



Gaotiejian

GTJ-4114 Non Nuclear Soil Density Gauge Operation Manual

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Electrical Density Gauge User Manual

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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 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.

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 、 Electrical Soil Measurement Sensor 、 Dart

Template、 Hammer、 Cables/Clips for Soil Measurement Sensor、 Soil Darts、 Battery Charger、 Temperature Probe、 Break-Out Cable 。

Components:

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. 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.

Soil Electrical Measurement Sensor:

The Soil Sensor is connected to the Soil Darts and EDG Computer using cables and clips. Then the Soil Sensor gathers electrical information about the soil under test and transfers the information to the EDG computer.

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.

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.

Temperature Probe:

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.

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.

The Break-Out Cable:

The Break-Out Cable provides a USB connector for connection to a host PC for use in Data Sharing mode.

Note:

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.

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 user can assign names to Soil Models and Job Sites to help keep track of data. 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.

Note that these assigned names do not have to be unique, so the operator needs to avoid later confusion. 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 (more than three) chosen Test Spots. For each Test Spot, the physical wet density, dry density, and percent moisture is obtained by laboratory test.

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.

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 two wires connecting the Soil Darts are not allowed to be crossed (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 (associating Soil Model in advance). 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, print or file the EDG data by importing to the Excel.

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:

- 98% compaction with 5% moisture
- 98% compaction with 7.5% moisture
- 98% compaction with 10% moisture
- 92% compaction with 5% moisture
- 92% compaction with 7.5% moisture

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:

EDG Main

Job Sites

Soil Models

View Data Sharing

Transfer Data

Setup

Job Sites: 1 Soil Models: 1 Bat : 100%

Temp : 24°C [2012-07-05 13:38:46]

Can Not Connect Soil Interface

系统信息指示

Note: System Info Indicator is used to display the status of equipment.

Indicator 1: Can Not Connect Soil Probe !

Indicator 2: No Temperature!

Indicator 3: Low Power!!

4、From the EDG Main menu, select “Soil Models” by using the ▲ or ▼ ,and then press **SEL**.

EDG Soils Models

Creat New Soil Model

Select Existing Soil Model

Job Sites: 1 Soil Models: 1 Bat : 100%

Temp : 24°C [2012-07-05 13:38:46]

Can Not Connect Soil Interface

Select "Creat New Soil Model", then press **SEL**.

Creat A New Soil Model ?

Enter The Soil Model Name:

S1234

Job Sites: 1 Soil Models: 1 Bat : 100%

Temp: 24°C [2012-07-05 13:38:46]

Can Not Connect Soil Interface

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. The ► or ◀ key can be used to choose the next letter. (Note: The first letter must be T when assign a name to the Soil Model, which is unchangeable, while the first letter should be J for naming the Job Site.)

6、 Press **SEL** to save the name of the Soil Model and return to the Soil Model menu. Move the cursor to "Select Existing Soil Model" by using ▲ or ▼.

Press **SEL**, you will see the new Soil Model as : 0001[TGJ34].0001 is a unique number assigned to the Soil Model, and [TGJ34] is the name just assigned while creating the Soil Model.

Soil Summary

0001[S1234]

Job Sites: 1 Soil Models: 1 Bat : 100%

Temp: 24°C [2012-07-05 13:38:46]

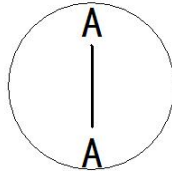
Can Not Connect Soil Interface

DEL can be used to delete data. Move the cursor to "Delete All the Data" or "Delete the Last Data", and then answer **YES** or **SEL** to acknowledge.

7、 Now move the cursor to the new soil model 0001[TGJ34] and press **SEL**, you will reach the following interface.

| | | |
|-------------------------------------|----------------|-----------------------|
| Soil Model : 0001[S1234] | | |
| Creat New Soil Test | | |
| Select Existing Soil Test | | |
| Max Density/Opt.Moisture/Soil Class | | |
| More Options | | |
| <hr/> | | |
| Job Sites: 1 | Soil Models: 1 | Bat : 100% |
| Temp: 24°C | | [2012-07-05 13:38:46] |
| Can Not Connect Soil Interface | | |

8. 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. The screen will show the Soil Model number, the Soil Model name, the Soil Test Number, and “Prepare for the A--A Test”.

| | | |
|--|-----------------|-----------------------|
| 0001 [SGJ34] | | |
| Soil Test0001 | | |
| Prepare for the A--A Test | | |
| Press “TEST” key When Ready | | |
|  | | |
| <hr/> | | |
| Job Sites : 1 | Soil Models : 2 | Bat : 100% |
| Temp: 24°C | | [2012-07-05 14:27:15] |

9、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. Then connect it to the Soil Sensor.

10、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”.

11、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. (Note: The temperature probe must be used when creating a Soil Model.)

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

13、 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. 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.

14、 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 15 cm 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.

15、 Note:

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 cannot be displayed." It is advisable at this point to throw away the data and do the test over.

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

17、 Pull the Soil Darts out of the ground and find another Test Spot of different dry density and 1 or Moisture Content. Move the EDG test set-up and repeat the electrical tests on a new Test Spot.

18、 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.

19、 A Proctor model 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.

20、 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 menu.

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

| Max Density And Opt.Moisture | |
|--|------------------------|
| Max Density | 2.500g/cm ³ |
| Opt.Moisture | 12.000% |
| Job Sites: 1 Soil Models: 1 Bat : 100% | |
| Temp: 24°C [2012-07-05 13:38:46] | |
| Can Not Connect Soil Interface | |

22、 Enter the lab-determined Maximum Dry Density (Enter 0.0 if no Max Dry Density is available).For example, pressing “1” , “.”,“7” and“8”keys makes“1.78”.Press “YES”to save data when done while press “No” to quit and the data will be lost. Then press “↓” to select “Optimum Moisture Content” and enter the lab-determined Optimum Moisture. (Enter 0.0 if no Optimum Moisture value is available.) Press YES or No when done.

23、 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 menu and select “Select Existing Soil Test”.

24、 Those Soil Model entries that are lacking physical data will be flagged as "Needs phy data". Select a Soil Test to see the Physical Data entry screen.

| TestNo | STATUS |
|--|--------|
| Test0001(Needs phy data) | Normal |
| Test0002(Needs phy data) | Normal |
| Test0003(Needs phy data) | Normal |
| Test0004(Needs phy data) | Normal |
| Job Sites: 1 Soil Models: 1 Bat : 100% | |
| Temp: 24°C [2012-07-05 13:38:46] | |
| Can Not Connect Soil Interface | |

"Needs phy data" means that physical data of the Soil Model has not been entered into the EDG. The data requires to be input according to laboratory results.

25、 Press **SEL** to move to the entry screens for the physical data, then enter lab-determined wet density and moisture content. When input physical data, check the entry carefully for accuracy. Use ► or ◀ to move to the incorrect number and over-write it with the correct one.

Press **YES** to save data when done while press **NO** to quit and the data will

be lost.

26、 Press ▼ and enter the physical data for Moisture content.

27、 When you have completed entering physical data, the screen will show “Complete” for that Soil Test.

| TestNo | STATUS |
|---|--------|
| Test0001(Complete) | Normal |
| Test0002(Complete) | Normal |
| Test0003(Complete) | Normal |
| Test0004(Complete) | Normal |
| Job Sites: 1 Soil Models: 1 Bat : 100% | |
| Temp: 24°C [2012-07-05 13:38:46] | |
| Can Not Connect Soil Interface | |

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

29、 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 1 indicates the “goodness” of lab-determined wet density and physical data, and Fit 2 indicates the “goodness” of lab-determined Moisture content and physical data. It is ideal that both Fit 1 and Fit 2 are 1, which also means the Soil Model for the moment is the most accurate and the highest accuracy of measurement.

| More Options | |
|---|--------------|
| | |
| Fit1 = 0.999 | Fit2 = 0.914 |
| Job Sites: 1 Soil Models: 1 Bat : 100% | |
| Temp: 24°C [2012-07-05 13:38:46] | |
| Can Not Connect Soil Interface | |

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.

- 1、 From the EDG Main menu, move the cursor to Job Site and press SEL.
- 2、 Select “Create A New Job” or “Select A Existing Job”, and press SEL.

Creat A New Job

Enter The Job Name:

JGJ34

Job Sites: 1 Soil Models: 1 Bat : 100%

Temp: 24°C [2012-07-05 13:38:46]

Can Not Connect Soil Interface

When a new Job Site is created, you can assign a name to the Job Site using the keypad. After assigning a name to the Job Site, a unique Job Site number will be displayed for this Job Site.

4、 After assigning a name to the Job Site, press EXIT to return to the EDG Main menu.

5、 Select “Select Existing Site”, and press SEL.

Choose desired number of Job Site, and press SEL to enter into the Job Site menu

Job Site: 0001[JGJ34]

Perform EDG Testing

Associate Soil Model

Job Sites: 1 Soil Models: 1 Bat : 100%

Temp: 24°C [2012-07-05 13:38:46]

Can Not Connect Soil Interface

6、 After selecting the assigned name, choose “Associate Soil Model”;

| | | |
|--------------------------------|-----------------------|------------|
| Soil Summary | | |
| 0001[S1234] | | |
| | | |
| Job Sites: 1 | Soil Models: 1 | Bat : 100% |
| Temp: 24°C | [2012-07-05 13:38:46] | |
| Can Not Connect Soil Interface | | |

7、 Move the cursor to the appropriate Soil Model and press **SEL**

Note: the program will prevent an association of an incomplete Soil Model with a Job Site. If correct association failed, it means the physical data has not been entered into the Soil Model or there is any other problem. Therefore, check over the Soil Model is required.

| | | |
|-------------------------------------|-----------------------|------------|
| Job Site: 0001[JGJ34] --0001[S1234] | | |
| Perform EDG Testing | | |
| Associate Soil Model | | |
| | | |
| Job Sites: 1 | Soil Models: 1 | Bat : 100% |
| Temp: 24°C | [2012-07-05 13:38:46] | |
| Can Not Connect Soil Interface | | |

After successful association, the next step is conducting a Field Test. The Soil Model and a Job Site also can be associated after the Field Test, but the actual physical characteristics such as Wet Density and Moisture content are unable to be determined on the site. It needs to input correct physical characteristics of the Soil Model first and conduct association next before view the data from "Data Preview".

Procedure for EDG Testing

- 1、 Connect Soil Sensor Unit with Temperature Probe and turn EDG on;
- 2、 Select " Perform EDG Testing", press **SEL**.
- 3、 Press **SEL** or **EXIT** as promoted for the new Field Test
- 4、 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 **TEST**.
- 5、 Swap Cables, press **TEST**.
- 6、 Press **YES** to see the EDG measurement results as promoted. There

are two possibilities as followings when “Can not view the result!” appears on the screen.

1) Association of the Soil Model has not been conducted. 2) The measurement data has been overflowed; make sure sensor cable connection is normal, or check to see if there is any virtual connection or short circuit.

- 7、 Select “Perform EDG Testing” to do more testing, or press **EXIT** to quit.

Data View

Select “Data View” and enter. You can view the measurement data stored.

| | | |
|--------------------------------|-----------------------|------------|
| Job Sites | | |
| 0001 [J1234] | | |
| <hr/> | | |
| Job Sites: 1 | Soil Models: 1 | Bat : 100% |
| Temp: 24°C | [2012-07-05 13:38:46] | |
| Can Not Connect Soil Interface | | |

Select a job, and press **SEL**, you can see a list of test data:

| | | |
|--------------------------------|-----------------------|------------|
| View EDG Results | [1 / 1] | Page[1] |
| Test0001 | | |
| <hr/> | | |
| Job Sites: 1 | Soil Models: 1 | Bat : 100% |
| Temp: 24°C | [2012-07-05 13:38:46] | |
| Can Not Connect Soil Interface | | |

Using **▶** or **◀** to turn page ,and using **▲** or **▼** to select a test data. Then press **SEL** to view the data.

| View EDG Results | | |
|--------------------------------|----------------|-------------------------|
| Wet Density | | Moisture Content |
| 2. 299g/cm ³ | | 13. 531% |
| Compaction Degree | | Dry Density |
| 91. 988% | | 2. 205g/cm ³ |
| Job Sites: 1 | Soil Models: 1 | Bat : 100% |
| Temp: 24℃ | | [2012-07-05 13:38:46] |
| Can Not Connect Soil Interface | | |

Setup

- 1、 Time Setting: to work with GPS. This function is not available on this model.
- 2、 GPS: view the information of GPS.
- 3、 Temperature: calibrate the temperature by adjusting the offset
- 4、 Battery: check the voltage
- 5、 Language: this model provide user two languages, “简体中文”and “English”. Select desired language and save by pressing **SEL**.
- 6、 BackLight: turn on/off the background light by pressing **SEL**.

Transfer Data

Select “Transfer Data” and enter. Then operate the software installed on the PC and upload the data through the Data Cable. Detailed instructions can be found in the Disc.

Notice

*1. EDG is a kind of instrument based on electromagnetic measurement. The measuring energy present when using EDG is less than one tenth of that when you are using a cell phone. There is no nuclear radiation and it is absolutely safe!

*2.EDG itself cannot measure the density and moisture content directly and need to associate physical data with electronic data by creating the Soil Model. Therefore, EDG accuracy is dependent upon the accuracy of the calibration of the Soil Model, and the precision of the standard physical tests.

*3.When the measurement is conducting, a stable electromagnetic field is created between two soil darts and the strength of electromagnetic field is directly related to the distance between darts, which eventually effect the precision of measurement. Therefore, when driving the darts using hammer, try to keep the positions of darts and the hole on the template fixed and guarantee the darts are vertical to the ground to maximum extent.

*4. As the EDG memory space is limited, it is better to transfer the data to PC, form EXCEL file, save and conduct filing when the measurement is done each time. Press **DEL** to delete and clear the data in EDG.

Appendix 1: EDG Technical Specifications

EDG is packaged in a water-resistant enclosure and employs water resistant connectors, but it is not intended for use during rain.

EDG will operate correctly to an altitude of 10,000 ft

Wet Density Range: As found in typical compacted earth sites, with Dry Density Accuracy: Typically within 3% of standard physical tests

Moisture Content Range: As found in typical compacted earth sites, with Moisture Content Accuracy: Typically within 3% of standard test

Maximum RS-232 Cable Length: 100 cm ft.

Internal Power: 12V lead acid gel cell, 2000mAh capacity; Battery Time: about 24 hours

Ambient Temperature Range: a deg. C to 50 deg. C; Ambient Humidity Range: 5% to 90% non-condensing

EDG Console Weight:: 8kg

EDG Console Size: 300*260*140mm

Weight of EDG Accessories: about 3kg

Memory Capacity:

Soil Models: Approx. 30

Soil Tests per Job Site: 15

Job Sites: Approx. 70

Field Tests per Job Site: 80

Appendix 2: Recommended Physical Test Standards

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

A partial list of standards for testing materials by the United States that may be used when calibrating the EDG are 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 3: Soil Density

Soil Density Test is one of the three physical test indices, gravity, density and percent moisture. Combined with Percent Moisture and Soil Gravity, Soil Density can be used to calculate out six physical indices, Dry Density, Saturation Density, Buoyant Density, Pore Space Ratio, Porosity and Saturation. Soil Density measurement is required no matter in lab test, field investigation or construction quality control.

1、 Soil Wet Density ρ

$$\rho = \frac{m}{V}$$

In the formula:

ρ —Soil Wet Density (g/cm^3)

m —Total Mass of Wet Soil (g)

V —Volume of the Soil (cm^3)

Usually in the case of no special instructions, soil density refers to the Soil Wet Density. Therefore, the soil density is not soil particle density, and the soil particle density does not refer to the gravity of soil particle or soil. Although the density and gravity of the soil particle are the same on numerical value, the two bear different physical meanings. Density is a dimensional quantity while gravity is a non-dimensional quantity.

2、 ρ_d Soil Dry Density

$$\rho_d = \frac{m_s}{V}$$

In the formula:

ρ_d —— Soil Dry Density (g/cm^3)

m_s —— Mass of Dry Soil (Soil Particle) (g)

V —— Volume of the Soil (cm^3)

3、 Soil Saturation Density ρ_m

$$\rho_m = \frac{m_s + V_Y \rho_W}{V}$$

In the formula:

ρ_m —— Soil Saturation Density (g/cm^3)

m_s —— Mass of Dry Soil (Soil Particle) (g)

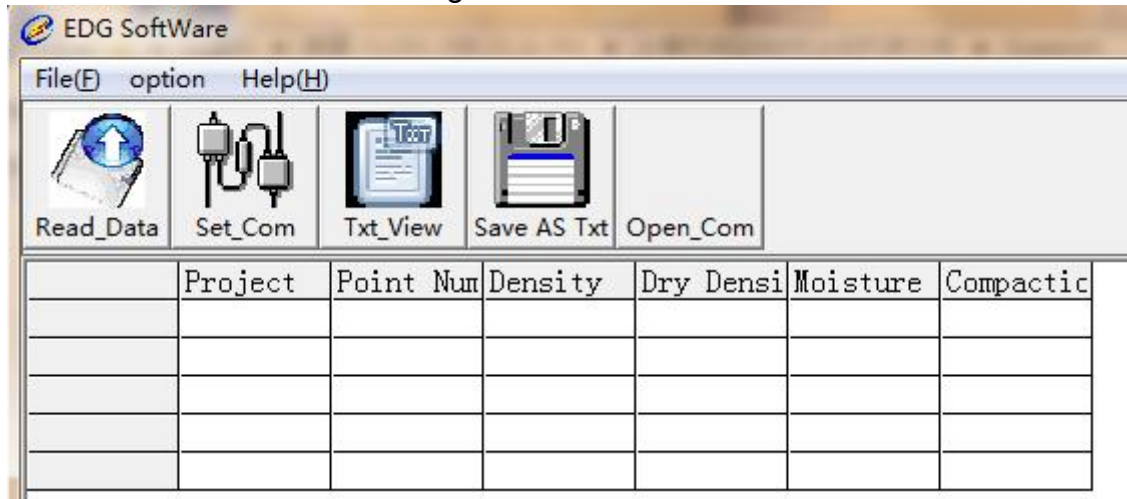
V_Y —— Volume of Soil Void (cm^3)

ρ_W —— Water Density (g/cm^3)

V —— Volume of the Soil (cm^3)

EDG Software Manual

- 1、 Brief Introduction: EDG Software will allow you to transfer data in EDG gauges to PC, and works in conjunction with Microsoft Excel or Word to present test data in Excel or Word format files, easy to read, print, filing, etc.
- 2、 Click “EDG Communication Drive System” stored in the disc and set it up first.
- 3、 Set up EDG software after installing drive system. Click Setup.exe inside the disc, and set up following suggested steps. Find the software in "Start Menu" and open it after installment. The following interface will show itself:



Data reading: can read testing data of Job Site inside EDG (Note: can only read measurement data of calibrated soil Model. Data can not be transferred to PC if the soil models are not calibrated in advance. Association of soil models are needed before uploading the data)

Port Setting: to set a port for communicating with EDG. This can be viewed in the following way.

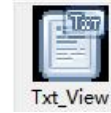


Click "OK" after setting up. You just need to set port once. Another setting of port is unnecessary thereafter.



Transfer test results inside EDG to PC by clicking "Data Reading" after setting up the port.

The interface shows as follows.(Note: the units of Wet Density and Dry Density both are g/cm3)



4、 TEXT VIEW enables to view the data directly in text format. Click the following interface will show itself:

| Project | Point Number | Density | Dry Density | Moisture Content | Compaction Degree |
|---------|--------------|---------|-------------|------------------|-------------------|
| J1234 | Test1 | 2.29 | 2.02 | 13.52% | 81% |

5、



allows to save measurement data in Excel format(Office software is required to install in advance). The action interface is as follows.

| | A | B | C | D | E | F | G |
|---|---------|--------------|---------|-------------|-----------------|-------------------|---|
| 1 | Project | Point Number | Density | Dry Density | Moisture Conten | Compaction Degree | |
| 2 | J1234 | | | | | | |
| 3 | | Test1 | 2.29 | 2.02 | 13.52% | 91% | |
| 4 | | | | | | | |
| 5 | | | | | | | |
| 6 | | | | | | | |

EDG Error Messages and Warnings

1. Error: No reaction after powering EDG on
Analysis: The battery voltage is too low
Method: The battery needs to be charged
2. Error: EDG shutdown after emit a beep when startup
Analysis: The battery voltage is too low
Method: The battery needs to be charged
3. Error: The bottom of the screen prompts "Can Not Connect Soil Interface! "
Analysis: a) The Soil Probe maybe disconnected
b) Probe cable maybe damaged
c) Probe maybe damaged
Method:
a) Connect the Soil Probe

b) Check whether the probe cable has a broken place. If there is a broken place, please use after soldering, or return to factory repair, or replace the probe cable.

c) Replace the probe

4. Error: Temperature is displayed as "---", with the bottom tipping "No Temperature! "

Analysis: a) The Temperature Probe maybe disconnected

b) Probe maybe damaged

Method:

a) Connect the Temperature Probe

b) Replace the probe

5. Error: No option of "Create a New Test Spot " when conducting Soil Model test

Analysis: The Temperature Probe is disconnected

Method:

Connect the Temperature Probe

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

6.

Error: Association of the Soil Model fails

Analysis: a) There is no created soil model

b) The physical data has not been entered into the EDG unit

c) The fit number of the soil model is too small

Method:

a) Create the Soil Model (Only by creating a qualified soil model before you can normally associate the soil model)

b) Input the physical data into the EDG unit

c) If $\text{fit} < 0.6$, please check if there is a problem with the method of creating the Soil Model, if the measurement results of Wet density, Moisture Content and Percent Compaction gained from laboratory test deviate too much from the normal value.

Note: If the association still can not be done even qualified Soil Model has been created, please associate the Soil Model repeatedly as the computation is intensive when creating the Soil Model and fast operation may fail.)

7. Error: Cannot view measurement results

Analysis: No associated Soil Model

Method: Refer to method for Error 6

Packing List

| No. | Name | |
|-----|-------------------------------|---|
| 1 | EDG Unit | 1 |
| 2 | Soil Sensor | 1 |
| 3 | Soil Darts | 4 |
| 4 | Temperature Probe connector | 1 |
| 5 | HDB—4S Hammer | 1 |
| 6 | Soil Darts Connection Cable | 2 |
| 7 | Battery Charger | 1 |
| 8 | Charging Connector(USB Cable) | 1 |
| 9 | Soil Sensor Cable | 1 |
| 10 | Soil Template | 1 |
| 11 | User Manual | 1 |
| 12 | Disc | 1 |
| 13 | Packing Box | 1 |
| 14 | Certificate | 1 |

After you open the package, check the contents of the delivery carefully against the packing list supplied. Report any missing components or damage to the local representative.



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