Electrical Density Gauge

Contact Information

Testing Equipment for   Construction Materials

HUMBOLDT
www.humboldtmfg.com

Record your Gauge information below:
(This information can be obtained from the EDG's
Main Menu selection: View Information.)

EDG Model Number: _____

EDG Serial Number: _____

Software Version Number: _____

This is a general user manual for Electrical Density Gauge. It contains a description of the EDG and its components, and guidelines for use and calibration. It is strongly recommended that you review this manual carefully before using EDG. The information in this manual has been carefully checked and is believed to be entirely reliable. However, no responsibility is assumed for inaccuracies. Furthermore, EDG, LLC reserves the right to make changes to products herein described without prior notice, so as to improve reliability, function, or design.

Revision History

REV	DESCRIPTION	DATE	BY
Rev A.	EDG-MOD-C	07/10/08	JRL
Rev B.	EDG-MOD-C	07/28/08	DMA

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Introduction

Your Electrical Density Gauge (EDG) is capable of providing accurate readings of soil density, moisture content, and percent compaction on soils typically used for roads and foundations. The precision by which the EDG can determine these physical parameters depends highly upon you, the operator. Reading and understanding the contents of this manual is a very important step toward utilizing EDG to its maximum potential.

Please review the packing list of items (part number 9093929) that constitute the complete EDG, and that were shipped to you. If there is any doubt as to whether you received the complete set of items, please contact the factory immediately.

The following will give you an overview of the EDG process and help you understand the more detailed steps found later in the manual.

Is EDG Safe To Use?

Absolutely! There is far less measuring energy present when using EDG than when you are using a cell phone.

Introduction to the EDG Process

The EDG process introduces some new terminology with which you need to be familiar.

A Soil Model is a combination of electrical soil data and user-entered physical soil data. The Soil Model provides the basis for testing a specific soil type within an area of similar soil characteristics. To make a Soil Model, several electrical signatures are acquired using the EDG at different Test Spots (the Test Spots for a Soil Model are called Soil Tests.) For each Test Spot that an electrical signature is acquired, a Sand Cone test is also performed to obtain physical wet density, dry density, and percent moisture information. A proctor test can optionally be performed to determine the maximum dry density. The physical information determined by the Sand Cone and Proctor Mold laboratory tests are entered into the EDG unit, thereby tying electrical signature information to physical data.

The Soil Model can be thought of as a way of "calibrating" the EDG to the particular soil type. At least three Test Spots (Soil Tests) are required to create a Soil Model; more Test Spots make for a more representative Soil Model. Further, Test Spots that exhibit a broad range of density and moisture content make for more accurate Soil Models.

Once the Soil Model has been created, the EDG is ready for testing at a Job Site. A Job Site is an area of similar soil characteristics in which the user wishes to determine the physical characteristics of the soil. A single Soil Model is generally created for each different Job Site.

Once a Soil Model has been created that accurately models the Job Site, the soil characteristics of any Test Spot within the Job Site can be accurately and quickly determined by the EDG by performing a Field Test. A Field Test is electrical soil data at a particular Test Spot that is fed into the Soil Model to produce physical soil characteristics.

Components of the EDG Unit

EDG Console/Computer

Safety Glasses

Electrical Soil Measurement Sensor

Calibration Check Unit

Dart Template

Hammer

HUMBOLDT

Battery Charger

Temperature Probe

Soil Darts

Cables/Clips for Soil Measurement Sensor

Break-Out Cable

Components:

Soil Darts: To get electrical data from the soil, 4 Soil Darts are pounded into the ground with a hammer. A template is provided to accurately position the Soil Darts. The Soil Darts are machined from stainless steel, and are expected to last many years. If the conical end becomes flattened from hitting too many rocks, either file or grind off any mushrooming at the point to maintain a conical shape to the Dart. If the top end of the Dart becomes damaged or starts to crack from excessive hammering, file off the damaged part to avoid having pieces of steel flying off when driving in the Dart. Always wear safety glasses when hammering in the Soil Darts.

Electrical Soil Measurement Sensor: The Soil Sensor gathers electrical information about the soil under test and transfers the information to the EDG computer. The Soil Sensor is connected to the Soil Darts using cables and clips. The Soil Sensor connects to the EDG unit using the left panel receptacle.
The Soil Sensor requires no maintenance or adjustment, so there is no need to open the enclosure. Keep it clean and dry when using it. It is an electronic circuit, so treat it with the same respect you use with your cell phone. If the Sensor Pins become loose, hold the pin with pliers while tightening the nut against the enclosure.

Temperature Probe: The temperature probe attaches to the right panel receptacle. When performing EDG testing, the temperature probe should be placed into the soil. The soil temperature is an important variable in accurate EDG testing. The EDG computer uses the temperature information to perform temperature compensation, resulting in more accurate EDG results. The temperature probe must be connected when creating Soil Models; use of the temperature probe is optional when performing Field Testing. If the temperature probe is not used during Field Testing, the EDG results cannot be temperature compensated.

The Break-Out Cable: The Break-Out Cable provides a 9-pin D-SUB connector for connection to a host PC for use in Data Sharing mode. The Break-Out Cable also has a second connector that is the receptacle for the battery charger plug. When in use, the Break-Out Cable is plugged into the right panel receptacle. Note that this receptacle is also used for the Temperature Probe when the EDG is used in the field; the Temperature Probe connector must be removed to attach the Break-Out Cable. Also note that if the Break-Out Cable is inadvertently plugged into the left panel receptacle, no damage will result. Keep the cable connector out of the dirt to avoid getting dirt into the connector pinholes. A paperclip can be used to clean out the pinholes if necessary.

EDG Battery/Battery Charger: The EDG battery is rated at a capacity of 4.0 Amp-Hours. This is enough energy for continuous operation for over 8 hours. The Battery Charger that is provided with EDG will charge the battery in approximately 14 hours. Therefore, EDG should be placed on charge each day after use, and be allowed to charge overnight. The battery will not be overcharged if left on charge for a two day weekend period. As noted above, the Temperature Probe must be removed and the Break-Out Cable attached to charge the battery.

EDG Console/Computer: The EDG unit contains a computer that applies mathematical formulas to determine the physical characteristics of the soil. The computer also contains memory that remains intact after the EDG has been powered off; this memory is used to save Soil Models and Job Site data. See Appendix A for information on EDG memory capacity. The EDG console has an LCD display that is used to provide visual information to the user and a keypad that allows the user to key information into the EDG unit.

The EDG Process In Depth

Soil Models, Soil Tests (a Soil Test is a single Test Spot in a Soil Model), Job Sites, and Field Tests (a Field Test is a single Test Spot in a Job Site) are identified in the EDG process by a simple numbering system. The EDG automatically assigns numbers to newly-created Soil Models, Soil Tests, Job Sites, and Field Tests. Also, the use can assign names to Soil Models and Job Sites to help keep track of data. Note that these assigned names do not have to be unique, so the operator may want to ensure that different names are assigned to avoid later confusion. An optional GPS installed in the EDG can be used to identify the location where EDG testing has been performed. If the EDG does not have the optional GPS installed, or if the GPS is not used while performing EDG testing at various Test Spots, the operator is required to
manually keep track of the location that is associated with a particular Soil Test or Field Test. A log or map might prove useful in keeping track of this data.

If a Soil Model or Soil Test is deleted, the Soil Model number or Soil Test number is not re-used by the EDG. Similarly, if a Job Site or Field Test is deleted, the Job Site number or Field Test number is not re-used by the EDG.

For an untested type of soil, a Soil Model is created first. To create a Soil Model, EDG electrical testing is performed at several chosen Test Spots. Readings of two soil connection configurations are taken at a single Test Spot, the electrical results of which are averaged and automatically stored to provide a unique electrical signature for that Test Spot. Next, Sand Cone and Moisture laboratory tests are run on soil from the center of the Test Spot

after the EDG soil darts are removed. This physical data obtained from the Sand Cone test will be entered into the EDG and combined with the electrical data that was stored in the EDG when the EDG testing was done on the Test Spot. In addition to the Sand Cone test, if compaction results are desired from the EDG, a Proctor Mold test is required to determine the point of optimum moisture content and maximum compaction. EDG will store Proctor Mold test data so that percent compaction information can be computed. When electrical and physical data for three or more Test Spots (Soil Tests) on the same soil type have been accumulated, this Soil Model must be Associated with the particular Job Site where the data was gathered by choosing "Associate Soil Model" in the EDG Job Site menu. The Soil Model listing will show that it is INCOMPLETE until all the lab data has been entered, at which time it will show COMPLETE. The Soil Model data is kept in the EDG until deleted, so that it can be associated with other Job Sites as required.

 After a Job Site has its Soil Model Completed and Associated, the EDG can be used to test any other Job Site that is constructed with this same soil type. EDG tests are performed by first selecting the Job Site menu, then testing with EDG. The EDG test is performed by (first) driving four Soil Darts into the Test Spot at four quadrant points of a twelve inch (12") circle. A Template is provided to ensure accurate positioning of the Soil Darts. The Soil Sensor is then set up on the Template to make it easy to connect the Sensor Pins to the Darts in the required sequences. The EDG has internal memory for 30 Job Sites and 30 Soil Models. See the section Appendix A for details on EDG memory capacity.

Two configurations are tested to assure that a good electrical signature of the soil is obtained. They are labeled A↔A and B↔B. The EDG programming will guide the operator through each different configuration. Simply, the A↔A connection might be a North-South connection of the Sensor Pins to the nearest Darts. When switching wires it is important that the space between the wires never be allowed to be less than 1 inch, otherwise there may be some small errors introduced in the measurement. The other B↔B test would be an East-West configuration.

When the test (or more specifically, Field Test) is completed, the EDG will immediately display the measured Wet Density, Dry Density, Moisture Content, and Percent Compaction. This data is stored for later viewing from the EDG or from Data Sharing mode using a PC and a Windows™ EDG software application. The Data Sharing mode of the EDG interacts with the EDG software running on a PC and allows the operator to share Job Site and Soil Model data with the PC application. Using the EDG Software running on the PC, the operator can also share Soil Models between different EDG units, and perform a number of other useful tasks. To link the EDG to the PC for Data Sharing mode, the operator must attach the EDG Data Cable to a COM port on the PC (or use a serial-to-USB converter and connect to a USB port on the PC).

Making a Soil Model

A Soil Model must be created so that the soil electrical signature can be correctly related to the physical characteristics of that soil type. It is important that the Soil Model be created with the same soil type at Test Spots of differing moisture content and dry density. EDG Results suffer considerably when the moisture contents are limited to either a high or a low range only. Probably the best soil model will result when samples of soil with moistures at 5.0%, 7.5%, and 10.0% are used as Test Spots. The ideal Test Spots for Soil Model samples will probably look like this:

1. 98% compaction with 5% moisture
2. 98% compaction with 7.5% moisture
3. 98% compaction with 10% moisture
4. 92% compaction with 5% moisture
5. 92% compaction with 7.5% moisture
6. 92% compaction with 10% moisture

A minimum of three (3) Test Spots (or more specifically, Soil Tests) are required for a valid Soil Model.

To create a Soil Model:

1. Screw on the connector for the Soil Sensor Unit to the left side panel receptacle. Be sure that the connector is tight so as to prevent the entry of dirt or moisture.

2. Screw on the Temperature Probe connector to the right side panel receptacle.

3. Turn the EDG ON.

4. From the EDG Main menu, select Soil Models by using the ↓ key and then pressing the SEL key.

EDG Main	JOB SITES	3
Job Sites	SOIL MODELS	3
Soil Models	BATTERY	89%
View Data Sharing	TEMP PROBE	87F
View Information	GPS	ACTIVE
Setup	08/01/2008	11:27A

5. Create a new Soil Model by pressing SEL and answering "Yes" to "Create a new Soil Model?"

EDG Soil Models	JOB SITES	3
→ Create New Soil Model	SOIL MODELS	3
Select Existing Soil Model	BATTERY	89%
Exit	TEMP PROBE	87F
	GPS	ACTIVE
	08/01/2008	11:27A

At this point, you can assign a name to the Soil Model using the keypad. Most keys on the keypad have multiple number/letter assignments; press a key quickly to toggle between the different number/letter assignments. Wait briefly until the selection flashes to lock in the number/letter choice. Use the DEL or ← key to delete the number/letter to the left of the cursor. The – key can be used as an underscore; the . key can also be used in a name assignment. Press SEL after assigning a name to the Soil Model.

6. Press SEL to return to the Soil Model menu. Now move the cursor to Select Existing Soil Model using the ↓ arrow and press SEL.

EDG Soil Models	JOB SITES	3
Create New Soil Model	SOIL MODELS	3
→ Select Existing Soil Model	BATTERY	89%
Exit	TEMP PROBE	87F
	GPS	ACTIVE
	08/01/2008	11:27A

You will see the new Soil Model as:
[LOCAL] xxxxx (NEW_NAME)

with a status of INCOMPLETE. [LOCAL] designates that the Soil Model was created by the local EDG, xxxxx is a unique number assigned to this Soil Model, and (NEW NAME) is the name just assigned above while creating the Soil Model. A Soil Model classification can also be assigned to the Soil Model.

SOIL MODEL SUMMARY				STATUS
EDG SN	SM NO	SM NAME	CLASS	
[LOCAL]	00012	(NEW NAME)		INCOMPLETE

7. Move the cursor to the new Soil Model and press SEL.

8. Press SEL at Create New Soil Test.

Soil Model xxxxx (NEW NAME)	JOB SITES	3
Create New Soil Test	SOIL MODELS	3
Select Existing Soil Test	BATTERY	89%
Max. Density/Opt. Moisture/Soil Class	TEMP PROBE	87F
More Options	GPS	ACTIVE
Exit	08/01/2008	11:27A

9. Press SEL to acknowledge the new Soil Test as the first of (at least) three (3) Test Spots that will make up the Soil Model. If the optional GPS is not installed, record the location of this Test Spot on a map of the Job Site so the data can be correctly identified later.

Soil Test 001 has been created.

Press SELECT or EXIT

10. The screen will show the Soil Model number, the Soil Model name, the Soil Test Number, and "Prepare for the A – A Electrical Test". It is now time to place the Soil Darts and connect to the Soil Sensor Unit.

Soil Model
00012
(NEW NAME)

SOIL TEST 001

Prepare for the A ↔ A
Electrical Test

Press the EDG Key
When Ready

A ↔ A
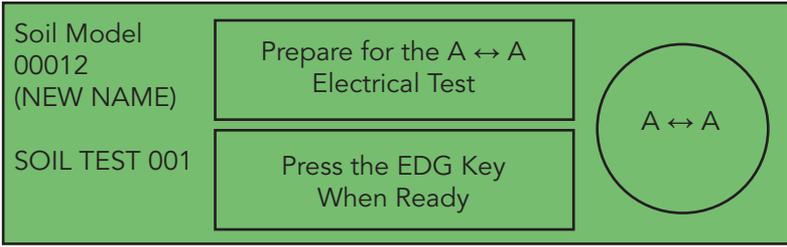
11. Lay the Dart Template on the Test Spot. Drive the four (4) Darts into the soil through the holes in the Template until the Dart shoulder is just even with, or slightly lower than, the soil surface.

12. Place the Soil Sensor Unit in the center of the Template with the Probe Pins pointing up. Using the Red Cable, connect a Probe Pin to the nearest Dart, and with the Black Cable, connect the other Probe Pin to the Dart on the opposite side of the circle. Let the Cables loop upward when connecting, and keep them separated from one another. We'll call this first configuration "A↔A"

13. When using the Temperature Probe, drive a large nail 2 in. deep into the soil near the Test Spot. Insert the Temperature Probe, and press down the soil around the probe shaft. The temperature probe must be used when creating a Soil Model.

14. Keep your hands away from the Cables, Darts, or Soil Sensor Unit, or you may cause errors. Press the EDG key to start testing. Testing will take approximately two (2) seconds.

15. Test Connection "B↔B" will be performed with the Soil Darts that have not yet been used. This will generate a measurement pattern that is at right angle to the first test. Connect the cables to the yet unused Darts, and press the EDG key.

Soil Model
00012
(NEW NAME)

SOIL TEST 001

Prepare for the B ↔ B
Electrical Test

Press the EDG Key
When Ready

B ↔ B
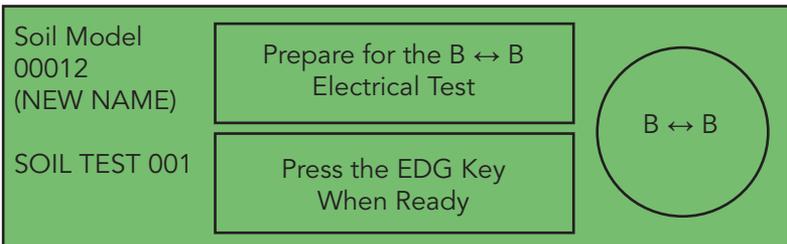
There are now four (4) electrical soil measurements (2 for the A↔A configuration, and 2 for the B↔B configuration) recorded in EDG memory that will be averaged into one final electrical signature of that test spot. The completion of the series of tests is announced.

```
┌──────────────────────────────────────────────┐
│                                              │
│  EDG test completed.                         │
│                                              │
│                                              │
│                                              │
│          ███████████████████████████         │
│          █ Press SELECT or EXIT █            │
│          ███████████████████████████         │
│                                              │
└──────────────────────────────────────────────┘
```

16. It is necessary to make physical determinations of the Wet Density, Dry Density, and Moisture Content % of the soil at the center of each Test Spot (Soil Test). A Sand Cone test must be performed for each Test Spot. Soil from the rat hole is removed and lab tested. Wrap or properly enclose the soil sample to prevent it from drying out before the moisture test can be run. Be sure that the Sand Cone soil is from the center of the Dart pattern and that the rat hole is at least 4 to 5 in. deep. The physical characteristics determined in the lab will later be entered into the EDG to provide the EDG with a relationship between electrical data and physical data. Be sure to keep track of which soil sample goes with which Soil Test.

17. Notes:

    • If a bad connection exists at any of the Cable connecting points, a message will advise you of this problem. The test will be terminated, and that test's data (only) will be lost.

    • If the EDG determines that the electrical data may be questionable, it will report "Electrical data for this test was found to be scattered. Do you want to keep this test?" It is advisable at this point to throw away the data and do the test over. Soil Model entries that are not thrown away are marked with "variation" to show that the data is questionable.

18. When the Soil Model electrical test for that Test Spot is complete, pressing SEL will return you again to the Soil Model xxxxx menu.

```
┌─────────────────────────────────┬──────────────────────────┐
│ Soil Model xxxxx (NEW NAME)     │ JOB SITES          3     │
│ Create New Soil Test            │ SOIL MODELS        3     │
│ Select Existing Soil Test       │ BATTERY           89%    │
│ Max. Density/Opt. Moisture/Soil │ TEMP PROBE        87F    │
│   Class                         │ GPS            ACTIVE    │
│ More Options                    │                          │
│ Exit                            │ 08/01/2008      11:27A   │
└─────────────────────────────────┴──────────────────────────┘
```

19. Pull the Soil Darts out of the ground and find another Test Spot of different dry density and / or Moisture Content. Move the EDG test set-up and repeat the electrical tests on a new Test Spot.

20. Test a minimum of three (3) Test Spots (Soil Tests) for this Soil Model. Taking a greater number of electrical tests on a wider variety of Test Spots will enhance the accuracy of EDG.

21. A Proctor mold test is also run on the soil type to determine maximum dry density and optimum moisture content. These data are later entered into EDG to complete the Soil Model.

22. After the Sand Cone and Proctor mold lab tests are complete, the Maximum Density, Optimum Moisture, and Soil Class are entered into EDG by selecting the Soil Model xxxxx menu, then selecting menu option Max. Density/Opt. Moisture/Soil Class.

Soil Model xxxxx (NEW NAME)	JOB SITES	3
Create New Soil Test	SOIL MODELS	3
Select Existing Soil Test	BATTERY	89%
Max. Density/Opt. Moisture/Soil Class	TEMP PROBE	87F
More Options	GPS	ACTIVE
Exit	08/01/2008	11:27A

23. To enter the Maximum Density and Optimum Moisture, select Max. Density/Opt. Moisture from the menu.

Soil Model xxxxx (NEW NAME)	JOB SITES	3
Max. Density/ Opt. Moisture	SOIL MODELS	3
Soil Classification	BATTERY	89%
Exit	TEMP PROBE	87F
	GPS	ACTIVE
	08/01/2008	11:27A

24. Enter the lab-determined Maximum Dry Density (for example 134.7). (Enter 0.0 if no Max Dry Density is available).

What is the Max. Density (lb/ft^3)
for Soil Model xxxxx (NEW NAME) ?
134.7
Enter 0.0 if a Max Dry Density
is not available

Press SEL when done.

Enter the lab-determined Optimum Moisture. Enter 0.0 if no Optimum Moisture value is available.

What is the the Optimum Moisture (%)
for Soil Model xxxxx (NEW NAME) ?
0.0
Enter 0.0 if a Max Dry Density
is not available

Press SEL when done.

25. If desired, a Unified Soil Classification System designation can be entered into the EDG to preserve the soil classification for this Soil Model. Select the Soil Classification menu option to enter a soil classification.

Soil Model xxxxx (NEW NAME)	JOB SITES	3
Max. Density/ Opt. Moisture	SOIL MODELS	3
Soil Classification	BATTERY	89%
Exit	TEMP PROBE	87F
	GPS	ACTIVE
	08/01/2008	11:27A

26. Use the ↑ and ↓ keys to select a primary soil classification.

> Choose PRIMARY soil classification for
> Soil Model xxxxx (NEW NAME)
> Current classification: none
> GW well graded gravel, fine to coarse gravel
> Use the UP/DOWN arrow to change symbol.
> Press SELECT to save, EXIT to cancel

Press SEL to save the selection.

27. Use the ↑ and ↓ keys to select a secondary soil classification.

> Choose SECONDARY soil classification for
> Soil Model xxxxx (NEW NAME)
> Current classification: none
> GW well graded gravel, fine to coarse gravel
> Use the UP/DOWN arrow to change symbole.
> Press SELECT to save, EXIT to cancel

Press SEL to save the selection.

28. Next, the lab-determined physical data needs to be entered into the
     EDG for each Test Spot (Soil Test) in the Soil Model. Return to the Soil
     Model xxxxx menu and select Select Existing Soil Test.

Soil Model xxxxx (NEW NAME)	JOB SITES	3
Create New Soil Test	SOIL MODELS	3
Select Existing Soil Test	BATTERY	89%
Max. Density/Opt. Moisture/Soil Class	TEMP PROBE	87F
More Options	GPS	ACTIVE
Exit	08/01/2008	11:27A

29. Those Soil Model entries that are lacking physical data will be flagged as "needs physical data entered". Select a Soil Test to see the Physical Data entry screen.

```
Soil Test for Soil Model xxxxx (NEW NAME)    WARNING
Soil Test 001 (needs physical data entered)  No Temp
Soil Test 002 (needs physical data entered)  Varies, NT
Soil Test 003 (needs physical data entered)  variation
```

30. SEL Physical Data, and a screen will show you when the electrical data was gathered. SEL this to get to the entry screens for the physical data.

```
Soil Model xxxxx (NEW NAME)  Soil Test xxx
Physical Data
Enable/Disable Soil Test
```

```
Soil Test 001 was created:
1:59:30P 06/27/2008 (M/D/Y) Friday
```

31. When entering physical data, check the entry carefully for accuracy. Use the → or ← arrows to move to the incorrect number and over-write it with the correct one. Press SEL to move to the next screen.

What is the West Density (lb/ft^3)
for this Soil Test?
0.0_

Enter the physical data for Wet Density: for example 125.2.

What is the West Density (lb/ft^3)
for this Soil Test?
125.2_

Press SEL to enter the Percent Moisture for this Soil Test.

What is the Percent Moisture
for this Soil Test?
0.0_

Enter the physical data for Percent Moisture: for example 5.5.

What is the Percent Moisture
for this Soil Test?
5.5_

Press SEL

32. If you enter a number that is out of the expected range, you will get an error message. Recheck your entry.

33. When you have completed entering physical data, the screen will show "COMPLETE" for that Soil Test.

Soil Test for Soil Model xxxxx (NEW NAME)	WARNING
Soil Test 001 (complete)	No Temp
Soil Test 002 (complete)	Varies, NT
Soil Test 003 (needs physical data entered)	variation

34. After entering all data, review the Soil Tests for Soil Model xxxxx screen to be sure that there are at least three entries, and that they are all complete.

35. Once a Soil Model becomes valid (3 complete Soil Tests), a check is run to see how well the Soil Model "fits" the standard statistical Soil Model. If the Soil Model doesn't fit the statistical model very well, a warning message is generated. Also a "goodness" of fit number of between 0 and 1 is reported, where 1 is ideal.

Fit = 0.981

Press SELECT

36. The Soil Model may be edited to improve the Fit by using the Soil Model "More Options" feature. After selecting a Soil Model to work with select the "More Options" feature and then select the "View Soil Model Graph."

Soil Model xxxxx (NEW NAME)	JOB SITES	3
Create New Soil Test	SOIL MODELS	3
Select Existing Soil Test	BATTERY	89%
Max. Density/Opt. Moisture/Soil Class	TEMP PROBE	87F
More Options	GPS	ACTIVE
Exit	08/01/2008	11:27A

37. The graphs show electrical properties verses physical properties. The
     capacitance / resistance (C/R) verses the water content (W) curve is on
     the right and will generally give a best fit number that is greater than that
     of the Wet Density verses the impedance curve (D/ Z).
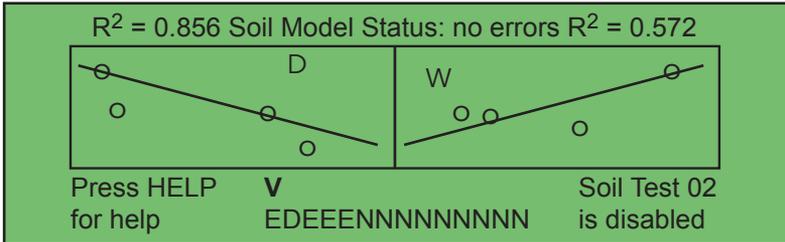
Both graphs should be examined for "Outlier" points that seem to be farther
from the best fit line than the majority of the points. The specific point that is
being assessed for use in the curve have either the letter W or D showing
the location of the point on the graph. This specific point may be disabled or
enabled by pressing Select. Each point in the Soil Model is denoted by either
a letter
"E" for enabled or a letter "D" for disabled as shown on the bottom of the
graph. See if eliminating a specific point (that corresponds a single Soil
Model Test Entry) causes the fit value to be a higher number. If so
eliminate that point and re-run the Soil Test, checking to see that the
re-run point comes closer to the
regression line. The objective of editing these curves is to increase the value
of the Soil Model fit to a number that approaches 1.0. After modifying the Soil
Model by editing out points that cause the graph to be flat, the test data will
be recalculated using the improved Soil Model Fit. In general a graph with
a steep slope will be better than a graph with a slope that is approaching a
horizontal line. A Soil Model with only three tests entries may not be edited,
because each Soil Model is required to have a minimum of three entries.
A Soil Model with eight to twenty test entries may be easily edited to improve
the Soil Model Fit.

Short Step-by-Step Procedure for Making a Soil Model

1. Connect Soil Sensor and Temperature Probe. Turn EDG ON.
2. From the EDG Main menu, choose "Soil Models" and press SEL.
3. Choose "Create New Soil Model", press SEL.
4. Enter a Soil Model name, if desired.
5. Press SEL or EXIT as prompted.
6. Choose "Select Existing Soil Model", press SEL.
7. Scroll to new Soil Model that was just created, press SEL.
8. Choose "Create New Soil Test", press SEL.
9. Press SEL or EXIT as prompted.
10. Prepare for the first of 2 electrical test steps for this Test Spot (Soil Test) by setting the template, placing the Temperature Probe, driving the Soil Darts, connecting the Cables, and pressing the EDG key.
11. Attach Cables to second pair of Soil Darts at 90° to the first pair. Press EDG.
12. Remove Sand Cone soil sample from center of Test Spot (at least 4 to 5 in. deep). Weigh and wrap for future moisture % test.
13. Perform steps 8 through 12 on at least two more Test Spots.
14. After determining Wet Density, Dry Density, Moisture Content %, and Maximum Dry Density from the laboratory tests, find the "Soil Model Summary" menu.
15. Press SEL on desired Soil Model.
16. Choose Max. Density/Opt. Moisture/Soil Class, press SEL.
17. Choose Max. Density/Opt. Moisture to enter the Maximum Density and Optimum Moisture.
18. Choose Soil Classification to note the soil classification for this Soil Model.
19. Return to the Soil Model menu with the Select Existing Soil Test menu option.
20. Choose Select Existing Soil Test, press SEL.
21. Choose the Soil Test that needs physical data entered, press SEL.
22. Choose "Physical Data", press SEL.
23. Press SEL or EXIT as prompted.
24. Enter Wet Density, % Moisture.
25. Repeat until all Soil Tests are COMPLETE.
26. Press MAIN to get to the EDG Main menu.

Associating a Soil Model With a Job Site

Before Field Tests can be performed at a particular Job Site, a Soil Model must be Associated with the Job Site. The following tells how to Associate a Soil Model with a Job Site.

From the EDG Main menu, move the cursor to Job Sites and press SEL. Move to Select Existing Job Site or Create New Job Site, and press SEL. When a new Job Site is created, you can assign a name to the Job Site using the keypad. Most keys on the keypad have multiple number/letter assignments; press a key quickly to toggle between the different number/letter assignments. Wait briefly until the selection flashes to lock in the number/letter choice. Use the DEL or ← key to delete the number/letter to the left of the cursor. The – key can be used as an underscore; the . key can also be used in a name assignment. Press SEL after assigning a name to the Job Site. After assigning a name to the Job Site, a unique Job Site number will be displayed for this Job Site.

1.

EDG Job Sites	JOB SITES	3
Create New Jobe Site	SOIL MODELS	3
Select Existing Job Site	BATTERY	89%
Exit	TEMP PROBE	87F
	GPS	ACTIVE
	08/01/2008	11:27A

2. If you have just created a new Job Site with which to Associate a new Soil Model, EXIT, and move to Select Existing Job Site. You will now see the new Job Site number with no associated Soil Model. Move to the new Job Site number and press SEL.

EDG Job Sites	JOB SITES	3
Create New Jobe Site	SOIL MODELS	3
Select Existing Job Site	BATTERY	89%
Exit	TEMP PROBE	87F
	GPS	ACTIVE
	08/01/2008	11:27A

JOB SITE SUMMARY		ASSOCIATED SOIL MODEL		
JS NO.	JS NAME	EDG SN	SM NO.	SM NAME
00001 (JS NAME)		no associated Soil Model		

3. The Job Site xxxxx Menu will now show the choice "Associate Soil Model". Move to that choice and press SEL.

Job Site 00001 (IS NAME)	JOB SITES	3
Perform EDG Testing	SOIL MODELS	3
View EDG Resuts	BATTERY	89%
Associate Soil Model	TEMP PROBE	87F
Change Job Site Name	GPS	ACTIVE
Exit	08/01/2008	11:27A

4. Move the cursor to "Select a Soil Model" and press SEL.

Associate Soil Model
Select a Soil Model
Remove Association
Exit

5. Move the cursor to the appropriate Soil Model and press SEL. Note that there is nothing that prevents an Association of an incomplete Soil Model with a Job Site at this point in the program.

SOIL MODEL SUMMARY				STATUS
EDG SM	SM NO.	SM NAME	CLASS	
(LOCAL) 00012	(NEW_NAME)			COMPLETE

Short Step-by-Step Procedure for Associating a Soil Model with a Job Site

1. Create a New Job Site, or skip to step 2.
2. Choose "Select Existing Job Site", press SEL.
3. Scroll to the appropriate Job Site and press SEL.
4. Choose "Associate Soil Model" and press SEL.
5. Choose "Select a Soil Model" and press SEL.
6. Scroll to desired Soil Model and press SEL.
7. Press SEL or EXIT as prompted.

Detailed Step-by-Step Procedure for EDG Testing a Soil that Has Already Been Calibrated

As explained earlier, a Job Site is a work area in which you wish to determine soil properties and in which the type of soil in the area is similar enough that it can be modeled by a single EDG Soil Model. EDG permits the use of the same Soil Model for many different Job Sites. The following assumes that a Soil Model has already been Associated with a Job Site.

1. Screw on the connector for the Soil Sensor Unit to the left side panel receptacle. Be sure that the connector is tight so as to prevent the entry of dirt or moisture.
2. Screw on the Temperature Probe connector to the right side panel receptacle.
3. Turn EDG ON.

4. When you see the EDG Main menu screen, the cursor will be on the Job Site menu option. Press SEL to select the Job Site number that you wish to use for the EDG testing session.

EDG Main	JOB SITES	3
Job Sites	SOIL MODELS	3
Soil Models	BATTERY	89%
View Data Sharing	TEMP PROBE	87F
View Information	GPS	ACTIVE
Setup	08/01/2008	11:27A

5. You will first be given the option of creating a New Job Site. It is assumed for this example that you will be using a previously calibrated Soil Model and Associated Job Site, so move the cursor down with the ↓ arrow to Select Existing Site and press SEL.

EDG Job Sites	JOB SITES	3
Create New Job Site	SOIL MODELS	3
Select Existing Job Site	BATTERY	89%
Exit	TEMP PROBE	87F
	GPS	ACTIVE
	08/01/2008	11:27A

6. A list of available Job Sites will be displayed that shows the Site number and Associated Soil Model.

JOB SITE SUMMARY		ASSOCIATED SOIL MODEL		
JS NO.	JS NAME	EDG SN	SM NO.	SM NAME
00001 (JS NAME)		(LOCAL)	00001	(SM_NAME)

7. Move the cursor to the desired Job Site using the up or down arrow keys, and press SEL.

8. The cursor will be on Perform EDG Testing. Press SEL at this option to start soil testing. A new data record will be opened and identified as Field Test xxx. If the optional GPS is not installed, record the location of this test on a map of the Job Site so the data can be correctly identified after Field Testing. Press SEL to proceed.

<u>Job Site 00001 (IS NAME</u>)	JOB SITES	3
Perform EDG Testing	SOIL MODELS	3
View EDG Results	BATTERY	89%
Associate Soil Model	TEMP PROBE	87F
Change Job Site Name	GPS	ACTIVE
Exit	08/01/2008	11:27A

Field Test 001 has been created

Press SELECT OF EXIT

9. The screen will prompt you to prepare for Test A↔A. It is now time to place the Soil Darts and connect to the Soil Sensor Unit.

Soil Model
00001
(JS_ NAME)

Field Test 001

Prepare for the A ↔ A
Electrical Test

Press the EDG Key
When Ready

A ↔ A

10. Lay the Dart Template on the Test Spot. Drive the four (4) Darts into the soil at the four semicircle notches at the four quadrants of the Template until the Dart shoulder is just even with, or slightly lower than, the soil surface.

11. Place the Soil Sensor Unit in the center of the Template with the Probe Pins pointing up. The Template has a Velcro strip in the center. The Soil Sensor has a Velcro strip on the bottom of the sensor that is used to attach the Soil Sensor to the Template in a vertical position. Using the Red Cable, connect a Probe Pin to the nearest Dart, and with the Black Cable, connect the other Probe Pin to the Dart on the opposite side of the circle. Let the Cables loop upward when connecting, and keep them separated from one another. We'll call this first configuration "A↔A"

12. When using the Temperature Probe, drive a large nail 2 in. deep into the soil near the Test Spot. Insert the Temperature Probe, and press down the soil around the probe shaft. If no Temperature Probe is used, temperature compensation cannot be performed by the EDG computer, making EDG results less accurate.

13. Keep your hands away from the Cables, Darts, or Soil Sensor Unit, or you will cause errors. Press the EDG key to start testing. Testing will take about two (2) seconds. If you are not using the Temperature Probe, you will get an error message that you can ignore.

14. Test Connections B↔B will be performed with the Soil Darts that have not yet been used. This will generate a measurement pattern that is at right angle to the first test. Connect the cables to the yet unused Darts), and press EDG. This test will be labeled "B↔B".

| Job Site 00001 (JS_ NAME) | Prepare for the B ↔ B Electrical Test | B ↔ B |
| Field Test 001 | Press the EDG Key When Ready | |
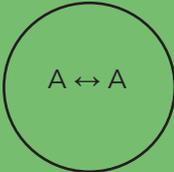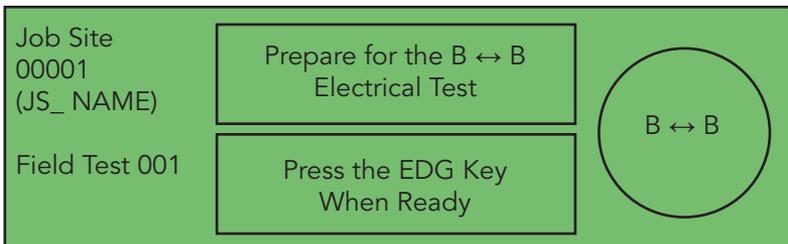
Short Step-by-Step Procedure for Testing a Soil that Has Already Been Calibrated

1. Connect Soil Sensor and Temperature Probe. Turn EDG ON.

2. From the EDG Main menu, choose "Job Sites" and press SEL.

3. Choose "Select Existing Job Site" and press SEL.

4. Find the desired Job Site, press SEL.

5. Choose "Perform EDG Testing", press SEL.

6. Press SEL or EXIT as prompted for the new Field Test.

7. Prepare for the first of 2 test configurations for this Test Spot by setting the template, placing the Temperature Probe, driving the Soil Darts, connecting the Cables, and pressing the EDG key.

8. Attach Cables to second pair of Soil Darts at 90° to the first pair. Press EDG.

9. Press SEL or EXIT as prompted to see the EDG measurement results.

10. Press SEL to do more testing, or EXIT to quit.

Data Sharing

When the EDG is placed in Data Sharing mode, the data stored on the EDG can be shared with a PC through the Data Cable. An EDG software application can be installed on the PC to provide these features:

• View a summary of Soil Models on the EDG

• View a summary of Job Sites on the EDG

• Transfer Soil Models from the EDG to the PC

• Transfer Soil Models from the PC to an EDG

• View Field Test results

• View Field Test and Soil Model GPS locations

Note that the Data Cable is RS-232 serial and is intended to connect to a COM port on the computer. You may need to use a USB-to-serial converter if your computer does not have a serial port available.

See Appendix C for the EDG PC software application and for more information on the Data Sharing capabilities.

Other Features of EDG

A number of housekeeping features are provided in the EDG software.

1. One of the EDG Main menu selections is View Information. This selection contains the following:

    a. Contact numbers from which to obtain help and other services.

    b. The Model Number, Serial Number, Software Version Number.

    c. Current GPS location information (if the optional GPS is installed). Note that the EDG must be able to "see" the sky in order for the GPS to obtain a fix. A GPS fix generally cannot be obtained indoors.

    d. Calibration Check permits evaluation of EDG performance on the optional Calibration Check Unit. If the EDG FAILS this Calibration Check, factory service is required. See Appendix D for more information.

2. Another Main Menu selection is Setup. These features are found here:

    a. Set Date and Time.

    b. Adjust the brightness and contrast of the display.

    c. Change the display to use US units or Metric units.

    d. Turn the GPS off to save power.

3. The Keypad has several keys that perform specific tasks:

    a. The EDG key is used to initiate the series of electrical measurements that are used to generate the electrical signature of a Test Spot (either a Soil Test or a Field Test).

    b. The SEL key is used as the general "Enter" key, and will either select a particular menu choice that is highlighted by the cursor, or move to the next screen or program function.

    c. Soil Tests, Soil Models, Field Tests and Job Sites can be deleted by moving the cursor to the desired item to be deleted, and pressing the DEL key. This is a permanent DELETE, so be sure that you have taken appropriate precautions.

    d. The XFR key will upload data to a PC via the Data Cable. This is for operators that don't wish to use the EDG Software application with Data Sharing mode. See Appendix C for more information.

    e. The YES and NO keys are used to answer questions that call for Yes/No answers.

    f. The MAIN key will take you back to the EDG Main menu from most menu locations.

4. The EDG will turn itself off after a period of 30 minutes of keypad inactivity.

Error Messages and Warnings

Section 1: Self-test Errors and Warnings after Power-up

The following errors and warnings may occur right after powering the EDG on. The EDG software performs a number of self-tests while the EDG is powering up.

One or more gains or offsets was out of range.
Defaults were used.

This is an internal software error that should not occur in the field. However, if it does occur, it's probably best to return the EDG to the factory for recalibration.

The battery is getting low and needs
to be charged.

The battery is dead. Turn the EDG off and
charge the battery.

These warnings let the user know that the battery is either dead or getting low and needs to be charged.

This warning lets the user know that the temperature probe is not attached
and that any EDG testing will be more accurate if the temperature probe is
used.

The temperature is too low to make
EDG measurements

This warning lets the user know that the EDG detected a temperature below
the freezing point. EDG testing cannot be performed if the temperature is
below the freezing point.

The temperature reading is unusually high.
The EDG unitmay need to be calibrated.

This warning lets the user know that the EDG detected a temperature above
130° Fahrenheit.
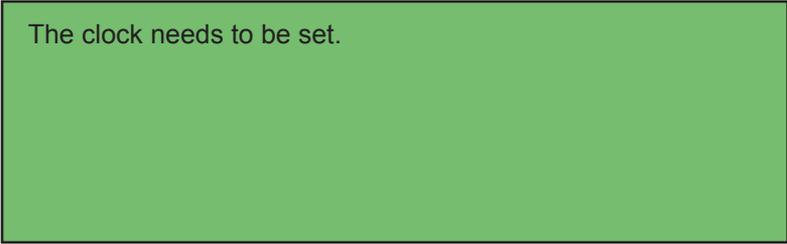
> The clock needs to be set.

This warning occurs if the real time clock in the EDG has never been set, or if a date of February 29 occurs in a year that is not a leap year.

Section 2- Errors and Warnings while creating a Soil model

While creating a new Soil Model, this error may occur:

> There are no more unused
> Soil Models.

The number of Soil Models that can be created is limited. This error means that that limit has been reached and that another Soil Model cannot be created without deleting one of the other Soil Models.

While performing EDG testing for a particular Soil Model, this warning may occur:
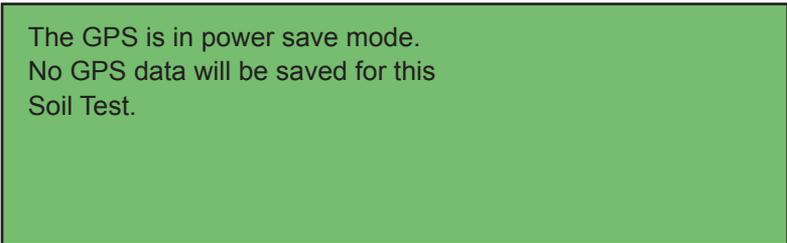
> The GPS is in power save mode.
> No GPS data will be saved for this
> Soil Test.

The power to the GPS can be turned off to conserve battery power. Turn the power back on to save GPS information while performing a Soil Test.

While performing EDG testing for a particular Soil Model, this error may occur:

> The GPS was not able to obtain a fix.
> GPS data cannot be saved for this test.
> Continue (Y/N)?

GPS location data can be saved at each Test Spot (assuming the optional GPS is installed). Sometimes it can take a couple of minutes to acquire the GPS location information from the GPS. Also, the EDG must be able to "see" the sky in order for the GPS to acquire a satellite fix.

> The battery is too low to product
> accurate EDG results.

The EDG can detect the charge level of the battery. If it gets too low, the EDG results will not be meaningful, so the EDG does not allow further testing until the battery is charged.

While performing EDG testing on a particular Job Site, this error may occur:

> There may be a bad connection or short
> in the cables to the soil darts, or
> you may need to spread the soil darts
> farther apart. See the user manual for
> more information.

This error means that the electrical information gathered by the EDG during an EDG test could not be used to create a Soil Test either because of a bad connection to the soil darts, or because of unusual soil conditions. In the case of unusual soil conditions, spreading the soil darts farther apart during testing resolves this problem.

While performing EDG testing to create a Soil Test, this error may occur:

> The EDG Measurement Unit is not firmly
> mated, not connected or is defective.

This error means that the electrical information gathered by the EDG during an EDG test indicates that the EDG Measurement Unit may not be properly connected.

While performing EDG electrical testing, this error may occur:

> The temperature is too high to produce
> accurate EDG results.

EDG results are less accurate outside a particular temperature range. This error occurs when the EDG detects a temperature above 175° Fahrenheit.

While performing EDG testing to create a Soil Model Entry, this error may occur:

> It appears that the temperature probe
> may be disconnected. The temperature
> probe must be connected when creating
> a Soil Model.

The EDG will not allow a Soil Model to be created without the temperature probe connected.

After completing a Soil Test, this warning may occur:

Electrical data for this test was found
to be scattered. Do you want to keep
this EDG test?

Electrical information gathered by the EDG for the A↔A and B↔B tests
was found to be inconsistent. This warning allows the user to keep the
inconsistent data, if desired (generally not a good idea).

While viewing the Soil Model "fit", and after entering Soil Model Physical
Data, this error may occur:

The Soil Model does not yet contain
3 or more complete Soil Tests. A Soil
Model must have at least 3 complete
Soil Tests before it becomes valid.

"Fit" data cannot be displayed if the Soil Model doesn't have at least
3 complete Soil Model Entries.

While viewing the Soil Model "fit", and after entering Soil Model Physical
Data, this warning may occur:

>WARNING<
The information in Soil Model
(LOCAL) xxxxx (SM NAME)
lacks the range of densities and moistures
needed to generate accurate EDG results.

While computing the Soil Model "fit", the EDG determined that the Soil Model
contained at least one questionable Soil Test. This warning just lets the user
know that the EDG results may not be accurate.

Section 3- Errors and Warnings in "View System"

While performing an EDG calibration, the following error may occur:

> The battery is too low to perform
> the calibration check.

While performing an EDG calibration, the following error may occur:

> The calibration module is either
> not connected, or the EDG unit
> needs to be repaired.

While performing an EDG calibration, the following error may occur:

> The calibration check FAILED.

Section 4- Errors and Warnings during Field Testing

While creating a new Job Site, this error may occur:

> There are no more unused
> Job Sites.

The number of Job Sites that can be created is limited. This error means that that limit has been reached and that another Job Site cannot be created until a Job Site is deleted.

While performing EDG testing on a particular Job Site, this error may occur:
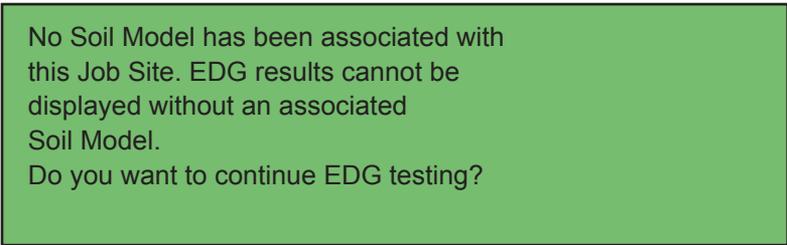
> No Soil Model has been associated with
> this Job Site. EDG results cannot be
> displayed without an associated
> Soil Model.
> Do you want to continue EDG testing?

This error means that the user needs to associate a Soil Model with the Job Site before EDG results can be displayed

While performing EDG testing on a particular Job Site, this warning may occur:

> The Soil Model associated with this
> Job Site is invalid or incomplete.
> EDG resultscannot be displayed
> without a valid Soil Model.
> Do you want to continue EDG testing?

This warning means that the Soil Model associated with this Job Site either does not have enough Test Spots (Soil Tests) to make a valid Soil Model or that there are not enough Soil Tests with Physical Data (sandcone information) entered to make a valid Soil Model.

While performing EDG testing on a particular Job Site, this error may occur:

> There are already 30
> (the maximum) Field Tests.

The number of Field Tests that can be created in a given Job Site is limited. This error means that that limit has been reached and that another Field Test cannot be created until a Field Test is deleted.

While performing EDG testing on a particular Job Site, this error may occur:

> The GPS is in power saver mode.
> No GPS data will be saved for this
> Field Test.

The power to the GPS can be turned off to conserve battery power. Turn the power back on to save GPS information while performing a Field Test.

While performing EDG testing on a particular Job Site, this error may occur:

> The GPS was not able to obtain a fix.
> GPS data cannot be saved for this test.
> Continue (y/N)?

GPS location data can be saved at each Test Spot (assuming the optional GPS is installed). Sometimes it can take a couple of minutes to acquire the GPS location information from the GPS. Also, the EDG must be able to "see" the sky in order for the GPS to acquire a satellite fix.

While performing EDG testing on a particular Job Site, this error may occur:

> The battery is too low to produce
> accurate EDG results.

The EDG can detect the charge level of the battery. If it gets too low, the EDG results will not be meaningful, so the EDG does not allow further testing until the battery is charged.

While performing EDG testing on a particular Job Site, this error may occur:

> There may be a bad connection or short
> in the cables to the soil darts, or
> you may need to spread the soil darts
> farther apart. See the user manual for
> more information.

This error means that the electrical information gathered by the EDG during an EDG test could not be used to produce EDG results either because of a bad connection to the soil darts, or because of unusual soil conditions. In the case of unusual soil conditions, spreading the soil darts farther apart during testing resolves this problem.

While performing EDG testing on a particular Job Site, this error may occur:

> The EDG Measurement Unit is not firmly
> mated, not connected, or is defective.

This error means that the electrical information gathered by the EDG during an EDG test indicates that the EDG Measurement Unit may not be properly connected.

While performing EDG testing on a particular Job Site, this error may occur:

> The temperature is too high to produce
> accurate EDG results.

EDG results are less accurate outside a particular temperature range. This error occurs when the EDG detects a temperature above 175° Fahrenheit.

While performing EDG testing on a particular Job Site, this warning may occur:

> It appears that the temperature probe
> may be disconnected.
> Continue (Y/N)?

The EDG is more accurate when temperature compensation is performed. Temperature compensation cannot be performed when the temperature probe is not attached. This warning lets the user know that the temperature probe is not attached, but allows testing to continue without the temperature probe if the user wishes.

While performing EDG testing on a particular Job Site, this error may occur:
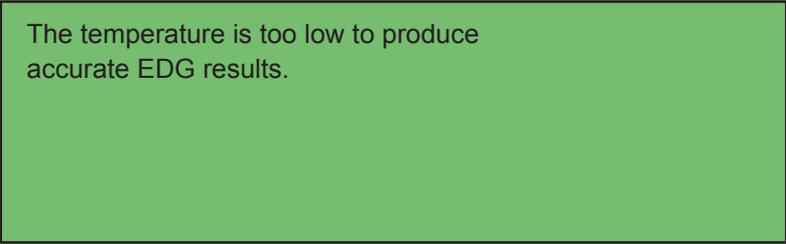
> The temperature is too low to produce
> accurate EDG results.

EDG results are less accurate outside a particular temperature range. This error occurs when the EDG detects a temperature at or below 32° Fahrenheit.

While performing EDG testing on a particular Job Site, this error may occur:

> EXIT was pressed before all testing was
> completed. This test's data was lost.

Both A↔A and B↔B EDG tests must be completed, or the Field Test will not be saved.

After completing a Field Test, this warning may occur:

> Electrical data for this test was found
> to be scattered. Do you want to keep
> this EDG test?

Electrical information gathered by the EDG for the A↔A and B↔B tests was found to be inconsistent. This warning allows the user to keep the inconsistent data, if desired (generally not a good idea).

While displaying EDG results for a particular Field Test, this error may occur:

> No Soil Model has been associated with
> this Job Site. EDG results cannot be
> displayed without an associated
> Soil Model.
> Do you want to continue EDG testing?

A Soil Model must be associated with a Job Site before EDG Field Test results can be displayed.

While displaying EDG results for a particular Field Test, this error may occur:

> The Soil Model associated with this
> Job Site is invalid or incomplete.
> EDG results cannot be displayed
> without a valid Soil Model.

A Soil Model must have at least three complete Soil Model Entries (with the associated sandcone Physical Data) before it can be used to display EDG results.

While displaying EDG results for a particular Field Test, this warning may occur:

> One or more Electrical Tests of the Field
> Test does not have a valid temperature.
> EDG results are more accurate when soil
> temperatures are measured.

If any of the Electrical Test that make up a Field Test do not have a temperature associated (i.e., the temperature probe was not connected during the EDG test), then the EDG cannot use temperature compensation when calculating EDG
results. This warning just lets the user know that at least one of the Electrical Tests is missing a temperature value, and that the results have not been temperature compensated.

While displaying EDG results for a particular Field Test, this warning may occur:

> >WARNING<
> The information in Soil Model
> (LOCAL) xxxxx (SM NAME)
> lacks the range of densities and moistures
> needed to generate accurate EDG results.

While computing EDG results, the EDG determined that the Soil Model contained at least one questionable Soil Test. This warning just lets the user know that the EDG results may not be accurate.

While displaying EDG results for a particular Field Test, this warning may occur:

>WARNING<
The information in Field Test xxx falls
outside of the limits of the associated
Soil Model. EDG results for Field
Test xxx may not be accurate.

This warning lets the user know that the electrical data contained in the Soil Model does not necessarily provide enough information to provide accurate EDG results for a particular Field Test. The user is advised to go back to the Soil Model and add more Soil Tests to give a better representation of the soil characteristics of the soil found throughout the Job Site.

Appendix A—
Electrical Density Gauge, Model-C Technical Specifications

General:
- EDG is packaged in a water-resistant enclosure and employs water resistant connectors. It is not intended for use during heavy rain.
- EDG will operate correctly to an altitude of 10,000 ft.

Wet Density Range: As found in typical compacted earth sites

Dry Density Accuracy: Typically within 3% of standard physical tests

Moisture Content Range: As found in typical compacted earth sites

Moisture Content Accuracy: Typically within 2% of standard test

Maximum RS-232 Cable Length: 50 ft.

Internal Power: 12V lead acid gel cell, 4.0 AH capacity

Operating Time Before Recharge: Approx. 8 hr.

Ambient Temperature Range: 0 deg. C to 50 deg. C

Ambient Humidity Range: 5% to 90% non-condensing

EDG Console Weight: 11 lb.

EDG Console Dimensions: 13.5 in. x 12 in. x 6 in.

Weight of EDG Accessories: Approx. 4 lb.

Memory Capacity:
- Job Sites: 30
- Field Tests per Job Site: 30
- Soil Models: 30
- Soil Tests per Soil Model: 3 to 16

Appendix B—
Recommended Physical Test Standards

For best accuracy of EDG calibration, it is important to perform the various required physical tests according to the correct recognized standard procedure.

A partial list of American Society for Testing Materials (ASTM) standards that may be used when calibrating the EDG is shown below. Additional ASTM standards or other industry recognized standards, such as American Association of State Highway and Transportation Officials (AASHTO) standards for obtaining soil material physical properties may be may be used in the EDG soil calibration procedure.

ASTM D 1556 – 00
Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method

ASTM D 2922 – 96e1
Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)

ASTM D 698 – 07e1
Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12 400 ft-lbf/ft3 (600 kN-m/m3))

ASTM D 1557 – 07
Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3(2,700 kN-m/m3))

ASTM D 4959 – 07
Standard Test Method for Determination of Water (Moisture) Content of Soil By Direct Heating

ASTM D 4643 – 08
Standard Test Method for Determination of Water (Moisture) Content of Soil by Microwave Oven Heating

Appendix C— EDG Software

EDG Software will allow you to communicate effortlessly with your EDG gauges and only requires minimal setup by the user. EDG Software provides a complete solution for the acquisition, storing, and presentation of Job and Soil Model data. EDG Software works in conjunction with Microsoft Excel to present test data in easy-to-read Excel workbook format files, which can be evaluated directly or sent to any computer using Microsoft Excel. Jobs can be grouped together within projects for organization and reporting.

EDG Software Features

- Communicate with all your EDG gauges.
- Download Job Data.
- Create reports from downloaded job data.
- Download Soil Model Data.
- Create reports from downloaded soil model data.
- Upload soil models to any EDG.
- Input proctor data for use in job data or soil model data.
- View maps of test locations.
- Customize Report.

Operating System Requirements

Windows 2000 (with at least Service Pack 4), Windows XP Professional, Windows XP Home, and Windows Vista. Other versions, such as Windows 3.1, Windows 95, 98, and NT are not supported.

Software Requirements

Microsoft Excel is required for creating reports.

Hardware Requirements

- Pentium 4 (32-bit) equivalent or faster.

- Minimum 512 MB RAM

- 300 MB swap space (or more)

- CD-ROM or DVD Drive if installing using installation disc.

- 1024 x 768 display resolution.

Internet Connection
It is recommended that you have an internet connection.
With an internet connection you can:

- Check for software updates.

- Soil Models can be exported and sent to anyone.

- Comments and questions can be sent to Humboldt.

- In the event of issues with the software we can connect to your computer remotely.

Using the EDG Software
The Installation disc contains the complete EDG Software offering.
If you did not receive a disc, the installation can be downloaded from www.humboldtmfg.com, and is downloadable within the support section of the Humboldt web site. After installation on your computer, please use the Help button located in the Introduction tab.

Appendix D—
Using HyperTerminal to Transfer Job Site and Soil Model Information
(Legacy Data Transfer Method)

Note that the preferred method of data transfer between the EDG unit and a PC is the EDG Data Sharing mode. Data Sharing allows an EDG to be connected to the EDG Software running on a PC to share information back and forth between EDG units. The information provided in this section describes the legacy method for transferring data from the EDG to a PC.

EDG data from a Job Site or Soil Model that has been stored on the EDG can be transferred from the EDG Console to a PC using HyperTerminal (or another serial communication program.) The EDG data is transferred in comma-delimited form and can be imported directly into EXCEL after being transferred to a file on the PC.

The EDG Console communicates using a baud rate of 19200, 8 data bits, no parity, and 1 stop bit (8N1). To set up HyperTerminal to communicate with the EDG Console, perform the following steps (note that different versions of HyperTerminal may vary):

1. From the HyperTerminal File menu option, select Properties→Connect To. Select the COM port on your PC that you are going to use to communicate with the EDG (note that you may have to use the HyperTerminal Call→Disconnect menu option before performing this step). Also from Properties→Connect To, select Configure→Port Settings. Set the Port Setting to 19200 baud, 8 data bits, no parity, 1 stop bit, and hardware flow control.

2. From the HyperTerminal File menu option, select Properties→Settings→ASCII Setup. Deselect (uncheck) all options under ASCII Receiving.

3. Connect the EDG breakout cable with the battery charger connector and the 9 pin D-SUB connector to the rightmost connection (labeled "TEMPERATURE DATA -- CHARGE").

4. Connect a standard serial cable from the PC COM port to the 9-pin D-SUB connector on the EDG breakout cable.

5. From the HyperTerminal Transfer menu option, select Capture Text. Assign a file name for the text to be captured from the EDG and choose Start. After step 5, HyperTerminal still says "Disconnected" in the lower left hand corner of the screen, and then the user needs to select Call->Call from Hyper Terminal. HyperTerminal should then report "Connected" in the lower left hand corner of the screen. The EDG data

can now be transferred. After the EDG Transfer is completed, the user should choose Transfer->Capture Text->Stop from HyperTerminal.

6. From the EDG Console menus, put the EDG cursor on either the particular Job Site, Field Test, Soil Model, or Soil Test that you would like to transfer to the PC.

7. Press XFR on the EDG keypad to transfer data to the PC. (If the EDG cursor was placed on a Job Site or Soil Model, all entries of the Job Site or Soil Model will be transferred to the PC. If the EDG cursor was placed on a Field Test or Soil Test, just that entry's data will be transferred to the PC).

Transferred Job Site information has this format:

Line 1:   EDG serial number TC = ON/OFF

Line 2:   latitude degrees, latitude minutes, latitude direction, longitude degrees, longitude minutes, longitude direction

Line 3:   date and time

Line 4:   job site number: [soil model serial number] soil model number: field test number, average wet density, average dry density, average moisture, average compaction (or 0.00 if no Max Density)

Line 1 shows the 5 digit serial number of the EDG unit.

Line 1 also shows "TC=ON" if the temperature probe was used while making the Field Test. If the temperature probe was not used, line 1 will show "TC = OFF" to show that the EDG gauge test could not be temperature compensated because the temperature probe was not used. Using the temperature probe provides more accurate EDG results. Line 1 will only appear once when transferring multiple Field Tests in a Job Site.

Line 2 shows GPS location information for the Field Test.

Line 3 shows the date and time that the Field Test was created.

Line 4 shows the Job Site number, the associated Soil Model serial number and Soil Model number, the Field Test number and the EDG-computed wet density, dry density, %moisture, and compaction for this Field Test.

Lines 2, 3, and 4 will be repeated for each transferred Field Test.

Transferred Soil Model information has this format:

Line 1:   EDG serial number TC = ON/OFF

Line 2:   latitude degrees, latitude minutes, latitude direction, longitude degrees, longitude minutes, longitude direction

Line 3:   date and time

Line 3:   Soil Model number:Soil Test number, wet density, dry density, % moisture, max density

Line 1 shows the 5 digit serial number of the EDG unit.

Line 1 also shows "TC=ON" to show that the temperature probe was used while making the Soil Model. This line will only appear once when transferring multiple Soil Tests in a Soil Model.

Line 2 shows GPS location information for the Soil Test.

Line 3 shows the date and time that the Soil Test was created.

Line 4 shows the Soil Model number, Soil Test number, and the user-entered, laboratory-sandcone-test-determined wet density, dry density, % moisture, and max density for this Soil Test.

Lines 2, 3, and 4 will be repeated for each transferred Soil Test.

Appendix E—
Using the Calibration Check Unit

The Calibration Check Unit contains electrical components that simulate a soil of medium compaction and medium moisture content. It has the same serial number as the EDG Soil Sensor that it is used with. The correct EDG reading for the Unit is loaded into memory at the factory. When the Calibration Check menu item is exercised, the latest reading is compared with the expected factory reading, and if within tolerance, PASSED is displayed. If the latest reading differs too much, FAILED is displayed, which indicates that the EDG should be serviced.

To use the Calibration Check Unit, place the Soil Sensor on a flat surface with the Probe Pins pointing up. Push the Calibration Check Unit onto the Probe Pins so that they are fully seated in the receptacles. Enter SEL at the menu screen to activate the measurement process.

Note: EDG accuracy is dependent upon the accuracy of the calibration of the Soil Model, and the precision of the standard physical tests.

Appendix F—
Sample Field Test Data Log Notes

This form can be downloaded from our website:
http://www.humboldtmfg.com/pdf/EDG_datalog.pdf

Date: _____

User Name: _____

EDG Serial Number: _____

Location: _____

Brief Material Description: _____

Weather Condition & Approximate Temperature: _____

Nuclear Density Gauge Make & Model: _____

Testing Equipment for **Construction Materials**

HUMBOLDT

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Job Site JS XXX	Soil Model SM XXX	FT XXX	EDG Density	EDG Moisture	Sand Cone Density	Sand Cone Moisture	Nuclear Density	Nuclear Moisture	Remarks

Warranty

Humboldt Mfg. Co. warrants its products to be free from defects in material or workmanship. The exclusive remedy for this warranty is Humboldt Mfg. Co., factory replacement of any part or parts of such product, for the warranty of this product please refer to Humboldt Mfg. Co. catalog on Terms and Conditions of Sale. The purchaser is responsible for the transportation charges. Humboldt Mfg. Co. shall not be responsible under this warranty if the goods have been improperly maintained, installed, operated or the goods have been altered or modified so as to adversely affect the operation, use performance or durability or so as to change their intended use. The Humboldt Mfg. Co. liability under the warranty contained in this clause is limited to the repair or replacement of defective goods and making good, defective workmanship.

Testing Equipment for   Construction Materials

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