Plus and 3440 Plus Surface Moisture-Density Gauges. This appendix covers topics related to radiation theory and the safe operation of the gauge. A brief overview of the regulatory requirements related to the ownership and use of the gauge, as well as a listing of radiation safety-related warnings and cautions, is included.

CONTENTS

Radiation Theory	A-2
Atomic Structure	A-2
Radioactivity	A-3
Types of Radiation	A-4
Radiation Safety.....	A-5
Radiation Dose	A-5
Limiting Exposure.....	A-6
Personnel Monitoring.....	A-8
Source Encapsulation	A-8
Source Rod Inspection	A-9
Daily Inspection	A-10
Cleaning the Tungsten Block	A-11
Leak Testing.....	A-13
Regulatory Requirements	A-14
Licensing	A-14
Training	A-14
Disposal.....	A-15
Emergency Procedures.....	A-15
Gauge Use Precautions	A-17
Radiation Profile.....	A-18

RADIATION THEORY

A more detailed discussion of radiological theory can be found in the *Troxler Nuclear Gauge Safety Training Program* manual, provided at the Troxler Safety Class.

ATOMIC STRUCTURE

All matter is made up of atoms. For example, water has two atoms of hydrogen (H) and one atom of oxygen (O), which in chemical notation is written H_2O .

An atom is made up of a dense nucleus, consisting of positively charged protons and uncharged neutrons, surrounded by a cloud of negatively charged electrons. Under normal circumstances, the number of electrons in an atom equals the number of protons. The number of protons in the atom is called the *atomic number (Z)*. A chemical element consists of all atoms having the same atomic number.

The number of protons plus neutrons in the nucleus is called the *atomic mass (A)*. Atoms of a given chemical element can exist in slightly different variants called *isotopes* that have different atomic masses. For example, carbon-12 (C-12) is non-radioactive and carbon-14 (C-14) is radioactive. Isotopes that are radioactive are termed radioisotopes or radionuclides.

Figure A-1 depicts a helium atom consisting of two protons and two neutrons in the nucleus and two orbiting electrons.

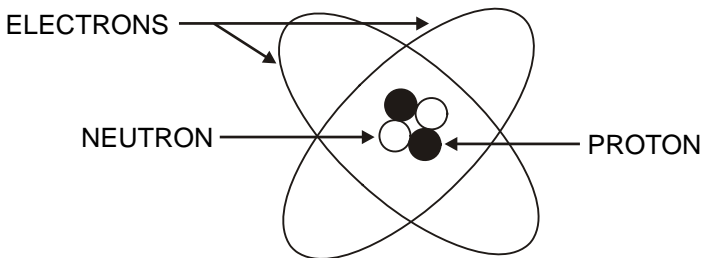


Figure A-1. Diagram of an Atom

RADIOACTIVITY

Radioactivity is the spontaneous transformation (or disintegration) of an unstable nucleus into a more stable configuration accompanied by the emission of radiation.

The quantity of a radioactive material is measured in terms of the average number of nuclear disintegrations per unit time. The traditional unit of measure for radioactivity (or *activity*) is the *curie* (Ci), which is defined as 3.7×10^{10} disintegrations per second. The activities of the radioactive sources in nuclear gauges are so small that they are typically measured in *millicuries* (mCi), which is one-thousandth of a curie, or *microcuries* (μ Ci), which is one-millionth of a curie.

In the Standard International (SI) (or *metric*) system, the unit of activity is the *becquerel* (Bq), which equals one disintegration per second. Because the becquerel is such an extremely small unit, the activity of sources in nuclear gauges is normally expressed in *megabecquerel* (MBq), which is one million becquerels, or *gigabecquerel* (GBq), which is one billion Bq.

The radioactivity of a source is not constant, but decreases with time as the source decays. The time it takes for one-half of the original atoms to disintegrate is called the *half-life*. In successive half-lives, the activity decreases to 1/2, 1/4, 1/8 and so on of the initial value. After seven half-lives, less than 1% of the original radioactive atoms remain. Each radioisotope has a characteristic half-life, which can range from seconds to billions of years. The half-lives for the typical radioisotopes used in nuclear gauges are:

Radioisotope	Half-life
Cs-137	30 years
Am-241	432 years

TYPES OF RADIATION

The radioactive sources in the gauge produce four types of radiation:

- Alpha particles
- Beta particles
- Gamma rays (photons)
- Neutrons

The alpha and beta particles are stopped by the source capsule. Therefore, they present no external hazard to personnel. Only the gamma and neutron radiation from sealed sources contribute to any occupational radiation exposure.

Gamma rays (photons) are a type of electromagnetic radiation, like X rays, radio waves, and visible light. Photons have no mass or electrical charge, and travel at the speed of light. Gamma rays are energetic and penetrating. Dense materials (such as lead, tungsten, and so on) provide the best shielding against gamma radiation.

Neutrons are a form of particulate radiation but, unlike alpha and beta particles, they have no electrical charge. This makes neutron radiation very penetrating. Fast neutrons lose energy primarily by so-called “billiard ball” elastic collisions with the nuclei of low atomic number atoms, especially hydrogen. The best shielding materials for fast neutrons are those with a high hydrogen content, such as water, concrete, and polyethylene.

RADIATION SAFETY

This section discusses the principles of general radiation safety. This information includes specific procedures for operating, inspecting, cleaning, and leak testing the gauge to ensure safe operation.

RADIATION DOSE

Radiation cannot be detected by any of the human senses (sight, touch, hearing, smell). However, using appropriate instruments and devices, radiation can be detected and measured at levels far below those that significantly affect health.

For purposes of radiation protection, the basic unit of radiation dose is the *rem*. The SI unit is the *sievert (Sv)*, where $1 \text{ Sv} = 100 \text{ rem}$. The rem is a relatively large unit, so often radiation dose is expressed in smaller units called millirem (mrem), where $1 \text{ rem} = 1000 \text{ mrem}$.

The risk of injury from radiation is generally related to the total radiation dose received over a period of time. It is also related to the dose rate, which is the amount of dose received per unit time. The same amount of radiation received over a long period (months to years) is much less hazardous than if received over a very short period (hours). This has to do with the body's ability to repair cell damage caused by the radiation.

The U.S. Nuclear Regulatory Commission (NRC) has established the following limits on the amount of whole body radiation exposure that individuals may safely receive from licensed radioactive materials.

Type of Individual	Dose Limit
Adult worker	5000 mrem per year
Minor (under 18 years old)	500 mrem per year
Member of the public	100 mrem per year

LIMITING EXPOSURE

Under average conditions, an individual working with the gauge will receive less than 200 millirem per year.

A basic principle of radiation protection is that radiation exposure should be kept as far below the limits as is reasonably achievable. This is known as the *ALARA* (as low as reasonable achievable) principle. The three methods for limiting exposure are:

Time

Distance

Shielding

Time

The simplest way to reduce exposure is to minimize the time spent around a radioactive source. If the time spent near a source is cut in half, then the exposure is halved, all other factors remaining constant.

Distance

Distance is another effective means to reduce radiation exposure. A formula known as the *inverse square law* relates the radiation exposure rate to distance (Figure A-2). Doubling the distance from a radiation source reduces the exposure to one-fourth its original value. If the distance is tripled, then the exposure is reduced by a factor of nine, and so on.

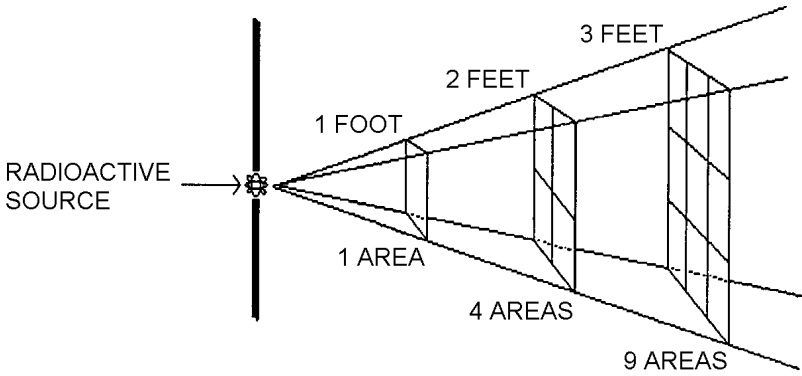


Figure A-2. Effect of Distance on Exposure

Shielding

Shielding is any material used to reduce the radiation exposure rate from a radioactive source. The gauge has some built-in shielding, which reduces the exposure rate. When gauges are in storage, additional shielding may be necessary to keep exposure to personnel in adjacent areas below the dose limits for members of the public.

The thickness of any material that reduces the incident radiation intensity by one-half is known as the *half-value layer (HVL)*. The HVL of a material varies with the type and energy of radiation. The HVL values of certain common shielding materials are shown below for gamma and fast neutron radiation.

Material	Cs-137 Gamma Half-Value Layer	Am-241:Be Neutrons Half-Value Layer
Concrete	1.9 inches	4.3 inches
Lead	0.3 inches	*

* Lead does not provide any effective shielding of fast neutrons.

PERSONNEL MONITORING

In the United States, anyone working with or near radioactive materials is subject to occupational dose limits. Individual monitoring of each authorized user is recommended in order to demonstrate compliance with these dose limits.

The most common types of individual monitoring devices used by licensees are film badges and thermoluminescent dosimeter (TLD) badges. Film badges are typically exchanged and processed monthly due to concerns about film fading. TLD badges are usually exchanged quarterly. Troxler offers NVLAP-certified personnel monitoring services using TLD badges.

In Canada, nuclear gauge users are not normally classified as Atomic Radiation Workers. In such cases, the general public dose limit of 500 mrem/year applies. Users may not be required to wear a dosimeter. To establish the personnel monitoring requirements for your application, consult the conditions of your radioisotope license and the CNSC regulatory document *R91: Monitoring and Dose Recording for the Individual*.

SOURCE ENCAPSULATION

The neutron (Am-241:Be) and photon (Cs-137) source materials are welded inside stainless steel capsules. These sealed sources meet U.S. and international regulatory requirements for classification as “Special Form” radioactive material for purposes of transportation. The sealed sources are designed to prevent leakage of radioactive material under severe accident conditions. They are also designed to comply with applicable ANSI classification requirements for sealed sources used in portable gauges.

SOURCE ROD INSPECTION

To ensure the integrity of the source rod, Troxler recommends that a qualified Troxler service person inspect the gauge and the source rod at least once every five years. This inspection includes checking for excessive wear, corrosion, or damage that could affect the safety of gauge operation.

However, as a precaution, ensure that the tip of the source rod is intact and undamaged (that is, ensure that the source is not missing). Use a radiation survey meter to check the radiation levels at the gauge base surface (without extending the source rod). A maximum reading of 10-20 mrem/hr is normal, and indicates the source is present. However, if the maximum reading is less than 1 mrem/hr or if a survey meter is not available, perform a visual inspection of the source rod tip as follows to confirm its integrity:

1. Extend the source rod just far enough to see the source rod tip. The tip should appear flat to slightly rounded and smooth.
2. Stay at least three feet away from the tip of the unshielded source rod and complete the inspection as quickly as possible to minimize exposure (the dose rate at three feet from the unshielded source is about 2.7 mrem/hr).

If the visual inspection indicates that the source rod tip is broken off (source is missing):

1. Immediately contact your Radiation Safety Officer (RSO).
2. Initiate a search for the source starting at the location where the gauge was last used.
3. Report lost or missing radioactive sources to the state or federal radiation control agency in accordance with applicable regulatory requirements.

Contact the Troxler Radiation Safety Department for further advice.

DAILY INSPECTION

The gauge should be inspected daily before use to ensure proper operation of all safety features as follows:

- ✓ The source rod opening in the bottom of the gauge is equipped with a spring-loaded tungsten sliding block that shuts when the source rod is in the **SAFE** (shielded) position. To check the operation of the sliding block, push the source rod down into the backscatter position (see **Figure 3–3** on page 3–5), and then raise it back to the **SAFE** position. You should hear a *click* as the sliding block snaps shut. Turn the gauge over and verify that the sliding block is shut. If any portion of the opening is uncovered, the sliding block should be cleaned before using, transporting, or storing the gauge. Refer to page A–11 for instructions on cleaning the sliding block.

NOTE

The bottom edge of the tungsten sliding block is beveled, as shown in Figure A–3 on page A–12. As a result, there may appear to be a slight opening when the sliding block is closed. However, you should hear a *click* as the sliding block snaps shut when the source rod is raised to the SAFE position.



WARNING

Do not store or transport the gauge unless the sliding block is closed. Increased radiation levels may cause excessive personnel radiation exposure and may violate transportation regulations.

- ✓ If a radiation survey instrument is available, verify that the radioactive gamma source is in place by measuring the exposure rate at the surface of the gauge. The exposure rate should be approximately 10–20 mrem per hour. A reading of about 1 mrem or less indicates either that the survey instrument is not working properly or that the cesium-137 source may be missing. Refer to the *Troubleshooting* section on page C–2 for further instructions.

CLEANING THE TUNGSTEN BLOCK

If the tungsten sliding block is not kept clean, it may stick partially or completely open when the source rod is raised to the **SAFE** (shielded) position. This will result in high radiation levels near or in line with the source rod opening on the bottom of the gauge. After cleaning and reassembling the gauge as described below, check the operation of the sliding block by pushing the source rod into the backscatter position, then returning it to the **SAFE** position. You should hear a *click* as the sliding block snaps shut. Inspect the opening on the base of the gauge to confirm that the sliding block is closed. If not, check that the sliding block spring was properly installed after cleaning. If the sliding block still does not close properly, immediately contact the nearest Troxler Service Center. For a list of Troxler and authorized Troxler service centers, refer to page iii of this manual or visit the Troxler website at www.troxlerlabs.com/SERVICES/services.shtml.



WARNING

Do not store or transport the gauge unless the sliding block is closed. Increased radiation levels may violate transportation regulations, and may cause excessive personnel radiation exposure.

The tungsten sliding block may require cleaning if the source rod becomes difficult to lower into the “measure” position, or if a *click* is not heard when the source rod is raised to the **SAFE** (shielded) position. An improperly operating sliding block may also result in erratic or incorrect density readings and increased radiation levels.



WARNING

Removal of the sliding block results in dose rates of up to one rem per hour in the path of the beam. Stand clear of the gauge bottom while performing this procedure and proceed as quickly as possible while working in the cavity to minimize exposure to your extremities.

- ✓ With the source rod in the **SAFE** (shielded) position, place the gauge on its side.
- ✓ Clean the heads of the four corner screws that hold the bottom plate to the gauge base (Figure A-3). Using a Phillips screwdriver, remove the four screws in the corner of the plate and remove the plate.
- ✓ To reduce radiological exposure, stand to one side of the gauge. Paying close attention to the position of the sliding block, remove the block.
- ✓ Using a stiff brush or rag soaked in alcohol, clean the sliding block and the cavity.
- ✓ Re-install the sliding block with the angled side up. Apply a light coating of Magnalube-G paste to the **top angled** surface of the sliding block.
- ✓ Re-install the bottom plate. **Do not over-tighten screws!** Ensure that the source rod moves up and down freely.

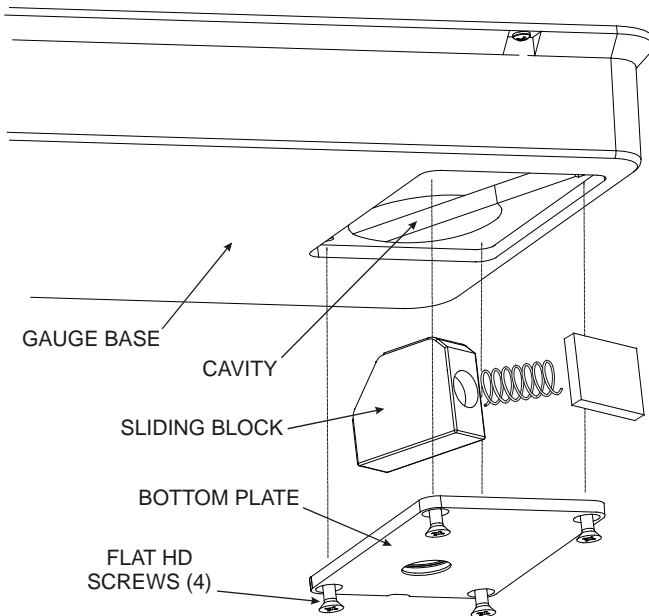


Figure A-3. Cleaning the Tungsten Sliding Block

LEAK TESTING

Unless specified otherwise by your license or state regulations, the gauge must be leak tested at intervals not exceeding 12 months to ensure the integrity of the radioactive source encapsulation. Sample analysis must be performed by a licensed laboratory only.

Using the Troxler Model 3880 Leak Test Kit (PN 102868) and accompanying instructions, perform the following procedure:



WARNING

Ensure that the source rod is in the SAFE position (see Figure 3-3 on page 3-5).

- ✓ Write the date, gauge model number, and serial number on the sample form and label.
- ✓ Remove the control panel from the gauge topshell. Locate the yellow radiation label on the top surface of the base.
- ✓ Holding the wipe disk with the tongs, wipe the radiation label.
- ✓ Turn the gauge on its side and locate the opening where the source rod extends through the gauge base.
- ✓ Holding the wipe disk with tongs, wipe the area around and inside the opening where the source rod extends from the gauge base.
- ✓ Pack the disk, as instructed, in the envelope and mail to Troxler Electronic Laboratories, Inc. for analysis.
- ✓ Secure the gauge properly.

REGULATORY REQUIREMENTS

This section summarizes the licensing and training requirements that pertain to ownership or operation of a nuclear gauge. This section also provides information on the proper disposal of the gauge, as well as emergency procedures to follow if the gauge is lost, stolen, or damaged.

LICENSING

In the United States, possession and use of the radioactive materials in a nuclear gauge require a license issued by the U.S. Nuclear Regulatory Commission (NRC) or an Agreement State licensing agency. Detailed information on obtaining a license is contained in the *Troxler Licensing Guide*. Copies of this guide are available from Troxler, or can be downloaded from the Troxler website, www.troxlerlabs.com.

To purchase a nuclear gauge in Canada, an owner must obtain a radioisotope license from the Canadian Nuclear Safety Commission (CNSC). The owner should obtain copies of the CNSC Regulations and the Transportation of Dangerous Goods Act and Regulations. For other countries, please consult your local regulatory agency.

TRAINING

In the United States, anyone working with or near radioactive materials must complete a radiation safety training course to be designated an *authorized user*. Authorized users must be trained in the precautions and procedures to minimize radiation exposure; applicable regulatory requirements; and the operating, emergency, maintenance, and transportation procedures for the gauge. Troxler offers training classes designed to meet regulatory agency training requirements for nuclear gauge users.

DISPOSAL

A nuclear gauge contains licensed radioactive material. At the end of a gauge's service life, it must not be discarded as ordinary trash, recycled as scrap material, or abandoned. Instead, a nuclear gauge must be transferred to an authorized recipient licensed by the NRC or an Agreement State. For further information on gauge disposal, contact Troxler.

EMERGENCY PROCEDURES

If the nuclear gauge is lost or stolen, then immediately notify the gauge owner's Radiation Safety Officer (RSO).

The gauge owner should complete the emergency contact information on the lines furnished below. (Note that *company* refers to the gauge owner's company, not Troxler Electronic Laboratories.) This information should be readily available to the gauge operator at all times.

The company RSO is _____

Call the RSO at _____

The regulatory agency is _____

Call the agency at _____

If a gauge is damaged, then follow the steps below:

1. Locate the gauge and/or sources.
2. Do not touch or move the gauge.
3. Immediately rope off an area around the nuclear gauge and/or sources. A radius of 15 ft (5 m) is sufficient. Do not leave the area unattended.
4. Keep all unauthorized personnel from the nuclear gauge.

5. If a vehicle is involved, it must be stopped until the extent of contamination, if any, can be established.
6. The gauge user should perform a visual inspection of the nuclear gauge to determine if the source housing or shielding has been damaged.
7. Use a survey meter (such as the TroxAlert Survey Meter) to measure the dose rate at a distance of one meter (3 ft) from the gauge.
8. Contact the company RSO (name and number given at the beginning of this section). Provide the RSO with the following:
 - a. The date, time, and location of the accident
 - b. The gauge model and serial number
 - c. The nature of the accident
 - d. The location and condition of the gauge and/or source
 - e. The dose rate at 3 ft (1 m) from the gauge
9. If you are unable to reach the RSO, then call your regulatory agency (name and number given at the beginning of this section).
10. Follow the instructions of the RSO. The RSO may need to report the incident to the regulatory agency. The RSO may also be required to notify the USDOT of accidents during transport.
11. Before shipping a damaged gauge to Troxler, obtain an RGA (Returned Goods Authorization) number from the Troxler Customer Service Department, as described in the *Returning the Gauge for Service* section on page C-30.

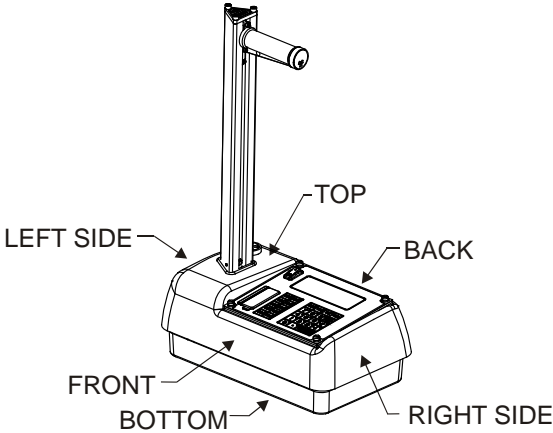
GAUGE USE PRECAUTIONS

The following precautions should be observed when transporting, storing, maintaining, or operating the gauge.

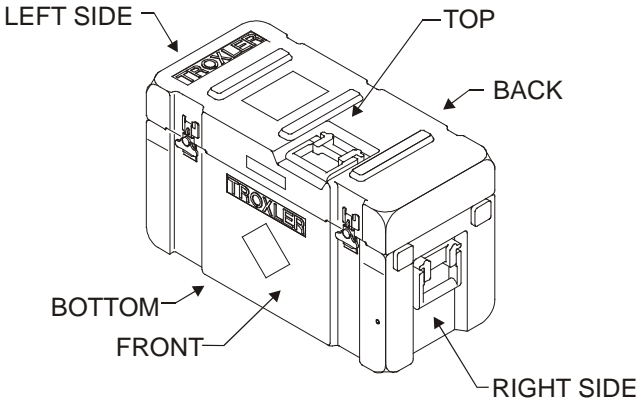
- ◆ Never touch the unshielded tip of the source rod with your bare hands. The dose rates on contact with the source rod tip can result in exposures exceeding the annual dose limits to the skin of the extremities within a short time period (about 1 hour).
- ◆ When not taking readings, always keep the source rod in the **SAFE** (shielded) position. For added user safety, the source rod automatically retracts to the **SAFE** position when the gauge is lifted by the handle.
- ◆ If you do not hear a *click* when the gauge is raised to the **SAFE** position, look at the bottom of the gauge to verify that the tungsten sliding block is completely closed. If the gauge base opening is not completely closed by the sliding block, the sliding block may require cleaning. Refer to Appendix C for cleaning instructions.
- ◆ Do not store or transport the gauge unless the sliding block is completely closed. Increased radiation levels may cause excessive personnel radiation exposure and may violate transportation regulations.
- ◆ When preparing a test site, use the drill rod assembly to drill the test hole. **Under no circumstances should the source rod of the gauge be used to drill holes.**
- ◆ Do not tamper with or modify the gauge. Also, do not remove the sealed source from the gauge. Tampering with or modifying the gauge or removing the sealed source can be dangerous. Such actions are illegal unless authorized by your radioactive materials license.

RADIATION PROFILE

Table A-1 shows the radiation profile for the gauge. The table lists the radiation dose equivalent rates (in mrem/hour) for each side of the gauge and transport case shown in Figure A-4.



GAUGE



TRANSPORT CASE

Figure A-4. Gauge and Transport Case

Table A–1. Radiation Profile for Gauge
(Dose Rate in Millirems per Hour)

	5 cm			30 cm			1 m		
	Gamma	Neutron	Total	Gamma	Neutron	Total	Gamma	Neutron	Total
GAUGE									
Back	9	0.6	9.6	1.4	0.2	1.6	0.3	0.05	0.3
Right Side	4	0.3	4.3	1.6	0.1	1.7	0.3	<0.05	0.3
Front	5.5	0.4	5.9	0.9	0.15	1.0	0.1	<0.05	0.1
Left Side	16	0.3	16.3	1.4	0.05	1.5	0.2	<0.05	0.2
Top	11	0.75	11.8	1.5	0.2	1.7	0.2	<0.05	0.2
Bottom	17	2	19.0	0.5	0.2	0.7	0.1	0.05	0.1
GAUGE IN TRANSPORT CASE									
Back	2.0	0.3	2.3	0.7	0.09	0.8	0.1	0.05	0.2
Right Side	7.5	1	8.5	0.7	0.2	0.9	0.1	0.05	0.1
Front	4.0	0.3	4.3	0.8	0.1	0.9	0.1	0.05	0.2
Left Side	0.4	0.09	0.4	0.1	0.05	0.2	<0.1	<0.05	0.1
Top	9.0	0.2	9.2	1.1	0.1	1.2	0.2	<0.05	0.2
Bottom	3.1	0.3	3.4	1.3	0.09	1.4	0.3	<0.05	0.3

NOTES:

1. All radiation measurements are in millirem per hour.
2. Gamma measurements were obtained with a Bicon Microrem survey meter, serial number B464Y, calibrated April 11, 2006.
3. Neutron measurements were obtained with a Nuclear Research Corporation Model NP-2 survey meter, serial number 183404, calibrated July 13, 2006.

NOTES

APPENDIX B

TRANSPORTATION AND SHIPPING

Devices containing radioactive materials must be transported in accordance with the rules of the U.S. Department of Transportation (DOT) and the International Atomic Energy Agency (IAEA). The IAEA recommendations have been codified in the International Air Transport Association (IATA) Dangerous Goods Regulations. International customers should consult their local government or licensing authority for applicable regulations.

CONTENTS

U.S. Shipping Requirements.....	B-2
Accident Notification Requirements.....	B-3
Hazmat Training.....	B-3
Canadian Shipping Requirements.....	B-4

U.S. SHIPPING REQUIREMENTS

The U.S. DOT hazmat regulations (49 CFR, Parts 100–185) apply any time a nuclear device is transported by motor vehicle on a public highway or by other means of transport (rail, air, ship).

The major requirements for transporting a nuclear gauge in the United States are listed below. For more detailed information about these requirements, please refer to the *Troxler Transportation Guide*.

- ◆ A copy of the current IAEA Certificate of Competent Authority for each source in the gauge (Special Form Certificate) must be kept on file. Current versions can be downloaded from the Troxler website, www.troxlerlabs.com.
- ◆ A copy of the results of the Type A package testing must be kept on file.
- ◆ Hazmat employee training records must be kept on file.
- ◆ An *Emergency Response Information* document must be in the vehicle and immediately accessible to the driver.
- ◆ A properly completed bill of lading must be in the vehicle and immediately accessible to the driver. The shipping papers must include a 24-hr emergency response phone number.
- ◆ If shipping by air, a *Shipper's Declaration for Dangerous Goods* must accompany the air waybill.
- ◆ The package must be properly marked and labeled in accordance with hazmat regulations.
- ◆ The package must have a tamper-evident seal.
- ◆ The package must be inspected prior to each shipment.
- ◆ The package must be securely blocked and braced in the vehicle to prevent shifting during transport.

ACCIDENT NOTIFICATION REQUIREMENTS

In the event of a reportable incident involving radioactive material, notify the licensing agency as soon as practical. The operator is also required to notify, at the earliest practical moment, the U.S. DOT at 1-800-424-8802 of an accident that occurs during the course of transportation (including loading, unloading, and temporary storage) in which fire, breakage, spillage, or suspected contamination occurs involving shipment of radioactive materials.

HAZMAT TRAINING

The U.S. DOT regulations require every hazmat employer to train, test, certify, and maintain records for each hazmat employee. Hazmat training applies to anyone who transports or prepares for transport radioactive materials. Refresher training is required every three years.

CANADIAN SHIPPING REQUIREMENTS

The *Transportation of Dangerous Goods Act and Regulations* (TDG) and *Transport Packaging of Radioactive Materials Regulations* (TPRM) apply any time a nuclear device used in commerce is transported by any means in Canada.

For training and accident notification requirements, consult the *Transportation Of Dangerous Goods Regulations*. For further information on transporting a nuclear device, contact the transportation section of The Canadian Nuclear Safety Commission (CNSC).

APPENDIX C

TROUBLESHOOTING AND SERVICE

This appendix provides details for troubleshooting and servicing the Troxler Model 3430 Plus and 3440 Plus Surface Moisture-Density Gauges. For further details, contact the nearest Troxler Service Center or representative. For a list of Troxler and authorized Troxler service centers, refer to page iii of this manual or visit the Troxler website at www.troxlerlabs.com/SERVICES/services.shtml.

CONTENTS

Troubleshooting	C-2
Error Messages	C-6
Display Contrast	C-9
Batteries	C-10
Battery Status	C-10
Charging the NiMH Batteries	C-12
Charge Calibration	C-12
Replacing the NiMH Battery Pack	C-13
Installing and Using Alkaline Batteries	C-14
Mechanical Maintenance	C-15
Cleaning the Base and Top Shell	C-15
Lubricating the Source Rod	C-16
Replacing Gasket and O-Ring	C-17
Replacement Parts	C-18
Accessories	C-29
Options	C-29
Maintenance Supplies	C-29
Returning the Gauge for Service	C-30

TROUBLESHOOTING

GAUGE FAILS STANDARD COUNTS

- ✓ Ensure the source rod opening on the bottom of the gauge is completely closed or covered by the tungsten sliding block. If any opening is visible, the sliding block should be cleaned. Refer to page A-11 for instructions. If the sliding block still does not close completely, contact the nearest Troxler Service Center.
- ✓ Ensure that the standard count site is asphalt, concrete, or compacted soil at least 10 cm (4 in.) thick.
- ✓ Check for 3 m (10 ft) clearance around gauge.
- ✓ Check that any sources are at least 10 m (33 ft) away.
- ✓ Ensure the source rod handle is fully latched in the **SAFE** (shielded) position.
- ✓ Check that the gauge is positioned correctly on the reference standard block (see **Figure 4-1** on page 4-3).
- ✓ Perform the standard count again. If the standard count still fails, contact the nearest Troxler Service Center.

NO DENSITY READINGS

- ✓ The most likely reason for no density readings is an electronic problem, such as a failure of the detector preamplifier. However, there is a remote possibility that the radioactive source could have become dislodged or lost. Refer to the *Source Rod Inspection* section on page A-9 for instructions on inspecting the source rod.

GAUGE READINGS APPEAR ERRATIC

- ✓ If taking readings in the backscatter position, ensure the source rod is properly locked in the notch and not resting on the test material.
- ✓ Check the inside of the gauge for moisture. To dry the gauge interior, remove the keypad. If necessary, use a hair dryer (on low heat) to circulate warm air for one to three hours.
- ✓ Remove any foreign objects from inside the gauge.
- ✓ Ensure the hardware mounting screws are tight and in place.
- ✓ Check count time – a four-minute count will give the highest precision, with a repeatability of ± 1 pcf on repeated tests performed without moving the gauge.
- ✓ Erratic density readings may be caused by a dirty tungsten sliding block. Clean the sliding block (see page A-11).
- ✓ Perform a stat test (see page 5-5):
 - ▶ If test passes, proceed with job.
 - ▶ If test fails, repeat two more times. If test fails two out of three times, contact the nearest Troxler Service Center.

GAUGE WILL NOT COMMUNICATE WITH PRINTER OR COMPUTER

- ✓ Check that the correct cable is being used.
- ✓ Ensure that the gauge and printer/computer baud rates are the same (9600 baud).
- ✓ Ensure that all other parameters match:
 - ◆ Data bits = 8
 - ◆ Stop bits = 1
 - ◆ Parity = none

SOFTWARE LOCKS UP

- ✓ Turn the gauge off.
- ✓ Check the inside of the gauge for moisture. To dry the gauge interior, remove the keypad. If necessary, use a hair dryer (on low heat) to circulate warm air for one to three hours.
- ✓ Remove any foreign objects from inside the gauge.
- ✓ The scaler (control unit) may be defective. To test, replace the suspect (control unit) scaler with a good scaler.

GARBAGE OR XXXXXX IS DISPLAYED

- ✓ If a value exceeds the display area, the gauge will display +++++.
- ✓ Check the standard counts in memory. If the standard counts are suspect, perform new standard counts. If counts equal zero for both systems, the high voltage board must be replaced (contact the nearest Troxler Service Center).
- ✓ Check gauge for water damage. If the gauge is wet, dry the gauge interior with hair dryer (on low heat) for 3 hours.
- ✓ Check that the calibration constants are valid.
- ✓ Ensure that the measurement depth displayed by the gauge corresponds to the actual source rod depth.

GAUGE TURNS OFF AFTER IT IS TURNED ON

- ✓ The gauge may be wet. If the gauge is wet, dry the gauge interior with hair dryer (on low heat) for 3 hours.

CAUTION

Do not turn the gauge on until all moisture is removed from gauge interior! Component damage may result.

- ✓ Replace the alkaline batteries.
- ✓ If the rechargeable battery is below 5.5 volts, recharge or replace the batteries (see page C-10).
- ✓ The scaler (control unit) may be defective. To test, replace the suspect scaler with a good scaler.

SHORT BATTERY LIFE AFTER RECHARGING

- ✓ 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.
- ✓ 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.
- ✓ Check that you are using the correct charger.
- ✓ The ac charger may be defective. To check, use the dc adapter to charge the batteries.

SATISFACTORY COUNTS BUT RESULTS ARE IN ERROR

- ✓ Ensure that the measurement depth displayed by the gauge corresponds to the actual source rod depth.
- ✓ Check that the calibration constants are valid.
- ✓ Check to see if an offset (density, moisture, trench or special) is enabled.
- ✓ Ensure the standard counts are correct.

ERROR MESSAGES

Table C–1 displays a list of the gauge error messages, as well as the possible causes and recommended solutions for each message.

Table C–1. Error Messages

Error Message	Possible Causes	Solution
Bad Checksum! Default Settings Restored	Gauge settings and/or project data stored in memory have been corrupted and default (factory) settings have been restored.	Set up user preferences (such as measurement mode, count time, and so on) as described starting on page 3–9.
Cannot Close File after Writing.	An error occurred when attempting to store data to a USB flash drive.	Try to store the data again. If error recurs, try a different USB flash drive.
Cannot Initialize Media	An error occurred when trying to access the USB flash drive.	Check that the USB flash drive is installed properly. If error recurs, try a different USB flash drive.
Cannot Open Printer	An error occurred when trying to communicate with a USB printer.	Check that the printer is powered on and is properly connected to the USB port. Ensure that the printer is compatible with the gauge. A list of compatible USB devices is available at: www.troxlerlabs.com/PRODUCTS/PRODLIT/otherlit.shtml
Cannot Write to the File	An error occurred when attempting to store data to a USB flash drive.	Try to store the data again. If error recurs, try a different USB flash drive.
Cannot Write to the Printer	An error occurred when trying to communicate with a USB printer.	Check that the printer is powered on and is properly connected to the USB port. Ensure that the printer is compatible with the gauge. A list of compatible USB devices is available at: www.troxlerlabs.com/PRODUCTS/PRODLIT/otherlit.shtml
Depth Sensor Error. Enable Manual Mode	A hardware problem has occurred with the depth strip (available only on the Model 3440 Plus).	To continue using the gauge, enable <i>Manual</i> depth mode (see page 3–10). Contact the nearest Troxler Service Center (see page iii).

Table C-1. Error Messages (Continued)

Error Message	Possible Causes	Solution
Error Writing to the File	An error occurred when attempting to store data to a USB flash drive.	Try to store the data again. If error recurs, try a different USB flash drive.
Error! Stat Test Not Valid	Operator has tried to run a drift test without having a valid stat test.	Perform a stat test as described on page 5-5, then run a drift test.
Gauge Requires Re-calibration! Contact Tech Support	The calibration constants stored in the gauge have become corrupted.	Contact the nearest Troxler Service Center (see page iii).
Gmb Target Exceeds Limits!	The target value must be between 20.0 and 200.0 pcf. The operator has entered a value outside this range.	Enter a target value between 20.0 and 200.0 pcf.
Gmm Target Exceeds Limits!	The target value must be between 20.0 and 200.0 pcf. The operator has entered a value outside this range.	Enter a target value between 20.0 and 200.0 pcf.
Invalid Access Code	Operator entered an invalid access code.	Enter the correct access code (see page xiii).
Invalid Depth	The source rod is not at a valid depth when starting a measurement.	Ensure the source rod position is at a valid depth when starting a measurement. Contact the nearest Troxler Service Center (see page iii).
Low Battery. Gauge Shutting Down. Turn off & Charge	The following three items are all true : the charger is not connected, the NiMH batteries are low, and the alkaline batteries need replacing.	Charge the NiMH batteries and replace the alkaline batteries.
Moisture Offset Exceeds Limits!	The moisture offset (k) value must be between -200 and 200. When performing a moisture offset, the resulting k value was outside of these limits.	Enter a new moisture offset as described on page 7-4.
No active project!	Operator tried to store measurement data, but no project is active.	Select an existing project or create a new project and select as active as described in Chapter 8.
Proctor Target Exceeds Limits!	The target value must be between 20.0 and 200.0 pcf. The operator has entered a value outside this range.	Enter a target value between 20.0 and 200.0 pcf.

C. TROUBLESHOOTING

Table C-1. Error Messages (Continued)

Error Message	Possible Causes	Solution
Project has No Data!	Operator attempted to view a project with no data.	Select the correct project when attempting to view.
Overlay Thickness Exceeds Limits!	When using the <i>Nomograph</i> function (see page 5-10), the overlay thickness value must be between 0 and 10 in. The operator has entered a value outside this range.	Enter an overlay thickness value between 0 and 10 in.
Warning!! Time to Reach Precision too high	When using the <i>Precision</i> function (see page 5-15), the time required to reach the selected precision value exceeds 60 minutes.	Enter a different precision value or disable the Precision function.

DISPLAY CONTRAST

The gauge display may be difficult to read when viewed in bright light. If so, adjust the display contrast as follows:

- ✓ Loosen the four captive screws located in the corners of the keypad.
- ✓ Gently lift the control unit from the gauge and tilt it forward.
- ✓ As shown in Figure C-1, an adjustment potentiometer for the display contrast is located inside an access hole in the back panel of the control unit.
- ✓ Using a small screwdriver, adjust the potentiometer to obtain the desired display contrast.
- ✓ Gently place the control unit inside the gauge and tighten the four captive screws in the corners of the keypad.

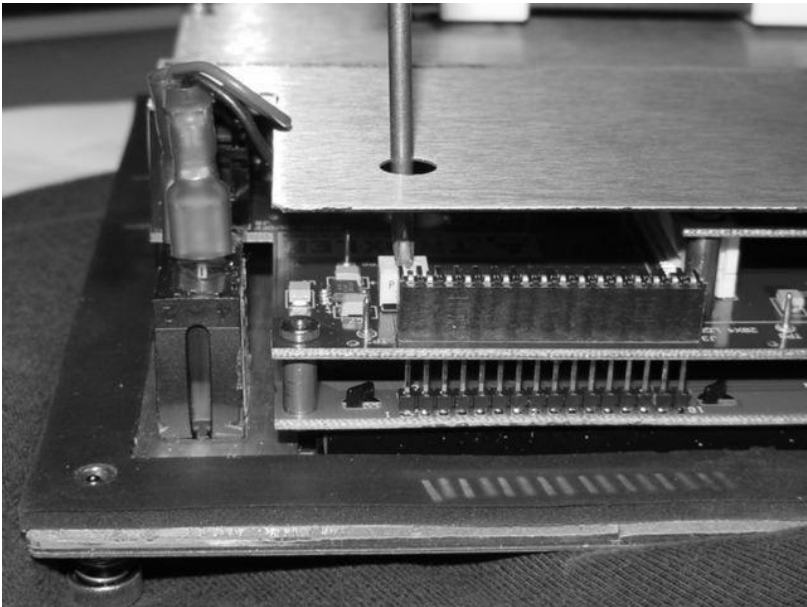


Figure C-1. Adjusting the Display Contrast

BATTERIES


The gauge is equipped with a rechargeable nickel-metal hydride (NiMH) battery pack containing five C batteries (see Figure C-2). When the NiMH batteries drop below 5.5 V, the gauge shuts off. Troxler recommends that the operator recharge the NiMH batteries, as described on page C-12. The NiMH batteries can be fully recharged in only 3 hours.

Backup gauge power can also be supplied using the AA alkaline batteries supplied with the gauge as described on page C-14.

Table C-2 shows the typical operating life of a new, fully charged NiMH battery pack and a set of new AA alkaline batteries. As shown in the table, the typical battery operating life is impacted by the use of the backlight and whether or not the gauge is equipped with a GPS unit (available only on the Model 3440 Plus).

BATTERY STATUS

The *Battery Status* function displays the voltage and charge status of the NiMH batteries, as well as the status (*GOOD* or *BAD*) of the charge calibration. To access the *Battery Status* function, press **<SETUP>** to display the **Setup** menu, then press **<9>**. The gauge displays:



```
Volts: #.##  ## %Full  
Charge Cal.: GOOD  
  
Press <ENTER>
```

If the battery voltage is 6.0 volts or less, recharge the batteries as described on page C-12. If the charge calibration is *BAD*, recalibrate as described on page C-12.

Press **<ENTER/START>** to return to the **Setup** menu.

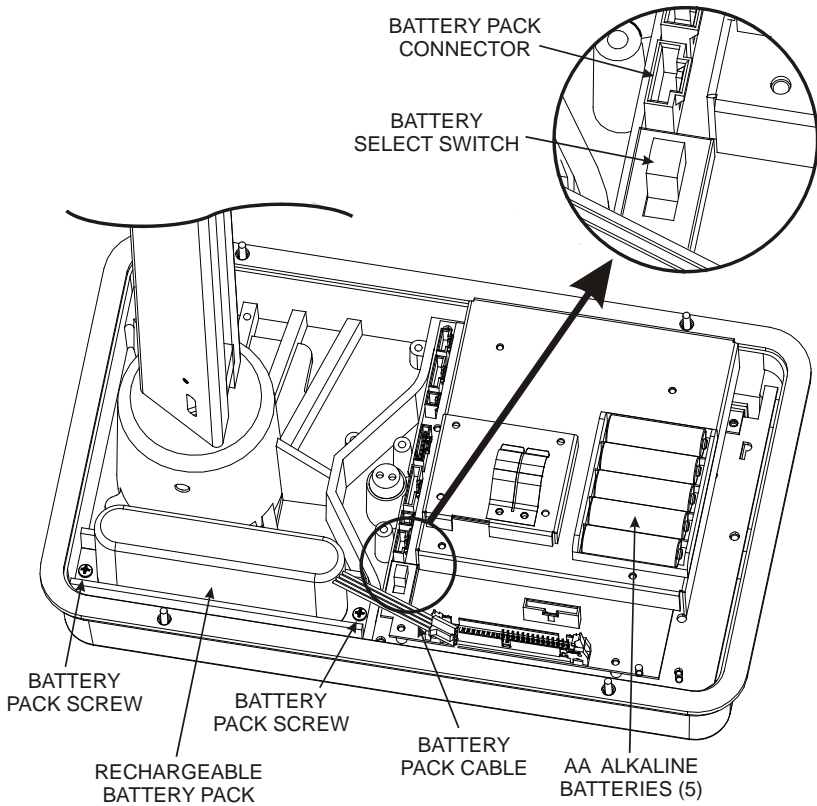


Figure C-2. NiMH Battery Pack and AA Batteries

Table C-2. Typical Battery Operating Life

Backlight	GPS Installed?	Typical Life, NiMH Battery Pack*	Typical Life, AA Batteries*
Off	No	110 hours	55 hours
Off	Yes	35 hours	18 hours
On	Yes	15 hours	8 hours
On	No	25 hours	13 hours

* From full charge

CHARGING THE NIMH BATTERIES

To charge the NiMH batteries:

- ✓ Plug the ac charger or dc adapter into the charger connector in the gauge's control panel (see **Figure 3–2** on page 3–3).
- ✓ If using the ac charger, plug the other end of the charger into a standard 100–240 V ac outlet. If using the dc adapter, connect the other end to any 12–14 V dc source (such as a vehicle's cigarette lighter). The battery charging indicator will light.
- ✓ To ensure a full charge, allow the batteries to charge until the battery charging indicator goes out (approximately 3 hours).
- ✓ After recharging the batteries, unplug the ac charger or dc adapter and store for later use.

NOTE

The battery select switch (see Figure C–2) must be in the RECHARGEABLE position to charge the NiMH batteries.

CHARGE CALIBRATION

If the *Battery Status* display (see page C–11) shows that the charge calibration is *BAD*, recalibrate as follows:

- ✓ Recharge the batteries as described above. When the battery charging indicator goes out, press **<STATUS>** and ensure that the battery charge is *100%*.
- ✓ Disconnect the ac charger or dc adapter. Turn the gauge on and press the **<LIGHT>** key to turn on backlight.
- ✓ Leave the power and backlight on and allow the batteries to discharge completely. The gauge will shut off automatically when it senses that the batteries are completely discharged.

NOTE

DO NOT recharge the batteries as described in the following step until they have been *completely* discharged.

- ✓ Recharge the batteries as described in the previous section.
- ✓ After the batteries are fully charged, check the status as described on page C-11. Ensure that the charge calibration status is *GOOD*.

REPLACING THE NIMH BATTERY PACK

To replace the NiMH battery pack (PN 110374):

- ✓ Turn the gauge off.
- ✓ Using a 7/64-inch Allen wrench, remove the six screws that hold the top shell to the gauge base.
- ✓ Clean the screws and set them aside.
- ✓ Carefully remove the gauge top shell and slide it up, out of the way. To keep the top shell out of the way, tie it to the handle.
- ✓ Unplug the battery cable from the battery connection on the top circuit board (see Figure C-2). Gently squeeze the connector to disconnect.
- ✓ Remove the two battery pack screws and set them aside.
- ✓ Remove the old NiMH battery pack and install the replacement pack.
- ✓ Replace the two screws.
- ✓ Plug the battery cable into the battery connection on the top circuit board.
- ✓ Re-assemble the gauge top shell.

INSTALLING AND USING ALKALINE BATTERIES

To power the gauge using five AA alkaline batteries, install the batteries as follows:

- ✓ Turn the gauge off.
- ✓ Loosen the four captive screws on the control unit.
- ✓ Carefully lift the control unit from the gauge.
- ✓ Unplug the ribbon cable from the control unit.
- ✓ Install five standard AA alkaline batteries into the battery holder (see Figure C-2).
- ✓ Set the battery select switch to the **ALKALINE** position.
- ✓ Plug the ribbon cable into the control unit.
- ✓ Attach the control unit to the gauge with the four captive screws.

MECHANICAL MAINTENANCE

CAUTION

– EUROPEAN COUNTRIES –

Do not separate the control unit from the base. Doing so will result in non-compliance with EMC directive. Call your Troxler representative for additional information.

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. **Be careful not to damage the gauge base!** After removing any large accumulations, wipe the gauge base with a cloth soaked in WD-40® (see note below). The WD-40 should remove the remaining debris.

CAUTION

WD-40 can damage the keypad. Do not allow WD-40 to come in contact with the keypad! The keypad may be cleaned using a mild soap (such as 409™ or Fantastic™), followed by clean water.

The gauge 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. 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.**

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.

LUBRICATING THE SOURCE ROD

If the source rod does not slide up and down freely, the source rod bearing may require lubrication. A grease fitting is located beneath the top shell at the base of the source rod tower.

- ✓ Remove the control unit from the gauge by loosening the four captive screws that secure the control unit to the top shell. Lift the control unit out of the gauge and disconnect the ribbon cable.
- ✓ Locate the grease fitting at the bottom of the source rod tower.
- ✓ Using a standard 16-oz grease gun loaded with a Magnalube®-G cartridge, apply five shots of lubricant to the grease fitting.
- ✓ Re-assemble the control unit.

REPLACING GASKET AND O-RING

The gauge uses a gasket and O-rings to protect its electronics from moisture, dirt, and debris. However, if the gauge has been exposed to extremely wet weather or high humidity, or if the gauge was used in the cold and stored in a warm building, condensation may form inside the gauge. If this happens, remove the control unit to allow the gauge to dry. Use a hair dryer (on low heat) if necessary to remove any built-up moisture. If moisture continues to be a problem or debris is present inside the gauge base, the control panel gasket or top shell O-ring may need replacing.

To replace the control panel gasket (part number 110841), loosen the four captive screws that attach the control unit (keypad) to the top shell. Carefully lift the control unit from the top shell and detach the ribbon cable. **Gently** peel the old gasket from the panel and replace it with a new gasket. Reconnect the ribbon cable and reinstall the control unit.

To replace the top shell O-ring (part number 110899), remove the six screws that hold the top shell to the gauge base. Lift the top shell from the gauge base to expose the O-ring. Peel the old O-ring from the groove in the gauge base. Place the replacement O-ring in the groove, and run your finger around its circumference to ensure it is properly seated in the groove. If the O-ring is too long, cut it to length, ensuring that the two ends butt against each other. Reassemble the top shell to the base.

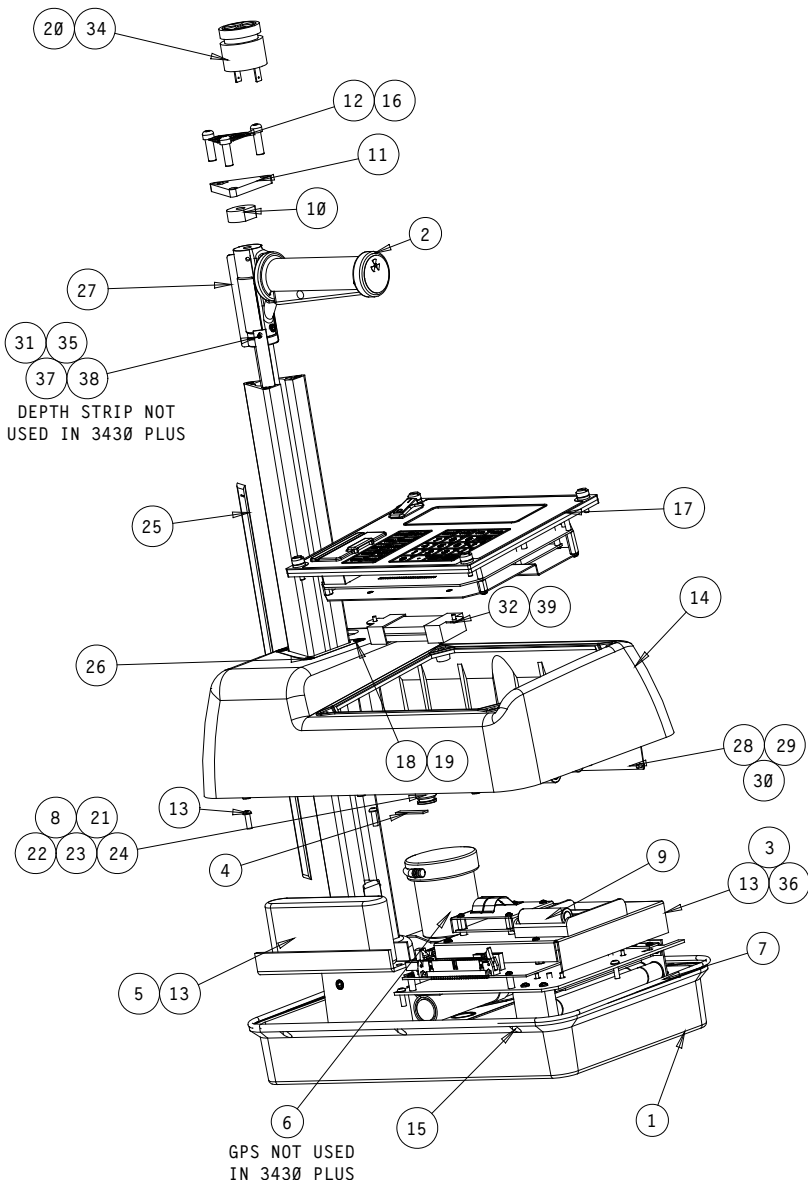
REPLACEMENT PARTS

This section provides drawings and parts list for the gauge final assembly, base assembly, scaler assembly (control unit), and baseboard assembly.

NOTE

For each parts list, match the *Item* number with the correct part in the accompanying figure.

Figure C-3. Final Assembly, Part Numbers
110795_XXXX (3430 Plus) and 110800_XXXX (3440 Plus)



*Figure C-3. Final Assembly, Part Numbers
110795_XXXX (3430 Plus) and 110800_XXXX (3440 Plus)
(Continued)*

ITEM	PART #	DESCRIPTION	QTY
1	110015.XXXX	3440 + BASE ASSEMBLY	1
2	110810.X000	SOURCE ROD ASSY.	1
3	110877	3440 PLUS BASEBOARD ASSY.	1
4	102070	HEAT SHIELD	2
5	110016	NIMH BATTERY ASSY.	1
6*	110854	GPS AND MOUNT ASSY.	1
7	110899	O-RING TOPSHELL	1
8	107413	LEAD DISK	2
9	008221	AA BATTERY	5
10	110830	SOURCE ROD BUMPER	1
11	110839	EXTRUSION ENDCAP W HOLE	1
12	110897	1/4-28 SHCS TAMPER	3
13	000408.1431	#8 X .5 PH SELF TAPPING	5
14	110821	TOPSHELL	1
15	000410.4801	#8-32 X 5/8 SHCS	6
16*	110818	REMOTE KEYPAD	1
17	110876	SCALER ASSY	1
18	007158	ORING "TOWER TRIANGLE"	1
19	110898	TOWER ORING CAP	1
20	015203	BEEPER	1
21	102451.4700	AMBE SOURCE	1
22	107414	SOURCE SPACER	1
23	107412	SOURCE CAP	1
24	107415	LABEL SOURCE AMBE	1
25	110845.XXXX	LABEL DEPTH INDICATION	1
26	000408.1101	#8-32 X 1/2 FH SCREW	3
27	102126	RADIATION WARNING LABEL	1
28	104122	NAMEPLATE RAD. SAFETY	1
29	110848.0040	NAMEPLATE	1
30	000900.0621	NAMEPLATE RIVET	8
31*	250121	DEPTH STRIP	1
32	110822	FERRITE CABLE ASSY.	1
33	103484	REFERENCE STANDARD ASSY.	1
34	110842	BEEPER CABLE ASSY.	1
35*	101604.0611	1/8" X 3/8" ROLL PIN	1
36*	110823	3440 + USB EXT. CABLE	1
37*	106358.0010	WIRE CRIMP CONDUCTRECPT	4
38*	106359.0004	5 ROW HOUSING W LATCH 4POS	1
39	000203.1401	4-40 x 3/16 LG PH SCREW	2

* Items 6, 16, 31, 35, 36, 37, and 38 are included only on Model 3440 Plus gauges.

Figure C-4. Base Assembly, Part Number 110015_XXXX

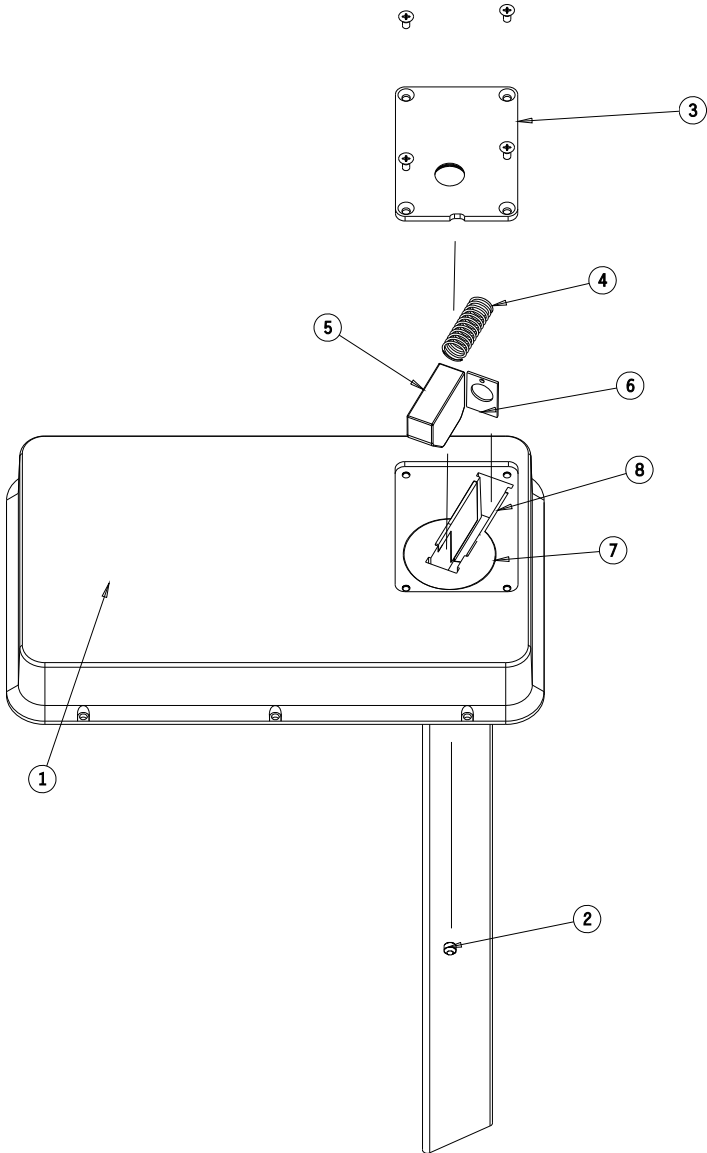


Figure C-4. Base Assembly, Part Number 110015_XXXX
(Continued)

<u>ITEM</u>	<u>PART #</u>	<u>DESCRIPTION</u>	<u>QTY</u>
1	110014.XXXX	EXTRUSION ASSY	1
2	001010.0440	5/16-18 SET SCREW	2
3	110013	BOTTOM PLATE ASSY	1
4	102399	SPRING SLIDING BLOCK	1
5	100996	SLIDING BLOCK	1
6	110844	GUIDE PLATE	1
7	110803	BIO-SHIELD MOLDED	1
8	110843	TEFLON PAD BIO	2

Figure C-5. Scaler Assembly, Part Numbers 110791 (3430 Plus) and 110876 (3440 Plus)

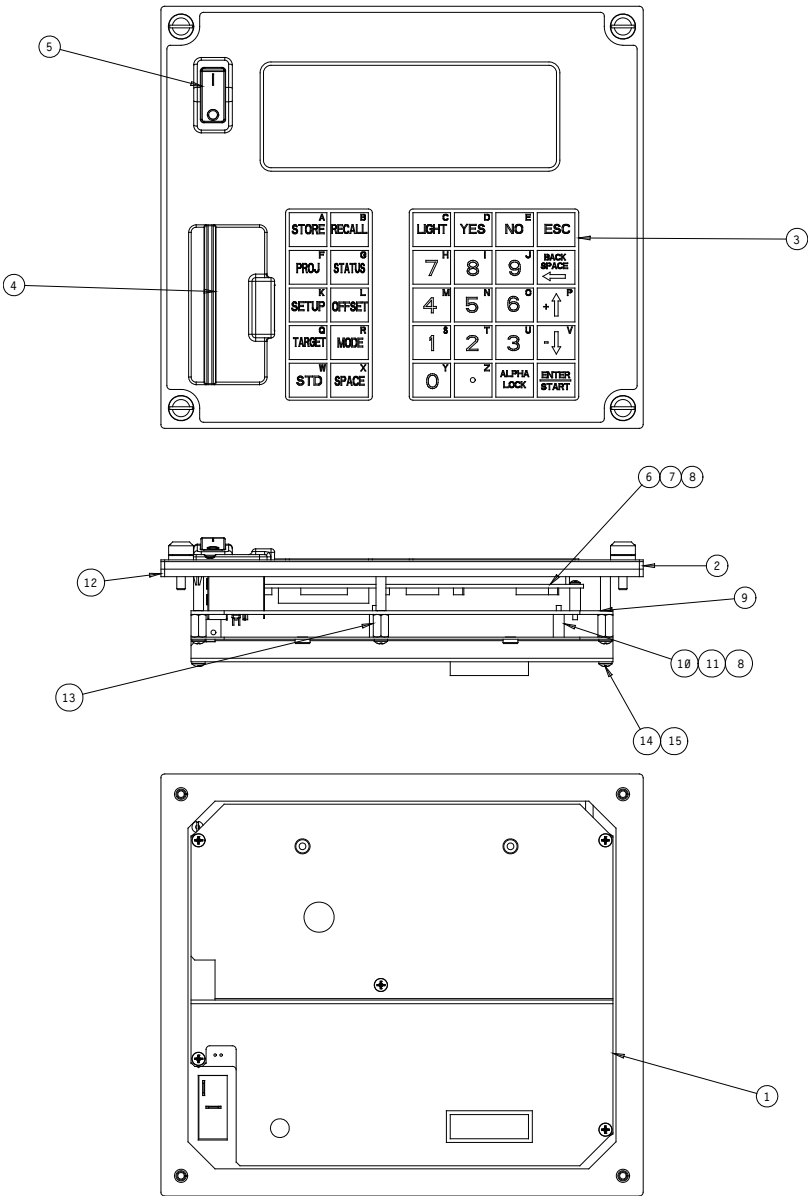
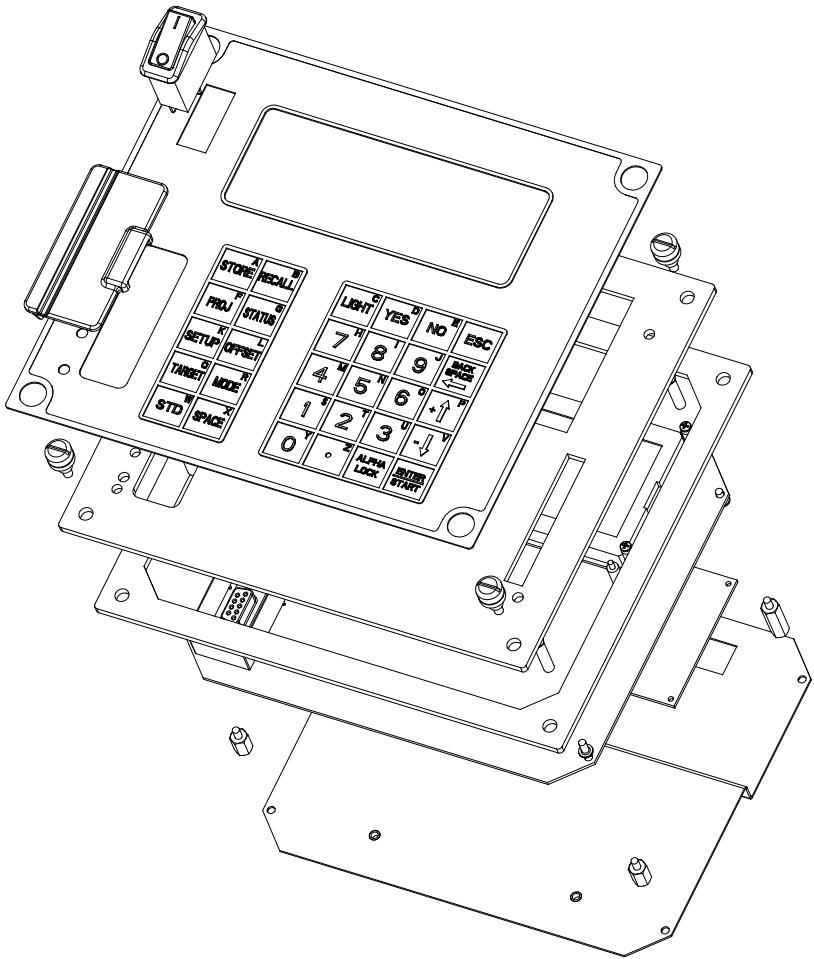


Figure C-5. Scaler Assembly, Part Numbers 110791 (3430 Plus) and 110876 (3440 Plus) (Continued)



*Figure C-5. Scaler Assembly, Part Numbers
110791 (3430 Plus) and 110876 (3440 Plus) (Continued)*

<u>ITEM</u>	<u>PART #</u>	<u>DESCRIPTION</u>	<u>QTY.</u>
1	110826	BACKPLATE ASSY SCALER	1
2	110802	PANEL ASSY KEYBOARD	1
3	110801	3430 PLUS OVERLAY	1
	110817	3440 PLUS OVERLAY	
4	110859	RUBBER COVER	1
5	110832	SPST ROCKER SWITCH	1
6	108176	SCALER DISPLAY	1
7	000921.1259	STANDOFF .4"	4
8	003090.0116	16PINROWCONN	1
9	000104.1400	2-56 SCREW	8
10	250129	CPU BOARD ASSY.	1
11	110881	STANDOFF .5"	4
12	110841	SCALER GASKET	1
13	000923.1251	3/8" STANDOFF	3
14	000204.1400	PH SCREW	5
15	000923.2442	.75" STANDOFF	2
16	250137.3440	ASSY CONTROL PCB 3440+	1
17	110825	ON/OFF POWER CABLE	1

Figure C-6. Baseboard Assembly, Part Numbers 110790 (3430 Plus) and 110877 (3440 Plus)

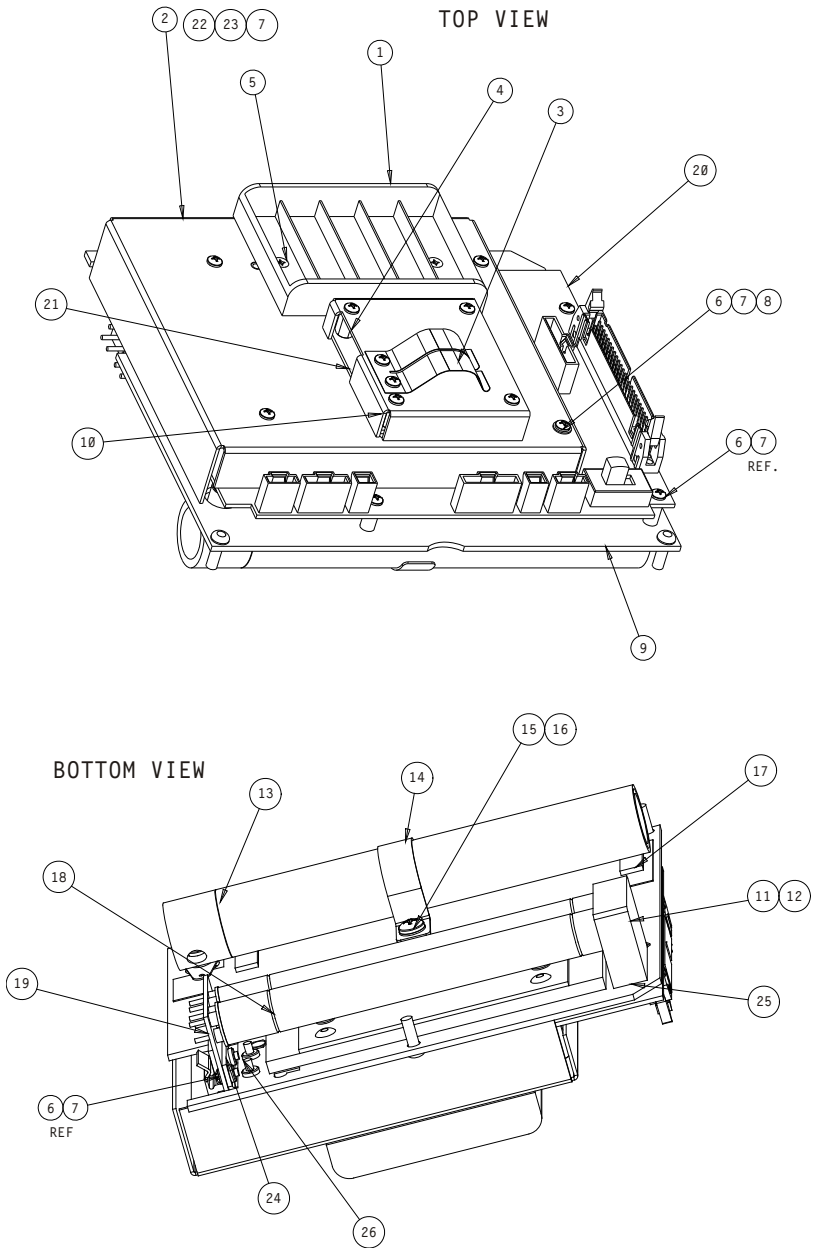


Figure C-6. Baseboard Assembly, Part Numbers 110790 (3430 Plus) and 110877 (3440 Plus) (Continued)

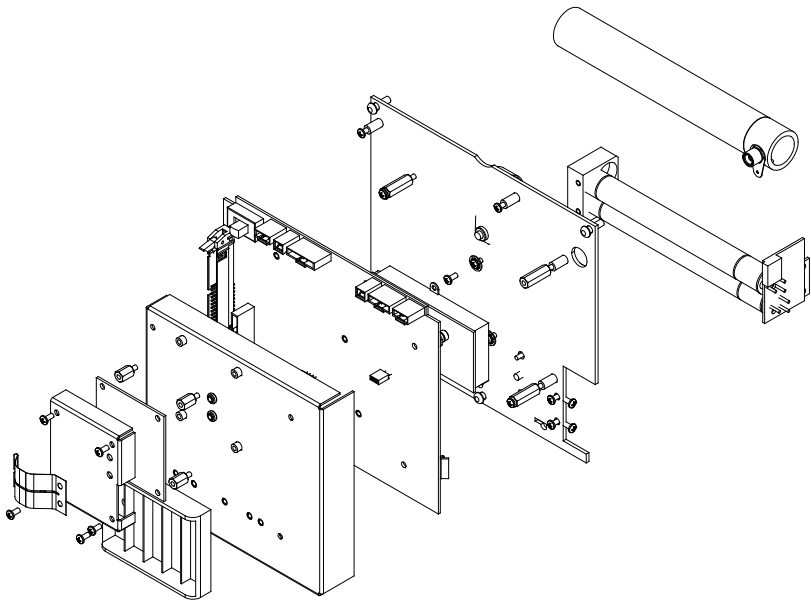


Figure C–6. Baseboard Assembly, Part Numbers
110790 (3430 Plus) and 110877 (3440 Plus) (Continued)

<u>ITEM</u>	<u>PART#</u>	<u>DESCRIPTION</u>	<u>QTY.</u>
1	110880	BATTERY HOLDER	1
2	110838	BASEBOARD COVER	1
3	015610.2000	CONTACT STRIP	1
4	110875	USBWIZ COVER	1
5	000204.1101	#4 FH SCREW	2
6	000204.1400	#4 PH SCREW	15
7	000001.0401	#4 INT LOCKWASH	17
8	000923.2442	STANDOFF	4
9	110835	BASEPLATE ASSY	1
10	000923.1251	#4 STANDOFF 3/8	4
11	107854	GM TUBE HOLDER	1
12	102119	PAD	1
13	104094	ASSY, 900V TUBE	1
14	103540	TUBE CLAMP	1
15	000604.1400	#10 PH SCREW	1
16	000001.1000	#10 LOCK WASHER	1
17	102095	HE3 BUMPER PAD	2
18	100156	GM TUBE	2
19	104098	GM TUBE INTFC.	1
20	110250	BASE BOARD ELEC	1
21*	110874	USBWIZ BOARD	1
22	107164	HIGH VOLT ASSY	1
23	000203.1401	#4 SCREW 3/16	2
24	104136	BRACKET	1
25	000306.1401	GM TUBE SCREW	2
26	000206.1400	GM TUBE SCREW	2

* Item 21 is included only on Model 3440 Plus gauges.

ACCESSORIES

<u>PART #</u>	<u>DESCRIPTION</u>
110017	Model 3430 Plus & 3440 Plus Shipping Case/Carton Assembly
100421	Forged Drill Rod
102111	Scraper Plate
103680.1000	Extraction Tool
103484	Reference Standard Block Assembly
110403	AC Adapter, 12 V CE
110865	AC Adapter, International, 6 pc
104156	DC Charger
110890	Model 3430 Plus & 3440 Plus Manual of Operation and Instruction
110888	Model 3430 Plus & 3440 Plus Quick Reference Card
113128	RS-232 Cable

OPTIONS

<u>PART #</u>	<u>DESCRIPTION</u>
107480	Concrete Adapter
021140	Radiation Sign Kit
102868	3880 Leak Test Kit
102873	1-oz Solution Detergent
102876.0005	Leak Test Packet (4 units)
109661	TroxAlert Survey Meter w/beeper
105817	Kit, Emergency Response
104661.4000	Printer Package
110003	Weigh-Tronix WP-233 Printer
110724	Battery Pack Kit for Printer
113128	Cable Assembly, Serial Direct, 6 ft
110004	Adapter, D-sub 9-25 POS M-M

MAINTENANCE SUPPLIES

<u>PART #</u>	<u>DESCRIPTION</u>
012784	Lubricant Magnalube-G Paste 1.5 oz
012786	Lubricant Magnalube-G Paste 1 lb Can
012789	Lubricant Magnalube-G 14.5 oz
100761	Source Rod Pig

RETURNING THE GAUGE FOR SERVICE

All shipments within the United States to the factory must be accompanied by an RGA (Returned Goods Authorization) number, and a description of the instrument and its problem. This information is used by Troxler shipping and service personnel to expedite the repair work.

To obtain an RGA number, please call or fax the factory or branch office with your request. Please have the following information available when contacting Troxler for an RGA number:

- ◆ 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.

NOTE

When returning a gauge, follow the required special handling and shipping procedures detailed in Appendix B. Please contact a Troxler Sales Support or Service Representative with any questions.

APPENDIX D

STANDARD COUNT LOG

Use the form in this appendix as a guide when recording the daily standard counts. To verify gauge stability, compare the daily standard count to the average of the last four recorded standard counts.

STANDARD COUNT LOG

Gauge Serial Number _____

Date	MS	DS

Date	MS	DS

STANDARD COUNT LOG

Gauge Serial Number _____

Date	MS	DS

Date	MS	DS

STANDARD COUNT LOG

Gauge Serial Number _____

Date	MS	DS

Date	MS	DS

APPENDIX E

UNIT CONVERSION

The Troxler Model 3430 Plus and 3440 Plus Surface Moisture-Density Gauges can display measurement results in either SI (metric) units or English units. Also, HM-181 of 49 CFR changes the standard units of radioactivity in the United States from the English unit of *curies (Ci)* to the SI unit of *becquerel (Bq)*. This requires the shipper to convert the activity on the Bill of Lading from curies to becquerels (GBq). Until everyone is accustomed to the SI units, it is permitted to follow the SI units with the English units in parentheses to clarify the description [for example: 1.48 GBq (40 mCi)].

To help our users convert from English units to SI units, the table in this appendix provides SI conversion factors for common English units relevant to the gauge.

CONTENTS

Measurement Units.....	E-2
Radiological Units	E-2

MEASUREMENT UNITS

$$1 \text{ in.} = 25.4 \text{ mm}$$

$$1 \text{ in.} = 2.54 \text{ cm}$$

$$1 \text{ ft} = 30.48 \text{ cm}$$

$$1 \text{ ft} = 0.3048 \text{ m}$$

$$1 \text{ pcf} = 16.02 \text{ kg/m}^3$$

$$1 \text{ pcf} = 1.6 \times 10^{-2} \text{ g/cm}^3$$

RADIOLOGICAL UNITS

$$1 \text{ rem} = 0.01 \text{ Sv}$$

$$1 \text{ Ci} = 37 \text{ GBq}$$

$$1 \text{ mCi} = 37 \text{ MBq}$$

$$1 \text{ } \mu\text{Ci} = 37 \text{ kBq}$$

The following table is provided to assist the operator in converting from millicuries to gigabequerels:

<u>mCi</u>	to	<u>GBq</u>
8.0.....		0.30
40.....		1.48

APPENDIX F

GAUGE SPECIFICATIONS

This appendix contains gauge and measurement specifications for the Troxler Model 3430 Plus and 3440 Plus Surface Moisture-Density Gauges.

CONTENTS

Measurement Specifications	F-2
SI Units.....	F-2
U.S. Customary Units.....	F-3
Radiological Specifications	F-4
Electrical Specifications	F-5
Mechanical Specifications	F-7

MEASUREMENT SPECIFICATIONS

SI UNITS

Density at 2000 kg/m³

Direct Transmission (150 mm)

	<u>.25 min</u>	<u>1 min</u>	<u>4 min</u>
Precision (kg/m ³)	±6.8	±3.40	±1.70
Composition error (kg/m ³)	±20.0	±20.0	±20.0
Surface error (kg/m ³) (100% Void)	-17.0	-17.0	-17.0

Backscatter (98%, 100 mm)

	<u>.25 min</u>	<u>1 min</u>	<u>4 min</u>
Precision (kg/m ³)	±16.0	±8.00	±4.00
Composition error (kg/m ³)	±40.0	±40.0	±40.0
Surface error (kg/m ³) (100% Void)	-75.0	-75.0	-75.0

Moisture at 240 kg/m³

	<u>.25 min</u>	<u>1 min</u>	<u>4 min</u>
Precision (kg/m ³)	±10.3	±5.1	±2.6
Surface error (1.25 mm, 100% void, kg/m ³)	-18.0	-18.0	-18.0

Precision is defined as ±one (1) standard deviation in density readings. This number is calculated by the ratio of the standard deviation in the counting rate and the slope of the calibration curve at a given density.

U.S. CUSTOMARY UNITS

Density at 125 PCF

Direct Transmission (6 inches)

	<u>.25 min</u>	<u>1 min</u>	<u>4 min</u>
Precision (pcf)	±0.42	±0.21	±0.11
Composition error (pcf)	±1.25	±1.25	±1.25
Surface error (pcf) (100% Void)	-1.06	-1.06	-1.06

Backscatter (98%, 4 inches)

	<u>.25 min</u>	<u>1 min</u>	<u>4 min</u>
Precision (pcf)	±1.00	±0.50	±0.25
Composition error (pcf)	±2.50	±2.50	±2.50
Surface error (pcf) (100% Void)	-4.68	-4.68	-4.68

Moisture at 15 PCF

	<u>.25 min</u>	<u>1 min</u>	<u>4 min</u>
Precision (pcf)	±0.64	±0.32	±0.16
Surface error (0.05 in., 100% void, pcf)	-1.12	-1.12	-1.12

RADIOLOGICAL SPECIFICATIONS

Gamma Source	0.30 GBq (8 mCi) \pm 10% Cs-137
Neutron Source	1.48 GBq (40 mCi) \pm 10% Am-241:Be
Source Type	Sealed Source – Special Form
Source Housing	Stainless Steel, Encapsulated
Shielding	Lead, Tungsten
Surface Dose Rate	See Radiation Profile on page A-18
Shipping Case	Type A, Yellow II, TI = 0.3

ELECTRICAL SPECIFICATIONS

Stored Power	4 ampere hours
Average Current Consumption	
Normal	35 mA
With backlight on	140 mA
With GPS on	105 mA
With backlight and GPS on	210 mA
Time Before Automatic Shutdown	5 hours of complete inactivity
Power Source(s):	
Main	5 C NiMH (Rechargeable Pack) batteries
Backup	5 AA alkaline batteries
Charge Source	12 V dc, 2A
Battery Recharge Time	3 hours maximum, automatic cutoff (may be charged incrementally without damaging the batteries)
Liquid Crystal Display	Alphanumeric, 4 line × 20 character, backlit
Keypad	30-key sealed membrane
Serial Data Format	9600 baud 1 stop bit No parity 8 data bits Xon-Xoff flow control

**Gauge to PC Computer Cable
(Null Modem Serial Cable, Part Number 113128)**

<u>9 pin FEMALE</u>	<u>9 pin FEMALE</u>
Rx (pin 2).....	Tx (pin 3)
Tx (pin 3).....	Rx (pin 2)
Gnd (pin 5)	Gnd (pin 5)

USB Port

A list of compatible USB devices is available at:
www.troxlerlabs.com/PRODUCTS/PRODLIT/otherlit.shtml



MECHANICAL SPECIFICATIONS

Gauge Size (w/ handle)

12-Inch Rod 597 H × 368 L × 229 W mm
(23.5 H × 14.5 L × 9 W in.)

8-Inch Rod 495 H × 368 L × 229 W mm
(19.5 H × 14.5 L × 9 W in.)

Shipping Case Size 745 H × 419 L × 353 W mm
(29.35 H × 16.5 L × 13.88 W in.)

Weight

Model 3430 Plus 13.8 kg (30.5 lb)

Model 3440 Plus 14.1 kg (31.0 lb)

Shipping Weight 37.6 kg (83.0 lb)

Operating Temperature 0 to 70 °C
(Ambient) 32 to 158 °F

Max Test Material Surface Temperature 175 °C (347 °F) for 15 minutes

Storage Temperature -55 to 85 °C
-67 to 185 °F

Humidity 98%, non-condensing

USB Port Will accept devices up to
10 H × 29 W mm
(0.40 H × 0.79 W in.)

CAUTION

This instrument contains sensitive electronic and nuclear components. This instrument *must not* be subjected to stress, abuse, or use other than in accordance with the standard operating procedures listed in this manual.

NOTES

APPENDIX G

SPECIAL EUROPEAN CONSIDERATIONS

This section applies only to those Troxler Model 3430 Plus and 3440 Plus Surface Moisture-Density Gauges with the CE mark that are to be used in European countries.

CONTENTS

Declaration of Conformity.....	G-2
Safety Warnings.....	G-3

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 3430 Plus and 3440 Plus Surface Moisture-Density Gauges because there are no voltages greater than 75 V dc that are accessible by the operator.

Standards to Which Conformity is Declared:

Guidance Documents:

Emissions: EN 61326-2:1997 +A1:1998 +A2:2001
Immunity: EN 61326-2:1997 +A1:1998 +A2:2001

Test Methods:

Emissions: EN 55011:1998, EN 61000-3-2:2000,
EN 61000-3-3:1995 +A1:2001
Immunity: EN 61000-4-2:1995 +A1:1998 +A2:2001,
EN 61000-4-3:2002, EN 61000-4-4:1995,
EN 61000-4-5:1995 +A1:1996,
EN 61000-4-6:1996 +A1:2001,
EN 61000-4-11:2001

Manufacturer: Troxler Electronic Laboratories, Inc.
P.O. Box 12057
3008 Cornwallis Road
Research Triangle Park, North Carolina
27709
U.S.A.

Apparatus: Model 3430 Plus and 3440 Plus
Surface Moisture-Density Gauges

Type of Equipment: Measurement, Control, and Laboratory Use

Class of Equipment: Class A

Year of Declaration: 2006



SAFETY WARNINGS

Owners are encouraged to require study of this manual before allowing anyone to use the gauge. **A potential hazard does exist if improperly used.** The sections of the manual covering radiological safety should be required reading for all users and potential users. **If these sections are not completely understood, users should seek assistance from Troxler, an appointed Troxler representative, or others designated within the user's organization.**

The following list of safety warnings applies to gauges with the CE mark and that are to be used in European countries. In addition to these safety warnings, all other safety warnings and cautions throughout this manual apply to gauges with the CE mark.

- ◆ There are no user-serviceable parts — only qualified service personnel should remove shields or covers to attempt repairs.
- ◆ Do not remove any shields or covers. A high-voltage hazard is located under the baseboard cover.
- ◆ The dc adapter shall be used on properly fused vehicle cigarette lighters only.
- ◆ European countries shall use a proper IEC input cord to the European charger (specified by local laws and practices).
- ◆ Do not throw batteries into fires. There is a risk of explosion.
- ◆ Use caution when lifting, moving, and/or carrying the gauge — it is heavy.
- ◆ See Appendix A for radiation safety instructions.

NOTES

APPENDIX H

PRINTING (UPLOADING) PROJECT DATA

Current versions of Microsoft® Windows® (Windows XP and later) include a *HyperTerminal* communications program that can be used to transfer project data from the Model 3430 Plus and 3440 Plus Surface Moisture-Density Gauges. This appendix provides instructions on using the *HyperTerminal* program to print (upload) data from the gauge.

CONTENTS

Windows Hyperterminal.....	H-2
HyperTerminal Setup	H-2
Equipment Connection.....	H-3
Printing (Uploading) Project Data.....	H-3
Viewing Project Data.....	H-5

WINDOWS HYPERTERMINAL

To print (upload) data from the gauge to a computer equipped with a Microsoft Windows XP operating system, use the *HyperTerminal* program as described in the following sections.

HYPERTERMINAL SETUP

To configure the Windows *HyperTerminal* program and set up a dedicated icon to transfer data from the gauge, perform the following steps:

1. Click on the **Start** button, select the **Programs** menu, and then the **Accessories** folder. Select the **Communications** subfolder, and then select the **HyperTerminal** icon.
2. From the **HyperTerminal** window, double-click on the **Hypertrm** icon. The **Connection Description** window is displayed. This window is used to set up a new connection.
3. In the **Name** box, enter a name (for example, *Troxler Data*) for the new connection. Select an icon to use for the connection, then click **OK**. The **Connect To** window is displayed.
4. In the **Connect To** window, *do not* enter a telephone number. Instead, select **Direct to Com1**, **Direct to Com2**, **Direct to Com3**, or **Direct to Com4**, depending upon the computer. The **COM# Properties** window is displayed, where # is the number of the selected COM port.
5. Configure the **Port Settings** as follows:

<u>B</u>its per second	9600
<u>D</u>ata bits	8
<u>P</u>arity	None
<u>S</u>top bits	1
<u>F</u>low control	Xon-Xoff

6. Click **OK**. The **Troxler Data – HyperTerminal** window is displayed, where *Troxler Data* is the icon name entered in step 3.
7. From the toolbar, click on **F**ile and select **S**ave from the dropdown menu.
8. Close the **Troxler Data – HyperTerminal** window by selecting **E**xit from the **F**ile menu.

EQUIPMENT CONNECTION

Connect the gauge to the computer using the appropriate serial cable (see the list of *Options* on page C-29). Connect the gauge's serial port (see Figure 3-1 on page 3-2) to the computer COM port selected in step 4 of the *HyperTerminal Setup* section on the previous page.

PRINTING (UPLOADING) PROJECT DATA

To print (upload) project data from the gauge to the computer:

1. On the computer, click on the **S**tart button, then select the **P**rograms menu and the **A**ccessories folder. Select the **C**ommunications subfolder, then select the **H**yperTerminal icon.
2. From the **H**yperTerminal window, double-click on the **Troxler Data – HyperTerminal** icon (where *Troxler Data* is the icon name entered in the *HyperTerminal Setup* section on the previous page). The **Troxler Data – HyperTerminal** window is displayed.

3. From the toolbar, click **T**ransfer, then select **C**apture Text from the dropdown menu. The **Capture Text** window is displayed, showing a default folder and filename to be used to store the data. Troxler recommends using the default settings when first using the program. After selecting a filename, click **S**tart to enable data capture.
4. On the gauge, select the project data to be printed (uploaded) to the computer, and follow the instructions in Chapter 8 to print the data to the computer. The project data will be displayed in the **Troxler Data – HyperTerminal** window as it is uploaded.
5. When the data transmission is complete, select **T**ransfer from the toolbar. Then select **C**apture Text and **S**top from the dropdown submenu.
6. Exit the *HyperTerminal* program.

VIEWING PROJECT DATA

After project data has been printed (uploaded) to the computer, the *.txt* file can be viewed using Microsoft Notepad or a word processing program, such as Microsoft Word®.

The data can also be imported into an Excel spreadsheet, which can then be used to manipulate and manage the data. To import the data into an Excel spreadsheet:

1. Open the Excel program.
2. From the Excel toolbar, click **Data**, then select **Get External Data** and **Import Text File**. The **Import Text File** window is displayed.
3. Select the file that was saved when data was downloaded using the *Hyperterminal* program, then click **Import**. The **Text Import Wizard** is displayed.
4. In step 1 of the **Text Import Wizard**, check the **Delimited** radio button, then click **Next**. In step 2 of the wizard, select only the **Comma** checkbox, then click **Next**. In step 3, select the **General** radio button, then click **Finish**. The **Import Data** window is displayed.
5. Check the **Existing worksheet** radio button, then click **OK** to import the data.

Figure 8–1 on page 8–9 defines the information contained in each column of the spreadsheet.

NOTES

APPENDIX I

GLOBAL POSITIONING SYSTEM (GPS)

The Model 3440 Plus Surface Moisture-Density Gauge can be equipped with an optional *global positioning system (GPS) receiver* that provides accurate information on the location (latitude and longitude) of the gauge. This appendix gives an overview of how this feature operates and its accuracy.

CONTENTS

GPS Accuracy.....	I-2
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GPS ACCURACY

As described earlier, the Model 3440 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 in the Model 3440 Plus 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.

The global positioning system 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 GPS information can be affected by a number of atmospheric forces and other conditions. The Wide Area Augmentation System (WAAS) corrects for these factors by placing 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 a 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 satellites may not be available to gauge users in locations where trees, mountains, and other large objects obstruct the view of the horizon. On other occasions, 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 .

NOTE

The Wide Area Augmentation System (WAAS) is currently functional only in the United States.

Table I-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.

INDEX

A

AC charger.....	1-6
Access code	xiii, 3-11, 9-2
Accessories	1-5, C-29
Accident notification	B-3
Accuracy	2-5, 4-2
Adapter, dc.....	1-6
Alkaline batteries	C-14
ALPHA LOCK key	3-4
Alpha particles	A-4
American Society of Testing and Materials (ASTM) standards...	1-3
Americium-241:beryllium (Am-241:Be).....	2-3
Asphalt	
Mode setup.....	3-15
Site preparation.....	4-9
Taking measurements	4-14
Atomic Energy Control Regulations (AEC).....	B-4
Atomic structure	A-2
Automatic	
Depth mode.....	3-10
Shutdown	3-8, F-5
Auto-Store.....	8-12

B

BACK SPACE key	3-4
Backlight.....	3-16
Backscatter position.....	2-2, 3-5
Battery.....	C-10
Alkaline.....	C-14
Charge.....	C-12, F-5
Low warning.....	9-7
Replace NiMH battery pack	C-13
Specifications.....	F-5
Status.....	5-18, C-10
Beeper, external	5-17
Beta particles	A-4
Bottom density.....	5-10

C

Cable pinouts.....	F-6
Calibration.....	2-5
Battery charge.....	C-12
Density	7-3
Moisture	7-4
Offset.....	7-2
Trench.....	7-8
Canadian Nuclear Safety Commission (CNSC).....	1-4, A-14, B-4
Canadian shipping requirements	B-4
Cesium-137 (Cs-137)	2-2
Charge	
Batteries.....	C-12
Calibration.....	C-12
Charger, ac	1-6
Cleaning	
Base and top shell.....	C-15
Tungsten block	A-11
Clock/Calendar	3-12, 9-3
Code of Federal Regulations (CFR).....	1-4
Concrete	
Site preparation.....	4-9
Taking measurements.....	4-14
Contrast, display	C-9
Convert units	E-1
Count time	3-9, 5-4
Create project	8-5
Customer name.....	3-14, 9-3

D

Date	3-13
Format	3-13
DC adapter.....	1-6
Deactivate project.....	8-11
Declaration of Conformity	1-4, G-2
Density	2-2, 2-5, 4-11, 4-14
Bottom.....	5-10
Offset.....	2-5, 7-2, 7-3
Department of Transportation (DOT)	B-1

Depth	
Mode	3-10, 5-4
Of measurement	2-3
Detectors	1-6, 2-2
Direct transmission	2-2, 3-5
Disable	
Moisture offset	7-7
Target value	6-4
Display	
Backlight	3-16
Contrast	C-9
Specifications	F-5
Disposal	A-15
Drift test	5-7
Drill rod	1-6, 4-7
Drill rod guide	1-6

E

Emergency procedures	A-15
Enable	
Moisture offset	7-4
Target value	6-3
Encapsulation	A-8
ENTER/START key	3-4
Erase	
Project	8-6
Standard counts	9-6
Erratic readings	5-5, C-3
Error messages	C-6
ESC key	3-4
European considerations	G-1
Exposure, limiting	A-6
Extended menu	3-11, 9-1
Extraction tool	1-6, 4-7

F

Fix quality (GPS)	I-3
Format	
Project output	8-8
Serial data	F-5

G

Gamma rays.....	A-4, F-4
Gasket, replacing	C-17
Geiger-Mueller (G-M) tubes	2-2
Global positioning system (GPS)	5-17, I-1
Gmb (Marshall) value	6-2
Gmm (Voidless density) value	6-2

H

Half-life	9-5
Half-value layer (HVL)	A-7
Hazmat training	B-3
Helium-3 detector.....	2-3
Humidity.....	F-7
HyperTerminal program.....	H-2

I

ID number, sample	8-12
Inspection	
Daily	3-6, A-10
Source rod.....	A-9
Upon receipt	1-7
International Air Transport Association (IATA).....	B-1
International Atomic Energy Agency (IAEA)	B-1

K

K value (moisture offset).....	7-4
Keypad	3-3, F-5

L

Language	9-4
Leak test	A-13
Licensing	1-4, A-14
LIGHT key	3-4
Liquid crystal display (LCD)	3-16, F-5
Low battery warning	9-7
Lubricating source rod.....	C-16

M

Manual	
Depth mode.....	3-10
Store.....	8-14
Measurement	
Mode.....	3-15
Specifications.....	F-2
Microsoft	
Excel.....	H-5
Notepad.....	H-5
Windows.....	H-1
Word.....	H-5
Mode	
Asphalt.....	3-15, 4-14
Backscatter.....	2-2
Concrete.....	4-14
Depth.....	3-10, 5-4
Direct transmission.....	2-2
Measurement.....	3-15
Nomograph.....	3-15
Soil.....	3-15, 4-11
MODE key.....	3-4
Moisture.....	2-3, 4-11
New offset.....	7-4
Offset.....	2-5, 7-2, 7-4
Offset disable.....	7-7
Offset enable.....	7-4
Offset, gauge-derived.....	7-6
Offset, manual entry.....	7-5
Monitoring personnel.....	A-8

N

Neutrons.....	2-3, A-4, F-4
NiMH battery pack.....	C-13
NO key.....	3-4
Nomograph function.....	5-10

O

Offset	2-5
Calibration	7-2
Density	2-5, 7-2, 7-3
Menu	7-2
Moisture	2-5, 7-2, 7-4
Trench	2-5, 7-2, 7-8
OFFSET key	3-4
Options	5-17, C-29
O-ring, replacing	C-17
Output project	8-7
Destination	8-10

P

Parts	1-5
Parts, replacement	C-18
Percent air voids	5-19
Photons	2-2, A-4
Port	
Serial	8-7, 8-10
USB	1-3, 3-3, 8-7, 8-10, F-6, F-7
Power switch	3-7
Precautions	A-17
Precision	F-2
Function	5-15
Print	
Drift test	5-9
Project data	H-3
Stat test	5-6
Printer	1-6
Cable	1-6
Proctor value	6-2
Profile, radiation	A-18
PROJ key	3-4, 8-2

Project	
Create	8-5
Deactivate	8-11
Erase	8-6
Function	3-16
Menu	8-2
Output data.....	8-7
Output destination.....	8-10
Output format.....	8-8
Select.....	8-3
View.....	8-4

R

Radiation	
Converting units.....	E-1
Dose	A-5
Exposure	A-6
Monitoring	A-8
Profile	A-18
Safety	A-5
Specifications.....	F-4
Theory.....	A-2
Types.....	A-4
Radioactivity.....	A-3
Reading	4-10
Asphalt.....	4-14
Concrete.....	4-14
Soil.....	4-11
Ready screen	3-7
Recall data	4-17
RECALL key	3-4
Recharge time	F-5
Reference standard block.....	1-6, 4-2
Regulations	1-4, A-14
Canadian shipping	B-4
U.S. shipping	B-2
Replace	
Gasket and O-ring.....	C-17
NiMH battery pack	C-13
Replacement parts.....	C-18

S

SAFE position	3-5
Safety warnings (European countries).....	G-3
Sample identification (ID) number.....	8-12
Scraper plate	1-6, 4-7
Select project	8-3
Self-test.....	3-7
Serial	
Data format.....	F-5
Port	8-7, 8-10
Service.....	C-30
Centers.....	iii
Set units	3-10, 5-4
Setup.....	3-9
Menu.....	3-9, 5-3
SETUP key	3-4
Shielding.....	A-7, F-4
Shipper's Declaration for Dangerous Goods	B-2
Shipping	B-1
Canadian requirements	B-4
Case	F-4, F-7
U.S. requirements	B-2
Shutdown, automatic	3-8, F-5
Site	
Preparing test.....	4-7
Standard count.....	4-2
Software reset.....	9-8
Soil	
Mode setup	3-15
Site preparation.....	4-7
Taking measurements.....	4-11

Source	F-4
Americium-241:beryllium (Am-241:Be).....	2-3, 9-5
Cesium-137 (Cs-137).....	2-2, 9-5
Decay	9-5
Encapsulation.....	A-8
Gamma ray.....	F-4
Neutron	F-4
Rod inspection	A-9
Rod lubrication	C-16
Rod positions	3-5
Shielding	A-7, F-4
SPACE key	3-4
Special European considerations	G-1
Specifications.....	F-1
Spreadsheet, column definitions	8-9
Standard count	4-2
Log.....	D-1
New.....	4-3
View.....	4-6
Stat test.....	5-5
Status	
Battery.....	5-18, C-10
Function	3-9
STATUS key	3-4
STD key	3-4, 4-2
Store	
Auto	8-12
Manual	8-14
Measurements	4-13, 4-16
Target value	6-4
STORE key	3-4

T

Taking measurements	4-10
TARGET key	3-4
Target value	6-2
Disable	6-4
Enable	6-3
Store.....	6-4
Temperature.....	F-7

Test	
Drift	5-7
Site preparation.....	4-7
Stat.....	5-5
Theory	2-1
Density	2-2
Moisture	2-3
Offset.....	2-5
Radiation	A-2
Thermalization.....	2-3
Thermoluminescent dosimeter (TLD).....	A-8
Time	3-12
Count	3-9, 5-4
Format	3-13
Training	1-4, A-14
Hazmat	B-3
Transport case.....	F-4, F-7
Transport Packaging of Radioactive Materials	
Regulations (TPRM)	B-4
Transportation	
Canadian requirements	B-4
U.S. requirements	B-2
Transportation of Dangerous Goods Act and	
Regulations (TDG)	1-4, B-4
Trench offset.....	2-5, 7-2, 7-8
Troubleshooting.....	C-2
Tungsten block, cleaning.....	A-11

U

U.S. shipping requirements	B-2
Unit conversion	E-1
Units, measurement	3-10, 5-4
Unpacking	1-7
Upload project data	H-3
USB port.....	1-3, 3-3, 8-7, 8-10, F-6, F-7
Compatible devices	1-3, 8-7, 8-10, F-6
Dimensions.....	8-7, 8-10, F-7
User ID	3-14, 9-3

V

Vertical structure offset 2-5, 7-2, 7-8

View

- Drift test 5-9
- Project 8-4
- Standard counts 4-6
- Stat test 5-6

Void ratio 5-19

W

Wide Area Augmentation System (WAAS) I-2

Y

YES key 3-4

NOTES

NOTES

WARRANTY

TROXLER ELECTRONIC LABORATORIES, INC.

LIMITED WARRANTY

TROXLER ELECTRONIC LABORATORIES, INC., and subsidiary, TROXLER INTERNATIONAL, LTD., hereinafter referred to as "TROXLER," warrants this instrument, Model 3430 Plus or 3440 Plus, Serial Number _____, against defects in material and workmanship for a period of 18 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.

THERE ARE NO WARRANTIES WHICH EXTEND BEYOND THE DESCRIPTION ON THE FACE HEREOF, AND THIS WARRANTY IS EXPRESSLY IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, AND TROXLER NEITHER ASSUMES, NOR AUTHORIZES ANYONE TO ASSUME FOR IT ANY OTHER LIABILITY IN CONNECTION WITH THE SALE OF THE INSTRUMENT. THIS WARRANTY SHALL NOT APPLY TO THE INSTRUMENT OR ANY PART THEREOF, WHICH HAS BEEN SUBJECTED TO DAMAGE BY ACCIDENT, NEGLIGENCE, ALTERATION, ABUSE, MISUSE, OR SERVICE NOT AUTHORIZED IN WRITING BY TROXLER. SUCH DAMAGE TO INCLUDE BUT NOT BE LIMITED TO BURNING OF CIRCUIT BOARDS AND HARNESS FROM IMPROPER SOLDERING TECHNIQUES AND DAMAGE TO THE INSTRUMENT DUE TO PURCHASER'S FAILURE TO PERFORM MAINTENANCE AS OUTLINED IN THE AUTHORIZED OPERATOR'S MANUAL. DUE TO THE NATURE OF THEIR USE, MECHANICAL ACCESSORY PARTS AND BATTERIES ARE WARRANTED FOR 90 DAYS ONLY FROM DATE OF SHIPMENT.

TROXLER ELECTRONIC LABORATORIES, INC.

Troxler International, Ltd.
Troxler Electronics (Canada), Ltd.
3008 Cornwallis Road
Post Office Box 12057
Research Triangle Park, NC 27709 USA

NOTICE TO CONSUMERS

Any disclaimer or limitation on the remedies expressed above shall not be effective to the extent prohibited by state or federal law.

NOTE: THIS WARRANTY EXCLUDES DAMAGE INCURRED IN SHIPMENT. IF THIS INSTRUMENT IS RECEIVED IN DAMAGED CONDITION, THE CARRIER SHOULD BE CONTACTED IMMEDIATELY. ALL CLAIMS FOR DAMAGE IN TRANSIT SHOULD BE FILED WITH THE CARRIER. IF REQUESTED, TROXLER WILL AID IN FILING OF CLAIMS AND/OR LOCATING GAUGES LOST IN TRANSIT.