product manual 02.25

H-6500.3F

Electrical Density Gauge

HUMBOLDT

EDGe

Testing Equipment For Construction Materials

HUMBOLDT

Introduction 5
EDG App 7
Accessories. 7
Laboratory Unit 8
Field Unit. 10
Set up 12
Lab Testing 13
Field Testing 27
Appendix A — Menu Tab Review 39
Main Navigation — Proctor Data Tab 39
    Selected Proctor Data Project Actions 41
Main Navigation — Field Sites Tab 44
    Field Sites Actions 44
    Selected Proctor Data Project Actions 45
Main Navigation — Utilities Tab 47
    Utilities Tab — Top Portion 47
    Utilities Tab — Lower Portion 47
    Utilities Tab — Device Information 48
    Utilities Tab — Preferences 49
        Global Preferences 49
        General. 49
        GPS 50
        Other. 50
Proctor Optimization (Default). 50
Proctor Selection 50
Preferences – Selected Proctor 50
Utilities Tab — Advanced 51
    Update 51
    Tools 51
Main Navigation — About Tab. 51

Introduction

Humboldt's New Electrical Density Gauge Model E (EDGe) is used for determining the density and moisture content of aggregate, soil aggregate compacted type I or II base, or native soil materials that are suitable for shallow foundations, such as secondary roads or base aggregate that is compacted in-place prior to the asphalt or concrete placement at the final grade. The EDGe quality assurance / quality control (QA/QC) system is lightweight, easy to use, and nuclear free.

The EDGe system requires both the lab unit and the field unit to complete the testing process, which can be purchased by purchasing the EDGe Starter Unit, H-6500.3F. These two separate units work together in conjunction with the Microsoft app to ensure precise and accurate measurements. The lab unit correlates the Proctor test data of a representative aggregate/soil sample, while the field unit provides corresponding readings of the same material in real-world conditions. Both units are essential—without them, the test cannot be completed. You can purchase additional units to run multiple tests at the same time see below for more info.

The lab unit provides you with the tools to take readings directly from six-inch Proctor molds, while performing standard or modified Proctor tests. The field unit is lightweight and comes with a carrying case for easy transport and storage. Both units are nuclear free, which eliminates the need for radiation safety compliance regimens and transportation restrictions. The EDGe is simple to use.

EDGe Complete Unit - H-6500.3F

Description	Qty	Part #
EDGe Lab Unit	1	H-6500L.3F

Description	Qty	Part #
EDGe Field Unit	1	H-6500F.3F

The advantages of using the EDGe are:

- Complies with AASHTO TP112 and is an enhancement of ASTM D7698 that includes a laboratory aggregate calibration procedure
- Nuclear-free device
- Accurate and repeatable results that correlate to either ASTM D1557 or ASTM D698 standard Proctor tests
- Does not require highly trained or licensed technicians
- Does not require special handling for shipping or regulatory compliance for hazardous materials
- Easy-to-learn and easy-to-use with its step-by-step menu
- Lightweight and easily transportable
- Eliminates costs associated with nuclear gauges

EDGe Sensor Electrical Specifications:

Description	
Sensor RF Output Signal:	<1 Vpp or 354 mV RMS
Maximum Sensor RF Output Power:	<0.32 mW
Frequency Range:	10 kHz – 40 MHz
Internal Batteries:	3 x AAA NiMH, Rechargeable
Charging Voltage:	7.5 V – 9 V DC
Charging Current:	500 mA
Maximum Charging Time:	2 hours
Charging Indicator:	Green LED
Battery Life:	Approx. 40 Tests

EDGe App

The EDGe App is available free from the Microsoft App Store. This app allows you to operate both the Lab and Field units of the EDGe, as well as provides the field unit with the lab Proctor data. In the field, the app will record dry density, wet density, percent moisture content, relative compaction, date; time, GPS coordinates and generate a location map. This data is routinely used for construction QA/QC certification reporting. The app can generate the reports in a PDF format, which can be saved or shared with others.

EDGe Software Features:

- Download job data
- Save and share customized reports in PDF format
- Operate both the Lab and Field Unit
- Provide the Field Unit with Proctor Data
- Time/Date, GPS stamps for each test
- Generate a location map
- **Computer/Tablet Required But Not Included**

Recommended Computers:

- Laboratory Use: Any Windows 10 Laptop or Tablet with Bluetooth® LE 4.0 or higher (e.g. MS Surface Pro or MS Surface Go 3)
- Field Use: MS Surface Go 3 Tablet with Ruggedized Shell with Bluetooth® LE 4.0 or higher (recommended: Urban Armor Gear Shell & Screen Shield for Surface Go 3)
- Microsoft compatible pen for laboratory and field use, optional mouse for laboratory use.
- A keyboard is recommended for laboratory use

Accessories:

4" Dart— H-4114.4
6" Dart— H-4114.6
8" Dart— H-4114.8
10" Dart— H-4114.10
12" Dart— H-4114.12

4" Proctor Center Dart - H-6500.6

Darts are designed in various lengths to correspond to different lift heights. They can be sold individually.

Laboratory Unit

The laboratory aggregate calibration procedure involves electrical testing of a representative sample of the construction aggregate or soil materials while performing either an ASTM D1557 Standard Test Method for Laboratory Compaction using a Modified Effort of 56,000 ft-lbf/cubic foot or the ASTM D698 Standard Test Method for Laboratory Compaction using a Standard Effort of 12,000 ft-lbf/cubic.

During the laboratory test, the EDGe lab-sensor and a Windows 10 laptop or tablet are used to collect and manage the physical and electrical data during the Proctor test. The software generates a Proctor curve that displays the maximum dry density at the calculated optimum moisture content and is saved and typically printed for client reports. The empirically derived correlations relate the electrical and physical properties of the aggregate or soil that is scheduled for placement and compaction on construction project sites, such as road construction or other shallow foundation. The physical and electrical data from the Proctor test is saved on the laboratory laptop computer. This data can then be transferred to a ruggedized field Windows 10 tablet by USB stick, a cloud service, or via wireless connection for use with the EDGe field equipment for quality assurance/quality control (QA/QC) testing and construction quality certification.

The EDGe laboratory unit

EDGe Lab Unit - H-6500L.3F

Description	Item #	Qty
Soil Sensor, Lab Version	H-6500.500	1
Temperature Probe	H-6500.700	1
Temperature Probe Spike	H-4114.040	1
Proctor Center Dart, 4"	H-6500.6	1
Lab Dart Adapter	H-6500.550	1
Hammer	H-4890A	1
Dart Seating Tool	H-6500.8	1
HDPE Proctor Mold Base	H-6500.7	1
AC/DC Wall Mount Adapter (Charger)	H-6500.02	1

Requires Windows computer or tablet, which is not supplied.

Field Unit

The EDGe field unit is a portable, battery-powered instrument capable of being used anywhere without the concerns and regulations associated with nuclear devices. It uses a lightweight, carrying case for easy transport and storage. Just grab the case and you're off to your testing site.

During the field quality assurance/quality control testing, the EDGe field-sensor and a ruggedized Windows 10 tablet or computer manages the project data. The EDGe field hardware is used along with the EDGe field sensor and a tablet to test the density and moisture of the construction materials. In the field, the EDGe measures the electrical properties of the aggregate and calculates physical properties by utilizing the established relationship of the electrical and physical characteristics from the Proctor calibration test of the same aggregate performed in the laboratory. Field tests take a few minutes to perform, and the material properties are displayed in real-time, as well as being saved for reports. The EDGe field reports provide the user and/or client with quality assurance/quality control data that includes the compacted material dry density, wet density, the percent moisture content, relative compaction, date, time, GPS coordinates and a location map. The client reports can include additional project information such as the project name and number, the EDGe field sensor's unique identification number, the EDGe operator's name, the company name, and other information in the remarks section, such weather conditions, if needed.

Tablet not included.

The EDGe field unit

EDGe Field Unit - H-6500F.3F

Description	Item #	Qty
Soil Sensor, Field Version	H-6500.100	1
Temperature Probe	H-6500.700	1
Temperature Probe Spike	H-4114.040	1
Case	H-6500.800	1
Field Dart Template	H-6500.200	1
6" Field Darts	H-4114.6	4
Field Dart Adapter	H-6500.300	1
Hammer	H-4890A	1
AC/DC Wall Mount Adapter (Charger)	H-6500.02	1

Requires Windows computer or tablet, which is not supplied.

Set-Up

After ensuring all parts are present and undamaged, charge the Lab Laptop and Field Tablet, as well as the EDGe Field sensor and Lab sensor. Charging takes 2 hours and ensure all devices are fully charged before use. When under 20% battery, a red LED will blink. Ensure that the EDGe is registered with Humboldt.

If you use a new Windows 10 laptop and/or tablet, you need to create a user account with login and password, and then you need to register your account with Microsoft to access the Microsoft store. You may want to also purchase a license for Microsoft Office, although this is not required to run the EDG-E application software.

On the Windows 10 laptop, go to the Windows icon and open the Microsoft Store. Search any of these terms: Electrical Density Gauge; EDG; EDGe; Electrical Gauge, or Humboldt,and press enter. Click the icon as shown and the app will download. After it is installed, a popup window will appear reading “this product is installed.” You should now be ready to begin the lab testing regimen.

In the lab, determine and record the mass of each six inch proctor mold and base plate without the collar or soil — then assemble and secure each mold and collar to the base plate.

The lab technician will be performing either an ASTM D1557 Standard Test Method for Laboratory Compaction using a Modified Effort of 56,000 cubic foot pounds force or the ASTM D698 Standard Test Method for Laboratory Compaction using a Standard Effort of 12,000 cubic foot pounds force. Refer to the ASTM specifications for specific instructions.

Lab Testing with the EDGe Lab Unit

The EDGe uses proctor data, determined in the lab to provide accurate readings in the field. Here you can see the results of the lab tests and the proctor curve that is generated. This data is then transferred to the field unit. This allows the field unit to link the proctor data, such as maximum dry density, optimum moisture and percent of optimum dry density to the field tests.

The collection of the base material that will be tested in the lab is the most important step in using the EDGe. The sample must be representative of the materials that will be field tested. The field technician should follow ASTM D75 / D75M-19 Standard Practice for Sampling Aggregates when collecting the representative field sample from a road base, subbase or stockpiles.

The proctor test will consist of preparing and compacting 5 to 6 proctor molds containing soil at progressively higher moisture contents. It is best if three of the five proctor points are performed below the optimum moisture content and two of the five proctor points are performed over the material optimum moisture content.

The technician will need to check the project specification to identify the correct proctor method is used for the laboratory procedure. If no proctor method is specified, the most common proctor used is ASTM D1557. For the EDGe the proctor tests are performed using a six-inch diameter proctor mold.

To begin, determine and record the mass of each six-inch proctor mold and base plate without the collar or soil. Then, assemble and secure each mold and collar to a base plate. You can use either proctor – ASTM D698– or modified proctor – ASTM D1557 molds for this purpose.

The lab technician will be performing either an ASTM D1557 Standard Test Method for Laboratory Compaction using a Modified Effort of 56,000 cubic foot pounds force or the ASTM D698 Standard Test Method for Laboratory Compaction using a Standard Effort of 12,000 cubic foot pounds force.

The technician using the EDGe will need to check the project specification that will identify the proctor method for the laboratory procedure. If no proctor method is specified, the most common proctor used is the Modified test under ASTM D1557. For the EDGe the proctor tests are performed using the six-inch diameter proctor mold.

You are now ready to fill the molds with the soil per the ASTM specification. Generally you will be producing 5 to 6 molds with the representative soil you collected. These molds will use soil of varying moisture levels with which to build the Proctor curve.

Make sure the moisture conditioned soil is well mixed and left over night so that the moisture is evenly distributed throughout the sample and the soil electrolytes are in equilibrium.

IMPORTANT: We strongly recommend using only distilled or purified water, since tap water loaded with electrolytes may skew the laboratory soil calibration. At least three soil test points should have moistures that are below optimum moisture. This is a requirement to properly calibrate the electrical parameters of the soil for the field tests.

Once these molds have been produced, One at a time, remove the collar and carefully trim the excess compacted material above the mold by scraping a straightedge across the top of the mold to form a plane surface.

Then, using a scale – weigh the specimen mold and base plate to determine the mass within the nearest gram.

Next, take the sample mold and base plate and set it on a stable surface. Take the white HDPE base plate supplied with the EDG Lab Kit and place it on top of the mold.

Take the steel dart from the Lab Kit and with the supplied hammer, pound it into the center of the sample using the hole in the center of the HDPE base plate as a guide.

Remove the HDPE base plate and make sure to pound the dart into the sample so that the shoulder of the dart is flush with the surface.

Then, taking the dart seating tool, place it over the dart, and with the hammer, strike the seating tool one time to ensure the electrode makes excellent contact with the material being tested to allow for the best electrical measurements possible. This is a critical step in the lab testing practice.

Next, using the t-handle probe and the hammer, drive the probe into the soil. This will be used to insert the temperature probe later.

Now, take the HDPE base plate, turn it over and place the proctor mold into the round recessed area.

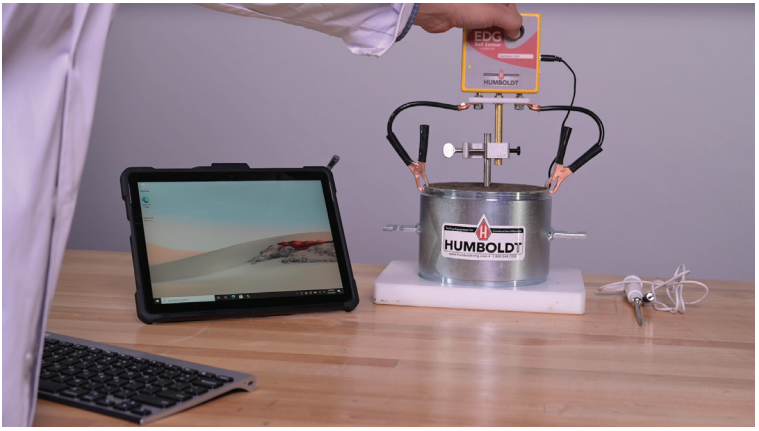
Take the proctor lab sensor and attach it to the mounting device. Attach the combined device to the dart.

Attach the two wired clips to the rim of the proctor mold.

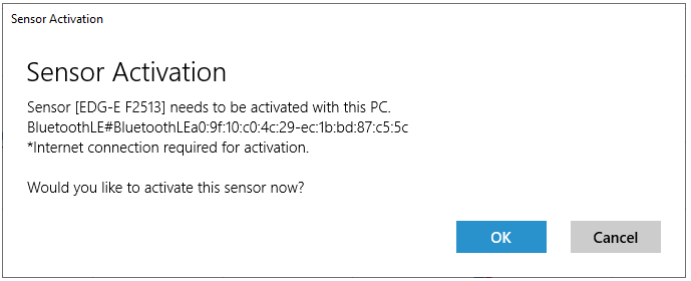
Plug the power cord into the side of the EDGe lab sensor

You should now be ready to work from the EDG App. If you haven't already — you should download it from the Microsoft App store. https://www.microsoft.com/en-us/store/apps/windows

Turn on the EDGe Lab Sensor by holding the button down until the blinking green light appears

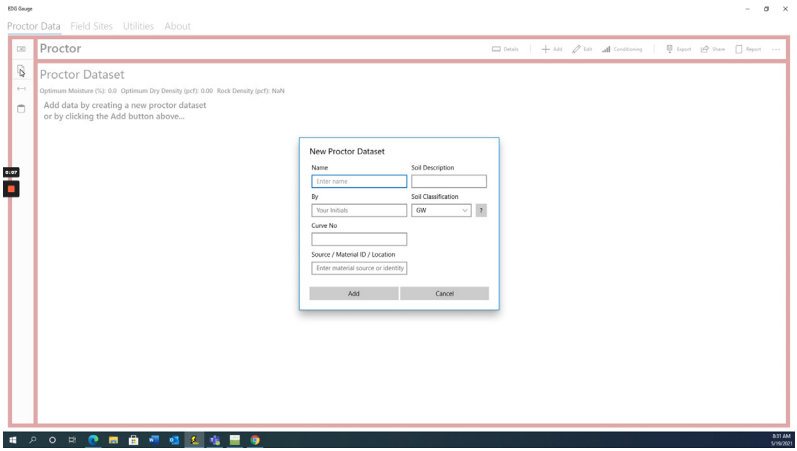


Start the app, if you haven't already activated the EDGe Lab unit sensor the application will detect the unactivated sensor automatically and will display the following prompts.

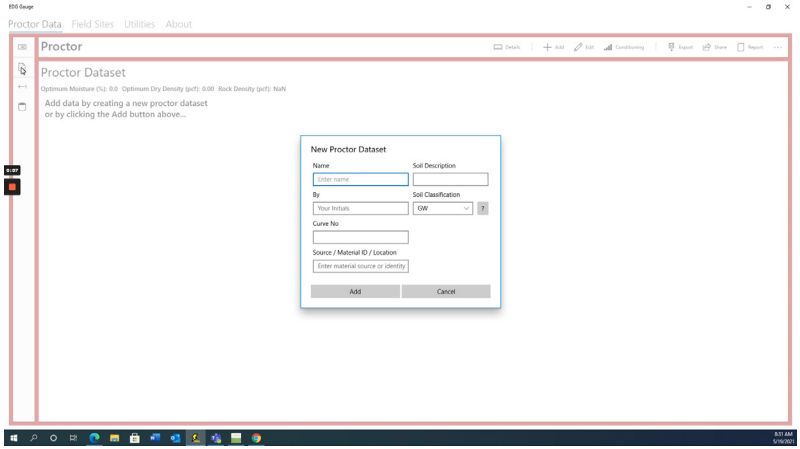


Main Navigation — Proctor Data

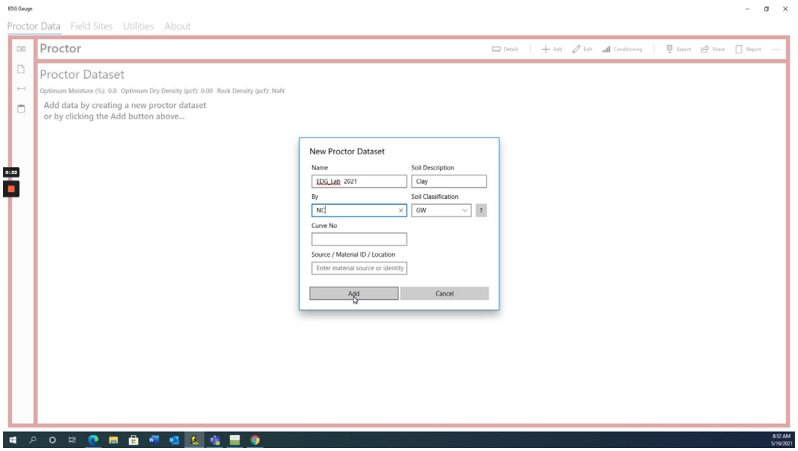
Click on the blank file icon on the left to create a new Proctor data set. A Proctor data set window will appear. Give the data set a name and provide a soil description.



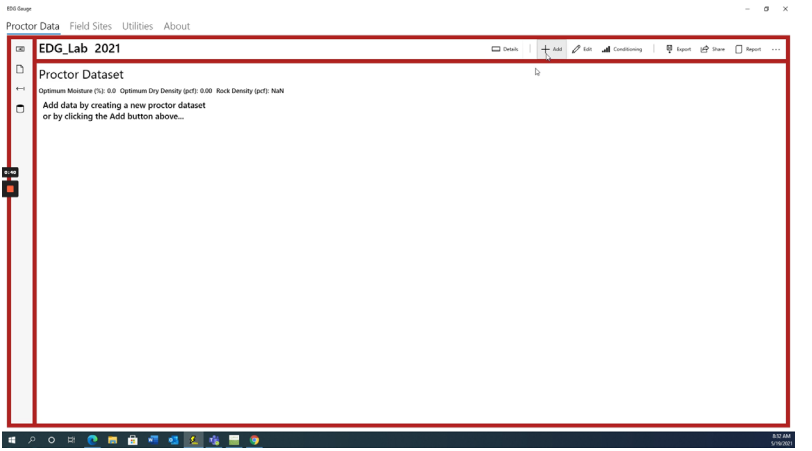
You can fill in a name for the lab technician, soil classification, refer to a curve number; and add information for material source, material ID or a location.



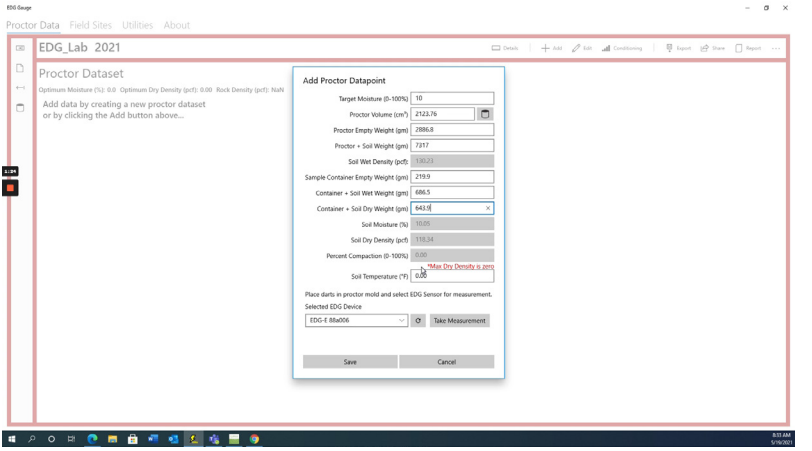
Then click the add button.



Click the add button in the Nav and the Add Proctor Data point window will appear.

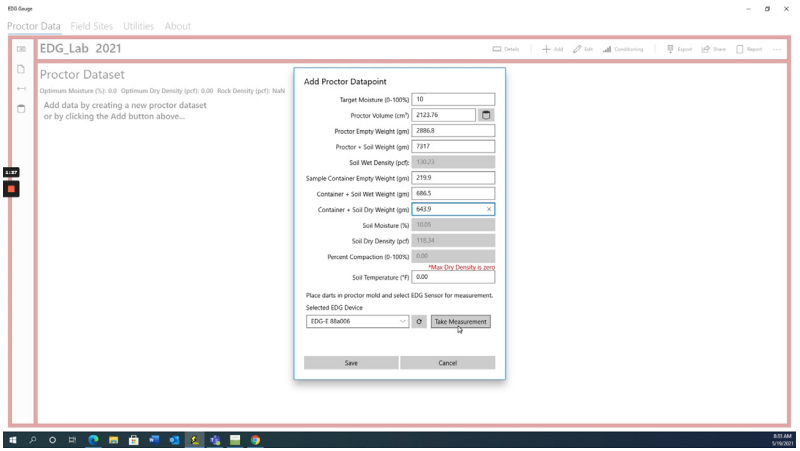


Fill in the appropriate information in the fields. This information includes: target moisture percentage, proctor volume, proctor mold empty weight, sample container empty weight, container plus soil wet weight, and container plus soil dry weight.

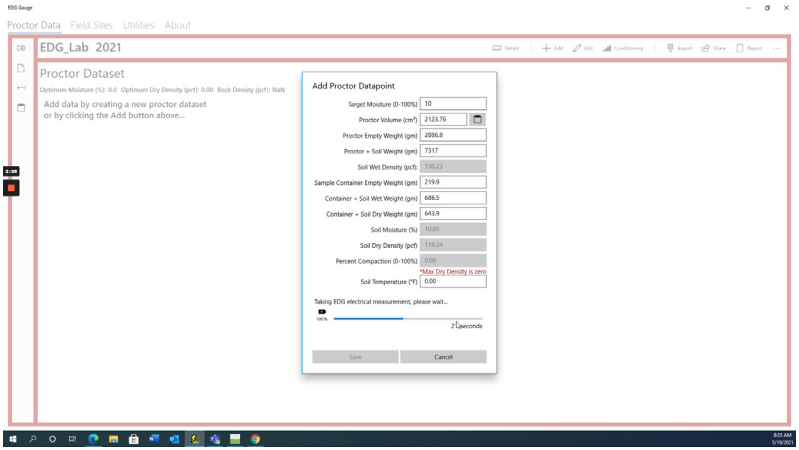


As you fill in this data you will see the app calculate the numbers for soil wet density, as well as soil moisture percentage, soil dry density and percentage compaction.

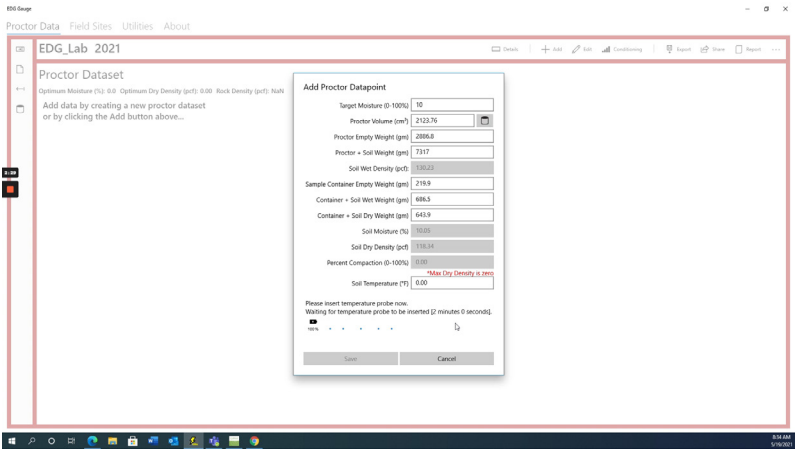
Now you are ready to take your first reading from a proctor sample. Check to make sure the Correct EDG Device is chosen — and click the Take Measurement button to obtain a reading.



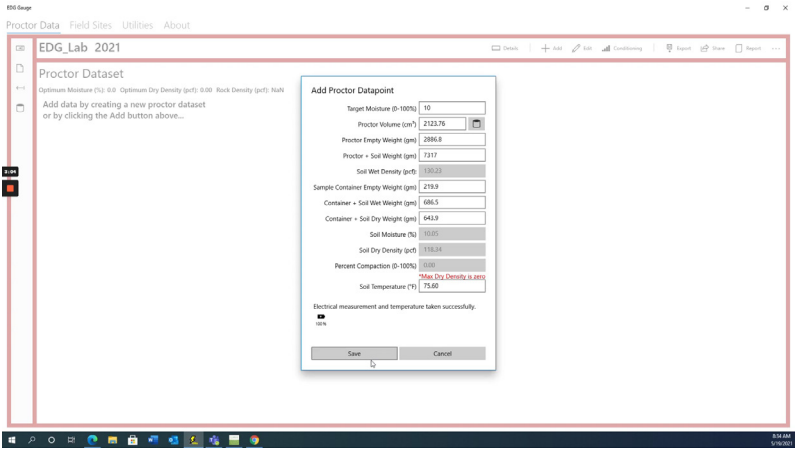
The EDGe will begin to take a reading from the Proctor mold.



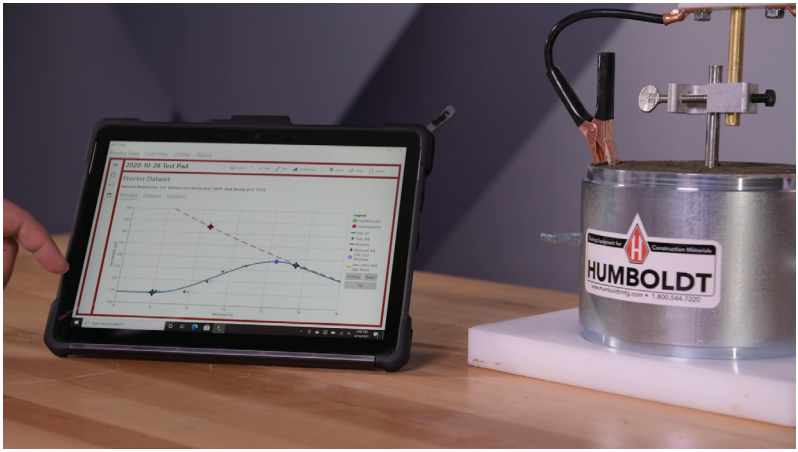
When prompted, insert the thermometer into the hole you created previously to get a temperature reading.



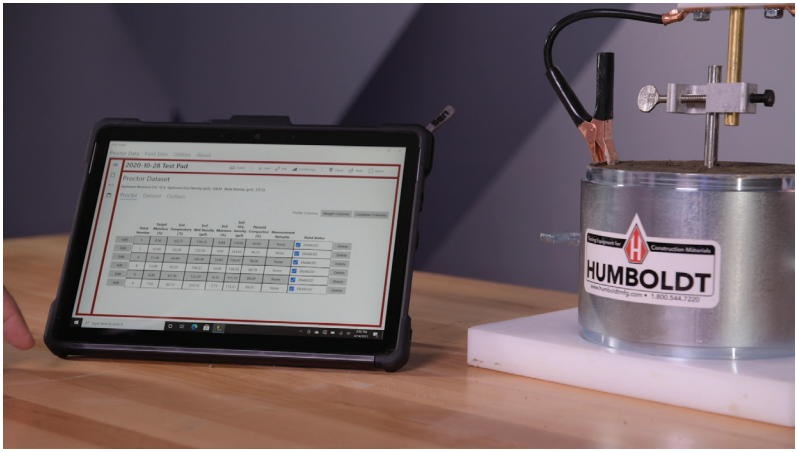
The EDG will record the temperature and display it in the soil temperature field. Once complete, you will see that the Electrical measurement and temperature taken successfully message. At this point save your data point and prepare for the next proctor measurement.



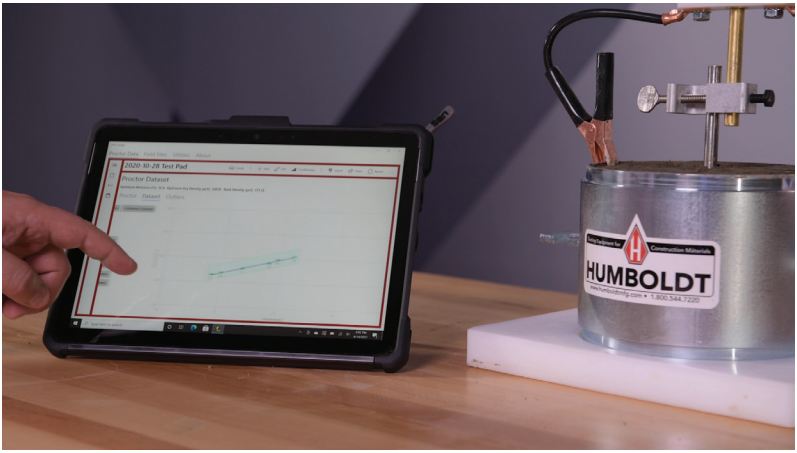
Once all your proctor measurements have been taken, the EDG app will display them in a proctor curve. You can view this curve by selecting Proctor from the menu bar.



By clicking Data Set you will see a table of each point in the data set, and its attributes.



By clicking Outliers, you will see a simple graph depicting the data points along the expected linear line for good data quality. This graph easily depicts any outliers. If any of the points is a gross outlier (orange color), it is likely due to poor electrical contact of the dart with the compacted soil, and this proctor point should be repeated. The outlier point can be deleted,or simply disabled, under ‘Dataset’ tab and the proctor for that moisture point can be repeated.



The lab testing is now complete. The completed proctor data set needs to be transferred to the Tablet or PC that will be used for field tests. This can be done via a USB thumb drive.

To perform a typical EDG field test, first, lay the yellow electrode template on the ground, and proceed to hammer the four electrodes into their appropriate positions on the template.

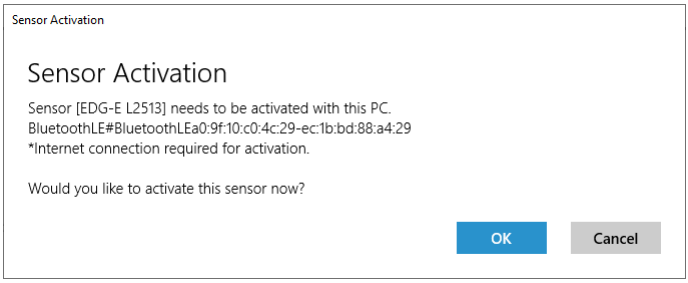
When hammering the electrodes into the soil, make sure to maintain a tight fit between the soil and the dart. Do not hit the dart from the side, as this may cause a loose fit and produce inaccurate readings.

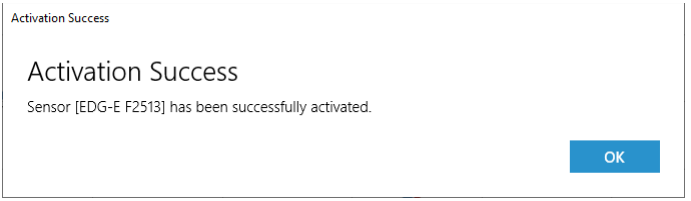
Next, connect the field sensor to the field dart assembly and attach them to the center electrode. Be careful not to loosen or dislodge the center electrode when doing this.

In line with one of the three outer electrodes, make a hole for the temperature sensor, using the t-handle probe. This hole should be about three inches in depth. Then, Insert the sensor into this hole and plug the temperature cable into its input on the field unit. Try to keep the cable up off the ground to ensure better readings during testing.

Attach the electrode clamps to the three outer electrodes and turn the EDG unit on.

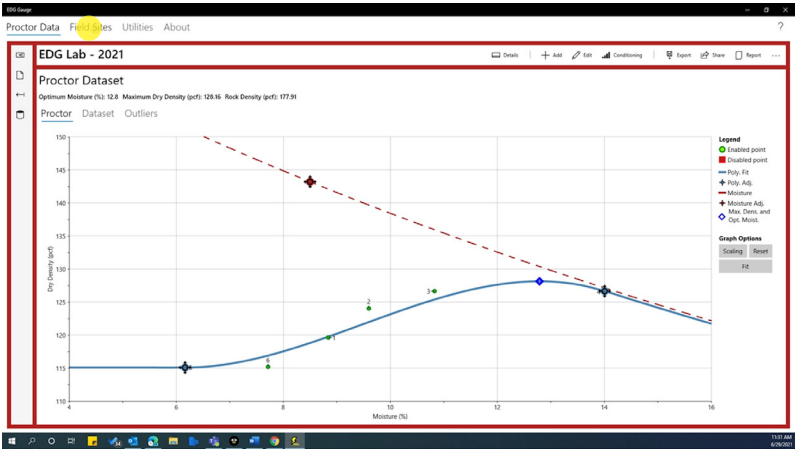
To begin to set up a test, take your tablet or laptop and open the EDG application you've downloaded from the Microsoft App store. Start the app, if you haven't already activated the EDGe Field unit sensor the application will detect the unactivated sensor automatically and will display the following prompts.



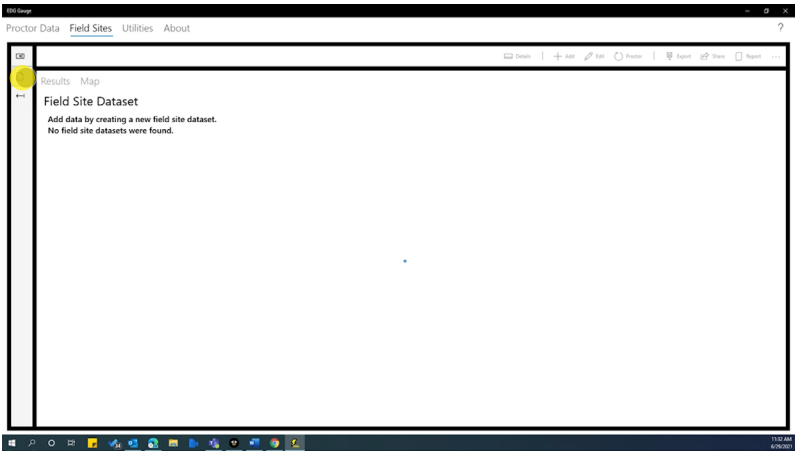


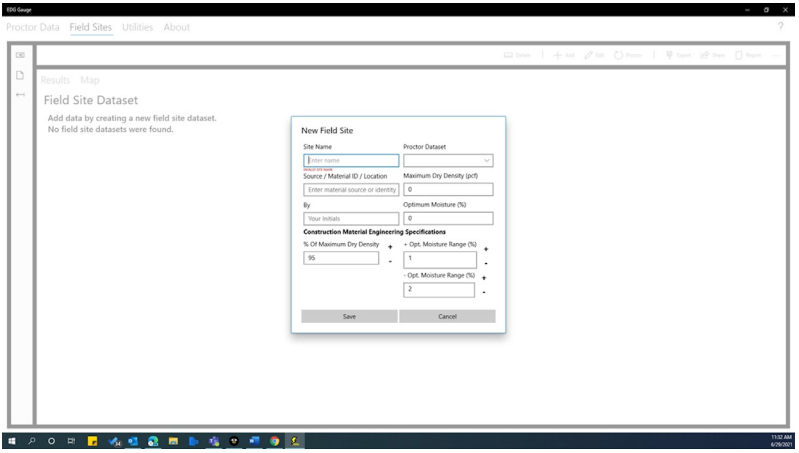
Main Navigation — Field Sites Tab

To start a field test, click on the field sites tab at the top of the window.

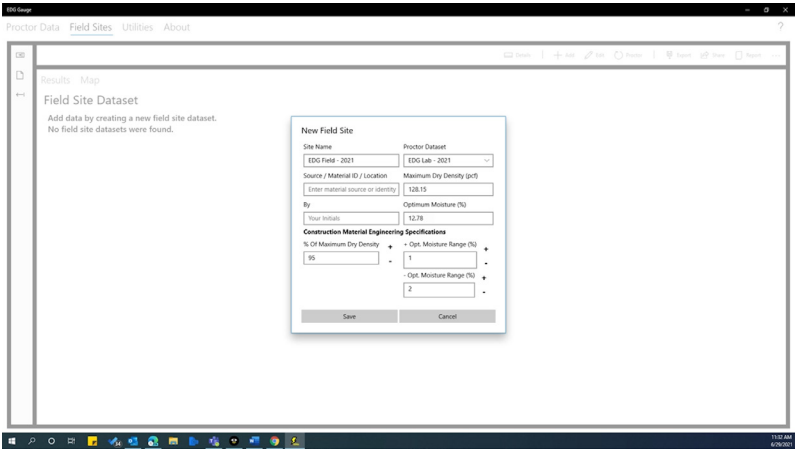


You will see a blank Field Site Dataset page. Click on the file icon at the left. This will bring up a New Field Site form.





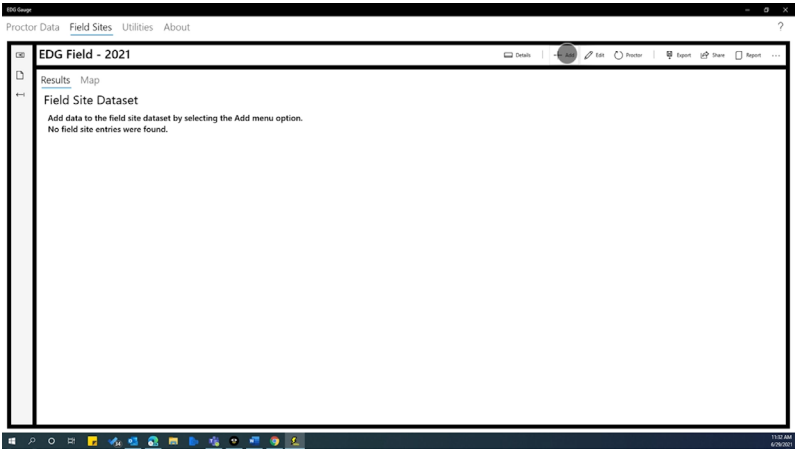
Give the new test site a name. Then click on the Proctor dataset field and choose the appropriate Proctor lab test from the pop-up menu.



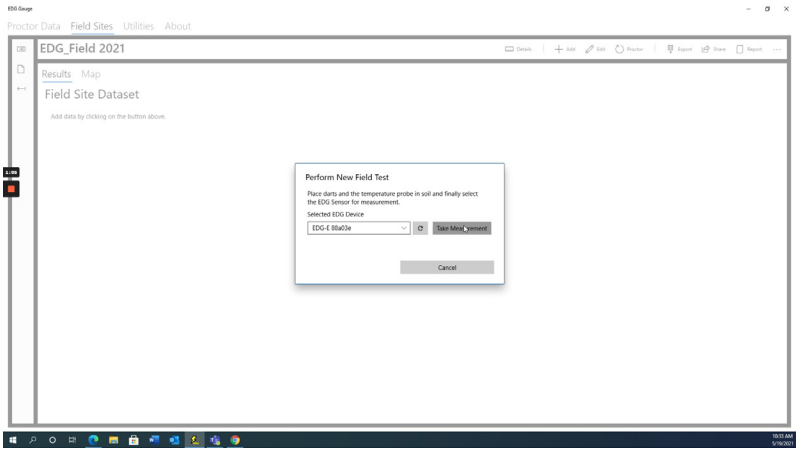
This links the proctor lab test data to this field test and the program will populate the maximum dry density, optimum moisture and the project specifications for percent of Dry Density to achieve a quality assurance — quality control passing test specifications.

On this window, you will also be able to set the acceptable range of moisture percentage for the test.

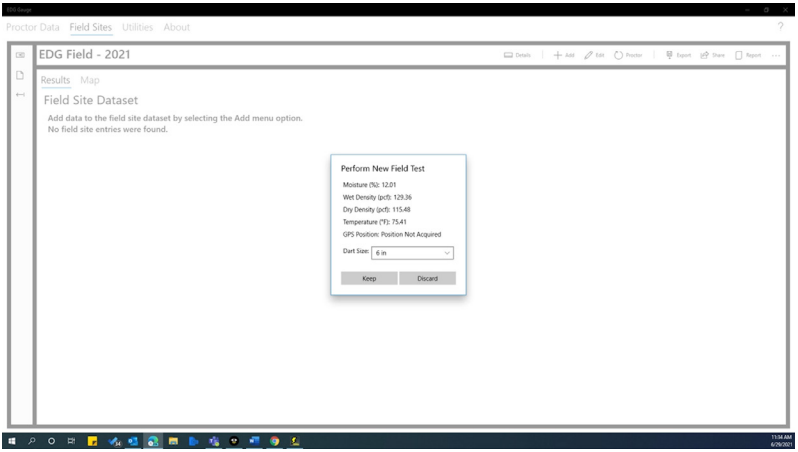
Click on the Save button, which will set the testing parameters for all tests assigned to this field site. Next, Click on the Add button and the Perform New Field Test window will appear.



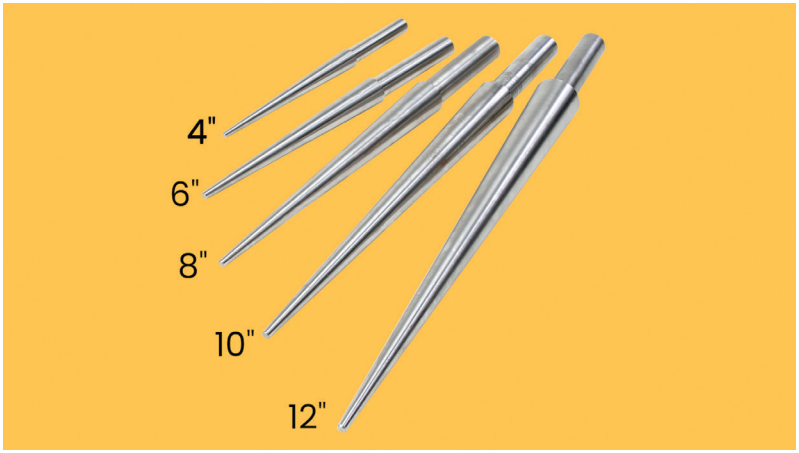
The EDG will take a few seconds to link to the Correct EDG device. Click on the Take Measurement button. The EDG will begin to take a reading. This may take a few seconds.



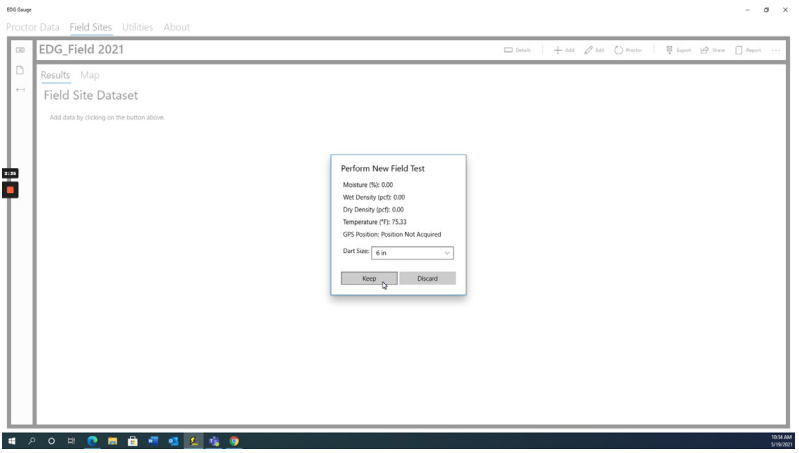
When complete, the EDG will provide a window showing the results of the test. It will list percent moisture, wet density, dry density, temperature, GPS position and the dart size.



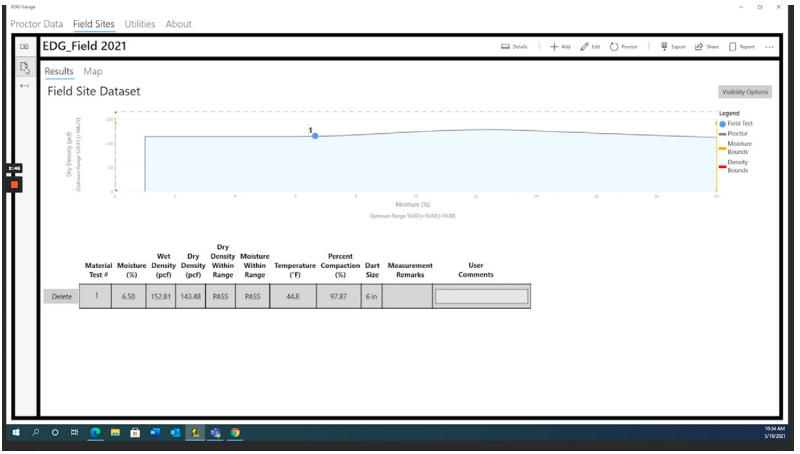
Be sure to fill in the correct dart size you used in your field test. Dart sizes are available in four, six, eight, ten and twelve inch to match the compacted aggregate lift thickness.



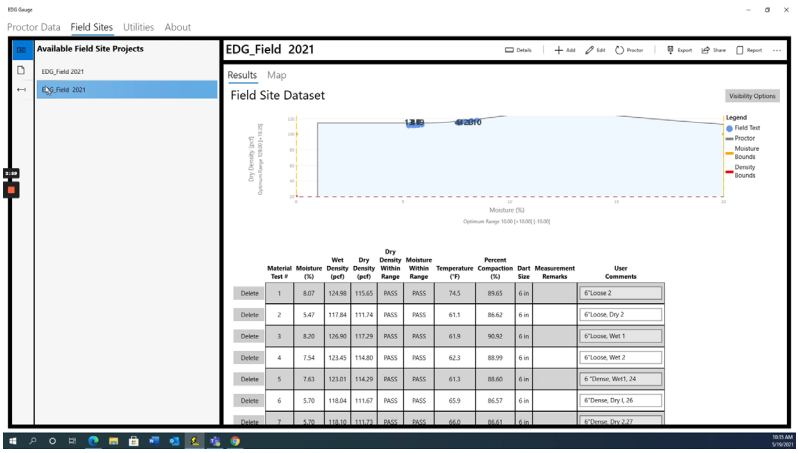
Then, if you are satisfied with the results, click the Keep button and the EDG will save the info to this data set. Other wise you can discard the test.



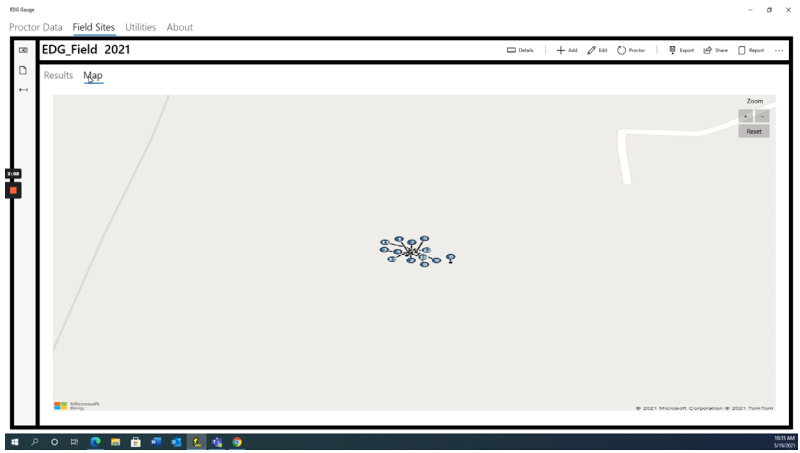
After clicking the Keep button, the EDG program will switch to the results page, which will show the results of your test in a chart and locate the test point on the dry density moisture graph.



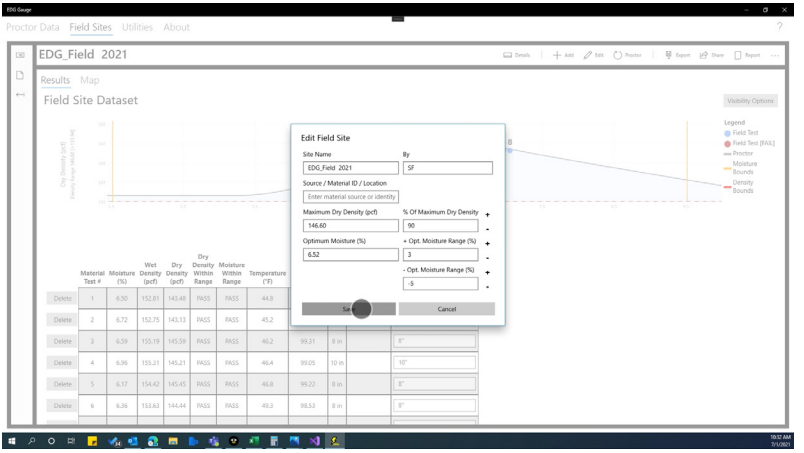
As you do more tests, the results will add to the chart and graph. This allows you to monitor, as well as keep track of all tests within the field data set.



By clicking on the Map tab, you will see all the test locations for the field site.

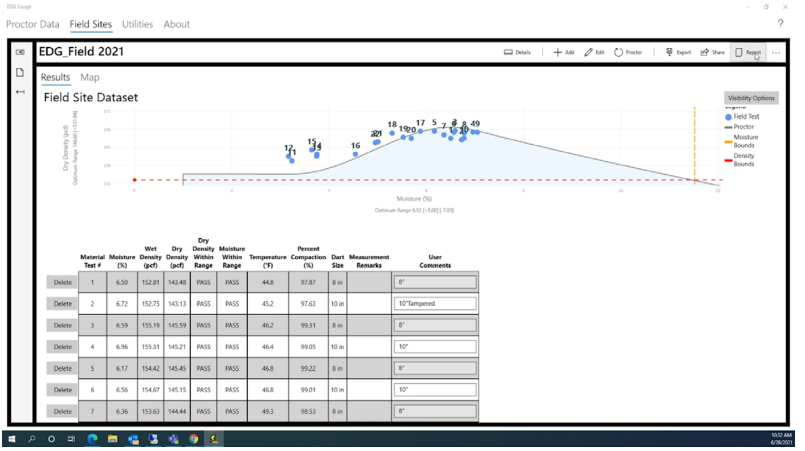


By clicking back to the Results page, and clicking the Edit button at the top, you will be able to edit project specification information.

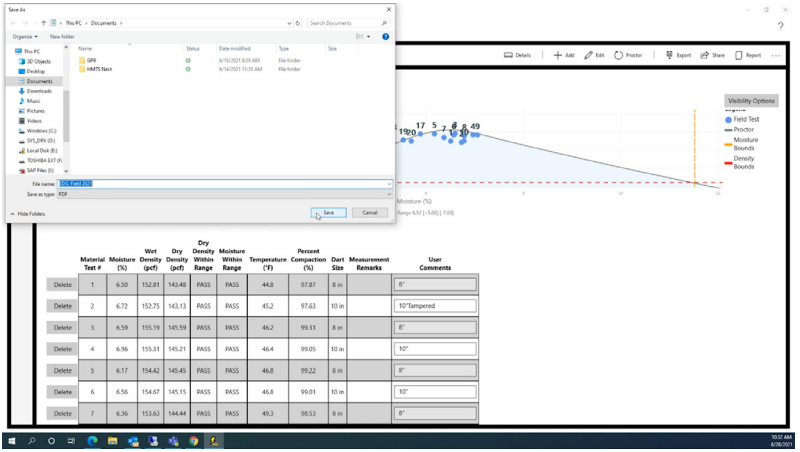


Once your changes are made — click the Save button to save your changes.

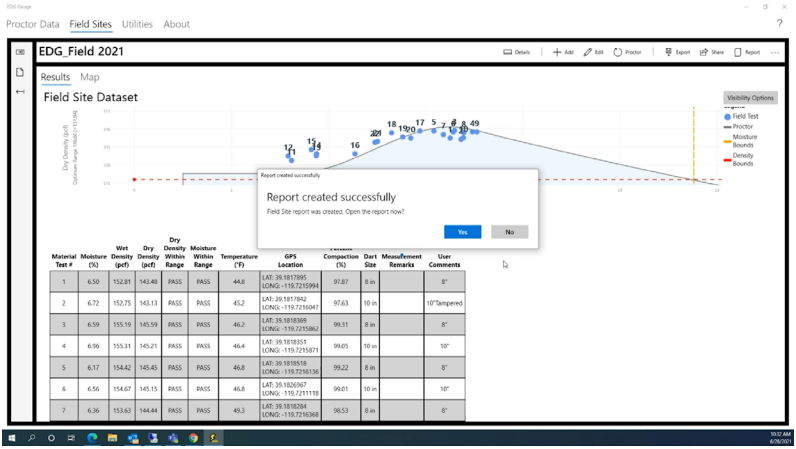
To generate a report of all the data, click on the report icon at the top of the window.



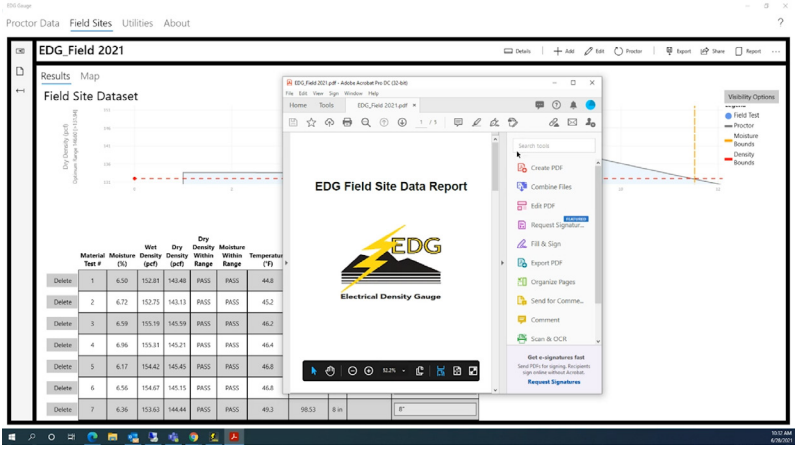
A window will pop up where you can tell the program where to save the report, while also allowing you to name the file and decide what format to save it as.



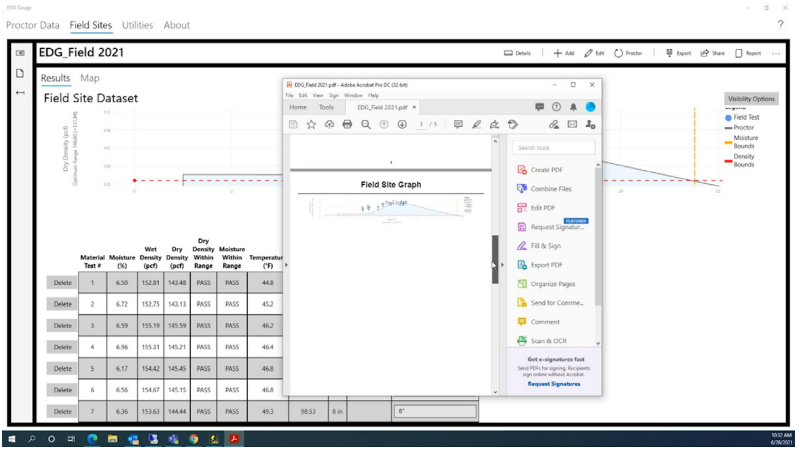
Here it has been saved as a PDF.



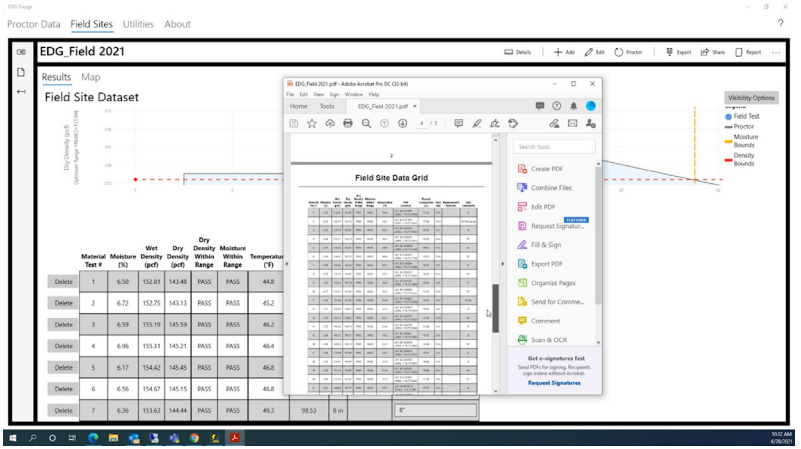
Report created successfully window.



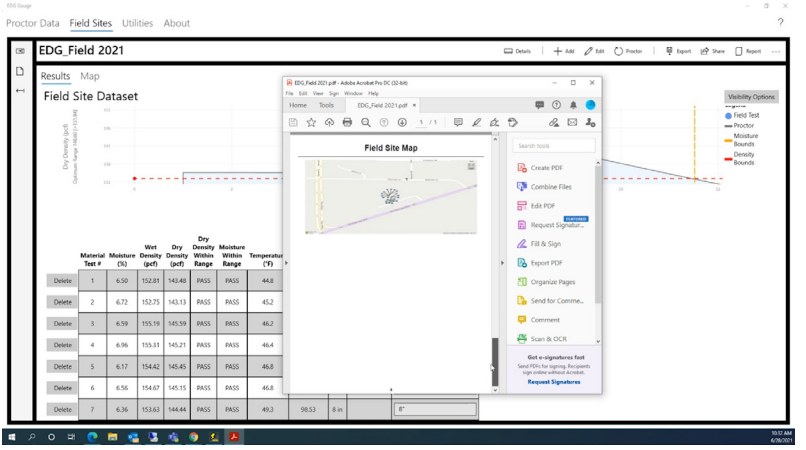
Completed PDF Data Report



Field Site Graph from Field Site Data Report



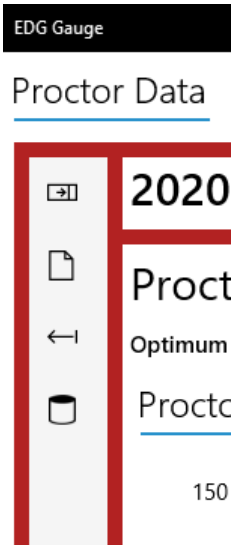
Field Site Data Grid from Field Site Data Report



 Field Site Map from Field Site Data Report

Appendix A — Menu Tab Review

Main Navigation — Proctor Data Tab



Proctor Data Projects – Click to expand/ collapse list of Proctor Data Projects.

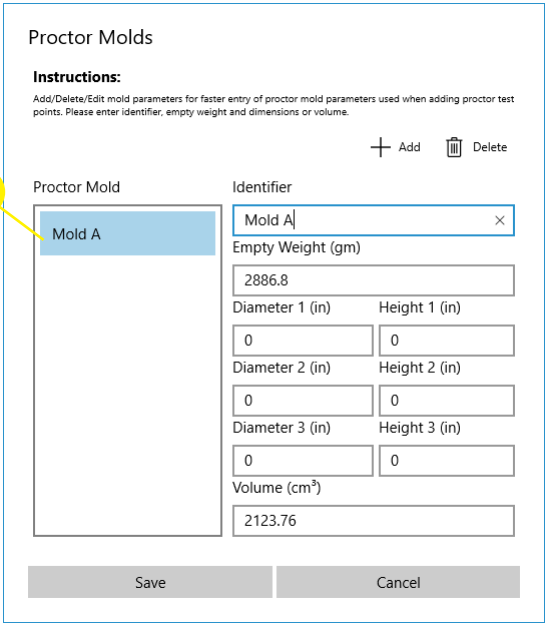
Create a new Proctor Data project.

Import a Proctor Data project.

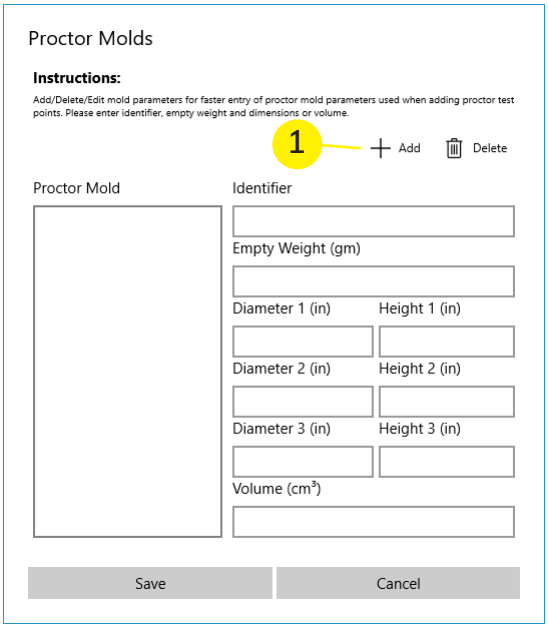
Add/Modify/Delete/Save Proctor Mold parameters. See section on Proctor Molds below.

Proctor Molds

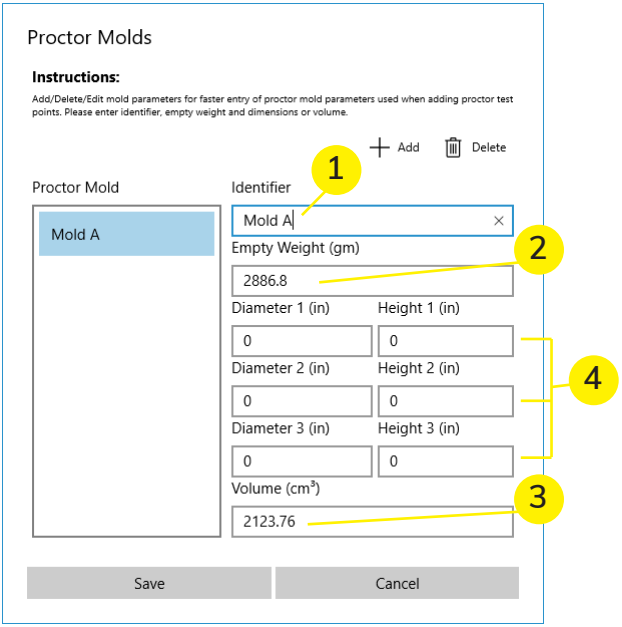
To ease data entry for proctor data points mold details can be stored. These molds will show up in the Proctor Mold field on the left of the window **(1)**.



To begin, click the Add button to add a new proctor mold.



Give the mold an identifier, in this case Mold A **(1)**. Then, enter the empty weight of the mold **(2)**.



If you already have calculated the Volume of the mold, you can just add that number in the Volume (cm^3) field **(3)**. If not, you will need to measure the mold to determine the Volume. Three measurements are usually used in calculating volume, but the App will calculate the volume with only one measurement as well. Three fields are provided for both Diameter and Height for these measurements **(4)**. Only non-zero Diameter and Height values are averaged together to calculate Volume.

Once complete, Save the information to a saved Proctor Mold in the list at left.

Selected Proctor Data Project Actions

(1) Details – Click for an expanded view which shows the Proctor Maximum Dry Density, Optimum Moisture, Rock Density, Soil Description, and Soil Classification.

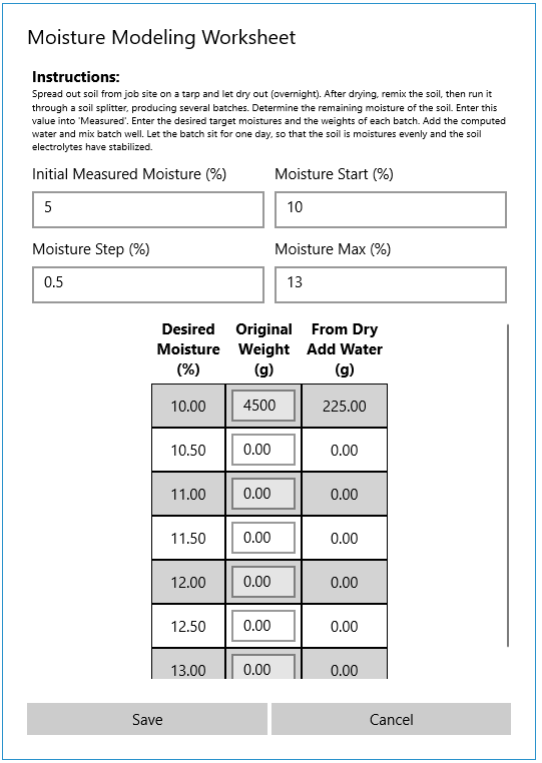
(2) Add – Add a new proctor point.

(3) Edit – Edit the Proctor Data Project properties.

(4) Conditioning – Opens a conditioning worksheet which will help calculate the water to add to achieve a desired moisture target.

Clicking on the Conditioning button will bring up the Moisture Modeling Worksheet, which aids in the moisture addition process by calculating the amount of water needed to add to the soil to achieve a desired moisture content.

On the next page is the Moisture Modeling Worksheet. Directions for its use are explained on the worksheet.

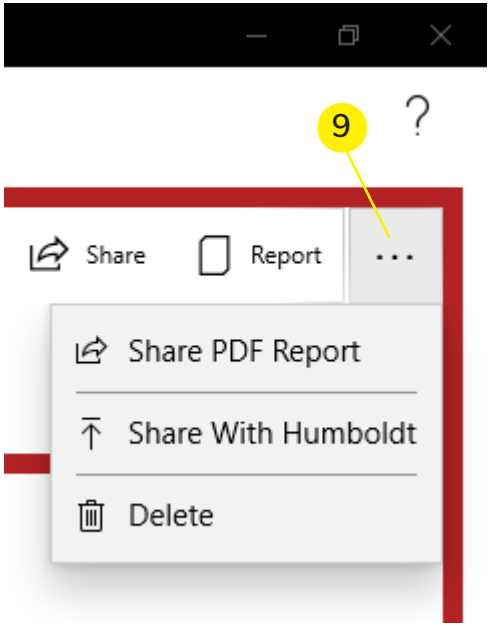


(5) Export – Export the Proctor Data Project to a user selectable location.

(6) Share – Share the Proctor Data Project with nearby PC's or by e-mail.

(7) Report – Create a PDF report of the Proctor Data Project.

(8) Question Mark – Opens the user manual.

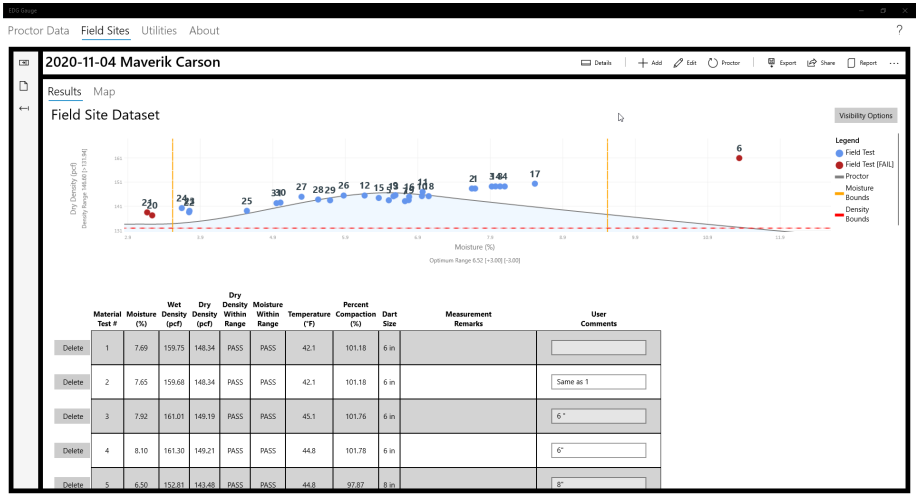


(9) …
Share PDF Report – Creates a PDF report and opens sharing to share report with nearby PCs or e-mail.

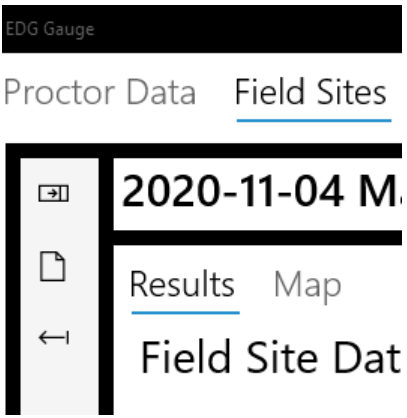
Share With Humboldt – Share the Proctor Data Project with Humboldt. The data shared is used to improve the EDG gauge. The data is not and will not be shared with anyone else.

Delete – Deletes the Proctor Data Project.

Main Navigation — Field Sites Tab



Field Sites Actions



Field Sites Projects – Click to expand/collapse list of Field Sites Projects.

Create a new Field Site project.

Import a Field Site project.

Selected Proctor Data Project Actions

(1) – Click for an expanded view which contains the Proctor Data Project used with this Field Site, Maximum Dry Density, Optimum Moisture, and the density and moisture bounds.

(2) Add – Add a new Field Site data point.

(3) Edit the Field Site Project properties.

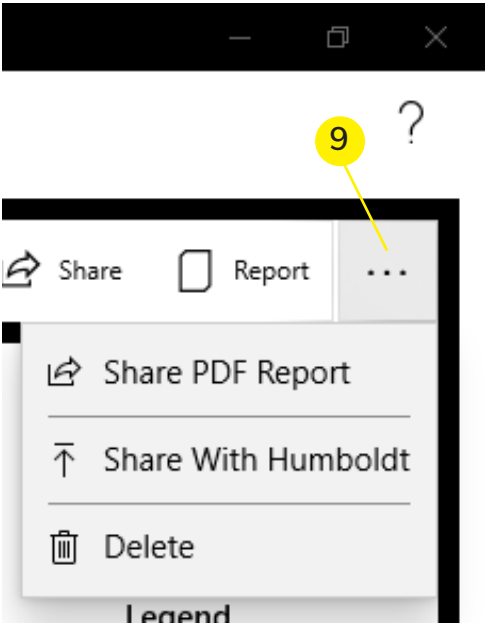
(4) Proctor – Select or change the proctor used with the Field Site Project.

(5) Export – Export the Field Site Project to a user selectable location.

(6) Share – Share the Field Site Project with nearby PC's or by e-mail.

(7) Report – Create a PDF report of the Field Site Project.

(8) Question Mark – Opens the user manual.

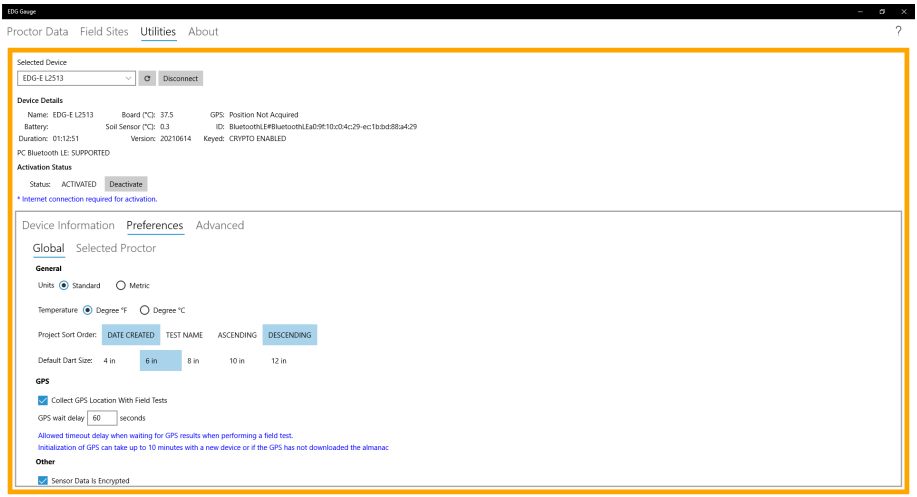


(9) ...
Share PDF Report – Creates a PDF report and opens sharing to share report with nearby PCs or e-mail.

Share With Humboldt – Share the Field Site Project with Humboldt. The data shared is used to improve the EDG gauge. The data is not and will not be shared with anyone else.

Delete – Deletes the Field Site Project.

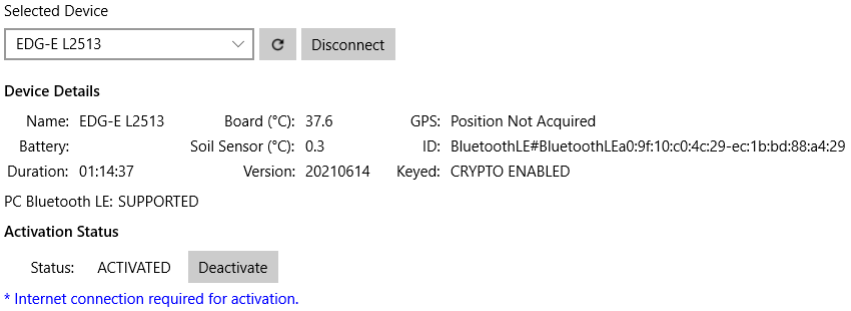
Utilities Tab



The Utilities section is where diagnostics, preferences, and sensor updates can be viewed or changed.

Utilities Tab — Top Portion

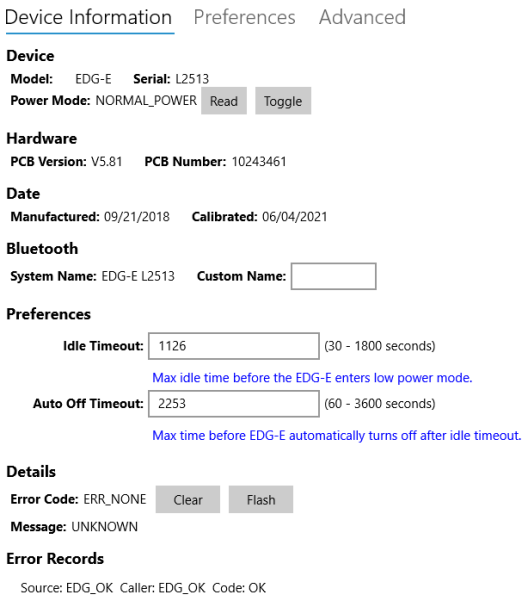
The top portion of the Utilities tab allows a connection to made to an EDGe sensor, and to view sensor information and diagnostics. Device Activation/Deactivation can also be performed manually here.



Utilities Tab — Lower Portion

The lower portion of the Utilities tab contains the following sub tabs: Device Information, Preferences, and Advanced.

Utilities Tab — Device Information



When connected to a sensor the software will query extended information about the device which includes error codes and build information.

When connected the following actions can be performed:

- Read and toggle the sensor power mode.

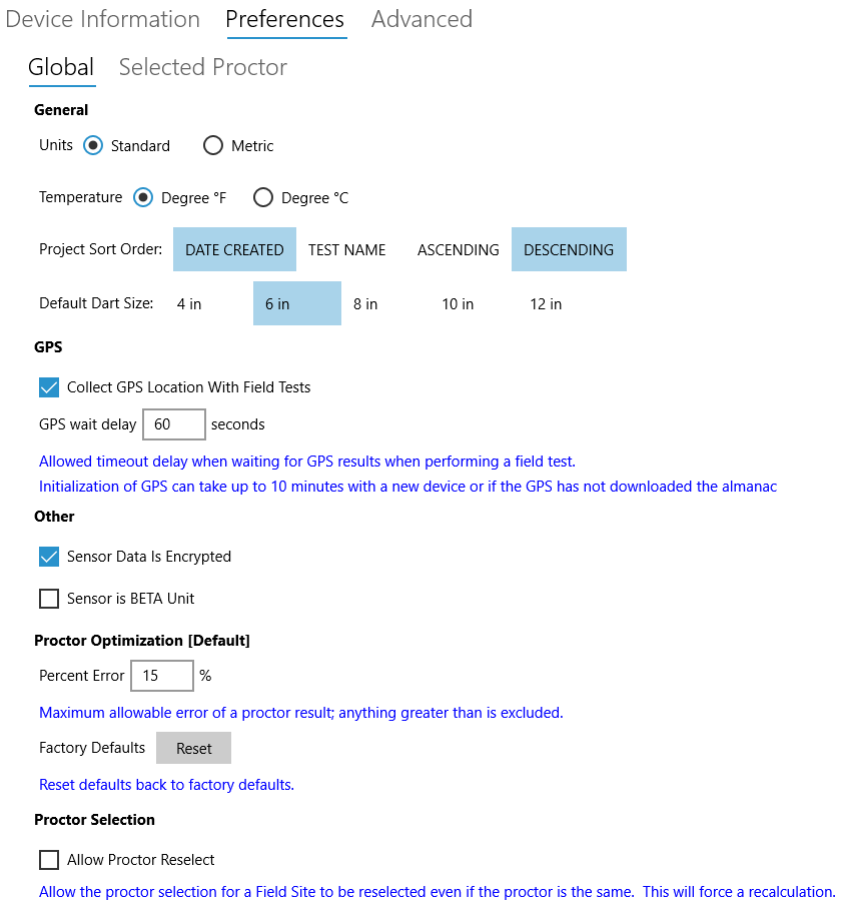
- Change the timeouts. Idle timeout is the time duration until the sensor will enter low power mode. Auto Off Timeouts is how long the sensor will stay on if not being interacted with.

- The Error codes can also be reset.

  When connected or not connected but the sensor is selected the user can provide a custom identifier or name to better determine what sensor they are working with.

Utilities Tab — Preferences

Global Preferences



General

Units – Standard or Metric units uses by the application.

Temperature Units – Degree F or C; temperature units displayed in software.

Project Sort Order – Changes to ordering of Proctor Data Projects and Field Site Projects.

Default Dart Size – The default dart size automatically selected when performing new Field Site Data points.

GPS

GPS – Choose to collect GPS data with Field Site Data points and how long to wait for a valid GPS location.

Other

Sensor Data Is Encrypted – This option should always be checked as all sensor data is encrypted. Only BETA unit sensors are not encrypted.

Sensor is BETA Unit – If you have a BETA unit sensor this box should be checked to ensure proper communications.

Proctor Optimization [Default]

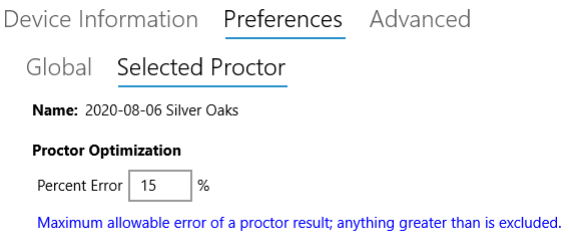
Percent Error – Sets the default range when automatically enabling/disabling Proctor Data Project points.

Factor Defaults Reset – Resets all preferences to factor defaults.

Proctor Selection

Allow Proctor Reselect – Will allow a Field Site Project to reselect the Proctor Data Project even if it is the same. This is only necessary to force a recalculation of Field Site results or the Proctor Data Project curve has been modified after applying the Proctor Data Project to the field site.

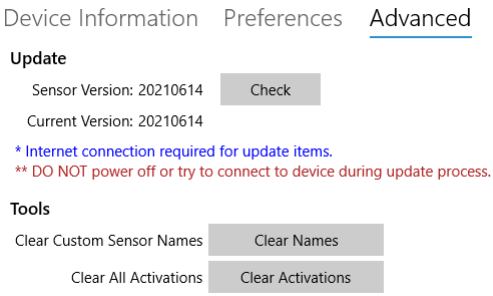
Preferences – Selected Proctor



Proctor Optimization

Percent Error – Modify the percent error bounds for automatically enabling/disabling Proctor Data points of the selected Proctor.

Utilities Tab – Advanced



Update

Update Check – Checks for available sensor updates. An internet connection is required.

OTA Update (Over the Air Update) – Will update the selected sensor with a new sensor firmware. An internet connection is required.

Tools

Clear Names – Will clear all custom names given to sensors.

Clear Activations – Clears all sensor Activations.

About Tab

The About tab provides software details, links to Humboldt products, self-support, and directs the user in creating a support ticket if technical support is required.

Humboldt Mfg. Co.
875 Tollgate Road
Elgin, Illinois 60123 U.S.A.

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Voice: 1.708.468.6300
Fax: 1.708.456.0137
E-mail: hmc@humboldtmfg.com

Testing Equipment For Construction Materials

HUMBOLDT

HUMBOLDT EDGe