TROXLER SERVICE CENTERS

The list of Troxler service centers that appears on pages iii and C-17 has been updated as follows:

**Troxler Corporate Headquarters**
3008 Cornwallis Road
P.O. Box 12057
Research Triangle Park, NC 27709
Tel (919) 549-8661
Fax (919) 549-0761
E-mail: troxserv@troxlerlabs.com
Web: www.troxlerlabs.com

**Maryland Service Center**
9574 Deereco Road
Timonium, MD 21093
Tel (410) 561-5850
Fax (410) 561-5852
E-mail: troxlermd@troxlerlabs.com

**Midwestern Branch Office**
1430 Brook Drive
Downers Grove, IL 60515
Tel (630) 261-9304
Fax (630) 261-9341
E-mail: troxmidw@troxlerlabs.com

**Western Regional Branch Office**
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Rancho Cordova, CA 95742
Tel (916) 631-0234
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**Southwestern Branch Office**
2000 East Randol Mill Road
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Arlington, TX 76011
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Fax (817) 275-8562
E-mail: troxsw@troxlerlabs.com

**Florida Service Center**
2376 Forsyth Road
Orlando, FL 32807
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E-mail: troxlerfl@troxlerlabs.com

**Alabama Service Center**
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Tel (205) 945-0755
Fax (205) 945-0757
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**Canadian Branch Office**
7125 Pacific Circle, Unit 13
Mississauga, Ontario L5T-2A5
Canada
Tel (905) 565-0633
Fax (905) 564-7092
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**Troxler European Subsidiary**
Troxler Electronics GmbH
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D-82239 Alling nr. Munich, Germany
Tel ++49-8141-71063
Fax ++49-8141-80731
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This page has been revised per the July 2001 supplement.
HOW TO USE THIS MANUAL

Congratulations on the purchase of the Troxler Model 4640-B Thin Layer Density Gauge. Take a few minutes to read this short overview before using the gauge to obtain a better idea of where to find gauge information quickly.

This manual is organized into six chapters and six appendices. The chapters describe the theory of operation and all the operations of the gauge. The appendices include information on radiation theory and safety, gauge specifications, troubleshooting and maintenance, shipping, unit conversion, and printing (uploading) data to a computer.

The Model 4640-B Maintenance and Service Information manual (PN 105280) is available for those users who will perform service and calibration functions on the Model 4640-B gauge.
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 〈YES〉” means to press the key labeled YES.

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

♦ 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.
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<td>D–5</td>
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ATTENTION GAUGE OWNER

This gauge 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, see Chapter 6.

The ACCESS CODE for this gauge is:


This page should be removed if the access code is not to be distributed to other parties or users of this gauge.
This chapter provides the user with a brief overview of the Model 4640-B Thin Layer Density Gauge’s many features and capabilities. The user can also find information on storage site selection in this chapter.

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INTRODUCTION

The Model 4640-B Thin Layer Density Gauge can quickly and precisely determine the density of thin lift asphaltic concrete overlays. The 4640-B determines the density of thin lift asphalt overlays using backscatter gamma radiation technology. A patented system with G-M detectors in the gauge base detects the gamma radiation. A microprocessor converts the counts into a thin layer density reading.

The gauge may be specially calibrated to accommodate many different hot mix asphalt (HMA) mixes with variations in aggregate size and type. The operator-selected depth of measurement assures that the measurement is not influenced by underlying material. Measurements may be obtained in as little as 60 seconds, and up to 750 readings may be stored for later use.

The nuclear method of testing asphalt density has been approved by the American Society of Testing and Materials (ASTM) and the Model 4640-B meets or exceeds all the requirements of ASTM D-2950-91: Standard Test Method for Density of Bituminous Concrete in Place by Nuclear Method.

Some information contained in this manual is used in training courses offered by Troxler Electronic Laboratories, Inc., to assist purchasers in obtaining a Radioactive Materials License from the U.S. Nuclear Regulatory Commission (NRC) or an Agreement State. Owners of this gauge must maintain a current radioactive materials license as long as they own the gauge, even if it is in storage and not actively being used.

Any licensing issues discussed in this manual are for the United States. To purchase a Model 4640-B in Canada, owners must obtain a radioisotope license from the Atomic Energy Control Board (AECB). The owner should obtain copies of the AECB Regulations and the Transportation of Dangerous Goods Act and Regulations. This manual provides a guide to Canadian shipping requirements on page D-11.
Owners are encouraged to require study of this manual before allowing anyone to use the gauge. To monitor exposure to radiation, any user of the gauge should wear a dosimeter while operating or cleaning. While no radiation hazard is imposed on operator(s) during normal use, a potential hazard does exist if improperly used. The sections of the manual covering radiological safety should be required reading for all operators and potential operators. 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. Additional nuclear safety information is available by attending a Troxler Nuclear Gauge Training Course.

As changes are made to local, state, and federal regulations on a continuing basis, the owner/operator must maintain awareness of current regulations. 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 shows the Model 4640-B gauge and its accessories. Use this figure and the list below to identify the gauge and parts as they are unpacked.

1. The Gauge is the portable instrument containing all electronic modules, rechargeable battery packs, detectors, and the radioactive source.

2. The Air Gap Spacer is used whenever a reference standard count is taken. The spacer ensures that underlying material does not influence the reference standard count.

3. The (Magnesium) Reference Block provides a uniform reference material for gauge adjustment due to such factors as source decay.

4. The Charger/Adapter provides a means to recharge the gauge batteries. The charger/adapter for domestic use operates on 120 V ac/60 Hz; the charger/adapter available for use outside the U.S. operates on 120/230 V ac (50/60 Hz). Also included is a 12 V dc charger.

5. The Transport Case is a DOT-approved shipping container that may be used for shipping the gauge and accessories.

6. The optional Serial Printer connects to the gauge for printing data.

7. The optional Serial Interface Cable (not shown) may be used to connect the gauge to a printer or computer.
Figure 1–1. Model 4640-B Parts and Accessories
The 4640-B keypad consists of 22 keys, the 20 keys shown in Figure 1–2 and the \{ON\} and \{OFF\} keys. The gauge is equipped with a “beeper” to verify keystrokes were received by the gauge. If a “beep” is not heard, the keystroke did not register and should be repeated. The \{YES\} and \{NO/CE\} keys are used for responses to specific questions displayed on the screen.

When the gauge provides several options, select the desired option by pressing the corresponding numerical key or highlighting the option using \{YES\} then pressing \{START/ENTER\}.

The \{SHIFT\} key provides access to the functions located above the numeric keys.

Table 1–1 provides a more detailed description of the individual keys and the location in the manual where the functions are described.

![Figure 1–2. Model 4640-B Keypad](image-url)
# Table 1–1. Model 4640-B Keypad Functions

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<tr>
<th>KEYS</th>
<th>DESCRIPTION</th>
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<td>YES</td>
<td>Exit</td>
<td>1–6</td>
</tr>
<tr>
<td></td>
<td>Answers display prompts</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Exit calculator mode</td>
<td></td>
</tr>
<tr>
<td>NO/CE</td>
<td>Answer or clear entry</td>
<td>1–6</td>
</tr>
<tr>
<td>CE/C</td>
<td>Clears calculator entry</td>
<td></td>
</tr>
<tr>
<td>STATUS</td>
<td>Displays gauge status</td>
<td>5–2</td>
</tr>
<tr>
<td>7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AVERAGE</td>
<td>Average readings</td>
<td>5–3</td>
</tr>
<tr>
<td>8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SPECIAL</td>
<td>Special functions</td>
<td>6–1</td>
</tr>
<tr>
<td>9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>STORE</td>
<td>Store data in memory</td>
<td>4–3</td>
</tr>
<tr>
<td>MS</td>
<td>Calculator memory store</td>
<td></td>
</tr>
<tr>
<td>THICK</td>
<td>Overlay thickness</td>
<td>3–14</td>
</tr>
<tr>
<td>MR</td>
<td>Calculator memory recall</td>
<td></td>
</tr>
<tr>
<td>PROJECT</td>
<td>Enter/view/erase project</td>
<td>4–2</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PRINT</td>
<td>Print data</td>
<td>4–4</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ERASE</td>
<td>Erase data</td>
<td>4–6</td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MA/</td>
<td>Marshall or voidless</td>
<td>3–15</td>
</tr>
<tr>
<td>VOIDLESS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>+</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TIME</td>
<td>Count time interval</td>
<td>3–5</td>
</tr>
<tr>
<td>−</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SP. CAL.</td>
<td>Special calibration</td>
<td>5–5</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>OFFSET</td>
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<td>5–8</td>
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<tr>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CALC.</td>
<td>Calculator mode</td>
<td>5–9</td>
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<tr>
<td>3</td>
<td></td>
<td></td>
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<tr>
<td>SHIFT</td>
<td>SHIFT function modes</td>
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<tr>
<td>×</td>
<td></td>
<td></td>
</tr>
<tr>
<td>STD</td>
<td>Reference standard count</td>
<td>3–9</td>
</tr>
<tr>
<td>÷</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RECALL</td>
<td>Recall data for viewing</td>
<td>5–10</td>
</tr>
<tr>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>START/</td>
<td>See manual text</td>
<td></td>
</tr>
<tr>
<td>ENTER</td>
<td></td>
<td></td>
</tr>
<tr>
<td>−</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
UNPACKING AND INSPECTION

Upon receipt of the gauge from the factory, a complete inspection and inventory should be performed. If the shipping case, any other part of the container, and/or the gauge appears to be 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 D.

Check to see if the following literature and components have been included:

♦ Manual of Operation and Instruction
♦ Quick Reference Card
♦ Gauge Warranty
♦ Gauge Certificate
♦ Calibration Data Sheet
♦ Troxler Regulatory Update (contains required shipping documents)
♦ Magnesium Reference Block
♦ Air Gap Spacer
♦ Charger/Adapter
♦ Power Adapter (for cigarette lighter)
♦ Keys for Handle Lock
♦ Non-Rechargeable Battery Case

Lift the gauge from the 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 and check the source rod operation. It should move up and down with little effort. Return the gauge to the transport case. Remember to wear a dosimeter while working with the gauge.

Remember to wear a dosimeter while working with the gauge.
When deciding where to store the gauge, take into consideration the rules governing the storage of low-level radioactive devices that are set forth by your regulatory agency and the conditions of your gauge license.

♦ The gauge should be locked in the **SAFE** position (page 3–8) and the gauge stored in its transport case.

♦ It is recommended that the gauge and transport case should be stored at least 15 ft (5 m) from full-time work areas, preferably in a locked closet/storage area in a dry location (indoors).

♦ The storage area should be marked with a radiation sign that reads “CAUTION RADIOACTIVE MATERIALS” (can be obtained from Troxler).

♦ The storage of a nuclear gauge in a motor vehicle is not recommended.
This chapter contains a brief description of the 4640-B theory of operation based on backscatter of gamma radiation.

CONTENTS

Theory of Operation ................................................................. 2–2
THEORY OF OPERATION

The 4640-B Thin Layer Density Gauge obtains density measurements using backscattered gamma radiation (photons). The photons from an 8 mCi cesium-137 source located in the base of the gauge penetrate the asphalt overlay (see Figure 2–1). The photons collide with the electrons in the material and are either scattered or absorbed. As the density increases, the number of photons scattered back to the detectors decreases.

The 4640-B uses two sets (referred to as System 1 and System 2) of Geiger-Mueller (G-M) tubes for photon detection. When the source rod is in the “measure” position, the source and detectors are in the same horizontal plane. Ideally, no photons should reach the detectors in a direct path from the source. In the “backscatter” mode, the photons must be scattered at least once before reaching the detectors.

Figure 2–1. Gauge in Measurement Position on Thin Layer Material
Photons reaching the G-M detectors in the 4640-B are counted for selected intervals of time (*the number of photons counted is directly related to the density of the material*). The gauge program uses the counts to determine the density of the material top layer and the results are automatically displayed on the screen.

The gauge is calibrated using a set of metallic blocks of different densities and thicknesses. Readings are taken on these blocks and the counts obtained are used during the density calibration. The calibration range is 100 to 170 pcf (1602 to 2723 kg/m³). The thickness range is 1.0 to 4.0 in. (2.5 to 10 cm) with over 95% of the influence from the top 2.5 in. (6.4 cm).

**NOTE**

The source rod of a 4640-B gauge has two positions: SAFE and measurement. With the source rod all the way up, the gauge is referred to as being in the SAFE position (page 3–8). In this configuration, the source is surrounded by shielding. This position is used for transporting and storing the gauge. In the measurement position, the source rod is pushed down against the stop pin (page 3–8). This removes the shielding under the source, allowing the photons to penetrate the material directly under the gauge. The shielding around the source rod remains in place at all times.
This chapter explains the basic operation of the Model 4640-B Thin Layer Density Gauge. Instructions for gauge parameter set-up, taking the daily standard count, and taking density measurements are included.

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DAILY INSPECTION

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

✔ Push the source rod down into the measurement position, and then raise it back to the safe (shielded) position. 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 position. Turn the gauge over and verify that the sliding block is completely shut. If any portion of the opening is uncovered, the tungsten sliding block and fixed tungsten block should be cleaned as described in Appendix C, page C–11 before using, transporting, or storing the gauge.

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

✔ 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 of Appendix C for further instructions.
3. OPERATING THE GAUGE

The gauge uses rechargeable NiCad batteries (included) as a power source.

To turn the gauge on, press <ON>.

When first turned on, the gauge executes an LCD test. After the screen fills with test characters, the gauge proceeds to the self-test.

After the 300-second self-test, the gauge enters the Ready mode. In this state, any of the gauge functions may be accessed. The Ready display is:

```
<READY> mm/dd/yy
Avg: xx
Time: xx mins.
BATT LIFE xx Hrs
```

The first line of the display alternates between the current time and date. The second line of the display indicates any gauge options that are enabled such as Average Mode. The third line indicates the enabled count time. The last line indicates the current battery voltage.
GAUGE PARAMETER SETUP

After unpacking and turning the gauge on, several parameters can be initialized. These parameters do not usually require changing and may include the measurement units, count time, company name, and time/date.

SELECTING UNITS

The 4640-B allows measurement results to be displayed in either metric or U.S. units. To select the unit type, press (SHIFT) and (SPECIAL). The display will be:

```
SPECIAL FUNCTION
YES - next menu
1- Surface Voids
2- Recover Erase
```

Press (YES) twice then (START/ENTER), or press (7) for the display:

```
Units in US
Select 1- US
2- METRIC
ENTER- no change
```

To select the required units, press either (1) or (2).
**SETTING THE COUNT TIME**

Typically, the count time may be selected once and will not require changing except for special measurements. Increasing the count time improves the measurement precision.

Press **(TIME)** for the display:

```
- Count Time -
  xx min.
Do you want
to change ?
```

Press **(YES)** for the display:

```
Sel: 1- 0.5 min.
  2- 1 min.
  3- 2 min.
  4- 4 min.
```

Press **(1)**, **(2)**, **(3)**, or **(4)** to select the desired count time. The display will return to *Ready* mode.

**SETTING THE TIME AND DATE**

Press **(SHIFT)** and **(SPECIAL)**. The display will be:

```
SPECIAL FUNCTION
YES- next menu
1- Surface Voids
2- Recover Erase
```
Press either (YES) three times then (START/ENTER), or press (10) for the display:

```
SPECIAL FUNCTION
Set Time/Date
Enter code ----
and Press ENTER
```

The Time/Date function is a restricted function and requires an access code for operation. This is to ensure that unauthorized personnel do not change the time and date.

Input the access code (see page xi) and press (START/ENTER). The display will be:

```
Date: mm/dd/yy
Do you want to change Date?
```

Press (YES). Select the format to be used: dd/mm/yy or mm/dd/yy.

Input the new date and press (START/ENTER).

Repeat the above procedure to change the time.

**CHANGE CUSTOMER NAME**

The gauge may be programmed to display your name or any other message (not to exceed 16 characters) during the powerup/self-test stage.

Press (SHIFT) and (SPECIAL).
The display will be:

**SPECIAL FUNCTION**
YES- next menu
1- Surface Voids
2- Recover Erase

Either press (YES) three times then (START/ENTER), or press (9) for the display:

**Customer Name:**
Do you want to change name?

The *Customer Name* function is a *restricted function* and requires an access code for operation. This is to ensure that unauthorized personnel do not change the name/message.

Press (YES). Input the access code (see page xi) and press (START/ENTER). The display is:

A----------
SHIFT- see chars
YES- select
ENTER- finished

Scroll through the alphabet by pressing (SHIFT). To select the letter and move to the next position, press (YES). To complete the operation, press (START/ENTER).
SOURCE ROD POSITIONS

To position source rod in the SAFE position, pull the source rod handle to the upper position and ensure that the plunger is engaged in the index notch (see Figure 3–1).

![Figure 3–1. Source Rod in SAFE Position](image)

The gauge is in the measurement position when the source rod handle is all the way down (see Figure 3–2). The handle must rest on the stop pin.

![Figure 3–2. Source Rod in Measurement Position](image)
**STANDARD COUNT**

The 4640-B uses a cesium-137 gamma source for taking density measurements. This low-level radioactive source undergoes a natural decay process that results in a gradual loss of strength. The time required for the source strength to diminish by 50% is referred to as the *half-life*. The half-life of cesium-137 is approximately 30 years.

To compensate for the source decay a daily reference *standard count* is performed. It is very important to take a standard count on a daily basis to ensure the highest accuracy and precision possible with the gauge.

The 4640-B is equipped with two methods of testing the reference standard count. The first method compares the new standard count with the average of the last four standard counts. This method is the *Multi-Standard Mode*. The second method compares the new standard count to the decay corrected factory calibration reference standard count. The factory standard count is corrected for the decay over the elapsed time. The new count is compared to the decay corrected calibration count and is referred to as the *Single-Standard Mode*. Refer to Chapter 6, page 6–12 for information on selecting Single-Standard or Multi-Standard Mode.

**TAKING THE STANDARD COUNT**

The gauge comes with a magnesium (Mg) reference block and an air gap spacer for taking the standard count. Place the reference block on a dry, flat surface at least 10 ft (3 m) from any large vertical surface (for example, a concrete block wall) and at least 33 ft (10 m) from any other radioactive source. The surface should be asphalt or concrete at least 4 in. (10 cm) thick.

Place the spacer on the Mg reference block and then place the gauge on top of the spacer. The gauge must be in the *SAFE* position. The handle end of the gauge should rest over the two posts on the spacer.
Press (STD) for the display:

```
-Standard Count-
   xxx  xxx
  Take a new
Standard Count?
```

Press (YES).

```
Place Gauge on
Spacer & both on
Block, Put Rod in
SAFE, Press ENTER
```

Check the gauge position. Press (START/ENTER) to start the count.

```
Taking
Standard Count.
xxx seconds
remaining.
```

After the count is completed, accept the new count by pressing (YES). The pass/fail tolerance is based on a 1% maximum allowed variation for System 1 reference standard counts and a 1.2% maximum allowed variation for System 2 standard counts.
VIEWING STANDARD COUNTS

The last four standard counts stored in gauge memory may be viewed.

Press \( \text{SHIFT} \) and \( \text{SPECIAL} \). Either press either \( \text{YES} \) four times then \( \text{START/ENTER} \), or press \( \text{12} \) for the display:

```
System #1 counts
1=xxxx  2=xxxx
3=xxxx  4=xxxx
YES for System 2
```

To view the counts for System #2, press \( \text{YES} \).

```
System #2 counts
1=xxxx  2=xxxx
3=xxxx  4=xxxx
YES to Exit
```
The 4640-B Thin Layer Density Gauge is designed for use on asphalt surfaces and does not require a great deal of site preparation.

**NOTE**

Keep the gauge turned parallel to the direction of the paver and rollers (see Figure 3–4).

- Remove any loose material (sand, aggregate, and so on) from the test site.

- Ensure that the gauge does not “rock;” it must remain level and steady. If rocking occurs, find a more suitable test site. To take a measurement around a core, the operator may move the gauge a few inches away from the core to level the gauge.

Figure 3–4 shows the gauge positioned *around* a core site. This type of measurement is taken *after* the core has been cut. When taking this type of measurement, Troxler recommends averaging four 1-minute counts taken around the core site.

Figure 3–5 shows the gauge positioned *over* a core site. This type of measurement is taken *before* the core is removed.
3. OPERATING THE GAUGE

Keep gauge turned in the direction of the paver!

Figure 3–4. Gauge Positioned Around a Core Site
(After Core Has Been Removed)

Figure 3–5. Gauge Positioned Over a Core Site
(Before Removing Core)
NOTE
When not taking readings, always keep the source rod in the SAFE position. For added operator safety, the source rod on the 4640-B gauge 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, page C–11 for cleaning instructions.

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

OVERLAY THICKNESS SELECTION
To ensure underlying material does not influence the readings, input the overlay thickness prior to taking a measurement with the 4640-B.

Press (THICK) for the display:

Layer Thickness:
  x.xx in.
Input and Press ENTER

It is recommended that unless the overlay thickness is known, the user should enter a value slightly less than the target thickness. This ensures that the gauge reads only the new overlay. Input the thickness of the overlay and press (START/ENTER).
MARSHALL/VOIDLESS DENSITY PARAMETERS

Input the target density prior to taking a measurement. Press (MA/VOIDLESS) for the display:

| MA: xxxxx PCF |
| VD: xxxxx PCF |
| Do you want to change? |

Press (YES) and input any target Marshall and voidless density values.

NOTE
The “voidless” density is the maximum theoretical density obtained in laboratory tests.

TAKING A READING

For added user safety, the source rod on the 4640B gauge retracts to the SAFE position when the gauge is picked up by the handle.

Place the gauge over the test site. Release the gauge handle and push it down until the handle is resting on top of the stop pin.

Press (START/ENTER):

| MA: xxxxx PCF |
| Thick: xxx in. |
| Avg: xx |
| Time: xx secs. |
After the count time has elapsed, the display will be:

<table>
<thead>
<tr>
<th>Dens:  x.x PCF</th>
<th>%MA:  x.xxx%</th>
</tr>
</thead>
<tbody>
<tr>
<td>100-%MA: xx.xxx%</td>
<td>%VOID: x.xx</td>
</tr>
</tbody>
</table>

NOTE
If Surface Voids mode has been enabled, the surface voids density value will be displayed. Refer to Chapter 6, page 6–2 for more information.

VIEWING THE COUNTS
To view the actual counts for detector systems 1 and 2, press (SHIFT) and (RECALL).
CHAPTER 4

STORING PROJECT DATA

This chapter explains the procedures for assigning project numbers, storing gauge measurements, printing project data, and erasing old projects from memory.

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Creating a Project ................................................................. 4–2
  Create a New Project .......................................................... 4–2
  View/Erase Project ............................................................ 4–2

Storing a Measurement ......................................................... 4–3

Printing Measurement Data .................................................... 4–4

Erasing a Project ................................................................. 4–6
CREATING A PROJECT

The Project function allows the user to create, retrieve, view, and/or erase projects. Data is stored in the 4640-B under a project number. If the user presses the (STORE) key after a reading is taken (see page 4–3), the reading will be stored in the gauge memory under the active project number.

Press (SHIFT) and (PROJECT) for the display:

```
Current Project: xxxxxxx
Do you want a new Project #?
```

From this screen projects can be created (press (YES)) or viewed and/or erased (press (NO/CE)).

CREATE A NEW PROJECT

Input the number of a new project. The project will be active until a new project number is entered. All gauge readings that are stored will be stored under the new project.

VIEW/ERASE PROJECT

```
PR# xxxxx
1- View Proj.
2- Erase Proj.
3- Next Proj.
```

Scroll through the project numbers by pressing (3). When the desired project number is displayed, the user may either view the project data (press (1)) or erase the project from the gauge memory (press (2)). After making the selection to either view or erase, follow all instructions on the gauge display.
STORING A MEASUREMENT

After reviewing the data, the reading may be stored under the *active project number*, allowing the data to be recalled and printed at a later time.

When the measurement has been completed press *(STORE)*. The display will request a station number.

```
Station Number?
-------
Input and
Press ENTER
```

Input a station number or reading number (up to six characters) and press *(START/ENTER)*.

```
Distance from center line?
-------
(Press ENTER)
```

Input the distance from the centerline (if applicable) and press *(START/ENTER)*. The gauge will request if the measurement was to the *left* (press *(1)*) or *right* (press *(2)*) of the centerline.

Additional information such as grid coordinates, mix type, or any other numeric information may be stored (up to twelve characters per line). To store additional information, press *(YES)*. To exit, press *(NO/CE)*.
PRINTING MEASUREMENT DATA

The measurement data from *one* project or from *all* projects may be printed (uploaded) to a computer file if the gauge control unit is connected to the serial port. Appendix F provides instructions on using the HyperTerminal program in Microsoft® Windows 95® and Windows 98® or the Terminal program in Windows® 3.1 to print (upload) data to a computer. The optional Procomm Plus® data processing package available from Troxler may also be used to print (upload) data.

Press (SHIFT) and (PRINT). The display will be:

Connect serial device & Select:
1- one Project
2- all Projects

Connect the printer to the RS-232 serial port located on the front of the gauge (see Figure 4–1). See page 6–10 for information on the serial port parameters.

To print a single project, press (1). To print *all* projects, press (2).

If printing all files the gauge will return to the Ready mode upon completion.

Figure 4–1. Gauge Connections
If printing a single file, the gauge will display the first project number in memory.

Scroll through the project numbers with (2). When the project for printing is displayed, press (1).
ERASING A PROJECT

The *Erase* function allows project data to be erased or removed from gauge memory.

Press *(SHIFT)* and *(ERASE)*. The display will be:

```
Select to ERASE:
  1- one Project
  2- all Projects
```

To erase a single project, press *(1)*.

To erase all projects stored in the gauge, press *(2)*.

**NOTE**

In the event that project data is inadvertently erased, the *Recover Erase* feature may recover lost data. See page 6–4 for information on using the *Recover Erasure* feature.
This chapter gives brief explanations of the Shift functions available on the Model 4640-B Thin Layer Density Gauge. These functions are accessed by pressing (SHIFT) and the corresponding function key.

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Status .............................................................................................5–2

Average ..........................................................................................5–3

Project ...........................................................................................5–4

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Erase ..............................................................................................5–4

Special Calibration (SP. CAL.) .....................................................5–5
  New Calibration ..........................................................................5–6

Offset ............................................................................................5–8

Calculator (CALC.) .....................................................................5–9

Recall ............................................................................................5–10
The *Status* function allows the user to view each gauge setting without accessing the individual function.

Press *(SHIFT)* and *(STATUS)* for the display:

```
-CONTROL STATUS-
  Press YES to
  view settings
  (CE to exit)
```

To view the settings, press *(YES)*.

```
UNITS: US
SV: DISABLED
Offset: DISABLED
(Press YES)
```

To continue viewing gauge settings, press *(YES)*.

To exit, press *(NO/CE)*.
The *Average* function provides a method of averaging from two to twelve readings. This technique is especially useful if taking measurements around a core or core site.

When the gauge is in the *average mode*, the display will automatically prompt the user to take the required measurements.

Press *(SHIFT)* and *(AVERAGE)* for the display:

```
No. of readings to average: xx
Do you want to change?
```

Press *(YES)* and input the number of readings to be averaged.

When the next measurement is taken, the display will reflect that the current reading is one of a total number of readings to be averaged.

```
Reading# x of xx
Thick: x.xx
Avg: xxxx
Time: xxx
```

To continue taking readings, press *(START/ENTER)*.

When all the readings are complete, the average result will be displayed.
PROJECT
Refer to page 4–2 for information on setting up or viewing project files.

PRINT
The *Print* function allows project data to be printed or downloaded to a computer. For more information on the use of this function, see page 4–4.

ERASE
See page 4–6 for information on erasing projects. In case of accidental erasure, see page 6–4.
The 4640-B Thin Layer Density Gauge is factory calibrated for a density range of 100 to 170 pcf (1602 to 2723 kg/m³). However, in some instances the asphalt mix may contain materials such as iron slag, glass, large aggregate, rubber, and so on that will result in a different asphalt composition and texture for which the gauge is not calibrated.

The Special Calibration function allows the user to re-calibrate the gauge for use on materials that are not covered by the factory calibration. Once the special calibration is enabled, it remains active until the gauge is turned off or the factory calibration is enabled again.

Special Calibration uses the average of 5 to 25 measurements. This average and the density obtained by another method (such as core samples) are used to re-calculate the gauge constants.

Up to eleven calibrations can be stored in the gauge. These calibrations will be referenced by the calibration number.

Press [SHIFT] and [SP. CAL.].

SPEC. CALIB: OFF
Press: 1- enable
2- disable
3- New calib.
NEW CALIBRATION

To perform a special calibration, press (3). Input the calibration number and the number of readings to be averaged.

The core value is the density obtained using an alternative method of measurement. If the core has not yet been removed, position the gauge over the alternative test site as shown in Figure 5–1. If the core has been removed, position the gauge around the alternative test site as shown in Figure 5–2. Take the readings and enter the core value.

To enable the calibration, press (START/ENTER). Disable the calibration by pressing (2).

A special calibration may be erased by performing a new calibration and using the number of the existing calibration.
5. SHIFT FUNCTIONS

Figure 5–1. Gauge Positioned Over Alternative Test Site

Figure 5–2. Gauge Positioned Around Alternative Test Site
The Offset function, like a special calibration, allows the gauge to be adjusted for asphalt mixes not covered by the factory calibration. This function is quicker than performing a special calibration but less accurate. The offset should be used only to temporarily adjust the gauge readings.

An offset may be a positive or negative value. If the offset is positive, the value will be added to the gauge density readings. If the offset is negative, the value will be subtracted from the density readings. Offset values may be stored in memory for later recall or input from the keypad.

Press (SHIFT) and (OFFSET).

To enable a stored offset or enter a new offset, press (1). To change the value, press (YES).

For a keypad entry, press (1) and choose whether the number is positive or negative. Input the offset. To enable the new value, press (START/ENTER).

To recall a previously stored offset, press (2).
CALCULATOR (CALC.)

The 4640-B Thin Layer Density Gauge is equipped with a four-function calculator. The function keys are located on the two left rows of the keypad. When the calculator function is active, these keys are enabled.

Press **SHIFT** and **CALC.**.

To perform the calculator functions, use the **+**, **−**, **×**, and **÷** keys located in the lower left corner of the keypad. The **=** key is located on the **START/ENTER** key.

An example of a calculator entry display is as follows.

```
- CALCULATOR -
  4.125
+ 3.273
= 7.39800000
```

Results may be stored in memory by pressing **MS**.

Results may be retrieved from memory by pressing **MR**.

Exit the calculator mode by pressing **EXIT** (located on the **YES** key).
The *Recall* function allows the last reading taken with the 4640-B Thin Layer Density Gauge to be recalled for review.

Press *(SHIFT)* and *(RECALL)* for the display:

![Display](image)

To return to the *Ready* mode, press *(NO/CE)*.
This chapter gives brief explanations of the *Special* functions available on the Model 4640-B Thin Layer Density Gauge. These functions are accessed by pressing *(SHIFT)* and *(SPECIAL)*, then the corresponding function key.

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- Surface Voids ................................................................. 6–2
- Recover Erase ................................................................. 6–4
- Stat Test ........................................................................ 6–5
- Drift Test ....................................................................... 6–7
- Target Precision ............................................................. 6–9
- Print/Baud Set ................................................................. 6–10
- Units .............................................................................. 6–11
- Battery .......................................................................... 6–11
- Customer Name ............................................................. 6–12
- Time/Date ....................................................................... 6–12
- Standard Mode ............................................................... 6–12
- Standard Data ................................................................. 6–12
- Source Decay ................................................................. 6–13
- Erase Standard Counts .................................................. 6–14
SURFACE VOIDS

In cases where thin layer measurements must be taken on asphalt mixes containing large aggregate (open mixes), the surface voids mode may be enabled to obtain a more accurate reading. Refer to Figure 6–1 on the following page to aid the decision of surface voids mode usage.

When measuring a thin layer containing large aggregate, the gauge bottom will not make uniform contact with the asphalt surface. The resulting “air voids” may shift or bias the density readings. In surface voids mode, the 1-inch magnesium reference block is placed under the gauge to remove the air voids between the gauge and the road surface (see Figure 6–2). The readings calculated will reflect the bulk density of the top 3 in. (8 cm) of the material under the block and will be unaffected by the thickness setting of the gauge.

NOTE
In most cases, a special calibration will provide satisfactory readings on large aggregate mixes. If the user suspects that the gauge readings are skewed, perform a special calibration. Refer to page 5–5 for more information.

To enable the surface voids mode press (SHIFT) and (SPECIAL).

Press 1.

The display returns to the Ready mode.
6. SPECIAL FUNCTIONS

Figure 6–1. Normal Versus Surface Voids Mode Selection

Figure 6–2. Gauge/Reference Block Position
If project data is inadvertently erased, the *Recover Erase* function may recover the lost information.

**NOTE**
There is no guarantee that the *Recover Erase* function will successfully recover the lost data. If any data has been stored after the accidental erasure, a successful recovery is impossible.

To use the *Recover Erase* function, press *(SHIFT)* and *(SPECIAL)*.

Press *(2)*. If the recovery is successful, the display will be:

```
Project Number: xxxxx
Data Recovered!
```

If the recovery is not successful, the display is:

```
NO DATA RECOVERED!
```
Erratic readings or readings that seem to fluctuate may indicate a problem with the gauge. If the readings are suspect, the stat test or statistical stability test may be performed by an operator to validate the normal operation of the gauge.

A stat test consists of twenty 1-minute counts. From the twenty counts, the standard deviation is calculated. This standard deviation is compared to a theoretical standard deviation value. Ideally, this ratio should be one. However, the 4640-B pre-scales (or divides) the counts by 8, resulting in an ideal ratio of (0.35). The acceptable limits for the ratios are from (0.25) to (0.45). The gauge is considered unstable if the ratios are outside these limits for two out of three stat tests.

To execute a stat test, press (SHIFT) and (SPECIAL).

Either press (YES) once then (START/ENTER), or press (3) for the display:

Place Gauge on Spacer & both on Block, Put Rod in SAFE, Press ENTER

Place the gauge on the air gap spacer with the handle end resting over the two posts (on the bottom of the fixture). Place the gauge and spacer on the 1-inch magnesium reference block. Place the source rod in the SAFE position. To start taking the twenty counts press (START/ENTER).

After the twenty counts have been completed, the gauge will display the average counts and indicate if the test passed or failed. The individual count data may be viewed or printed at this time. Figure 6–3 shows a sample printout of the stat test data.
<table>
<thead>
<tr>
<th>Reading</th>
<th>Counts</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>6948</td>
</tr>
<tr>
<td>2</td>
<td>6900</td>
</tr>
<tr>
<td>3</td>
<td>6894</td>
</tr>
<tr>
<td>4</td>
<td>6880</td>
</tr>
<tr>
<td>5</td>
<td>6886</td>
</tr>
<tr>
<td>6</td>
<td>6857</td>
</tr>
<tr>
<td>7</td>
<td>6884</td>
</tr>
<tr>
<td>8</td>
<td>6893</td>
</tr>
<tr>
<td>9</td>
<td>6913</td>
</tr>
<tr>
<td>10</td>
<td>6926</td>
</tr>
<tr>
<td>11</td>
<td>6930</td>
</tr>
<tr>
<td>12</td>
<td>6908</td>
</tr>
<tr>
<td>13</td>
<td>6909</td>
</tr>
<tr>
<td>14</td>
<td>6913</td>
</tr>
<tr>
<td>15</td>
<td>6920</td>
</tr>
<tr>
<td>16</td>
<td>6874</td>
</tr>
<tr>
<td>17</td>
<td>6897</td>
</tr>
<tr>
<td>18</td>
<td>6923</td>
</tr>
<tr>
<td>19</td>
<td>6921</td>
</tr>
<tr>
<td>20</td>
<td>6849</td>
</tr>
</tbody>
</table>

* Troxler 4640 Stability Test *
5/31/89 8:10 AM
Serial #: 590
Reading: COUNTS

Figure 6–3. Sample Stat Test Printout
DRIFT TEST

If the stat test has already been performed (and passed), but gauge readings seem to drift between tests, a drift test can be performed to check the long-term drift of the 4640-B.

A drift test consists of five 4-minute counts that are begun approximately 3-4 hours after completion of a stat test.

NOTE
The gauge should not be turned off or removed from the location the stat test was performed between the stat test and drift test. The stat test must be current.

With the gauge still on the air gap spacer and reference block, press (SHIFT) and (SPECIAL).

Either press (YES) once then (START/ENTER), or press (4) for the display:

Place Gauge on Spacer & both on Block, Put Rod in SAFE, Press ENTER

To start taking the five counts, press (START/ENTER).

After the five counts have been completed, the gauge will display the average counts and indicate if the test passed or failed.

Avg: xxxx xxxx
DriftA: x.xx% P
DriftB: x.xx% P
View DRIFT data?

The pass/fail tolerance for System 1 is 0.50%; the tolerance for System 2 is 0.80%.

The individual count data may be viewed or printed at this time. Figure 6–4 shows a sample printout of the drift test data.
**TROXLER 4640 Drift Test**

Gauge Serial #: 590  
5/31/89 11:10 AM  
READING: COUNTS

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>8375</td>
<td>3340</td>
</tr>
<tr>
<td>2</td>
<td>8414</td>
<td>3376</td>
</tr>
<tr>
<td>3</td>
<td>8339</td>
<td>3348</td>
</tr>
<tr>
<td>4</td>
<td>8381</td>
<td>3352</td>
</tr>
<tr>
<td>5</td>
<td>8215</td>
<td>3416</td>
</tr>
</tbody>
</table>

Average counts: 8345 3366  
DriftA: 0.22% PASS  
DriftB: 0.33% PASS

*Figure 6–4. Sample Drift Test Printout*
TARGET PRECISION

If better than normal precision is required, the 4640-B may be programmed to automatically increase the count time to reach the desired precision.

The 4640-B count time will be adjusted (up to a maximum of 60 min) to obtain the specified precision. The required precision time is rounded to the nearest 15-second interval.

Press \(\text{SHIFT}\) and \(\text{SPECIAL}\). Either press \(\text{YES}\) once then \(\text{START/ENTER}\), or \(5\) for:

\[
\begin{array}{c}
\text{Target Precision} \\
\text{-----.-- xxx} \\
\text{Input Precision} \\
& \text{Press ENTER}
\end{array}
\]

Input the desired precision and press \(\text{START/ENTER}\).

The gauge will request the thickness of the overlay for measurement. Input the thickness and press \(\text{START/ENTER}\).

Place the gauge on the asphalt and start the 1-minute baseline count.

\[
\begin{array}{c}
\text{Target Precision} \\
\text{xx.xx} \\
\text{Time: xx mins.} \\
\text{(START to begin)}
\end{array}
\]

When the baseline count is complete, start the \textit{target precision} count.

**NOTE**

Refer to page B-2 for precision specifications.
The Print/Baud Setup function allows the user to configure the gauge for communication with an RS-232 serial device such as a printer or computer.

The baud rate or communication speed should be set to match the peripheral device. Refer to the device owner's manual for the proper settings. The Print/Baud Setup function also provides a line feed option to automatically transmit a line feed with each carriage return.

Press \text{(SHIFT)} and \text{(SPECIAL)}. Either press \text{(YES)} two times then \text{(START/ENTER)}, or press \text(6) for the display:

\begin{center}
\begin{tabular}{|c|}
\hline
Print/Baud Setup
\text{Select:}
\text{1- Baud Rate}
\text{2-Auto Line Feed}
\hline
\end{tabular}
\end{center}

To access the baud rate selection menu, press \text{(1)}. To activate the automatic line feed feature, press \text{(2)}.

\begin{center}
\begin{tabular}{|c|}
\hline
Baud rate: xxxx
Do you want
to change?
\hline
\end{tabular}
\end{center}

To change the baud rate, press \text{(YES)}.

\begin{center}
\begin{tabular}{|c|}
\hline
Baud rate: xxxx
1- 300, 3- 1200
2- 600, 4- 2400
\text{(CE to abort)}
\hline
\end{tabular}
\end{center}

Choose the appropriate baud rate with the numeric keys. The gauge returns to the \text{Ready} mode.
6. SPECIAL FUNCTIONS

UNITS

Refer to page 3–4 for information on the Units function.

BATTERY

The Battery Monitor function provides the user with multiple methods for displaying the battery status. The recommended display method is actual battery voltage. However, the other choices may be useful. The following choices are available:

♦ Display the actual battery voltage
♦ Display the estimated battery life
♦ Display the elapsed time from the last charge

Press <SHIFT> and <SPECIAL>. Either press <YES> twice then <START/ENTER>, or press <8> for the display:


To change the battery status display, press <1> and follow the instructions on the gauge display.

To review the current battery status (voltage, charge date, time used, and so on), press <2>.

- Battery Status- Batt. Volts:xx.x (7.0 =Batt. Low) (Press YES)

To view the date of the last charge and elapsed time, press <YES>. 
CUSTOMER NAME

Refer to page 3–6 for information on entering the customer name.

TIME/DATE

The Time/Date function is discussed on page 3–5.

STANDARD MODE

Refer to page 3–9 for detailed information on when to use this function.

Press (SHIFT) and (SPECIAL). Either press (YES) three times then (START/ENTER), or press (11) for the display:

```
Std Mode #Single
Select:
  1- Single Std
  2- Multi. Std
```

With the numerical keys, choose the method best suited for your applications.

STANDARD DATA

The last four standard counts stored in gauge memory may be viewed. Refer to page 3–11 for more information.
**SOURCE DECAY**

Refer to page 3–9 for more information on the use of this feature.

The *Source Decay* function instructs the gauge to calculate a theoretical set of standard counts. The factory standard counts are “adjusted” mathematically to compensate for the 2.3% per year source decay. These counts can be compared to the current standard count. The correction formula uses daily increments to compensate the effects source decay on the standard counts.

The adjusted counts may be compared to the existing daily standard counts to determine if the gauge is operating properly.

Press *(SHIFT)* and *(SPECIAL)*.

Either press *(YES)* four times then *(START/ENTER)*, or press *(13)* for the display:

```
Std after Decay
Sys 1  Sys 2
xxxx  xxxx
(Press any key)
```

To exit, press any key.
ERASE STANDARD COUNTS

The Erase Standard Counts function allows the user or technician to erase all four standard counts from gauge memory. This may be desirable if the gauge has been repaired or mechanical changes have been made. These factors may affect the standard counts and comparing the new one to the average of the last four may cause the gauge to fail the standard count test when nothing is wrong with the gauge.

NOTE
This function will erase all the standard counts from memory!

Press (SHIFT) and (SPECIAL).

Either press (YES) four times then (START/ENTER), or press (14) for the display:

Do you want to erase all Standard Counts in gauge?

To erase the standard counts, press (YES).
This appendix is required reading for anyone who will operate the 4640-B nuclear system. This appendix covers radiation theory along with a brief explanation of radiation statistics and radiation terminology.

CONTENTS

Radiation Theory ................................................................. A–2
  Atomic Structure .................................................................. A–2
  Radiation Theory .................................................................. A–3
  Radiation Terminology ..................................................... A–3
  Radiation Statistics .......................................................... A–4

Radiation Safety ..................................................................... A–5
  Types of Radiation .......................................................... A–5
  Limiting Exposure ........................................................... A–5
  Monitoring Radiation ......................................................... A–7
  4640-B Radiation Profile .................................................. A–8
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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 materials consist of chemical elements that cannot decompose by ordinary chemical methods. Some examples are:

(H) Hydrogen (C) Carbon (O) Oxygen
(U) Uranium (Cf) Californium (Co) Cobalt

Each element contains an atom with a unique structure (see Figure A–1). The atom consists of smaller particles such as protons, neutrons, and electrons. The protons and neutrons are grouped together in the nucleus. The electrons orbit the nucleus. Under normal circumstances, an atom is electrically neutral because the positive protons cancel out the negative electrons.

Protons carry a positive charge, and are described as having a mass of one. Neutrons have no charge and have a mass of one. Electrons carry a negative charge and essentially have no mass.

<table>
<thead>
<tr>
<th>MASS (ATOMIC WEIGHT SCALE)</th>
<th>CHARGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protons</td>
<td>+1</td>
</tr>
<tr>
<td>Neutrons</td>
<td>0</td>
</tr>
<tr>
<td>Electrons</td>
<td>−1</td>
</tr>
</tbody>
</table>

Figure A–1. Diagram of an Atom

Appendix A–2
Since protons and neutrons are clustered together in the nucleus, the mass of an atom is concentrated in the nucleus. The atom in Figure A–1 has two protons and two neutrons; therefore, it is a helium atom. The atomic weight of an atom is the sum of the protons and neutrons.

**RADIATION THEORY**

Radioactivity is the spontaneous breakdown of unstable nuclei (radioisotopes) with the resulting emission of radiation. The basic unit of radiation used in the U.S. is the curie (Ci). The curie is defined as \(3.7 \times 10^{10}\) disintegrations of nuclei per second. In the “Special Form” encapsulated sealed sources used in the 4640-B, the unit of measure is the millicurie (1/1,000 of a curie). The SI unit of radiation is the becquerel (Bq). A becquerel equals one disintegration per second. Therefore, one curie equals \(3.7 \times 10^{10}\) becquerels.

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 cesium-137 (Cs-137) source is 30 years.

**RADIATION TERMINOLOGY**

The rad or radiation absorbed dose, is the unit of absorbed dose equal to 0.01 joules/kg in any medium. To account for the effect of various types of radiation on biological tissue, the roentgen equivalent man (rem), or more appropriate for Troxler users, the millirem (mrem), is used when measuring radiation dose. The rem is derived from scaling the radiation absorbed dose (rad) by a quality factor (QF). One rad is equal to the exposure of one rem of gamma radiation.

For example, the quality factor (QF) for the cesium-137 gamma source in the 4640-B is one. Therefore, one rad of absorbed dose produces a dose equivalent (absorbed dose × QF) of 1 rem. Note that other types of radiation may have quality factors greater than 1.
RADIATION STATISTICS

Radioactive emission is a random process. The number of emissions in a given time period is not constant but varies statistically about an average value. The variation about the true mean value is a Poisson distribution. In this distribution, the standard deviation (\( \sigma \)) about the mean (\( n \)) is defined as:

\[
\sigma = \sqrt{n}
\]

When the mean is greater than 100, the Poisson distribution can be closely approximated by the normal distribution (Figure A–2). The normal distribution predicts the probability that any given count rate will fall within a selected region about the mean.

![NORMAL DISTRIBUTION](image)

*Figure A–2. Variation of Radioactive Emission*

Using the mean of a larger number of counts to approximate the true mean, the distribution shows that 68.3% of the time the count rate obtained will be within ± 1 standard deviation of the mean. Figure A–2 shows the chance of counts falling within three standard deviations of the mean. The user may perform a statistical stability test (stat test) to compare the experimental standard deviation to the theoretical standard deviation (see page 6–5).
RADIATION SAFETY

This section provides a brief discussion of general radiation safety. The exposure profile for the Model 4640-B gauge is also included, along with a discussion of the source encapsulation.

TYPES OF RADIATION

The radioactive source in the Model 4640-B produces two types of radiation:

- Beta particles
- Photons (gamma rays)

The beta particles are stopped by the source capsule. Only the gamma radiation contributes to any occupational radiation exposure.

Gamma radiation is electromagnetic radiation, as are x-rays, radio waves, and visible light. Visible light and gamma rays have no mass, a zero electrical charge, and travel at the speed of light. Gamma rays are energetic and penetrating. Dense materials (such as lead, cadmium, and so on) provide the best shielding against gamma radiation.

LIMITING EXPOSURE

WARNING

Do not tamper with or modify the Model 4640-B gauge. Also, do not remove the sealed source from the gauge. Tampering with or modifying the gauge or removal of the sealed source can be dangerous. Such actions are illegal unless authorized by your radioactive materials license.

Government agencies set occupational exposure limits. The current limit in the United States and many other countries is 5,000 mrem per year. Under average conditions, a full-time employee working with the 4640-B will receive less than 200 mrem per year.
Taking advantage of all available means to limit radiation exposure is always recommended. The three methods of limiting exposure are:

- **TIME**
- **DISTANCE**
- **SHIELDING**

These methods are a part of an *ALARA* (As Low As Reasonably Achievable) program.

**Time**

The simplest way to reduce exposure is to keep the time spent around a radioactive source to a minimum. If time is cut in half, so is the exposure, with 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–3). Doubling the distance from a radiation source reduces the exposure to one-fourth its original value. If the distance is tripled, the exposure is reduced by a factor of nine, and so on.

*Figure A–3. Effect of Distance on Exposure*
Shielding

Shielding is any material used to reduce the radiation reaching the user from a radioactive source. While some types of radiation such as alpha particles may be stopped by a single sheet of paper, other particles such as gamma rays require much more shielding. Dense materials, such as lead, shield gamma rays. The Model 4640-B has shielding built into the system that reduces the exposure.

MONITORING RADIATION

In the United States, anyone working with or near radioactive materials is subject to the limits on occupational exposure and must complete a radiation safety training course to be designated an authorized user. As an authorized user, an individual so designated must work in a “controlled” environment to the extent that their exposure to radiation must be monitored. Several means of personnel monitoring or dosimetry exist; the most common methods are film badges and thermoluminescent dosimeter (TLD) badges.

In Canada, nuclear gauge users are not normally classified as Atomic Radiation Workers. In such cases, the general public dose limit of 0.5 rem/year would apply. 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 AECB regulatory document R91 “Monitoring and Dose Recording for the Individual.”
2. * indicates a reading of less than 0.1 mrem/h.
3. All reading in mrem/hr.
4. Dose rates measured by the State of North Carolina Department of Environment, Health, and Natural Resources, Division of Radiation Protection.

Figure A–4. Radiation Profile
SOURCE ENCAPSULATION

The source in the Model 4640-B gauge meets regulatory requirements of U.S. and international authorities as “Special Form” or “Sealed” source material. With the exception of the direct radiation hazard, these sources are considered extremely safe.

Sealed sources are encapsulated to prevent leakage of the radioactive material and to meet radiation safety requirements.

The photon, or gamma source (cesium-137) in the 4640-B is in a capsule.

Proper use of this gauge (following the instructions in this manual) and the shielding design of the gauge will keep the exposure levels at a minimum under normal conditions. It is, however, required that 4640-B users wear personnel dosimetry when using the gauge.

EMERGENCY PROCEDURES

If the nuclear gauge is lost or stolen, then immediately notify the 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:

✔ Locate the gauge and/or source.

✔ Do not touch or move the gauge.

✔ Immediately cordon off an area around the nuclear gauge and/or source. A radius of 15 ft (5 m) will be sufficient. Do not leave the area unattended.

✔ Keep all unauthorized personnel from the nuclear gauge.

✔ If a vehicle is involved, it must be stopped until the extent of contamination, if any, can be established.

✔ The gauge user should perform a visual inspection of the nuclear gauge to determine if the source housing and/or shielding has been damaged.

✔ Use a survey meter to measure the dose rate at a distance of 3 ft (1 m) from the gauge.

✔ Contact the company RSO (name and number given at the beginning of this section). Provide the RSO with the following:

♦ The date, time, and location of the accident

♦ The gauge model and serial number

♦ The nature of the accident

♦ The location and condition of the gauge and/or source

♦ The dose rate at 3 ft (1 m) from the gauge
If you are unable to reach the RSO, then call your regulatory agency (name and number given at the beginning of this section).

Follow the instructions of the RSO. The RSO should report the incident to the regulatory agency. The RSO may also be required to notify the U.S. DOT of accidents during transport.

Before shipping a damaged gauge to Troxler, obtain an RGA (Returned Goods Authorization) number from the Troxler RSO.
This appendix contains gauge and measurement specifications for the Model 4640-B Thin Layer Density Gauge.

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Measurement Specifications ......................................................... B–2
  Gauge Precision at 140 PCF (2240 kg/m³) ............................. B–2
Radiological Specifications ....................................................... B–3
Electrical Specifications ......................................................... B–4
Mechanical Specifications ...................................................... B–6
## MEASUREMENT SPECIFICATIONS

### GAUGE PRECISION AT 140 PCF (2240 KG/M³)

<table>
<thead>
<tr>
<th>Time (min)</th>
<th>Thickness</th>
<th>PCF</th>
<th>kg/m³</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5</td>
<td>1.0&quot; (2.5cm)</td>
<td>± 1.4</td>
<td>± 22</td>
</tr>
<tr>
<td></td>
<td>2.0&quot; (5.0cm)</td>
<td>± 0.85</td>
<td>± 14</td>
</tr>
<tr>
<td></td>
<td>2.5&quot; (6.3cm)</td>
<td>± 0.69</td>
<td>± 11</td>
</tr>
<tr>
<td></td>
<td>4.0&quot; (10.0cm)</td>
<td>± 0.69</td>
<td>± 11</td>
</tr>
<tr>
<td>1.0</td>
<td>1.0&quot; (2.5cm)</td>
<td>± 1.0</td>
<td>± 16</td>
</tr>
<tr>
<td></td>
<td>2.0&quot; (5.0cm)</td>
<td>± 0.60</td>
<td>± 10</td>
</tr>
<tr>
<td></td>
<td>2.5&quot; (6.3cm)</td>
<td>± 0.50</td>
<td>± 8</td>
</tr>
<tr>
<td></td>
<td>4.0&quot; (10.0cm)</td>
<td>± 0.5</td>
<td>± 8</td>
</tr>
<tr>
<td>2.0</td>
<td>1.0&quot; (2.5cm)</td>
<td>± 0.71</td>
<td>± 11</td>
</tr>
<tr>
<td></td>
<td>2.0&quot; (5.0cm)</td>
<td>± 0.42</td>
<td>± 7</td>
</tr>
<tr>
<td></td>
<td>2.5&quot; (6.3cm)</td>
<td>± 0.37</td>
<td>± 6</td>
</tr>
<tr>
<td></td>
<td>4.0&quot; (10.0cm)</td>
<td>± 0.37</td>
<td>± 6</td>
</tr>
<tr>
<td>4.0</td>
<td>1.0&quot; (2.5cm)</td>
<td>± 0.50</td>
<td>± 8</td>
</tr>
<tr>
<td></td>
<td>2.0&quot; (5.0cm)</td>
<td>± 0.30</td>
<td>± 5</td>
</tr>
<tr>
<td></td>
<td>2.5&quot; (6.3cm)</td>
<td>± 0.25</td>
<td>± 4</td>
</tr>
<tr>
<td></td>
<td>4.0&quot; (10.0cm)</td>
<td>± 0.25</td>
<td>± 4</td>
</tr>
</tbody>
</table>

Precision is defined as ± one 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.
## RADIOLOGICAL SPECIFICATIONS

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gamma source</td>
<td>0.30 GBq (8 mCi) ± 10% cesium-137</td>
</tr>
<tr>
<td>Source type</td>
<td>Sealed Source – Special Form</td>
</tr>
<tr>
<td>Source housing</td>
<td>Stainless steel, encapsulated</td>
</tr>
<tr>
<td>Shielding</td>
<td>Tungsten, lead, and cadmium</td>
</tr>
<tr>
<td>Surface dose rate</td>
<td>See radiation profile on page A-8.</td>
</tr>
<tr>
<td>Source rod material</td>
<td>Stainless steel</td>
</tr>
<tr>
<td>Shipping case</td>
<td>DOT 7A, Type A, Yellow II, TI. 0.2</td>
</tr>
</tbody>
</table>
# ELECTRICAL SPECIFICATIONS

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time accuracy and stability</td>
<td>±0.005% ±0.0002% / °C</td>
</tr>
<tr>
<td>Power supply stability</td>
<td>±0.01% / °C</td>
</tr>
<tr>
<td>Stored power</td>
<td>30 watt-hours</td>
</tr>
<tr>
<td>Battery recharge time</td>
<td>16 hours, automatic cutoff</td>
</tr>
<tr>
<td>Charge source</td>
<td>110/220 V ac, 50/60 Hz/12 V dc</td>
</tr>
<tr>
<td>Liquid crystal display</td>
<td>4-line x 16-character alphanumeric</td>
</tr>
<tr>
<td>Keypad</td>
<td>22-key sealed membrane</td>
</tr>
<tr>
<td>Power consumption</td>
<td>0.16 watts average</td>
</tr>
<tr>
<td>RAM</td>
<td>32 kilobytes non-volatile</td>
</tr>
<tr>
<td>ROM</td>
<td>64 kilobytes</td>
</tr>
<tr>
<td>Serial data format:</td>
<td>8 Data Bits</td>
</tr>
<tr>
<td></td>
<td>2 Stop Bits</td>
</tr>
<tr>
<td></td>
<td>No Parity</td>
</tr>
</tbody>
</table>

**Gauge to PC Compatible Computer Cable (PN 104334.1000):**

- Rx (pin 3) ............ Tx (pin 2)
- Tx (pin 2) ............ Rx (pin 3)
- DTR (pin 20) ........ DSR (pin 6)
- DSR (pin 6) ........ DTR (pin 20)
- Gnd (pin 7) ............. Gnd (pin 7)
Gauge to WEIGH-TRONIX\textsuperscript{2} Printer Cable (PN 104324.1000):

\begin{itemize}
  \item Tx (pin 2) .......... Rx (pin 2)
  \item CTS (pin 5) .......... DSR (pin 6)
  \item DSR (pin 6) .......... CTS (pin 5)
  \item Gnd (pin 7) .......... Gnd (pin 7)
\end{itemize}

4640-B Gauge Serial Pin Description

<table>
<thead>
<tr>
<th>1</th>
<th>GND</th>
<th>Signal Ground</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>TXD</td>
<td>Transmit Data</td>
</tr>
<tr>
<td>3</td>
<td>RXD</td>
<td>Receive Data</td>
</tr>
<tr>
<td>4</td>
<td>RTS</td>
<td>Request To Send</td>
</tr>
<tr>
<td>5</td>
<td>CTS</td>
<td>Clear To Send</td>
</tr>
<tr>
<td>6</td>
<td></td>
<td>Not used</td>
</tr>
<tr>
<td>7</td>
<td>GND</td>
<td>Signal Ground</td>
</tr>
<tr>
<td>8</td>
<td></td>
<td>Not used</td>
</tr>
<tr>
<td>9</td>
<td></td>
<td>Not used</td>
</tr>
<tr>
<td>10</td>
<td></td>
<td>Not used</td>
</tr>
<tr>
<td>11</td>
<td></td>
<td>Not used</td>
</tr>
<tr>
<td>12</td>
<td></td>
<td>Not used</td>
</tr>
<tr>
<td>13</td>
<td>CGND</td>
<td>Charger Ground (Reserved)</td>
</tr>
<tr>
<td>14</td>
<td></td>
<td>Not used</td>
</tr>
<tr>
<td>15</td>
<td></td>
<td>Not used</td>
</tr>
<tr>
<td>16</td>
<td></td>
<td>Not used</td>
</tr>
<tr>
<td>17</td>
<td></td>
<td>Not used</td>
</tr>
<tr>
<td>18</td>
<td></td>
<td>Not used</td>
</tr>
<tr>
<td>19</td>
<td></td>
<td>Not used</td>
</tr>
<tr>
<td>20</td>
<td>DTR</td>
<td>Data Terminal Ready</td>
</tr>
<tr>
<td>21</td>
<td></td>
<td>Not used</td>
</tr>
<tr>
<td>22</td>
<td>–5</td>
<td>–5 Volts (Reserved)</td>
</tr>
<tr>
<td>23</td>
<td>CHG</td>
<td>Gauge Charger (Reserved)</td>
</tr>
<tr>
<td>24</td>
<td>CHG</td>
<td>Gauge Charger (Reserved)</td>
</tr>
<tr>
<td>25</td>
<td>CGND</td>
<td>Charger Ground (Reserved)</td>
</tr>
</tbody>
</table>
## MECHANICAL SPECIFICATIONS

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base</td>
<td>Cast aluminum</td>
</tr>
<tr>
<td>Gauge size (w/o handle)</td>
<td>18.6 x 9.1 x 6.2 in.</td>
</tr>
<tr>
<td></td>
<td>472 x 231 x 157 mm</td>
</tr>
<tr>
<td>Gauge height (w/ handle)</td>
<td>11.1 in.</td>
</tr>
<tr>
<td></td>
<td>282 mm</td>
</tr>
<tr>
<td>Weight</td>
<td>29.7 lb</td>
</tr>
<tr>
<td></td>
<td>13.5 kg</td>
</tr>
<tr>
<td>Shipping weight</td>
<td>77.5 lb</td>
</tr>
<tr>
<td></td>
<td>35.2 kg</td>
</tr>
<tr>
<td>Operating temperature</td>
<td>Ambient: 14 to 158 °F</td>
</tr>
<tr>
<td></td>
<td>–10 to 70 °C</td>
</tr>
<tr>
<td></td>
<td>Surface: 350 °F</td>
</tr>
<tr>
<td></td>
<td>177 °C</td>
</tr>
<tr>
<td>Storage temperature</td>
<td>–70 to 185 °F</td>
</tr>
<tr>
<td></td>
<td>–57 to 85 °C</td>
</tr>
<tr>
<td>Vibration test</td>
<td>0.1 in. (2.54 mm) at 12.5 Hz</td>
</tr>
<tr>
<td>Drop test</td>
<td>11.8 in. (300 mm) onto 0.98 in. (25 mm) steel ball</td>
</tr>
</tbody>
</table>
This appendix contains important information for maintaining and servicing the Model 4640-B Thin Layer Density Gauge. The following procedures should be performed to keep the 4640-B in good working order. In the event that a serious problem with the gauge arises, contact your nearest Troxler Service Center or representative for instructions. Troxler Service Center addresses and telephone numbers are included in this appendix.

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TROUBLESHOOTING

BATTERY LIFE HOURS INCORRECT

✔ Charge the gauge overnight (16 hours).
✔ Check battery voltage (refer to page 6–11).
  ✔ If battery voltage is equal or greater than 7.0 volts, manually enter the correct hour value. With a new gauge after a full 16-hour charge, enter a battery life of 200. With age the battery life will decrease, so enter 200 hours and monitor the gauge until battery low is displayed. After the next recharge, enter the new battery life (200 – battery low life). The user may leave the gauge in voltage mode for future reference.
  ✔ If battery voltage is less than 7.0 volts, change the mode to the elapsed time since last charge. Monitor gauge until BATTERY LOW! is displayed. If the time is too low (less than 16 hours), replace the batteries.

GAUGE FAILS STANDARD COUNTS

✔ Check for 10 ft (3 m) clearance around gauge.
✔ Check that any sources are at least 33 ft (10 m) away.
✔ Check that the source rod handle is fully notched in the safe position (see page 3–8).
✔ Check for correct gauge position on the magnesium reference block (see page 3–9).
✔ If the gauge is in Multi Standard Mode, make sure the last standard count was taken within the last three months. If the count was taken over three months ago, erase the standard counts and take a new count.
✔ If the gauge is in Single Standard Mode, check the calibration date and standard count. If both values are correct, take a new standard count and accept the new value. Measure the magnesium reference block. If the density is within 108-112 pcf (1730-1794 kg/m³), continue the job.
Ensure that the source rod opening on the gauge bottom is completely closed or covered by the tungsten sliding block. If any opening is visible, the sliding block should be cleaned. Refer to page C-11 for instructions. If the sliding block still does not close completely, contact the nearest Troxler Service Center (see page C–17).

**ASPHALT READINGS ARE HIGH/LOW**

- Take magnesium (Mg) reference block readings. When taking Mg block reference readings, place the 1-inch Mg reference block on top of a uniform 4 in. (10 cm) thick asphalt or concrete layer. Place the gauge on top of the Mg reference block. Set the count time to 4 minutes and the layer thickness to 1 in. (2.5 cm). Place the source rod in the measurement position. Take a count. If the readings are high or low, proceed to the next step.
- Check the thickness and count time parameters.
- Incorrect special calibration and/or incorrect offset should be disabled.
- Check calibration constants against the factory calibration sheet.
- If all of the above parameters are correct, use the special calibration to calibrate the gauge for the job.

**GAUGE READS REFERENCE BLOCK HIGH/LOW**

(Perform a Mg Reference Block reading as described above)

- Check thickness parameter.
- Check standard counts.
- Check source rod measurement position (see page 3–8).
- Special calibration disabled?
- Offsets disabled?
- Surface under the reference block should have at least 4 in. (10 cm) of homogenous material such as asphalt or concrete.
- Surface under the reference block must be smooth, flat and dry.
- The gauge may need to be sent back for re-calibration.
GAUGE READINGS APPEAR ERRATIC

✓ Check the count time – A 4-minute count will give highest precision with a repeatability of ± 1 pcf (± 16 kg/m³).
✓ Perform statistical stability (stat) test. If test passes, proceed with job. If test fails, repeat two more times. If test fails two out of three times, contact your nearest Troxler Service Center (see page C-17).

GAUGE WILL NOT COMMUNICATE WITH PRINTER OR COMPUTER

✓ Check the cable for continuity.
✓ Ensure that the correct cable is in use.
✓ Make sure the gauge and printer/computer baud rates are the same (see page 6–10).
✓ Make sure all other parameters match:
  ♦ Data bits = 8
  ♦ Stop bits = 2
  ♦ Parity = none
  ♦ Protocol = DSR/DTR

GARBAGE OR XXXXX IS DISPLAYED

✓ Check the standard counts in memory.
✓ Check gauge for water damage – dry gauge interior with hair dryer on low heat) for 3 hours.
✓ Perform new standard counts. If counts = 0 for both systems, replace high voltage module (contact your nearest Troxler Service Center, see page C-17).
✓ Check calibration constants against the factory calibration sheet.
GAUGE IN MEASUREMENT POSITION BUT DISPLAY INDICATES SAFE POSITION

✓ Switch is defective.
  ✓ Press (START/ENTER) again.
  ✓ Call your nearest Troxler Service Center (page C-17) for replacement part (page C-13).

NO DENSITY READINGS

✓ The most likely reason for no density readings is an electronic problem, such as a failure of the detector preamplifier. 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 3 ft (1 m) away from the tip of the unshielded source rod and complete the inspection as quickly as possible to minimize exposure (the dose rate at 3 ft 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.
4. Contact the Troxler Radiation Safety Department for further advice.
BATTERY CHARGING

The 4640-B with fully charged batteries will remain operational for approximately 8 weeks under normal conditions.

If the batteries become discharged, the following message will be displayed on the gauge:

<READY> mm/dd/yy
Avg: xx
Time: xx min.
BATTERY LOW!

When this display appears, there are a few hours remaining before the battery must be recharged. For emergency use, a 30-minute recharge with the dc or ac charger provides several hours of use.

Although batteries cannot be “overcharged,” rechargeable batteries have a “memory” and repeated needless recharging will shorten the battery life. If possible, run the batteries down before recharging.

NOTE
Batteries should not be recharged unless the BATTERY LOW! indicator is visible!

ALKALINE BATTERY USE

If recharging is not an option, alkaline batteries may be installed temporarily. A separate battery case is supplied for this purpose.

WARNING
Do not mix alkaline and rechargeable batteries in the gauge. Charging may cause alkaline batteries to explode!
To exchange the rechargeable battery packs with alkaline battery packs use the following procedure:

✓ Remove the four screws holding the display panel. Lift off the panel.

✓ Remove the ribbon cable on the back of the panel.

✓ Remove the protective box covering the baseboard.

✓ Locate the two battery packs. The battery leads are red and black with white plugs.

✓ Unplug the leads from the baseboard. Remove the screw holding the battery pack to the gauge base. Slide the battery pack forward and lift out (see note).

**NOTE**

*If necessary, loosen the plastic top shell to exchange the batteries. After the top shell has been removed, proceed.*

✓ Insert D-size alkaline batteries in the two reserve packs. Install the packs in the gauge in accordance with the polarity indicated on the labels.

✓ **REMEMBER** to reconnect the battery packs and the control panel ribbon cable. Reverse the above removal procedure for installation.
LEAK TESTING

To ensure the integrity of the radioactive source encapsulation, the 4640-B must be leak tested at intervals not exceeding six months unless otherwise indicated by your license.

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

✔ Write the gauge model number and serial number on the wipe disk.

✔ Locate the area directly to the left of where the handle mechanism enters the top shell (body) of the gauge.

✔ Using the wipe disk, wipe the area around and to the left of the location where the handle mechanism enters the gauge body.

✔ Pack the disk, as instructed, in the envelope and mail to Troxler Electronic Laboratories, Inc. for analysis.

✔ Secure the gauge properly.
MECHANICAL MAINTENANCE

The 4640-B will not need much maintenance, but the gauge should be inspected periodically to ensure precise operation. When performing maintenance on the gauge, monitor radiation by wearing a dosimeter.

INSPECTING THE SOURCE ROD

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

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 4640-B gauge top shell is manufactured from an engineering thermoplastic designed specifically to provide high impact strength and 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.

✔ Carefully remove the gauge top shell and slide it up, out of the way. To keep it out of the way, tie the top shell to the handle.

✔ To catch any grease, place a rag or cloth under the Allen-head screw located below the grease fitting on the source rod tower. Remove the Allen-head screw. Removal of this screw allows the old grease to be ejected. Failure to remove this screw may result in severe mechanical damage to the base assembly.

✔ Using a standard 16-oz grease gun loaded with a Magnalube® cartridge, apply 5 shots of lubricant or until all dirty grease is ejected and clean grease is visible.

✔ Re-assemble the gauge.
CLEANING THE TUNGSTEN SLIDING 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 measurement 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 completely 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.

CAUTION

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

If the source rod becomes difficult to lower into the measurement position or a click is not heard when the source rod is raised to the SAFE position, the sliding block may require cleaning. An improperly operating sliding block may also result in erratic density readings.

厦 With the source rod in the SAFE position, place the gauge on its side.

厦 Clean the heads of the four screws that hold the bottom plate to the gauge base. Using a screwdriver, remove the four screws and the plate. Replace the plate if excessive wear is evident on the inside surface of the plate.

厦 Remove the sliding block. Pay close attention to the position of the block as it is removed. Clean the block and the cavity with a stiff brush or rag soaked in alcohol.
Re-install the sliding block with the angled side up. Apply a light coating of Magnalube to the top angled surface of the block only.

Re-install the bottom plate. Do not overtighten screws! Ensure that the source rod moves up and down freely.

GASKET REPLACEMENT

Four gaskets seal the gauge from moisture, dirt, and debris. However if the gauge has been out in extremely wet weather, 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 top shell and 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 gaskets may need replacing.

To replace the control panel gasket, remove the four screws and take the panel off the gauge top shell. Use care in removing the panel and ribbon cable. Gently peel the old gasket from the panel and top shell and replace with new gaskets. Replace the connectors and the control panel.

To replace the top shell gaskets, remove the screws that hold the top shell to the gauge base. Gently peel the gaskets away from the top shell and gauge base and replace. Tighten top shell screws to 6 in-lb.

If replacing the post gasket slide it up over the source rod. A light coating of talcum powder on the inside of the new post gasket will aid in re-assembly.
## REPLACEMENT PARTS

<table>
<thead>
<tr>
<th>PART NUMBER</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
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<td>104983</td>
<td>Front Panel Assembly</td>
</tr>
<tr>
<td>103948</td>
<td>20 Pin Ribbon Cable assembly (front panel to base)</td>
</tr>
<tr>
<td>104184</td>
<td>Cover Plate Assembly</td>
</tr>
<tr>
<td>100528.3000</td>
<td>Captive screw (Front panel)</td>
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<tr>
<td>104767</td>
<td>4640B Overlay (keypad)</td>
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<tr>
<td>104520</td>
<td>4640-B Top shell</td>
</tr>
<tr>
<td>012200</td>
<td>Spring (trigger)</td>
</tr>
<tr>
<td>104553</td>
<td>Plunger 3400 (indexer)</td>
</tr>
<tr>
<td>105108</td>
<td>Trigger</td>
</tr>
<tr>
<td>104305</td>
<td>Handle sleeve</td>
</tr>
<tr>
<td>101603.1010</td>
<td>Roll Pin, 3/32 D x 5/8 L (index rod)</td>
</tr>
<tr>
<td>012176</td>
<td>Lock with 2 keys</td>
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<tr>
<td>012176.1000</td>
<td>Key P812 (handle lock)</td>
</tr>
<tr>
<td>012804</td>
<td>Seal (bearing)</td>
</tr>
<tr>
<td>012752</td>
<td>Seal Wiper</td>
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<tr>
<td>013200</td>
<td>Fitting 3/16 Grease w/ serrated shank.</td>
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<td>104190</td>
<td>Wiper Cap, 4640</td>
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<tr>
<td>102096</td>
<td>3400 Cap screw</td>
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<tr>
<td>102103</td>
<td>Cap Screw Bumper</td>
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<tr>
<td>104634</td>
<td>Source Rod Bearing (2 required)</td>
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<tr>
<td>100761</td>
<td>Source Rod Pig</td>
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<tr>
<td>100996</td>
<td>3400, Sliding Block</td>
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<tr>
<td>100999.0001</td>
<td>Bottom Plate</td>
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<tr>
<td>102399</td>
<td>Shield Spring, 3400</td>
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<tr>
<td>104035</td>
<td>4640 Tungsten Shield</td>
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<tr>
<td>104171</td>
<td>Post Gasket, 4640</td>
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<tr>
<td>104982</td>
<td>Front panel gasket (2 required)</td>
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<tr>
<td>103928.1000</td>
<td>Top gasket, foam</td>
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<tr>
<td>100156</td>
<td>GM tube (3 required)</td>
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<tr>
<td>105062</td>
<td>3/4-in. tube (2 required)</td>
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<td>PART NUMBER</td>
<td>DESCRIPTION</td>
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<tr>
<td>104149</td>
<td>Battery set (w/ case) (rechargeable)</td>
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<tr>
<td>104113.1000</td>
<td>Battery Holder Part A (rechargeable-bottom)</td>
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<tr>
<td>104113.2000</td>
<td>Battery Holder Part B (rechargeable-top)</td>
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<td>104150</td>
<td>Battery Pack Three D Cells</td>
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<tr>
<td>016230</td>
<td>Fuse 1/2 A 3AG</td>
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<tr>
<td>104639</td>
<td>HV power supply module assembly</td>
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<tr>
<td>104761</td>
<td>4640-B Baseboard Assembly</td>
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<tr>
<td>104764</td>
<td>4640-B CPU board Assembly</td>
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<tr>
<td>106785</td>
<td>4640B 2 Tube Inter BD Assembly (Interface Board)</td>
</tr>
<tr>
<td>106363</td>
<td>PCB Assembly 4640B 3 Tube (Interface Board)</td>
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<tr>
<td>105396</td>
<td>Cover Box (4640B)</td>
</tr>
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</table>

### ACCESSORIES

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<tr>
<th>PART NUMBER</th>
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<tbody>
<tr>
<td>021140</td>
<td>Radiation Sign Kit</td>
</tr>
<tr>
<td>105005</td>
<td>4640B Instruction manual</td>
</tr>
<tr>
<td>102868</td>
<td>3880 Leak Test Kit w/ 4 Packets</td>
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<tr>
<td>102876.0005</td>
<td>Leak Test Packet (4 unit)</td>
</tr>
<tr>
<td>102873</td>
<td>1 oz solution</td>
</tr>
<tr>
<td>104262</td>
<td>Survey Meter with Accessories</td>
</tr>
<tr>
<td>104262.0001</td>
<td>Troxler Survey Meter w/ Beeper Option</td>
</tr>
<tr>
<td>105026</td>
<td>Air Gap Fixture Assembly 4640B</td>
</tr>
<tr>
<td>104148</td>
<td>Battery Case Assembly (non-rechargeable)</td>
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<tr>
<td>104410</td>
<td>AC Charger, 12 V dc 500 mA</td>
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<tr>
<td>104155</td>
<td>AC Charger, 13.6 V dc 500 mA (international)</td>
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<tr>
<td>104156</td>
<td>DC Charger</td>
</tr>
<tr>
<td>104340</td>
<td>Printer</td>
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<tr>
<td>104324.1000</td>
<td>Cable, Printer-to-Gauge (Male/Male)</td>
</tr>
<tr>
<td>104334.1000</td>
<td>Cable, PC-to-Gauge (Female/Male)</td>
</tr>
<tr>
<td>106104</td>
<td>Procomm Plus (software)</td>
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</table>
## MAINTENANCE SUPPLIES

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<th>PART NUMBER</th>
<th>DESCRIPTION</th>
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<tbody>
<tr>
<td>012784</td>
<td>Lubricant Magnalube 1.5 oz Tube</td>
</tr>
<tr>
<td>012786</td>
<td>Lubricant Magnalube 1 lb Can</td>
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<tr>
<td>012787</td>
<td>Lubricant Magnalube 5 lb Can</td>
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<tr>
<td>012789</td>
<td>Lubricant Magnalube 14.5 oz</td>
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</tbody>
</table>
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 4640-B gauge, follow the required special handling and shipping procedures detailed in Appendix D. Please contact a Troxler Sales Support or Service Representative with any questions.
This page has been revised per the July 2001 supplement.

**TROXLER SERVICE CENTERS**

The list of Troxler service centers that appears on pages iii and C-17 has been updated as follows:

**Troxler Corporate Headquarters**
3008 Cornwallis Road  
P.O. Box 12057  
Research Triangle Park, NC 27709  
Tel (919) 549-8661  
Fax (919) 549-0761  
E-mail: troxserv@troxlerlabs.com  
Web: www.troxlerlabs.com

**Maryland Service Center**
9574 Deereco Road  
Timonium, MD 21093  
Tel (410) 561-5850  
Fax (410) 561-5852  
E-mail: troxlermd@troxlerlabs.com

**Midwestern Branch Office**
1430 Brook Drive  
Downers Grove, IL 60515  
Tel (630) 261-9304  
Fax (630) 261-9341  
E-mail: troxmidw@troxlerlabs.com

**Western Regional Branch Office**
11300 Sanders Drive, Suite 7  
Rancho Cordova, CA 95742  
Tel (916) 631-0234  
Fax (916) 631-0541  
E-mail: troxca@troxlerlabs.com

**Southwestern Branch Office**
2000 East Randol Mill Road Suite 611  
Arlington, TX 76011  
Tel (817) 275-0571  
Fax (817) 275-8562  
E-mail: troxsw@troxlerlabs.com

**Florida Service Center**
2376 Forsyth Road  
Orlando, FL 32807  
Tel (407) 681-4221  
Fax (407) 681-3188  
E-mail: troxlerfl@troxlerlabs.com

**Alabama Service Center**
225 Oxmoor Circle, Suite 811  
Birmingham, AL 35209  
Tel (205) 945-0755  
Fax (205) 945-0757  
E-mail: troxleral@troxlerlabs.com

**Canadian Branch Office**
7125 Pacific Circle, Unit 13  
Mississauga, Ontario L5T-2A5  
Canada  
Tel (905) 565-0633  
Fax (905) 564-7092  
E-mail: troxler@istar.ca

**Troxler European Subsidiary**
Troxler Electronics GmbH  
Gilchinger Strasse 33  
D-82239 Alling nr. Munich, Germany  
Tel ++49-8141-71063  
Fax ++49-8141-80731  
E-mail: troxler@t-online.de
Devices containing radioactive materials are required to be transported within the guidelines of regulations of the United States Department of Transportation (U.S. DOT) and the International Atomic Energy Association (IAEA). The Troxler Model 4640-B in its transport case meets or exceeds all shipping requirements.

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The regulations in 49 CFR “TRANSPORTATION” (U.S. DOT) apply any time a nuclear device is transported by motor vehicle on a public highway, regardless of the carrier. The device cannot be transported in the passenger compartment of a vehicle. It must be properly secured in the cargo area of a vehicle to prevent movement of the device during transportation and to prevent theft. Always contact the common carrier, licensing agency, U.S. DOT, or Troxler for shipping assistance. International customers outside the jurisdiction of the United States must consult their government or licensing authority for applicable regulations. The following are needed to transport the 4640-B gauge in the United States:

- A copy of the “IAEA Certificate of Competent Authority” for each source in the gauge (Special Form Source Certificate) must be on file.

- A copy of the results of the “TYPE A” package testing must be on file.

- Hazmat training verification must be on file.

- An “Emergency Response Information” document must be in the vehicle and immediately accessible to the driver.

- A properly completed “Bill of Lading” (Figure D–1 and Figure D–2) must be in the vehicle and immediately accessible to the driver.

- The package must be locked or otherwise sealed.

- The package must be inspected (QC) prior to each shipment.

If shipping by air inside the U.S., a “Shipper's Declaration for Dangerous Goods” (Figure D–3) must accompany the shipping documents.
CERTIFICATE OF COMPETENT AUTHORITY

Regulations require that a shipper keep a copy of the IAEA Certificate(s) of Competent Authority (or Special Form Certificate(s)) “for at least one year after the latest shipment.” Please note that this certification does expire. The operator must have a current copy in possession before legally shipping the gauge. Refer to the Troxler certificate for the required special form source certificate identification numbers (Example: GB/353/S-85). Troxler has provided a copy of the applicable certificates in the Transportation Guide. Troxler recommends that the operator place copies of the applicable certificate in all 4640-B files.

A certificate issued by Troxler with each 4640-B gauge gives the model and serial number, along with relevant source and ownership information. The Troxler certificate has been confused with the certificate of competent authority required above. The Troxler certificate is not a legally required document for purposes of shipment. However, it is a desirable document to have when being inspected, since it provides relevant device information.

RESULTS OF TYPE A PACKAGE TESTING

The regulations require that each shipper of a (Specification 7A) Type A package “must maintain on file for at least one year after the latest shipment” the testing methods and results for the Type A package. Troxler has provided this document, entitled “Testing Results for Type A Packages for Troxler Gauges…” in the Transportation Guide.

EMERGENCY RESPONSE SHEET

The regulations require that emergency response information (Emergency Response Sheet) accompany the shipment of a nuclear gauge. This document must be in the transport vehicle and immediately accessible to the driver during transportation on a public highway. A copy is included with the Transportation Guide. For additional copies of this sheet, contact Troxler.
EMERGENCY RESPONSE TELEPHONE NUMBER

A 24-hour emergency response telephone number must be provided on the Bill of Lading. This number must be manned continuously while the 4640-B gauge is in transport. The person at this number must be one who is “knowledgeable of the hazards and characteristics of the hazardous material being shipped, has comprehensive emergency response and accident mitigation information for that material, or has immediate access to a person who possesses such knowledge and information.” Troxler currently provides this service to Troxler instrument operators at no charge. The Troxler emergency response number is (919) 839-2676.

LABELING REQUIREMENTS

The package must be labeled with two Yellow II labels and a label that gives the package type and proper shipping name of the material. In addition, the package must be labeled with a “Cargo Aircraft Only” label if the package will be shipped by air in the United States.

BILL OF LADING REQUIREMENTS

The regulations specify the requirements for the Bill of Lading (or Shipping Papers). The Bill of Lading must accompany the driver of the vehicle during the transportation of the 4640-B gauge upon a public highway.

LOCKING OR SEALING OF PACKAGE

For Type A packages, the regulations require that “the outside of the packaging incorporate a feature, such as a seal, that is not readily breakable, and that, while intact, is evidence that the package has not been opened.” This requirement can be satisfied by locking the shipping case with a padlock.
INSPECTION OF PACKAGE BEFORE SHIPMENT

The regulations require the shipper to inspect each package before shipment to ensure that the package is physically sound and that each closure device (hinge, hasp, latch, and so on) “is properly installed, secured, and free of defects.”

ACCIDENT NOTIFICATION REQUIREMENTS

Notify the licensing agency as soon as practical after a device accident. 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.” In Canada, contact CANUTEC at (613) 996-6666 if a gauge is involved in a transport accident or incident.

HAZMAT TRAINING

Maintain records of current training for each employee who transports radioactive material per 49 CFR 172 subpart H. Nuclear gauge operators must renew hazardous material (Hazmat) training every three years.
The intra-company Bill of Lading (Figure D–1) must accompany devices transported by private carrier (for example, transportation by employee of a company in a privately owned vehicle). Troxler recommends that the operator complete a Bill of Lading for each device in possession, and that the operator type this document on company letterhead. Please note that this document should not be dated, thus allowing the operator to reuse the Bill of Lading when transporting a Troxler device.

When transporting a nuclear gauge via Federal Express®, the Federal Express shipping form must indicate the nature of the hazardous material (Figure D–4). Note the hazardous material indication under item 4, (Instructions), the Shipper's Certification For Restricted Articles/Dangerous Goods, the general description, shipment limitations, and shipment type.
BILL OF LADING

Shipper: ABC Paving Company
0000 Road Drive
Anywhere, U.S.A.

Radioactive material, Type A package,
Special Form, Non-fissile or fissile-excepted,
7, UN3332

Cs-137 0.30 GBq (8.0 mCi)

Radioactive Yellow II Label, TI = 0.2

**** EMERGENCY CONTACT: (919) 839-2676 ****

(SIGNATURE)
SHIPPER

Figure D–1. Sample Private Carrier Bill of Lading
**SB Freightways**

**BILL OF LADING**

<table>
<thead>
<tr>
<th>RED E. WAITING</th>
<th>DEF PAVING INTERNATIONAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABC PAVING COMPANY</td>
<td>456 MAIN STREET</td>
</tr>
<tr>
<td>123 DIRT ROAD</td>
<td>ANY OTHER TOWN, U.S.A. 67890</td>
</tr>
<tr>
<td>ANYTOWN, U.S.A. 12345</td>
<td></td>
</tr>
<tr>
<td>PHONE NO.</td>
<td>919-839-2676</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Number of Packages</th>
<th>HM</th>
<th>Kind of Packaging, Description of Articles, Special Marks and Exceptions</th>
<th>Weight (lb)</th>
<th>Class or Rate Ref.</th>
<th>Cube (Optional)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>x</td>
<td>Radioactive Material, Type A package, Special Form, Non-fissile or fissile-excepted, Cs-137 0.30 GBq (8.0 mCi) Radioactive Yellow II label, Tl = 0.2 Dim 42 x 40 x 62 cm</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Emergency Contact:** (919) 839-2676

**THIS IS TO CERTIFY THAT THE ABOVE-NAMED MATERIALS ARE PROPERLY CLASSIFIED, DESCRIBED, PACKAGED, MARKED, AND LABELED AND ARE IN PROPER CONDITION FOR TRANSPORTATION ACCORDING TO THE APPLICABLE REGULATIONS OF THE DEPARTMENT OF TRANSPORTATION.**

<table>
<thead>
<tr>
<th>SHIPPER/CONSIGNOR</th>
<th>CARRIER</th>
</tr>
</thead>
<tbody>
<tr>
<td>WANDA SHIPPITT</td>
<td>SB FREIGHTWAYS</td>
</tr>
<tr>
<td>AUTHORIZED SIGNATURE</td>
<td>DATE</td>
</tr>
<tr>
<td>AUTHORIZED SIGNATURE</td>
<td></td>
</tr>
</tbody>
</table>

*Figure D–2. Sample Common Carrier Bill of Lading*

Figures D-1 through D-5 have been revised per the July 2001 supplement.
The Shipper’s Declaration of Dangerous Goods must be completed for all shipments transported by air.

Figure D–3. Sample Shipper’s Declaration for Dangerous Goods
Figures D-1 through D-5 have been revised per the July 2001 supplement.

NOTE

The Federal Express form is equivalent to the Shipper’s Declaration for Dangerous Goods shown in Figure D-3.

Figure D–4. Sample Federal Express Form
CANADIAN SHIPPING REQUIREMENTS

The “Transportation of Dangerous Goods Act and Regulations” (TDG), “Atomic Energy Control Regulations” (AEC), and “Transport Packaging of Radioactive Materials Regulations” (TPRM) apply any time a nuclear device used in commerce is being transported by motor vehicle on a public highway, regardless of carrier. Always contact the common carrier, licensing agency, or Troxler for shipping assistance.

For shipping requirements and accident notification regulations, consult the Transportation of Dangerous Goods Act and Regulation. For further information on shipping a nuclear device, contact the Transportation Section of the Atomic Energy Control Board (AECB), Ottawa at (613) 995-0553. If the gauge is involved in a transport accident or incident, contact CANUTEC at (613) 996-6666.

Note that the owner must maintain the Type A testing methods and results on file for at least two years after the latest shipment.

See Figure D–5 for a sample Bill of Lading for Canadian shipments.
**Date:** Ship Date

**Initial Carrier:** Canadian Freight Company

**Consignor:**
ABC Paving International  
123 Dirt Road  
Anytown, Province L9T9S9

**Consignee:**
Wanda Shippitt  
456 Main Street  
Other Town, Province L3T3S3

<table>
<thead>
<tr>
<th>UNITS</th>
<th>TYPE</th>
<th>DG</th>
<th>Shipping Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>pkg</td>
<td>X</td>
<td>Radioactive Material, Type A Package, Special Form, Non-Fissile or Fissile-Excepted, Class 7, UN3332, Cs-137 0.30 GBq (8 mCi), Radioactive Yellow II label, TI=0.2, Four Class 7 placards required</td>
</tr>
</tbody>
</table>

**EMERGENCY CONTACT:** 1-919-839-2676, Troxler Electronic Laboratories, Inc.

This shipping document is issued under the authority of the consignor per ____________________________ Date __________

**Required items include:**
- Date
- Initial Carrier
- Document ID Number
- Consignor Name & Address
- Consignee Name & Address
- Radionuclides
- Label Category
- Emergency Telephone Number
- Statement of Authority

- X in the Dangerous Goods (DG) Column
- Shipping Name
- Class
- UN Number
- Package Authorization
- Activity in Units of Becquerel
- Transportation Index (for other than White I)
- Number and Type of Placards (unless the licensee has an Equivalent Level of Safety Permit issued by Transport Canada)

*Figure D–5. Sample Canadian Bill of Lading*
The 4640-B gauge 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 conversions factors for common English units relevant to the 4640-B gauge.

**CONTENTS**

Measurement Units................................................................. E–2

Radiological Units................................................................. E–2
MEASUREMENT UNITS

1 in. = 25.4 mm
1 in. = 2.54 cm

1 ft = 30.48 cm
1 ft = 0.30 m

1 pcf = 16.02 kg/m³
1 pcf = 1.6 x 10⁻² g/cm³

RADIOLOGICAL UNITS

1 rem = 0.1 Sv

1 Ci = 37 GBq
1 mCi = 37 MBq

The following table is provided to assist the user in converting from microcuries (µCi) and millicuries (mCi) to gigabequerels (GBq):

<table>
<thead>
<tr>
<th>µCi</th>
<th>to</th>
<th>MBq</th>
</tr>
</thead>
<tbody>
<tr>
<td>60</td>
<td></td>
<td>2.22</td>
</tr>
<tr>
<td>100</td>
<td></td>
<td>3.70</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>mCi</th>
<th>to</th>
<th>GBq</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.0</td>
<td></td>
<td>0.19</td>
</tr>
<tr>
<td>7.2, 7.3, 7.4</td>
<td></td>
<td>0.27</td>
</tr>
<tr>
<td>7.5, 7.6</td>
<td></td>
<td>0.28</td>
</tr>
<tr>
<td>7.7, 7.8, 7.9</td>
<td></td>
<td>0.29</td>
</tr>
<tr>
<td>8.0, 8.1, 8.2</td>
<td></td>
<td>0.30</td>
</tr>
<tr>
<td>8.3, 8.4, 8.5</td>
<td></td>
<td>0.31</td>
</tr>
<tr>
<td>8.6, 8.7</td>
<td></td>
<td>0.32</td>
</tr>
<tr>
<td>8.8, 8.9</td>
<td></td>
<td>0.33</td>
</tr>
<tr>
<td>10</td>
<td></td>
<td>0.37</td>
</tr>
<tr>
<td>40</td>
<td></td>
<td>1.48</td>
</tr>
<tr>
<td>100</td>
<td></td>
<td>3.70</td>
</tr>
<tr>
<td>300</td>
<td></td>
<td>11.10</td>
</tr>
</tbody>
</table>
Microsoft® Windows 95®, Windows 98®, and Windows® 3.1 all include communications programs that can be used to transfer project data from the Model 4640-B Thin Layer Density Gauge to a computer. This appendix provides instructions on using the Windows 95/98 HyperTerminal program and the Windows 3.1 Terminal program to print (upload) data from the gauge.

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    Printing (Uploading) Project Data .......................................F–3

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    Terminal Setup...............................................................F–5
    Equipment Connection ......................................................F–5
    Printing (Uploading) Project Data .......................................F–6

Viewing Project Data ..............................................................F–7
To print (upload) data from the 4640-B gauge to a computer equipped with the Windows 95 or 98 operating system, use the HyperTerminal program as described in the following sections.

**HYPERTERMINAL SETUP**

To configure the Windows 95/98 HyperTerminal program and set up a dedicated icon to transfer data from the 4640-B gauge, perform the following steps:

1. Click on the **Start** button, then select the **Programs** menu and the **Accessories** folder.
   - In Windows 95, select the **HyperTerminal** icon.
   - In Windows 98, select the **Communications** subfolder, 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:

   - **Bits per second**: 2400
   - **Data bits**: 8
   - **Parity**: None
   - **Stop bits**: 1
   - **Flow control**: Hardware

Appendix F–2
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 **File** and select **Save** from the dropdown menu.

8. Close the **Troxler Data – HyperTerminal** window by selecting **Exit** from the **File** menu.

**EQUIPMENT CONNECTION**

Connect the gauge to the computer using the appropriate serial cable (see the list of *Accessories* on page C–14). Connect the gauge’s serial port (see Figure 4–1 on page 4–4) 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 **Start** button, then select the **Programs** menu and the **Accessories** folder.
   - In Windows 95, select the **HyperTerminal** icon.
   - In Windows 98, select the **Communications** subfolder, then select the **HyperTerminal** icon.

2. From the **HyperTerminal** 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 on **Transfer**, then select **Capture Text** from the dropdown menu. The **Capture Text** window is displayed, showing the default folder and filename to be used to store the data. Troxler recommends using the default settings when first using the program.
4. On the 4640-B gauge, select the project data to be printed (downloaded) to the computer, and follow the instructions in Chapter 4 to print the data to the computer. The project data will be displayed in the Troxler Data – HyperTerminal window as it is downloaded.

5. When the data transmission is complete, select Transfer from the toolbar. Then select Capture Text and Stop from the dropdown submenu.
To print (upload) data from the 4640-B gauge to a computer equipped with the Windows 3.1 operating system, use the Terminal program as described in the following sections.

**TERMINAL SETUP**

To configure the Windows 3.1 Terminal program to transfer data from the 4640-B gauge, perform the following steps:

1. From the Windows Program Manager, select **Accessories** then click on the **Terminal** icon. The **Terminal** window is displayed.

2. From the toolbar, select **Settings**, then select **Communications** from the dropdown menu.

3. Configure the communications settings as follows:

<table>
<thead>
<tr>
<th>Setting</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baud Rate</td>
<td>2400</td>
</tr>
<tr>
<td>Data Bits</td>
<td>8</td>
</tr>
<tr>
<td>Stop Bits</td>
<td>1</td>
</tr>
<tr>
<td>Parity</td>
<td>None</td>
</tr>
<tr>
<td>Flow control</td>
<td>Hardware</td>
</tr>
<tr>
<td>Connector</td>
<td>Select COM1, COM2, COM3, or COM4, depending on the computer</td>
</tr>
</tbody>
</table>

4. Click **OK** to return to the **Terminal** window.

**EQUIPMENT CONNECTION**

Connect the gauge to the computer using the appropriate serial cable (see the list of **Accessories** on page C–14). Connect the gauge’s serial port (see Figure 4–1 on page 4–4) to the computer COM port selected in step 3 of the **Terminal Setup** section above.
PRINTING (UPLOADING) PROJECT DATA

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

1. From the Terminal window toolbar, select Transfers, then select Receive Text File from the dropdown menu.

2. From the Receive Text File window, select the directory in which the project data is to be stored, then enter a filename in the Name box. Troxler recommends naming the file with a .txt extension. Click OK to return to the Terminal window.

3. On the 4640-B gauge, select the project data to be printed (downloaded) to the computer, and follow the instructions in Chapter 4 to print the data to the computer. The project data will be displayed in the Terminal window as it is uploaded.

4. When the data transmission is complete, select Transfer from the Terminal window toolbar. Then select Stop from the dropdown menu.
VIEWING PROJECT DATA

After project data has been printed (uploaded) to the computer, it can be viewed using either a word processing program (such as Microsoft Word®) or a spreadsheet program (such as Microsoft Excel®). To view the data, open the desired program, then open the file in which the project data was stored.

NOTE
The user can also use the spreadsheet program to design a spreadsheet to manipulate and manage the data.
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<table>
<thead>
<tr>
<th>Topic</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPECIAL key</td>
<td>6–1</td>
</tr>
<tr>
<td>Specifications</td>
<td></td>
</tr>
<tr>
<td>Electrical</td>
<td>B–4</td>
</tr>
<tr>
<td>Measurement</td>
<td>B–4</td>
</tr>
<tr>
<td>Mechanical</td>
<td>B–6</td>
</tr>
<tr>
<td>Radiological</td>
<td>B–3</td>
</tr>
<tr>
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