Manual of Operation and Instruction

Troxler
Legacy
Calibration Suite

Troxler Electronic Laboratories, Inc.
3008 Cornwallis Road • P.O. Box 12057
Research Triangle Park, NC 27709
Phone: 1.877.TROXLER
Outside the U.S.A.: +1.919.549.8661
Fax: +1.919.549.0761
www.troxlerlabs.com

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TROXLER SERVICE CENTERS

Troxler Corporate Headquarters
3008 Cornwallis Road
P.O. Box 12057
Research Triangle Park, NC 27709
Phone: 1.877.TROXLER (1.877.876.9537)
Outside the U.S.A.: +1.919.549.8661
Fax: +1.919.549.0761
Web: www.troxlerlabs.com

Technical Support
Phone: 1.877.TROXLER (1.877.876.9537)
E-mail: TroxTechSupport@troxlerlabs.com

Midwestern Branch Office
1430 Brook Drive
Downers Grove, IL 60515
Fax: 630.261.9341

Western Regional Branch Office
11300 Sanders Drive, Suite 7
Rancho Cordova, CA 95742
Fax: 916.631.0541

Southwestern Branch Office
2016 East Randol Mill Road
Suite 406
Arlington, TX 76011
Fax: 817.275.8562

Florida Service Center
2376 Forsyth Road
Orlando, FL 32807
Fax: 407.681.3188

Troxler European Subsidiary
Troxler Electronics GMbH
Gilchinger Strasse 33
D.82239 Alling nr. Munich, Germany
Phone: ++49.8141.71063
Fax: ++49.8141.80731
E-mail: troxler@t-online.de

NOTE

To locate an independent, Troxler-authorized service center near you, call 1.877.TROXLER (1.877.876.9537).

HOW TO USE THIS MANUAL

Congratulations on purchasing the **Troxler Legacy Calibration Suite.**

The **Troxler Legacy Calibration Suite** *Manual of Operation and Instruction* explains how to install and register the software, and provides procedures for using the Calibration Suite to calibrate Troxler gauges.

GUIDE TO SYMBOLS

Throughout this manual symbols often reveal the purpose of the text. The symbols and their purpose are as follows:

NOTE

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

⟨**KEY**⟩ Angle brackets and a different typestyle indicate a key or character (number or letter) to press on the gauge keypad. For example, "Press ⟨**START/ENTER**⟩" means to press the key labeled *START/ENTER.*

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

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

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

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

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

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CHAPTER 1

INTRODUCTION AND INSTALLATION

This chapter contains a general introduction to the Troxler Legacy Calibration Suite. The information includes a list of the hardware and software requirements for using the Troxler Legacy Calibration Suite software, and instructions for installing the software.

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INTRODUCTION

The Troxler *Legacy* Calibration Suite provides a group of software applications that can be used to calibrate Troxler Model 3401-B, 3411-B, 3430, 3440, 3450 RoadReader™ Plus, 4640-A, and 4640-B gauges. The software is designed to operate on a personal computer (PC) equipped with a Microsoft® Windows® XP Professional Edition, Windows XP Home Edition, Windows XP Media Center Edition, or Windows 2000 operating system.

NOTE

The Troxler Legacy Calibration Suite does *not* include calibration applications for Troxler Model 3430 Plus, 3440 Plus, or 3451 Enhanced RoadReader Plus gauges. Calibration software for these gauges is contained in the Troxler *Plus* Calibration Suite.

The user-friendly software prompts the user for needed information. The software then reads and records the counts from the gauge, calculates the calibration constants and stores the data for later use.

The following manual provides instructions on how to calibrate the gauges listed above using the applications in the Troxler Legacy Calibration Suite, and manually collecting and recording gauge counts. In addition to this document, you will need the *Manual of Operation and Instruction* (user manual) for the particular gauge model that is being calibrated.

The user manuals for the Model 3430, 3440, 3450, and 4640-B gauges are available for download from the Troxler web site at www.troxlerlabs.com. Model 3401-B, 3411-B, and 4640-A gauges (and their user manuals) are no longer produced, but the necessary passages from the user manual are reproduced in this manual.

Note that this manual does not purport to address **any** of the safety concerns involved in the calibration and/or use of these Troxler products. Refer to the appropriate *Manual of Operation and Instruction*, or contact a Troxler representative if any such questions or concerns should arise.

This manual also does not purport to describe the manner in which a nuclear gauge calibration facility is designed, constructed, or maintained. Information on nuclear gauge calibration facilities can be obtained from ASTM D7013-04, *Standard Guide for Nuclear Surface Moisture and Density Gauge Calibration Facility Setup*, or by contacting a Troxler representative.

Finally, this manual is written for use in calibration facilities that are *not* equipped with the Model 5032 Calibration Control System hardware that automatically collects calibration data. For information on calibrating Model 3401-B, 3411-B, 3430, and 3440 gauges using the Calibration Control System, refer to the Model 5032 *Manual of Operation and Instruction*, part number 106337.

This manual also does not describe the two “special” quality assurance (QA) measurements that Troxler takes on all new gauges after their calibration – the measurements on the special QA limestone block, and the measurement on the special QA mag/poly block.

COMPUTER REQUIREMENTS

The following sections list the hardware and software requirements for using the Troxler Legacy Calibration Suite with the following operating systems.

NOTE

When running any of the applications included in the Troxler Legacy Calibration Suite, the Windows *Regional and Language Options* must be set to *English (United States)* in order for the data storage, data computations, and date formatting to be performed correctly.

WINDOWS XP PROFESSIONAL EDITION

Minimum Hardware

Personal computer with a Pentium® 300 MHz processor or better and:

- 512 MB RAM
- Hard disk with 10 MB of free disk space
- CD-ROM drive
- VGA graphics adapter and monitor (default) with 256 colors or better
- Mouse
- Keyboard
- PCI serial card or an available USB port with an RS-232 serial-to-USB adapter

Recommended Hardware

- Pentium 1 GHz processor
- 1 Gigabyte RAM
- SVGA graphics adapter and monitor (default) with 1024 colors

WINDOWS XP HOME EDITION

Minimum Hardware

Personal computer with a Pentium 300 MHz processor or better and:

- 256 MB RAM
- Hard disk with 10 MB of free disk space
- CD-ROM drive
- VGA graphics adapter and monitor (default) with 256 colors or better
- Mouse
- Keyboard
- PCI serial card or an available USB port with an RS-232 serial-to-USB adapter

Recommended Hardware

- Pentium 1 GHz processor
- 512 MB RAM
- SVGA graphics adapter and monitor (default) with 1024 colors

WINDOWS XP MEDIA CENTER EDITION

Minimum Hardware

Personal computer with a Pentium 300 MHz processor or better and:

- 512 MB RAM
- Hard disk with 10 MB of free disk space
- CD-ROM drive
- VGA graphics adapter and monitor (default) with 256 colors or better
- Mouse
- Keyboard
- PCI serial card or an available USB port with an RS-232 serial-to-USB adapter

Recommended Hardware

- Pentium 1 GHz processor
- 1 Gigabyte RAM
- SVGA graphics adapter and monitor (default) with 1024 colors

WINDOWS 2000 EDITION

Minimum Hardware

Personal computer with a Pentium 300 MHz processor or better and:

- 128 MB RAM
- Hard disk with 10 MB of free disk space
- CD-ROM drive
- VGA graphics adapter and monitor (default) with 256 colors or better
- Mouse
- Keyboard
- PCI serial card or an available USB port with an RS-232 serial-to-USB adapter

Recommended Hardware

- Pentium 1 GHz processor
- 512 MB RAM
- SVGA graphics adapter and monitor (default) with 1024 colors

SOFTWARE INSTALLATION

The Troxler Legacy Calibration Suite contains three separate software applications. One application, the *Troxler Calibration Station*, or *TCS*, is used for Troxler Model 3401-B, 3411-B, 3430, and 3440 gauges (but *not* the 3430 Plus and 3440 Plus gauges; calibration software for these gauges is contained in the Troxler Plus Calibration Suite). The second software application is exclusively for Troxler Model 4640-A and 4640-B gauges. The third software application is exclusively for Troxler Model 3450 gauges (but *not* the Troxler Model 3451 gauge; calibration software for this gauge is contained in the Troxler Plus Calibration Suite). Each of these three software packages must be installed separately.

To install the Troxler Legacy Calibration Suite application(s) of your choice:

Insert the Calibration CD-ROM into the computer's CD-ROM drive.

The CD-ROM is AutoPlay (or AutoRun) enabled. Wait for the AutoPlay screen for this CD-ROM to be displayed. Follow the onscreen instructions for installing the software application (or applications) that you wish to use.

NOTE

If the AutoPlay function is disabled on this computer, follow your operating system's instructions for running the AutoPlay program on a CD-ROM.

The installation of any of the three software applications adds a **Troxler Legacy** program group to the computer's **Programs** menu. Each application will have its own program subgroup within the **Troxler Legacy** program group. Each program subgroup will have three menu items:

- The calibration software application itself
- An **Uninstall** item for the software application
- A **Help and Support** item

NOTES

CHAPTER 2

MODEL 3400 SERIES CALIBRATION

This chapter provides instructions for calibrating a Model 3401-B, 3411-B, 3430, or 3440 Surface Moisture-Density Gauge using the *Troxler Calibration Station* (TCS) application included in the Troxler Legacy Calibration Suite software. The information presented here includes procedures for resolving issues encountered during the calibration process. A calibration procedure outline and checklist for each gauge model number is provided at the end of this chapter.

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COLLECTING CALIBRATION DATA

In order to calibrate a gauge, specific measurements on materials of different densities and/or moisture contents, as well as standardization reference measurements, need to be obtained. This section describes how to obtain this information.

1. Turn on the gauge and allow it to warm up for at least fifteen (15) minutes.

2. Place the polyethylene standard block for the gauge either (a) in the center of the mag/aluminum calibration block for the calibration bay, (b) if there is no mag/aluminum calibration block, in the center of the aluminum calibration block, or (c) on the floor or ground, with no objects or walls within 1 meter (3 feet) of the block.

3. Place the gauge, in safe position, on the polyethylene standard block.

4. Conduct a stat test with the gauge:

   - Model 3430 and 3440 gauges have a *stat test* function that conducts and evaluates the stat test. See the *Manual of Operation and Instruction* for the particular gauge model for instructions on taking a stat test and evaluating the results.
   - If the gauge being calibrated is a Model 3401-B or 3411-B, refer to the *Instruction Manual* if available, or refer to page 2–41.

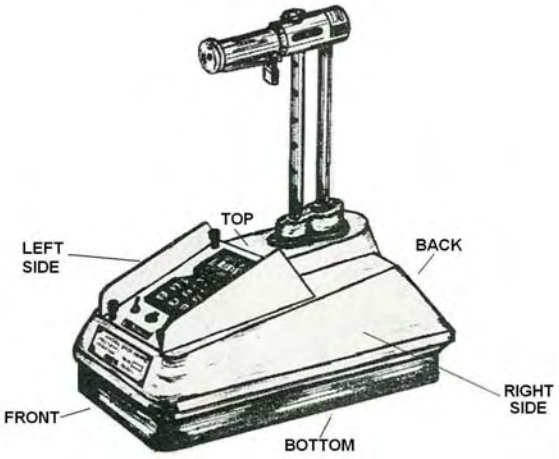
5. If the stat test passes the appropriate evaluation, proceed to step 6. If the stat test fails the evaluation, repeat step 4. If the stat test fails for a second time, this gauge is not stable enough to conduct a calibration; discontinue the calibration.

6. Record the average density and moisture count from the stat test onto the indicated place on the *Calibration Data Recording Form* on page 2–44.

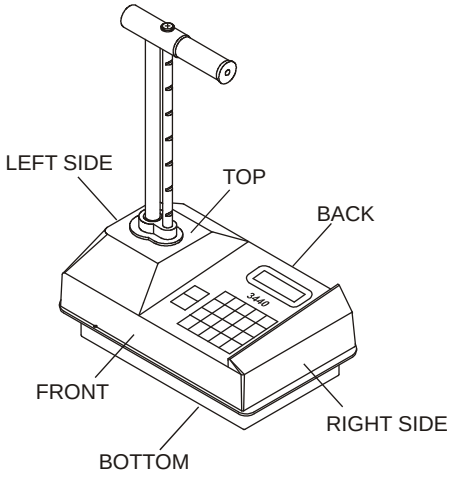
7. Set the gauge to take a 4-minute count. Refer to the *Manual of Operation and Instruction* for directions on setting the gauge count time to 4 minutes. If the gauge is a Model 3401-B or 3411-B, the count time is set to four minutes by turning the **PWR/TIME** switch to **SLOW**.

8. Take the gauge to the **magnesium** calibration block and place the gauge on top of the block.

   - If the gauge is a Model 3401-B or 3411-B, face the scaler and pull the gauge towards yourself or push it away until there is 1.5 inches (2.54 cm) of space between the back of the gauge and the center of the access hole in the calibration block. The “back” of the gauge is identified in Figure 2–1, and the proper orientation of the gauge with respect to the access hole is shown in Figure 2–2. In this orientation, the access hole will be *behind*, not *under*, the gauge. Ensure that the left and right sides of the gauge are equidistant from the left and right sides of the calibration block, respectively.
   - If the gauge is a Model 3430 or 3440, then face the scaler and slide the gauge to the left or to the right until there is 1.5 inches (2.54 cm) of space between the left side of the gauge and the center of the access hole in the calibration block. The “left side” of the gauge is identified in Figure 2–1, and the proper orientation of the gauge with respect to the access hole is shown in Figure 2–2. In this orientation, the access hole will be to the *left*, not *under*, the gauge. Ensure that the front and back of the gauge are equidistant from the left and right sides of the calibration block, respectively.



Model 3401-B and 3411-B



Model 3430 and 3440

Figure 2–1. Orientation Conventions for Model 3401-B, 3411-B, 3430, and 3440 Gauges

Top view of a Model 3411-B on the magnesium calibration block in backscatter position

Back view of a Model 3411-B on the magnesium block in backscatter position

Top view of a Model 3430 on the magnesium calibration block in backscatter position

Left side view of a Model 3430 on the magnesium block in backscatter position

Figure 2–2. Orientation of Model 3401-B or 3411-B Gauge and Calibration Block Access Hole

9. Put the gauge source rod in backscatter position. Figure 2–3 shows the various source rod positions.

10. Start a 4-minute reading with the gauge. For a Model 3430 or 3440 gauge, refer to the *Manual of Operation and Instruction* for instructions on taking a reading, or measurement. Note that it does not matter whether the gauge is in *Soil* or *Asphalt* mode. For a Model 3401-B or 3411-B gauge, refer to page 2–46 for instructions on taking a reading.

11. Once the reading has concluded, record the density count in the appropriate location on the *Calibration Data Recording Form* on page 2–44. If the calibration block is magnesium, then also record the moisture count.

    - For a Model 3440 gauge, use the *Count* function to display the density and moisture counts. Refer to the *Manual of Operation and Instruction.*
    - For a Model 2320 gauge, use the up and down arrows to display the density and moisture counts. Refer to the *Manual of Operation and Instruction.*
    - For a Model 3401-B or 3411-B gauge, refer to page 2–46 for instructions on obtaining the density and moisture counts.

12. If the preceding count was taken with the source rod at its lowest position, then proceed to step 16. However, if there are deeper positions on the index rod that have not been measured in the current calibration block, then place the gauge over the access hole in the current calibration block, lower the source rod to the next deepest index rod position, and proceed to step 13.

13. If the gauge is a Model 3401-B or 3411-B, face the scaler module and pull the gauge toward yourself in order to seat the source rod in firm contact with the side of the hole. If the gauge is a Model 3430 or 3440, face the scaler module and gently slide the gauge to the right in order to seat the source rod in firm contact with the side of the hole.

14. Start a 4-minute reading with the gauge.

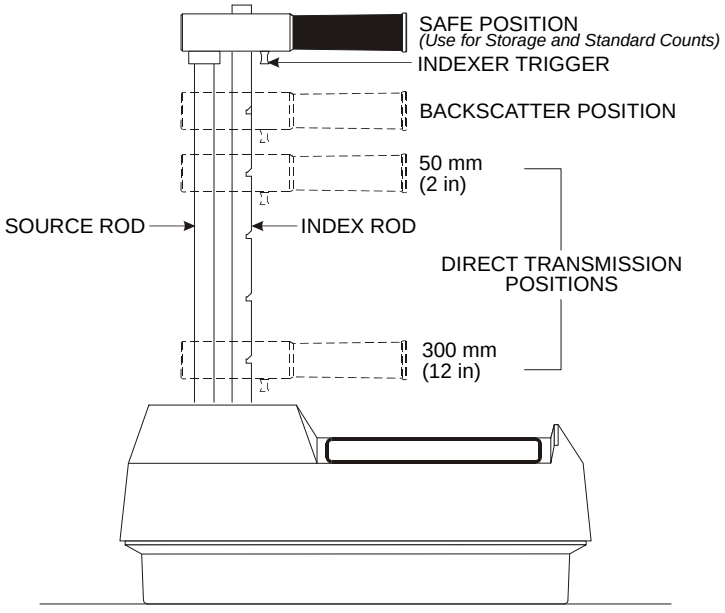


Figure 2–3. Gauge Source Rod Positions

15. Once the reading has concluded, record the density count in the appropriate location on the *Calibration Data Recording Form* on page 2–44, and return to step 12.

16. Two separate backscatter readings must be taken on this block. To take the second backscatter reading, repeat steps 9 through 11, then proceed to step 17.

17. If the preceding measurement were made on the aluminum calibration block, then proceed to step 24. Otherwise, proceed to step 18.

18. If the proceeding measurements were made on the **mag/aluminum** calibration block, then proceed to step 22. Otherwise, proceed to step 19.

19. If this calibration facility has a mag/aluminum calibration block, then proceed to step 20. Otherwise, proceed to step 22.

20. Take the gauge to the **mag/aluminum** calibration block and place the gauge on top of the block.

21. Return to step 9 to take the necessary counts in the mag/aluminum block.

22. Take the gauge to the **aluminum** calibration block and place the gauge on top of the block.

23. Proceed to step 9 to take the necessary counts in the aluminum block.

24. If this calibration facility has a mag/poly moisture block, then proceed to step 25. Otherwise, proceed to step 31.

25. Place the gauge, with the source rod in **SAFE** position, on the mag/poly block.

    - If the gauge is a Model 3401-B or 3411-B, face the scaler and pull the gauge towards yourself or push it away until there is 1.5 inches (2.54 cm) of space between the back of the gauge and the center of the access hole in the calibration block. The “back” of the gauge is identified in Figure 2–1, and the proper orientation of the gauge with respect to the access hole is shown in Figure 2–2. In this orientation, the access hole will be *behind*, not *under*, the gauge. Ensure that the left and right sides of the gauge are equidistant from the left and right sides of the calibration block, respectively.
    - If the gauge is a Model 3430 or 3440, then face the scaler and slide the gauge to the left or to the right until there is 1.5 inches (2.54 cm) of space between the left side of the gauge and the center of the access hole in the calibration block. The “left side” of the gauge is identified in Figure 2–1, and the proper orientation of the gauge with respect to the access hole is shown in Figure 2–2. In this orientation, the access hole will be to the *left*, not *under*, the gauge. Ensure that the front and back of the gauge are equidistant from the left and right sides of the calibration block, respectively.

26. Start a 4-minute reading with the gauge.

27. Once the reading has concluded, record the moisture count in the *Mag/Poly Moisture Count* section of the *Calibration Data Recording Form* on page 2–44.

28. For a Model 3401-B or 3411-B gauge, place the 1.3-mm (0.05-inch) thick surface roughness shims under the left and right sides of the gauge base, as shown in Figure 2–4. Note that there is one shim on each side of the gauge.

Figure 2–4. Location of Surface Roughness Shims
(Note: There is one shim on each side of the gauge.)

29. Start a 4-minute reading with the gauge.

30. Once the reading has concluded, record the moisture count in the *Mag/Poly SR Count* section of the *Calibration Data Recording Form* on page 2–44.

31. Orient the gauge as described in steps 2 and 3 in preparation for a drift test.

32. Conduct a drift test with the gauge:

    - Model 3430 and 3440 gauges have a *drift test* function that conducts and evaluates the drift test. See the *Manual of Operation and Instruction* for the particular gauge model for instructions on taking a Drift Test and evaluating the results.
    - If the gauge being calibrated is a Model 3401-B or 3411-B, refer to page 2–43.

33. If the drift test passes the appropriate evaluation, then proceed to step 34. If the drift test fails the evaluation for the first time, repeat step 32 to perform a second drift test. If the drift test has failed the evaluation two times in a row, then proceed to step 34.

34. On the *Calibration Data Recording Form* on page 2–44, record the average density count and the average moisture count obtained by the drift test that was just completed, as well as the percent drift values for both density and moisture.

35. If the drift test failed twice, then a *provisional drift test* is required; proceed to step 36. However, if the last drift test passed, then proceed to step 41.

36. Perform a stat test by repeating steps 2 through 4. There is no need to record these results.

37. If the stat test in step 36 passes the appropriate evaluation, then proceed to step 37. If the stat test fails the evaluation, repeat step 36. If the stat test fails for a second time, this gauge is not stable enough to conduct a calibration; discontinue the calibration.

38. Leave the gauge stationary for between 3 to 8 hours, without moving the gauge or any part of the gauge for this period.

39. Perform the provisional drift test by repeating step 32. There is no need to record these results.

40. If the drift test conducted in step 39 passes the system (or systems) that were failed in the failed drift test that preceded it, then this gauge is electronically stable, and the calibration process can continue. Proceed to step 41. However, if the drift test conducted in step 39 fails the same system(s) that the drift test that preceded it also failed, then this gauge is unsuitable for use; discontinue the calibration.

41. On the *Calibration Data Recording Form* on page 2–44, compute and record the *Average Backscatter Values* for each calibration block. These values are obtained by averaging, for each individual block, the first and second backscatter count taken on that block.

42. On the *Calibration Data Recording Form*, compute and record the *Average Density Standard Count.* This value is obtained by averaging the density count average from the stat test and the density count average from the drift test.

43. On the *Calibration Data Recording Form*, compute and record the *Average Moisture Standard Count.* This value is obtained by averaging the moisture count average from the stat test and the moisture count average from the drift test.

44. The data acquisition portion of the gauge calibration is complete. Proceed to the *Entering Calibration Data into the TCS Program* section on page 2–9.

ENTERING CALIBRATION DATA INTO THE TCS PROGRAM

Once the measurement data has been collected, it must be entered into the TCS application. This software package will enable the user to compute the gauge calibration constants, evaluate the performance parameters of the resulting calibration functions, print a calibration report, and archive the data.

1. If the TCS application has been installed on computer, a **TCS** icon will be displayed on the Windows desktop. Double-click this icon to start the TCS application. A splash screen, showing the software version number and date, is briefly displayed.

2. After a few seconds, the splash screen is replaced by the **Metal Block Main Menu** shown in Figure 2–5. This menu contains buttons that pertain to particular Troxler gauge models and versions. Click the button that matches the gauge type and version that is currently under calibration.

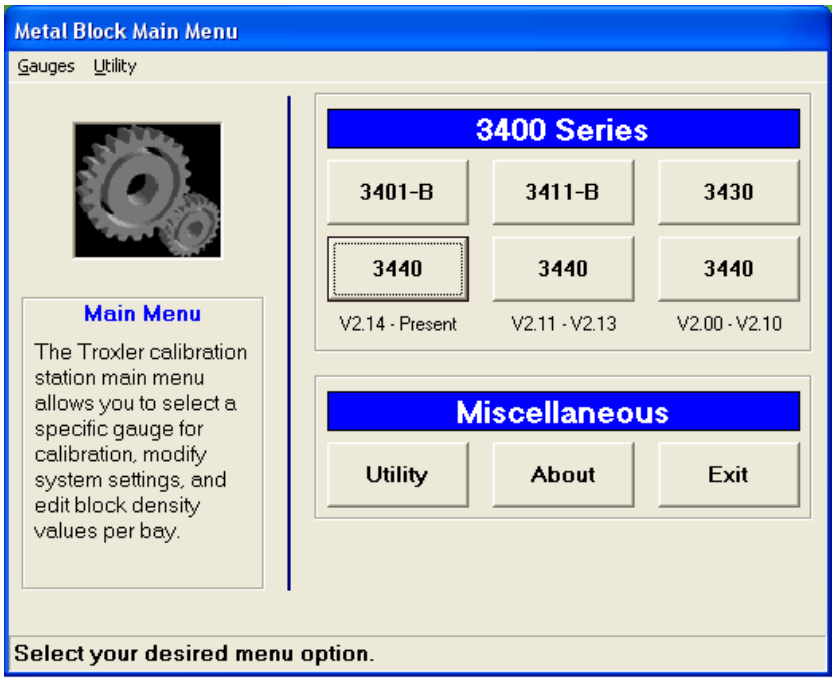


Figure 2–5. Metal Block Main Menu

3. The **Function Menu** (see Figure 2–6) is displayed. Note that some of the buttons in the **Function Menu** may be different, depending upon the gauge model selected on the **Metal Block Main Menu**. Click the ⟨**Special Menu**⟩ button.

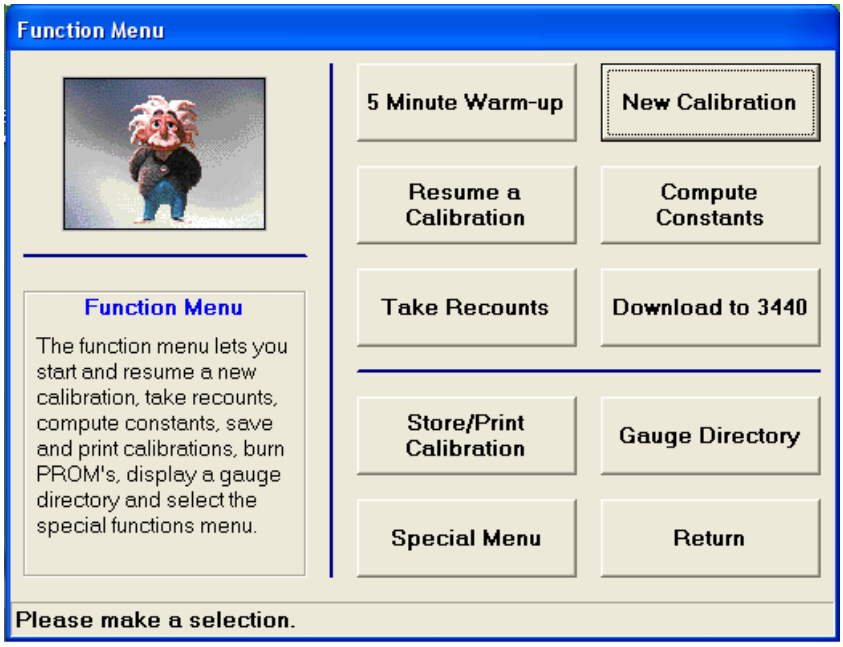


Figure 2–6. Function Menu

4. The **Special Function Menu** (see Figure 2–7) is displayed. Again, some of the buttons in the **Special Function Menu** may be different, depending upon the gauge model selected on the **Metal Block Main Menu**. Click the ⟨**Manual Entry of New Calib. Data**⟩ button.

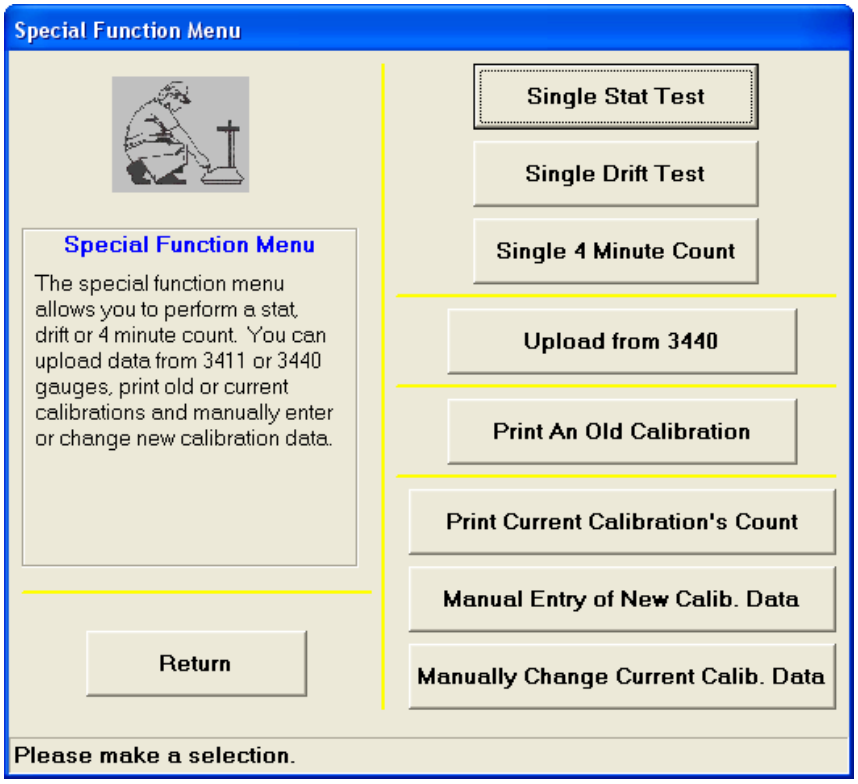


Figure 2–7. Special Function Menu

5. After the ⟨**Manual Entry of New Calib. Data**⟩ button is clicked, the **New Calibration Menu** (see Figure 2–8) is displayed. The **Gauge Model** field will be set on this menu, but all other values are either left blank or are filled in with default values. There are a total of nine values that can be filled in on the **New Calibration Menu**. All values pertain to the gauge type and calibration type. If you are uncertain about what values to fill in for any of these quantities, consult the *Manual of Operation and Instruction* or your Troxler Representative. Fill in all of these values, then click the ⟨**Continue**⟩ button.

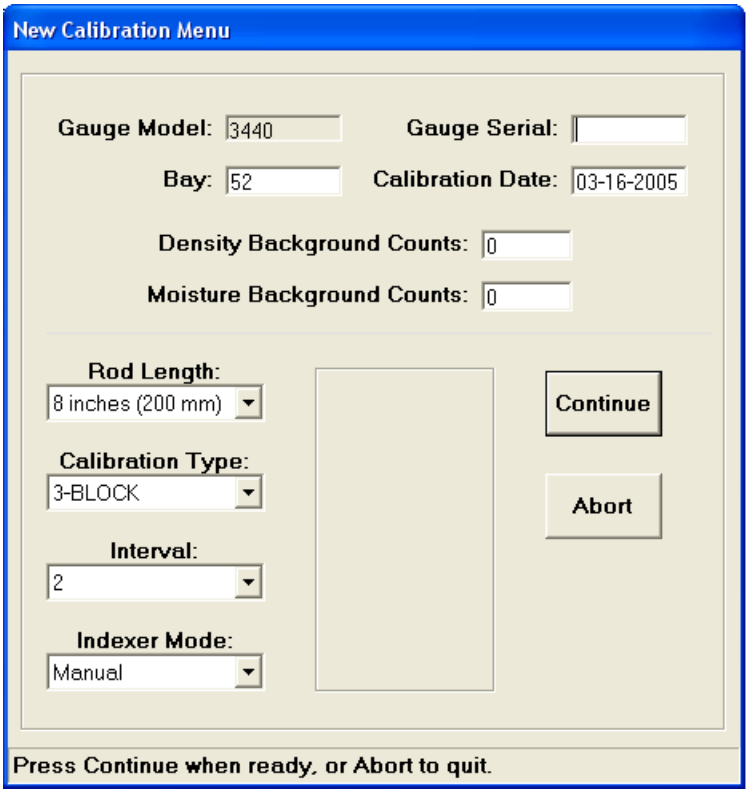


Figure 2–8. Sample New Calibration Menu

6. The **Manual Entry of New Calibration** screen (see the samples in Figure 2–9 and Figure 2–10) is now displayed. The appearance of this screen will differ according to the rod length, interval, and calibration type values selected on the **New Calibration Menu** in step 5. For example, the sample screen shown in Figure 2–9 is for a 12-inch rod, 2-inch interval, and a 3-block calibration. Figure 2–10 is for an 8-inch rod, 1-inch interval, 2-block recalibration.

   a. Refer to the *Calibration Data Recording Form*. Look in Part 6, at the value entered as the *Final Density Standard Count Value*. Enter this value into the block entitled **D Std Ct** on the **Manual Entry of New Calibration** screen.

   b. Again refer to the *Calibration Data Recording Form*. Look in Part 6, at the value entered as the *Final Moisture Standard Count Value*. Enter this value into the block entitled **M Std Ct** on the **Manual Entry of New Calibration** screen.

7. Refer to the *Calibration Data Recording Form*. Look in the five-column table in Part 3. The fifth column, *Magnesium Block Moisture Count*, has only two values entered in it: the magnesium moisture count taken for backscatter count number one, and the magnesium moisture count taken for backscatter count number two. Determine the average of these two counts, and enter the result into the block entitled **Mag M Ct** on the **Manual Entry of New Calibration** screen.

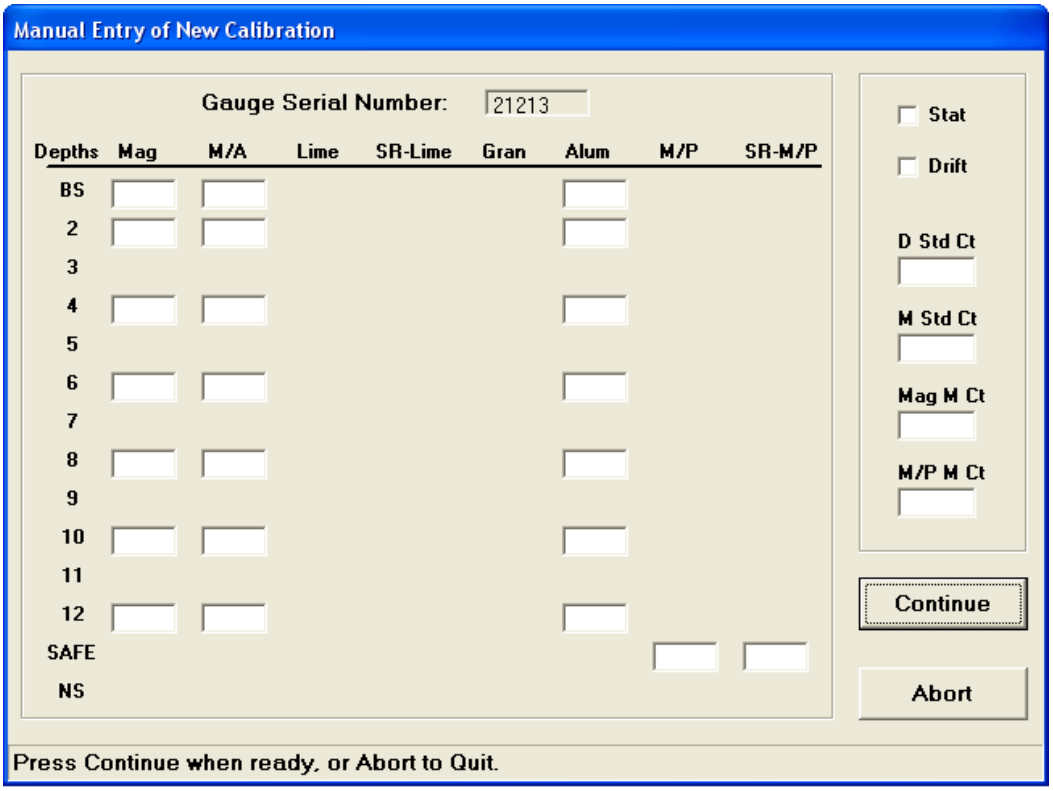


Figure 2–9. Manual Entry of New Calibration Screen for a 12-2 Gauge, 3-Block Calibration

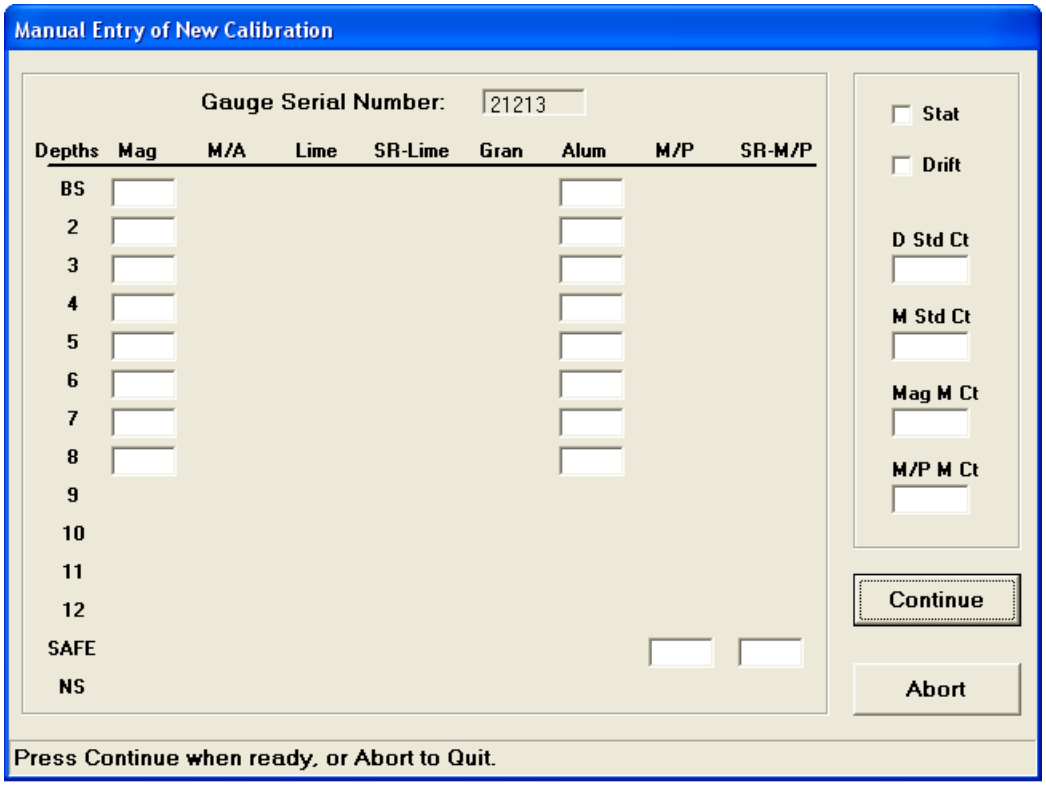


Figure 2–10. Manual Entry of New Calibration Screen for an 8-1 Gauge, 2-Block Recalibration

8. Refer to the *Calibration Data Recording Form*. Look at the end of Part 3, beneath the table, at the entry labeled *Mag/Poly Moisture Count*. The value written in this entry must be entered into **two** places on the **Manual Entry of New Calibration** screen. First, enter this value into the block entitled **M/P M Ct**. Second, enter the same value into the block that resides in the **M/P** column and the **SAFE** row of the table on the screen.

9. Refer to the *Calibration Data Recording Form*. Look at the end of Part 3, beneath the table, at the entry labeled *Mag/Poly SR Count*. Enter this value into the block that resides in the **SR-M/P** column and the **SAFE** row of the table on the **Manual Entry of New Calibration** screen.

10. Refer to Part 5 of the *Calibration Data Recording Form* and perform the following:

    a. Look for the entry labeled *Average Magnesium Backscatter Value*. Enter this value in the block that resides in the **Mag** column and the **BS** row of the table on the **Manual Entry of New Calibration** screen.

    b. Look in Part 5 of the *Calibration Data Recording Form* for the entry labeled *Average Mag/Aluminum Backscatter Value*. If there is a value written in this entry, enter it in the block that resides in the **M/A** column and the **BS** row of the table on the **Manual Entry of New Calibration** screen. If, however, the calibration is a 2-block recalibration, there is no value to record.

    c. Look in Part 5 of the *Calibration Data Recording Form* for the entry labeled *Average Aluminum Backscatter Value*. Enter this value in the block that resides in the **Alum** column and the **BS** row of the table on the **Manual Entry of New Calibration** screen.

11. Refer to Part 3 of the *Calibration Data Recording Form*. Look at the second column in the table in Part 3, *Magnesium Block Density Count*. Starting at the 2-inch row of this column and working down to the 12-inch row, enter the counts written in this column into the corresponding cells in the **Mag** column on the **Manual Entry of New Calibration** screen. Ignore the values in the **Backscatter Count #1** and **Backscatter Count #2** cells in the *Calibration Data Recording Form*, as the backscatter values were processed earlier.

12. Refer to Part 3 of the *Calibration Data Recording Form*. Look at the third column in the table in Part 3, *Mag/Aluminum Block Density Count*. If this is a 2-block recalibration, skip this step and proceed to step 13. Otherwise, if this is a 3-block calibration, starting at the 2-inch row of this column and working down to the 12-inch row, enter the counts written in this column into the corresponding cells in the **M/A** column on the **Manual Entry of New Calibration** screen. Ignore the values in the **Backscatter Count #1** and **Backscatter Count #2** cells in the *Calibration Data Recording Form*, as the backscatter values were processed earlier.

13. Refer to Part 3 of the *Calibration Data Recording Form*. Look at the fourth column in the table in Part 3, *Aluminum Block Density Count*. Starting at the 2-inch row of this column and working down to the 12-inch row, enter the counts written in this column into the corresponding cells in the **Alum** column on the **Manual Entry of New Calibration** screen. Ignore the values in the **Backscatter Count #1** and **Backscatter Count #2** cells in the *Calibration Data Recording Form*, as the backscatter values were processed earlier.

14. All of the text boxes on the **Manual Entry of New Calibration** screen should now contain non-zero values. (The two check boxes labeled **Stat** and **Drift** should remain un-checked.) Click ⟨**Continue**⟩.

15. The **Special Function Menu** (see Figure 2–7) is again displayed. Click the ⟨**Return**⟩ button.

16. The **Function Menu** (see Figure 2–6) is now displayed. The data entry process is complete.

COMPUTING CALIBRATION CONSTANTS AND PERFORMANCE PARAMETERS

Once the measurement data have been entered into the TCS application, the gauge calibration constants must be computed and the subsequent performance parameters evaluated.

1. From the **Function Menu** (see Figure 2–6), click the ⟨**Compute Constants**⟩ button.

2. The **Compute Current Calibration Constants Menu** is displayed, allowing you to review the calibration data entered in the previous section. Click the ⟨**Yes**⟩ button.

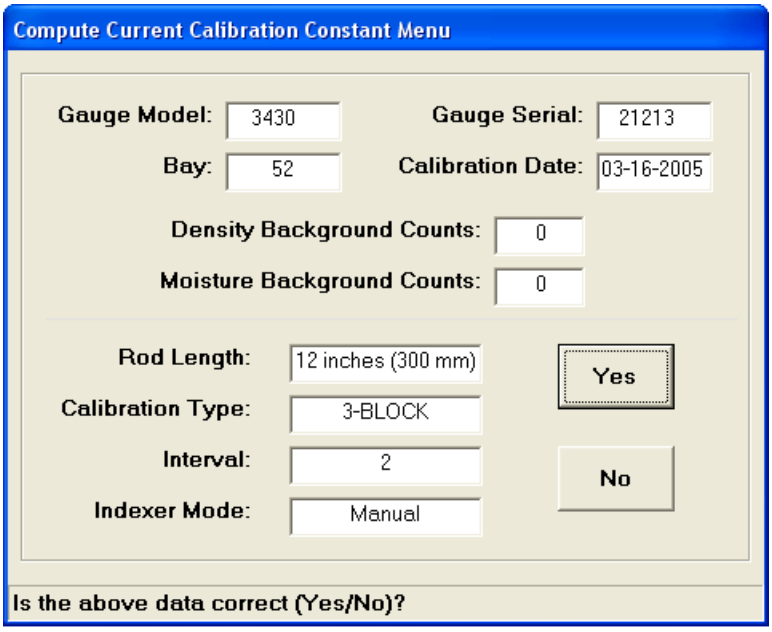


Figure 2–11. Sample Compute Current Calibration Constants Menu

3. The program automatically sends a listing of calibration counts to the Windows default printer, and a message box that asks **Metric Calibration?** is displayed.

4. Because the metric calibration constants will be needed for the *Entering Calibration Constants into the Gauge* section that begins on page 2–22, click ⟨**Yes**⟩.

5. The software then displays a message box that asks **Print tables?**

   - If the gauge being calibrated is a Model 3401-B, these tables will be needed later. Click ⟨**Yes**⟩.
   - If the gauge being calibrated is *not* a Model 3401-B, click ⟨**No**⟩.

6. The software then displays a message box that asks **Change Normalization Factor?** Unless you are performing a specialized, non-standard calibration, you should click ⟨**No**⟩. The software then displays the **User Entered Results Screen** (see Figure 2–12), summarizing the decisions made in the last few steps.

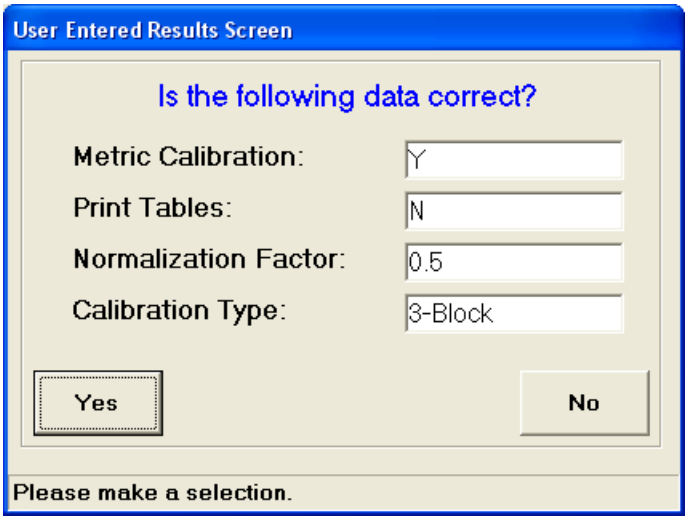


Figure 2–12. User Entered Results Screen

7. If the data shown on the **User Entered Results Screen** is correct, click ⟨**Yes**⟩. The next step depends upon whether the gauge calibration is a 3-block calibration or a 2-block recalibration:
   - If a 3-block calibration is being performed, then proceed to step 10.
   - If instead a 2-block recalibration is being performed, proceed to step 8.

8. For a 2-block recalibration, there are no mag/aluminum block density counts made during the measurement process of the calibration. To compensate for this omission, one must know and reuse the B values from the last 3-block calibration that was performed on this gauge. At this point, the program searches through the archived calibrations on the computer to see if these B values are available.
   - If these B values are found, the program proceeds to step 9.
   - If these B values cannot be found, they must be entered by hand. The program displays the **B Value Decision Screen** shown in Figure 2–13. Click ⟨**Yes**⟩ to enter the B values manually and continue with the calibration.

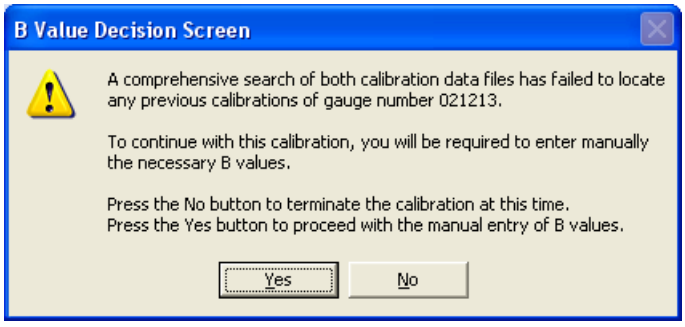


Figure 2–13. Sample B Value Decision Screen

9. The **B Value Display Screen** (see Figure 2–14) is now displayed. If the program was successful in finding the pertinent calibration B values in step 8, they will be displayed in the **B Value Display Screen**. If the program could not find the pertinent B values in step 8, the **B Value Display Screen** will display all zeros, as shown in Figure 2–14.

   - If the values displayed by the **B Value Display Screen** are correct, click the ⟨**Continue**⟩ button.
   - Otherwise, if the B values need to be entered or changed, enter the correct values and click the ⟨**Continue**⟩ button.

NOTE

The B values can be obtained from the calibration report for the last calibration of this gauge. If this report cannot be located, contact your Troxler representative for assistance.

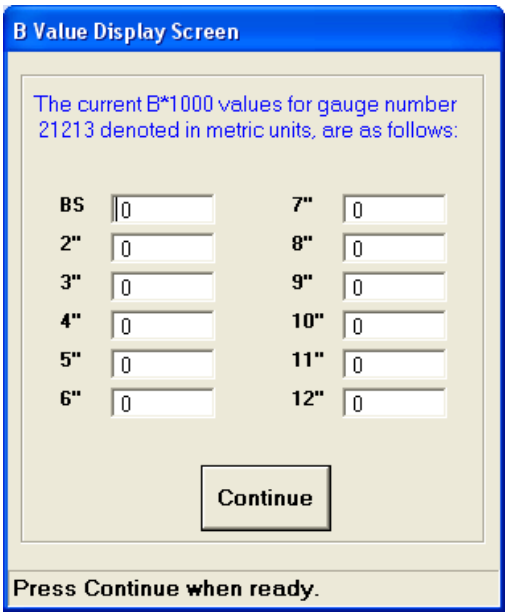


Figure 2–14. Sample B Value Display Screen

10. The program then computes the calibration constants. Once the calibration constants are computed, the program will compute the performance parameters. Once the performance parameters are computed, the values will be compared against the average values for these performance parameters to see if the values are reasonable. These computations are typically done in less than a second or so, depending on the computer's processor speed.

    - Once all of the computations are complete, if the performance parameters for this calibration all have values that fall within a 97% confidence interval around their typical values, the computer displays the **Performance Parameter Passed Message** shown in Figure 2–15. If this message is displayed, click the ⟨**OK**⟩ button and proceed to the section on *Entering Calibration Constants into the Gauge* section that begins on page 2–22.

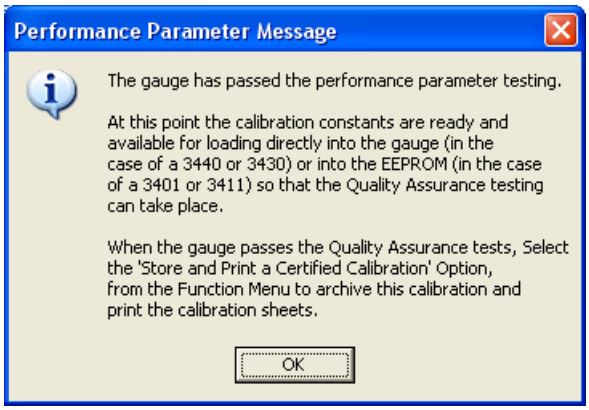


Figure 2–15. Performance Parameter Passed Message

- If, however, one or more of the performance parameters for this calibration fails to fall within a 97% confidence interval around their typical values, the computer displays the **Calibration Error Notification Prompt** shown in Figure 2–16. If this prompt appears, click the ⟨**OK**⟩ button. A report of the calibration inconsistencies will be sent to the Windows default printer. Collect this report and proceed to the *Addressing Calibration Inconsistencies* section that begins on the following page.

Figure 2–16. Calibration Error Notification Prompt

ADDRESSING CALIBRATION INCONSISTENCIES

If this juncture has been reached in the calibration routine, then one or more calibration performance parameters has been found to be "inconsistent." At this point a brief discussion about what the performance parameters are and their significance is in order. A detailed discussion of performance parameters and their role in gauge calibration is contained in the 1995 Troxler Publication *Factory Calibration of Troxler Model 3400 Surface Moisture/Density Gauges*. Contact your Troxler representative for a copy of this publication.

The performance parameters are a series of "mathematical signatures" of a moisture calibration or a density calibration at a particular source rod position. If one considers the entire population of Troxler gauges, each of these "signatures" has a normal or near-normal distribution, with a mean value and a standard deviation. These distributions have been determined by analyzing a population of thousands of Troxler factory calibrations.

When the TCS performs a calibration, it computes each performance parameter values for *that particular calibration*, then compares it to the *population mean value* and *standard deviation* for the specific performance parameter population. The population mean value and standard deviation values, as mentioned previously, were computed from a large quantity of Troxler factory calibrations.

For the density calibrations, if a particular performance parameter of a particular calibration falls within 2.3 standard deviations of the population mean value for that performance parameter, then the calibration "passes" that performance parameter. For the moisture calibrations, if a particular performance parameter of a particular calibration falls within 2.7 standard deviations of the population mean value for that performance parameter, then the calibration "passes" that performance parameter.

If, however, a particular density performance parameter is more than 2.3 standard deviations different from the population mean value, then an "inconsistency" exists for that calibration. A given density calibration at a given depth can have multiple inconsistencies, since there are more than one density performance parameter at each depth and some of them are covariant.

Likewise, if a particular moisture performance parameter is more than 2.7 standard deviations different from the population mean value, then an "inconsistency" exists for that calibration. A given moisture calibration can have multiple inconsistencies, since there are more than one moisture performance parameter and some of them are covariant.

Does a performance parameter inconsistency mean that there is a problem with the calibration? Probably, but not necessarily. What it does mean, at the very least, is that the affected calibration is atypical of most Troxler factory calibrations performed at this depth (for a density calibration) or that it is atypical of most moisture calibrations. The prudent course of action would be to do the following:

- Take one or more sets of recounts for the affected depth (for density inconsistencies), or take a complete set of moisture recounts (for moisture inconsistencies).
- If the recounts are *different from* the original counts, then re-enter the new counts and try a recalibration.
- If the recounts are instead *similar to* the original counts and the inconsistencies persist, check the gauge for electrical or mechanical problems.
- If no electrical or mechanical problems exist, contact your Troxler representative for further guidance.

Therefore, in the event of a calibration inconsistency, follow these steps:

1. At this point in the process, the TCS program will be displaying the **Calibration Approval Prompt** (see Figure 2–17).
   - If the calibration will be accepted regardless of the inconsistency or inconsistencies encountered, then click the ⟨**Yes**⟩ button. The software returns to the **Function Menu** (see Figure 2–6). Proceed to the section on *Entering Calibration Constants into the Gauge* that begins on page 2–22.
   - Otherwise, to reject the current calibration and try to solve the inconsistency problem, click the ⟨**No**⟩ button. The software returns to the **Function Menu** (see Figure 2–6). Proceed to step 2.

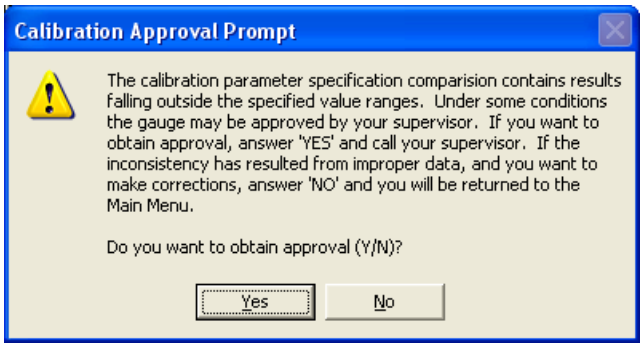


Figure 2–17. Calibration Approval Prompt

2. Obtain a copy of the *Calibration Recount Form* from pages 2–47 and 2–48. Fill in the data in Part 1 of this form.

3. If there were no density inconsistencies to be addressed with this calibration, then proceed to step 14. Otherwise, proceed to step 4.

4. Review the calibration inconsistency report generated during step 10 of the *Computing Calibration Constants and Performance Parameters* section. Find the shallowest depth (BS is shallowest, 12 inches is deepest) at which a density calibration inconsistency still needs to be addressed.

5. Place the gauge on the magnesium block, with the source rod at the measurement position selected in step 4. Orient the gauge as described in the first section of this chapter.

6. Take a 4-minute count with the gauge. Record the results in the first available blank line in the table in Part 2 of the *Calibration Recount Form*.

7. If this is a 3-block calibration, proceed to step 8. Otherwise, proceed to step 10.

8. Place the gauge on the mag/aluminum block, with the source rod at the measurement position selected in step 4. Orient the gauge as described in the first section of this chapter.

9. Take a 4-minute count with the gauge. Record the results in the first available blank line in the table in Part 2 of the *Calibration Recount Form*.

10. Place the gauge on the aluminum block, with the source rod at the measurement position selected in step 4. Orient the gauge as described in the first section of this chapter.

11. Take a 4-minute count with the gauge. Record the results in the first available blank line in the table in Part 2 of the *Calibration Recount Form*.

12. Review the calibration inconsistency report generated during step 10 of the *Computing Calibration Constants and Performance Parameters* section. If the gauge readings just completed are at the deepest depth at which a density calibration inconsistency is to be addressed, then proceed to step 13. Otherwise, return to step 4.

13. If there were no moisture measurement inconsistencies that need to be addressed, proceed to step 20. Otherwise, continue to step 14.

14. Place the gauge on the magnesium block with the source rod in the **SAFE** position. Orient the gauge as described in the first section of this chapter.

15. Take a 4-minute count with the gauge. Record the moisture count in the first available blank line in the table in Part 3 of the *Calibration Recount Form*.

16. Place the gauge on the mag/poly block, with the source rod in the **SAFE** position. Orient the gauge as described in the first section of this chapter.

17. Take a 4-minute count with the gauge. Record the moisture count in the first available blank line in the table in Part 3 of the *Calibration Recount Form*.

18. Place the gauge on the magnesium block, with the source rod in the **SAFE** position. Orient the gauge as described in the first section of this chapter. Place the 1.3-mm (0.05-inch) thick surface roughness shims under the left and right sides of the gauge base, as shown in Figure 2–4. Note that there is one shim on each side of the gauge.

19. Take a 4-minute count with the gauge. Record the moisture count in the first available blank line in the table in Part 3 of the *Calibration Recount Form*.

20. It is now time to enter all of the data taken in this section into the TCS program as recounts. From the **Function Menu** (see Figure 2–6), click the ⟨**Special Menu**⟩ button.

21. The **Special Function Menu** (see Figure 2–7) is displayed. Click the ⟨**Manually Change Current Calib. Data**⟩ button.

22. The **Manually Change the Current Calibration** menu #1 (see Figure 2–18) is displayed. This menu is similar to the **Compute Current Calibration Constants Menu** shown in Figure 2–11.

23. Click the ⟨**Continue**⟩ button.

24. The **Manually Change the Current Calibration** menu #2 (see Figure 2–19) is displayed. (Note that in this example, the calibration is a 3-block for a 12-2 gauge. Different calibration types and source rod designs will have different layouts.) This menu is similar to the **Manual Entry of New Calibration** menu, with the data taken prior to the most recent recounts entered in. Go to the appropriate boxes on this form and enter all of the recounts, density and moisture, that were just taken, then click ⟨**Continue**⟩.

25. The **Special Function Menu** is again displayed. Click the ⟨**Return**⟩ button.

26. The **Function Menu** is again displayed. Return to the *Computing Calibration Constants and Performance Parameters* section on page 2–14 to re-compute the calibration constants.

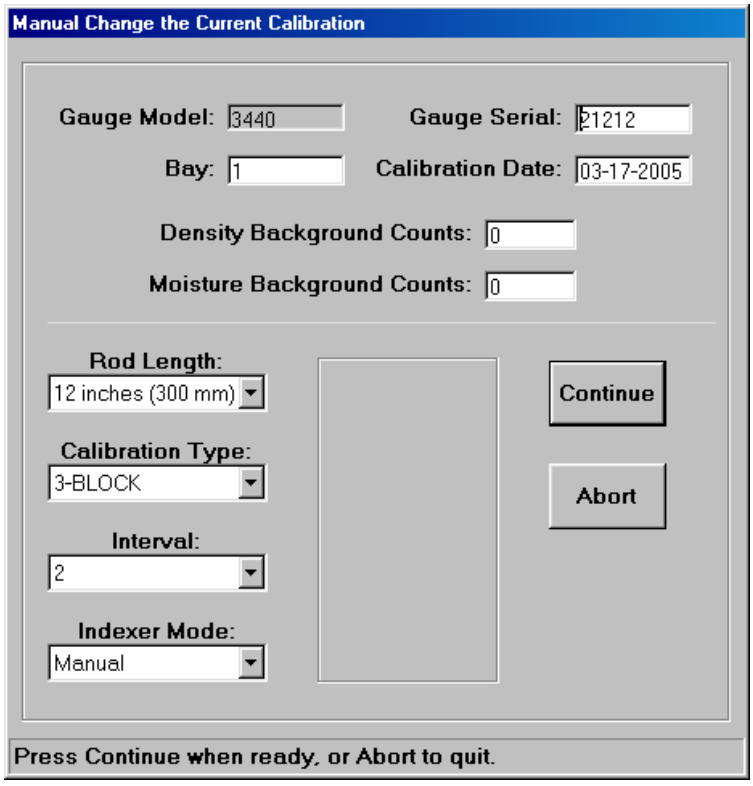


Figure 2–18. Sample Manually Change the Current Calibration Menu #1.

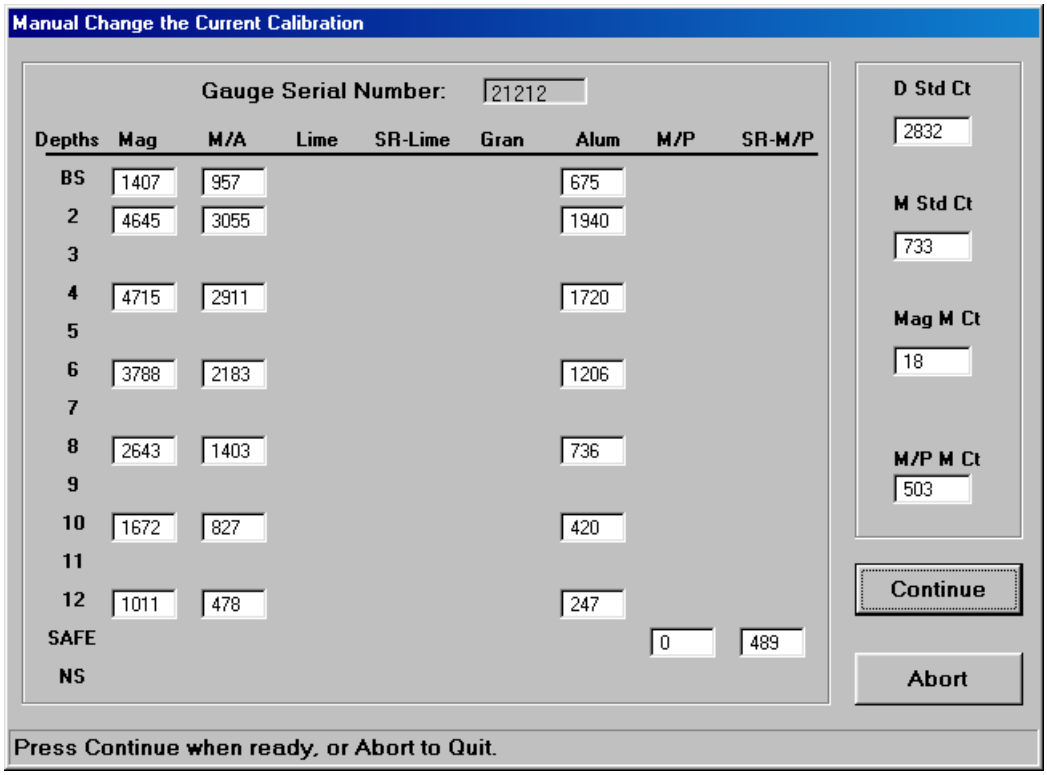


Figure 2–19. Sample Manually Change Current Calibration Menu #2.

ENTERING CALIBRATION CONSTANTS INTO THE GAUGE

Each of the four gauge models that this chapter addresses (Models 3401-B, 3411-B, 3430, and 3440) has a different way in which the calibration constants must be entered into the gauge. Some of these models have multiple ways in which the constants can be entered into it as well. This section will instruct the user in the most direct way to enter these calibration constants into the gauge. For more options, contact your Troxler representative.

This section is structured into four separate subsections, one for each of the four models covered by this chapter. Proceed to the appropriate subsection in order to get the calibration constants ready for gauge use.

MODEL 3401-B

There actually is no way to enter the calibration constants into the Model 3401-B. This particular gauge does not do the mathematical calculations involved in converting a density count ratio into a density value or a moisture count ratio into a moisture content value. Instead, when one takes a field reading with a Model 3401-B, only the density and moisture count are displayed. One must then compute the density and count ratios using a calculator, then use printed tables to look up the density and moisture values based on the density and moisture count ratios. This is why the user is instructed to select click ⟨**Yes**⟩ when the software displays the **Print Tables?** message box in step 5 on page 2–14.

To obtain the tables, look in the *C:\cal\bas* folder on the calibration computer for a file named *tables.txt*. This file contains the tables one will need to conduct the Quality Assurance testing for this gauge calibration. Print this table, then proceed to the *Performing Quality Assurance Testing* section on page 2–31. The layout of the text in this file may need to be reformatted in order to obtain a usable printout.

MODEL 3411-B

Unlike the 3401-B, one can enter the calibration constants into the Model 3411-B, and the Model 3411-B does perform the calculations to convert the density counts and moisture counts into density values and moisture content values. However, unlike the Models 3430 and 3440, one cannot enter these values into the gauge by typing them into the scaler.

With the Model 3411-B, one must instead create an *Intel Hex* file that contains the calibration constants, **then** burn that file onto a 2716 EEPROM. The TCS software will create the required Intel Hex file and then allow the user to use either the Shooter (PromPro series only) from Logical Devices, Inc. or the EP-1 from JDR Microdevices to burn the Intel Hex file to the EEPROM. However, if the user wishes to use a different type of EEPROM programmer to burn the Intel Hex file onto the EEPROM, that option is also available.

To create the Intel Hex file containing the calibration constants and burn them onto a 2716 EEPROM, do the following:

1. The **Function Menu** for the Model 3411-B gauge is shown in Figure 2–20. From the **Function Menu**, click the ⟨**Burn 3411 PROM**⟩ button.

Figure 2–20. Function Menu for Model 3411-B gauge

2. The **Select EPROM Programmer** screen shown in Figure 2–21 is displayed.
   - To use the Shooter to program the EEPROM, select the **Shooter** radio button. Then click ⟨**Continue**⟩ and proceed to step 3.
   - To use the EP-1 to program the EEPROM, select **EP-1 EPROM Programmer** radio button. Click ⟨**Continue**⟩ and proceed to step 11.
   - If you only wish to create the Intel Hex file, but do not wish to use the TCS software to burn the file onto the EEPROM, select the **EP-1 EPROM Programmer** radio button. Click ⟨**Continue**⟩ and proceed to step 18.

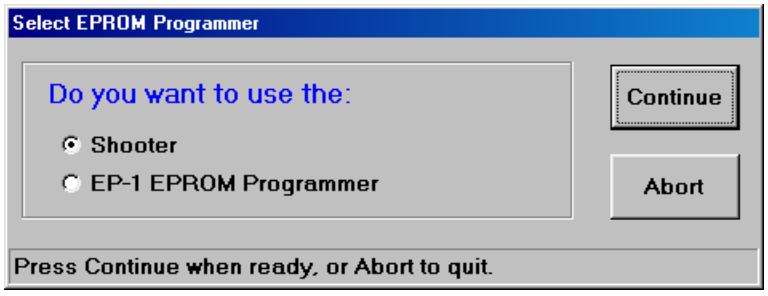


Figure 2–21. Select EPROM Programmer Screen

3. The TCS application now displays the prompt **Press Continue to start the process of converting the calibration constants to hex.** Click ⟨**Continue**⟩ to proceed with the conversion.

4. The TCS application creates the Intel Hex file. When the data is ready, the software displays the message **All data are prepared and ready to be sent to the Shooter.** As directed, ensure that the Shooter is turned on and properly connected, then click the ⟨**Continue**⟩ button.

5. The computer sends the contents of the Intel Hex file to the Shooter. During this time, the software displays **Downloading data to the Shooter.** Wait until this process is complete.

6. When the Intel Hex file contents have been successfully loaded into the Shooter, the software displays the prompt **Insert the 2716 EPROM into the Shooter socket.** Load the 2716 EEPROM into the Shooter as directed and click the ⟨**Continue**⟩ button.

7. The Intel Hex file is then programmed into the EPROM. During this process, the software displays the message **Burning PROM.** Wait for the process to finish; it could take a few minutes.

8. When the EEPROM programming is complete, the software displays the **Successful PROM Burn Message** box. Click ⟨**OK**⟩ to return to the **Function Menu**.

9. Remove the EEPROM from the Shooter.

10. Proceed to step 16 for instructions on installing the EEPROM in the gauge.

11. You have indicated that you wish to burn an EPROM using the EP-1 programmer. The **EP-1 Eprom Programmer Menu** (see Figure 2–22) is displayed on the computer. Click the ⟨**Continue**⟩ button.

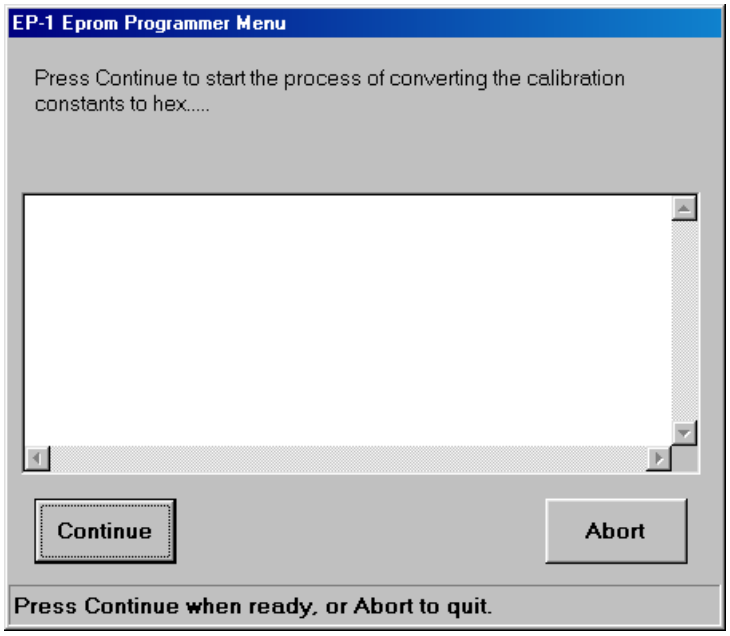


Figure 2–22. The EP-1 Eprom Programmer Menu

12. The computer computes the Intel Hex values and saves them to the Intel Hex file. When this computation process is complete, the **EP-1 Eprom Programmer Menu** displays the message **All data are prepared and ready to be sent to the EP-1.** As directed, ensure that the EP-1 is turned on and properly connected to the computer, then click the ⟨**Continue**⟩ button.

13. The software displays the prompt **Insert the 2716 EPROM into the Shooter socket.** Load the 2716 EEPROM into the EP-1 as directed and click the ⟨**OK**⟩ button.

NOTE

The TCS software assumes that the EPROM that you are using is an AMD brand 2716 EEPROM. If any other brand of 2716 EEPROM is used, the EPROM may not program properly. Contact your Troxler representative if you own an EP-1 but do not have an AMD 2716 EEPROM.

14. The **EP-1 Eprom Programmer Menu** displays the message **Downloading data to the EP-1 EPROM Programmer** as shown in Figure 2–23. The EP-1 burns the contents of the Intel Hex file created in step 12 onto the EEPROM in the EP-1 programmer. Allow the process to finish; it may take several minutes. When the process is complete, the software displays a **Successful Prom Burn Message** box. Click ⟨**OK**⟩ on the message box to continue.

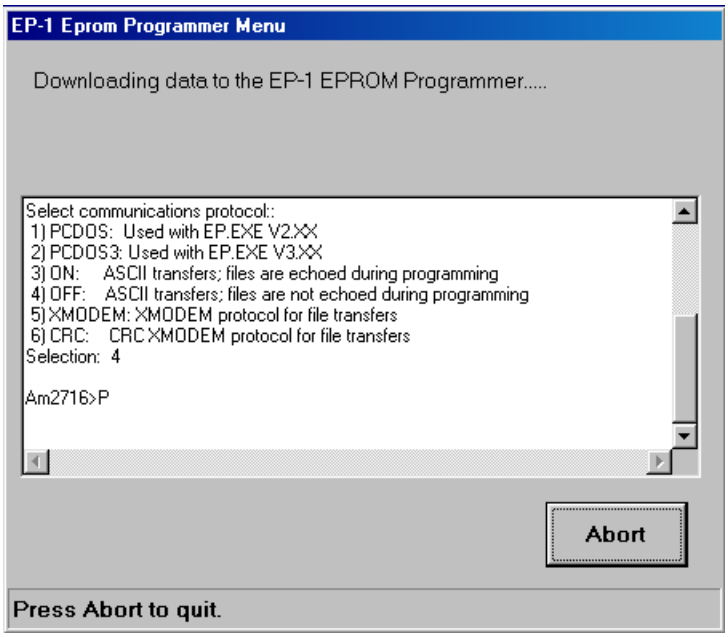


Figure 2–23. Downloading Data to the EP-1 EPROM Programmer

15. The EEPROM is now ready to put into the gauge. Remove the EEPROM from the EP-1.

16. Install the freshly programmed EEPROM in the Model 3411-B scaler as shown in Figure 2–24.

17. Re-connect the scaler to the Model 3411-B gauge and proceed to the *Performing Quality Assurance Testing* instructions on page 2–31.

18. At this point you have decided that you wish to use the TCS software to *create* the Intel Hex file to burn onto the 2716 EEPROM, but you do not wish to use the TCS software to *burn* the EEPROM. The two most likely reasons for doing this are (1) you do not use a Shooter or EP-1 to burn EEPROMS, or (2) you use the EP-1 to burn EEPROMS, but you are not using the AMD brand EEPROM that the TCS defaults to when it uses the EP-1. Regardless of the reason, you first need to create the Intel Hex file. Therefore, the **EP-1 Eprom Programmer Menu** (see Figure 2–22) is displayed on the computer. Click the ⟨**Continue**⟩ button.

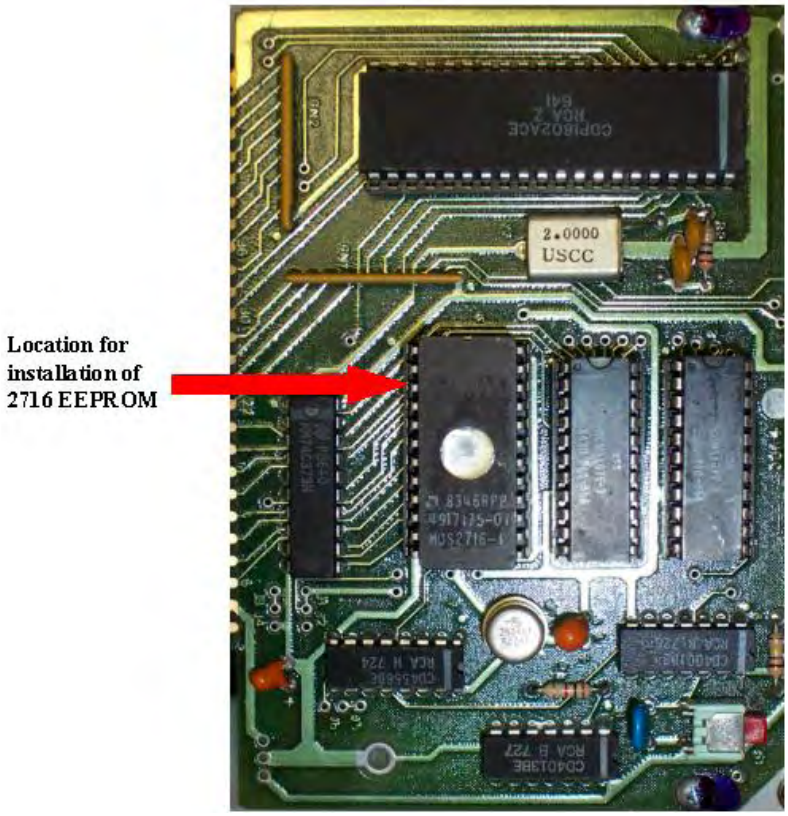


Figure 2–24. Location for 2716 EEPROM in Troxler Model 3411-B Scaler

19. The computer computes the Intel Hex values and saves them to the Intel Hex file. When this computation process is complete, the **EP-1 Eprom Programmer Menu** displays the message **All data are prepared and ready to be sent to the EP-1.** Click the ⟨**Abort**⟩ button to stop the process at this point. The program returns to the **Function Menu**.

20. The Intel Hex file that you will want to burn onto the EEPROM is *C:\cal\bas\pout.dat*. Using whatever device you choose, burn this file onto a 2716 EEPROM.

21. When the Intel Hex file is burned onto the EEPROM, remove it from the programming device and proceed to step 16.

MODEL 3430

For the Model 3430 gauge, the calibration constants can be entered into the gauge by typing them into the scaler. There is no need to use tables or to burn an EEPROM. However, in order to type in the calibration constants, you must first obtain a listing of them.

1. Open the file *C:\cal\bas\calsheet.txt*. The first page of this document contains the density calibration constants under the section labeled *Density Performance Parameters* and the moisture calibration constants under the section labeled *Moisture Performance Parameters*. Since the ⟨**Yes**⟩ button was clicked when the **Metric Calibration?** message box was displayed (see steps 3 and 4 on page 2–14, this document lists the *B*1000* values and the *F*1000* value in metric units (cubic meters per kilograms.)

2. Print the file *C:\cal\bas\calsheet.txt*. You will probably have to change the formatting of the text in order to obtain a legible printout.

3. Once the printout is complete, press the ⟨**SPECIAL**⟩ key on the gauge. The first of the *Special* functions is displayed.

4. Using the up and down arrows on the scaler, scroll through the *Special* functions until the option **CAL. CONSTANTS** is displayed. When that option is given press the ⟨**START/ENTER**⟩ key.

5. The gauge prompts the user to enter a code. This code is ***4678***. Using the up and down arrows to select the value for each flashing digit, enter the access code. To accept the flashing value and select the next digit, press ⟨**START/ENTER**⟩. The digits are entered in descending order of significance, so *4* is the first number entered, *6* is second, *7* is third, and *8* is last.

6. After the code is entered, the gauge prompts the user to enter the *E* value for the gauge. The *E* value is a moisture performance parameter and is found under that section in the *calsheet.txt* printout. For the first keystroke:

   - Press the up arrow if you wish for the sign of *E* to be positive
   - Press the down arrow if you wish for the sign of *E* to be negative

   At this point the most significant digit will be highlighted. Once this digit is highlighted (it will blink on and off), use the up and down arrows to get to the correct value, then press ⟨**START/ENTER**⟩ to save this value and move to the next digit down. Repeat the process of selecting the digit with the arrows and saving it with the ⟨**START/ENTER**⟩ key until all digits for *E* are filled in.

7. Once the value for *E* is completed, the user will be prompted to enter the value for *F*. You will find the value for *F* that you need to enter into the gauge in the moisture performance parameter section, under the heading *F*1000*. You will want to enter this value **exactly** as it is printed in *calsheet.txt*. Again, for the first keystroke:

   - Press the up arrow if you wish for the sign of *F* to be positive
   - Press the down arrow if you wish for the sign of *F* to be negative

   At this point the most significant digit will be highlighted. Once this digit is highlighted (it will blink on and off), use the up and down arrows to get to the correct value, then press ⟨**START/ENTER**⟩ to save this value and move to the next digit down. Repeat the process of selecting the digit with the arrows and saving it with the ⟨**START/ENTER**⟩ key until all digits for *F* are filled in.

8. Once the *E* and *F* values are complete, the gauge prompts you to enter the source rod position where you want to enter the calibration constants. The default value will be backscatter, which is where you will want to begin anyway. When **Depth: BACKSCAT.** is displayed on the first line of the gauge display, press ⟨**START/ENTER**⟩.

9. The gauge now prompts the user to enter the *A* value for the current depth. This value can be found in the *Density Performance Parameter* section of the calibration printout. Press either the up or down arrow to highlight the most significant digit. Once this digit is highlighted (it will blink on and off), use the up and down arrows to get to the correct value, then press ⟨**START/ENTER**⟩ to save this value and move to the next digit down. Repeat the process of selecting the digit with the arrows and saving it with the ⟨**START/ENTER**⟩ key until all digits for *A* are filled in.

10. The gauge now prompts the user to enter the *B* value for the current depth. This value can be found in the *Density Performance Parameter* section of the calibration printout, under the *B*1000* column. This value must be entered **exactly** as it is printed in *calsheet.txt*. Press either the up or down arrow to highlight the most significant digit. Once this digit is highlighted (it will blink on and off), use the up and down arrows to get to the correct value, then press ⟨**START/ENTER**⟩ to save this value and move to the next digit down. Repeat the process of selecting the digit with the arrows and saving it with the ⟨**START/ENTER**⟩ key until all digits for *B* are filled in.

11. The gauge now prompts the user to enter the *C* value for the current depth. Unlike *A* and *B,* which are both always positive, *C* can be either positive or negative, depending on the index rod position. Therefore, for the first keystroke:

    - Press the up arrow if you wish for the sign of *C* to be positive
    - Press the down arrow if you wish for the sign of *C* to be negative

    At this point the most significant digit will be highlighted. Once this digit is highlighted (it will blink on and off), use the up and down arrows to get to the correct value, then press ⟨**START/ENTER**⟩ to save this value and move to the next digit down. Repeat the process of selecting the digit with the arrows and saving it with the ⟨**START/ENTER**⟩ key until all digits for *C* are filled in.

12. Once the entry of *C* is completed, the screen will display **Calib. Constants finished ?** If all of the calibration constants for all of the depths have been completed, then press the ⟨**ON/YES**⟩ key and proceed to step 15. Otherwise, press the ⟨**OFF/NO**⟩ key and proceed to step 13.

13. The gauge now prompts the user to enter the source rod position where you want to enter the calibration constants. Use the up and down arrows to select the next source rod depth, then press ⟨**START/ENTER**⟩ when this depth is highlighted.

14. Once the next depth has been selected, return to step 9.

15. The calibration constants are now in the gauge memory. Proceed to the *Performing Quality Assurance Testing* instructions on page 2–31.

MODEL 3440

For the Model 3440 gauge, the calibration constants can be entered into the gauge by typing them into the scaler. There is no need to use tables or to burn an EEPROM. However, in order to type in the calibration constants, you must first obtain a listing of them.

1. Open the file *C:\cal\bas\calsheet.txt*. The first page of this document contains the density calibration constants under the section labeled *Density Performance Parameters* and the moisture calibration constants under the section labeled *Moisture Performance Parameters*. Since the ⟨**Yes**⟩ button was clicked when the **Metric Calibration?** message box was displayed (see steps 3 and 4 on page 2–14, this document lists the *B*1000* values and the *F*1000* value in metric units (cubic meters per kilograms.)

2. Print the file *C:\cal\bas\calsheet.txt*. You will probably have to change the formatting of the text in order to obtain a legible printout.

3. Once the printout is complete, go the gauge and press the ⟨**SHIFT**⟩ and ⟨**SPECIAL**⟩ keys to access the gauge's *Special Functions.*

4. Press ⟨**1**⟩, then ⟨**9**⟩ on the gauge keypad to access the gauge's *Extended Functions*. The gauge prompts the user to enter a code.

5. Enter the code ***4688*** and press ⟨**START/ENTER**⟩. The *Extended Functions* menu is displayed.

6. Press the ⟨**5**⟩ key on the gauge scaler to enter the calibration constants. The gauge again prompts for a code.

7. This time, enter the code ***5936*** and press ⟨**START/ENTER**⟩. The first screen of the calibration constants entry routine is displayed.

8. The gauge prompts you to enter the sign of the calibration constant *E*. E is a moisture performance parameter and will be found under that section in the *calsheet.txt* printout. Since *E* is always positive, press the ⟨**1**⟩ key. The screen for entering the value of *E* is now displayed. The cursor will be located at the most significant digit and the digit will be flashing. Using the numeric keypad, enter the digits for the *E* value. Once all of the digits are entered, press ⟨**START/ENTER**⟩ to save this value.

9. The gauge prompts you to enter the sign of the calibration constant *F*. The *F* value is listed on the *calsheet.txt* printout in the *Moisture Performance Parameter* section, under the heading *F*1000*. This value must be entered into the gauge **exactly** as it is printed in *calsheet.txt*. Since *F* is always positive, press the ⟨**1**⟩ key. The screen for entering the value of *F* is now displayed. The cursor will be located at the most significant digit and the digit will be flashing. Using the numeric keypad, enter the digits for the *E* value. Once all of the digits are entered, press ⟨**START/ENTER**⟩ to save this value.

10. Once the *E* and *F* values are complete, the gauge prompts you to enter the source rod position where you want to enter the calibration constants. Press ⟨**0**⟩ for *0* inches (backscatter), then press ⟨**START/ENTER**⟩.

11. The gauge prompts you to enter the sign of the *A* value for the current depth. This value is listed in the *Density Performance Parameter* section of the calibration printout. Since *A* is always positive, press the ⟨**1**⟩ key. The cursor will be located at the most significant digit and the digit will be flashing. Using the numeric keypad, enter the digits for the *A* value. Once all of the digits are entered, press ⟨**START/ENTER**⟩ to save this value for *A*.

12. The gauge prompts you to enter the sign of the *B* value for the current depth. This value is listed in the *Density Performance Parameter* section of the calibration printout, under the *B*1000* column. This value must be entered **exactly** as it is printed in *calsheet.txt.* Since *B* is always positive, press the ⟨**1**⟩ key. The cursor will be located at the most significant digit and the digit will be flashing. Using the numeric keypad, enter the digits for the *B* value. Once all of the digits are entered, press ⟨**START/ENTER**⟩ to save this value for *B*.

13. The gauge prompts you to enter the sign of the *C* value for the current depth. This value is listed in the *Density Performance Parameter* section of the calibration printout. Since *C* can be either positive or negative depending on the index rod depth, press the ⟨**1**⟩ key if *C* is positive or the ⟨**2**⟩ key if *C* is negative. The cursor will be located at the most significant digit and the digit will be flashing. Using the numeric keypad, enter the digits for the *C* value. Once all of the digits are entered, press ⟨**START/ENTER**⟩ to save this value for *C*.

14. The gauge prompts you to enter the source rod position where you want to enter the calibration constants. If all of the calibration constants for all of the depths have been entered, then proceed to step 16. Otherwise, if there are calibration constants to be entered at other depths, proceed to step 15.

15. On the keypad, enter the depth where the next set of calibration constants will be entered. Press the ⟨**START/ENTER**⟩ key and return to step 11.

16. Once the calibration constants for all the depths have been entered, you need to break out of the calibration data entry loop in the gauge. To do so, simply press ⟨**START/ENTER**⟩ without entering a depth value.

17. Now that the calibration constants have been entered into the gauge, the date on which the calibration was performed must be entered. From the *Ready* mode, press the ⟨**SHIFT**⟩ and ⟨**SPECIAL**⟩ keys to access the gauge's *Special Functions.*

18. Press ⟨**1**⟩, then ⟨**9**⟩ on the gauge keypad to access the gauge's *Extended Functions*. The gauge prompts the user to enter a code.

19. Enter the code ***4688*** and press ⟨**START/ENTER**⟩. The *Extended Functions* menu is displayed.

20. Press the ⟨**4**⟩ key. The gauge prompts you to enter the date of calibration.

21. Using the keypad, enter the date when the calibration was performed in *mm/dd/yyyy* format. Press ⟨**START/ENTER**⟩ to save the date.

22. Press the ⟨**NO/CE**⟩ key to exit the *Extended Functions* menu.

23. The calibration constants and calibration date are now in the gauge memory. Proceed to the *Performing Quality Assurance Testing* instructions on page 2–31.

PERFORMING QUALITY ASSURANCE TESTING

A Troxler surface moisture-density gauge has not finished its calibration process until it has passed quality assurance testing. Quality assurance testing is a way to confirm that the gauge will read to within 16 kg/m^3 (1 pcf) of the assigned block density at each index rod depth, and that the gauge will read to within 16 kg/m^3 (1 pcf) of the assigned moisture content value for the mag/poly block. These requirements are specified in ASTM D6938.

When a gauge goes through the quality assurance testing process the first time after a calibration has been completed, it may fail to meet the ±16 kg/m^3 (1 pcf) accuracy requirement at one or more index rod positions, or at moisture. If this is the case, then recounts will be required at this depth or depths, as well as the re-calculation of the calibration constants at that particular depth (or moisture.) The gauge must then go through the quality assurance testing for that depth or depths again – but **not** for the depths that have already passed the quality assurance testing.

Once all index rod positions and moisture have passed the quality assurance testing, the gauge calibration is complete, and the calibration is ready for reporting and archival.

The quality assurance testing requires that:

- The gauge be set to specific measurement times,
- Measurements be taken on different calibration blocks at different index rod positions, and
- When the measurement has concluded, the count values and density (or moisture) values be read from the gauge.

The manner in which these tasks are accomplished for the different gauge models is described in detail in the *Collecting Calibration Data* section that begins on page 2–3, and will not be repeated in this section. If further information is needed on these tasks, refer to the *Collecting Calibration Data* or contact your Troxler representative.

1. If this is the first time for this particular calibration that the gauge has reached the quality assurance testing phase, then the *Standard Count Test* must be conducted: proceed to step 2. Otherwise, if the quality assurance testing phase has already been performed once and recounts are currently being tested, proceed to step 17 on page 2–33.

2. Print a copy of the *Calibration Quality Assurance Accuracy Check Form* on page 2–49. Fill in the *Model Number*, *Serial Number*, *Bay Number*, *Date*, and *Technician Name* in the form.

3. Refer to the *Calibration Data Recording Form* that was filled out in the *Collecting Calibration Data* section 1 during the accumulation of the calibration data. In *Part 6* of the *Calibration Data Recording Form*, the *Final Density Standard Count Value* is recorded. Copy this value to the *Calibration Quality Assurance Accuracy Check Form*. The place where the value will be copied is in the *Standard Count Test* section, on the row labeled *Calibration STD Count*, beside the heading *(1) DS:*.

4. Again refer to the *Calibration Data Recording Form*. In *Part 6* of the form, the *Final Moisture Standard Count Value* is recorded. Copy this value to the *Calibration Quality Assurance Accuracy Check Form*. The place where the value will be copied is in the *Standard Count Test* section, on the row labeled *Calibration STD Count*, beside the heading *(2) MS:*.

5. If the gauge being calibrated is a Model 3440, then the standard counts that are stored in the gauge memory need to be erased; proceed to step 6. Otherwise, if the gauge is a 3430, 3411-B, or 3401-B, no such erasure is required; proceed to step 7.

6. Erase the existing standard counts in the gauge. Refer to the Model 3440 *Manual of Operation and Instruction* for instructions on erasing the standard counts. This function is an *Extended Function* and requires the access code **4688**.

7. Place the polyethylene standard block for the gauge either (a) in the center of the mag/aluminum calibration block for the calibration bay, (b) if there is no mag/aluminum calibration block, in the center of the aluminum calibration block, or (c) on the floor or ground, with no objects or walls within 1 meter (3 feet) of the block.

8. Place the gauge on the polyethylene standard block with the source rod in the **SAFE** position.

9. Take a *standard count* with the gauge. For a Model 3430 or 3440 gauge, refer to the gauge's *Manual of Operation and Instruction* for instructions on taking a standard count. For a Model 3401-B or 3411 gauge, refer to the gauge's *Manual of Operation and Instruction*, if available, or see page 2–50.

10. Record the *density standard count* acquired in step 9 on the *Calibration Quality Assurance Accuracy Check Form*. This value would be recorded in the *Standard Count Test* section, on the row labeled *Take a 4 min STD Count*, beside the heading *(3) DS:*.

11. Record the *moisture standard count* acquired in step 9 on the *Calibration Quality Assurance Accuracy Check Form*. This value would be recorded in the *Standard Count Test* section, on the row labeled *Take a 4 min STD Count*, beside the heading *(4) MS:*.

12. Using the formula given on the *Calibration Quality Assurance Accuracy Check Form* in the *Standard Count Test* section, compute the *DS % Difference value*. This is the percent difference between the density standard count taken in step 9 and the density standard count used to compute the calibration constants.

13. Using the formula given on the Calibration Quality Assurance Accuracy Check Form in the "Standard Count Test" section, compute the *MS % Difference value*. This is the percent difference between the moisture standard count taken in step 9 and the moisture standard count used to compute the calibration constants.

14. If the *DS % Difference* value just calculated exceeds ±1%, or if the *MS % Difference* value just calculated exceeds ±2%, then a recount is required; proceed to step 15. Otherwise, if both *% Difference* values are within the specified limits, then no recount is necessary; proceed to step 17.

15. Repeat steps 9 through 13 to formulate a second *MS % Difference* value and a second *DS % Difference* value.

16. If neither of the two *MS % Difference* values that have been computed are within the ±2% limits, **or** neither of the two *DS % Difference* values are within the ±1% limits, then this gauge may have been unstable during the calibration process. Check the gauge for mechanical or electrical problems, and repeat the calibration process ***in its entirety***. Otherwise, if at least one of the *MS % Difference* values is within the ±2% limits, **and** at least one of the *DS % Difference* values is within the ±1% limits, then this gauge has passed the *Standard Count Test*; proceed to step 17.

17. Take the gauge to the magnesium calibration block. Do one of the following, depending on the particular situation at hand:

    - If this it the first time that the gauge has gone through the quality assurance testing for this particular calibration, then put the gauge in the measurement position for the first index rod depth that has not yet been checked for density accuracy.
    - If this **is not** the first time that the gauge has gone through the quality assurance testing for this particular calibration, then put the gauge in the measurement position for the first index rod depth that failed to pass the density accuracy test.
    - If this **is not** the first time that the gauge has gone through the quality assurance testing for this particular calibration, but there are no density recounts required, then skip this step and proceed to step 67 on page 2–36 to repeat the moisture quality assurance testing.

18. If the gauge is in either backscatter or 12-inch position, then set the gauge measurement time to 1 minute. Otherwise, set the gauge measurement time to 15 seconds.

19. Take a measurement with the gauge for the time indicated in step 18.

20. Go to the *Density Quality Test* section of the *Calibration Quality Assurance Accuracy Check Form*, to the table labeled * *Mg* *. Refer to the row corresponding to the index rod position where the count in step 19 was taken. Record the ***density count*** in this row, under the column marked *CNT*.

21. If the gauge is a Model 3411-B, 3430, or 3440, then proceed to step 26. Otherwise, if the gauge is a Model 3401-B, proceed to step 22.

22. Divide the density count acquired in step 19 by the density standard count listed on the *Calibration Quality Assurance Accuracy Check Form* beside the heading *(3) DS:*. The resulting quotient is the *Density Count Ratio*.

23. Now, refer to the calibration tables that were printed in the *Entering Calibration Constants into the Gauge* section that begins on page 2–22. There will be a page in these tables for the index rod position that the gauge is currently in. Find this page and use it in the next two steps.

24. In the tables, look in the columns labeled *Cr*. Find the value for *Cr* in these columns that is closest to the *Density Count Ratio* value in step 22.

25. Look to the right of the *Cr* value that you identified in step 24. There will be a density value, in kilograms per cubic meter, listed beside the *Cr* value. **This density value is the wet density that was just measured by the gauge**.

26. Go to the *Density Quality Test* section of the *Calibration Quality Assurance Accuracy Check Form*, to the table labeled * *Mg* *. Refer to the row corresponding to the index rod position where the count in step 19 was taken. Record the ***wet density value*** measured by the gauge in this row, under the ***first*** column marked *DENS*.

27. The magnesium block has a density value assigned to it. This value is printed in the file *C:\cal\bas\calsheet.txt*, in the *Density calibration count data* section, directly under the *Magnes* column heading. This density value is in kilograms per cubic meter. Multiply this value by *0.988* to obtain the *magnesium soil equivalent density value* for this block.

28. Compare the wet density value from step 26 to the magnesium soil equivalent density value computed in step 27. If these values differ by less than 16 kilograms per cubic meter (1 pcf), then there is no need for a recount; proceed to step 40. If, however, the values differ by more than 16 kilograms per cubic meter (1 pcf), a recount is required; proceed to step 29.

29. If the index rod is in backscatter or 12-inch position, then set the measurement time to 4 minutes. If the index rod is in any other position, then set the measurement time to 1 minute.

30. Take a measurement with the gauge for the time indicated in step 29.

31. Go to the *Density Quality Test* section of the *Calibration Quality Assurance Accuracy Check Form*, to the table labeled * *Mg* *. Refer to the row corresponding to the index rod position where the count in step 30 was taken. Record the ***density count*** in this row, under the column marked *RC*.

32. If the gauge is a Model 3411-B, 3430, or 3440, then proceed to step 37. Otherwise, if the gauge is a Model 3401-B, proceed to step 33.

33. Divide the density count acquired in step 30 by the density standard count listed on the *Calibration Quality Assurance Accuracy Check Form* beside the heading *(3) DS:*. The resulting quotient is the *Density Count Ratio*.

34. Now, refer to the calibration tables that were printed in the *Entering Calibration Constants into the Gauge* section that begins on page 2–22. There will be a page in these tables for the index rod position that the gauge is currently in. Find this page and use it in the next two steps.

35. In the tables, look in the columns labeled *Cr*. Find the value for *Cr* in these columns that is closest to the *Density Count Ratio* value in step 33.

36. Look to the right of the *Cr* value that you identified in step 35. There will be a density value, in kilograms per cubic meter, listed beside the *Cr* value. **This density value is the wet density that was just measured by the gauge**.

37. Go to the *Density Quality Test* section of the *Calibration Quality Assurance Accuracy Check Form*, to the table labeled * *Mg* *. Refer to the row corresponding to the index rod position where the count in step 30 was taken. Record the ***wet density value*** measured by the gauge in this row, under the ***second*** column marked *DENS*.

38. The magnesium block has a density value assigned to it. This value is printed in the file *C:\cal\bas\calsheet.txt*, in the *Density calibration count data* section, directly under the *Magnes* column heading. This density value is in kilograms per cubic meter. Multiply this value by *0.988* to obtain the *magnesium soil equivalent density value* for this block.

39. Compare the wet density value from step 37 to the magnesium soil equivalent density value computed in step 38. If these values differ by less than 16 kilograms per cubic meter (1 pcf), then there is no need for a recount. If, however, the values differ by more than 16 kilograms per cubic meter (1 pcf), then this depth must be recalibrated. **Make note of the fact that this depth must be recalibrated.** However, if this depth has been recalibrated more than twice and still will not pass the quality assurance test, then the gauge must be checked for electrical or mechanical problems, and the calibration must be terminated and repeated in its entirety after the repairs are completed.

40. If QA counts are required for other depths in the magnesium block, then return to step 17 on page 2–33 to take and evaluate them. Otherwise, it is time to measure the aluminum block; proceed to step 41.

41. Move the gauge to the aluminum block.

42. Place the gauge in the first available index rod position that meets both of the following criteria:

    - The index rod position has not yet passed the quality assurance accuracy test for **both** magnesium and aluminum for the current calibration, and
    - The most recent quality assurance counts made for this calibration at this depth on the magnesium block **did not** reveal that a recalibration is necessary at this depth.

43. If the gauge is in either backscatter or 12-inch position, then set the gauge measurement time to 1 minute. Otherwise, set the gauge measurement time to 15 seconds.

44. Take a measurement with the gauge for the time indicated in step 43.

45. Go to the *Density Quality Test* section of the *Calibration Quality Assurance Accuracy Check Form*, to the table labeled * *Al* *. Refer to the row corresponding to the index rod position where the count in step 44 was taken. Record the **density count** in this row, under the column marked *CNT*.

46. If the gauge is a Model 3411-B, 3430, or 3440, then proceed to step 51. Otherwise, if the gauge is a Model 3401-B, proceed to step 47.

47. Divide the density count acquired in step 44 by the density standard count listed on the *Calibration Quality Assurance Accuracy Check Form* beside the heading *(3) DS:*. The resulting quotient is the *Density Count Ratio*.

48. Now, refer to the calibration tables that were printed in the *Entering Calibration Constants into the Gauge* section that begins on page 2–22. There will be a page in these tables for the index rod position that the gauge is currently in. Find this page and use it in the next two steps.

49. In the tables, look in the columns labeled *Cr*. Find the value for *Cr* in these columns that is closest to the *Density Count Ratio* value in step 47.

50. Look to the right of the *Cr* value that you identified in step 49. There will be a density value, in kilograms per cubic meter, listed beside the Cr value. **This density value is the wet density that was just measured by the gauge**.

51. Go to the *Density Quality Test* section of the *Calibration Quality Assurance Accuracy Check Form*, to the table labeled * *Al* *. Refer to the row corresponding to the index rod position where the count in step 44 was taken. Record the **wet density value** measured by the gauge in this row, under the **first** column marked *DENS*.

52. The aluminum block has a density value assigned to it. This value is printed in the file *C:\cal\bas\calsheet.txt*, in the *Density calibration count data* section, directly under the *Alumin* column heading. This density value is in kilograms per cubic meter. Multiply this value by 0.964 to obtain the *aluminum soil equivalent density value* for this block.

53. Compare the wet density value from step 26 to the aluminum soil equivalent density value computed in step 52. If these values differ by less than 16 kilograms per cubic meter (1 pcf), then there is no need for a recount; proceed to step 65. If, however, the values differ by more than 16 kilograms per cubic meter (1 pcf), a recount is required; proceed to step 54.

54. If the index rod is in backscatter or 12-inch position, then set the measurement time to 4 minutes. If the index rod is in any other position, then set the measurement time to 1 minute.

55. Take a measurement with the gauge for the time indicated in step 54.

56. Go to the *Density Quality Test* section of the *Calibration Quality Assurance Accuracy Check Form*, to the table labeled * *Al* *. Refer to the row corresponding to the index rod position where the count in step 55 was taken. Record the **density count** in this row, under the column marked *RC*.

57. If the gauge is a Model 3411-B, 3430, or 3440, then proceed to step 62. Otherwise, if the gauge is a Model 3401-B, proceed to step 58.

58. Divide the density count acquired in step 55 by the density standard count listed on the *Calibration Quality Assurance Accuracy Check Form* beside the heading *(3) DS:*. The resulting quotient is the *Density Count Ratio*.

59. Now, refer to the calibration tables that were printed in the *Entering Calibration Constants into the Gauge* section that begins on page 2–22. There will be a page in these tables for the index rod position that the gauge is currently in. Find this page and use it in the next two steps.

60. In the tables, look in the columns labeled *Cr*. Find the value for *Cr* in these columns that is closest to the *Density Count Ratio* value in step 58.

61. Look to the right of the *Cr* value that you identified in step 60. There will be a density value, in kilograms per cubic meter, listed beside the *Cr* value. **This density value is the wet density that was just measured by the gauge**.

62. Go to the *Density Quality Test* section of the *Calibration Quality Assurance Accuracy Check Form*, to the table labeled * *Al* *. Refer to the row corresponding to the index rod position where the count in step 55 was taken. Record the **wet density value** measured by the gauge in this row, under the **first** column marked *DENS*.

63. The aluminum block has a density value assigned to it. This value is printed in the file *C:\cal\bas\calsheet.txt*, in the *Density calibration count data* section, directly under the *Alumin* column heading. This density value is in kilograms per cubic meter. Multiply this value by 0.964 to obtain the *aluminum soil equivalent density value* for this block.

64. Compare the wet density value from step 62 to the aluminum soil equivalent density value computed in step 63. If these values differ by less than 16 kilograms per cubic meter (1 pcf), then there is no need for a recount. If, however, the values differ by more than 16 kilograms per cubic meter (1 pcf), then this depth must be recalibrated. **Make note of the fact that this depth must be recalibrated.** However, if this depth has been recalibrated more than twice and still will not pass the quality assurance test, then the gauge must be checked for electrical or mechanical problems, and the calibration must be terminated and repeated in its entirety after the repairs are completed.

65. If QA counts are required for other depths in the aluminum block, then return to step 42 to take and evaluate them. Otherwise, it is time to measure the moisture block; proceed to step 66.

66. If you performed a moisture calibration on this gauge, and the moisture system has yet to pass the quality assurance testing, then proceed to step 67. Otherwise, proceed to step 89.

67. Set the gauge count time to 1 minute.

68. Place the gauge on the mag/poly calibration block with the source rod in the **SAFE** position.

69. Take a measurement with the gauge for the time indicated in step 67.

70. Go to the *Moisture Quality Test* section in the *Calibration Quality Assurance Accuracy Check Form*, to the heading labeled *Moisture count*. On the line beneath this heading, record the **moisture count.**

71. If the gauge is a Model 3411-B, 3430, or 3440, then proceed to step 76. Otherwise, if the gauge is a Model 3401-B, proceed to step 72.

72. Divide the moisture count acquired in step 69 by the moisture standard count listed on the *Calibration Quality Assurance Accuracy Check Form* beside the heading *(4) MS:*. The resulting quotient is the *Moisture Count Ratio*.

73. Now, refer to the calibration tables that were printed in the *Entering Calibration Constants into the Gauge* section that begins on page 2–22. There will be a page in these tables for the moisture calibration. Find this page and use it in the next two steps.

74. In the tables, look in the columns labeled *Cr*. Find the value for *Cr* in these columns that is closest to the *Moisture Count Ratio* value in step 72.

75. Look to the right of the *Cr* value that you identified in step 74. There will be a moisture content value, in kilograms per cubic meter, listed beside the *Cr* value. **This moisture content value is the moisture content that was just measured by the gauge**.

76. Go to the *Moisture Quality Test* section in the *Calibration Quality Assurance Accuracy Check Form*, to the heading labeled *Gauge Moisture Content*. Record the **moisture content value** measured by the gauge on the line beneath the *Gauge Moisture Content* heading.

77. The mag/poly block has a density value assigned to it. This value is printed in the file *C:\cal\bas\calsheet.txt*, in the *Moisture calibration count data* section, directly under the *Mag/poly* column heading. This moisture content value is in kilograms per cubic meter. If you have not already done so, record this moisture content value on the *Calibration Quality Assurance Accuracy Check Form*, under the *Moisture Quality Test* section, on the line beneath the heading *Block Value*.

78. Compare the moisture content value from step 76 to the moisture content value listed on the *Calibration Quality Assurance Accuracy Check Form*, under the *Moisture Quality Test* section, on the line beneath the heading *Block Value*. If these values differ by less than 16 kilograms per cubic meter (1 pcf), then there is no need for a recount; proceed to step 89. If, however, the values differ by more than 16 kilograms per cubic meter (1 pcf), a recount is required; proceed to step 79.

79. Set the measurement time to 4 minutes.

80. Take a measurement with the gauge for the time indicated in step 79.

81. Go to the *Moisture Quality Test* section in the *Calibration Quality Assurance Accuracy Check Form*, to the heading labeled *Moisture count*. On the line beneath this heading, record the **moisture count.**

82. If the gauge is a Model 3411-B, 3430, or 3440, then proceed to step 87. Otherwise, if the gauge is a Model 3401-B, proceed to step 83.

83. Divide the moisture count acquired in step 80 by the moisture standard count listed on the *Calibration Quality Assurance Accuracy Check Form* beside the heading *(4) MS:*. The resulting quotient is the *Moisture Count Ratio*.

84. Now, refer to the calibration tables that were printed in the *Entering Calibration Constants into the Gauge* section that begins on page 2–22. There will be a page in these tables for the moisture calibration. Find this page and use it in the next two steps.

85. In the tables, look in the columns labeled *Cr*. Find the value for *Cr* in these columns that is closest to the *Moisture Count Ratio* value in step 83.

86. Look to the right of the *Cr* value that you identified in step 85. There will be a moisture content value, in kilograms per cubic meter, listed beside the *Cr* value. **This moisture content value is the moisture content that was just measured by the gauge**.

87. Go to the *Moisture Quality Test* section in the *Calibration Quality Assurance Accuracy Check Form*, to the heading labeled *Gauge Moisture Content*. Record the **moisture content value** measured by the gauge on the line beneath the *Gauge Moisture Content* heading.

88. Compare the moisture content value from step 87 to the moisture content value listed on the *Calibration Quality Assurance Accuracy Check Form*, under the *Moisture Quality Test* section, on the line beneath the heading *Block Value*. If these values differ by less than 16 kilograms per cubic meter (1 pcf), then there is no need for a recount; proceed to step 89. If, however, the values differ by more than 16 kilograms per cubic meter (1 pcf), then a recalibration of the moisture system is required; **make note of the fact that this system must be recalibrated.** However, if the moisture system has been recalibrated more than twice and still will not pass the quality assurance test, then the gauge must be checked for electrical or mechanical problems, and the calibration must be terminated and repeated in its entirety after the repairs are completed.

89. If his point has been reached and none of the index rod positions have to be recalibrated **and** the moisture system does not have to be recalibrated, then the quality assurance testing is complete; proceed to the *Archiving and Reporting the Completed Calibration* section on page 2–39. However, if any of the depths have to be recalibrated, or the moisture system has to be recalibrated, then proceed to step 90.

90. If any depths must be recalibrated, then there is a *density inconsistency* at that depth. Make note of all index rod positions that have density inconsistencies; they will all need to be recalibrated. Likewise, if the moisture system has to be recalibrated, then the calibration has a *moisture inconsistency*. Make note of the fact that the current calibration has a moisture inconsistency; the moisture system will have to be recalibrated.

91. Return to step 2 of the *Addressing Calibration Inconsistencies* instructions that begin on page 2–18 and proceed from there.

ARCHIVING AND REPORTING THE COMPLETED CALIBRATION

Once the quality assurance testing is complete, the gauge calibration process is essentially complete, and the gauge is ready to use. However, for archival and record keeping purposes, the gauge calibration information must be archived in a machine-readable database file, and a calibration report must be printed.

1. From the **Function Menu** of the TCS program (see Figure 2–6 on page 2–10), click the ⟨**Store/Print Calibration**⟩ button. The **Archive Reprint Confirmation Prompt** (see Figure 2–25) is displayed.

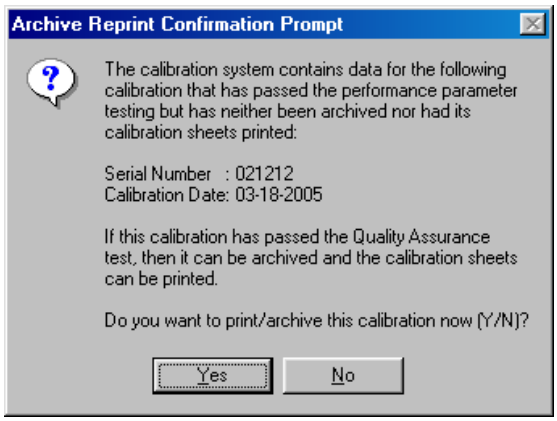


Figure 2–25. Archive Reprint Confirmation Prompt

2. Click the ⟨**Yes**⟩ button. The software prompts for a user ID. Enter the 2- or 3-letter initials of the person who performed the calibration and click the ⟨**Continue**⟩ button.

3. The calibration data is then archived to the calibration database file on the computer, and a calibration report is printed to the Windows default printer. If the calibration is for a Model 3401-B gauge, the tables are also printed. All values in the calibration report and the tables are metric. If you require that the calibration report be printed in English (imperial) units of pounds per cubic foot, proceed to step 4. **Otherwise, the calibration process is complete**.

4. At this point the **Function Menu** is displayed. To obtain a calibration report and/or tables printed in English (imperial) units of pounds per cubic foot, click the ⟨**Special Menu**⟩ button to access the **Special Function Menu** (see Figure 2–7 on page 2–10).

5. From the **Special Function Menu**, click the ⟨**Print an Old Calibration**⟩ button. The software prompts for the gauge serial number.

6. Enter the serial number of the gauge just calibrated, then click the ⟨**OK**⟩ button. The **Calibration Selection Screen** (see Figure 2–26) is displayed.

7. There may be more than one calibration listed on the **Calibration Selection Screen** for the selected gauge serial number. Select the index number corresponding to the calibration just performed, and enter that number into the text box at the lower right side of the **Calibration Selection Screen**. Once the index number is entered, click the ⟨**OK**⟩ button.

8. At this point, a message box that asks **Metric Calibration?** is displayed. Since an English (imperial) printout is needed, click the ⟨**No**⟩ button.

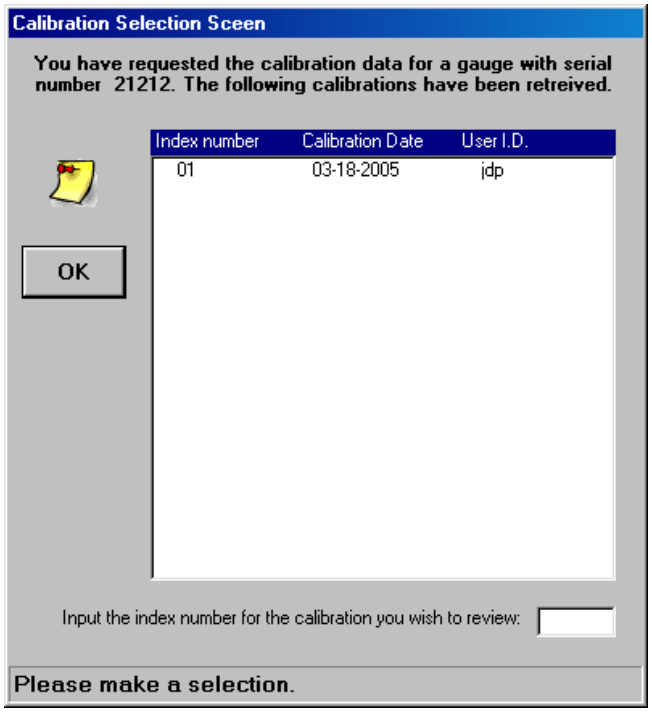


Figure 2–26. Calibration Selection Screen

9. After the ⟨**No**⟩ button is clicked in the previous step, The software then displays a message box that asks **Print tables?**

   - If the gauge being calibrated is a Model 3401-B, click ⟨**Yes**⟩, since the tables are essential in the computation of density and moisture values.
   - If the gauge is not a Model 3401, then tables are not needed. Click either ⟨**Yes**⟩ or ⟨**No**⟩, depending on whether or not you wish to print tables.

10. The software then displays a message box that asks **Change Normalization Factor?** Click ⟨**No**⟩ unless you are performing a specialized, non-standard calibration.

11. The **User Entered Results Screen** (see Figure 2–12 on page 2–15) is displayed, summarizing the decisions that were made in the last few steps. Click the ⟨**Yes**⟩ button.

12. The calibration report (and the tables, if requested) will be printed on the Windows default printer, and the program will return to the **Special Functions Menu**. **The calibration process is complete**.

After the gauge has been on for 15 to 20 minutes, take a series of 20 consecutive 1-minute moisture and density counts and record the results of each. An example is shown in the table below:

Test Number	Moisture Standard Count	Density Standard Count	Test Number	Moisture Standard Count	Density Standard Count
1	526	2400	11	522	2402
2	521	2379	12	526	2390
3	509	2379	13	527	2391
4	523	2410	14	533	2393
5	516	2412	15	524	2371
6	217	2388	16	525	2401
7	521	2376	17	515	2402
8	522	2387	18	516	2375
9	527	2410	19	533	2395
10	525	2394	20	516	2407

Once the data is collected, the sample mean value and sample standard deviation of the 20 density counts and 20 moisture counts must be calculated. These values can be computed using a spreadsheet program like Microsoft Excel® or using a calculator with statistical computation capabilities. If these resources are unavailable, the sample mean value is computed using the formula:

$$\textit{Equation 2–1.} \quad m = \frac{\sum_{i=1}^{n} x_i}{n}$$

where m is the sample mean value, n is the number of data points in the sample (in this case, $n = 20$), and x_i is the value of the ith observation in the sample (where each "observation" in this instance is an individual count). The sample standard deviation is computed using the formula:

$$\textit{Equation 2–2.} \quad s = \sqrt{\frac{\sum_{i=1}^{n} (x_i - m)^2}{n-1}}$$

where s is the sample standard deviation and x_i, n, and m retain the same definitions that they had in Equation 2–1.

For this particular example, the sample mean for the moisture counts is *522.7* with a sample standard deviation of *6.0*. The sample mean for the density counts is *2393.1* with a sample standard deviation of *12.5*.

The statistical stability test (*stat test*) is evaluated in terms of both the sample standard deviation and the sample mean value. The quantity that is evaluated is defined as the *Ratio*. The Ratio, denoted by *R*, is defined as:

$$\textit{Equation 2–3.} \quad R = \frac{s}{\sqrt{m}}$$

where *s* and *m* are defined as in Equation 2–1 and Equation 2–2, respectively.

For a given stat test, the ideal value for the Ratio would be *0.25*. However, the range of acceptable *R* values is between *0.18* and *0.35*. The stat test passes if the Ratio value lies between *0.18* and *0.35* for **both** the moisture counts and the density counts.

For this particular example, the Ratio value for the density system is *0.26*, and the Ratio value for the moisture system is also *0.26*. Since *0.26* lies between *0.18* and *0.35*, both systems pass the stat test, so the gauge passes the stat test.

DRIFT TEST INSTRUCTIONS FOR MODELS 3401-B AND MODEL 3411-B

The stat test is a good indicator of short-term gauge instability. To test for the possibility of long-term gauge instability, one conducts a *drift test*. After 3 to 8 hours have elapsed since the most recent stat test, and without moving the gauge or any part of the gauge after the stat test has concluded, take a series of five consecutive 4-minute (SLOW) moisture and density counts and record the results of each. An example of drift test data is shown in the table below:

Test Number	Moisture Standard Count	Density Standard Count
1	520	2392
2	522	2390
3	522	2397
4	520	2384
5	518	2393

Once the data is collected, the sample mean value of the five density counts and the five moisture counts must be calculated. These values can be computed using a spreadsheet program like Microsoft Excel® or using a calculator with statistical computation capabilities. If these resources are unavailable, the sample mean value is computed using Equation 2–1, where this time $n = 5$.

For this particular example, the sample mean for the moisture counts is *520.4*, and the sample mean for the density counts is *2391.2*.

The drift test is evaluated in terms of both the sample mean value of the most recent stat test and the sample mean value of the drift test. The quantity that is evaluated is defined as the *Drift*. The Drift, denoted by *D*, is defined as:

$$\textit{Equation 2–4.} \quad D = 200 \times \frac{\left| m_{Stat} - m_{Drift} \right|}{m_{Stat} + m_{Drift}}$$

where m_{Stat} is the sample mean value observed for the stat test and m_{Drift} is the sample mean value observed for the drift test. The vertical lines in the numerator indicate that the *absolute value* of the difference should be used in the evaluation of *D*. Drift is denoted as a percent value.

For a given drift test, the density Drift should be less than *0.5%*, and the moisture Drift should be less than *1%*. The drift test passes if the Drift value is less than *0.5%* for density **and** if the Drift value is less than *1%* for moisture.

For this particular example, the Drift value for the density system is *0.08%*, and the Drift value for the moisture system is *0.44%*. Since *0.44%* is less than *1%* for moisture, and *0.08%* is less than *0.5%* for density, the drift test passes.

CALIBRATION DATA RECORDING FORM

Part 1: General Calibration Information

Gauge Model Number: _____ Gauge Serial Number: _____

Calibration Date: _____ Technician Name: _____

Calibration Bay Number: _____

Part 2: Initial Stability Test (Stat Test)

Density Average Count: _____ Density R Value: _____

Moisture Average Count: _____ Moisture R Value: _____

Part 3: Measurements on Calibration Blocks (All Counts 4 Minutes in Duration)

Source Rod Position (in)	Magnesium Block Density Count	Mag/Aluminum Block Density Count	Aluminum Block Density Count	Magnesium Block Moisture Count
Backscatter Count #1				
2”				
3”				
4”				
5”				
6”				
7”				
8”				
9”				
10”				
11”				
12”				
Backscatter Count #2				

Mag/Poly Moisture Count: _____ Mag/Poly SR Count: _____

CALIBRATION DATA RECORDING FORM (Continued)

Part 4: Long Term Stability Test (Drift Test)

Density Average Count: _____ Density Drift (%): _____

Moisture Average Count: _____ Moisture Drift (%): _____

Part 5: Final Backscatter Count Calculation

From Part 3, add Backscatter Count #1 taken on the magnesium block and Backscatter Count #2 taken on the magnesium block. Divide the resulting sum by two, and record the results below, rounded off to the nearest whole number:

Average Magnesium Backscatter Count: _____

From Part 3, add Backscatter Count #1 taken on the mag/aluminum block and Backscatter Count #2 taken on the mag/aluminum block. Divide the resulting sum by two, and record the results below, rounded off to the nearest whole number:

Average Mag/aluminum Backscatter Count: _____

From Part 3, add Backscatter Count #1 taken on the aluminum block and Backscatter Count #2 taken on the aluminum block. Divide the resulting sum by two, and record the results below, rounded off to the nearest whole number:

Average Aluminum Backscatter Count: _____

Part 6: Final Density Standard Count and Moisture Standard Count

Add the Density Average Count from Part 2 (the Stat Test) to the Density Average Count from Part 4 (the Drift Test). Divide the resulting sum by two, and record the results below, rounded off to the nearest whole number:

Final Density Standard Count Value: _____

Add the Moisture Average Count from Part 2 (the Stat Test) to the Moisture Average Count from Part 4 (the Drift Test). Divide the resulting sum by two, and record the results below, rounded off to the nearest whole number:

Final Moisture Standard Count Value: _____

TAKING A READING WITH A MODEL 3401-B OR 3411-B GAUGE

MODEL 3401-B

Set the **PWR/TIME** switch to **SLOW** for a 4-minute count, **NORM** for a 1-minute count, or **FAST** for a 15-second count. Depress the ⟨**START**⟩ button. The **ERR** symbol will appear for the duration of the measurement. When the timing period expires, turn the **DISPLAY** switch to display the moisture count and density count.

MODEL 3411-B

Set the **PWR/TIME** switch to **SLOW** for a 4-minute count, **NORM** for a 1-minute count, or **FAST** for a 15-second count. Depress the ⟨**MEASURE**⟩ button. The **ERR** symbol will appear for the duration of the measurement. When the timing period expires, depress the ⟨**MC**⟩ and ⟨**DC**⟩ buttons to display the moisture count and density count, respectively.

CALIBRATION RECOUNT FORM

Part 1: General Calibration Information

Gauge Model Number: _____ Gauge Serial Number: _____

Calibration Date: _____ Technician Name: _____

Calibration Bay Number: _____

Part 2: Density Recounts

For each density recount required, fill out one row of the table shown below

Source Rod Position	Block Type	Density Count

CALIBRATION RECOUNT FORM (CONTINUED)

Part 2: Moisture Recounts

For each moisture recount required, fill out one row of the table shown below. The index rod should be in safe position for all readings

Block Type (Mag or Mag/Poly)	SR Shims in Place? (Yes or No)	Moisture Count

CALIBRATION QUALITY ASSURANCE ACCURACY CHECK FORM

Model_____ SN _____ Bay # _____ Date _____

Calibration Tech: _____

STANDARD COUNT TEST

Erase all standard counts in gauge memory before proceeding.
Calibration STD Count: (1) DS:_____ (2) MS: _____

Take a 4 min STD Count (3) DS:_____ (4) MS: _____

DS % Difference [[(3) / (1)] – 1] x 100 = _____ (Limit +/- 1 %)

MS % Difference [[(4) / (2)] – 1] x 100 = _____ (Limit +/- 2 %)

** If the above differences are outside the limits specified, retake one 4-minute STD Count and recalculate. If it does not pass, see your supervisor.

DENSITY QUALITY TEST

BS and 12 inches = 1-minute counts
2 through 10 inches = 15-second counts

* Mg *				
DEPTH	CNT	DENS	RC	DENS
BS				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				

* Al *			
CNT	DENS	RC	DENS

Limit is +/- 16 kilograms per cubic meter (+/- 1 Pounds per cubic foot)

MOISTURE QUALITY TEST

Mag/Poly Block

Moisture Count	Gauge Moisture Content	Block Value

Limit is +/- 16 kilograms per cubic meter (+/- 1 Pounds per cubic foot)

RECOUNTS:

Density – BS and 12 inch, take one 4-minute recount. 2 inch through 10 inch, take one 1-minute recount.
Moisture – Take one 4-minute recount. See Supervisor if both counts fail.

TAKING THE CALIBRATION QUALITY ASSURANCE STANDARD COUNT WITH A MODEL 3401-B OR 3411-B GAUGE

MODEL 3401-B

1. On the front panel module, set the **PWR/TIME** rotary switch to **SLOW**.

2. Depress the ⟨**START**⟩ button. The notation **ERR** will appear in the upper left corner of the display.

3. Wait 4 minutes for the count to finish. The **ERR** notation will disappear when the count is done.

4. Move the **DISPLAY** rotary switch on the front panel module to **DENSITY**. The *Density Standard Count* will be shown on the display. Take note of this count.

5. Move the **DISPLAY** rotary switch on the front panel module to **MOISTURE**. The *Moisture Standard Count* will be shown on the display. Take note of this count.

MODEL 3411-B

1. On the data processor module, set the **PWR/TIME** rotary switch to **SLOW**.

2. Depress and hold the key labeled ⟨**SHIFT**⟩.

3. Depress the ⟨**STANDARD**⟩ key and release it.

4. Release the ⟨**SHIFT**⟩ key. The notation **ERR** will appear in the upper left corner of the display.

5. Wait 4 minutes for the count to finish. The **ERR** notation will disappear when the count is done.

6. Depress the ⟨**DS**⟩ key. The *Density Standard Count* will be shown on the display. Take note of this count.

7. Depress the ⟨**MS**⟩ key. The *Moisture Standard Count* will be shown on the display. Take note of this count.

MODEL 3401-B CALIBRATION PROCEDURE OUTLINE AND CHECKLIST

- ❑ Turn on gauge and allow it to warm up for five minutes
- ❑ Turn off gauge and connect gauge to the Calibration Buffer Box by way of the 3411 Calibration Interface plate
- ❑ Start the TCS Program and enter the gauge serial number, index rod information, calibration type, and indexing mode
- ❑ Reset the Calibration Control System Buffer Box
- ❑ Conduct a successful stat test
- ❑ Consult *Calibration Inspection Limits* to ensure that the gauge density and moisture average standard counts from the stat test meet these limits
- ❑ Collect all required calibration counts as prompted by the TCS software
- ❑ Conduct a successful drift test
- ❑ Compute the calibration constants
- ❑ If necessary, take recounts required to pass Performance Parameter consistency tests
- ❑ Use the Excel Program *Model 3401 QA Form Maker.xls* to generate a Calibration Accuracy Test form for this gauge.
- ❑ Run the Calibration Accuracy Tests (QA Test) successfully
- ❑ From the TCS program, archive the calibration and print the calibration reports.
- ❑ File one copy of the calibration report, and put the other with the gauge

MODEL 3411-B CALIBRATION PROCEDURE OUTLINE AND CHECKLIST

- ❑ Turn on gauge and allow it to warm up for five minutes
- ❑ Turn off gauge and connect gauge to the Calibration Buffer Box by way of the 3411 Calibration Interface plate
- ❑ Start the TCS Program and enter the gauge serial number, index rod information, calibration type, and indexing mode
- ❑ Reset the Calibration Control System Buffer Box
- ❑ Conduct successful stat test
- ❑ Consult *Calibration Inspection Limits* to ensure that the gauge density and moisture average standard counts from the stat test meet these limits
- ❑ Collect all required calibration counts as prompted by the TCS software
- ❑ Conduct a successful drift test
- ❑ Compute the calibration constants
- ❑ If necessary, take recounts required to pass Performance Parameter consistency tests
- ❑ Burn the calibration constants onto a 2716 EEPROM and install the EEPROM in the gauge
- ❑ Run the Calibration Accuracy Tests (QA Test) successfully
- ❑ From the TCS program, archive the calibration and print the calibration reports.
- ❑ File one copy of the calibration report, and put the other with the gauge

MODEL 3430 CALIBRATION PROCEDURE OUTLINE AND CHECKLIST

- ❑ Turn on gauge and allow it to power up and complete the self-test
- ❑ Turn off gauge and connect gauge to the Calibration Buffer Box
- ❑ Start the TCS Program and enter the gauge serial number, index rod information, calibration type, and indexing mode
- ❑ Reset the Calibration Control System Buffer Box
- ❑ Conduct successful stat test
- ❑ Consult *Calibration Inspection Limits* to ensure that the gauge density and moisture average standard counts from the stat test meet these limits
- ❑ Collect all required calibration counts as prompted by the TCS software
- ❑ Conduct a successful drift test
- ❑ Compute the calibration constants
- ❑ If necessary, take recounts required to pass Performance Parameter consistency tests
- ❑ Download the calibration constants into the gauge
- ❑ Run the Calibration Accuracy Tests (QA Test) successfully
- ❑ From the TCS program, archive the calibration and print the calibration reports.
- ❑ File one copy of the calibration report, and put the other with the gauge

MODEL 3440 CALIBRATION PROCEDURE OUTLINE AND CHECKLIST

- ❑ Connect Gauge to the 25-Pin Calibration Cable
- ❑ Turn on gauge and allow it to power up and complete the self-test
- ❑ Check and confirm the gauge serial number from the *Extended Functions*
- ❑ Set the gauge rod length from the *Extended Functions*
- ❑ Calibrate the Depth Strip from the keypad *Depth* function
- ❑ Set the gauge baud rate to 2400 bps from the *Special Functions*
- ❑ Put the gauge in remote control from the *Extended Functions*
- ❑ Start the TCS Program and enter the gauge serial number, index rod information, calibration type, and indexing mode
- ❑ Reset the Calibration Control System Buffer Box
- ❑ Conduct successful stat test
- ❑ Consult *Calibration Inspection Limits* to ensure that the gauge density and moisture average standard counts from the stat test meet these limits
- ❑ Collect all required calibration counts as prompted by the TCS software
- ❑ Conduct a successful drift test
- ❑ Compute the calibration constants
- ❑ If necessary, take recounts required to pass Performance Parameter consistency tests
- ❑ Download the calibration constants into the gauge
- ❑ Run the Calibration Accuracy Tests (QA Test) successfully
- ❑ From the TCS program, archive the calibration and print the calibration reports.
- ❑ File one copy of the calibration report, and put the other with the gauge
- ❑ From the *Extended Functions*, ensure that the date and time of the gauge are correct
- ❑ From the *Extended Functions, Calibration Date* function, enter the date of calibration into the gauge
- ❑ From the *Extended Functions, Calibration Standard* function, enter the density calibration standard counts into the gauge

NOTE

To access the gauge's *Extended Functions*, press ⟨SHIFT⟩ ⟨SPECIAL⟩. The Special Function menu is displayed. Enter ⟨1⟩ ⟨9⟩. When prompted for a code, enter ⟨4⟩ ⟨6⟩ ⟨8⟩ ⟨8⟩. After the code is entered, the *Extended Functions* are available.

CHAPTER 3

MODEL 3450 THREE-BLOCK & FIVE-BLOCK RECALIBRATION

This chapter provides instructions for using the Troxler Legacy Calibration Suite software to perform a three-block or five-block recalibration on a Model 3450 RoadReader™ Plus Surface Moisture-Density Gauge. The information presented here includes procedures for resolving issues encountered during the calibration process. A calibration procedure outline and checklist is provided at the end of this chapter, as well as a *3450 Recalibration Data Sheet*.

CONTENTS

INITIAL STABILITY

1. Select a bay for calibration. The bay must contain the magnesium, mag/aluminum, aluminum, and mag/poly calibration blocks.

2. Print a copy of the *3450 Recalibration Data Sheet* on page 3–43. Fill in the *Date*, *Serial Number*, *Bay Number*, and *Index Rod* type information.

3. Place the gauge's poly standard block on the mag/aluminum block in the standard count orientation.

4. Position the gauge on the poly standard in the same orientation as any other Troxler Model 3400 gauge would be oriented for a standard count.

5. Turn the gauge on.

6. When the gauge finishes its self-test, it will display the battery status and the text **Press ENTER**. As directed, press the ⟨**ENTER**⟩ key. The gauge enters a warmup period.

7. Once the warmup concludes, the gauge is in *Ready* mode. Press the ⟨**SPECIAL**⟩ key.

8. The *Special* functions menu is now displayed. Press ⟨**2**⟩ to select the *Gauge Status/Test* functions.

9. From the *Gauge Status/Test* menu, select option ⟨**2**⟩ *STAT Test*.

10. From the *Stat Test* menu, press ⟨**1**⟩ *Take STAT Test*.

11. The display instructs the user to put the gauge in STD position on the standard block and to press the ⟨**ENTER**⟩ key. Position the gauge as directed and press ⟨**ENTER**⟩.

12. Wait for the stat test to finish. At the conclusion of the test, the display will look something like this:

```
STAT Test   Avg   R
D-1:PASS   6362 0.363
D-2:PASS   2671 0.321
M:PASS     1162 0.408
```

The stat test results screen shown above is divided into three columns and four rows. The first row is simply the column headings. In row 2, the first column identifies the system (*D-1* for System 1, density) and gives the *Pass/Fail* status for System 1. Row 2, column 2 lists the average count for System 1, and row 2, column 3 lists the *R* value for System 1. In row 3, the first column identifies the system (*D-2* for System 2, density) and gives the *Pass/Fail* status for System 2. Row 3, column 2 lists the average count for System 2, and row 3, column 3 lists the *R* value for System 3. In row 4, the first column identifies the system (*M* for Moisture system) and gives the *Pass/Fail* status for the Moisture system. Row 4, column 2 lists the average count for moisture, and row 4, column 3 lists the *R* value for M.

13. Obtain a copy of the *Calibration Inspection Limits*. Compare the standard count limits to the standard counts that were just obtained.

    On the *3450 Recalibration Data Sheet* in the *Stat Test Results* section, record the average count and *R* value for **only** the counting systems that **both** passed the stat test R value **and** met the *Calibration Inspection Limits*. Leave the form blank for any systems that failed this stat test.

14. Press the ⟨**ENTER**⟩ key.

15. If all three systems pass the stat test **and** the *Calibration Inspection Limits*, press the ⟨**ESC**⟩ key and then proceed to the *Index Rod Calibration* section on the following page. Otherwise, proceed to step 16.

16. Take another stat test by repeating steps 10 and 11.

17. Wait for the second stat test to finish. The layout of the data in the screen is described in step 12.

    On the *3450 Recalibration Data Sheet* in the *Stat Test Results* section, record the average count and *R* value for **only** the counting systems that failed the first stat test. Denote on the form if any system failed **both** stat tests. Also, check these newly recorded values against the *Calibration Inspection Limits*.

18. If any of the systems failed both the first and second stat tests, **or** if any system failed the *Calibration Inspection Limits* for both the first and second stat tests, return this gauge to Assembly or Service for analysis and repair.

    If all systems have passed the *Calibration Inspection Limits* and the stat test *R* value limits for at least one of the two stat tests, however, then proceed to step 19.

19. Press the ⟨**ENTER**⟩ key on the gauge, then press the ⟨**ESC**⟩ key to return to the *Ready* mode. Proceed to the *Index Rod Calibration* section on the following page.

INDEX ROD CALIBRATION

1. Place the gauge on any of the metallic calibration blocks.

2. Press the ⟨**SPECIAL**⟩ key.

3. From the *Special* functions menu, press the ⟨**4**⟩ key to initiate the *Gauge Setup* menu.

4. From the *Gauge Setup* menu, press the ⟨**3**⟩ key to initiate the *Depth Indicator* menu.

5. From the *Depth Indicator* menu, press the ⟨**3**⟩ key to initiate the *Calibrate Depth* function.

6. At this point the gauge will prompt you to put the source rod in the 2-inch position and press ⟨**ENTER**⟩. Perform these two tasks in the specified order.

7. At this point the gauge will prompt you to put the source rod in the 8-inch position and press ⟨**ENTER**⟩. Perform these two tasks in the specified order. Once this step is complete, the index rod calibration is complete.

8. Press the ⟨**ESC**⟩ key to return to the *Ready* mode.

BACKSCATTER & TRANSMISSION DENSITY CALIBRATION COUNTING

1. Place the gauge on the magnesium calibration block, in the measurement position. Place the source rod in backscatter position, making sure the handle clicks into the backscatter notch. Press down gently on the end of the handle (without touching the trigger) to ensure that the handle is properly seated.

2. Press the ⟨**SPECIAL**⟩ key.

3. Press ⟨**2**⟩ to select the *Gauge Status/Test* functions.

4. From the *Gauge Status/Test* menu, press ⟨**3**⟩ *DRIFT Test*.

5. From the *Drift Test* menu, press ⟨**1**⟩ *Take Drift Test*.

6. The screen instructs the user to put the gauge in STD position on the standard block and press the ⟨**ENTER**⟩ key. ***Leave the gauge in backscatter position*** and press ⟨**ENTER**⟩.

7. Wait for the drift test to finish. At the conclusion of the test, the display will look something like this:

```
DRIFT TEST AVG  %D
D-1:FAIL 15923 85.81
D-2:FAIL 3669  31.24
M:FAIL   34.80 188.4
```

NOTE

Ignore the Pass/Fail status and percent drift values; they are not relevant for this part of the procedure!

Like the stat test results screen, the drift test results screen shown above is divided into three columns and four rows. The first row is simply the column headings. In row 2, the first column identifies the system (*D-1* for System 1, density) and gives the *Pass/Fail* status for System 1. Row 2, column 2 lists the average count for System 1, and row 2, column 3 lists the *%D* (which stands for *% drift*) value for System 1. In row 3, the first column identifies the system (*D-2* for System 2, density) and gives the *Pass/Fail* status for System 2. Row 3, column 2 lists the average count for System 2, and row 3, column 3 lists the *%D* value for System 3. In row 4, the first column identifies the system (*M* for Moisture system) and gives the *Pass/Fail* status for the Moisture system. Row 4, column 2 lists the average count for Moisture, and row 4, column 3 lists the *%D* value for M.

Using the drift test results screen, record the System 1 and System 2 average counts under the respective *Backscatter Depth* for the calibration block upon which the backscatter count was taken. On the *3450 Calibration Form*, the locations in which these values are recorded are on the second page under the heading *Backscatter Counts*.

8. If the backscatter count was just taken on the magnesium block, then record the Moisture count on the second page, beside the label *Mag moist. count*. If this backscatter count was taken on any other block, skip this step and proceed to step 9.

9. Place the gauge on the mag/aluminum calibration block, in the measurement position. Place the source rod in backscatter position, making sure the handle clicks into the backscatter notch. Press down gently on the end of the handle (without touching the trigger) to ensure that the handle is properly seated.

10. Press the ⟨**ENTER**⟩ key. The *Drift Test* menu is displayed.

11. Repeat steps 5 through 7.

12. Place the gauge in the center of the aluminum calibration block. Place the source rod in backscatter position, making sure the handle clicks into the backscatter notch. Press down gently on the end of the handle (without touching the trigger) to ensure that the handle is properly seated.

13. Press the ⟨**ENTER**⟩ key. The *Drift Test* menu is displayed.

14. Repeat steps 5 through 7.

15. Press the ⟨**ESC**⟩ key. The *Ready* screen is again displayed.

16. Press the ⟨**TIME**⟩ key. The gauge gives the user the option of selecting the time of each gauge count. Press the ⟨**3**⟩ key to select 4-minute counts.

17. If the calibration underway is a 3-block calibration, then proceed to step 18. Otherwise, if the gauge is undergoing a 5-block calibration, proceed to step 22.

18. Place the gauge on the magnesium block, and position the source rod into the next measurement position. Take a 4-minute count, and record the System 1 and System 2 counts in the appropriate locations on the calibration form.

19. Place the gauge on the mag/aluminum block, and place the source rod into the same measurement position as in step 18. Take a 4-minute count, and record the System 1 and System 2 counts in the appropriate locations on the calibration form.

20. Place the gauge on the aluminum block, and place the source rod into the same measurement position as in steps 18. Take a 4-minute count, and record the System 1 and System 2 counts in the appropriate locations on the calibration form.

21. If the gauge is undergoing a 3-Block calibration, then skip ahead to step 26. If the gauge is undergoing a 5-Block calibration, proceed to step 22.

22. Place the gauge on the limestone block, and place the source rod into the same measurement position as in the preceding aluminum block density measurement. Take a 4-minute count, and record the System 1 and System 2 counts in the appropriate locations on the calibration form.

23. Place the shims under the base of the gauge to place it in surface roughness measurement mode. Take a 4-minute count, and record the System 1 and System 2 counts in the appropriate locations on the calibration form.

24. Place the gauge on the granite block, and place the source rod in the same measurement position as in the preceding density measurement (except without the shims). Take a 4-minute count, and record the System 1 and System 2 counts in the appropriate locations on the calibration form.

25. Place the gauge on the mag/poly block, and place the source rod in the same measurement position as in the preceding density measurement. Take a 4-minute count, and record the System 1 and System 2 counts in the appropriate locations on the calibration form.

26. If the source position measurements just completed were for the maximum source rod depth of this gauge, then the transmission density calibration measurements are complete. Otherwise, return to step 18.

MOISTURE CALIBRATION COUNTING

In step 8 of the *Backscatter & Transmission Density Calibration Counting* section on page 3–5, the moisture calibration count on the magnesium block was taken and recorded. In this section, the two remaining moisture calibration counts are taken.

1. Place the gauge on the mag/poly block, and put the source rod in backscatter position. Take a 4-minute count, and record the Moisture count in appropriate location on the calibration form.

2. Leave the source rod in backscatter position, and leave the gauge on the mag/poly block. Place the surface roughness shims under either side of the gauge. Take a 4-minute count, and record the Moisture count on appropriate location on the calibration form.

DRIFT TEST

1. Place the gauge's poly standard block on the mag/aluminum block, in the standard count position.

2. Position the gauge on the poly standard in the same orientation as any other Troxler Model 3400 gauge would be oriented for a Standard Count.

3. From *Ready* mode, press the ⟨**SPECIAL**⟩ key.

4. The *Special* functions menu is now displayed. Press ⟨**2**⟩ to select the *Gauge Status/Test* functions.

5. From the *Gauge Status/Test* menu, press ⟨**3**⟩ *DRIFT Test*.

6. From the *Drift Test* menu, press ⟨**1**⟩ *Take Drift Test*.

7. The screen will now instruct the user to put the gauge in STD position on the standard block and press the ⟨**ENTER**⟩ key. Press ⟨**ENTER**⟩.

8. Wait for the drift test to finish. At the conclusion of the test, the drift test results screen is displayed. A detailed description of the format of this screen in given in step 7 of the *Backscatter & Transmission Density Calibration Counting* section on page 3–5.

   The pass/fail limits for the gauge drift test are based on an assumption that the gauge has not been moved between the stat test and the drift test. Consequently, these limits are not valid in this application. Instead, the gauge passes the drift test in this application if it meets the following criteria:

   - System 1 passes if the *% Drift* value is 0.5% or less
   - System 2 passes if the *% Drift* value is 0.75% or less
   - Moisture passes if the *% Drift* value is 1.0% or less

   For any system that **passed** the drift test based on the limits listed above, record the average count and *% Drift* on the *3450 Recalibration Data Sheet*, at the bottom of page 2. Leave the form blank for any system or systems that **failed** the drift test based on the limits listed above, however.

9. If all three systems pass the drift test, press the ⟨**ENTER**⟩ key, then the ⟨**ESC**⟩ key, then proceed to step 34. Otherwise, proceed to step 10.

10. Press the ⟨**ENTER**⟩ key. The *Drift Test* menu is displayed.

11. Take a second drift test by repeating steps (6) through (7).

12. Wait for the second drift test to finish. At the conclusion of the test, the drift test results screen is displayed. A detailed description of the format of this screen in given in step 7 of the *Backscatter & Transmission Density Calibration Counting* section on page 3–5.

    The pass/fail limits for the gauge drift test are based on an assumption that the gauge has not been moved between the stat test and the drift test. Consequently, these limits are not valid in this application. Instead, the gauge passes the drift test in this application if it meets the following criteria:

    - System 1 passes if the *% Drift* value is 0.5% or less
    - System 2 passes if the *% Drift* value is 0.75% or less
    - Moisture passes if the *% Drift* value is 1.0% or less

On the *3450 Recalibration Data Sheet* in the *Drift Test Results* section, record the average count and *R* value from this second drift test for **only** the counting systems that failed the first drift test. Denote on the form if any system failed both drift tests based on the limits listed above.

13. Press the ⟨**ENTER**⟩ and ⟨**ESC**⟩ keys to return the gauge to the *Ready* mode.
    - If the gauge fails both drift tests for the same system or systems, then a *provisional drift test* will need to be performed; proceed to step 14.
    - If instead the gauge passes this second drift test for any system(s) that failed the first drift test, then this gauge has passed the drift test; proceed to step 34.

14. The first step in taking a provisional drift test is to take a *provisional stat test*. To start this process, press the ⟨**SPECIAL**⟩ key.

15. The *Special* functions menu is now displayed. Press ⟨**2**⟩ to select the *Gauge Status/Test* functions.

16. From the *Gauge Status/Test* menu, press ⟨**2**⟩ *STAT Test*.

17. From the *Stat Test* menu, press ⟨**1**⟩ *Take STAT Test*.

18. The gauges instructs the user to put the gauge in STD position on the standard block and press the ⟨**ENTER**⟩ key. Press ⟨**ENTER**⟩.

19. Wait for the stat test to finish. At the conclusion of the test, the display will look something like this:

```
STAT Test   Avg   R
D-1:PASS   6362 0.363
D-2:PASS   2671 0.321
M:PASS     1162 0.408
```

The stat test results screen shown above is divided into three columns and four rows. The first row is simply the column headings. In row 2, the first column identifies the system (*D-1* for System 1, density) and gives the *Pass/Fail* status for System 1. Row 2, column 2 lists the average count for System 1, and row 2, column 3 lists the *R* value for System 1. In row 3, the first column identifies the system (*D-2* for System 2, density) and gives the *Pass/Fail* status for System 2. Row 3, column 2 lists the average count for System 2, and row 3, column 3 lists the *R* value for System 3. In row 4, the first column identifies the system (*M* for Moisture system) and gives the *Pass/Fail* status for the Moisture system. Row 4, column 2 lists the average count for moisture, and row 4, column 3 lists the *R* value for M.

On the *3450 Recalibration Data Sheet* in the *Provisional Stat Test Results* section (page 2), record the average count and *R* value for **only** the counting systems that passed this stat test. Leave the form blank for any system that failed this stat test.

20. Press the ⟨**ENTER**⟩ key.

21. If all three systems pass the stat test, press the ⟨**ESC**⟩ key, then proceed to step 26. Otherwise, proceed to step 22.

22. Take another stat test by repeating steps 17 and 18.

23. Wait for the second stat test to finish. The layout of the data in the screen is described in step 19.

    On the *3450 Recalibration Data Sheet* in the *Provisional Stat Test Results* section, record the average count and *R* value for **only** the counting systems that failed the first stat test. Denote on the form if any system failed **both** stat tests.

24. If any of the systems failed both the first and second provisional stat tests, stop the calibration process and return the gauge to Service for analysis and repair. If the gauge passes this second provisional stat test, proceed to step 25.

25. Press the ⟨**ENTER**⟩ key on the gauge, then press the ⟨**ESC**⟩ key to get to *Ready* mode. Once the gauge is in the Ready mode, proceed to step 26.

26. **DO NOT MOVE THE GAUGE IN ANY WAY UNTIL THE UPCOMING PROVISIONAL DRIFT TEST IS COMPLETE.** Wait 3 hours before proceeding. Ensure that during this 3-hour pause, the gauge is turned on and connected to the charger.

27. After the 3-hour pause has elapsed, from the *Ready* mode, press the ⟨**SPECIAL**⟩ key.

28. The *Special* functions menu is now displayed. Press ⟨**2**⟩ to select the *Gauge Status/Test* functions.

29. From the *Gauge Status/Test* menu, press ⟨**3**⟩ *DRIFT Test*.

30. From the *Drift Test* menu, press ⟨**3**⟩ *Take Drift Test*.

31. The gauge instructs the user to put the gauge in STD position on the standard block and press the ⟨**ENTER**⟩ key. Press ⟨**ENTER**⟩.

32. Wait for the drift test to finish. At the conclusion of the test, the drift test results screen is displayed. A detailed description of the format of this screen in given in step 7 of the *Backscatter & Transmission Density Calibration Counting* section on page 3–5. Record the average count, the *% Drift*, and the *Pass/Fail* status on the *3450 Recalibration Data Sheet*, at the *Provisional Drift Test* section on page 2.

    For the first two drift tests that were performed (and failed), the System 2 Pass/Fail limit was 0.75%. However, for the provisional drift test, the Pass/Fail limits are the same as those in the gauge:

    - System 1 passes if the *% Drift* value is 0.5% or less
    - System 2 passes if the *% Drift* value is 0. 5% or less
    - Moisture passes if the *% Drift* value is 1.0% or less

    These "tighter" limits are used for the provisional drift test because, unlike the first two drift tests, the gauge is not moved between the provisional drift test and the provisional stat test.

33. If all three systems pass the provisional drift test, press the ⟨**ENTER**⟩ key, then the ⟨**ESC**⟩ key, then proceed to step 34. Otherwise, this gauge has electrical stability problems; take the gauge to Service for analysis and repair.

34. On page 2 of the *3450 Recalibration Data Sheet* there is a location for calculating the *calibration standard count*. Follow the instructions listed there and calculate and record the calibration standard count for all three gauge systems.

ENTERING CALIBRATION DATA INTO THE CALIBRATION PROGRAM

1. From the computer (in Windows mode) that contains the 3450 Calibration Software, start the software by double-clicking the icon for the **3450 Calibration**. If the default path was chosen when this software was installed, this program is in the directory *C:\Program Files\Cal3450*. The program itself is named *CAL3450.EXE*. A shortcut may be installed on the Windows desktop.

2. An introductory splash screen is displayed on the computer for approximately five seconds, followed by the **3450 Calibration Main Menu** shown in Figure 3–1.

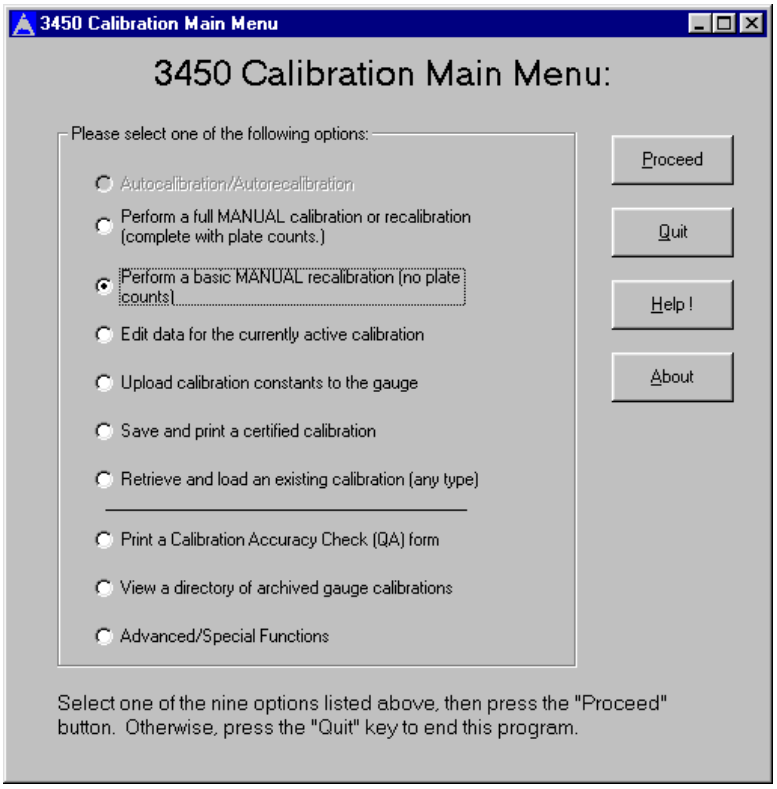


Figure 3–1. 3450 Calibration Main Menu

3. Select the **Perform a basic MANUAL recalibration (no plate counts)** option button and click ⟨**Proceed**⟩.

4. The software displays the screen shown in Figure 3–2, requesting data for the gauge calibration. Enter all of the requested data and click the ⟨**Next**⟩ button.

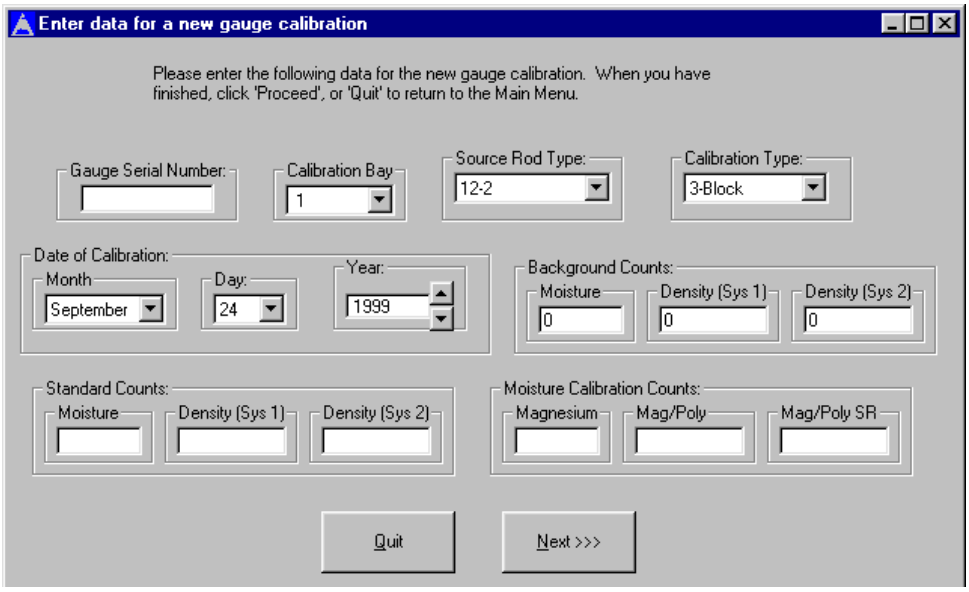


Figure 3–2. Gauge Calibration Data Entry Screen

5. The software then displays the data input screen shown in Figure 3–3. This screen allows the user to enter all of the depth density counts. Data for each source depth can be entered/accessed by clicking the tab that contains the caption for that source rod position. In Figure 3–3, the backscatter (**BS**) tab is shown. Enter all of the requested data, then click the ⟨**Next**⟩ key. To edit the data from the preceding screen, click the ⟨**Back**⟩ button.

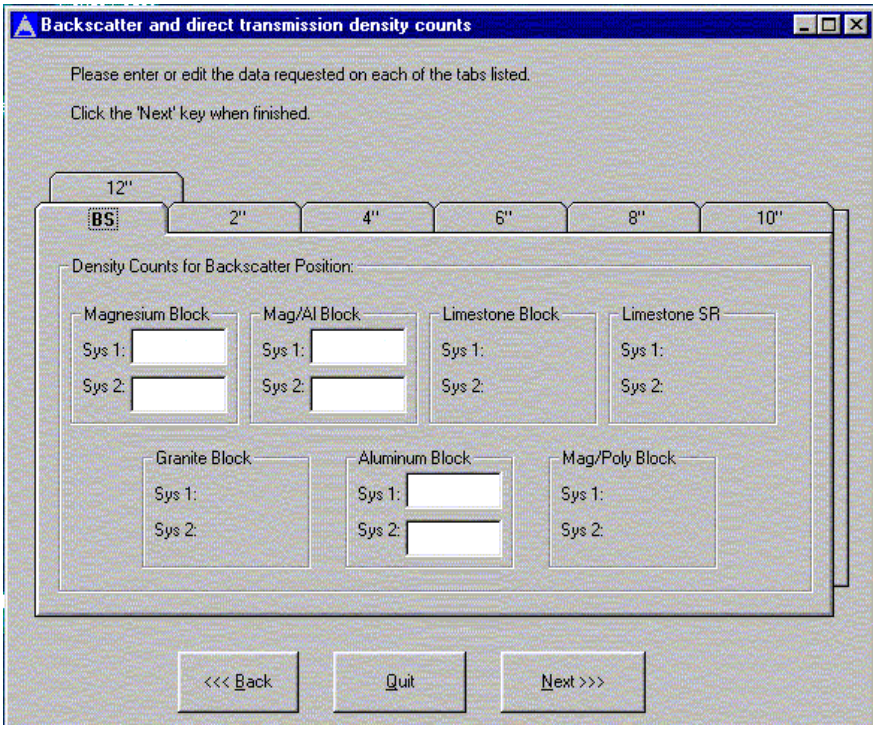


Figure 3–3. Density Counts Entry Screen

6. At this point, the user must enter the thin layer calibration constants (the *P1*, *Q1*, *R1*, *P2*, *Q2*, and *R2* values) from a previous calibration. These values can be read from a previous calibration sheet and manually entered into the computer, or they can be loaded directly from the gauge to the computer. The easier method, and the one that is less prone to errors, of entering these constants is to load them directly from the gauge to the computer. However, circumstances may be such that typing the constants into the computer is the only option.

   As shown in Figure 3–4, the software now prompts the user to select the method by which the thin layer calibration constants are to be entered. Select the desired method and click ⟨**Next**⟩. To edit the data from the preceding screen, click the ⟨**Back**⟩ button.

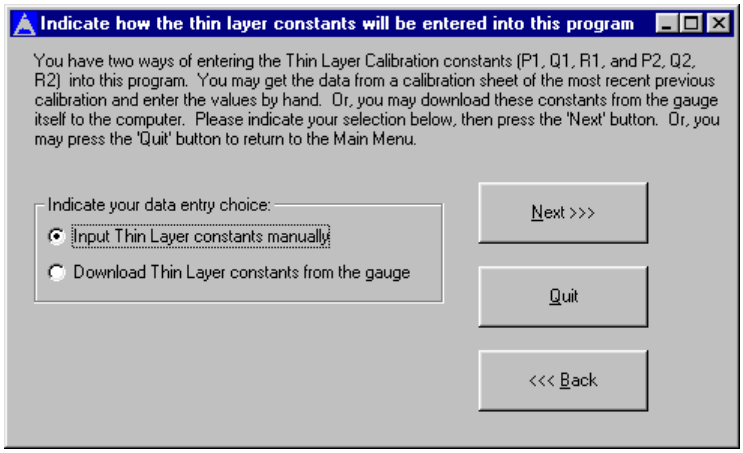


Figure 3–4. Thin Layer Constants Entry Method Selection Screen

7. To download the constants from the gauge to the computer, proceed to step 8. To enter these values manually, proceed to step 21.

8. There are two hardware options for downloading the calibration constants into the gauge. If the user owns the Troxler Calibration Control system (Troxler Part No. 106111), this system and the special 3450 Interface Adapter (Troxler Part No. B-109365) can be used as the gauge-computer interface. Otherwise, a 9-pin RS-232 null modem cable can be used to connect the gauge and computer.

   The default setting for the gauge-computer interface is the 9-pin RS-232 null modem cable. This setting may be changed at any time from the **Advanced/Special Functions** option on the **3450 Calibration Main Menu** (see Figure 3–1 on page 3–11). For more information, refer to the *Selecting the Gauge-Computer Interface* section on page 3–39.

   If the user has selected the Troxler Calibration Control system as the gauge-computer interface, then proceed to step 15. Otherwise, if the user has opted to use an RS-232 null modem cable as the interface between the gauge and the computer, proceed to step 9.

9. After the ⟨**Next**⟩ button is clicked in step 6, the software prompts the user to connect the gauge to the computer and place the gauge in *Remote Control* mode as shown in Figure 3–5.

   - To return to the display shown in Figure 3–4, click the ⟨**Back**⟩ button.
   - To return to the **3450 Calibration Main Menu** without saving any of the input data, click ⟨**Quit**⟩.
   - To view more information about this process, click ⟨**Help!**⟩.
   - To proceed with downloading the calibration constants from the gauge to the computer, click ⟨**Next**⟩.

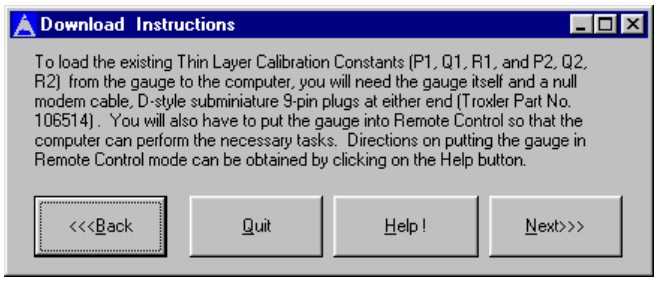


Figure 3–5. Download Instructions Window for RS-232 Cable

10. The software now prompts the user to select the serial communications (Com) port settings for the computer, as shown in Figure 3–6. Select the desired Com port and baud rate from the dropdown lists and click ⟨**Select**⟩, or click ⟨**Back**⟩ to return to the previous display.

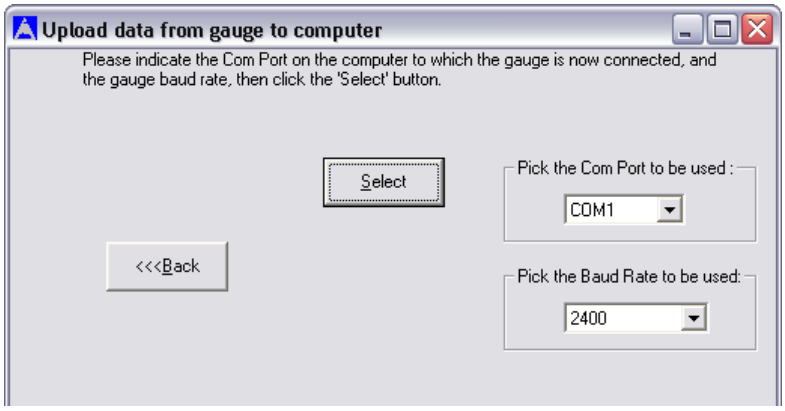


Figure 3–6. Selecting the Com Port and Baud Rate

11. After the user clicks the ⟨**Select**⟩ button in Figure 3–6, the software displays the **Upload data from gauge to computer** screen shown in Figure 3–7. Ensure that the gauge is set to the proper baud rate, is in *Remote Control* mode, and is properly connected to the computer using an RS-232 cable. Click the ⟨**Get Constants**⟩ button to continue.

12. The software now displays a message box that informs the user that, during the upload process, the computer will be unresponsive to user input (keyboard, mouse, etc.). However, the program will not "lock-up" – a timeout will occur after a predetermined amount of time and the user will be able to control the program again. Click the ⟨**OK**⟩ button to continue with the upload.

13. When the user clicks ⟨**OK**⟩ on the preceding message box, the software begins uploading the calibration constants from the gauge to the computer. The entire process takes about a minute.

    - If any communications problems are encountered during the upload, the software displays an error message box that prompts the user to check the computer Com port settings and the RS-232 cable and to try again. Click ⟨**OK**⟩ on this error message to return to step 9.
    - If the process is successful, the **Upload data from gauge to computer** screen similar to the one shown in Figure 3–8 is displayed. The values shown in the box are all of the calibration constants that are currently residing in the memory of the gauge. Click the ⟨**Next**⟩ button to continue.

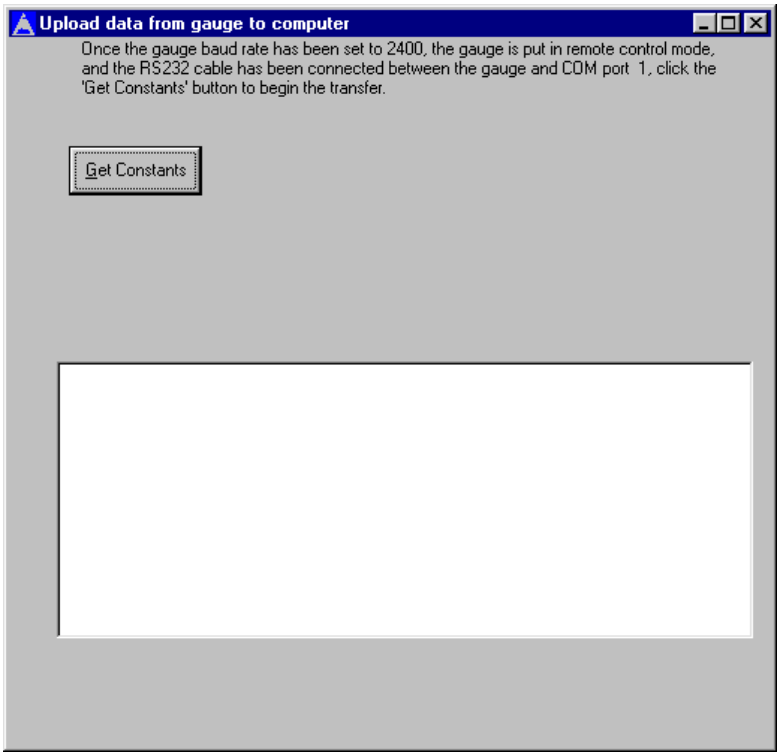


Figure 3–7. Upload Data from Gauge to Computer Screen, Before Upload

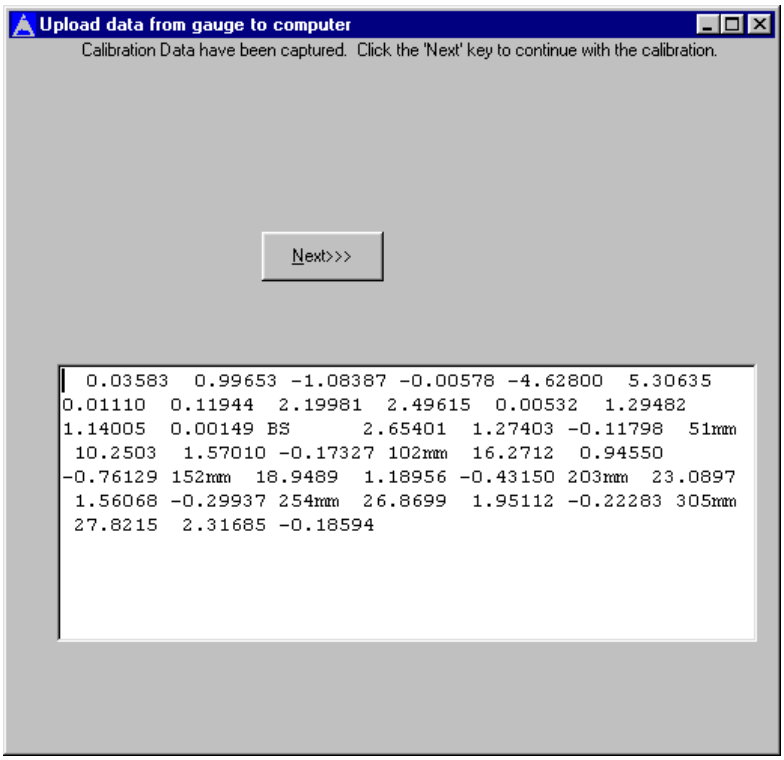


Figure 3–8. Upload Data from Gauge to Computer Screen, Upload Successful

14. After the ⟨**Next**⟩ button is clicked in step 13, the **Thin Layer Calibration Constants** screen shown in Figure 3–9 is displayed. Review the data on this screen and make any necessary changes (although there should be no changes to make).

    - To return to step 6 and re-enter the thin layer calibration constants, click the ⟨**Back**⟩ button.
    - To continue, click the ⟨**Next**⟩ button and proceed to step 22.

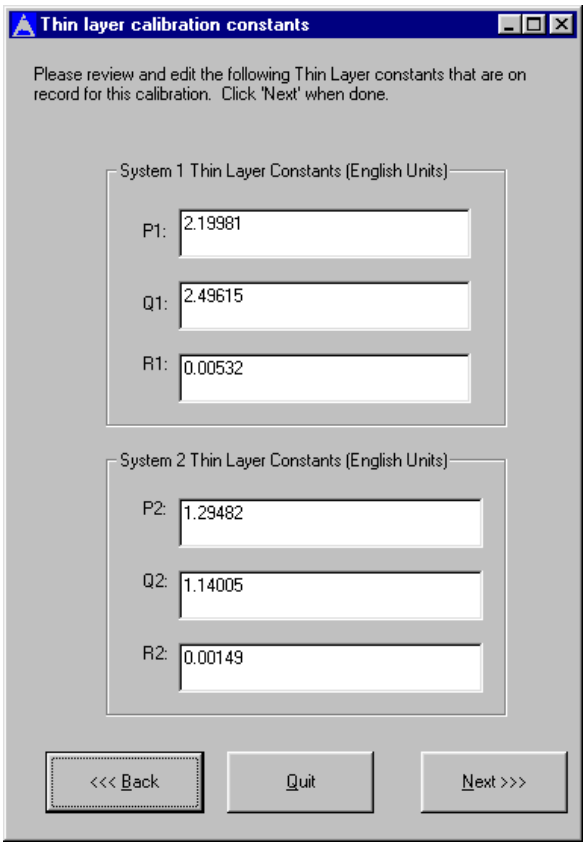


Figure 3–9. Thin Layer Calibration Constants Review Screen

15. If the user has selected the Troxler Calibration Control system as the gauge-computer interface, after the ⟨**Next**⟩ button is clicked in step 6 on page 3–13, the software displays the **Download Instruction** window shown in Figure 3–10.

    - To return to the display shown in Figure 3–4, click the ⟨**Back**⟩ button.
    - To return to the **3450 Calibration Main Menu** without saving any of the input data, click ⟨**Quit**⟩.
    - To view more information about this process, click ⟨**Help!**⟩.
    - To proceed with downloading the calibration constants from the gauge to the computer, click ⟨**Next**⟩.

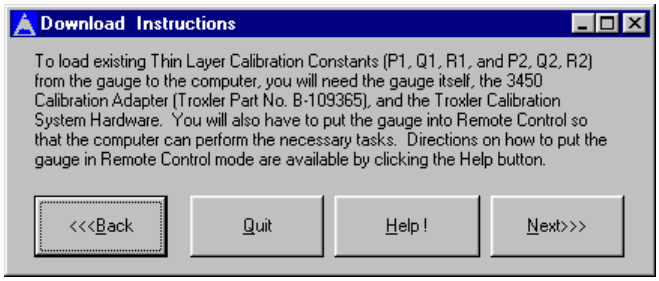


Figure 3–10. Download Instructions Window for Troxler Calibration Control System

16. The software now prompts the user to select the serial communications (Com) port settings for the computer. This display is similar to the one shown in Figure 3–6 on page 3–14. Select the desired Com port and baud rate from the dropdown lists and click ⟨**Select**⟩, or click ⟨**Back**⟩ to return to the previous display.

17. After the user clicks the ⟨**Select**⟩ button, the software displays the **Upload data from gauge to computer** screen shown in Figure 3–11. Ensure that the gauge is set to the proper baud rate and is in *Remote Control* mode, and that the 3450 adapter cable is properly connected between the gauge and the interface cable of the Troxler Calibration Control System. Click the ⟨**Get Constants**⟩ button to continue.

Figure 3–11. Upload Data from Gauge to Computer Screen, with Troxler Calibration Control System

18. The software now displays a message box that informs the user that, during the upload process, the computer will be unresponsive to user input (keyboard, mouse, etc.). However, the program will not "lock-up" – a timeout will occur after a predetermined amount of time and the user will be able to control the program again. Click the ⟨**OK**⟩ button to continue with the upload.

19. The software prompts the user to perform a manual reset of the calibration buffer box, as shown in Figure 3–12. If the calibration buffer box is not reset, the gauge will not be able to communicate with the computer to put it in the proper mode. Perform the reset operations as instructed, then click the ⟨**OK**⟩ button.

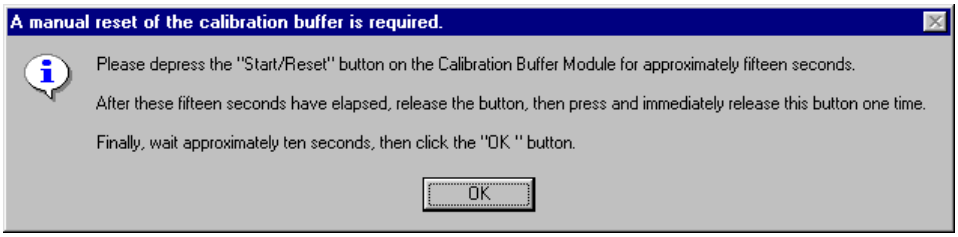


Figure 3–12. Calibration Buffer Box Manual Reset Prompt

20. The computer now sends an initialization string to the calibration buffer box. This initialization string, if received correctly, reconfigures the Calibration Control System. This reconfiguration will make the Calibration Control System, *if the 3450 converter cable (Troxler Part No. 109365) is connected to it*, behave like a null modem cable between the gauge and the computer.

    - If the initialization string is received correctly, the software displays a message box that confirms that the control box has been defeated and that calibration constants can now be sent. Click ⟨**OK**⟩ to go to step 13 on page 3–14.
    - If instead the initialization string was not received correctly, the displays an error message that states **The Troxler Calibration System controller could not be bypassed. Check configurations and settings and try again.** Click ⟨**OK**⟩ to return to step 16, and re-enter the serial port and baud rate.

21. If the user chose the **Input Thin Layer constants manually** option at step 6 on page 3–13, the software displays the screen shown in Figure 3–13.

    - To return to step 6 on page 3–13, click the ⟨**Back**⟩ button.
    - Otherwise, enter the thin layer constants in the appropriate locations. When finished, click the ⟨**Next**⟩ button and continue to step 22.

22. When the user clicks the ⟨**Next**⟩ button in step 14 or 21, the software displays the message **Data entry for this calibration is complete. Do you wish to print the data?**

    - To print the data, click ⟨**Yes**⟩. The software generates a printout and continues to step 23.
    - To continue to step 23 without generating a printout, click ⟨**No**⟩.

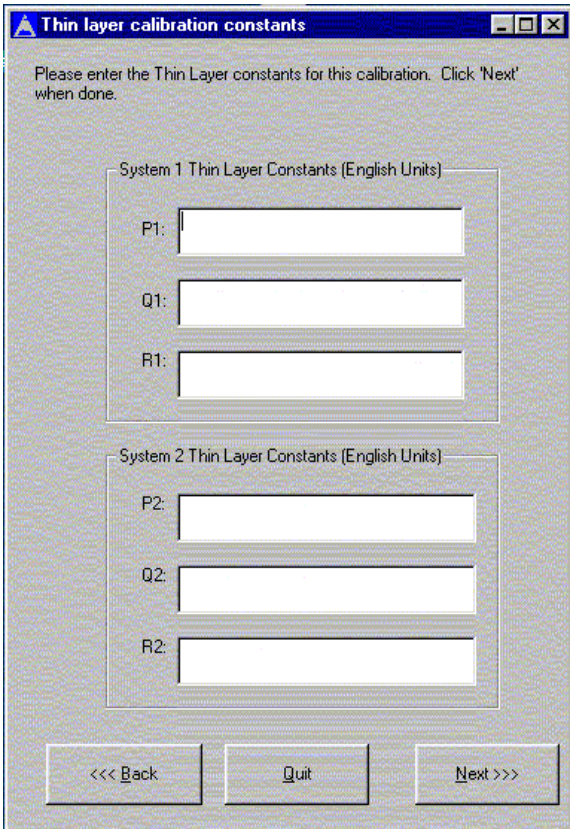


Figure 3–13. Thin Layer Calibration Constants Manual Entry Screen

23. The software now displays a message box confirming that the values have been saved in a temporary file. The message box gives the user the option to proceed to the calculation of the calibration constants, or to edit any of the entered values.

    - To edit any of the data entered, click the ⟨**Edit**⟩ button. The software returns to step 4 on page 3–11, with all the values that were previously entered still displayed on the screen.
    - To proceed to the calculation of the calibration constants, click ⟨**Proceed**⟩ and continue to step 24.

24. When the user clicks the ⟨**Proceed**⟩ button in the previous step, the software calculates the calibration constants.

    - If an error is encountered in the calculations, the software displays a message to that effect, and gives the user an opportunity to go back and edit the input date.
    - If the calculations are performed without any errors, the software displays a confirmation message. Click the ⟨**Proceed**⟩ button to view the printout.

25. When the ⟨**Proceed**⟩ button is clicked, the software formulates the calibration sheets and displays them for review as shown in Figure 3–14. The entire text of the calibration sheets, in formatted form, is displayed in the text box shown on this screen. The user can scroll up and down this text box to view the calibration sheet in its entirety. This sheet can be displayed in Metric or Imperial (English) units simply by clicking the appropriate option button in the lower right-hand portion of the screen.

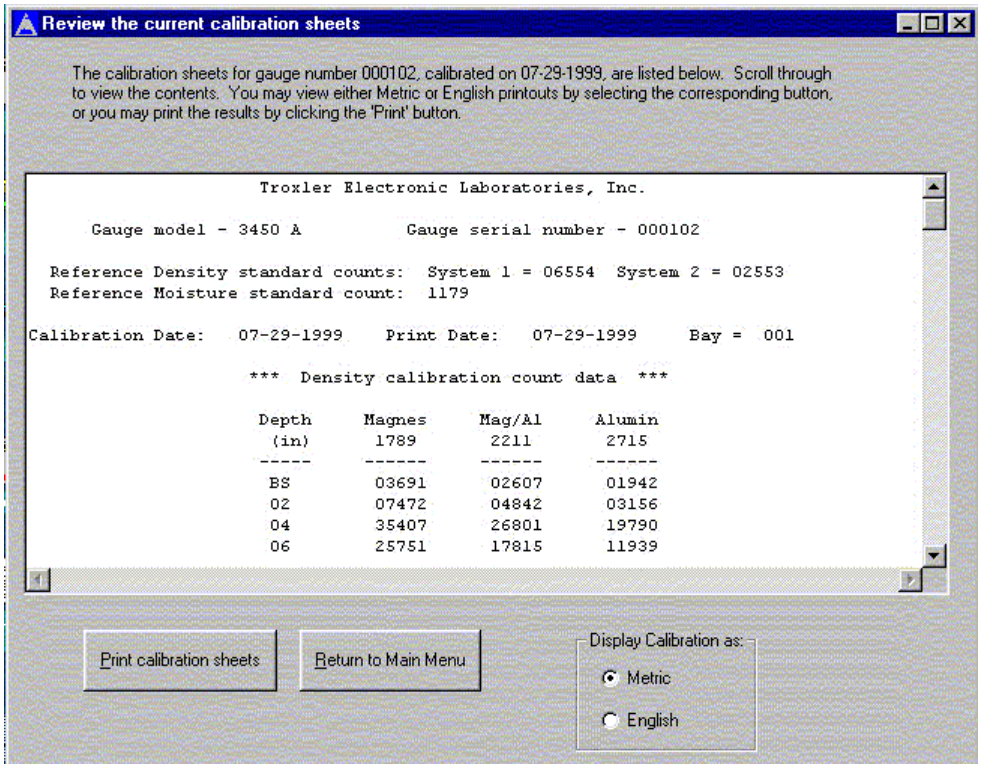


Figure 3–14. Review the Current Calibration Sheets Display

26. At this point the user should print the calibration sheets. Click the ⟨**Print calibration sheets**⟩ button and proceed to step 27.

27. The software now displays a message box warning the user that simply printing the calibration sheets at this point **does not** mean that the data is being permanently archived. The data can only be archived after the QA test has passed and the user has selected the **Save and Print a Certified Calibration** option from the **3450 Calibration Main Menu**. Click ⟨**OK**⟩ on this message box to proceed with the printout.

28. Refer back to the *Calibration Inspection Limits* for this gauge.

    - If the associated values on the calibration printout just generated fail to meet any of these limits, then recounts are necessary. Proceed to the *Editing the Calibration Data* section on the following page.
    - If the gauge instead meets all of the *Calibration Inspection Limits*, then proceed to the *Calibration Quality Assurance* section on page 3–22.

EDITING THE CALIBRATION DATA

The steps in this section are performed if there was a mathematical error in the calculation of the calibration constants or if the gauge failed one or more parts of the Quality Assurance Test.

1. Retake the count or counts that caused the calibration to fail whichever evaluation that it did fail. The manner in which this count or counts are collected is outlined in the *Backscatter & Transmission Density Calibration Counting* section on page 3–5 and the *Moisture Calibration Counting* section on page 3–7.

2. From the **3450 Calibration Main Menu** (see Figure 3–1 on page 3–11), select the **Edit data for the currently active calibration** option and click the ⟨**Proceed**⟩ button.

3. Proceed to step 4 of the *Entering Calibration Data Into the Calibration Program* section on page 3–11. You will have the opportunity to change the data that you need to, recalculate the calibration constants, and evaluate the thin layer residuals. At the end of that section, you will be directed where to proceed from there.

NOTE

Please note that the user does not have the opportunity to read calibration constants from the gauge again during this edit session. These constants are already in the computer, so there is no need to load them again. The user will have the opportunity to edit these calibration constants, however.

CALIBRATION QUALITY ASSURANCE

Before any Quality Assurance counting can take place, the calibration constants must be loaded into the gauge. These constants currently reside in the computer, but they can be easily loaded into the gauge by doing the following steps.

There are basically two ways to get these calibration constants into the gauge: enter them by hand through the gauge keypad, or download them from the gauge into the computer. Hand entry of these values is easy enough to do, but it is tedious, labor-intensive, and more prone to error. The preferred method of entering these values is through downloading them from the computer.

There are two hardware options for downloading the calibration constants into the gauge. If the user owns the Troxler Calibration Control system (Troxler Part No. 106111), this system and the special 3450 Interface Adapter (Troxler Part No. B-109365) can be used as the gauge-computer interface. Otherwise, a 9-pin RS-232 null modem cable can be used to connect the gauge and computer.

The default setting for the gauge-computer interface is the 9-pin RS-232 null modem cable. This setting may be changed at any time from the **Advanced/Special Functions** option on the **3450 Calibration Main Menu** (see Figure 3–1 on page 3–11). For more information, refer to the *Selecting the Gauge-Computer Interface* section on page 3–39.

To download the calibration constants from the computer into the gauge, please do the following:

1. From the **3450 Calibration Main Menu** (see Figure 3–1 on page 3–11), select the **Upload calibration constants to the gauge** option and click the ⟨**Proceed**⟩ button.

2. The software displays a message box warning the user that the gauge should contain software version 2.10 or higher. If not, the user may have difficulty correctly transferring calibration data. Confirm that the software version is no older than indicated. If not, upgrade the software to the most recent version before continuing. When ready, click the ⟨**OK**⟩ button to proceed to the next step.

3. The software now displays a message box showing the gauge serial number of the currently active calibration information stored on the computer. The message box asks if the user to confirm that this is the correct data to load into the gauge.
   - If this is the correct gauge, click the ⟨**Yes**⟩ button and proceed to step 4.
   - Otherwise, click the ⟨**No**⟩ button to return to the **3450 Calibration Main Menu**.

4. The next screen that is displayed depends on the interface between the gauge and the computer that has been selected.
   - If using the Troxler Calibration Control System hardware as the gauge-computer interface, proceed to step 10.
   - Otherwise, if the user will be using an RS 232 null modem cable as the gauge-computer interface, proceed to step 5.

5. After the ⟨**Next**⟩ button is clicked in step 3, the software prompts the user to connect the gauge to the computer and place the gauge in *Remote Control* mode as shown in Figure 3–15.
   - To return to the previous display, click the ⟨**Back**⟩ button.
   - To view more information about this process, click ⟨**Help!**⟩.
   - To proceed with downloading the calibration constants from the gauge to the computer, click ⟨**Next**⟩.

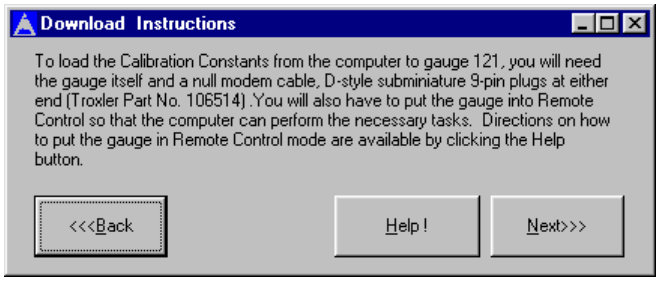


Figure 3–15. Download Instructions Window for RS-232 Cable

6. The software now prompts the user to select the serial communications (Com) port settings for the computer. This display is similar to the one shown in Figure 3–6 on page 3–14. Select the desired Com port and baud rate from the dropdown lists and click ⟨**Select**⟩, or click ⟨**Back**⟩ to return to the previous display.

7. The software displays the **Transfer of gauge contents from the computer to the gauge** screen shown in Figure 3–16. Ensure that the gauge is set to the proper baud rate, is in *Remote Control* mode, and is properly connected to the computer using an RS-232 cable. Click the ⟨**Send Constants**⟩ button to continue.

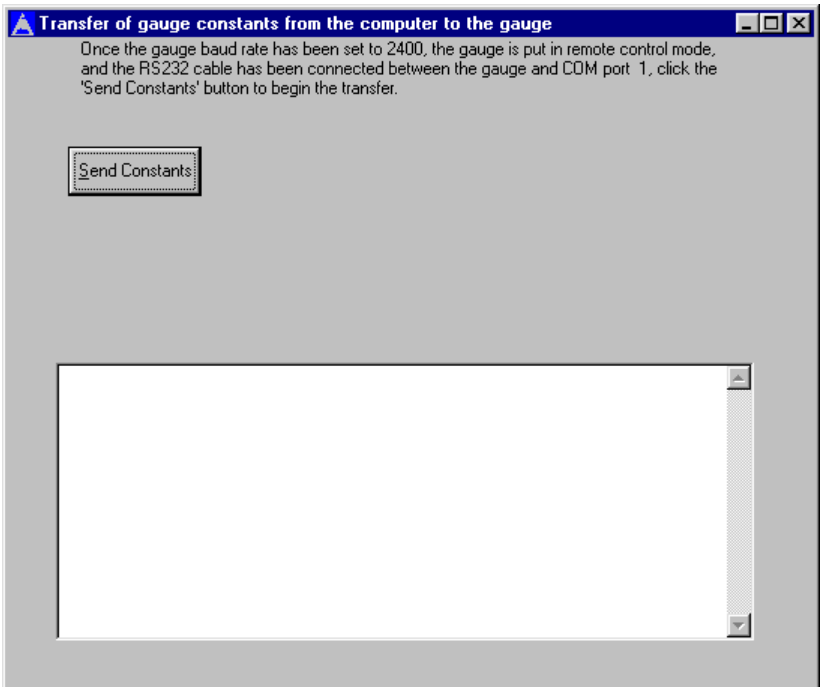


Figure 3–16. Transfer of Gauge Constants Screen, with RS-232 Cable

8. The software now displays a message box that informs the user that, during the upload process, the computer will be unresponsive to user input (keyboard, mouse, etc.). However, the program will not "lock-up" – a timeout will occur after a predetermined amount of time and the user will be able to control the program again. Click the ⟨**OK**⟩ button to continue with the upload.

9. When the user clicks ⟨**OK**⟩ on the preceding message box, the data transfer begins. The software sends the pertinent data to the gauge, then retrieves it back from the gauge for comparison and confirmation. The entire process takes about 2 minutes.

   - If any communications problems are encountered during the upload, the software displays an error message box that prompts the user to check the computer Com port settings and the RS-232 cable and to try again. Click ⟨**OK**⟩ on this error message to return to step 5.
   - If the process is successful, the software displays a confirmation message. Click the ⟨**Next**⟩ button to return to the **3450 Calibration Main Menu**, and proceed to step 16.

10. If the user has selected the Troxler Calibration Control system as the gauge-computer interface, after the ⟨**Next**⟩ button is clicked in step 3 on page 3–22, the software displays the **Download Instruction** window shown in Figure 3–17.

    - To return to the previous display, click the ⟨**Back**⟩ button.
    - To view more information about this process, click ⟨**Help!**⟩.
    - To proceed with downloading the calibration constants from the computer to the gauge, click ⟨**Next**⟩.

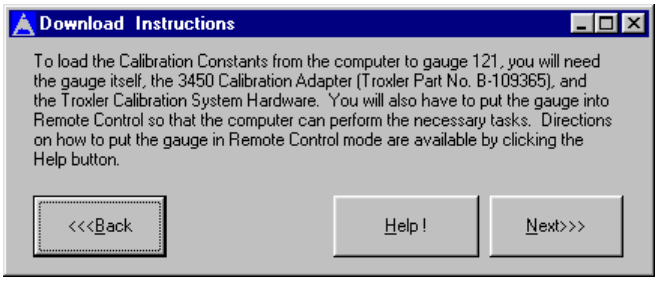


Figure 3–17. Download Instructions Window for Troxler Calibration Control System

11. The software now prompts the user to select the serial communications (Com) port settings for the computer. This display is similar to the one shown in Figure 3–6 on page 3–14. It is important that the baud rate of the gauge matches the baud rate of the computer. Select the desired Com port and baud rate from the dropdown lists and click ⟨**Select**⟩, or click ⟨**Back**⟩ to return to the previous display.

12. After the user clicks the ⟨**Select**⟩ button, the software displays the **Transfer of gauge constants from the computer to the gauge** screen shown in Figure 3–11. Ensure that the gauge is set to the proper baud rate and is in *Remote Control* mode, and that the 3450 adapter cable is properly connected between the gauge and the interface cable of the Troxler Calibration Control System. Click the ⟨**Send Constants**⟩ button to continue.

13. The software now displays a message box that informs the user that, during the upload process, the computer will be unresponsive to user input (keyboard, mouse, etc.). However, the program will not "lock-up" – a timeout will occur after a predetermined amount of time and the user will be able to control the program again. Click the ⟨**OK**⟩ button to continue with the download.

14. The software prompts the user to perform a manual reset of the calibration buffer box, as shown in Figure 3–12 on page 3–18. If the calibration buffer box is not reset, the gauge will not be able to communicate with the computer to put it in the proper mode. Perform the reset operations as instructed, then click the ⟨**OK**⟩ button.

Figure 3–18. Transfer of Gauge Constants Screen, with Troxler Calibration Control System

15. The computer now sends an initialization string to the calibration buffer box. This initialization string, if received correctly, reconfigures the Calibration Control system. This reconfiguration will make the Calibration Control System, *if the 3450 converter cable (Troxler Part No. 109365) is connected to it*, behave like a null modem cable between the gauge and the computer.

    - If the initialization string is received correctly, the software displays a message box that confirms that the control box has been defeated and that calibration constants can now be sent. Click ⟨**OK**⟩ to go to step 9 on page 3–24.
    - If instead the initialization string was not received correctly, the displays an error message that states **The Troxler Calibration System controller could not be bypassed. Check configurations and settings and try again.** Click ⟨**OK**⟩ to return to step 11, and re-enter the serial port and baud rate.

16. Now that the calibration constants are in the gauge, the *Calibration Accuracy Check Form* must be formulated and printed. The user will employ this form to record the Quality Assurance counts and evaluate the results. From the **3450 Calibration Main Menu** (see Figure 3–1 on page 3–11), select the **Print a Calibration Accuracy Check (QA) Form** option and click the ⟨**Proceed**⟩ button.

17. The software now displays a message box showing the gauge serial number for which the QA form is being printed.

    - If this is the correct gauge, click the ⟨**Yes**⟩ button and proceed to the next step.
    - Otherwise, click the ⟨**No**⟩ button to return to the **3450 Calibration Main Menu**.

18. The software now displays a screen that allows the user to select the units (English or Metric) to be used on the QA forms.

    - To proceed, select the desired units, click the ⟨**Print QA forms**⟩ button, and continue to the next step.
    - To return to the **3450 Calibration Main Menu** without printing the QA forms, click ⟨**Cancel**⟩.

19. The program now prints a hard copy of the QA form. When the printout is complete, click the ⟨**Cancel**⟩ button on the current screen and then proceed to the following step.

20. The calibration technician who is performing this calibration should record his or her name in the space beside the label *Calibration Technician* on page 1 of the QA form.

21. Place the gauge's poly standard block on the mag/aluminum block, in the standard count orientation.

22. Position the gauge on the poly standard in the same orientation as any other Troxler Model 3400 gauge would be oriented for a standard count.

23. Take a standard count. Record the results in the appropriate location on the QA form.

24. Following the instructions on the QA form, calculate the Density and Moisture Standard Percent differences and record them at the appropriate location.

25. If the Density and Moisture Standard Percent differences do not meet the required limits as listed on the QA form, take another standard count, and repeat step 24. If the Density and Moisture Standard Percent differences **still** do not meet the required limits as listed on the QA form, halt the calibration process and take the gauge to Service for analysis and repair.

26. From the *Ready* mode on the gauge, press the ⟨**MODE**⟩ key. The gauge displays its three modes of operation.

27. Press the ⟨**1**⟩ key to place the gauge in *Soil* mode.

28. When the gauge returns to the *Ready* mode, press the ⟨**TIME**⟩ key. The gauge displays its three selectable count times.

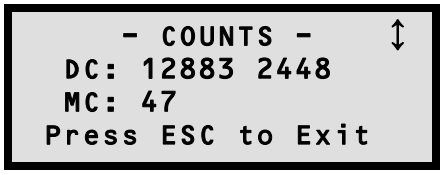
29. Press the ⟨**1**⟩ key to set the gauge count time to 1 minute.

30. Place the gauge on the magnesium calibration block, in the measurement position. Place the source rod in backscatter position, making sure the handle clicks into the backscatter notch. Press down gently on the end of the handle (without touching the trigger) to ensure that the handle is properly seated.

31. From the *Ready* mode, press the ⟨**START**⟩ key. The gauge takes a count.

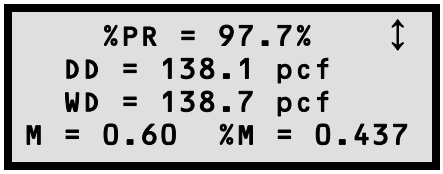
32. When the count is complete, the gauge displays either the System 1, System 2, and Moisture counts or the Wet Density, Dry density, Moisture content, and percent moisture. Which of these two displays is on the gauge depends on which was displayed the last time a count was taken.

- If the counts are listed, the display will be similar to the following:



In the *Magnesium block density measurements* section of the *Calibration Accuracy Form*, there is a table for recording these measurements. Find the row that corresponds to the current index rod position of the gauge. In the *SYS 1 CNT* column, record the System 1 density count (the first number in the gauge display line beginning *DC:*). In the *SYS 2 CNT* column, record the System 2 density count (the second number in the gauge display line beginning *DC:*).

- If instead of counts the gauge display shows density and moisture values, the display will be similar to the following:



In the *Magnesium block density measurements* section of the *Calibration Accuracy Form*, there is a table for recording these measurements. Find the row that corresponds to the current index rod position of the gauge. In the **first** *DENS* column (located between the *SYS 2 CNT* column and the *SYS 1 RC* column), record the Wet Density value. The Wet Density value is shown on the gauge display in the third row, after the heading *WD =*.

33. Once step 32 is complete and the values on the gauge display have been recorded, press either the up or down arrow key on the gauge. If the gauge counts were displayed in step 32, then the gauge density and moisture values will now be displayed. Conversely, if the gauge density and moisture values were displayed in step 32, the gauge counts should now be displayed. Record the appropriate values currently being displayed by the gauge on the *Calibration Accuracy Form*, as described in step 32.

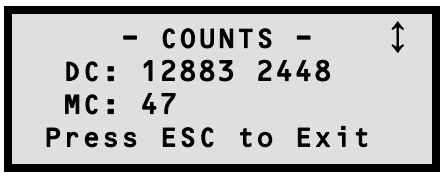
34. Press the ⟨**ESC**⟩ key on the gauge. If the wet density value measured by the gauge in step 32 falls within the respective range specified on the *Calibration Accuracy Check* form, then proceed to step 40. Otherwise, a recount must be taken. If a recount is needed, proceed to step 35.

35. Press the ⟨**TIME**⟩ key. The gauge will display its three selectable count times. Press the ⟨**3**⟩ key to select a 4-minute count time.

36. Repeat step 31.

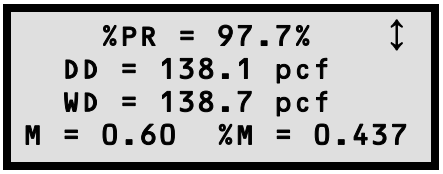
37. When the count is complete, the gauge displays either the System 1, System 2, and Moisture counts or the Wet Density, Dry density, Moisture content, and percent moisture. Which of these two displays is on the gauge depends on which was displayed the last time a count was taken.

- If the counts are listed, the display will be similar to the following:



In the *Magnesium block density measurements* section of the *Calibration Accuracy Form*, there is a table for recording these measurements. Find the row that corresponds to the current index rod position of the gauge. In the *SYS 1 RC* column, record the System 1 density count (the first number in the gauge display line beginning *DC:*). In the *SYS 2 RC* column, record the System 2 density count (the second number in the gauge display line beginning *DC:*).

- If instead of counts the gauge display shows density and moisture values, the display will be similar to the following:



In the *Magnesium block density measurements* section of the *Calibration Accuracy Form*, there is a table for recording these measurements. Find the row that corresponds to the current index rod position of the gauge. In the **second** *DENS* column (the rightmost column in the table), record the Wet Density value. The Wet Density value is shown on the gauge display in the third row, after the heading *WD* =.

38. Once step 37 is complete and the values on the gauge display have been recorded, press either the up or down arrow key on the gauge. If the gauge counts were displayed in step 37, then the gauge density and moisture values will now be displayed. Conversely, if the gauge density and moisture values were displayed in step 37, the gauge counts should now be displayed. Record the appropriate values currently being displayed by the gauge on the *Calibration Accuracy Form*, as described in step 37.

39. Press the ⟨**ESC**⟩ key on the gauge. If the wet density measured by the gauge in step 37 falls within the respective range specified on the *Calibration Accuracy Check* form, then continue to the next step. Otherwise, recounts are necessary; proceed to the *Editing the Calibration Data* section that begins on page 3–21 to acquire them.

40. Press the ⟨**TIME**⟩ key. The gauge will display its three selectable count times. Press the ⟨**1**⟩ key to select a 15-second count time.

41. Reposition the gauge on the magnesium calibration block in the 2-inch measurement position.

42. Repeat steps 31 through 33.

43. Press the ⟨**ESC**⟩ key on the gauge. If the wet density measured by the gauge in step 42 falls within the respective range specified on the *Calibration Accuracy Check* form, then proceed to step 48. Otherwise, a recount must be taken. If a recount is needed, proceed to step 44.

44. Press the ⟨**TIME**⟩ key. The gauge will display its three selectable count times. Press the ⟨**2**⟩ key to select a 1-minute count time.

45. Repeat steps 31 through 33.

46. Press the ⟨**ESC**⟩ key on the gauge. If the wet density measured by the gauge in step 45 falls within the respective range specified on the *Calibration Accuracy Check* form, then continue to the following step. Otherwise, recounts are necessary; proceed to the *Editing the Calibration Data* section that begins on page 3–21 to acquire them.

47. Press the ⟨**TIME**⟩ key. The gauge will display its three selectable count times. Press the ⟨**1**⟩ key to select a 15-second count time.

48. If the count just taken was the maximum source rod extension for this gauge, then proceed to step 51. Otherwise, proceed to step 49.

49. Reposition the gauge on the magnesium calibration block at the next measurement position.

50. Proceed to step 42.

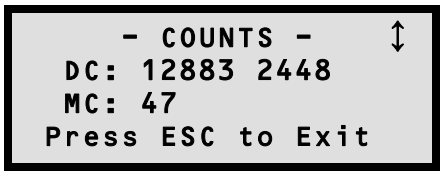
51. Press the ⟨**TIME**⟩ key. The gauge will display its three selectable count times. Press the ⟨**2**⟩ key to set the gauge count time to 1 minute.

52. Place the gauge on the aluminum calibration block, in measurement position. Place the source rod in the backscatter position, making sure the handle clicks into the backscatter notch. Press down gently on the end of the handle (without touching the trigger) to ensure that the handle is properly seated.

53. From the *Ready* mode, press the ⟨**START**⟩ key. The gauge takes a reading.

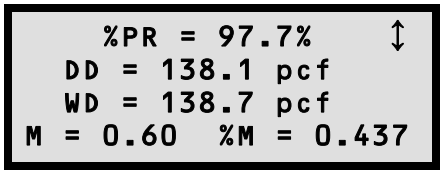
54. When the count is complete, the gauge displays either the System 1, System 2, and Moisture counts or the Wet Density, Dry density, Moisture content, and percent moisture. Which of these two displays is on the gauge depends on which was displayed the last time a count was taken.

    - If the counts are listed, the display will be similar to the following:



      In the *Aluminum block density measurements* section of the *Calibration Accuracy Form*, there is a table for recording these measurements. Find the row that corresponds to the current index rod position of the gauge. In the *SYS 1 CNT* column, record the System 1 density count (the first number in the gauge display line beginning *DC:*). In the *SYS 2 CNT* column, record the System 2 density count (the second number in the gauge display line beginning *DC:*).

    - If instead of counts the gauge display shows density and moisture values, the display will be similar to the following:



      In the *Aluminum block density measurements* section of the *Calibration Accuracy Form*, there is a table for recording these measurements. Find the row that corresponds to the current index rod position of the gauge. In the **first** *DENS* column (located between the *SYS 2 CNT* column and the *SYS 1 RC* column), record the Wet Density value. The Wet Density value is shown on the gauge display in the third row, after the heading *WD =*.

55. Once step 54 is complete and the values on the gauge display have been recorded, press either the up or down arrow key on the gauge. If the gauge counts were displayed in step 54, then the gauge density and moisture values will now be displayed. Conversely, if the gauge density and moisture values were displayed in step 54, the gauge counts should now be displayed. Record the appropriate values currently being displayed by the gauge on the *Calibration Accuracy Form*, as described in step 54.

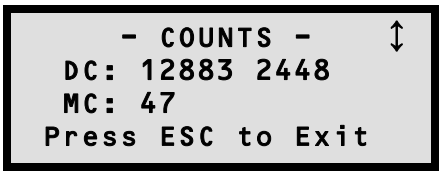
56. Press the ⟨**ESC**⟩ key on the gauge. If the wet density measured by the gauge in step 54 falls within the range specified on the *Calibration Accuracy Check* form, then a proceed to step 63. Otherwise, a recount must be taken. If a recount is needed, proceed to step 57.

57. Press the ⟨**TIME**⟩ key. The gauge will display its three selectable count times. Press the ⟨**3**⟩ key to select a 4-minute count time.

58. Repeat step 53.

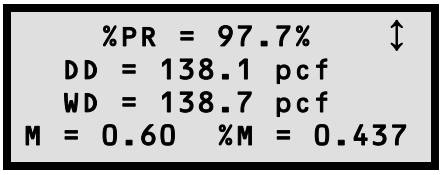
59. When the count is complete, the gauge displays either the System 1, System 2, and Moisture counts or the Wet Density, Dry density, Moisture content, and percent moisture. Which of these two displays is on the gauge depends on which was displayed the last time a count was taken.

    - If the counts are listed, the display will be similar to the following:



      In the *Aluminum block density measurements* section of the *Calibration Accuracy Form*, there is a table for recording these measurements. Find the row that corresponds to the current index rod position of the gauge. In the *SYS 1 RC* column, record the System 1 density count (the first number in the gauge display line beginning *DC:*). In the *SYS 2 RC* column, record the System 2 density count (the second number in the gauge display line beginning *DC:*).

    - If instead of counts the gauge display shows density and moisture values, the display will be similar to the following:



      In the *Aluminum block density measurements* section of the *Calibration Accuracy Form*, there is a table for recording these measurements. Find the row that corresponds to the current index rod position of the gauge. In the **second** *DENS* column (the rightmost column in the table), record the Wet Density value. The Wet Density value is shown on the gauge display in the third row, after the heading *WD* =.

60. Once step 57 is complete and the values on the gauge display have been recorded, press either the up or down arrow key on the gauge. If the gauge counts were displayed in step 57, then the gauge density and moisture values will now be displayed. Conversely, if the gauge density and moisture values were displayed in step 57, the gauge counts should now be displayed. Record the appropriate values currently being displayed by the gauge on the *Calibration Accuracy Form*, as described in step 57.

61. Press the ⟨**ESC**⟩ key on the gauge. If the wet density value measured by the gauge in step 57 falls within the respective range specified on the *Calibration Accuracy Check* form, then proceed to the following step. Otherwise, recounts are necessary; proceed to the *Editing the Calibration Data* section that begins on page 3–21 to acquire them.

62. Press the ⟨**TIME**⟩ key. The gauge will display its three selectable count times. Press the ⟨**1**⟩ key to select a 15-second count time.

63. Reposition the gauge on the aluminum calibration block in the 2-inch measurement position.

64. Repeat steps 53 through 55.

65. Press the ⟨**ESC**⟩ key on the gauge. If the wet density value measured by the gauge in step 64 falls within the respective range specified on the *Calibration Accuracy Check* form, then a proceed to step 69. Otherwise, a recount must be taken. If a recount is needed, proceed to step 66.

66. Press the ⟨**TIME**⟩ key. The gauge will display its three selectable count times. Press the ⟨**2**⟩ key to select a 1-minute count time.

67. Repeat steps 58 through 60.

68. Press the ⟨**ESC**⟩ key on the gauge. If the wet density value measured by the gauge in step 67 falls within the respective range specified on the *Calibration Accuracy Check* form, then a proceed to the following step. Otherwise, recounts are necessary; proceed to the *Editing the Calibration Data* section that begins on page 3–21 to acquire them.

69. Press the ⟨**TIME**⟩ key. The gauge will display its three selectable count times. Press the ⟨**1**⟩ key to select a 15-second count time.

70. If the count just taken was the maximum source rod extension for this gauge, then proceed to step 73. Otherwise, proceed to step 71.

71. Reposition the gauge on the aluminum calibration block at the next measurement position.

72. Proceed to step 53.

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73. From the *Ready* mode on the gauge, press the ⟨**TIME**⟩ key. The gauge will display its three selectable count times. Press the ⟨**3**⟩ key to select a 4 minute count time.

74. From the *Ready* mode on the gauge, press the ⟨**MODE**⟩ key. The gauge will display its three modes of operation. Press the ⟨**3**⟩ key to place the gauge in *Thin Layer* mode.

75. The gauge prompts the user to enter the thin layer thickness. Press the ⟨**1**⟩ key to indicate that the thin layer thickness will be 1 inch. After pressing the ⟨**1**⟩ key, press ⟨**ENTER**⟩.

76. From the *Ready* mode on the gauge, press the ⟨**SPECIAL**⟩ key.

77. From the *Special* functions menu, press the ⟨**1**⟩ key to select *Special Operations.*

78. From the *Special Operations* menu, press the ⟨**3**⟩ key to select *Number Averages*.

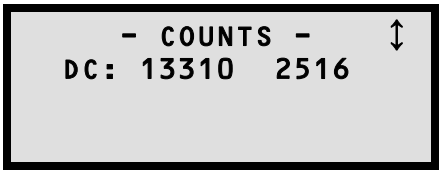
79. The gauge prompts the user to indicate how many thin layer counts will be averaged together to compute one thin layer measurement. Press the ⟨**1**⟩ key to indicate that a measurement will consist of only one count, then press ⟨**ENTER**⟩.

80. Place the gauge on the magnesium block, in the measurement position, and put the index rod in backscatter position.

81. Press the ⟨**START**⟩ key. The gauge displays that it is ready to take Count number 1 out of a total of 1 counts, and instructs the user to place the source rod in the backscatter position and to press the ⟨**START**⟩ key.

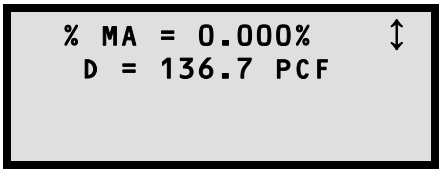
82. Press the ⟨**START**⟩ key a second time to begin the measurement.

83. When the count is complete, the gauge display is similar to the following. If the display does not look like this, press the up or down arrow, and it will.



On the third page of the *Calibration Accuracy Check* form is a table under the heading *PART I*. Go to the row of this table that corresponds to the calibration block where the gauge is currently located. In the column labeled *SYS 1 CNT*, record the *first* number listed in the second row of the gauge display (the number directly after the heading *DC* =). In the column labeled *SYS 2 CNT*, record the *second* number listed in the second row of the gauge display.

84. Press either the up arrow or the down arrow key. The gauge display will change to something like this:

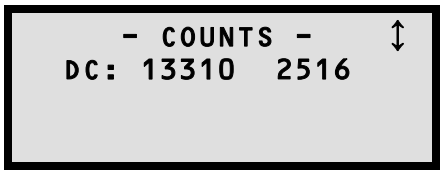


On the third page of the *Calibration Accuracy Check* form is a table under the heading *PART I*. Go to the row of this table that corresponds to the calibration block where the gauge is currently located. In the first column labeled *DENS* (near the center of the page), record the number shown in the second row of the gauge display (the number directly after the heading *D* =).

85. Just above the table where the values from steps 83 and 84 were recorded, there is a listing of allowed thin layer density measurement limits for the three metallic blocks. Compare the Density value just recorded in step 84 to the thin layer density limits for this block. If the measured density falls within the appropriate limits, then proceed to step 90. Otherwise, proceed to step 86.

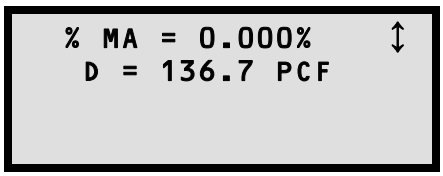
86. Repeat steps 81 and 82.

87. When the count is complete, the gauge display is similar to the following. If the display does not look like this, press the up or down arrow, and it will.



On the third page of the *Calibration Accuracy Check* form is a table under the heading *PART I*. Go to the row of this table that corresponds to the calibration block where the gauge is currently located. In the column labeled *SYS 1 RC*, record the *first* number listed in the second row of the gauge display (the number directly after the heading *DC* =). In the column labeled *SYS 2 RC*, record the *second* number listed in the second row of the gauge display.

88. Press either the up arrow or the down arrow key. The gauge display will change to something like this:



On the third page of the *Calibration Accuracy Check* form is a table under the heading *PART I*. Go to the row of this table that corresponds to the calibration block where the gauge is currently located. In the second column labeled *DENS* (near the center of the page), record the number shown in the second row of the gauge display (the number directly after the heading *D* =).

89. Just above the table where the data from steps 87 and 88 were recorded, there is a listing of allowed thin layer density measurement limits for the three metallic blocks. Compare the Density value just recorded in step 88 to the thin layer density limits for this block. If the measured density falls within the appropriate limits, then proceed to step 90. Otherwise, recounts are necessary; proceed to the *Editing the Calibration Data* section that begins on page 3–21 to acquire them.

90. Move the gauge to the Mag/Aluminum calibration block. Repeat steps 81 through 84.

91. Just above the table where the data from step 90 was recorded, there is a listing of allowed thin layer density measurement limits for the three metallic blocks. Compare the Density value just recorded in step 90 to the thin layer density limits for this block. If the measured density falls within the appropriate limits, then proceed to step 94. Otherwise, proceed to step 92.

92. Repeat steps 86 through 88.

93. Just above the table where the data from step 92 were recorded, there is a listing of allowed thin layer density measurement limits for the three metallic blocks. Compare the Density value just recorded in step 92 to the thin layer density limits for this block. If the measured density falls within the appropriate limits, then proceed to the following step. Otherwise, recounts are necessary; proceed to the *Editing the Calibration Data* section that begins on page 3–21 to acquire them.

94. Move the gauge to the Aluminum calibration block. Repeat steps 81 through 84.

95. Just above the table where the data from step 94 was recorded, there is a listing of allowed thin layer density measurement limits for the three metallic blocks. Compare the Density value just recorded in step 94 to the thin layer density limits for this block. If the measured density falls within the appropriate limits, then proceed to step 98. Otherwise, proceed to step 96.

96. Repeat steps 86 through 88.

97. Just above the table where the data from step 96 were recorded, there is a listing of allowed thin layer density measurement limits for the three metallic blocks. Compare the Density value just recorded in step 96 to the thin layer density limits for this block. If the measured density falls within the appropriate limits, then proceed to the following step. Otherwise, recounts are necessary; proceed to the *Editing the Calibration Data* section that begins on page 3–21 to acquire them.

98. Press the ⟨**TIME**⟩ key. The gauge will display its three selectable count times. Press the ⟨**2**⟩ key to select a 1-minute count time.

99. From the *Ready* mode on the gauge, press the ⟨**MODE**⟩ key. The gauge will display its three modes of operation.

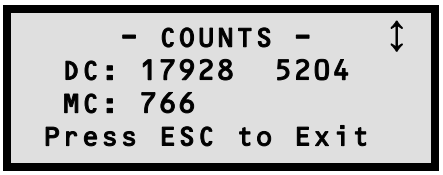
100. Press the ⟨**1**⟩ key to place the gauge in *Soil* mode.

101. Place the gauge in the center of the mag/poly calibration block. Place the source rod in backscatter position, making sure the handle clicks into the backscatter notch. Press down gently on the end of the handle (without touching the trigger) to ensure that the handle is properly seated.

102. From the *Ready* mode, press the ⟨**START**⟩ key. The gauge will take a count.

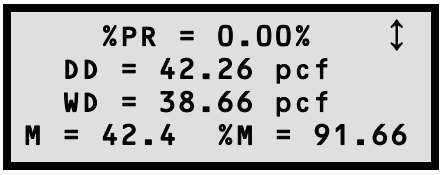
103. When the count is complete, the gauge displays either the System 1, System 2, and Moisture counts or the Wet Density, Dry density, Moisture content, and percent moisture. Which of these two displays is on the gauge depends on which was displayed the last time a count was taken.

- If the counts are listed, the display will be similar to the following:



  At the bottom of the second page of the *Calibration Accuracy Form*, there is a section entitled *MOISTURE QUALITY TEST*. Beside the heading *Moisture count:*, record the moisture count value listed on the gauge screen. This count value is on the third line of the display, after the letters *MC:*.

- If instead of counts the gauge display shows density and moisture values, the display will be similar to the following:



At the bottom of the second page of the *Calibration Accuracy Form*, there is a section entitled *MOISTURE QUALITY TEST*. There are two rows in this section where moisture data is recorded. In the <u>first</u> of these two rows, beside the heading *Measured moisture:*, record the moisture value listed on the gauge screen. The moisture value is *leftmost* number on the fourth line of the display, after the letters *M* =.

104. Once step 103 is complete and the values on the gauge display have been recorded, press the up or down arrow key on the gauge. If the gauge counts were displayed in step 103, then the gauge density and moisture values will now be displayed. Conversely, if the gauge density and moisture values were displayed in step 103, the gauge counts should now be displayed. Record the appropriate values currently being displayed by the gauge on the *Calibration Accuracy Form*, as described in step 103.

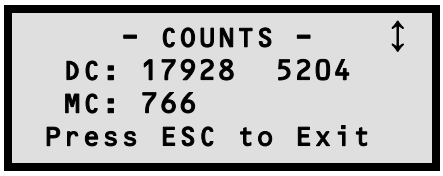
105. Press the ⟨**ESC**⟩ key on the gauge. If the measured moisture value measured by the gauge in step 103 falls within the range specified on the *Calibration Accuracy Check* form, then the Quality Assurance testing is complete and you may proceed to the *Archiving and Printing the Completed Calibration* section on page 3–37. Otherwise, proceed to the following step.

106. Press the ⟨**TIME**⟩ key. The gauge will display its three selectable count times. Press the ⟨**3**⟩ key to select a 4-minute count time.

107. Repeat step 102.

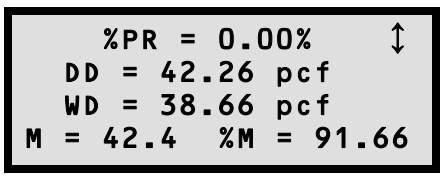
108. When the count is complete, the gauge displays either the System 1, System 2, and Moisture counts or the Wet Density, Dry density, Moisture content, and percent moisture. Which of these two displays is on the gauge depends on which was displayed the last time a count was taken.

    - If the <u>counts</u> are listed, the display will be similar to the following:



    At the bottom of the second page of the *Calibration Accuracy Form*, there is a section entitled *MOISTURE QUALITY TEST*. Beside the heading *Moist recount:*, record the moisture count value listed on the gauge screen. This count value is on the third line of the display, after the letters *MC:*.

    - If instead of counts the gauge display shows <u>density and moisture values</u>, the display will be similar to the following:



    At the bottom of the second page of the *Calibration Accuracy Form*, there is a section entitled *MOISTURE QUALITY TEST*. There are two rows in this section where moisture data is recorded. In the <u>second</u> of these two rows, beside the heading *Measured moisture:*, record the moisture value listed on the gauge screen. The moisture value is *leftmost* number on the fourth line of the display, after the letters *M* =.

109. Once step 108 is complete and the values on the gauge display have been recorded, press the up or down arrow key on the gauge. If the gauge counts were displayed in step 108, then the gauge density and moisture values will now be displayed. Conversely, if the gauge density and moisture values were displayed in step 108, the gauge counts should now be displayed. Record the appropriate values currently being displayed by the gauge on the *Calibration Accuracy Form*, as described in step 108.

110. Press the ⟨**ESC**⟩ key on the gauge. If the measured moisture value measured by the gauge in step 108 falls within the range specified on the *Calibration Accuracy Check* form, then the Quality Assurance testing is complete and you may proceed to the *Archiving and Printing the Completed Calibration* section on page 3–37. Otherwise, recounts are necessary; proceed to the *Editing the Calibration Data* section that begins on page 3–21 to acquire them.

ARCHIVING AND PRINTING THE COMPLETED CALIBRATION

Once the gauge has passed the QA tests, the calibration data must be archived in the database file. This is also the appropriate time to print out two sets of calibrations sheets – one for the customer and one for the files.

1. From the **3450 Calibration Main Menu** (see Figure 3–1 on page 3–11), choose the option **Save and print a certified calibration**, then click the ⟨**Proceed**⟩ button.

2. The software displays a message box that shows the current active calibration, and asks the user to confirm that this is the calibration he or she wishes to saves and print. Click ⟨**No**⟩ to return to the **3450 Calibration Main Menu** or ⟨**Yes**⟩ to continue.

3. If the user clicks ⟨**Yes**⟩, the software displays a message box requesting the user's initials. Enter your initials and click ⟨**OK**⟩. Note that at least two alphabetic characters must be entered. The program will not proceed unless a set of valid initials is entered.

4. When a valid set of initials is entered, the software saves the calibration data to the archive data file, and displays a confirmation message box. Click ⟨**Proceed**⟩ to continue with printing the calibration sheets.

5. The software displays the same screen shown in Figure 3–14 on page 3–20, giving the user the opportunity to print the calibration report.

   - To return to the **3450 Calibration Main Menu** without printing the calibration report, click the ⟨**Return to Main Menu**⟩ button.
   - To print the calibration sheets, click the ⟨**Print calibration sheets**⟩ button and proceed to the following step.

6. The software displays a dialog box that allows the user to select the printer to use to print the calibration sheets. Note, however, that the default value for **Number of Copies** is set to *2*, to encourage the user to print two calibration reports (one for the customer, the other for the lab files). Of course, the user may select any number of copies he or she wishes to pint.

   - If the user clicks the ⟨**Cancel**⟩ button, the print dialog box disappears, and the screen shown in Figure 3–14 is displayed.
   - If instead the user clicks the ⟨**Print**⟩ button, the calibration sheets are printed and the screen shown in Figure 3–14 is displayed.

7. Click the ⟨**Return to Main Menu**⟩ button to return to the **3450 Calibration Main Menu**.

FINAL INITIALIZATION AND STATUS CHECK

There are a few settings on the gauge that should be double-checked before releasing the gauge to calibration. This final stage performs these checks.

1. On the gauge, press the ⟨**SPECIAL**⟩ key. The *Special* functions menu is displayed.

2. From the *Special* functions menu, press ⟨**.**⟩ and then ⟨**9**⟩. The screen prompts the user to enter a code.

3. At the *Enter Code* prompt, enter the number *8148* and then press the ⟨**ENTER**⟩ key. The *Extended Functions* menu is displayed.

4. From the *Extended Functions* menu, press the ⟨**1**⟩ key to enter the gauge serial number.

5. When prompted, type in the gauge serial number and then press the ⟨**ENTER**⟩ key.

6. The gauge returns to the *Extended Functions* menu.
   - If the calibration constants and data were downloaded from the computer to the gauge in the *Calibration Quality Assurance* section on page 3–22, then the calibration date and the calibration standard counts are already in the gauge; proceed to step 11.
   - However, if the calibration constants were typed by hand into the gauge from the gauge keypad, then the calibration date and the calibration standard counts need to be entered into the gauge; proceed instead to step 7.

7. From the *Extended Functions* menu, press the ⟨**2**⟩ key to enter the date of the gauge calibration.

8. When prompted, type in the calibration date and press ⟨**ENTER**⟩. The gauge returns to the *Extended Functions* menu.

9. From the *Extended Functions* menu, press the ⟨**4**⟩ key to enter the standard counts acquired and used at the time of calibration.

10. When prompted, type in the requested calibration standard counts and press ⟨**ENTER**⟩ after each one is typed. After all values are entered the gauge returns to the *Extended Functions* menu.

11. Press the ⟨**ESC**⟩ key to return the gauge to *Ready* mode.

12. Check the time and date displayed on the gauge screen. If they are correct, proceed to step 19. If either one is incorrect, proceed to step 13.

13. On the gauge, press the ⟨**SPECIAL**⟩ key. The *Special* functions menu is displayed.

14. From the *Special* functions menu, press the ⟨**4**⟩ key to enter the *Gauge Setup* menu.

15. From the *Gauge Setup* menu, select press the ⟨**1**⟩ key to enter the *Time/Date* menu.

16. From the *Time/Date* menu, press the ⟨**1**⟩ key to change the time and/or press ⟨**2**⟩ to change the date.

17. Follow the screen prompts to change the time and/or date values.

18. When the date and time are correct, press ⟨**ESC**⟩ twice to return to the *Ready* mode.

19. The calibration process is now complete.

SELECTING THE GAUGE-COMPUTER INTERFACE

There are three instances in Troxler Model 3450 calibration usage where the user would wish to transfer data between the gauge and the calibration computer:

- Loading calibration constants from the computer to the gauge
- Retrieving thin layer calibration constants from the gauge to use in the recalibration program
- Sending the System Information from the gauge to the computer

There are two hardware options for performing these tasks. If the user owns the Troxler Calibration Control system (Troxler Part No. 106111), this system and the special 3450 Interface Adapter (Troxler Part No. B-109365) can be used as the gauge-computer interface. Otherwise, a simple 9-pin RS 232 null modem cable, connected from the RS-232 port of the gauge to the serial port of the computer, can be used as this interface.

The initial default setting for the gauge-computer interface is the 9-pin RS-232 null modem cable. To change this setting, select the **Advanced/Special Functions** option on the **3450 Calibration Main Menu** (see Figure 3–1 on page 3–11). The software displays the **3450 Advanced/Special Function Menu** shown in Figure 3–19. From this menu, choose the **Select interface medium…** option and click the ⟨**Proceed**⟩ button.

The **Select interface…** screen shown in Figure 3–20 is now displayed. This screen allows the user to select the desired interface between the gauge and calibration computer. The current hardware interface setting will be reflected in the option button that is selected. In Figure 3–20, the interface is the default setting, the RS-232 null modem cable.

- ▶ To leave the interface selection unchanged, click the ⟨**Quit**⟩ button.
- ▶ To change the interface selection, choose the desired option and click the ⟨**Select**⟩ button.

The software displays a message box confirming the selection of the gauge-computer interface. Click ⟨**OK**⟩ to return to the **3450 Calibration Main Menu**.

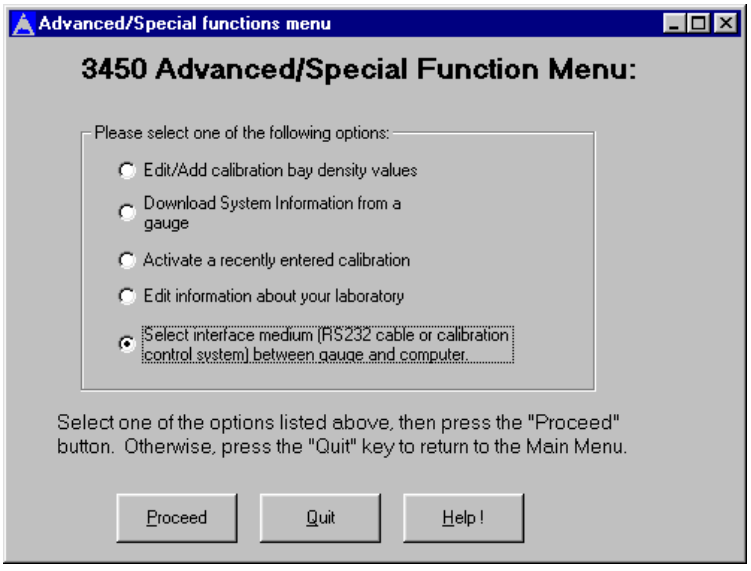


Figure 3–19. 3450 Advanced/Special Function Menu

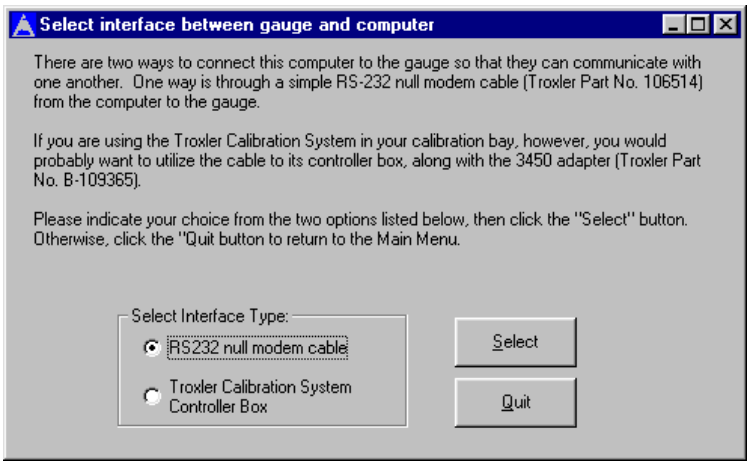


Figure 3–20. Select Interface Between Gauge and Computer Screen

NOTE

When the Select interface… screen is used to change the gauge-computer interface setting, the selected setting will <u>remain</u> the default interface setting – even after the program is terminated. The interface does not have to be reset each time the program is run.

CALIBRATION PROCEDURE OUTLINE AND CHECKLIST

- ❑ Obtain a copy of the recalibration data sheet for Model 3450 gauges and record the date, serial number, bay number, and index rod type on the form.
- ❑ Turn on gauge and allow it to power up and complete the self-test.
- ❑ Conduct a successful stat test and record the results on the recalibration data sheet. Make sure that all three standard counts fall within the specific Calibration Inspection Limit values.
- ❑ Calibrate the depth strip by pressing the ⟨**SPECIAL**⟩ key on the gauge, then enter the *Depth Indicator* menu, then enter the *Calibrate Depth* function. Follow the instructions to perform the strip calibration.
- ❑ Collect calibration data by performing and recording the counts listed on the recalibration data sheet. (Backscatter readings taken directly on the blocks must be 20 minutes in duration. Perform these counts by running the drift test from the *Special* functions menu. For these three tests, ignore whether the drift test fails, as these counts are not relevant to whether the gauge is drifting or not.)
- ❑ Once all of the calibration data is collected, perform a successful drift test. If necessary, take a provisional drift test.
- ❑ Once the drift test has passed, enter the data from the recalibration data sheet into the calibration program. Start the program on the bay computer, select the appropriate **Perform a…** option from the **Main Menu**, and follow the prompts to enter the calibration data.
- ❑ Once all of the calibration data have been entered, follow the prompts to compute the calibration constants and view the calibration report.
- ❑ When the calibration report is displayed, compare the relevant quantities on this report to the *Calibration Inspection Limits* to ensure that this calibration meets these requirements.
- ❑ Return to the **Main Menu** in the calibration program and follow the prompts to download the calibration constants from the computer into the gauge.
- ❑ Once the calibration constants are in the gauge, return to the **Main Menu** in the calibration program and follow the prompts to print a calibration *Quality Assurance Form*.
- ❑ Run the Calibration Accuracy Tests (QA Test) successfully.
- ❑ Once the QA Test has been completed successfully, return to the **Main Menu** in the calibration program and select the **Save and Print a Certified Calibration** option. Follow the prompts to archive the calibration and print the calibration report.
- ❑ File one copy of the calibration report, and put the other with the gauge.
- ❑ Access the gauge's *Extended Functions* menu (see instructions for this in the note at the end of this checklist). From the *Extended Functions* menu, enter the gauge serial number.

- ❑ If the calibration constants were entered into the gauge by hand from the gauge keypad (NOT by downloading from the computer), then access the *Extended Functions* menu and enter into the gauge the date when the gauge was calibrated and the standard counts that were used at the time of calibration. If instead the calibration constants were downloaded from the computer, these data do not have to be entered.

- ❑ Press the ⟨**SPECIAL**⟩ key on the gauge and, from the *Special* functions menu, access the *Gauge Setup* menu. From the *Gauge Setup* menu set the date and time in the gauge to their correct values.

NOTE

To access the *Extended Functions* menu in the gauge, press the ⟨SPECIAL⟩ key, then press ⟨.⟩ and ⟨9⟩. When the gauge prompts for the entry of a code, enter the number *8148* and then press the ⟨ENTER⟩ key. The *Extended Functions* menu will then be displayed.

3450 RECALIBRATION DATA SHEET

Date:		Model No.:	3450	Version:	A
Serial No.:		Bay No.:		Index Rod Type:	

Stat Test Results

System 1:		R:		System 2:		R:	
MOIST:		R:		Notes:	

Background Counts

System 1:		System 2:		MOIST:	

Direct Transmission Counts (4 min.)

Source Depth (in.)	Mag.		Mag./Alum.		Limestone		Granite		Aluminum		SR. Lime.		Mag/Poly	
	Sys 1	Sys 2	Sys 1	Sys 2	Sys 1	Sys 2	Sys 1	Sys 2	Sys 1	Sys 2	Sys 1	Sys 2	Sys 1	Sys 2
2														
3														
4														
5														
6														
7														
8														
9														
10														
11														
12														

3450 RECALIBRATION DATA SHEET (Continued)

Date:		Model No.:	3450	Version:	A
Serial No.:		Bay No.:			

Backscatter Counts (20 min. each)

Mag.		Mag./Alum.		Limestone		Granite		Aluminum		SR. Lime.		Mag/Poly	
Sys 1	Sys 2	Sys 1	Sys 2	Sys 1	Sys 2	Sys 1	Sys 2	Sys 1	Sys 2	Sys 1	Sys 2	Sys 1	Sys 2

Moisture Counts (4 min each)

Mag moist. count: Mg/Poly moist. count: Mg/Poly SR moist. count:

Drift Test Results

AVG 1: Drift: AVG 2: Drift:

MOIST: Drift: Notes:

Calibration Standard Counts (Average of Stat and Drift test): STD 1: STD 2: MOIST:

***Provisional* Stat Test Results**

System 1: R: System 2: R:

MOIST: R: Notes:

***Provisional* Drift Test Results**

AVG 1: Drift: AVG 2: Drift:

MOIST: Drift: Notes:

NOTE

The provisional stat test and drift test values on this page ARE NOT USED to compute the standard counts.

CHAPTER 4

MODEL 4640-A RECALIBRATION

This chapter provides instructions for recalibrating a Model 4640-A Thin Layer Density Gauge using the Troxler Legacy Calibration Suite software. The information presented here includes procedures for resolving issues encountered during the calibration process. A calibration procedure outline and checklist is provided at the end of this chapter, as well as a *4640-A Recalibration Data Sheet*.

CONTENTS

RECALIBRATION PROCEDURE

INITIAL STABILITY

1. Select a bay for calibration. The bay must contain the magnesium, mag/aluminum, and aluminum calibration blocks.

2. Obtain a *4640-A Recalibration Data Sheet* (see page 4–33) for recording the calibration data. Fill in the non-count data that can be entered at this point.

3. Place the gauge's magnesium standard plate on the mag/aluminum block.

4. Position the gauge on the magnesium standard, in the position normally used for taking a standard count.

5. Turn the gauge on. Leave this gauge on for at least twenty minutes to allow it to stabilize.

6. Press the sequence ⟨**T**⟩ ⟨**.**⟩ ⟨**3**⟩ ⟨**1**⟩ ⟨**6**⟩ ⟨**5**⟩ on the gauge keypad to put the gauge in *Calibration* mode.

7. Press the sequence ⟨**T**⟩ ⟨**1**⟩ to initiate the stat test procedure. When prompted by the gauge, press the ⟨**YES**⟩ key to begin the stat test.

8. Wait for the stat test to finish. At the conclusion of the test, the gauge display will show the average counts for System 1 and System 2. The display will also indicate if the stat test passed or not.

9. If both of the systems passed the stat test, then proceed to step 10. Otherwise, proceed to step 13.

10. Compare the average density standard counts to the respective density standard count limits in the *Calibration Inspection Limits* for the current gauge type.
    - If the observed standard counts fall within the allowed limits, then proceed to step 11.
    - If either standard count fails to fall within the specified *Calibration Inspection Limits*, however, then take another stat test by proceeding to step 13.

11. Record the average count, Ratio value, and Pass/Fail status for the two counting systems on the *4640-A Recalibration Data Sheet* under *Stat Test*.

12. Proceed to the following section, *Bulk Density Calibration Counting*, to collect the block counts.

13. Do not record the results of the preceding stat test. Instead, press the ⟨**NO/CE**⟩ key, then take another stat test by repeating steps 7 and 8.

14. Once this second stat test has concluded and the results are displayed on the gauge, record the average count, Ratio value, and Pass/Fail status for the two counting systems on the *4640-A Recalibration Data Sheet* under *Stat Test*.
    - If the gauge fails this second stat test, then halt the calibration process and take the gauge to Service or Assembly for analysis and repair.
    - If the gauge passes this second stat test, proceed to step 15.

15. Compare the average density standard counts to the respective density standard count limits in the *Calibration Inspection Limits* for the current gauge type.

    - If the observed standard counts fall within the allowed limits, then proceed to the following section, *Bulk Density Calibration Counting*, to collect the block counts
    - If either standard count fails to fall within the specified *Calibration Inspection Limits*, however, then halt the calibration process and take the gauge to Service or Assembly for analysis and repair.

BULK DENSITY CALIBRATION COUNTING

1. Place the gauge on the magnesium calibration block, in measurement position.

2. Place the source rod in backscatter position, making sure the handle properly sets into this orientation.

3. Press the sequence ⟨**T**⟩ ⟨**1**⟩ to initiate the stat test procedure. When prompted by the gauge, press the ⟨**YES**⟩ key to begin the stat test.

4. Wait for the stat test to finish. At the conclusion of the test, the gauge display will show the average counts for System 1 and System 2. The display will also indicate if the stat test passed or not.

5. If both systems pass the stat test, then record the average counts for System 1 and System 2 as the bulk density counts (or the "20-minute counts") for the block that the gauge is currently on, then proceed to step 8. Otherwise, proceed to step 6.

6. Take another stat test by repeating steps 3 and 4.

7. If the gauge fails this second stat test, check with your Supervisor. If the gauge passes this second stat test, then record the average counts for System 1 and System 2 as the bulk density counts (or the "20-minute counts") for the block that the gauge is currently on, then proceed to step 8.

8. If the gauge is currently on the magnesium block and the recalibration underway is a **3-block** recalibration, then move it to the mag/aluminum block and proceed to step 2. Otherwise, proceed to step 9.

9. If the gauge is currently on the magnesium block and the recalibration underway is a **2-block** recalibration, then move it to the aluminum block and proceed to step 2. Otherwise, proceed to step 10.

10. If the gauge is currently on the mag/aluminum block, then move it to the aluminum block and proceed to step 2. Otherwise, proceed to step 11.

11. If the gauge is currently on the aluminum block, then the bulk density counting is complete; proceed to the following section, *Drift Test*.

DRIFT TEST

1. Place the gauge's magnesium standard block on the center of the magnesium/aluminum calibration block.

2. Position the gauge on the magnesium standard block. Connect the gauge printer to the gauge, making sure that the baud rate is correct.

3. With the gauge in *Calibration* mode, press the sequence ⟨**T**⟩ ⟨**2**⟩ to initiate the drift test procedure. When prompted by the gauge, press the ⟨**YES**⟩ key to begin the drift test.

4. Wait until the drift test finishes. The gauge will print the drift test results to the gauge printer. The printout will contain the average System 1 and System 2 counts, along with the Pass/Fail results of the calibration.

5. In all likelihood, the printout will indicate that the drift test has failed. This is not a problem, since the last stat test taken with the gauge was not taken in the same configuration as the original stat test taken on the gauge's magnesium standard block. To calculate whether or not the drift test has actually been passed, one must enter the stat test and drift test data into the calibration program.

   Start the calibration program on the computer. When the **4640 Calibration Main Menu** appears, select the **Advanced/Special Functions** option as shown in Figure 4–1, then click the ⟨**Proceed**⟩ button. The **4640 Advanced/Special Function Menu** is displayed, as shown in Figure 4–2.

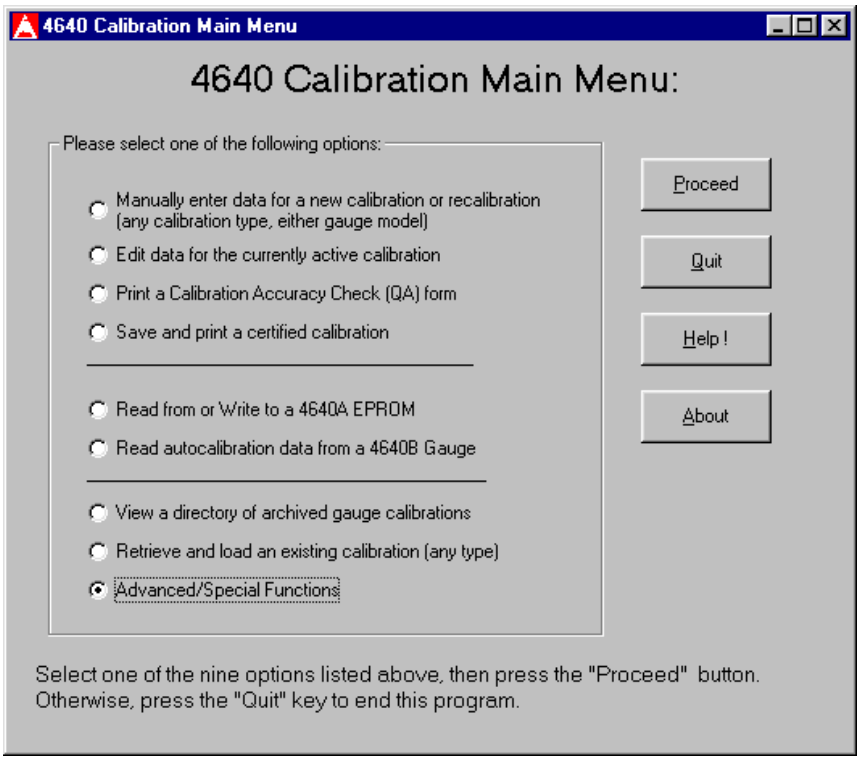


Figure 4–1. 4640 Calibration Main Menu

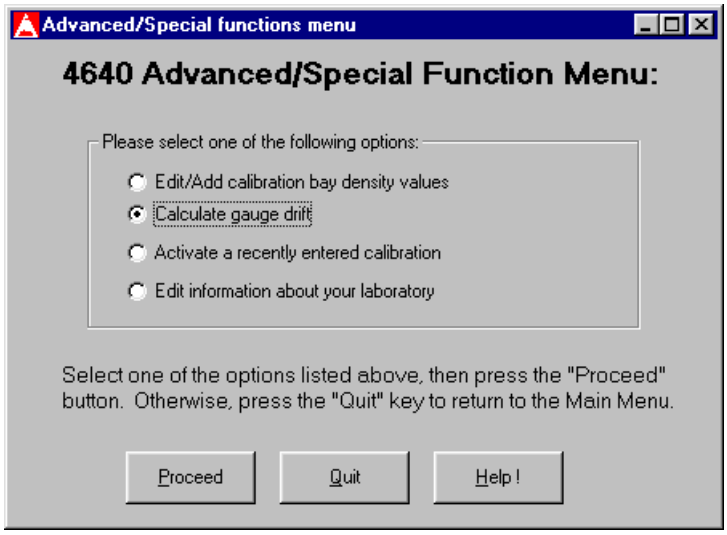


Figure 4–2. 4640 Advanced/Special Function Menu

6. Select the Calculate gauge drift option, then click the ⟨**Proceed**⟩ button. The **Calculate Percent Drift** screen (see Figure 4–3) is displayed.

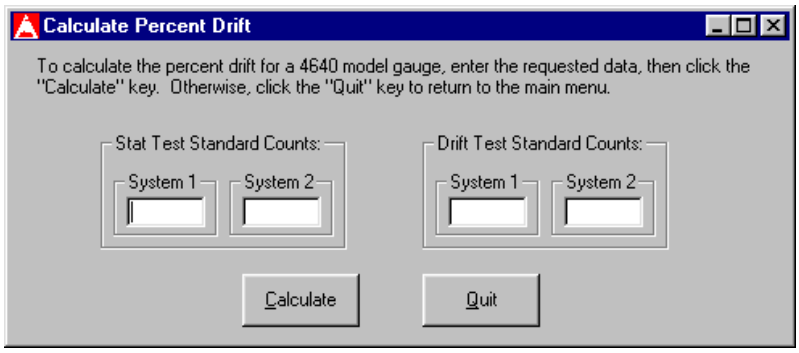


Figure 4–3. Calculate Percent Drift Screen

7. Enter the counts obtained from the stat test (see the *Initial Stability* section, step 7 or 10) and drift test (step 4 of this section) into the proper locations on this screen, then click the ⟨**Calculate**⟩ button. If any of the required fields are left blank, the program displays an error message box that states, **Critical data have been omitted or entered incorrectly.** If this error message occurs, click the ⟨**OK**⟩ button and correct the data entry error.

8. When the user clicks the ⟨**Calculate**⟩ button, the software displays the **Drift Test Results** screen shown in Figure 4–4. The limit for percent drift for System 1 is 0.5%, and the limit for percent drift for System 2 is 0.8%. In this example, both systems are within these limits, so both systems pass. If either system exceeds the limits, the drift test fails.
   - If the gauge passes the drift test for both systems, proceed to step 9.
   - If the gauge fails the drift test for either system, then do not record anything; proceed to step 15.

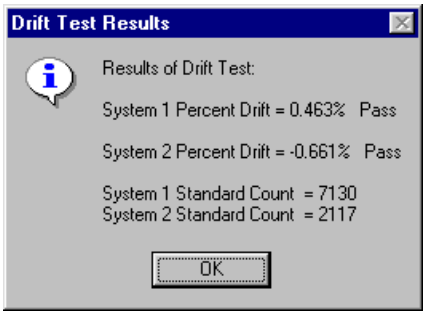


Figure 4–4. Drift Test Results Display

9. Retrieve the most recent drift test printout tape from step 4. Record the average System 1 and System 2 standard counts listed on the tape in the *Drift Test Results* section on the *4640-A Recalibration Data Sheet* in the designated space.

10. Now look back at the **Drift Test Results** display on the computer screen. Record the System 1 percent drift value and the System 2 percent drift values listed on this screen in the *Drift Test Results* section on the *4640-A Recalibration Data Sheet* in the designated space.

11. Finally, copy the System 1 Standard Count value and the System 2 Standard Count values from the **Drift Test Results** display into the *Calibration Standard Counts* section of the *4640-A Recalibration Data Sheet*. These values are the average of the stat and drift test.

12. Click the ⟨**OK**⟩ button on the **Drift Test Results** display. The program returns to the **Calculate Percent Drift** screen.

13. Click the ⟨**Quit**⟩ button on the **Calculate Percent Drift** screen to return the program to the **4640 Calibration Main Menu**.

14. Proceed to the *Entering Calibration Data Into the Calibration Program* section on page 4–13.

15. Move the gauge source rod up and down from **SAFE** position into measure position ten times, returning it to **SAFE** position after the tenth motion.

16. Take a second drift test by repeating steps 3 and 4.

17. On the computer, click the ⟨**OK**⟩ button on the **Drift Test Results** display. The program returns to the **Calculate Percent Drift** screen.

18. Leave the stat test data that are currently in the **Calculate Percent Drift** screen as they are, but replace the drift test data that are currently there with the data just obtained from the printout tape of the second drift test. Once the second drift test data have been entered, click the ⟨**Calculate**⟩ button.

19. Record the average System 1 and System 2 standard counts listed on the new drift test tape in the *Drift Test Results* section on the *4640-A Recalibration Data Sheet* in the designated space.

20. Now look back at the **Drift Test Results** display on the computer screen. Record the System 1 percent drift value and the System 2 percent drift values listed on this screen in the *Drift Test Results* section on the *4640-A Recalibration Data Sheet* in the designated space.

21. If the **Drift Test Results** display indicates that this second drift test has passed for both systems, then return to step 11. If, however, the gauge fails to pass this second drift test for either system, then a third *provisional* drift test is needed to see if the gauge drift is electronic in nature. Proceed to step 22 to run this provisional drift test.

22. In the provisional drift test, the results of the second drift test that was just performed (and failed) will be compared to a third drift test that will be conducted in 3 hours**. The gauge must be left untouched for this 3-hour period.** This way, any substantial count difference that is encountered between the second and third drift tests will truly be due to electronic drift.

    To start the provisional drift test process, click the ⟨**OK**⟩ button on the **Drift Test Results** display. The program returns to the **Calculate Percent Drift** screen.

23. Clear the values from the two **Stat Test Standard Counts** text boxes on the **Calculate Percent Drift** screen. However, leave the values in the two **Drift Test Standard Counts** text boxes as they are.

24. **Let the gauge sit untouched for 3 hours.**

25. After 3 hours, take a third drift test by repeating steps 3 and 4.

26. Leave the drift test values currently in the **Calculate Percent Drift** screen as they are. In the empty spaces for the ***stat test*** data, type in the data just obtained from the printout tape of this third ***drift test***. (Note that this is not a typo – enter the data from the ***drift test*** that was just performed in the spaces provided for the ***stat test***.) Once the second drift test data have been entered in this manner, click the ⟨**Calculate**⟩ button.

27. Proceed to the *Provisional Drift Test* section of the *4640-A Recalibration Data Sheet* and record the average System 1 and System 2 standard counts listed on the third drift test tape in the designated space.

28. Now look back at the **Drift Test Results** display on the computer screen. Record the System 1 percent drift value and the System 2 percent drift values listed on this screen in the *Provisional Drift Test Results* section on the *4640-A Recalibration Data Sheet* in the designated space.

29. If the **Drift Test Results** display indicates that this provisional drift test has passed for both systems, then return to step 11. If, however, the gauge fails to pass this provisional drift test for either system, then halt the calibration process and take the gauge to Service for analysis and repair.

ACQUIRING NECESSARY CALIBRATION CONSTANTS FROM A PREVIOUS CALIBRATION

1. Since the calibration that was just performed is a recalibration, the thin layer overlay counts were not taken. Therefore, the data just acquired is insufficient for calculating the thin layer calibration constants (A11, A12, A13, A21, A22, and A23). Furthermore, if the recalibration just performed is a 2-block recalibration, then the data just acquired is insufficient for calculating the Bulk Density "B" values (B1 and B2). Consequently, these values must be obtained from one of two sources: the calibration report from a previous calibration, or from the EPROM that is in the gauge.

   If the user has access to a calibration report from a previous calibration of this gauge and wishes to enter these values into the calibration program manually, then proceed to the *Entering Calibration Data Into the Calibration Program* section on page 4–13. Otherwise, if the user wishes to obtain these calibration constants from the EPROM of the gauge, proceed to step 2.

2. From the **4640 Calibration Main Menu** (see Figure 4–1 on page 4–4), select the option **Read from a 4640A EPROM**, then click ⟨**Proceed**⟩. Note that this option may be titled **Read From or Write to a 4640A EPROM**, depending on whether there is EPROM data currently stored in the program.

3. The program displays a message box that asks **Do you wish to read the data from a 4640A EPROM?** To abort this operation and return to the **4640 Calibration Main Menu**, click the ⟨**No**⟩ or ⟨**Cancel**⟩ button. Otherwise, click ⟨**Yes**⟩ and continue to step 4.

4. There are two types of EPROM programmer supported by this software: the Shooter by Logical Devices and the EP-1 by BP Microsystems. The software now asks the user if he or she will be using the Shooter, as shown in Figure 4–5.

   - To abort this operation and return to the **4640 Calibration Main Menu**, click the ⟨**Cancel**⟩ button.
   - If the Shooter will be used to burn the EPROM, click the ⟨**Yes**⟩ button and proceed to step 7.
   - If the EP-1 will be used to burn the EPROM, click the ⟨**No**⟩ button and proceed to step 14.

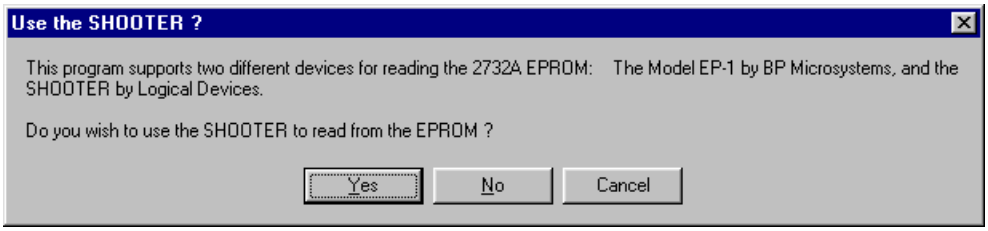


Figure 4–5. EPROM Programmer Selection Prompt

5. The software now displays a message box with instructions on preparing the Shooter for the upcoming tasks. Click the ⟨**Quit**⟩ button on this message box to abort this operation and return to the **4640 Calibration Main Menu**, or click ⟨**Help!**⟩ for more information. To proceed with the EPROM programming, perform the tasks listed in the message box and click the ⟨**Next**⟩ button.

6. The software displays the **Read EPROM constants from the SHOOTER** screen, as shown in Figure 4–6. This screen allows the user to select the communications port to which the Shooter is connected, as well as the baud rate to which the Shooter has been set. Confirm (and change, if necessary) these settings and click the ⟨**Select**⟩ button.

7. The screen changes as shown in Figure 4–7. The screen now informs the user of the selected communication port and baud rate, and instructs the user to click the ⟨**Read Constants**⟩ button to transfer the constants from the Shooter to the computer. Click the ⟨**Read Constants**⟩ button as directed. The software now displays a message box that informs the user that, during the data transfer, the computer will not respond to user input (keyboard, mouse, etc.). However, the program will not "lock-up" – a timeout will occur after a predetermined amount of time and the user will be able to control the program again. Click the ⟨**OK**⟩ button to continue with the data transfer.

8. After the user clicks the ⟨**OK**⟩ button, the EPROM programming process begins. If a problem is encountered in initiating the communications between the computer and the EPROM programmer, the program proceeds to step 9. If no such problem is encountered, the program proceeds to step 11.

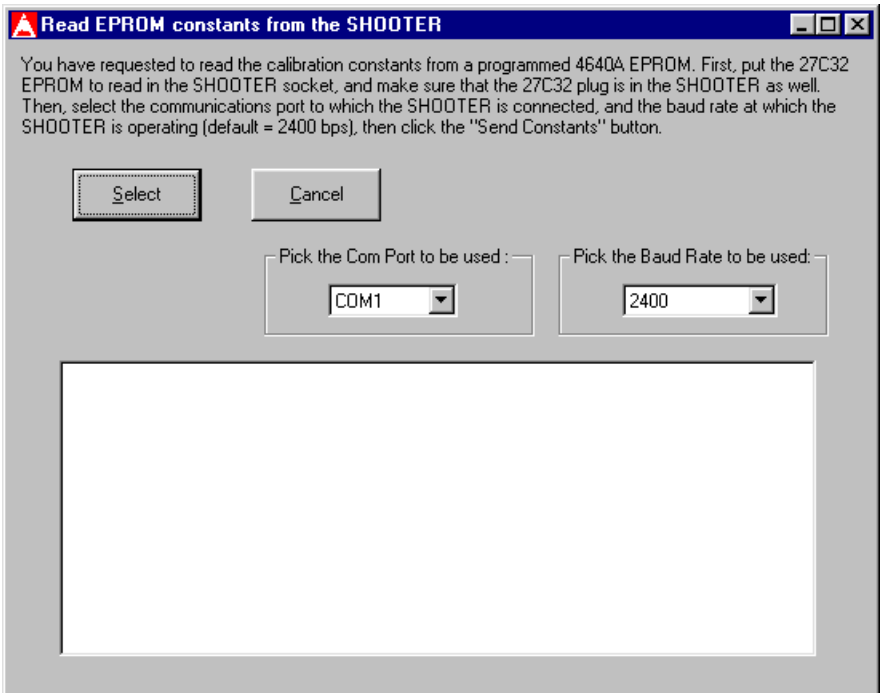


Figure 4–6. Read EPROM Constants from the Shooter, First Screen

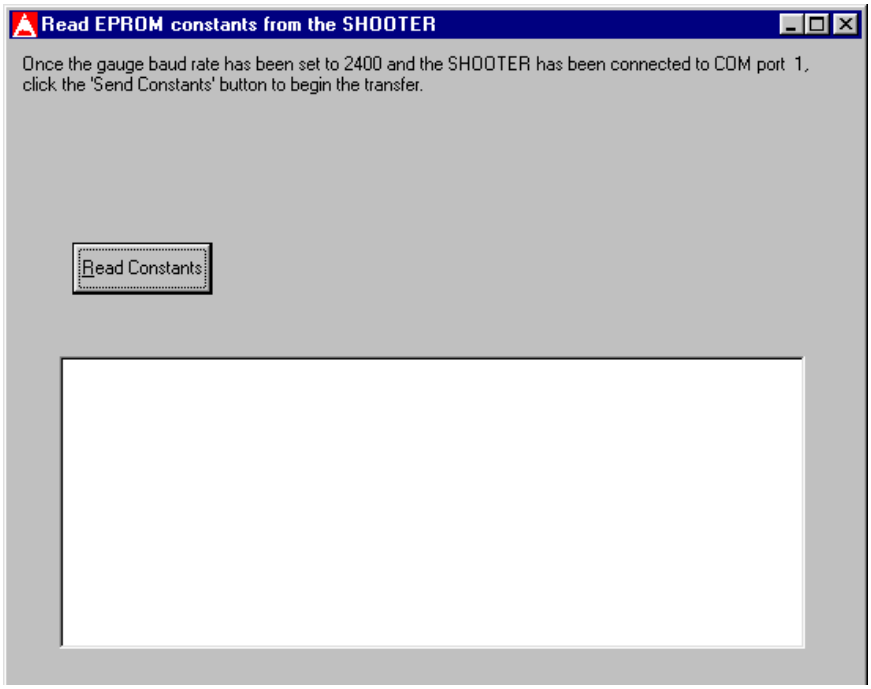


Figure 4–7. Read EPROM Constants from the Shooter, Second Screen

9. If the computer cannot initiate contact with the EPROM programmer, the program displays the error message box shown in Figure 4–8 after fifteen seconds.

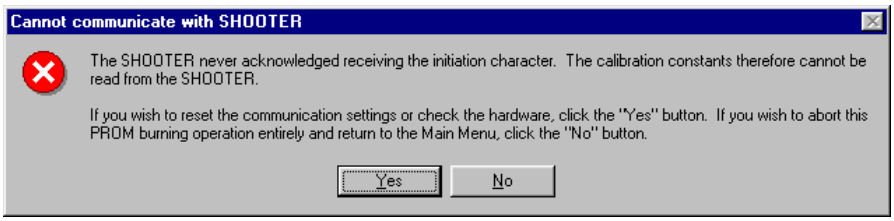


Figure 4–8. Cannot Communicate with SHOOTER Error Message

10. To abort the EPROM programming process and return to the **4640 Calibration Main Menu**, click the ⟨**No**⟩ button. To reset the communications settings, click the ⟨**Yes**⟩ button. The program prompts the user to manually reset the Shooter before continuing. As prompted, press the ⟨**RESET**⟩ button on the Shooter, then click the ⟨**OK**⟩ button on the message box. The program returns to step 5.

11. If the program is able to read the calibration data from the EPROM, a screen similar to Figure 4–9 is displayed. This screen displays the calibration constants just retrieved from the EPROM, both as decimal and hexadecimal values. Click the ⟨**Print**⟩ button to print these values as a backup, in case the data or the EPROM becomes damaged. After the printout is complete, click ⟨**Next**⟩ to return to the **4640 Calibration Main Menu**. The calibration constants have now been stored by the gauge, and can be accessed when the other calibration data is entered into the program. Proceed to the *Entering Calibration Data Into the Calibration Program* section on page 4–13.

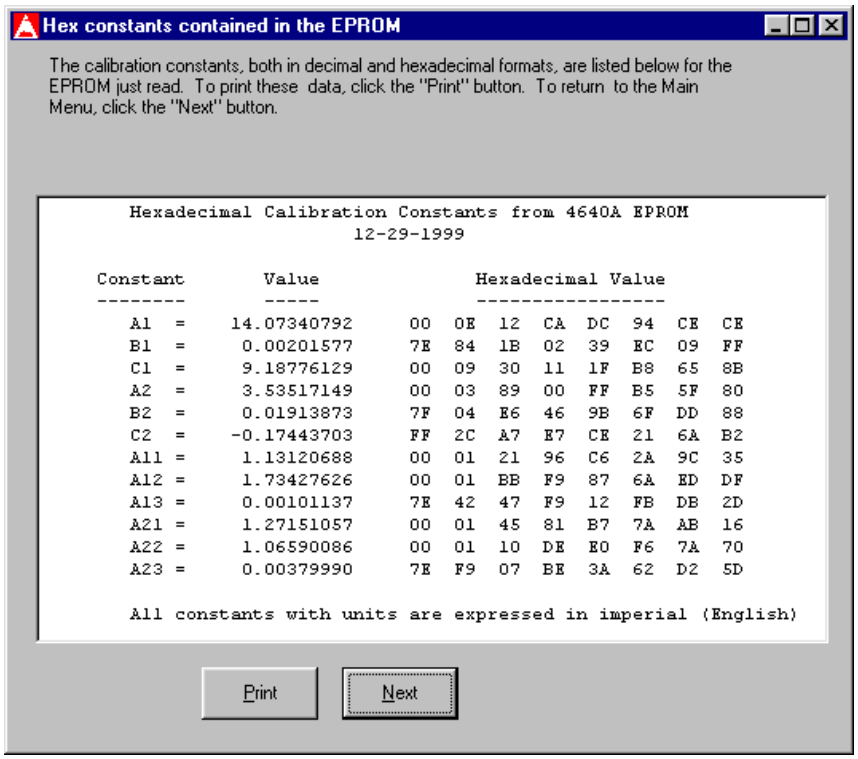


Figure 4–9. Hex Constants Contained in the EPROM Display

12. At this point the user has indicated that he or she does not wish to read the EPROM with the Shooter. The program displays a message box that asks **Do you instead wish to use the Model EP-1 to read the EPROM?**

    - To select the EP-1 as the EPROM programmer, click the ⟨**Yes**⟩ button and proceed to step 13.
    - To return to step 4, click ⟨**No**⟩.
    - To return to the **4640 Calibration Main Menu**, click ⟨**Cancel**⟩.

13. If the user clicks the ⟨**Yes**⟩ button on the preceding message box, the software displays a message box with instructions on configuring the EP-1 and EPROM to prepare for reading the EPROM. Click the ⟨**Quit**⟩ button on this message box to abort this operation and return to the **4640 Calibration Main Menu**, or click ⟨**Help!**⟩ for more information. To proceed with the EPROM programming, perform the tasks listed in the message box, click the ⟨**Next**⟩ button, and proceed to step 14.

14. The software displays the screen shown in Figure 4–10. This screen allows the user to select the communications port to which the EP-1 is connected. Select the appropriate communications port, click the ⟨**Select**⟩ button, and proceed to step 15. Note that the baud rate cannot be set: the baud rate of the EP-1 is forced to be 38400 bps. To return to the **4640 Calibration Main Menu**, click the ⟨**Cancel**⟩ button.

15. If the user clicks the ⟨**Select**⟩ button in the previous step, the screen changes as shown in Figure 4–11. The screen instructs the user to click the ⟨**Read Constants**⟩ button to transfer the constants from the EP-1 to the computer. Click the ⟨**Read Constants**⟩ button as directed and proceed to step 16.

16. The software now displays a message box that informs the user that, during the data transfer, the computer will not respond to user input (keyboard, mouse, etc.). However, the program will not "lock-up" – a timeout will occur after a predetermined amount of time and the user will be able to control the program again. Click the ⟨**OK**⟩ button to continue with the data transfer. If there is no problem with reading the data from the EPROM, the program collects the data and proceeds to step 19. If the program has a problem reading the EPROM, then the program instead proceeds to step 17.

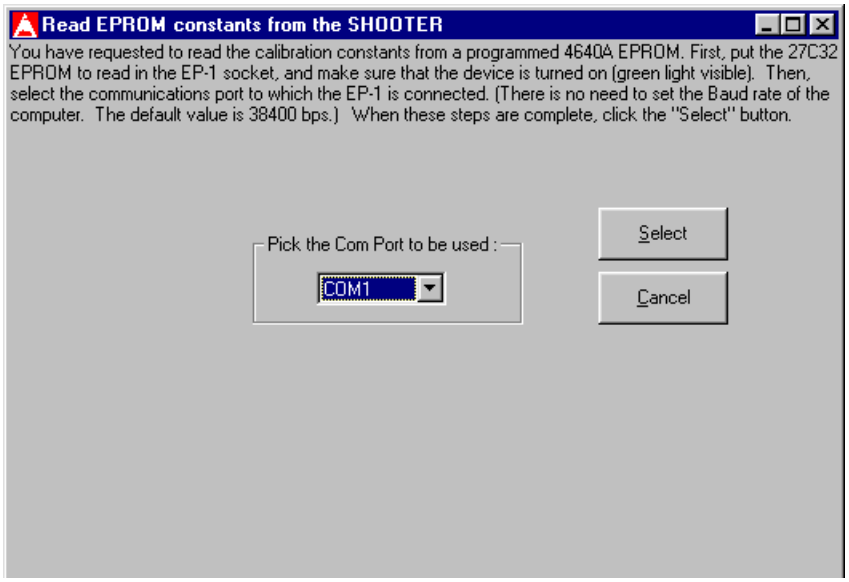


Figure 4–10. Read EPROM Constants from the EP-1, First Display

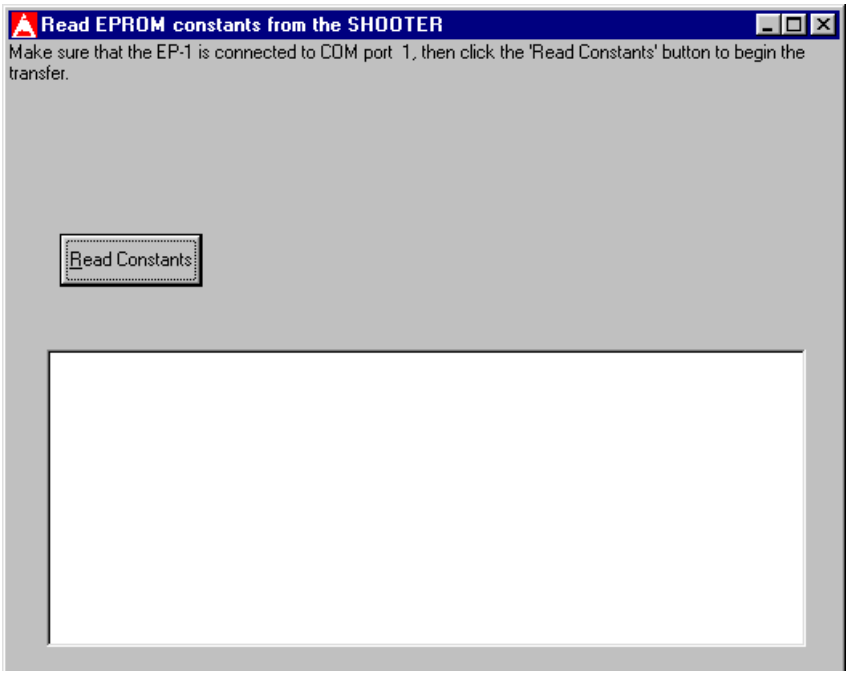


Figure 4–11. Read EPROM Constants from the EP-1, Second Display

17. If the program has difficulty communicating with the EP-1, the program displays the error message shown in Figure 4–12. To abort the EPROM programming process and return to the **4640 Calibration Main Menu**, clicking the ⟨**No**⟩ button. To try to fix the problem and try again to read the EPROM, click the ⟨**Yes**⟩ button and continue to step 18.

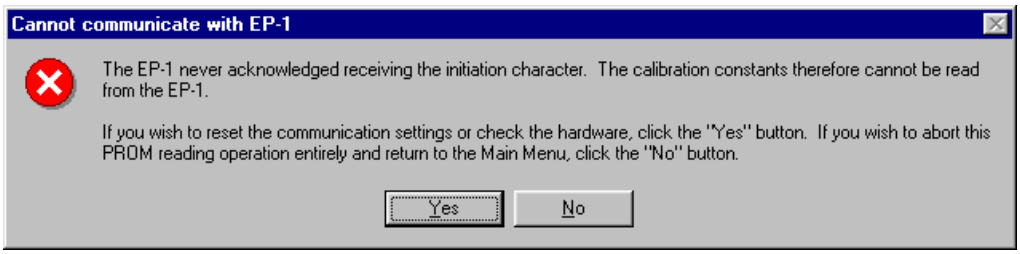


Figure 4–12. Cannot Communicate with EP-1 Error Message

18. If the user clicks the ⟨**Yes**⟩ button in the preceding message box, the program prompts the user to manually reset the EP-1 before continuing. As directed, switch the EP-1 off, then back on. Then click the ⟨**OK**⟩ button on the message box. The program returns to step 13.

19. If the program is able to read the calibration data from the EPROM, a screen similar to Figure 4–9 on page 4–10 is displayed. This screen displays the calibration constants just retrieved from the EPROM, both as decimal and hexadecimal values. Click the ⟨**Print**⟩ button to print these values as a backup, in case the data or the EPROM becomes damaged. After the printout is complete, click ⟨**Next**⟩ to return to the **4640 Calibration Main Menu**. The calibration constants have now been stored by the gauge, and can be accessed when the other calibration data is entered into the program. Proceed to the following section, *Entering Calibration Data Into the Calibration Program*.

ENTERING CALIBRATION DATA INTO THE CALIBRATION PROGRAM

1. From the **4640 Calibration Main Menu** (see Figure 4–1 on page 4–4), select the **Manually enter data for a new calibration or recalibration** option, then click the ⟨**Proceed**⟩ button.

2. The software displays a **Select the gauge model** screen, which prompts the user to select whether the gauge being calibrated is a Model 4640-A or 4640-B. Select the **4640 A** option button and click the ⟨**Proceed**⟩ button to go to the next step.

3. The software then displays a query message box that asks **Is this a full calibration of a 4640-A gauge?**

4. Since a recalibration of the Model 4640-A was just performed, click the ⟨**No**⟩ button to continue to the next step.

5. If calibration constants have recently been read from a 4640-A EPROM, the user may prefer to use these values rather than enter the required calibration constants manually. If calibration constants read from an EPROM do not exist in the program, the program proceeds to step 6. If calibration constants read from an EPROM do exist in the program, then these constants are identified by a query message box similar to the one shown in Figure 4–13.

   - To use these EPROM constants in the recalibration, click the ⟨**Yes**⟩ button and proceed to step 6.
   - To enter the required calibration constants into the program manually, click the ⟨**No**⟩ button and proceed to step 6.

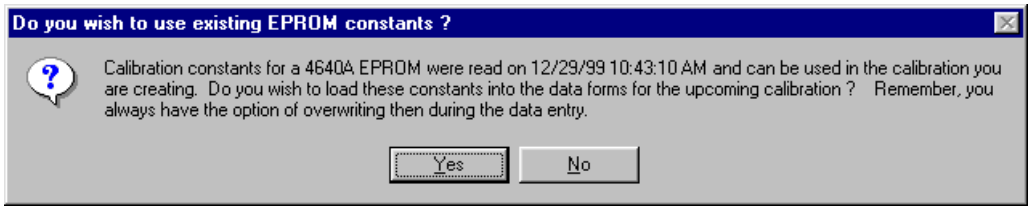


Figure 4–13. Use Existing Calibration Constants Query

6. As shown in Figure 4–14, the program now queries the user as to which type of recalibration was just performed.

   - If the user has just performed a 3-block calibration, click the ⟨**Yes**⟩ button and proceed to step 8.
   - If instead the user has just performed a 2-block calibration, click the ⟨**No**⟩ button and go to step 7.
   - To return to the **4640 Calibration Main Menu**, click the ⟨**Cancel**⟩ button.

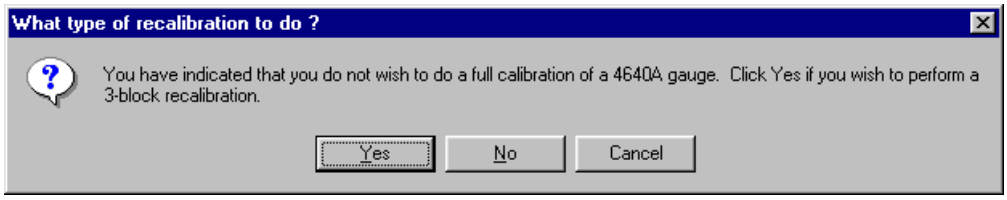


Figure 4–14. Recalibration Type Query

7. If the user clicks the ⟨**No**⟩ button on the preceding message box, the message box shown in Figure 4–15 is displayed.

   - If the calibration just performed was a 2-block calibration, click ⟨**Yes**⟩ and proceed to step 8.
   - If a mistake was made and this calibration was not a 2-block calibration, there are two ways to correct the error:
     - To return to step 2, click the ⟨**No**⟩ button.
     - To return to the **4640 Calibration Main Menu**, click the ⟨**Cancel**⟩ button.

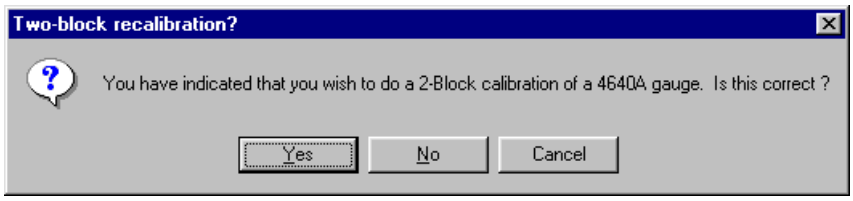


Figure 4–15. Two-Block Recalibration Query

8. The program now displays the first calibration data entry screen. If the user had indicated that the calibration was a 3-block calibration, the display is as shown in Figure 4–16, with spaces for entering the bulk density counts from the magnesium, mag/aluminum, and aluminum blocks. If instead the user selected a 2-block recalibration, the display is as shown in Figure 4–17, with the spaces for the mag/aluminum bulk density counts omitted.

   Note that the *Calibration Type* and *Gauge Model* on this screen are set to the values entered in the previous message boxes. Also note that the *Date*, *Background Counts*, and *Calibration Bay* are set to default values. The user may change any of these values.

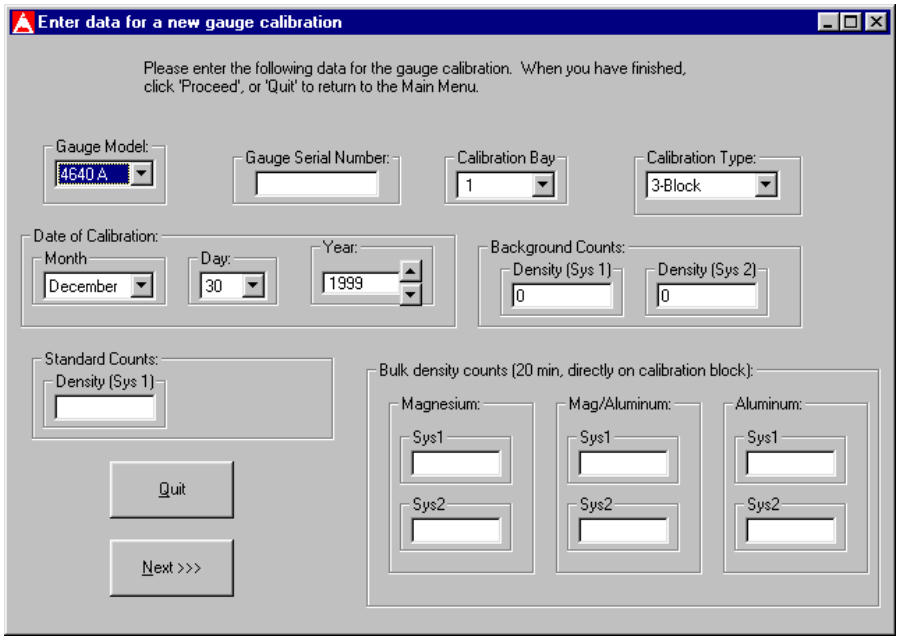


Figure 4–16. First Calibration Data Entry Screen, Three-Block Calibration

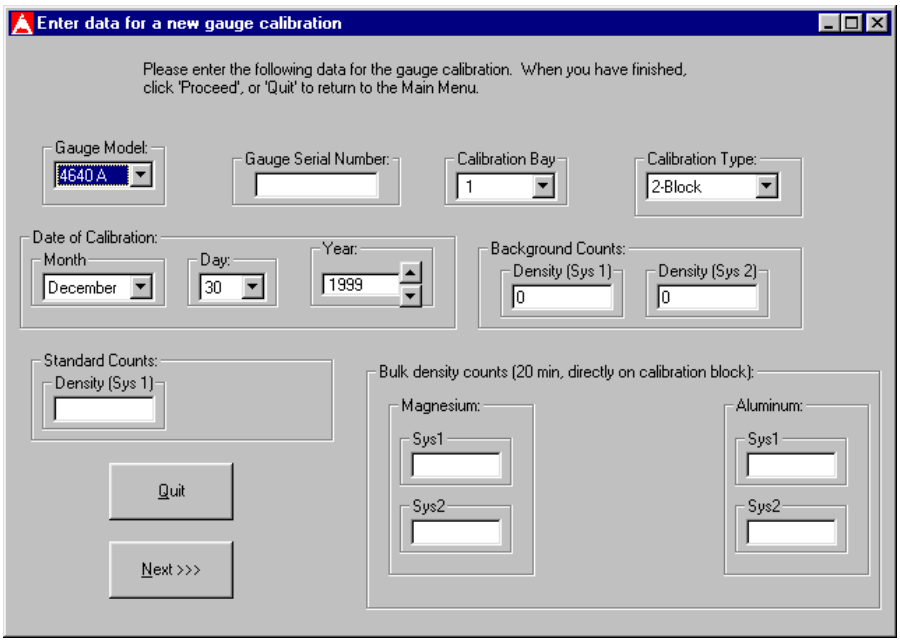


Figure 4–17. First Calibration Data Entry Screen, Two-Block Calibration

9. Using the appropriate data from the *4640-A Recalibration Data Sheet*, fill in the required text boxes on this screen, then click the ⟨**Next**⟩ button. If any necessary values are omitted, the program displays an error message box. Click ⟨**OK**⟩ on this message box to return to the first data entry screen and enter the required values.

10. If all of the required values are entered in step 9, then the second calibration data entry screen is displayed. The form of this screen depends on two factors: whether the user has elected to enter the calibration constants manually or use calibration constants downloaded from an EPROM, and whether the calibration is a 2-block or 3-block calibration. Since there are two factors and two instances of each of these factors, there are four possible options for the second calibration data entry screen:

    - If the recalibration is a 2-block and the user will be entering the calibration constants manually, proceed to step 11.
    - If the recalibration is a 2-block and the user will be using calibration constants read from an EPROM, proceed to step 12.
    - If the recalibration is a 3-block and the user will be entering the calibration constants manually, proceed to step 13.
    - Finally, if the recalibration is a 3-block and the user will be using calibration constants read from an EPROM, proceed to step 14.

11. If the recalibration is a 2-block and the user will be entering the calibration constants manually, the second calibration data entry screen shown in Figure 4–18 is displayed. Note that all of the data fields on this screen are blank; these fields must be filled in by the user. The user must enter the thin layer constants, as well as the bulk density B values. The constants *A12* and *A22* must be entered in English units (inverse inches), and the constants *B1* and *B2* must likewise be entered in English units (cubic feet per pound). Proceed to step 15.

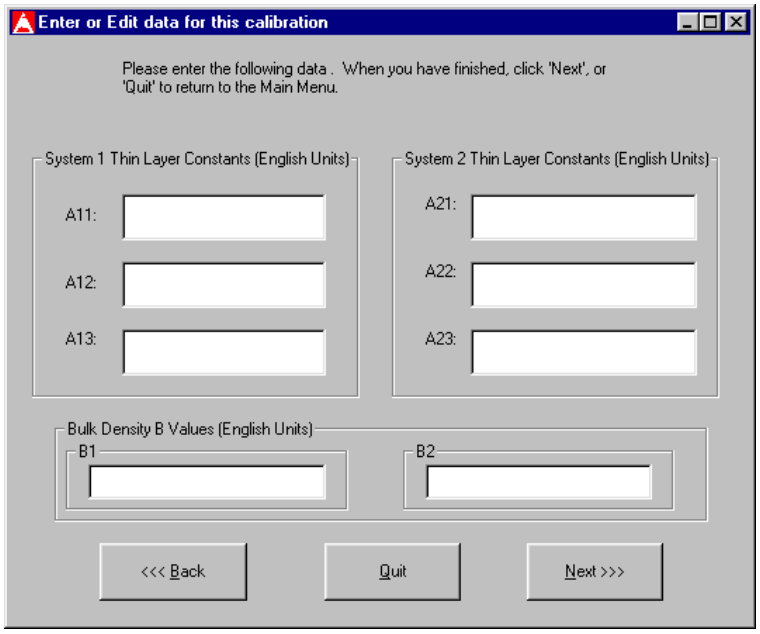


Figure 4–18. Second Calibration Data Entry Screen, Two-Block Calibration and Constants Entered Manually

12. If the recalibration is a 2-block and the user will be using calibration constants read from an EPROM, the second calibration data entry screen shown in Figure 4–19 is displayed. Note that this screen is similar to the one shown in Figure 4–18, except that the calibration constants are already entered in the form. These constants were read from the file that was created when the last EPROM read was performed. There is no need for the user to enter any of the calibration constants, but he or she may edit any or all of these values. If the user changes any of these values, the constants *A12* and *A22* must be entered in English units (inverse inches), and the constants *B1* and *B2* must likewise be entered in English units (cubic feet per pound). Proceed to step 15.

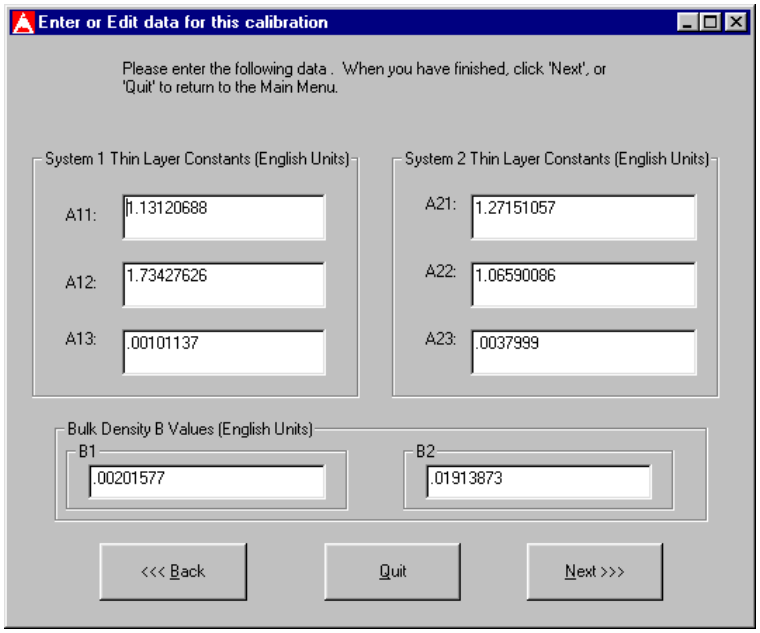


Figure 4–19. Second Calibration Data Entry Screen, Two-Block Calibration and Constants Read from EPROM

13. If the recalibration is a 3-block and the user will be entering the calibration constants manually, the second calibration data entry screen shown in Figure 4–20 is displayed. Note that this screen is similar to the one shown in Figure 4–18 except that, since this is a 3-block calibration, there is no need to enter the *B1* and *B2* values. Note that all of the data fields on this screen are blank; these fields must be filled in by the user. The constants *A12* and *A22* must be entered in English units (inverse inches). Proceed to step 15.

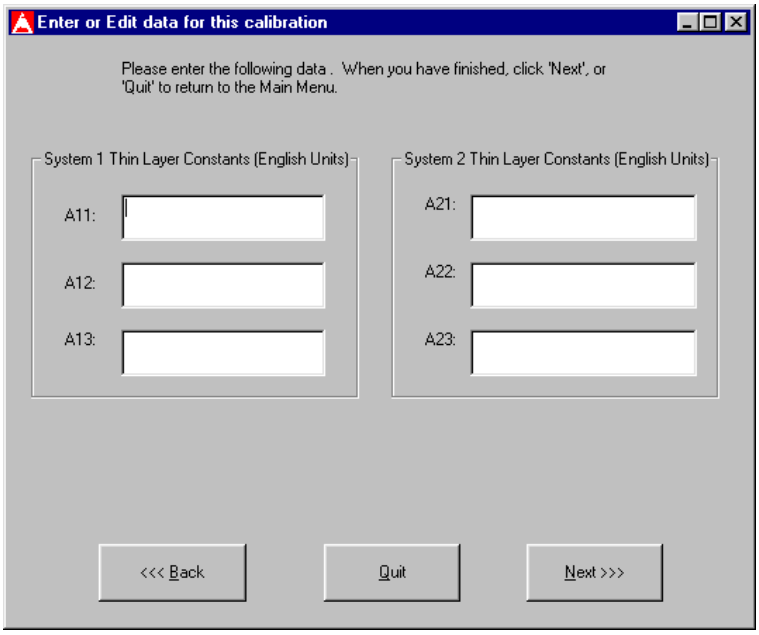


Figure 4–20. Second Calibration Data Entry Screen, Three-Block Calibration and Constants Entered Manually

14. If the recalibration is a 3-block and the user will be using calibration constants read from an EPROM, the second calibration data entry screen shown in Figure 4–21 is displayed. Note that this screen is similar to the one shown in Figure 4–20, except that the calibration constants are already entered in the form. These constants were read from the file that was created when the last EPROM read was performed. There is no need for the user to enter any of the calibration constants, but he or she may edit any or all of these values. If the user changes any of these values, the constants *A12* and *A22* must be entered in English units (inverse inches). Proceed to step 15.

15. Enter all of the requested data. When all of the values are entered, then click the ⟨**Next**⟩ button. To edit data from the preceding page, click the ⟨**Back**⟩ button.

16. If any necessary values are omitted, the program displays an error message box. Click ⟨**OK**⟩ on this message box to return to the second data entry screen and enter the required values.

17. When all of the required values have been entered and the ⟨**Next**⟩ button is clicked, the data is saved to a temporary file, and this data becomes the *Active Calibration*. The program displays a message box that confirms that the data entry is complete, and asks if the user wants to print the data. Click ⟨**Yes**⟩ to print a listing of the count data that was just entered and continue, or ⟨**No**⟩ to continue without printing.

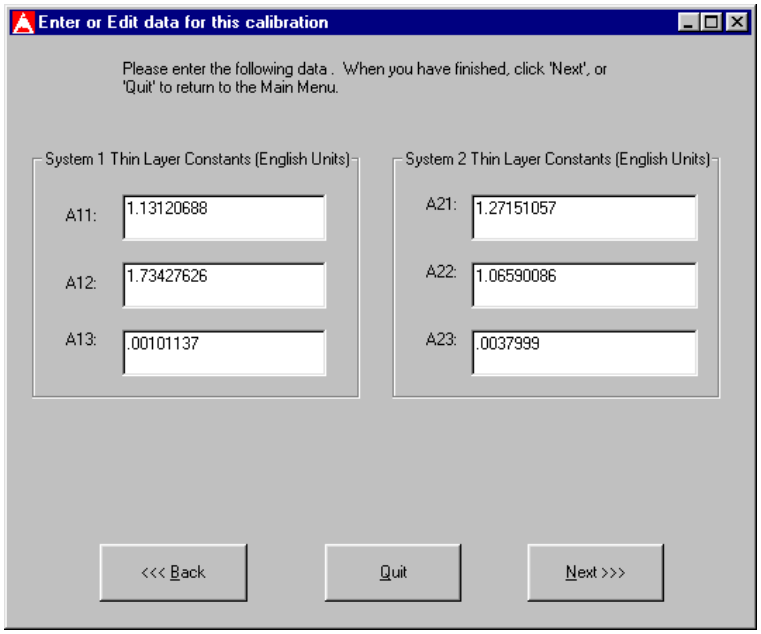


Figure 4–21. Second Calibration Data Entry Screen, Three-Block Calibration and Constants Read from EPROM

18. Regardless of whether the user elects to print the data entered or not, the query box shown in Figure 4–22 is eventually displayed.

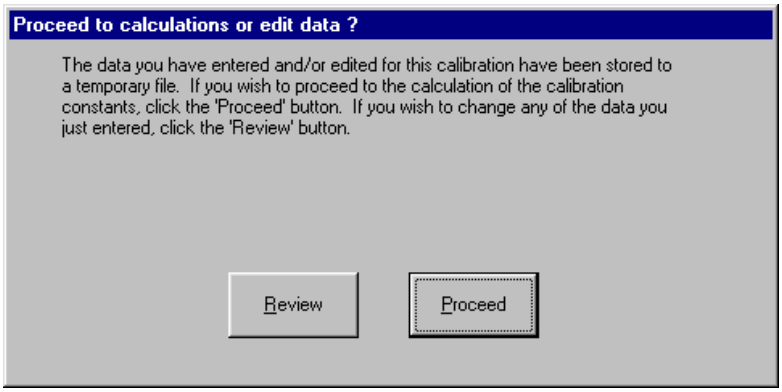


Figure 4–22. Proceed to Calculations or Edit Data Query

19. Click the ⟨**Proceed**⟩ button to proceed to step 20 and calculate the calibration constants. To review and/or modify the data entered in the previous steps, click the ⟨**Review**⟩ button. If the user clicks the ⟨**Review**⟩ button, the program returns to step 8; with all values previously entered intact on the screen.

20. When the user clicks the ⟨**Proceed**⟩ button on the preceding screen, the program calculates the calibration constants.

    - If the calculations are performed without any errors, the program displays the message box shown in Figure 4–23. Click the ⟨**Proceed**⟩ button.
    - If an error was encountered in the calculations, the program displays an error message and enables the user to go back and edit the input data.

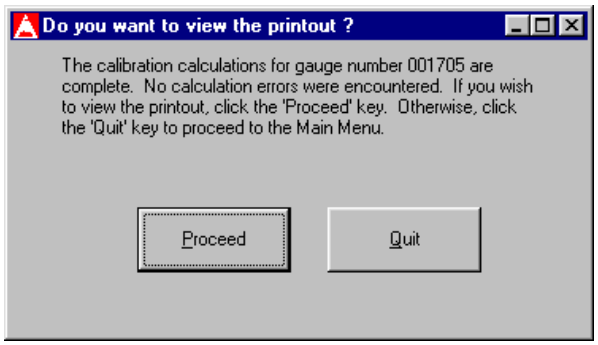


Figure 4–23. View Calibration Constants Printout Query

21. When the ⟨**Proceed**⟩ key is clicked, the calibration sheets are formulated and displayed as shown in Figure 4–24. The entire text of the calibration sheets, in formatted form, is shown in the text box on this screen. The user can scroll up and down this text box to view the calibration sheet in its entirety. These sheets can be displayed in Metric or Imperial (English) units by clicking the appropriate option button in the lower right-hand portion of the screen.

22. Click the ⟨**Print calibration sheets**⟩ button to print these sheets.

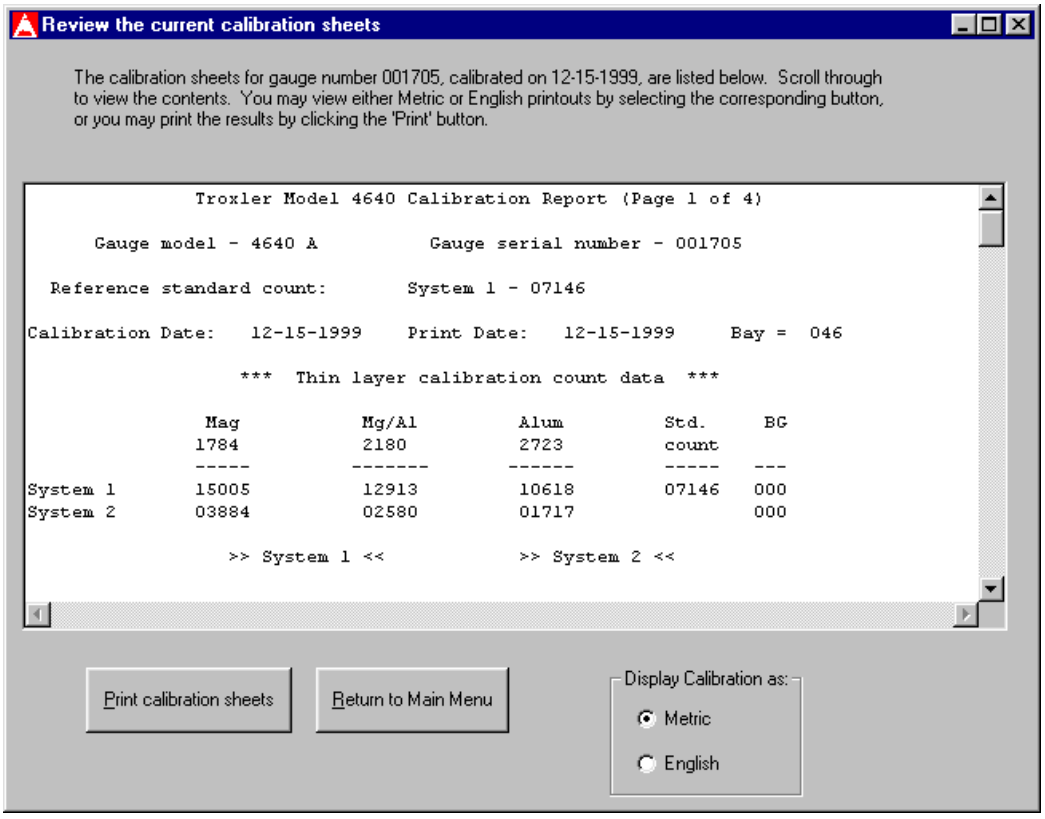


Figure 4–24. Review the Current Calibration Sheets Display

23. The software now displays a message box warning the user that simply printing the calibration sheets at this point **does not** mean that the data is being permanently archived. The data can only be archived after the QA test has passed and the user has selected the **Save and Print a Certified Calibration** option from the **4640 Calibration Main Menu**. Click ⟨**OK**⟩ on this message box to proceed with the printout.

24. At the conclusion of the printout, refer to the calibration sheet just printed and compare the results to the relevant quantities on the *Calibration Inspection Limits* for this gauge.
    - If the gauge fails to meet any of these limits, click the **Return to Main Menu** button and proceed to the following section, *Editing the Calibration Data*, to make the necessary recounts.
    - If, however, all of the associated quantities meet the *Calibration Inspection Limits*, then proceed to the *Programming the EPROM* section below.

EDITING THE CALIBRATION DATA

The steps in this section are performed if there was a mathematical error in the calculation of the calibration constants, or if the gauge failed one or more parts of the Quality Assurance Test.

1. Retake the count or counts that caused the calibration to fail whichever evaluation it failed. Instructions for collecting this count or counts are provided in the *Bulk Density Calibration Counting* section on page 4–3.

2. From the **4640 Calibration Main Menu** (see Figure 4–1 on page 4–4), select the **Edit data for the currently active calibration** option, then click the ⟨**Proceed**⟩ button.

3. Return to the *Entering Calibration Data Into the Calibration Program* section, and go to step 8 on page 4–14. Follow the instructions to change the data that is required, recalculate the calibration constants, and evaluate the thin layer residuals. At the end of that section, you will be directed where to proceed from there.

PROGRAMMING THE EPROM

1. To get the newly calculated calibration constants into the gauge, they must be burned onto a 2732A EPROM. This EPROM is then inserted into the gauge. To begin the EPROM burning process, select the option **Read from or Write to a 4640A EPROM** from the **4640 Calibration Main Menu** (see Figure 4–1 on page 4–4), then click the ⟨**Proceed**⟩ button. Note that the "…*or Write to…*" option will NOT be available unless there is an active calibration available.

2. The program displays a message box that asks **Do you wish to read the data from a 4640A EPROM?**
    - To return to the **4640 Calibration Main Menu**, click the ⟨**Cancel**⟩ button.
    - Since the task at hand is to *write* data *to* an EPROM rather than *read* data *from* it, click the ⟨**No**⟩ button. The program displays the message shown in Figure 4–25. This message box shows which calibration is active and available for writing to the EPROM.
        - If this is the correct calibration, click the ⟨**Yes**⟩ button.
        - To return to the **4640 Calibration Main Menu**, click the ⟨**No**⟩ button.

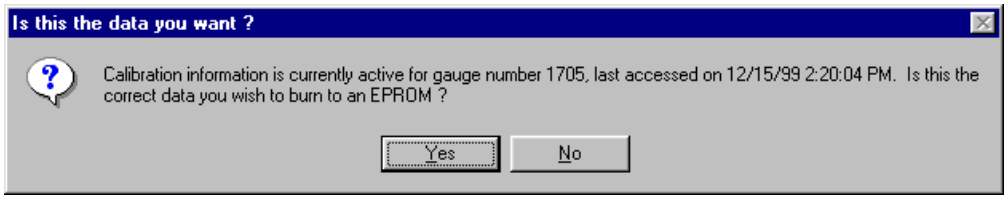


Figure 4–25. Active Calibration Confirmation Query

3. The calibration constants for the active calibration must be converted to the special 8-byte floating point hexadecimal format before they can be written to the EPROM. The software now displays a message box explaining this fact.

   - To return to the **4640 Calibration Main Menu**, click the ⟨**Quit**⟩ button.
   - To perform this conversion, click the ⟨**Convert to Hex**⟩ button on the message box.

4. When the user clicks the ⟨**Convert to Hex**⟩ button, the program performs the conversion, then displays the results as shown in Figure 4–26.

5. The decimal and hexadecimal values for the calibration constants of the active calibration are listed on this screen. To print these constants, click the ⟨**Print**⟩ button. After the printout is complete, click the ⟨**Quit**⟩ button to abort the operation and return to the **4640 Calibration Main Menu**, or click the ⟨**Next**⟩ button to proceed to step 6 and continue with the EPROM burning process.

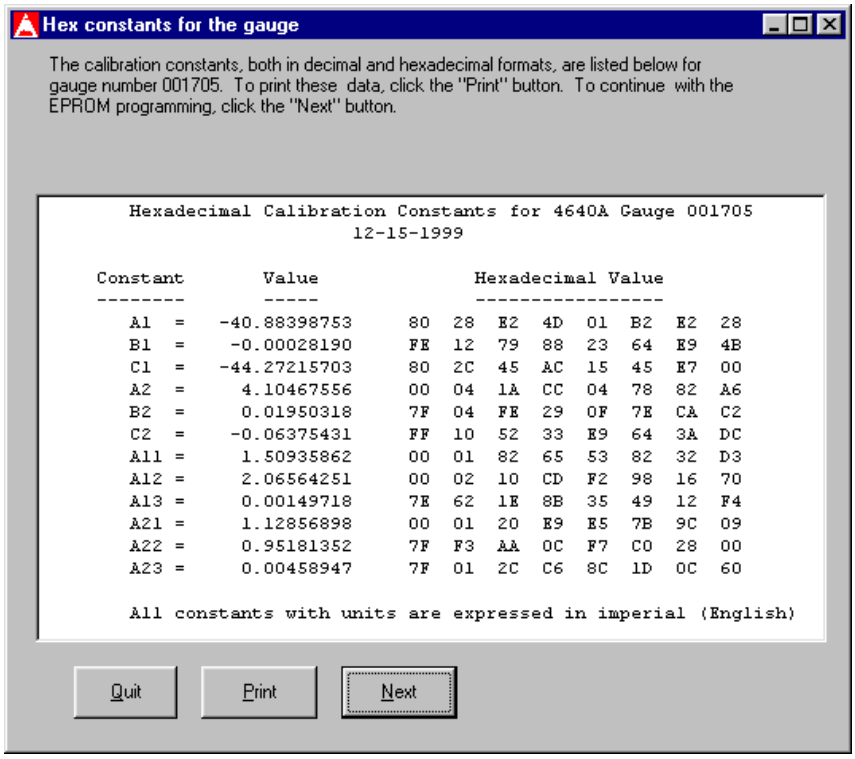


Figure 4–26. Hex Constants for the Gauge Display

6. As described earlier in this chapter, there are two types of EPROM programmer supported by this software: the Shooter by Logical Devices and the EP-1 by BP Microsystems. When the user clicks the ⟨**Next**⟩ button on the display shown in Figure 4–26, the software asks the user if he or she will be using the Shooter, as shown in Figure 4–27.

   - To abort this operation and return to the **4640 Calibration Main Menu**, click the ⟨**Cancel**⟩ button.
   - If the Shooter will be used to burn the EPROM, click the ⟨**Yes**⟩ button and proceed to step 7.
   - If the EP-1 will be used to burn the EPROM, click the ⟨**No**⟩ button and proceed to step 19.

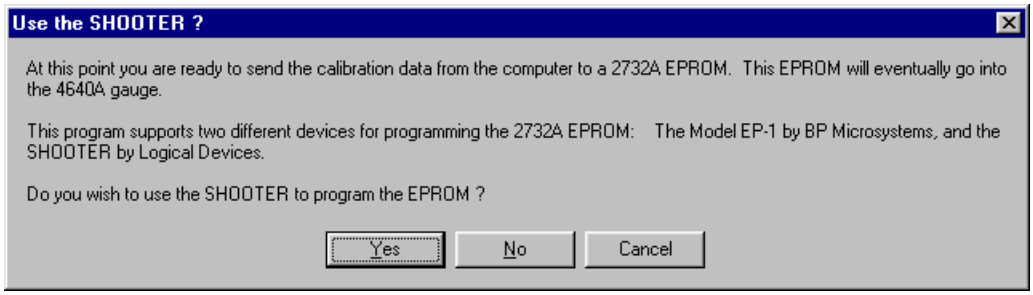


Figure 4–27. EPROM Programmer Selection Prompt

7. The software now displays a message box with instructions on preparing the Shooter for the upcoming tasks. Click the ⟨**Quit**⟩ button on this message box to abort this operation and return to the **4640 Calibration Main Menu**, or click ⟨**Help!**⟩ for more information. To proceed with the EPROM programming, perform the tasks listed in the message box and click the ⟨**Next**⟩ button.

8. After the ⟨**Next**⟩ button has been clicked, the software displays the screen shown in Figure 4–28. This screen allows the user to select the communications port to which the Shooter is connected, as well as the baud rate to which the Shooter has been set. Confirm (and change, if necessary) these settings and click the ⟨**Select**⟩ button.

9. The screen changes as shown in Figure 4–29. The screen now informs the user of the selected communication port and baud rate, and instructs the user to click the ⟨**Send Constants**⟩ button to transfer the constants from the computer to the Shooter. Click the ⟨**Send Constants**⟩ button as directed. The software now displays a message box that informs the user that, during the data transfer, the computer will not respond to user input (keyboard, mouse, etc.). However, the program will not "lock-up" – a timeout will occur after a predetermined amount of time and the user will be able to control the program again. Click the ⟨**OK**⟩ button to continue with the data transfer.

10. After the user clicks the ⟨**OK**⟩ button, the EPROM programming process begins. If a problem is encountered in initiating the communications between the computer and the EPROM programmer, the program proceeds to step 11. If no such problem is encountered, the program proceeds to step 13.

11. If the computer cannot initiate contact with the EPROM programmer, the program displays an error message similar to the one shown in Figure 4–8 on page 4–10 after fifteen seconds.

12. To abort the EPROM programming process and return to the **4640 Calibration Main Menu**, click the ⟨**No**⟩ button. To reset the communications settings, click the ⟨**Yes**⟩ button. The program prompts the user to manually reset the Shooter before continuing. As prompted, press the ⟨**RESET**⟩ button on the Shooter, then click the ⟨**OK**⟩ button on the message box. The program returns to step 7.

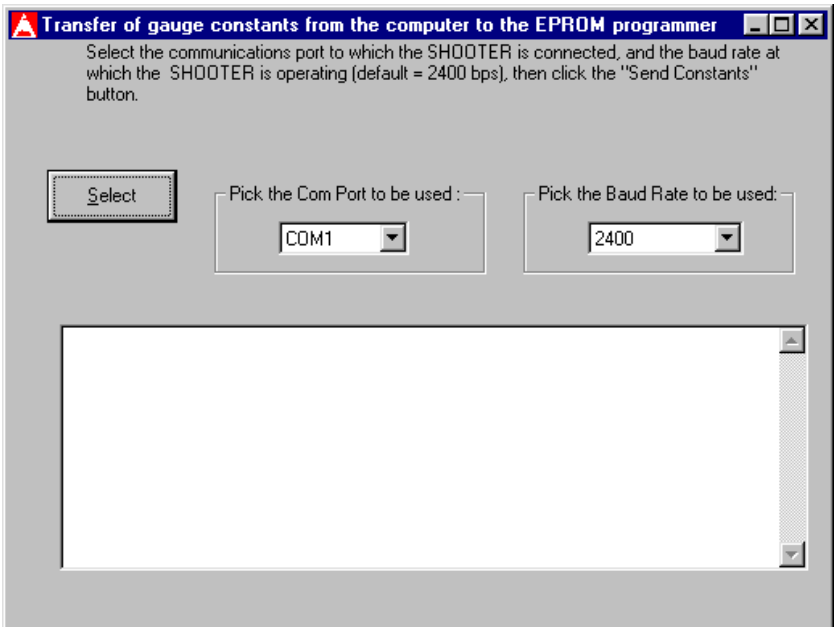


Figure 4–28. Transferring Gauge Constants from the Computer to the Shooter, First Screen

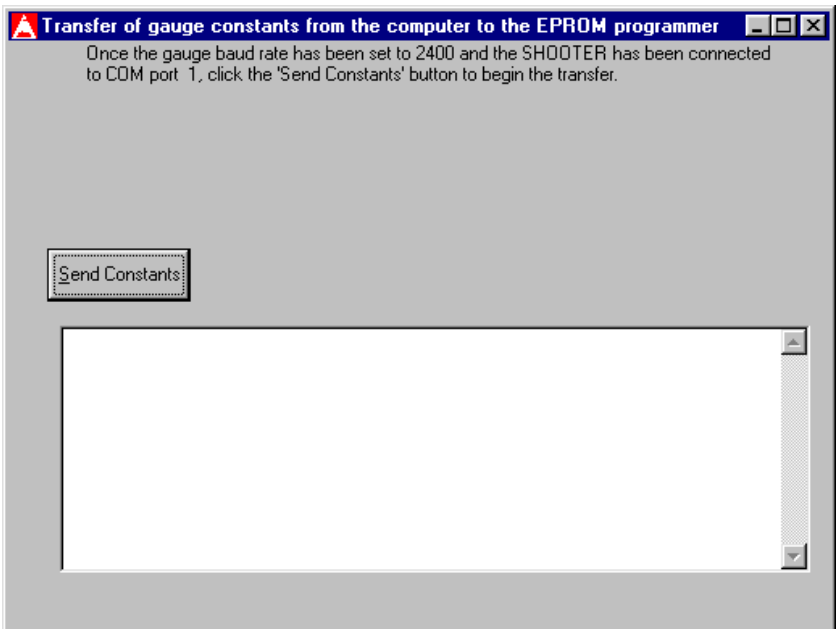


Figure 4–29. Transferring Gauge Constants from the Computer to the Shooter, Second Screen

13. If communications between the gauge and the EPROM programmer is initiated successfully, the EPROM constants will be printed to the screen as they are transferred to the EPROM programmer. When all constants have been transferred to the programmer, the software prompts the user to place a blank 27C32 EPROM in the Shooter socket.

    - To abort the EPROM programming process and return to the **4640 Calibration Main Menu**, click the ⟨**Cancel**⟩ button.
    - To continue with the EPROM programming, insert a blank 27C32 EPROM into the socket as directed – ensuring that the 2732 plug is in the CNF socket – then click the ⟨**OK**⟩ button.

14. Once the ⟨**OK**⟩ button is clicked, the data that has been transferred to the EPROM programmer is programmed into the EPROM. When the programming is complete, the program displays the message box shown in Figure 4–30. Troxler recommends that the user click ⟨**OK**⟩ and check the EPROM to ensure that the calibration constants were properly written to the EPROM. To return to the **4640 Calibration Main Menu** without checking the EPROM (which is **not** recommended), click the ⟨**Cancel**⟩ button.

Figure 4–30. Check the EPROM Contents Query

15. When the ⟨**OK**⟩ button is clicked, the program displays a screen similar to the one shown in Figure 4–28. This screen allows the user to re-select the communication port and baud rate at which the computer and EPROM programmer communicate. In all likelihood, there is no need to do this. Click the ⟨**Select**⟩ button to continue.

16. After the ⟨**Select**⟩ button is clicked, the program displays a screen similar to the one shown in Figure 4–7 on page 4–9. The screen now informs the user of the selected communication port and baud rate, and instructs the user to click the ⟨**Read Constants**⟩ button. Click the ⟨**Read Constants**⟩ button as directed. The software now displays a message box that informs the user that, during the data transfer, the computer will not respond to user input (keyboard, mouse, etc.). However, the program will not "lock-up" – a timeout will occur after a predetermined amount of time and the user will be able to control the program again. Click the ⟨**OK**⟩ button to continue with the data transfer.

17. At this point, the data is read from the EPROM and compared to the data that was sent to it. If each byte compares favorably, the program displays the message box shown in Figure 4–31. Click the ⟨**OK**⟩ button to return to the **4640 Calibration Main Menu**. The EPROM is now ready to use in the gauge. Proceed to step 30 for instructions on installing the EPROM and resetting the gauge memory.

Figure 4–31. EPROM Contains Correct Data Message

18. If the data read from the EPROM does not compare exactly to the data sent to it, the program displays the error message shown in Figure 4–32. As this message box states, the EPROM that was just read should not be used in the gauge. Click ⟨**OK**⟩ to return to the **4640 Calibration Main Menu**. Obtain a blank EPROM and return to step 1.

Figure 4–32. EPROM Data Mismatch Message

19. At this point the user has decided to use the EP-1 EPROM programmer to program the calibration constants into a 2732A EPROM for the Model 4640-A gauge. The program displays a message box that asks **Do you instead wish to use the Model EP-1 to program the EPROM?**
    - To select the EP-1 as the EPROM programmer, click the ⟨**Yes**⟩ button and proceed to step 20.
    - To return to step 4, click ⟨**No**⟩.
    - To return to the **4640 Calibration Main Menu**, click ⟨**Cancel**⟩.

20. If the user clicks the ⟨**Yes**⟩ button on the preceding message box, the software displays a message box with instructions on configuring the EP-1 and EPROM to prepare for programming the EPROM. Click the ⟨**Quit**⟩ button on this message box to abort this operation and return to the **4640 Calibration Main Menu**, or click ⟨**Help!**⟩ for more information. To proceed with the EPROM programming, perform the tasks listed in the message box, click the ⟨**Next**⟩ button, and proceed to step 21.

21. The software displays the screen shown in Figure 4–33. From this screen, the user can select the communications port through which the computer will communicate with the EP-1, but cannot set the baud rate. The baud rate is forced to be 38400 bps. Select the appropriate communications port, click ⟨**Select**⟩ and proceed to step 22. To return to the **4640 Calibration Main Menu**, click ⟨**Cancel**⟩.

22. The screen changes as shown in Figure 4–34. The screen now informs the user of the selected communication port, and instructs the user to click the ⟨**Write Constants**⟩ button to begin the transfer. Click the ⟨**Write Constants**⟩ button as directed. The software now displays a message box that informs the user that, during the data transfer, the computer will not respond to user input (keyboard, mouse, etc.). However, the program will not "lock-up" – a timeout will occur after a predetermined amount of time and the user will be able to control the program again. Click the ⟨**OK**⟩ button to continue with the data transfer.

23. At this point the computer configures the EP-1, ensures that the EPROM is not blank, and downloads the data to the EP-1.
    - If no problems are encountered during the data transfer, the EP-1 begins programming the EPROM. At this point, the software displays a message box that informs the user that the EP-1 is burning the EPROM. The message box instructs the user to wait until *only* the green **POWER** light is lit on the EP-1, which indicates that the burn is complete. When the burn is complete, click ⟨**OK**⟩ and proceed to step 26. Note that if the user clicks the ⟨**OK**⟩ button or removes the EPROM from the EP-1 before the burn is complete, all of the information may not be burned correctly to the EPROM.
    - If there is a problem with the data transfer, the program will not display the message box described above, but will instead proceed to step 24

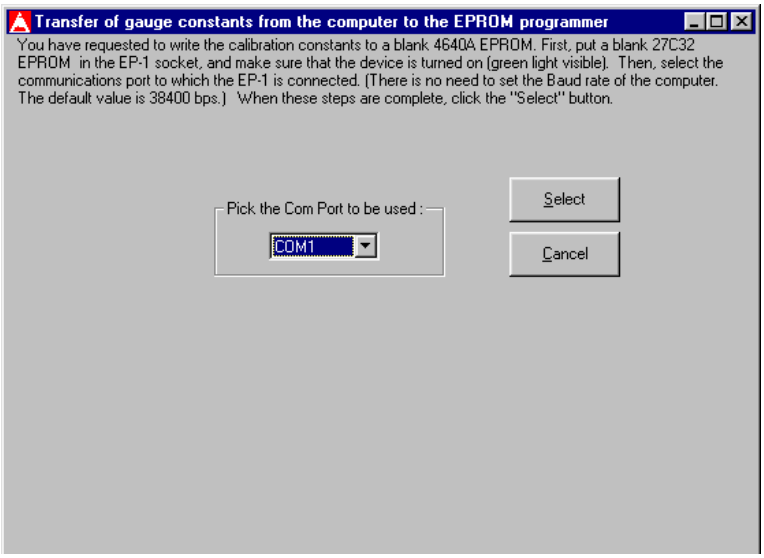


Figure 4–33. Transferring Gauge Constants from the Computer to the EP-1, First Screen

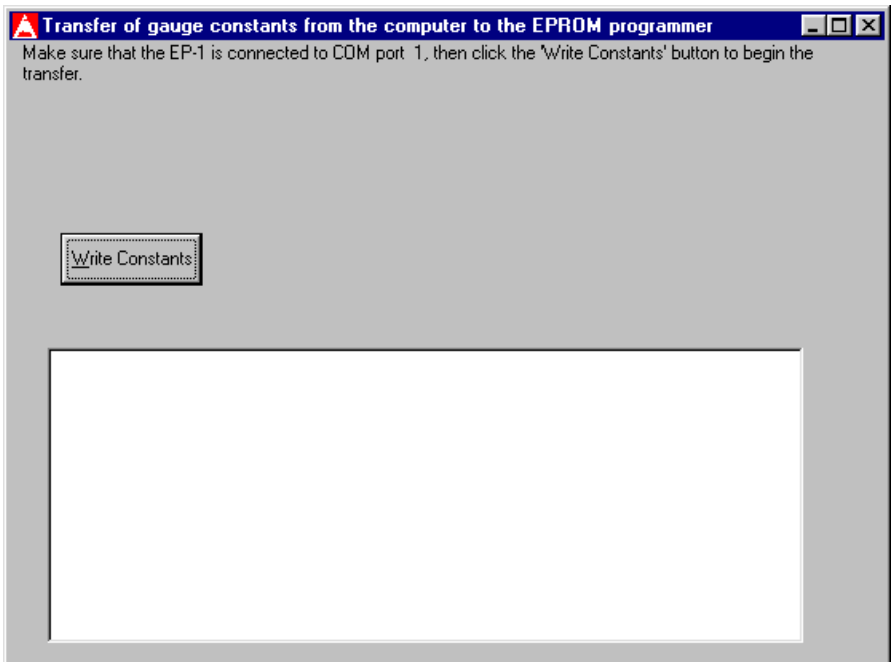


Figure 4–34. Transferring Gauge Constants from the Computer to the EP-1, Second Screen

24. If the computer has difficulty communicating with the EP-1, the program displays an error message similar to the one shown in Figure 4–12 on page 4–12. To abort the EPROM programming process and return to the **4640 Calibration Main Menu**, click the ⟨**No**⟩ button. To reset the communications settings, click the ⟨**Yes**⟩ button and proceed to step 25.

25. The program prompts the user to manually reset the EP-1. As directed, switch the EP-1 off, then back on. Click the ⟨**OK**⟩ button on the message box to return to step 20.

26. When the red light has gone out, the green light has come on, and the user has clicked the ⟨**OK**⟩ button, the program displays a message box similar to the one shown in Figure 4–30 on page 4–24. Troxler recommends that the user click ⟨**OK**⟩ and check the EPROM to ensure that the calibration constants were properly written to the EPROM. To return to the **4640 Calibration Main Menu** without checking the EPROM (which is **not** recommended), click the ⟨**Cancel**⟩ button.

27. When the ⟨**OK**⟩ button is clicked, the program displays a screen similar to the one shown in Figure 4–33. This screen allows the user to re-select the communication port through which the computer and EPROM programmer communicate. In all likelihood, there is no need to do this. Click the ⟨**Select**⟩ button to continue to step 28 or click the ⟨**Cancel**⟩ button to return to the **4640 Calibration Main Menu**.

28. The program displays a screen similar to the one shown in Figure 4–11 on page 4–12. The screen now informs the user of the selected communication port, and instructs the user to click the ⟨**Read Constants**⟩ button. Click the ⟨**Read Constants**⟩ button as directed. The software now displays a message box that informs the user that, during the data transfer, the computer will not respond to user input (keyboard, mouse, etc.). However, the program will not "lock-up" – a timeout will occur after a predetermined amount of time and the user will be able to control the program again. Click the ⟨**OK**⟩ button to continue with the data transfer.

29. At this point, the data is read from the EPROM and compared to the data that was sent to it. If there are no problems in this comparison, the program proceeds to step 17. Otherwise, the program proceeds to step 18.

30. It is now time to install the EPROM in the gauge and reset the gauge memory. Turn the gauge off and remove the six screws that secure the back panel. Remove the old EPROM, insert the new EPROM into gauge, and reinstall the back panel.

31. Turn the gauge back on.

32. On the gauge keypad, press ⟨**T**⟩ ⟨**.**⟩ ⟨**3**⟩ ⟨**1**⟩ ⟨**6**⟩ ⟨**5**⟩ to activate *Calibration* mode.

33. Press ⟨**T**⟩ ⟨**7**⟩ and press ⟨**YES**⟩ at the **RESET GAUGE MEMORY?** prompt.

34. The gauge now displays the prompt **Stored data will be lost – Is this OK?** Press the ⟨**YES**⟩ key. The gauge resets and the new constants are loaded. Proceed to the following section, *Performing the Quality Assurance Test*.

PERFORMING THE QUALITY ASSURANCE TEST

1. From the **4640 Calibration Main Menu** (see Figure 4–1 on page 4–4), select the **Print a Calibration Accuracy Check (QA) form** option and click the ⟨**Proceed**⟩ button.

2. The program displays a message box that identifies the active calibration and asks if the user wishes to print QA sheets for this calibration. Click the ⟨**Yes**⟩ button.

3. The program then displays a message box that allows the user to select the measurement units in which the *Calibration Accuracy Check Form* will be printed. Select the option button for the desired measurement units and click the ⟨**Print QA Sheets**⟩ button.

4. The *Calibration Accuracy Check Form* will be printed to the selected printer. Click the ⟨**Quit**⟩ button to return to the **4640 Calibration Main Menu**.

5. The calibration technician performing this calibration should record his or her name in the space beside the label *Calibration Technician* on page 1 of the *Calibration Accuracy Check Form*.

6. Place the gauge's magnesium standard block on the center of the calibration block where the standard count is typically taken. For a 3-block calibration, this is the mag/aluminum block; for a 2-block calibration, this is the aluminum block.

7. Position the gauge on the magnesium standard in the orientation that would be used for a standard count.

8. Take a standard count. Record the results in the appropriate location on the *Calibration Accuracy Check Form*.

9. Following the instructions on the *Calibration Accuracy Check Form*, calculate the Density and Standard Percent differences and record them at the appropriate location.

10. If the Density and Standard Percent differences do not meet the required limits listed on the *Calibration Accuracy Check Form*, take another standard count, and repeat step 9. If the Density Standard Percent differences **still** do not meet the required limits listed on the form, see your supervisor.

11. From the *Ready* mode, press the ⟨**THICK/MAR**⟩ key. The gauge displays the current setting for the layer thickness.

12. Ensure that the top layer thickness is set to 1 inch (2.54 cm) and press the ⟨**START/ENTER**⟩ key.

13. From the *Ready* mode, press the ⟨**TIME/DSP**⟩ key and set the gauge count time to 4 minutes.

14. Place the gauge on the magnesium block in the measurement position.

15. Place the source rod in backscatter position, making sure the handle clicks into the backscatter notch. Press down gently on the end of the handle (without touching the trigger) to ensure that the handle is properly seated.

16. From the *Ready* mode, press the ⟨**START/ENTER**⟩ key and wait for the count to finish. When the count is complete, the gauge displays the measured density. In the *Thin Layer Measurement Accuracy Check* portion of the *Calibration Accuracy Check Form*, there is a section for recording the density value measured on this block. Read the Density value from the top line of the gauge display and record it in the appropriate location on the *Calibration Accuracy Check Form*.

17. If the density value measured by the gauge in step 16 falls within the respective range specified on the *Calibration Accuracy Check form*, then proceed to step 20. Otherwise, a recount must be taken. If a recount is needed, proceed to step 18.

18. Repeat step16 and record the measured density under the area reserved for the recounts.

19. Press the ⟨**NO/CE**⟩ key on the gauge to return to the *Ready* mode. If the density value measured by the gauge in step 18 falls within the respective range specified on the *Calibration Accuracy Check Form*, then proceed to step 20. Otherwise, the gauge has failed this portion of the thin layer QA test and will probably require recounts. See your Supervisor.

20. Continue as follows:
    - If the calibration block that was just measured was the magnesium block and the recalibration performed was a ***3-block***, place the gauge in the center of the mag/aluminum block and go to step 21.
    - If the calibration block that was just measured was the magnesium block and the recalibration performed was a ***2-block***, place the gauge in the center of the aluminum block and go to step 21.
    - If the calibration block that was just measured was instead the mag/aluminum block, place the gauge in the center of the aluminum block and go to step 21.
    - If the calibration block just measured was instead the aluminum block, proceed to step 22.

21. Repeat steps 15 through 17.

22. For a Model 4640-A recalibration, the thin layer measurement capabilities of the device must be checked in the QA testing phase. Place the magnesium standard block for the gauge on top of the aluminum calibration block.

23. Place the gauge on the center of the magnesium standard block.

24. Place the source rod in backscatter position, making sure the handle clicks into the backscatter notch. Press down gently on the end of the handle (without touching the trigger) to ensure that the handle is properly seated.

25. From the *Ready* mode, press the ⟨**START/ENTER**⟩ key and wait for the count to finish. When the count is complete, the gauge displays the measured density. In the *Thin Layer Measurement Accuracy Check* portion of the *Calibration Accuracy Check Form*, Part II, there is a section for recording the density value measured on this block. Read the Density value from the top line of the gauge display, and record it in the appropriate location on the *Calibration Accuracy Check Form*.

26. If the density value measured by the gauge in step 25 falls within the respective range specified on the *Calibration Accuracy Check Form*, then proceed to step 29. Otherwise, a recount must be taken. If a recount is needed, proceed to step 27.

27. Repeat steps 24 and 25.

28. If the density value measured by the gauge in step 27 falls within the respective range specified on the *Calibration Accuracy Check Form*, then proceed to step 29. Otherwise, the gauge has failed this portion of the thin layer QA test and will probably require recounts. See your Supervisor.

29. The Quality Assurance testing is complete, and the calibration is now certified. Proceed to the following section, *Archiving the Calibration and Printing the Calibration Sheets*.

ARCHIVING THE CALIBRATION AND PRINTING THE CALIBRATION SHEETS

Once the gauge has passed the QA tests, it is time to archive the calibration data in the database file. It is also the appropriate time to print out two sets of calibrations sheets – one for the customer and one for the files.

1. From the **4640 Calibration Main Menu** (see Figure 4–1 on page 4–4), choose the **Save and print a certified calibration** and click the ⟨**Proceed**⟩ button:

2. The software displays a message box that shows the current active calibration, and asks the user to confirm that this is the calibration he or she wishes to saves and print. Click ⟨**No**⟩ to return to the **4640 Calibration Main Menu** or ⟨**Yes**⟩ to continue.

3. If the user clicks the ⟨**No**⟩ button, they are sent back to the **4640 Calibration Main Menu**. If the user clicks ⟨**Yes**⟩, the software displays a message box requesting the user's initials.

4. Enter your initials and click ⟨**OK**⟩. Note that at least two alphabetic characters must be entered. The program will not proceed unless a set of valid initials is entered.

5. When a valid set of initials is entered, the software saves the calibration data to the archive data file, and displays a confirmation message box. Click ⟨**Proceed**⟩ to continue with printing the calibration sheets.

6. After the ⟨**Proceed**⟩ button is clicked, The software displays the same screen shown in Figure 4–24 on page 4–19, giving the user the opportunity to print the calibration report.
   - To return to the **4640 Calibration Main Menu** without printing the calibration report, click the ⟨**Return to Main Menu**⟩ button.
   - To print the calibration sheets, click the ⟨**Print calibration sheets**⟩ button and proceed to the following step.

7. The software displays a dialog box that allows the user to select the printer to use to print the calibration sheets. Note, however, that the default value for **Number of Copies** is set to *2*, to encourage the user to print two calibration reports (one for the customer, the other for the lab files). Of course, the user may select any number of copies he or she wishes to pint.
   - If the user clicks the ⟨**Cancel**⟩ button, the print dialog box disappears, and the screen shown in Figure 4–24 is displayed.
   - If instead the user clicks the ⟨**Print**⟩ button, the calibration sheets are printed and the screen shown in Figure 4–24 is displayed.

8. Click the ⟨**Return to Main Menu**⟩ to return to the **4640 Calibration Main Menu**.

The calibration process is now complete.

CALIBRATION PROCEDURE OUTLINE AND CHECKLIST

- ❑ Turn on the gauge and allow it to power up and complete the self-test.
- ❑ Obtain a *4640-A Recalibration Data Sheet* and fill in the information preceding the stat test information
- ❑ Press the sequence ⟨**T**⟩ ⟨**.**⟩ ⟨**3**⟩ ⟨**1**⟩ ⟨**6**⟩ ⟨**5**⟩ on the keypad to put the gauge in *Calibration* mode.
- ❑ From *Calibration* ode, initiate a stat test by pressing ⟨**T**⟩ ⟨**1**⟩ and following the instructions.
- ❑ Run a successful stat test with the gauge and record the results. Ensure that the standard count(s) fall within the *Calibration Inspection Limits*.
- ❑ Take 20-minute counts with the gauge on each of the three metal blocks (magnesium, mag/aluminum, and aluminum). These counts can only be obtained by running the gauge's stat test with the gauge in measurement position while directly on the block. Record the resulting mean counts on the *4640-A Recalibration Data Sheet*.
- ❑ In the rare event that a full calibration is required, take the required thin layer overlay counts, where each of these counts is four minutes in duration.
- ❑ Run a successful drift test (with the gauge in standard count orientation) with the gauge. The drift test is initiated from *Calibration* mode by pressing ⟨**T**⟩ ⟨**2**⟩ and following the instructions. The printer will have to be connected to the gauge to collect the data. If necessary, conduct the provisional drift test.
- ❑ Once the gauge has finished with the drift test, run the calibration program. From the **4640 Calibration Main Menu** select the **Manually Enter Data for a New Calibration or Recalibration** option, then follow the instructions from the program.
- ❑ When the data entry is complete, follow the instructions from the gauge to compute the constants.
- ❑ When the calibration report is displayed, print a copy. Compare the relevant quantities on this report to the *Calibration Inspection Limits* to ensure that this calibration meets these requirements. If this is a full calibration, ensure that the thin layer residuals are all within the allowed limits.
- ❑ Get the calibration printout sheets from the printer.
- ❑ Remove the 2732 EPROM from the gauge.
- ❑ Return to the **4640 Calibration Main Menu** and select the **Read From or Write To a 4640A EPROM** option. Follow the instructions for programming the EPROM.

NOTE

If the EPROM that was removed in the preceding step is used, it must be erased before it can be re-programmed.

- ❑ Put the freshly programmed EPROM into the gauge
- ❑ Press the sequence ⟨**T**⟩ ⟨**.**⟩ ⟨**3**⟩ ⟨**1**⟩ ⟨**6**⟩ ⟨**5**⟩ on the gauge keypad to put the gauge in *Calibration* mode.

- ❑ From *Calibration* mode, perform a gauge memory reset by pressing ⟨**T**⟩ ⟨**7**⟩ and following the instructions.

- ❑ Once the calibration constants are in the gauge, return to the **4640 Calibration Main Menu** in the calibration program and follow the prompts to print a *Calibration Accuracy Check Form*.

- ❑ Run the Quality Assurance (QA) test successfully.

- ❑ Once the QA Test has been completed successfully, return to the **4640 Calibration Main Menu** in the calibration program and select the **Save and Print a Certified Calibration** option. Follow the prompts to archive the calibration and print the calibration report.

- ❑ File one copy of the calibration report, and put the other with the gauge.

4640-A RECALIBRATION DATA SHEET

Date:		Model No.:	4640	Version:	A
Serial No.:		Bay No.:		Order No.:	

Stat Test Results

System 1:		R:		System 2:		R:	

Bulk Density (Directly on the block, 20 minutes in duration)

Magnesium Block		Mag/Aluminum Block		Aluminum Block	
System 1	System 2	System 1	System 2	System 1	System 2

Drift Test Results

System 1:		% Drift:		System 2:		% Drift:	

Calibration Standard Counts (Average of stat and drift test values):	System 1:		System 2:

(Use the remainder of this page *only* if a provisional drift test is required.)

***Provisional* Drift Test Results**

System 1:		% Drift:		System 2:		% Drift:	

NOTE

The provisional drift test values ARE NOT USED to compute the calibration standard counts; they are used strictly to test the electrical stability of the gauge.

NOTES

CHAPTER 5

MODEL 4640-B MANUAL RECALIBRATION

This chapter provides instructions for performing a *manual* recalibration of a Model 4640-B Thin Layer Density Gauge using the Troxler Legacy Calibration Suite software. The information presented here includes procedures for resolving issues encountered during the calibration process. A calibration procedure outline and checklist is provided at the end of this chapter, as well as a *4640-B Recalibration Data Sheet*.

CONTENTS

RECALIBRATION PROCEDURE

INITIAL STABILITY

1. Get a *4640-B Recalibration Data Sheet* (see page 5–21) and fill in the general information about the gauge.

2. Select a bay for calibration. The bay must contain the magnesium, mag/aluminum, and aluminum calibration blocks. Once the bay is selected, place the gauge's magnesium standard plate on the center of the mag/aluminum block.

3. Position the gauge on the magnesium standard, with the air gap fixture in place.

4. Turn the gauge on.

5. When the gauge finishes its self-test, the gauge displays the ⟨**READY**⟩ screen, which shows the battery status. Press the ⟨**TIME**⟩ key.

6. The screen displays the count time of the gauge. If the count time is set to 4 minutes, then press the ⟨**NO/CE**⟩ key and proceed to step 8. Otherwise, press the ⟨**YES**⟩ key and proceed to step 7.

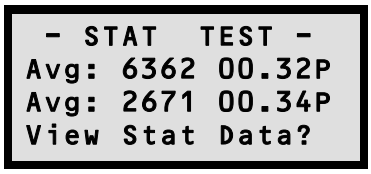
7. At this point the gauge screen will display a series of possible count times. Press the ⟨**4**⟩ key to set the count time to 4 minutes. The screen indicates that the count time has been set to 4 minutes, then returns to the *Ready* mode.

8. Press the yellow ⟨**SHIFT**⟩ key and the ⟨**SPECIAL**⟩ key to access the **SPECIAL FUNCTION** menu.

9. Press ⟨**3**⟩ to select the *stat test* function.

10. The screen now instructs the user to put the gauge in **SAFE** position on the spacer (the magnesium standard block) and press the ⟨**START/ENTER**⟩ key. Ensure that the gauge is in this orientation, then press the ⟨**START/ENTER**⟩ key.

11. Wait for the stat test to finish. At the conclusion of the test, the gauge displays the results of the test, as shown below. Row 2 shows the average Density count, Ratio value, and Pass/Fail status for System 1. Row 3 shows the average Density count, Ratio value, and Pass/Fail status for System 2.



12. If both systems passed the stat test, proceed to step 13. Otherwise, proceed to step 17.

13. Compare the average density standard counts to the respective density standard count limits in the *Calibration Inspection Limits* for the current gauge type.
    - If the observed standard counts fall within the allowed limits, then proceed to step 14.
    - If either standard count fails to fall within the specified *Calibration Inspection Limits*, however, then take another stat test by proceeding to step 17.

14. Record the average count, Ratio value, and Pass/Fail status for the two counting systems on the *4640-B Recalibration Data Sheet* under *Stat Test*.

15. Press the ⟨**NO/CE**⟩ key.

16. Proceed to the following section, *Bulk Density Calibration Counting*, to collect the block counts.

17. Do not record the results of the preceding stat test. Instead, press the ⟨**NO/CE**⟩ key, then take another stat test by repeating steps 8 through 11.

18. Once this second stat test has concluded and the results are displayed on the gauge, record the average count, Ratio value, and Pass/Fail status for the two counting systems on the *4640-B Recalibration Data Sheet* under *Stat Test*.

19. Press the ⟨**NO/CE**⟩ key.

20. If the gauge fails the second stat test, then halt the calibration process and take the gauge to Service or Assembly for analysis and repair. If the gauge passes this second stat test, proceed to step 21.

21. Compare the average density standard counts to the respective density standard count limits in the *Calibration Inspection Limits* for the current gauge type.
    - If the observed standard counts fall within the allowed limits, proceed to the following section, *Bulk Density Calibration Counting*, to collect the block counts.
    - If either standard count fails to fall within the specified *Calibration Inspection Limits*, however, then halt the calibration process and take the gauge to Service or Assembly for analysis and repair.

BULK DENSITY CALIBRATION COUNTING

1. Place the gauge in the center of the magnesium calibration block. Place the source rod in backscatter position, making sure the handle clicks into the backscatter notch. Press down gently on the end of the handle (without touching the trigger) to ensure that the handle is properly seated.

2. Press the yellow ⟨**SHIFT**⟩ key and the ⟨**SPECIAL**⟩ key to access the **SPECIAL FUNCTION** menu.

3. From the **SPECIAL FUNCTION** menu, press ⟨**4**⟩ to run a drift test.

4. The gauge prompts the user to ensure that the stat test is current. Press the ⟨**START/ENTER**⟩ key.

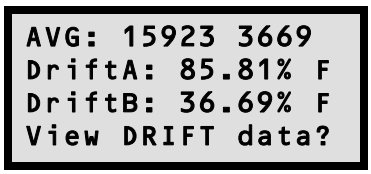
5. The screen now instructs the user to put the spacer block on the calibration block, to put the gauge in **SAFE** position on the spacer block, and to press the ⟨**START/ENTER**⟩ key. Instead, ***leave the gauge in backscatter position, sitting directly on the calibration block,*** and press ⟨**START/ENTER**⟩.

6. Wait for the drift test to finish. At the conclusion of the test, the gauge displays the results of the test, as shown below. The first row of the display shows the average System 1 count and average System 2 count. The second row identifies the system (*DriftA* for System 1), and shows the percent drift and Pass/Fail status for System 1. The third row identifies the system (*DriftB* for System 2), and shows the percent drift and Pass/Fail status for System 2.

NOTE

Ignore the Pass/Fail status and percent drift values; they are not relevant for this part of the procedure.

Using the drift test results screen, record the System 1 and System 2 average counts under the respective *Twenty Minute Count* table for the calibration block upon which the backscatter count was taken.



7. If the recalibration being performed is *2-block* recalibration, then proceed to step 11. Otherwise, if this is a *3-block* recalibration, proceed to step 8.

8. Place the gauge in the center of the mag/aluminum calibration block. Place the source rod in backscatter position, making sure the handle clicks into the backscatter notch. Press down gently on the end of the handle (without touching the trigger) to ensure that the handle is properly seated.

9. Press the ⟨**NO/CE**⟩ key. The ⟨**READY**⟩ screen is displayed.

10. Repeat steps 2 through 6.

11. Place the gauge in the center of the aluminum calibration block. Place the source rod in backscatter position, making sure the handle clicks into the backscatter notch. Press down gently on the end of the handle (without touching the trigger) to ensure that the handle is properly seated.

12. Press the ⟨**NO/CE**⟩ key. The ⟨**READY**⟩ screen is displayed.

13. Repeat steps 2 through 6.

14. Press the ⟨**NO/CE**⟩ key. The ⟨**READY**⟩ screen is displayed.

DRIFT TEST

1. Place the gauge's magnesium standard block on the center of the calibration block where the standard count is typically taken. For a *3-block* recalibration, use the mag/aluminum block; for a *2-block* recalibration, use the aluminum block.

2. Position the gauge on the magnesium standard block, with the air gap device in place.

3. From the ⟨**READY**⟩ screen on the gauge, press the yellow ⟨**SHIFT**⟩ key and the ⟨**SPECIAL**⟩ key to access the gauge's **SPECIAL FUNCTION** menu.

4. Press ⟨**4**⟩ to run a drift test.

5. The screen now instructs the user to put the spacer block on the calibration block, to put the gauge in **SAFE** position on the spacer block, and to press the ⟨**START/ENTER**⟩ key. Ensure that the gauge is in this orientation, then press the ⟨**START/ENTER**⟩ key.

6. Wait until the drift test finishes. The screen that is displayed by the gauge at the end of the drift test is described in detail in step 6 of the *Bulk Density Calibration Counting* section.

7. If both systems of the gauge pass the drift test, then proceed to step 8. Otherwise, proceed to step 11.

8. Record the drift test results in the appropriate location on the *4640-B Recalibration Data Sheet*.

9. Press the ⟨**NO/CE**⟩ key on the gauge.

10. Proceed to step 38.

11. Do not record the results of the preceding drift test. Instead, move the index rod of the gauge up and down ten times, from the **SAFE** position into the measurement position, then return it to the **SAFE** position.

12. Press the ⟨**NO/CE**⟩ key on the gauge.

13. Take another drift test by repeating steps 3 through 6.

14. If the gauge **fails** this second drift test, then a *provisional* drift test is required; proceed to step 15. If instead the gauge passes this second drift test, then the provisional drift test is unnecessary; go back to step 8.

15. Record the drift test results in the appropriate location on the *4640-B Recalibration Data Sheet*.

16. Press the ⟨**NO/CE**⟩ key on the gauge

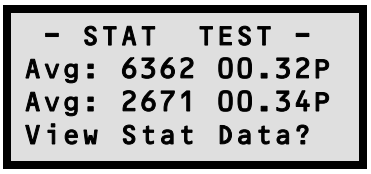
17. The first step in taking a provisional *drift* test is to take a provisional *stat* test. To start this process, press the ⟨**SPECIAL**⟩ key.

18. Press the yellow ⟨**SHIFT**⟩ key and the ⟨**SPECIAL**⟩ key to put the gauge in the **SPECIAL FUNCTION** menu.

19. Press ⟨**3**⟩ to perform a stat test.

20. The screen instructs the user to put the gauge in **SAFE** position on the spacer (the magnesium standard block) and press the ⟨**START/ENTER**⟩ key. Ensure that the gauge is in this orientation, then press the ⟨**START/ENTER**⟩ key.

21. Wait for the provisional stat test to finish. At the conclusion of the test, the gauge displays the results of the test, as shown below. Row 2 shows the average Density count, Ratio value, and Pass/Fail status for System 1. Row 3 shows the average Density count, Ratio value, and Pass/Fail status for System 2.



22. If both systems pass the provisional stat test, proceed to step 24. Otherwise, if either system fails the provisional stat test, then do not record the results; instead, repeat steps 16 through 21 in order to repeat the provisional stat test.

23. If the second provisional stat test fails, then record the results in the *Provisional Stat Test Results* section on the *4640-B Recalibration Data Sheet*, then halt the calibration process. Return the gauge to Assembly or Service to have it analyzed and repaired. If the second provisional stat test passes, then proceed to step 24.

24. On the *4640-B Recalibration Data Sheet* in the *Provisional Stat Test Results* section, record the average count and R value for both systems**.**

25. Press the ⟨**NO/CE**⟩ key on the gauge.

26. **DO NOT MOVE THE GAUGE IN ANY WAY UNTIL THE UPCOMING PROVISIONAL DRIFT TEST IS COMPLETE.** At this time, wait 3 hours before proceeding. Make sure that, during this 3-hour pause, the gauge is turned on and connected to the charger.

27. After the 3-hour pause has elapsed, from the ⟨**READY**⟩ screen, press the yellow ⟨**SHIFT**⟩ key and the ⟨**SPECIAL**⟩ key to put the gauge in the **SPECIAL FUNCTION** menu.

28. Press ⟨**4**⟩ to run a drift test.

29. The screen instructs the user to put the gauge in **SAFE** position on the spacer (the magnesium standard plate) standard block and press the ⟨**START/ENTER**⟩ key. Ensure that the gauge is in this orientation, then press the ⟨**START/ENTER**⟩ key.

30. Wait until the provisional drift test finishes. The screen that is displayed by the gauge at the end of the drift test is described in detail in step 6 of the *Bulk Density Calibration Counting* section.

31. If both systems pass the provisional drift test, then proceed to step 36. If either system fails, however, proceed to step 32.

32. Do not record the results of the preceding provisional drift test; instead, press the ⟨**NO/CE**⟩ key.

33. From the ⟨**READY**⟩ screen, press the yellow ⟨**SHIFT**⟩ key and the ⟨**SPECIAL**⟩ key to put the gauge in the **SPECIAL FUNCTION** menu.

34. Perform the provisional drift test over again by repeating steps 28 through 30.

35. If the second provisional drift test also fails either system, then record the results in the *Provisional Drift Test Results* section of the *4640-B Recalibration Data Sheet*. Halt the calibration process at this time, and return the gauge to Assembly or Service for analysis and repair. If, however, the second provisional drift test passes both systems, then proceed to step 36.

36. Record the results of the preceding provisional drift test in the *Provisional Drift Test Results* section of the *4640-B Recalibration Data Sheet*.

37. Press the ⟨**NO/CE**⟩ key.

38. On the *4640-B Recalibration Data Sheet* there is a location for calculating the *Calibration Standard Counts*. Follow the instructions listed there and calculate and record the Calibration Standard Count for both gauge systems.

39. Proceed to the following section, *Entering Calibration Data Into the Calibration Program*.

ENTERING CALIBRATION DATA INTO THE CALIBRATION PROGRAM

1. From the computer (in Windows mode) that contains the 4640 Calibration Software, start the software by clicking the icon for the **4640 Calibration**. If the default path was chosen when this software was installed, this program is in the directory *C:\Program Files\Cal4640*. The program itself is named *CAL4640.EXE*. A shortcut may be installed on the Windows Desktop.

2. An introductory splash screen is displayed for approximately five seconds, followed by the **4640 Calibration Main Menu**, as shown in Figure 5–1.

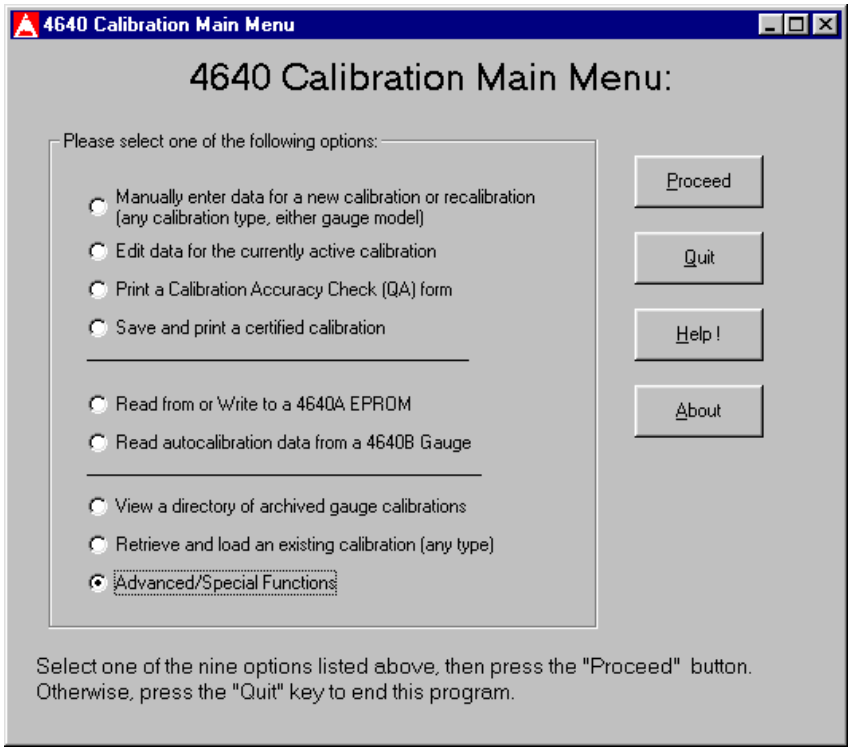


Figure 5–1. 4640 Calibration Main Menu

3. Select the **Advanced/Special Functions** option and click the ⟨**Proceed**⟩ button.

4. The software displays the **4640 Advanced/Special Function Menu** shown in Figure 5–2.

5. Select the **Calculate gauge drift** option and click the ⟨**Proceed**⟩ button. The software displays the **Calculate Percent Drift** screen shown in Figure 5–3.

6. Enter the counts taken from the stat test and the drift test into the appropriate text boxes on this screen.

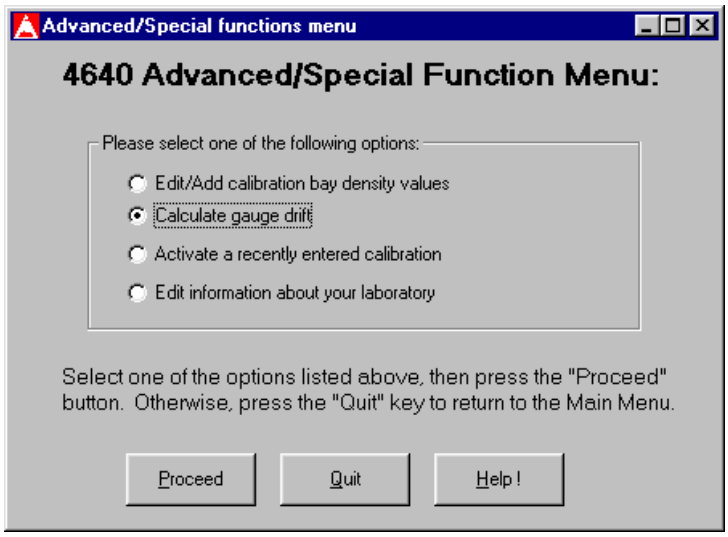


Figure 5–2. 4640 Advanced/Special Function Menu

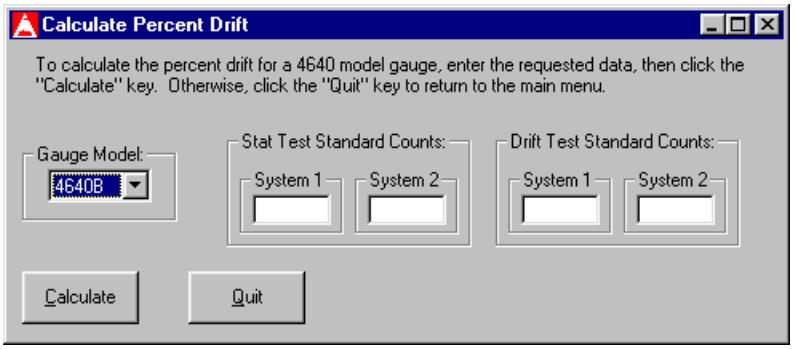


Figure 5–3. Calculate Percent Drift Screen

7. When all of the counts have been entered, click the ⟨**Calculate**⟩ button. The program uses the data entered to calculate the standard counts that will be used for the calibration. The program then displays the drift test results, as shown in Figure 5–4.

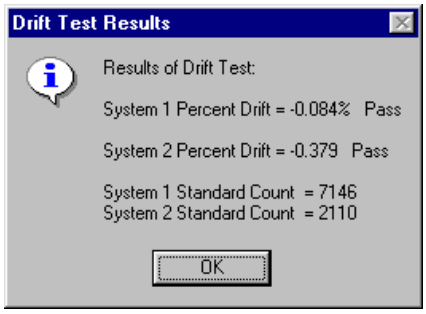


Figure 5–4. Drift Test Results Display

8. Record the data listed for the System 1 and System 2 standard counts on the Calibration Data Form, then click the ⟨**OK**⟩ button.

9. The **Drift Test Results** screen disappears and the **Calculate Percent Drift** screen comes to the foreground. Click the ⟨**Quit**⟩ button on this screen.

10. At this point the **4640 Calibration Main Menu** is again displayed, with the default option, **Manually enter data for a new calibration or recalibration**, selected. Click the ⟨**Proceed**⟩ button.

11. The software displays a **Select the gauge model** screen, which prompts the user to select whether the gauge being calibrated is a Model 4640-A or 4640-B. Select the **4640 B** option button and click the ⟨**Proceed**⟩ button to go to the next step.

12. The software then displays a message box that asks **Is this a full calibration of a 4640-B gauge?**

13. Since a recalibration of the Model 4640-B was just performed, click ⟨**No**⟩ to continue to the next step.

14. As shown in Figure 5–5, the program queries the user as to the type of recalibration just performed.
    - If the user has just performed a 3-block calibration, click the ⟨**Yes**⟩ button and proceed to step 16.
    - If instead the user has just performed a 2-block calibration, click the ⟨**No**⟩ button and go to step 15.
    - To return to the **4640 Calibration Main Menu**, click the ⟨**Cancel**⟩ button.

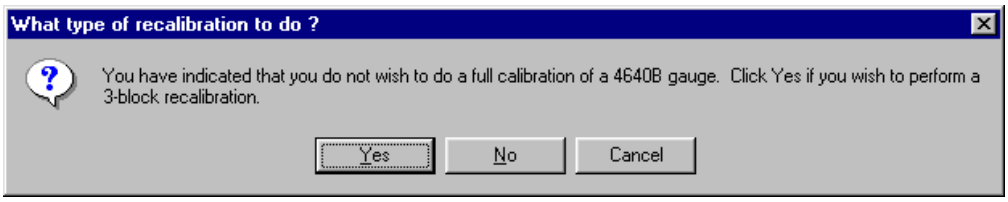


Figure 5–5. Recalibration Type Query

15. If the user clicks ⟨**No**⟩ on the preceding message box, the message box shown in Figure 5–6 is displayed.
    - If the calibration just performed was a 2-block calibration, click ⟨**Yes**⟩ and proceed to step 16.
    - To return to step 12, click the ⟨**No**⟩ button.
    - To return to the **4640 Calibration Main Menu**, click the ⟨**Cancel**⟩ button.

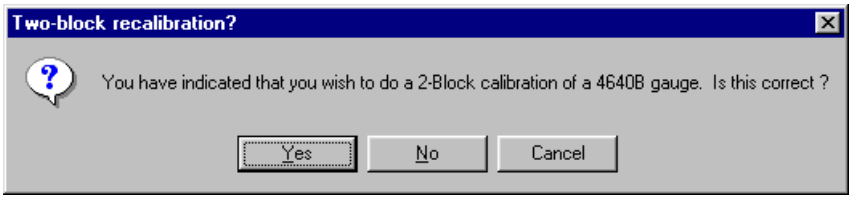


Figure 5–6. Two-Block Recalibration Query

16. The program now displays the first calibration data entry screen. If the user had indicated that the calibration was a 3-block calibration, the display is as shown in Figure 5–7, with spaces for entering the bulk density counts from the magnesium, mag/aluminum, and aluminum blocks. If instead the user selected a 2-block recalibration, the display is as shown in Figure 5–8, with the spaces for the mag/aluminum bulk density counts omitted.

    Note that the *Calibration Type* and *Gauge Model* on this screen are set to the values entered in the previous message boxes. Also note that the *Date*, *Background Counts*, and *Calibration Bay* are set to default values. The user may change any of these values.

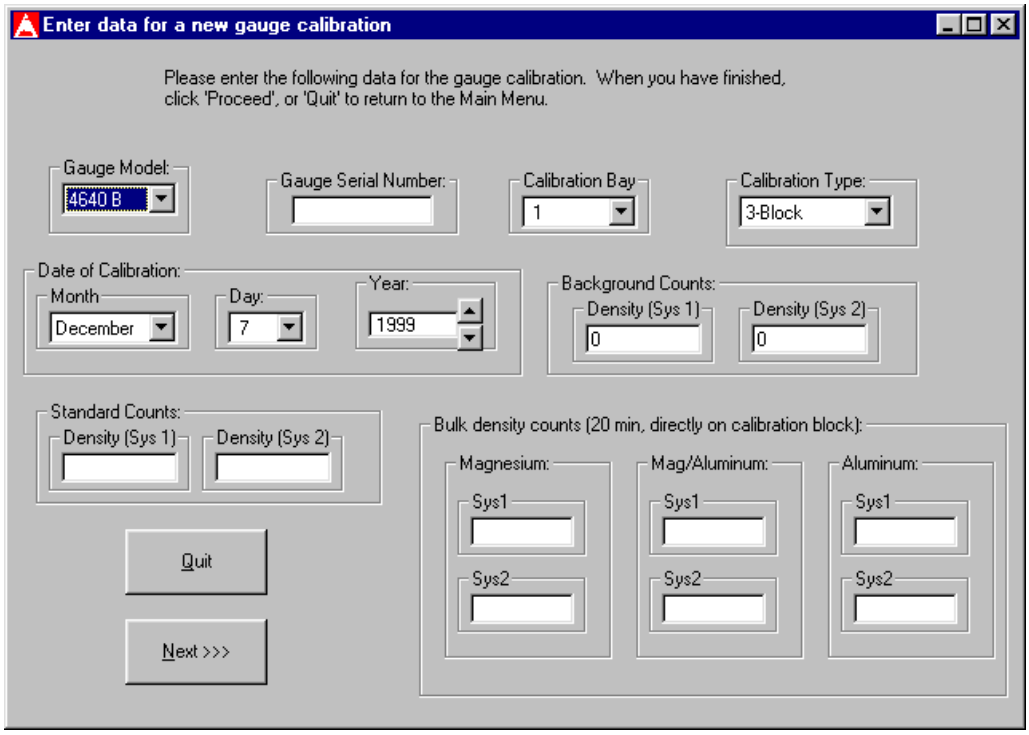


Figure 5–7. First Calibration Data Entry Screen, Three-Block Calibration

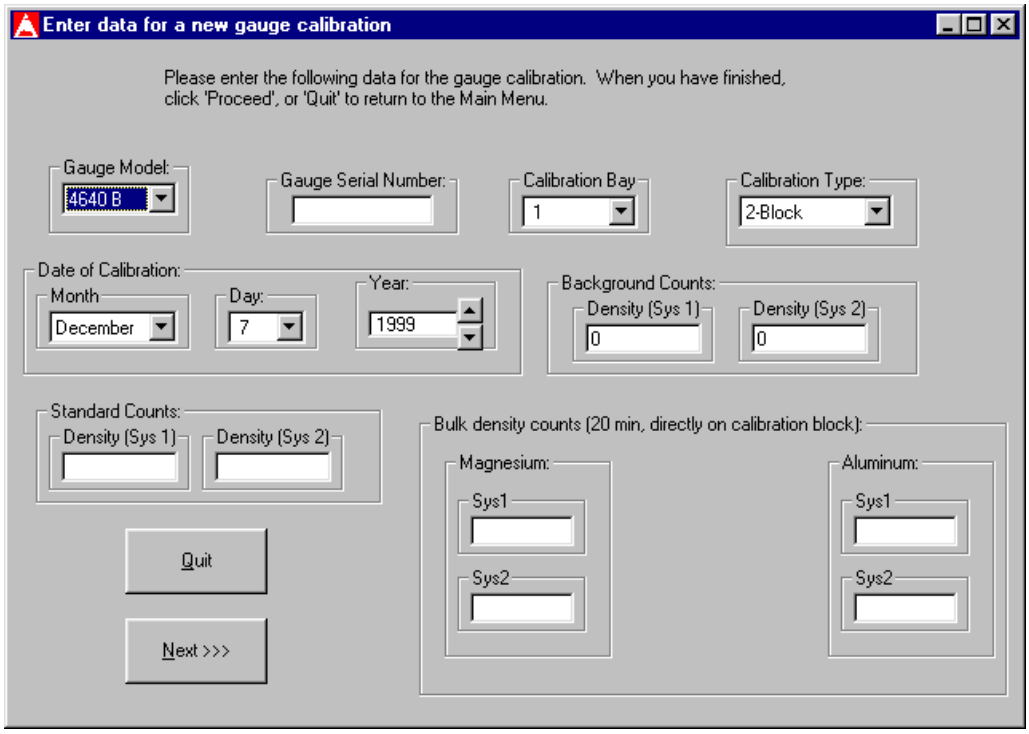


Figure 5–8. First Calibration Data Entry Screen, Two-Block Calibration

17. Using the appropriate data from the *4640-B Recalibration Data Sheet*, fill in the required text boxes on this screen, then click the ⟨**Next**⟩ button. If any necessary values are omitted, the program displays an error message box. Click ⟨**OK**⟩ on this message box to return to the first data entry screen and enter the required values.

18. If all of the required values are entered in step 17, then the second calibration data entry screen is displayed. If this is a 3-block recalibration, the second calibration data entry screen shown in Figure 5–9 is displayed; if this is a 2-block recalibration, the data entry screen shown in Figure 5–10 is displayed.

19. The current data screen requires the user to enter the thin layer calibration constants from the most recent full calibration of this gauge. If the recalibration is a *2-block* recalibration, the user must also enter the *B1* and *B2* bulk density calibration constants. These constants can be retrieved from the gauge (see the *Calibration Quality Assurance* section on page 5–14 for information on how to access the calibration constants in the gauge) or from the calibration sheets from the previous calibration. If the data are acquired from a calibration sheet, then use the constants printed on the third page of the calibration sheet, listed under the heading *Factory Calibration Re-Entry Constants*.

20. Enter all of the requested data. When all of the values are entered, then click the ⟨**Next**⟩ button. To edit data from the preceding page, click the ⟨**Back**⟩ button.

21. If any necessary values are omitted, the program displays an error message box. Click ⟨**OK**⟩ on this message box to return to the second data entry screen and enter the required values.

22. When all of the required values have been entered and the ⟨**Next**⟩ button is clicked, the data is saved to a temporary file, and this data becomes the *Active Calibration*. The program displays a message box that confirms that the data entry is complete, and asks if the user wants to print the data. Click ⟨**Yes**⟩ to print a listing of the count data that was just entered and continue, or ⟨**No**⟩ to continue without printing.

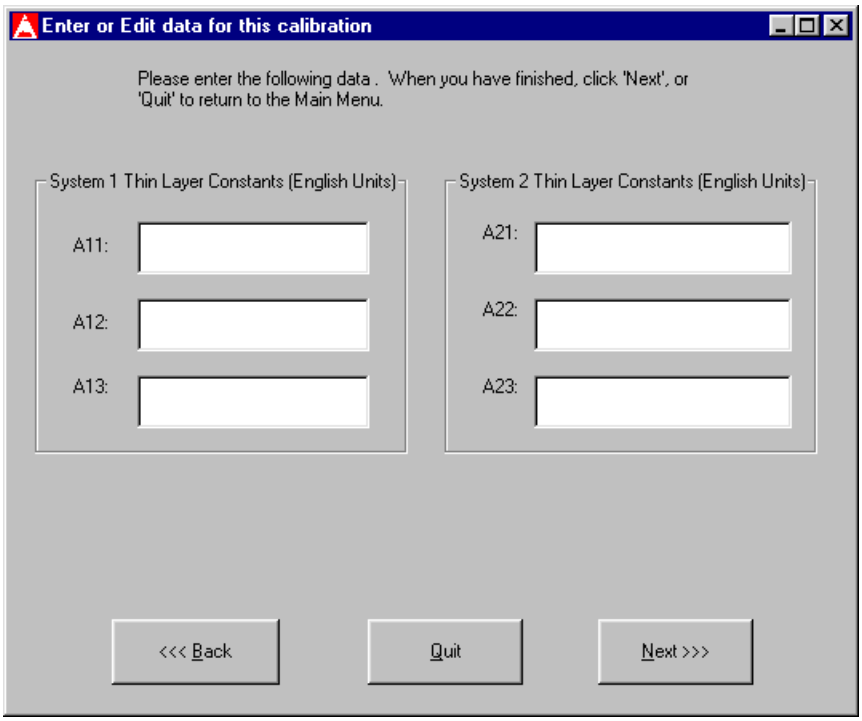


Figure 5–9. Second Calibration Data Entry Screen, Three-Block Calibration

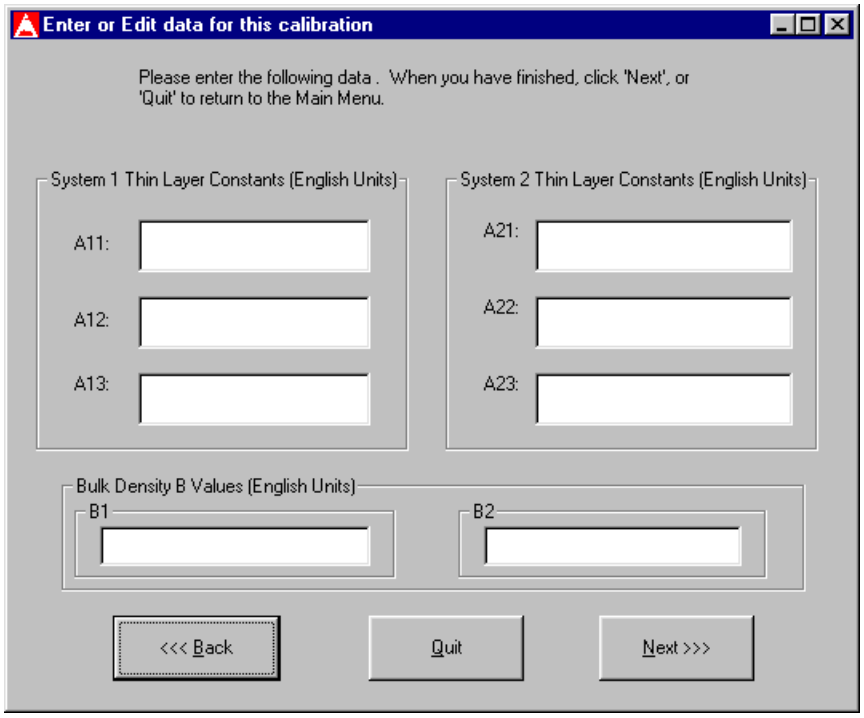


Figure 5–10. Second Calibration Data Entry Screen, Two-Block Calibration

23. Regardless of whether the user elects to print the data entered or not, the query box shown in Figure 5–11 is eventually displayed.

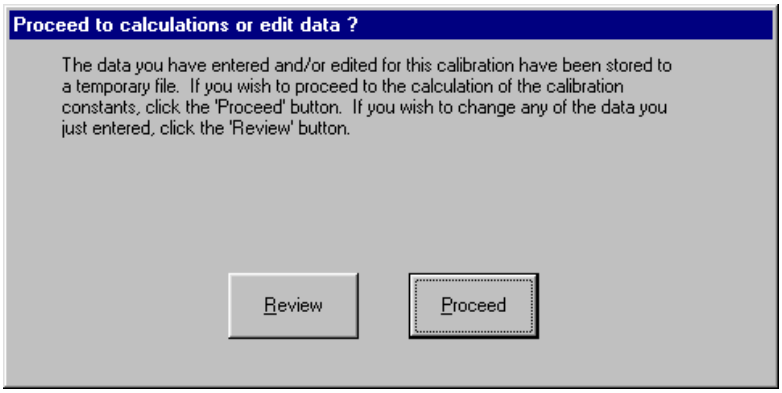


Figure 5–11. Proceed to Calculations or Edit Data Query

24. Click the ⟨**Proceed**⟩ button to proceed to step 25 and calculate the calibration constants. To review and/or modify the data entered in the previous steps, click the ⟨**Review**⟩ button. If the user clicks the ⟨**Review**⟩ button, the program returns to step 16; with all values previously entered intact on the screen.

25. When the user clicks the ⟨**Proceed**⟩ button on the preceding screen, the calibration calculations take place. If the calculations are performed without any errors, the program displays the message box shown in Figure 5–12.

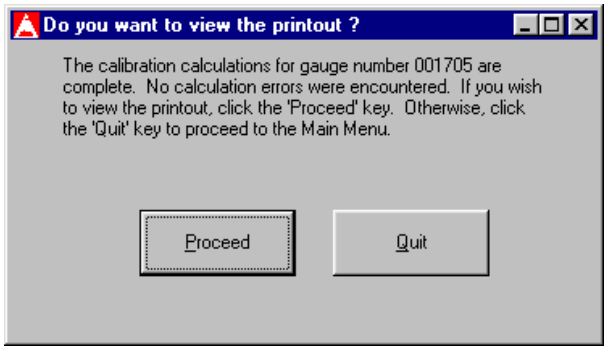


Figure 5–12. View Calibration Constants Printout Query

26. If an error was encountered in the calculations, the program displays an error message and enables the user to go back and edit the input data. Otherwise, the message box shown in Figure 5–12 is displayed. Click the ⟨**Proceed**⟩ button.

27. When the ⟨**Proceed**⟩ key is clicked, the calibration sheets are formulated and displayed as shown in Figure 5–13. The entire text of the calibration sheets, in formatted form, is shown in the text box on this screen. The user can scroll up and down this text box to view the calibration sheet in its entirety. These sheets can be displayed in Metric or Imperial (English) units by clicking the appropriate option button in the lower right-hand portion of the screen.

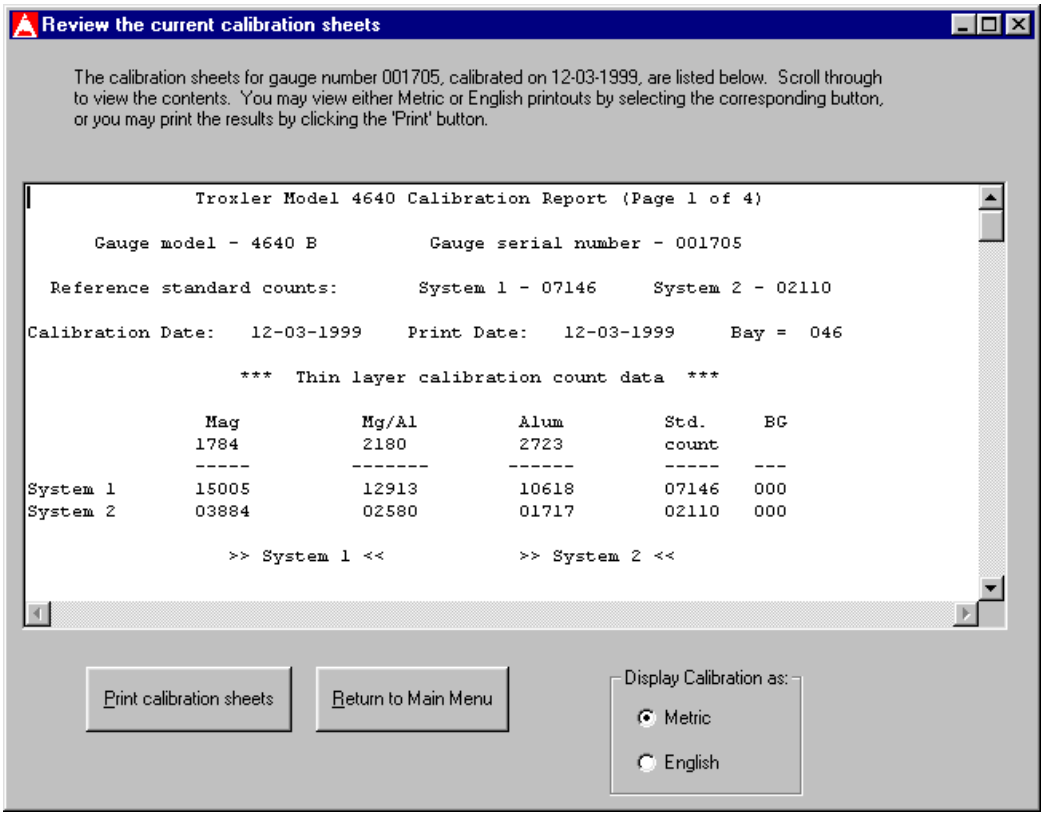


Figure 5–13. Review the Current Calibration Sheets Display

28. The user *must* print the calibration sheets, as the calibration constants listed on page 3 of the printout must be entered into the gauge during the *Calibration Quality Assurance* section below. Click the ⟨**Print calibration sheets**⟩ button to print these sheets, then proceed to step 29.

29. The software now displays a message box warning the user that simply printing the calibration sheets at this point **does not** mean that the data is being permanently archived. The data can only be archived after the QA test has passed and the user has selected the **Save and Print a Certified Calibration** option from the **4640 Calibration Main Menu**. Click ⟨**OK**⟩ on this message box to proceed with the printout.

30. At the conclusion of the printout, refer to the calibration sheet just printed and compare the results to the relevant quantities on the *Calibration Inspection Limits* for this gauge.
    - If the gauge fails to meet any of these limits, click the **Return to Main Menu** button and proceed to the following section, *Editing the Calibration Data*, to make the necessary recounts.
    - If, however, all of the associated quantities meet the *Calibration Inspection Limits*, then proceed to the *Calibration Quality Assurance* section on page 5–14.

EDITING THE CALIBRATION DATA

The steps in this section are performed if there was a mathematical error in the calculation of the calibration constants, or if the gauge failed one or more parts of the Quality Assurance Test.

4. Retake the count or counts that caused the calibration to fail whichever evaluation it failed. Instructions for collecting this count or counts are provided in the *Bulk Density Calibration Counting* section on page 5–3.

5. From the **4640 Calibration Main Menu** (see Figure 5–1 on page 5–7), select the **Edit data for the currently active calibration** option, then click the ⟨**Proceed**⟩ button.

6. Return to the *Entering Calibration Data Into the Calibration Program* section, and go to step 16 on page *4640-B Recalibration Data Sheet*. Follow the instructions to change the data that is required, recalculate the calibration constants, and evaluate the thin layer residuals. At the end of that section, you will be directed where to proceed from there.

CALIBRATION QUALITY ASSURANCE

1. Before any Quality Assurance counting can take place, the calibration constants must be *manually* entered into the gauge.

2. From the ⟨**READY**⟩ screen on the gauge, press the yellow ⟨**SHIFT**⟩ key and the ⟨**SPECIAL**⟩ key to access the **SPECIAL FUNCTION** menu.

3. From the **SPECIAL FUNCTION** menu, press the ⟨**1**⟩ and ⟨**9**⟩ keys. This initiates the **EXTENDED FUNCTIONS** menu, where the user is asked to enter a code number.

4. Enter the code number ***528***, then press the ⟨**START/ENTER**⟩ key.

5. At this point the first page of *Extended Functions* options is displayed. Press ⟨**4**⟩ to access the calibration constants.

6. Enter the calibration constants, which can be obtained from page 3 of the calibration printout, under the heading *Factory Calibration Re-Entry Constants*. This printout was generated step 29 of the *Entering Calibration Data Into the Calibration Program* section.

7. After all twelve calibration constants have been entered, generate a Quality Assurance (QA) form using the calibration software. From the **4640 Calibration Main Menu**, select the option **Print a Calibration Accuracy Check (QA) form** and click the ⟨**Proceed**⟩ button.

8. The program displays a message box that identifies the active calibration and asks if the user wishes to print QA sheets for this calibration. Click the ⟨**Yes**⟩ button.

9. The program then displays a message box that allows the user to select the measurement units in which the *Calibration Accuracy Check Form* will be printed. Select the option button for the desired measurement units and click the ⟨**Print QA Sheets**⟩ button.

10. The *Calibration Accuracy Check Form* will be printed to the selected printer. Click the ⟨**Quit**⟩ button to return to the **4640 Calibration Main Menu**.

11. The calibration technician performing this calibration should record his or her name in the space beside the label *Calibration Technician* on page 1 of the *Calibration Accuracy Check Form*.

12. Place the gauge's magnesium standard block on the center of the calibration block where the standard count is typically taken. For a 3-block calibration, this is the mag/aluminum block; for a 2-block calibration, this is the aluminum block.

13. Position the gauge on the magnesium standard in the orientation that would be used for a standard count.

14. Take a standard count. Record the results in the appropriate location on the *Calibration Accuracy Check Form*.

15. Following the instructions on the *Calibration Accuracy Check Form*, calculate the Density and Standard Percent differences and record them at the appropriate location.

16. If the Density and Standard Percent differences do not meet the required limits listed on the *Calibration Accuracy Check Form*, take another standard count, and repeat step 14. If the Density Standard Percent differences **still** do not meet the required limits listed on the form, see your supervisor.

17. From the ⟨**READY**⟩ screen on the gauge, press the ⟨**THICK**⟩ key. The gauge displays the current setting for the layer thickness.

18. Ensure that the top layer thickness is set to 1 inch (2.54 cm) and press the ⟨**START/ENTER**⟩ key.

19. From the ⟨**READY**⟩ screen, press the ⟨**TIME**⟩ key and set the gauge count time to 4 minutes.

20. Place the gauge on the magnesium calibration block in measurement position.

21. Place the source rod in backscatter position, making sure the handle clicks into the backscatter notch. Press down gently on the end of the handle (without touching the trigger) to ensure that the handle is properly seated.

22. From the ⟨**READY**⟩ screen, press the ⟨**START/ENTER**⟩ key and wait for the count to finish. When the count is complete, the gauge displays the measured density. In the *Thin Layer Measurement Accuracy Check* portion of the *Calibration Accuracy Check Form*, there is a section for recording both the counts and the density value measured on this block. Read the Density value from the top line of the gauge display and record it in the appropriate location on the *Calibration Accuracy Check Form*.

23. When step 22 is complete and the density value has been recorded, press the ⟨**SHIFT**⟩ key, followed by the ⟨**RECALL**⟩ key. The gauge now displays the two density counts (System 1 and System 2) that were just taken on the bottom row of the screen. Record these values in the appropriate location on the *Calibration Accuracy Check Form*.

24. Press the ⟨**NO/CE**⟩ key on the gauge to return to the ⟨**READY**⟩ screen. If the density value measured by the gauge in step 22 falls within the respective range specified on the *Calibration Accuracy Check Form*, then proceed to step 27. Otherwise, a recount must be taken; proceed to step 25.

25. Repeat steps 22 and 23, and record the counts and densities under the area reserved for the recounts.

26. Press the ⟨**NO/CE**⟩ key on the gauge to return to the ⟨**READY**⟩ screen. If the density value measured by the gauge in step 25 falls within the respective range specified on the *Calibration Accuracy Check Form*, then proceed to step 27. Otherwise, the gauge has failed this portion of the thin layer QA test and will probably require recounts. Halt the QA process and take the required recounts.

27. Continue as follows:

    - If (a) the calibration block that was just measured was the magnesium block **and** (b) the calibration for which this QA test is being conducted is **NOT** a 2-block calibration, place the gauge on the mag/aluminum block and proceed to step 28.
    - If either condition (a) or (b) mentioned in the last sentence are **NOT** true, then place the gauge on the aluminum block and proceed to step 28.
    - If the calibration block just measured was instead the aluminum block, proceed to step 29.

28. Repeat steps 21 through 24.

29. For a Model 4640-B recalibration, the thin layer measurement capabilities of the device must be checked in the QA testing phase. Place the magnesium standard block for the gauge on top of the aluminum calibration block.

30. Place the gauge on the center of the magnesium standard block.

31. Place the source rod in backscatter position, making sure the handle clicks into the backscatter notch. Press down gently on the end of the handle (without touching the trigger) to ensure that the handle is properly seated.

32. From the ⟨**READY**⟩ screen, press the ⟨**START/ENTER**⟩ key and wait for the count to finish. When the count is complete, the gauge displays the measured density. In the *Thin Layer Measurement Accuracy Check* portion of the *Calibration Accuracy Check Form*, Part II, there is a section for recording the density value measured on this block. Read the Density value from the top line of the gauge display, and record it in the appropriate location on the *Calibration Accuracy Check Form*.

33. When step 32 is complete and the density value has been recorded, press the ⟨**SHIFT**⟩ key, followed by the ⟨**RECALL**⟩ key. The gauge now displays the two density counts (System 1 and System 2) that were just taken on the bottom row of the screen. Record these values in the appropriate location on the *Calibration Accuracy Check Form*.

34. Press the ⟨**NO/CE**⟩ key on the gauge so that it will return to the ⟨**READY**⟩ screen. If the density value measured by the gauge in step 32 falls within the respective range specified on the *Calibration Accuracy Check Form*, then proceed to step 37. Otherwise, a recount must be taken; proceed to step 35.

35. Repeat steps 32 and 33, and record the counts and densities under the area reserved for the recounts.

36. Press the ⟨**NO/CE**⟩ key on the gauge to return to the ⟨**READY**⟩ screen. If the density value measured by the gauge in step 35 falls within the respective range specified on the *Calibration Accuracy Check Form*, then proceed to step 37. Otherwise, the gauge has failed this portion of the thin layer QA test and will probably require recounts. Halt the QA process and take the required recounts.

37. The Quality Assurance testing is complete, and the calibration is now certified. Proceed to the following section, *Archiving the Calibration and Printing the Calibration Sheets*.

ARCHIVING THE CALIBRATION AND PRINTING THE CALIBRATION SHEETS

Once the gauge has passed the QA tests, it is time to archive the calibration data in the database file. It is also the appropriate time to print out two sets of calibrations sheets – one for the customer and one for the files.

9. From the **4640 Calibration Main Menu** (see Figure 5–1 on page 5–7), choose the **Save and print a certified calibration** and click the ⟨**Proceed**⟩ button:

10. The software displays a message box that shows the current active calibration, and asks the user to confirm that this is the calibration he or she wishes to saves and print. Click ⟨**No**⟩ to return to the **4640 Calibration Main Menu** or ⟨**Yes**⟩ to continue.

11. If the user clicks the ⟨**No**⟩ button, the program returns to the **4640 Calibration Main Menu**. If the user clicks ⟨**Yes**⟩, the software displays a message box requesting the user's initials.

12. Enter your initials and click ⟨**OK**⟩. Note that at least two alphabetic characters must be entered. The program will not proceed unless a set of valid initials is entered.

13. When a valid set of initials is entered, the software saves the calibration data to the archive data file, and displays a confirmation message box. Click ⟨**Proceed**⟩ to continue with printing the calibration sheets.

14. After the ⟨**Proceed**⟩ button is clicked, The software displays the same screen shown in Figure 5–13 on page 5–13, giving the user the opportunity to print the calibration report.
    - To return to the **4640 Calibration Main Menu** without printing the calibration report, click the ⟨**Return to Main Menu**⟩ button.
    - To print the calibration sheets, click the ⟨**Print calibration sheets**⟩ button and proceed to the following step.

15. The software displays a dialog box that allows the user to select the printer to use to print the calibration sheets. Note, however, that the default value for **Number of Copies** is set to *2*, to encourage the user to print two calibration reports (one for the customer, the other for the lab files). Of course, the user may select any number of copies he or she wishes to pint.

    - If the user clicks the ⟨**Cancel**⟩ button, the print dialog box disappears, and the screen shown in Figure 5–13 is displayed.
    - If instead the user clicks the ⟨**Print**⟩ button, the calibration sheets are printed and the screen shown in Figure 5–13 is displayed.

16. Click the ⟨**Return to Main Menu**⟩ to return to the **4640 Calibration Main Menu**, then proceed to the following section, *Final Initialization and Status Check,* to finish.

FINAL INITIALIZATION AND STATUS CHECK

1. On the gauge keypad, press the yellow ⟨**SHIFT**⟩ key and the ⟨**SPECIAL**⟩ key to access the **SPECIAL FUNCTION** menu.

2. Press the ⟨**1**⟩ and ⟨**9**⟩ keys. The gauge displays the **EXTENDED FUNCTIONS** menu, and asks the user to enter a code number.

3. Enter the code number ***528***, then press the ⟨**START/ENTER**⟩ key. The first page of *Extended Functions* options is displayed.

4. Press ⟨**5**⟩ to access the function used to enter the calibration date. When prompted, enter the date that this calibration was completed.

5. After the calibration date entry is complete, the gauge will still be in the *Extended Functions* menu. Press ⟨**7**⟩ to access the function to enter the standard counts at the time of calibration.

6. When prompted, enter the System 1 and System 2 standard counts listed on the calibration report that was just printed in the previous section, *Archiving the Calibration and Printing the Calibration Sheets*.

7. After entering the calibration standard counts for System 1 and System 2, click the ⟨**NO/CE**⟩ key to return to the ⟨**READY**⟩ screen.

8. Press the yellow ⟨**SHIFT**⟩ key and the ⟨**SPECIAL**⟩ key to access the **SPECIAL FUNCTION** menu.

9. Press ⟨**1**⟩ and ⟨**0**⟩ on the keypad. The gauge displays a prompt asking for a code to access the gauge time and date functions.

10. Enter the number ***5888*** and press the ⟨**START/ENTER**⟩ key. The **Time/Date** menu is displayed.

11. Ensure that the current time and date in the gauge are correct. If not, set them correctly.

The calibration process is now complete.

CALIBRATION PROCEDURE OUTLINE AND CHECKLIST

- ❑ Turn on gauge and allow it to power up and complete the self-test.
- ❑ Obtain a *4640-B Recalibration Data Sheet* and fill in the information preceding the stat test information.
- ❑ Run a successful stat test with the gauge and record the results.
- ❑ Make sure that the standard counts obtained in the stat test meet the *Calibration Inspection Limits*.
- ❑ Take 20-minute counts with the gauge on each of the three metal blocks (magnesium, mag/aluminum, and aluminum). These counts can only be obtained by running the gauge's drift test with the gauge in measurement position while directly on the block. Record the resulting mean counts on the *4640-B Recalibration Data Sheet*.
- ❑ If this is a new gauge calibration, take the required thin layer overlay counts, where each of these counts is 4 minutes in duration.
- ❑ Run a successful drift test (with the gauge in standard count orientation) with the gauge. If necessary, conduct the provisional drift test.
- ❑ Once the gauge has finished with the drift test, run the calibration program. From the **4640 Calibration Main Menu** select the **Manually enter data for a new calibration or recalibration** option, then follow the instructions from the program.
- ❑ When the data entry is complete, follow the instructions from the gauge to compute the constants.
- ❑ When the calibration report is displayed, print a copy. Compare the relevant quantities on this report to the *Calibration Inspection Limits* to ensure that this calibration meets these requirements. If this is a full calibration, ensure that the thin layer residuals are all within the allowed limits.
- ❑ Get the calibration printout sheets from the printer. Access the **EXTENDED FUNCTIONS** menu in the gauge (see note 1 at the end of this section) and press ⟨**4**⟩ to allow the entry of the calibration constants into the gauge.
- ❑ Look at the *Factory Calibration Re-Entry Constants* section of the third page of the calibration printout. Follow the prompts on the gauge to enter these values into the gauge.
- ❑ When the calibration constants are in the gauge, return to the **4640 Calibration Main Menu** in the calibration program and follow the prompts to print a *Calibration Accuracy Check Form*.
- ❑ Run the Calibration Accuracy Tests (QA Test) successfully.
- ❑ Once the QA Test has been completed successfully, return to the **4640 Calibration Main Menu** and select the **Save and Print a Certified Calibration** option. Follow the prompts to archive the calibration and print the calibration report.
- ❑ File one copy of the calibration report, and put the other with the gauge.

- ❑ Access the gauge's **EXTENDED FUNCTIONS** menu (see note 1 below). From the **EXTENDED FUNCTIONS** menu, enter the date of the calibration and the standard counts that were used at the time of calibration (functions *5* and *7* on the menu, respectively).

- ❑ Access the gauge's **Time/Date** menu (see note 2 below). From this menu, set the date and time in the gauge to their correct values.

NOTES:

1. To access the gauge's **EXTENDED FUNCTIONS** menu, press the yellow ⟨**SHIFT**⟩ key and the ⟨**SPECIAL**⟩ key. Then press the ⟨**1**⟩ and ⟨**9**⟩ keys. When the gauge prompts for the entry of a code, enter the number ***528*** and then press the ⟨**START/ENTER**⟩ key. The **EXTENDED FUNCTIONS** menu is then displayed.

2. To access the **Time/Date** menu, press the ⟨**SHIFT**⟩ key, then the ⟨**SPECIAL**⟩ key, then press ⟨**1**⟩ and ⟨**0**⟩. When the gauge prompts for the entry of another code, enter the number ***5888*** and press the ⟨**START/ENTER**⟩ key. The **Time/Date** menu is then displayed.

4640-B RECALIBRATION DATA SHEET

Date:		Model No.:	4640	Version:	B
Serial No.:		Bay No.:		Order No.:	

Stat Test Results

System 1:		R:		System 2:		R:	

Bulk Density (Directly on the block, 20 minutes in duration)

Magnesium Block		Mag/Aluminum Block		Aluminum Block	
System 1	System 2	System 1	System 2	System 1	System 2

Drift Test Results

System 1:		% Drift:		System 2:		% Drift:	

Calibration Standard Counts (Average of stat and drift test values):	System 1:		System 2:	

(Use the remainder of this page *only* if a provisional drift test is required.)

Provisional Stat Test Results

System 1:		R:		System 2:		R:	

Provisional Drift Test Results

System 1:		% Drift:		System 2:		% Drift:	

NOTE

The provisional stat test and drift test values ARE NOT USED to compute the calibration standard counts; they are used strictly to test the electrical stability of the gauge.

NOTES

CHAPTER 6

MODEL 4640-B AUTOMATIC RECALIBRATION

This chapter provides instructions for performing an *automatic* recalibration of a Model 4640-B Thin Layer Density Gauge using the Troxler Legacy Calibration Suite software. The information presented here includes procedures for resolving issues encountered during the recalibration process. A calibration procedure outline and checklist is provided at the end of this chapter.

CONTENTS

RECALIBRATION PROCEDURE

The Model 4640-B gauge has an advantage over the Model 4640-A gauge in that an "automatic recalibration" can be performed with the 4640-B. An automatic recalibration prompts the user as to what data to enter into the gauge and what counts to acquire. The gauge then stores the data and counts, computes the calibration constants, and writes the constants into the gauge memory.

The data acquired and required by the 4640-B during an automatic recalibration is the same as that needed during a manual recalibration. However, the automatic recalibration provides a more guided, self-contained, and paper-free method of data collection and evaluation.

AUTOMATIC DATA COLLECTION PROCEDURE

1. Select a bay for recalibration. The bay must contain the magnesium and aluminum calibration blocks. If the recalibration being performed is a 3-block recalibration, then the bay must also contain a mag/aluminum calibration block.

2. Place the gauge's magnesium standard block on the center of the calibration block where the standard count is typically taken. For a 3-block recalibration, this is the mag/aluminum block; for a 2-block recalibration, this is the aluminum block.

3. Position the gauge on the magnesium standard, with the air gap fixture in place.

4. Turn the gauge on.

5. When the gauge finishes its self-test, it displays the ⟨**READY**⟩ screen, which shows the battery status. Press the yellow ⟨**SHIFT**⟩ key and the ⟨**SPECIAL**⟩ key to access the **SPECIAL FUNCTION** menu.

6. When the **SPECIAL FUNCTION** menu is displayed, press the ⟨**1**⟩ and ⟨**9**⟩ keys.

7. The gauge displays the **EXTENDED FUNCTIONS** menu, and asks the user to enter a code number. Enter the code number ***528***, then press the ⟨**START/ENTER**⟩ key.

8. The first page of *Extended Functions* options is displayed. Press the ⟨**6**⟩ key to initiate the *Gauge Calibration* functions.

9. After the ⟨**6**⟩ key is pressed, the gauge display again requests an access code. Enter the number ***528***, and then press the ⟨**START/ENTER**⟩ key.

10. The **4640B Recalib.** menu is now displayed. Press the ⟨**1**⟩ key to begin a 2-block recalibration or the ⟨**2**⟩ key to begin a 3-block recalibration.

11. The gauge displays now asks if the user wants to do a new recalibration, a recount, or a printout of the results. Press the ⟨**1**⟩ key to select a new recalibration.

12. The resulting gauge screens guide the user through all of the recalibration steps, in the following order:
    - ♦ General Calibration Information
    - ♦ Calibration Block Information
    - ♦ Stat Test
    - ♦ Bulk density counts (20-minute counts directly on the calibration blocks)
    - ♦ Drift Test

    Note that the density values that are entered for the calibration blocks are the true gravimetric densities of the blocks, as printed on the calibration sticker on the block.

    Also note that, when prompted for the densities of the magnesium and aluminum thin layer plates, the user should enter the same gravimetric density values that he or she enters for the magnesium and aluminum recalibration blocks.

    Follow all of the instructions given by the gauge. After all the data is collected, the gauge returns to the ⟨**READY**⟩ screen.

SEND THE AUTOCALIBRATION DATA TO THE COMPUTER

1. From the computer (in Windows mode) that contains the 4640 Calibration Software, start the software by clicking the icon for the **4640 Calibration**. If the default path was chosen when this software was installed, this program is in the directory *C:\Program Files\Cal4640*. The program itself is named *CAL4640.EXE*. A shortcut may be installed on the Windows Desktop.

2. An introductory splash screen is displayed for approximately five seconds, followed by the **4640 Calibration Main Menu**, as shown in Figure 6–1.

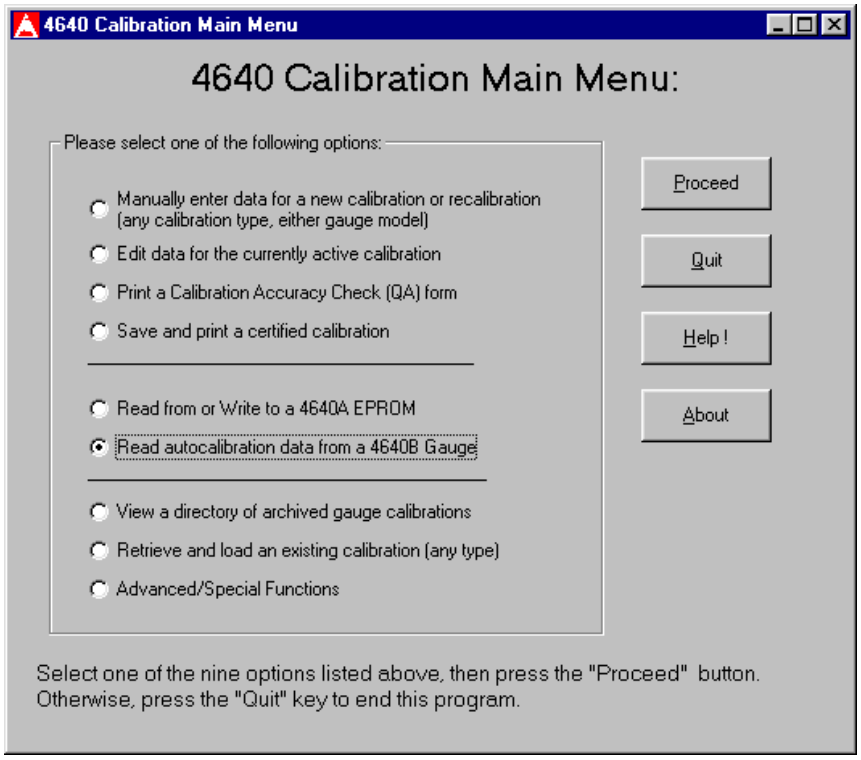


Figure 6–1. 4640 Calibration Main Menu

3. Select the **Read autocalibration data from a 4640B Gauge** option, then click the ⟨**Proceed**⟩ button.

4. The program displays a message box that notifies the user that the gauge must be available and ready for the data download.
   - Click the ⟨**Cancel**⟩ to return to the **4640 Calibration Main Menu**.
   - Click the ⟨**OK**⟩ button to continue to step 5.

5. The next screen that appears asks if the calibration data to be loaded to the computer is for a *full* calibration. Since this is a *recalibration* rather than a full calibration, click the ⟨**No**⟩ button and proceed to step 6.

6. As shown in Figure 6–2, the program asks if the calibration data to be loaded to the computer is for a 3-block calibration.
   - If the user has just performed a 3-block calibration, click the ⟨**Yes**⟩ button and proceed to step 8.
   - If instead the user has just performed a 2-block calibration, click the ⟨**No**⟩ button and go to step 7.
   - To return to the **4640 Calibration Main Menu**, click the ⟨**Cancel**⟩ button.

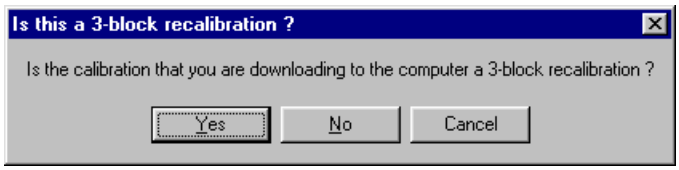


Figure 6–2. Recalibration Type Query

7. If the user clicks ⟨**No**⟩ on the preceding message box, the message box shown in Figure 6–3 is displayed.
   - If the calibration just performed was a 2-block calibration, click ⟨**Yes**⟩ and proceed to step 8.
   - To return to step 5, click the ⟨**No**⟩ button.
   - To return to the **4640 Calibration Main Menu**, click the ⟨**Cancel**⟩ button.

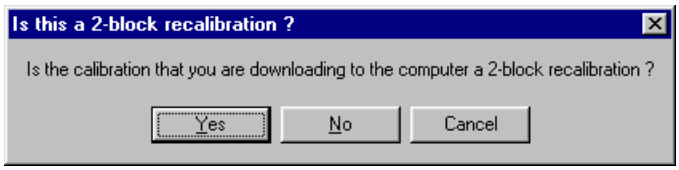


Figure 6–3. Two-Block Recalibration Query

8. During the recalibration procedure, the gauge can interface with the computer through a custom RS-232 cable connected directly to the computer, or through the Troxler Calibration System Controller. The program now asks the user to select which interface is to be used, as shown in Figure 6–4.
   - To connect the gauge and computer using the custom RS-232 cable, select this option, click the ⟨**Select**⟩ button and proceed to step 9.
   - To connect the gauge to the computer through Troxler Calibration System Control Box, select this option, click the ⟨**Select**⟩ button and proceed to step 40.
   - To abort this operation and return to the **4640 Calibration Main Menu**, click the ⟨**Quit**⟩ button.

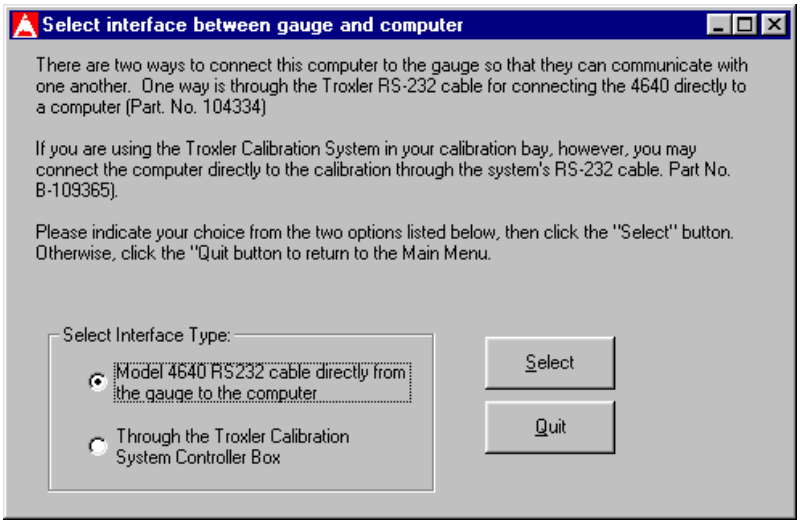


Figure 6–4. Gauge-Computer Interface Selection Screen

9. The program displays a message box confirming the interface selection. Click the ⟨**OK**⟩ button to continue.

10. The software now instructs the user on how to connect the gauge to the computer and configure the communications protocol, as shown in Figure 6–5.

    - Connect the gauge to the computer as directed, select the desired Com port and baud rate from the dropdown lists and click ⟨**Select**⟩ to continue to step 11.
    - To view more information about this process, click ⟨**Help!**⟩.
    - To abort the process and return the program to the **4640 Calibration Main Menu**, click ⟨**Quit**⟩.

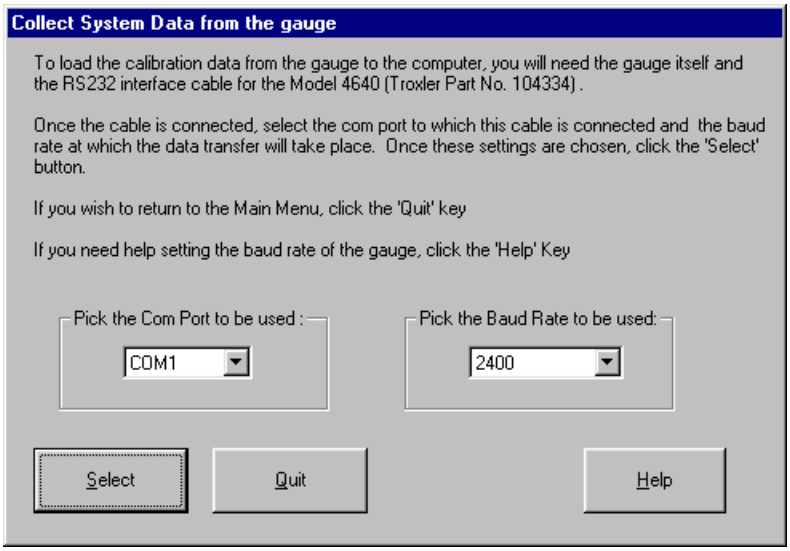


Figure 6–5. Selecting the Com Port and Baud Rate

11. The program then displays a message box that explains that the transfer (printout) of data from the gauge to the computer must be initiated from the *gauge* keypad. Furthermore, the computer must be ready to receive the data when it is time to make this transfer.
    - To continue with this process, click the ⟨**Proceed**⟩ button and proceed to step 12.
    - To view more information about this process, click ⟨**Help!**⟩.
    - To abort the process and return the program to the **4640 Calibration Main Menu**, click ⟨**Quit**⟩.

12. The program then displays the message box shown in Figure 6–6. This message box explains that the gauge must be ready to print the auto-recalibration data from the gauge to the computer within 15 seconds after the ⟨**OK**⟩ button on the message box is clicked.

    Do not click the ⟨OK⟩ button at this time! Follow the directions in steps 13 through 21 to prepare the gauge to transfer data to the computer before clicking the ⟨**OK**⟩ button on this message box.

Figure 6–6. Preparing the Computer to Receive the Data Transfer

13. From the ⟨**READY**⟩ screen on the gauge, press the yellow ⟨**SHIFT**⟩ key and the ⟨**SPECIAL**⟩ key to access the **SPECIAL FUNCTION** menu.

14. When the **SPECIAL FUNCTION** menu is displayed, press the ⟨**1**⟩ and ⟨**9**⟩ keys.

15. The gauge displays the **EXTENDED FUNCTIONS** menu, and asks the user to enter a code number. Enter the code number ***528***, then press the ⟨**START/ENTER**⟩ key.

16. The first page of *Extended Functions* options is displayed. Press the ⟨**6**⟩ key to initiate the **CALIBRATION** menu.

17. After the ⟨**6**⟩ key is pressed, the gauge display again requests an access code. Enter the number ***528***, and then press the ⟨**START/ENTER**⟩ key.

18. The **4640B Recalib.** menu is now displayed. If the recalibration just performed was a 2-block recalibration, then press the ⟨**1**⟩ key to initiate the process of printing out the results. Otherwise, if the recalibration just performed was a 3-block recalibration, then press the ⟨**2**⟩ key to initiate the process of printing out the results.

19. The gauge displays now asks if the user wants to do a new recalibration, a recount, or a printout of the results. Press the ⟨**3**⟩ key to select a printout of the results.

20. The gauge now calculates the calibration constants. During this process, the gauge display shows the progress of the calculations. For a 3-block calibration, this process takes about 1 minute; for a 2-block recalibration, the calculations are nearly instantaneous.

21. When the gauge calculations are complete, the gauge display informs the user that the recalibration is complete. The display also asks if the user would like a hardcopy. **Do not press the ⟨YES⟩ key yet.**

22. On the computer, the message box shown in Figure 6–6 should still be displayed. Click the ⟨**OK**⟩ button. The computer starts a 15-second countdown.

23. As soon as the computer countdown begins, return to the gauge and press the ⟨**YES**⟩ key.

24. The gauge begins sending data to the computer. A screen on the computer shows the progress of the transfer.

25. If the data transfer is completed successfully, the program displays a confirmation message box. Click ⟨**OK**⟩ on the message box and proceed to step 27.

26. If any communications problems are encountered during the upload, the software displays an error message box that prompts the user to check the computer Com port settings and the RS-232 cable and to try again. Click ⟨**OK**⟩ on this error message to return to step 10.

NOTE

Note that if you choose to try the download again, there is no need to go through steps 10 through 21. The gauge is already prepared to transfer the just-calculated calibration constants by pressing the ⟨YES⟩ key on the gauge keypad.

27. If the recalibration downloaded from the gauge is a 3-block recalibration, the **Review System Data** screen shown in Figure 6–7 is displayed, allowing the user to review the data just downloaded from the gauge to the computer. If the recalibration downloaded from the gauge is a 2-block recalibration, the screen shown in Figure 6–8 is displayed. The user can scroll through the data to ensure it was transmitted correctly. It is recommended that the user print the results by clicking the ⟨**Print**⟩ key, although it is not necessary. If the user chooses to print the results, the program will return to this screen when the printing is complete.

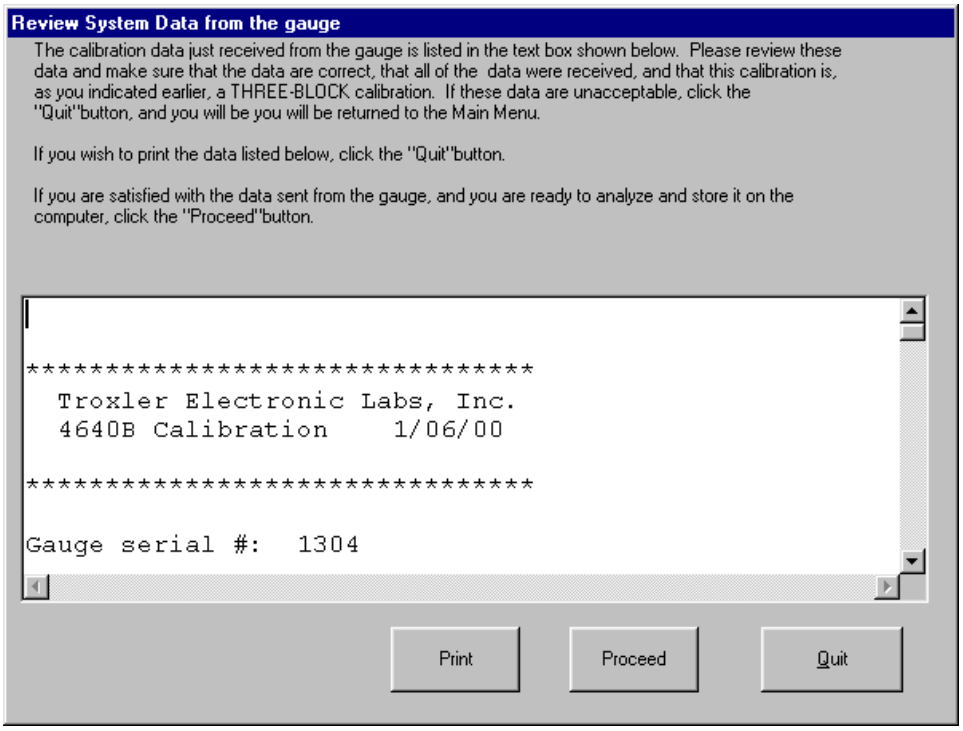


Figure 6–7. Review System Data Screen, Three-Block Calibration

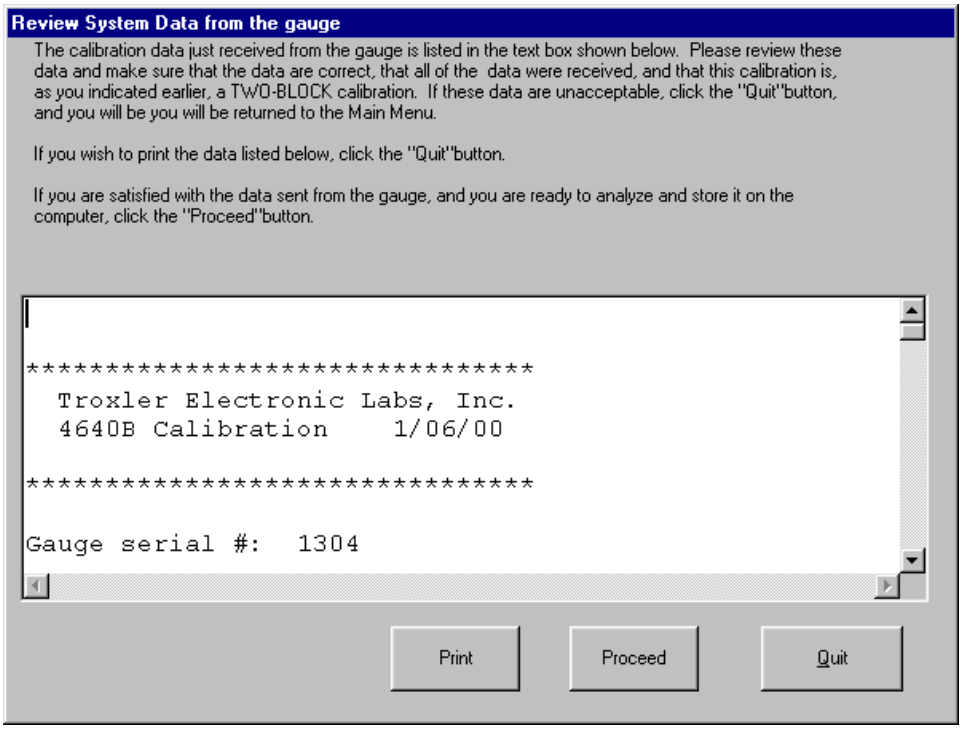


Figure 6–8. Review System Data Screen, Two-Block Calibration

28. From the screen shown in step 27, proceed as follows:

    - To continue this process and proceed to step 29, clicks the ⟨**Proceed**⟩ button.
    - To discontinue this process, click the ⟨**Quit**⟩ button. The program displays a warning that, by quitting, the user will abandon any data downloaded from the gauge.
        - To abandon the downloaded data and return to the **4640 Calibration Main Menu**, click the ⟨**OK**⟩ button on this message box.
        - To return to step 27, click the ⟨**Cancel**⟩ button on this message box.

29. At this point, the data downloaded from the gauge is stored in the format used by the recalibration program, and this recalibration is made the *active calibration* of the program. The user is given the option of viewing these data once more. For a 2-block recalibration, the screen shown in Figure 6–9 is displayed; for a 3-block calibration the screen shown in Figure 6–10 is displayed. Note that the 3-block recalibration review screen includes the mag/aluminum bulk density counts.

NOTE

The user can only *view* the data displayed on these screens. He or she cannot modify any of the displayed values.

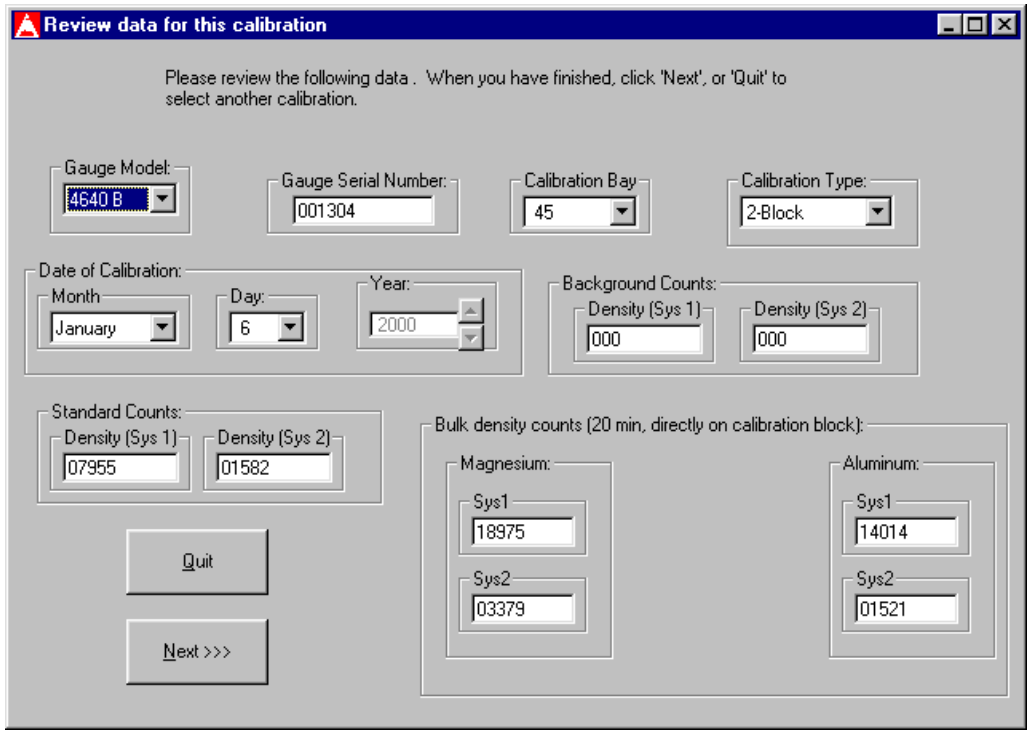


Figure 6–9. First Review Calibration Data Screen, Two-Block Calibration

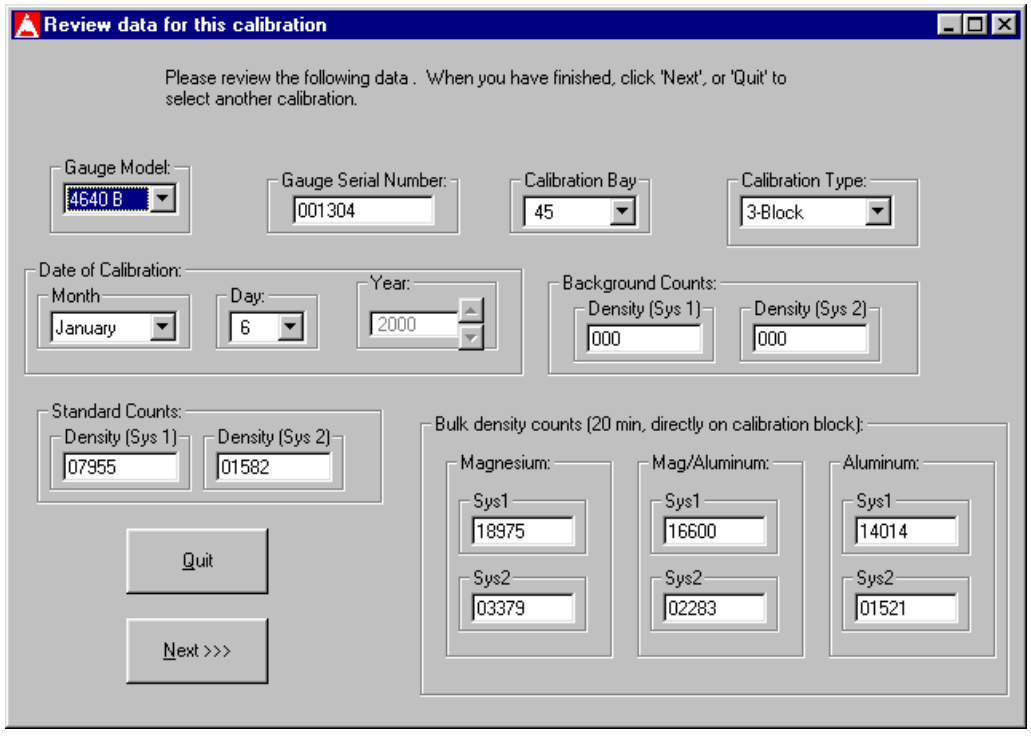


Figure 6–10. First Review Calibration Data Screen, Three-Block Calibration

30. From the screen shown in step 29, proceed as follows:
    - To continue to step 31, click the ⟨**Next**⟩ button.
    - To discontinue this process, click the ⟨**Quit**⟩ button. The program displays a warning that, by quitting, the user will abandon any additions or changes that were made to the calibration data.
        - To return to the **4640 Calibration Main Menu**, click the ⟨**OK**⟩ button on this message box. Since no changes have been made to the recalibration data, the program simply returns to the **4640 Calibration Main Menu**. The recalibration data downloaded from the gauge will remain as the active calibration.
        - To return to step 29, click the ⟨**Cancel**⟩ button on this message box.

31. The program now displays a screen that shows the thin layer calibration constants. If the recalibration that was downloaded is a 2-block recalibration, the screen shown in Figure 6–11 is displayed. Note that both the thin layer calibration constants (*A11*, *A12*, *A13*, *A21*, *A22*, and *A23*) and the Bulk Density B values (*B1* and *B2*) are displayed. If the recalibration that was downloaded is a 3-block recalibration, the screen shown in Figure 6–12 is displayed. This screen is similar to the one for a 2-block recalibration, but the bulk density constants *B1* and *B2* are not included.

NOTE

Again, the user can only *view* the data displayed on these screens. He or she cannot modify any of the displayed values.

- To return to the screen displayed in step 29, click the ⟨**Back**⟩ button.
- To discontinue this process, click the ⟨**Quit**⟩ button. The program proceeds to step 32.
- To continue this process, click the ⟨**Next**⟩ button and proceed to step 33.

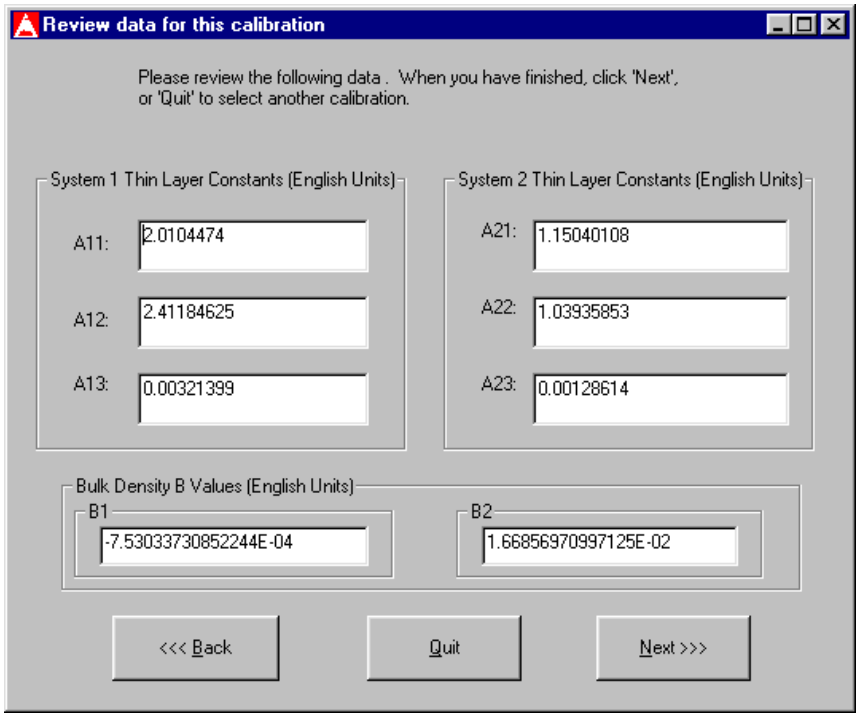


Figure 6–11. Second Review Calibration Data Screen, Two-Block Calibration

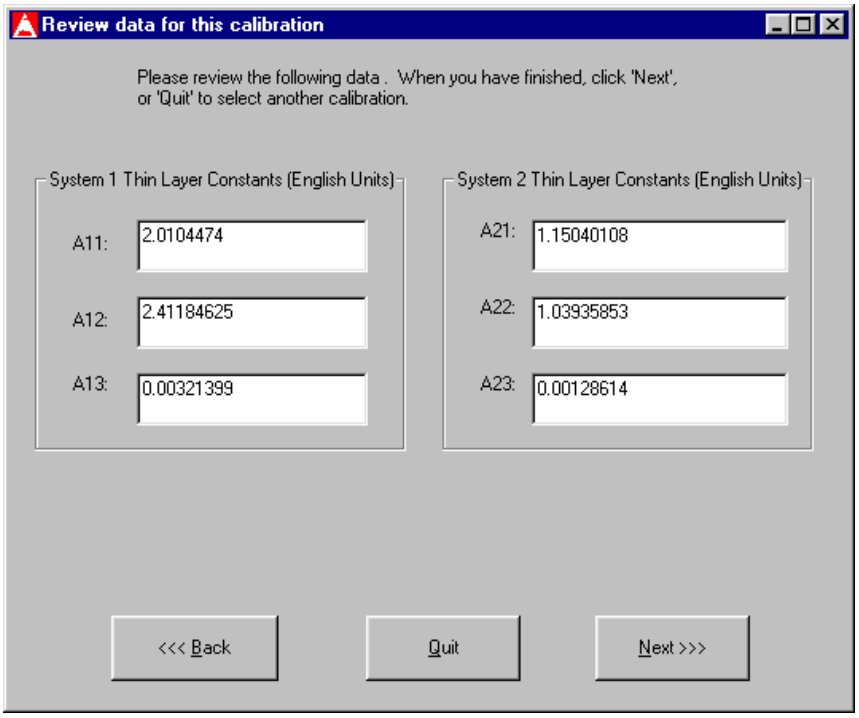


Figure 6–12. Second Review Calibration Data Screen, Three-Block Calibration

32. If the user clicks the ⟨**Quit**⟩ button on the screen shown in step 31, the program displays a warning that, by quitting, the user will abandon any additions or changes that were made to the calibration data.
    - ► To return to the **4640 Calibration Main Menu**, click ⟨**OK**⟩ on this message box. Since no changes have been made to the recalibration data, the program simply returns to the **4640 Calibration Main Menu**. The recalibration data downloaded from the gauge will remain as the active calibration.
    - ► To return to step 31, click the ⟨**Cancel**⟩ button on this message box.

33. When the user clicks the ⟨**Next**⟩ button on the screen shown in step 31, the program displays a message box that states **Data review for this calibration is complete. Do you wish to print the data?**

34. To print a list of the count data that was just entered, click the ⟨**Yes**⟩ button on this message box, or click ⟨**No**⟩ to continue without printing. Regardless of which option is chosen, the program displays a message box that explains that the data that was just reviewed has been stored to a temporary file. To proceed to the calculation of the calibration constants, click the ⟨**Proceed**⟩ button on this message box.

35. When the user clicks the ⟨**Proceed**⟩ button on the preceding screen, the calibration calculations take place. If the calculations are performed without any errors, the program displays a confirmation message box, and asks if the user wishes to view a printout of the calibration.
    - ► To view a printout, click the ⟨**Proceed**⟩ button. The program proceeds to step 36.
    - ► To return to the **4640 Calibration Main Menu**, click the ⟨**Quit**⟩ button.

36. When the ⟨**Proceed**⟩ button is clicked, the software formulates the calibration sheets and displays them for review as shown in Figure 6–13. The entire text of the calibration sheets, in formatted form, is displayed in the text box shown on this screen. The user can scroll up and down this text box to view the calibration sheet in its entirety. This sheet can be displayed in Metric or Imperial (English) units simply by clicking the appropriate option button in the lower right-hand portion of the screen.

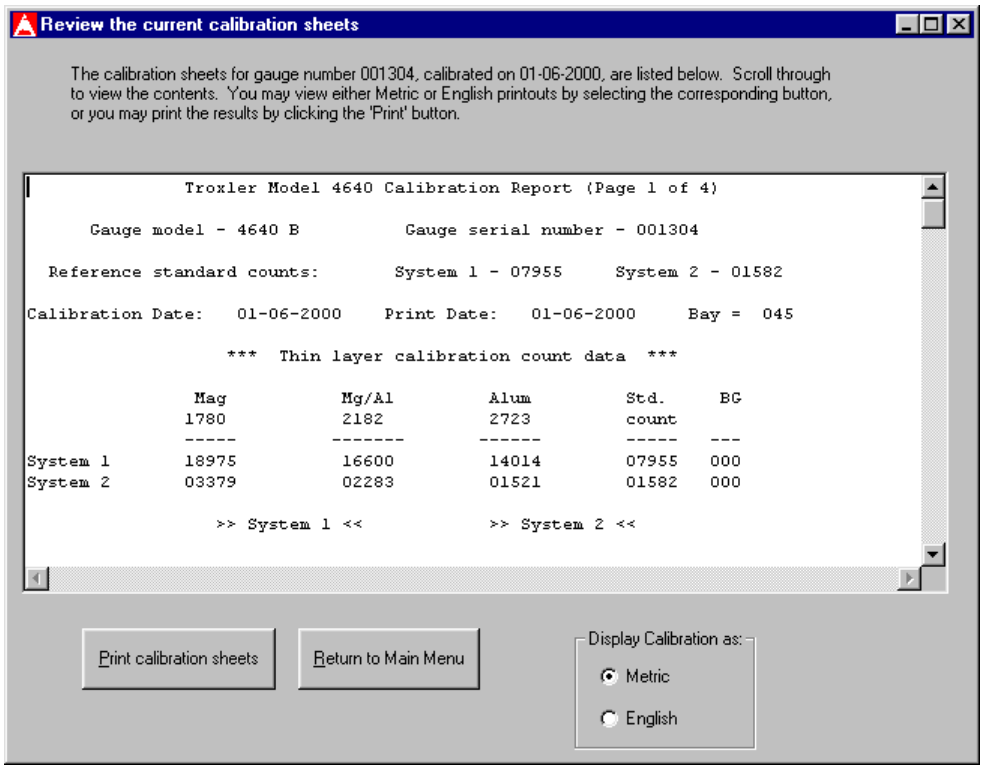


Figure 6–13. Review the Current Calibration Sheets Display

37. At this point the user should print the calibration sheets. Click the ⟨**Print calibration sheets**⟩ button and proceed to step 38.

38. The software now displays a message box warning the user that simply printing the calibration sheets at this point **does not** mean that the data is being permanently archived. The data can only be archived after the QA test has passed and the user has selected the **Save and Print a Certified Calibration** option from the **4640 Calibration Main Menu**. Click ⟨**OK**⟩ on this message box to proceed with the printout.

39. Refer back to the *Calibration Inspection Limits* for this gauge.
    - If the associated values on the calibration printout just generated fail to meet any of these limits, then recounts are necessary. Proceed to the *Modifying the Calibration Data* section on page 6–14.
    - If the gauge instead meets all of the *Calibration Inspection Limits*, then proceed to the *Calibration Quality Assurance* section on page 6–15.

40. In step 8, if the user chose to use the Troxler Calibration System Interface Box to transfer calibration data from the gauge to the computer, the program displays a message box confirming the interface selection. Click the ⟨**OK**⟩ button to continue.

41. The software now instructs the user on how to connect the gauge to the computer and configure the communications protocol, as shown in Figure 6–14.
    - Connect the gauge to the computer as directed, select the desired Com port and baud rate from the dropdown lists and click ⟨**Select**⟩ to continue to step 42.
    - To view more information about this process, click ⟨**Help!**⟩.
    - To abort the process and return the program to the **4640 Calibration Main Menu**, click ⟨**Quit**⟩.

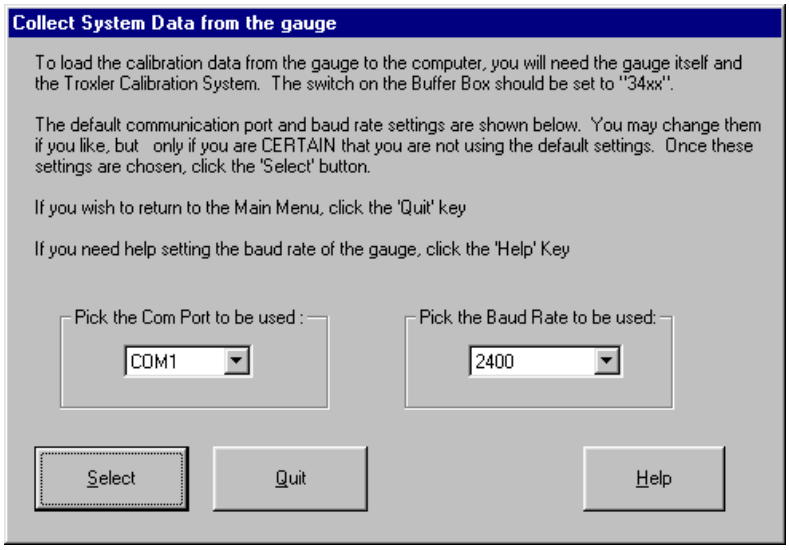


Figure 6–14. Selecting the Com Port and Baud Rate using the Troxler Calibration System

42. The program then displays a message box that explains that the transfer (printout) of data from the gauge to the computer must be initiated from the *gauge* keypad. Furthermore, the computer must be ready to receive the data when it is time to make this transfer.
    - ▶ To continue with this process, click the ⟨**Proceed**⟩ button and proceed to step 43.
    - ▶ To view more information about this process, click ⟨**Help!**⟩.
    - ▶ To abort the process and return the program to the **4640 Calibration Main Menu**, click ⟨**Quit**⟩.

43. If the ⟨**Proceed**⟩ button is clicked on the message box in step 42, the program directs the user to perform a manual reset of the calibration buffer box. As directed, press and hold the ⟨**Start/Reset**⟩ on the calibration buffer box for approximately 15 seconds. Release the button, then press it again and immediately release it. Wait approximately 10 seconds, then click the ⟨**OK**⟩ button on the message box displayed by the calibration program.

44. The program now deactivates the calibration buffer box, so that the Troxler Calibration System acts as a null modem cable between the gauge and the computer. If the deactivation proceeds correctly, the program proceeds to step 46. If there is a problem with deactivating the calibration buffer box, the program instead proceeds to step 45.

45. If instead the initialization string was not received correctly, the displays an error message that states **The Troxler Calibration System controller could not be bypassed. Check configurations and settings and try again.** Click ⟨**OK**⟩ to return to step 41, and re-enter the serial port and baud rate.

46. If the calibration buffer box was successfully deactivated, the software displays a message box that confirms that the control box has been defeated and that calibration constants can now be sent. Click ⟨**OK**⟩ to go to step 12 on page 6–6.

MODIFYING THE CALIBRATION DATA

The steps in this section are performed if there was a mathematical error in the calculation of the calibration constants or if the gauge failed one or more parts of the Quality Assurance Test.

Note that, unlike the recalibration procedure in which data is acquired and entered into the calibration program manually, the program itself cannot be used to edit autocalibration data. If the user were allowed to edit the data written into the active calibration in the *Send the Autocalibration Data to the Computer* section, the data in the computer would no longer match the data in the gauge. These two data sets must be kept consistent.

Suppose that the active calibration in the computer is the result of downloading calibration data from a Model 4640-B gauge, and the user selects the **Edit data for the currently active calibration** option from the **4640 Calibration Main Menu**. When the user clicks the ⟨**Proceed**⟩ button on the **4640 Calibration Main Menu**, the program displays the message shown in Figure 6–15.

- To return to the **4640 Calibration Main Menu**, click the ⟨**Cancel**⟩ button
- To view the calibration data, click the ⟨**OK**⟩ button. The program proceeds to step 29 of the *Send the Autocalibration Data to the Computer* section. However, as indicated in this message box, the user will not be able to change any of these data that he or she will be viewing.

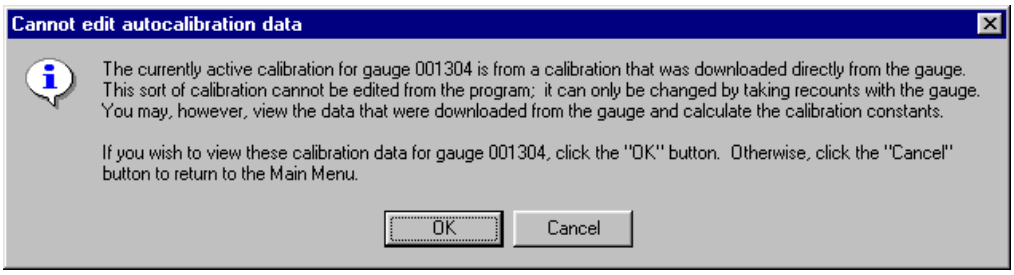


Figure 6–15. Cannot Edit Autocalibration Data Message

The only way to change any of the calibration data is to take recounts with the gauge, have the gauge recalculate the calibration constants, and load these new calibration constants back into the computer.

To modify the calibration data, do the following:

1. From the ⟨**READY**⟩ screen, press the yellow ⟨**SHIFT**⟩ key and the ⟨**SPECIAL**⟩ key to access the **SPECIAL FUNCTION** menu.

2. When the **SPECIAL FUNCTION** menu is displayed, press the ⟨**1**⟩ and ⟨**9**⟩ keys.

3. The gauge displays the **EXTENDED FUNCTIONS** menu, and asks the user to enter a code number. Enter the code number ***528***, then press the ⟨**START/ENTER**⟩ key.

4. The first page of *Extended Functions* options is displayed. Press the ⟨**6**⟩ key to initiate the *Gauge Calibration* functions.

5. After the ⟨**6**⟩ key is pressed, the gauge display again requests an access code. Enter the number ***528***, and then press the ⟨**START/ENTER**⟩ key.

6. The **4640B Recalib.** menu is now displayed. Press the ⟨**1**⟩ key to take recounts on a 2-block recalibration or the ⟨**2**⟩ key to take recounts on a 3-block recalibration.

7. The gauge displays now asks if the user wants to do a new recalibration, a recount, or a printout of the results. Press the ⟨**2**⟩ key to perform recounts.

8. Follow the gauge prompts and instructions to take the desired recounts.

9. Once the recount process is complete, return to step 1 of the *Send the Autocalibration Data to the Computer* section.

CALIBRATION QUALITY ASSURANCE

1. Before collecting the Quality Assurance data for this recalibration, the user should print a *Calibration Accuracy Check Form* using the calibration software. From the **4640 Calibration Main Menu** (see Figure 6–1 on page 6–3), select the **Print a Calibration Accuracy Check (QA) form** option and click the ⟨**Proceed**⟩ button:

2. The software now displays a message box showing the gauge serial number for which the QA form is being printed.
   - If this is the correct gauge, click the ⟨**Yes**⟩ button and proceed to the next step.
   - Otherwise, click the ⟨**No**⟩ button to return to the **4640 Calibration Main Menu**.

3. The software now displays a screen that allows the user to select the units (English or Metric) to be used on the QA forms.
   - To proceed, select the desired units, click the ⟨**Print QA Sheets**⟩ button, and go to the next step.
   - To return to the **4640 Calibration Main Menu** without printing the QA forms, click ⟨**Cancel**⟩.

4. The program now prints a hard copy of the QA form. When the printout is complete, click the ⟨**Quit**⟩ button to return to the **4640 Calibration Main Menu**.

5. The calibration technician who is performing this calibration should record his or her name in the space beside the label *Calibration Technician* on page 1 of the QA form.

6. Place the gauge's magnesium standard block on the center of the calibration block where the standard count is typically taken. For a 3-block recalibration, this is the mag/aluminum block; for a 2-block recalibration, this is the aluminum block.

7. Position the gauge on the magnesium standard in the orientation used for a standard count.

8. Take a standard count. Record the results in the appropriate location on the QA form.

9. Following the instructions on the QA form, calculate the Density and Standard Percent differences and record them at the appropriate locations.

10. If the Density Standard Percent differences do not meet the required limits as listed on the QA sheet, take another standard count, and repeat step 8. If the Density Standard Percent differences still do not meet the required limits as listed on the QA sheet, halt the QA process and return the gauge to Assembly or Service for analysis and repair.

11. From the gauge's ⟨**READY**⟩ screen, press the ⟨**THICK**⟩ key. The gauge will display the current setting for the layer thickness.

12. Make sure the top layer thickness is set to 1" (or 2.54 cm.) , and press the ⟨**START/ENTER**⟩ key.

13. From the ⟨**READY**⟩ screen, press the ⟨**TIME**⟩ key and set the gauge count time to 4 minutes.

14. Place the gauge on the magnesium calibration block in measurement position.

15. Place the source rod in backscatter position, making sure the handle clicks into the backscatter notch. Press down gently on the end of the handle (without touching the trigger) to ensure that the handle is properly seated.

16. From the ⟨**READY**⟩ screen, press the ⟨**START/ENTER**⟩ key and wait for the count to finish. When the count is complete, the gauge displays the measured density. In the *Thin Layer Measurement Accuracy Check* portion of the *Calibration Accuracy Check Form*, there is a section for recording both the counts and the density value measured on this block. Read the Density value from the top line of the gauge display and record it in the appropriate location on the *Calibration Accuracy Check Form*.

17. When step 16 is complete and the density value has been recorded, press the ⟨**SHIFT**⟩ key, followed by the ⟨**RECALL**⟩ key. The gauge now displays the two density counts (System 1 and System 2) that were just taken on the bottom row of the screen. Record these values in the appropriate location on the *Calibration Accuracy Check Form*.

18. Press the ⟨**NO/CE**⟩ key on the gauge to return to the ⟨**READY**⟩ screen. If the density value measured by the gauge in step 16 falls within the respective range specified on the *Calibration Accuracy Check Form*, then proceed to step 21. Otherwise, a recount must be taken; proceed to step 19.

19. Repeat steps 16 and 17, and record the counts and densities under the area reserved for the recounts.

20. Press the ⟨**NO/CE**⟩ key on the gauge to return to the ⟨**READY**⟩ screen. If the density value measured by the gauge in step 19 falls within the respective range specified on the *Calibration Accuracy Check Form*, then proceed to step 21. Otherwise, the gauge has failed this portion of the thin layer QA test and will probably require recounts. Halt the QA process and take the required recounts.

21. Continue as follows:

    - If (a) the calibration block that was just measured was the magnesium block **and** (b) the calibration for which this QA test is being conducted is **NOT** a 2-block calibration, place the gauge on the mag/aluminum block and proceed to step 22.
    - If either condition (a) or (b) mentioned in the last sentence are **NOT** true, then place the gauge on the aluminum block and proceed to step 22.
    - If the calibration block just measured was instead the aluminum block, proceed to step 23.

22. Repeat steps 15 through 18.

23. For a Model 4640-B recalibration, the thin layer measurement capabilities of the device must be checked in the QA testing phase. Place the magnesium standard block for the gauge on top of the aluminum calibration block.

24. Place the gauge on the center of the magnesium standard block.

25. Place the source rod in backscatter position, making sure the handle clicks into the backscatter notch. Press down gently on the end of the handle (without touching the trigger) to ensure that the handle is properly seated.

26. From the ⟨**READY**⟩ screen, press the ⟨**START/ENTER**⟩ key and wait for the count to finish. When the count is complete, the gauge displays the measured density. In the *Thin Layer Measurement Accuracy Check* portion of the *Calibration Accuracy Check Form*, Part II, there is a section for recording the density value measured on this block. Read the Density value from the top line of the gauge display, and record it in the appropriate location on the *Calibration Accuracy Check Form*.

27. When step 26 is complete and the density value has been recorded, press the ⟨**SHIFT**⟩ key, followed by the ⟨**RECALL**⟩ key. The gauge now displays the two density counts (System 1 and System 2) that were just taken on the bottom row of the screen. Record these values in the appropriate location on the *Calibration Accuracy Check Form*.

28. Press the ⟨**NO/CE**⟩ key on the gauge so that it will return to the ⟨**READY**⟩ screen. If the density value measured by the gauge in step 26 falls within the respective range specified on the *Calibration Accuracy Check Form*, then proceed to step 31. Otherwise, a recount must be taken; proceed to step 29.

29. Repeat steps 26 and 27, and record the counts and densities under the area reserved for the recounts.

30. Press the ⟨**NO/CE**⟩ key on the gauge to return to the ⟨**READY**⟩ screen. If the density value measured by the gauge in step 29 falls within the respective range specified on the *Calibration Accuracy Check Form*, then proceed to step 31. Otherwise, the gauge has failed this portion of the thin layer QA test and will probably require recounts. Halt the QA process and take the required recounts.

31. The Quality Assurance testing is complete, and the calibration is now certified. Proceed to the following section, *Archiving the Calibration and Printing the Calibration Sheets*.

ARCHIVING THE CALIBRATION AND PRINTING THE CALIBRATION SHEETS

Once the gauge has passed the QA tests, it is time to archive the calibration data in the database file. It is also the appropriate time to print out two sets of calibrations sheets – one for the customer and one for the files.

17. From the **4640 Calibration Main Menu** (see Figure 6–1 on page 6–3), choose the **Save and print a certified calibration** and click the ⟨**Proceed**⟩ button:

18. The software displays a message box that shows the current active calibration, and asks the user to confirm that this is the calibration he or she wishes to saves and print. Click ⟨**No**⟩ to return to the **4640 Calibration Main Menu** or ⟨**Yes**⟩ to continue.

19. If the user clicks the ⟨**No**⟩ button, the program returns to the **4640 Calibration Main Menu**. If the user clicks ⟨**Yes**⟩, the software displays a message box requesting the user's initials.

20. Enter your initials and click ⟨**OK**⟩. Note that at least two alphabetic characters must be entered. The program will not proceed unless a set of valid initials is entered.

21. When a valid set of initials is entered, the software saves the calibration data to the archive data file, and displays a confirmation message box. Click ⟨**Proceed**⟩ to continue with printing the calibration sheets.

22. After the ⟨**Proceed**⟩ button is clicked, The software displays the same screen shown in Figure 6–13 on page 6–12, giving the user the opportunity to print the calibration report.
    - To return to the **4640 Calibration Main Menu** without printing the calibration report, click the ⟨**Return to Main Menu**⟩ button.
    - To print the calibration sheets, click the ⟨**Print calibration sheets**⟩ button and proceed to the following step.

23. The software displays a dialog box that allows the user to select the printer to use to print the calibration sheets. Note, however, that the default value for **Number of Copies** is set to *2*, to encourage the user to print two calibration reports (one for the customer, the other for the lab files). Of course, the user may select any number of copies he or she wishes to pint.
    - If the user clicks the ⟨**Cancel**⟩ button, the print dialog box disappears, and the screen shown in Figure 6–13 is displayed.
    - If instead the user clicks the ⟨**Print**⟩ button, the calibration sheets are printed and the screen shown in Figure 6–13 is displayed.

24. Click the ⟨**Return to Main Menu**⟩ to return to the **4640 Calibration Main Menu**, then proceed to the following section, *Final Initialization and Status Check*, to finish.

FINAL INITIALIZATION AND STATUS CHECK

1. On the gauge keypad, press the yellow ⟨**SHIFT**⟩ key and the ⟨**SPECIAL**⟩ key to access the **SPECIAL FUNCTION** menu.
2. Press the ⟨**1**⟩ and ⟨**9**⟩ keys. The gauge displays the **EXTENDED FUNCTIONS** menu, and asks the user to enter a code number.
3. Enter the code number ***528***, then press the ⟨**START/ENTER**⟩ key. The first page of *Extended Functions* options is displayed.
4. Press ⟨**5**⟩ to access the function used to enter the calibration date. When prompted, enter the date that this calibration was completed.
5. After the calibration date entry is complete, the gauge will still be in the *Extended Functions* menu. Press ⟨**7**⟩ to access the function to enter the standard counts at the time of calibration.
6. When prompted, enter the System 1 and System 2 standard counts listed on the calibration report that was just printed in the previous section, *Archiving the Calibration and Printing the Calibration Sheets*.
7. After entering the calibration standard counts for System 1 and System 2, click the ⟨**NO/CE**⟩ key to return to the ⟨**READY**⟩ screen.
8. Press the yellow ⟨**SHIFT**⟩ key and the ⟨**SPECIAL**⟩ key to access the **SPECIAL FUNCTION** menu.
9. Press ⟨**1**⟩ and ⟨**0**⟩ on the keypad. The gauge displays a prompt asking for a code to access the gauge time and date functions.
10. Enter the number ***5888*** and press the ⟨**START/ENTER**⟩ key. The **Time/Date** menu is displayed.
11. Ensure that the current time and date in the gauge are correct. If not, set them correctly.

The calibration process is now complete.

CALIBRATION PROCEDURE OUTLINE AND CHECKLIST

- ❑ Turn on gauge and allow it to power up and complete the self-test.
- ❑ On the gauge, access the **4640B Calib.** Menu, as described in note 1 at the end of this section.
- ❑ The gauge guides the user through the calibration steps. Follow all prompts from the gauge. (Note that the plate and block densities that the gauge requests are the true gravimetric densities of the blocks.)
- ❑ When the gauge has finished the calibration, connect the gauge to the Calibration Control System and run the calibration program. From the **4640 Calibration Main Menu** select the **Read autocalibration data from a 4640B gauge** option and follow the instructions from the program.
- ❑ When the program reaches the point where the gauge has to send the printout to the program, ***do not*** click the ⟨**OK**⟩ button on the message box. Go back to the gauge and access the calibration printout from the **4640B Recalib.** menu. Instructions on accessing this menu are shown in note 1 at the end of this section.
- ❑ Follow the instructions from the gauge to compute the constants and get the printout ready. The computation of the constants can take as long as 5 minutes. Once the computation is complete, **do not** let it print.
- ❑ Return to the computer and click the ⟨**OK**⟩ button to get the computer ready to receive the printout from the gauge.
- ❑ Within 15 seconds of the previous step, go back to the gauge and start the printout. The computer will upload the data as it is printed by the gauge.
- ❑ Once all of the calibration data have been uploaded from the gauge, follow the prompts to compute the calibration constants and view the calibration report.
- ❑ When the calibration report is displayed, compare the relevant quantities on this report to the *Calibration Inspection Limits* to ensure that this calibration meets these requirements. If this is a full calibration, ensure that the thin layer residuals are all within the allowed limits.
- ❑ Return to the **4640 Calibration Main Menu** and follow the prompts to download the calibration constants from the computer into the gauge.
- ❑ Once the calibration constants are in the gauge, return to the **4640 Calibration Main Menu** and follow the prompts to print a *Calibration Accuracy Check Form*.
- ❑ Run the Calibration Accuracy Tests (QA Test) successfully.
- ❑ Once the QA Test has been completed successfully, return to the **4640 Calibration Main Menu** in the calibration program and select the **Save and Print a Certified Calibration** option. Follow the prompts to archive the calibration and print the calibration report.
- ❑ Check and confirm one last time that the data on the calibration report meets the requirements of the *Calibration Inspection Limits*.

- ❑ File one copy of the calibration report, and put the other with the gauge.

- ❑ Access the gauge's **EXTENDED FUNCTIONS** menu, as described in note 2 below.. From the **EXTENDED FUNCTIONS** menu, enter the date of the calibration and the standard counts that were used at the time of calibration.

- ❑ Access the gauge's **Time/Date** menu as described in note 3 below. From this menu, set the date and time in the gauge to their correct values.

NOTES:

3. To access the gauge's **4640B Calib.** menu, you must first access the **EXTENDED FUNCTIONS** menu as described in note 2. From the **EXTENDED FUNCTIONS** menu, press the ⟨**6**⟩ key. The gauge then prompts for the entry of another code. Enter the number ***5168*** and press the ⟨**START/ENTER**⟩ key. The **4640B Calib.** menu is now displayed.

4. To access the gauge's **EXTENDED FUNCTIONS** menu, press the yellow ⟨**SHIFT**⟩ key and the ⟨**SPECIAL**⟩ key. Then press the ⟨**1**⟩ and ⟨**9**⟩ keys. When the gauge prompts for the entry of a code, enter the number ***528*** and then press the ⟨**START/ENTER**⟩ key. The **EXTENDED FUNCTIONS** menu is then displayed.

5. To access the **Time/Date** menu, press the ⟨**SHIFT**⟩ key, then the ⟨**SPECIAL**⟩ key, then press ⟨**1**⟩ and ⟨**0**⟩. When the gauge prompts for the entry of another code, enter the number ***5888*** and press the ⟨**START/ENTER**⟩ key. The **Time/Date** menu is then displayed.