



Soil Density Gauge



Operator's Handbook

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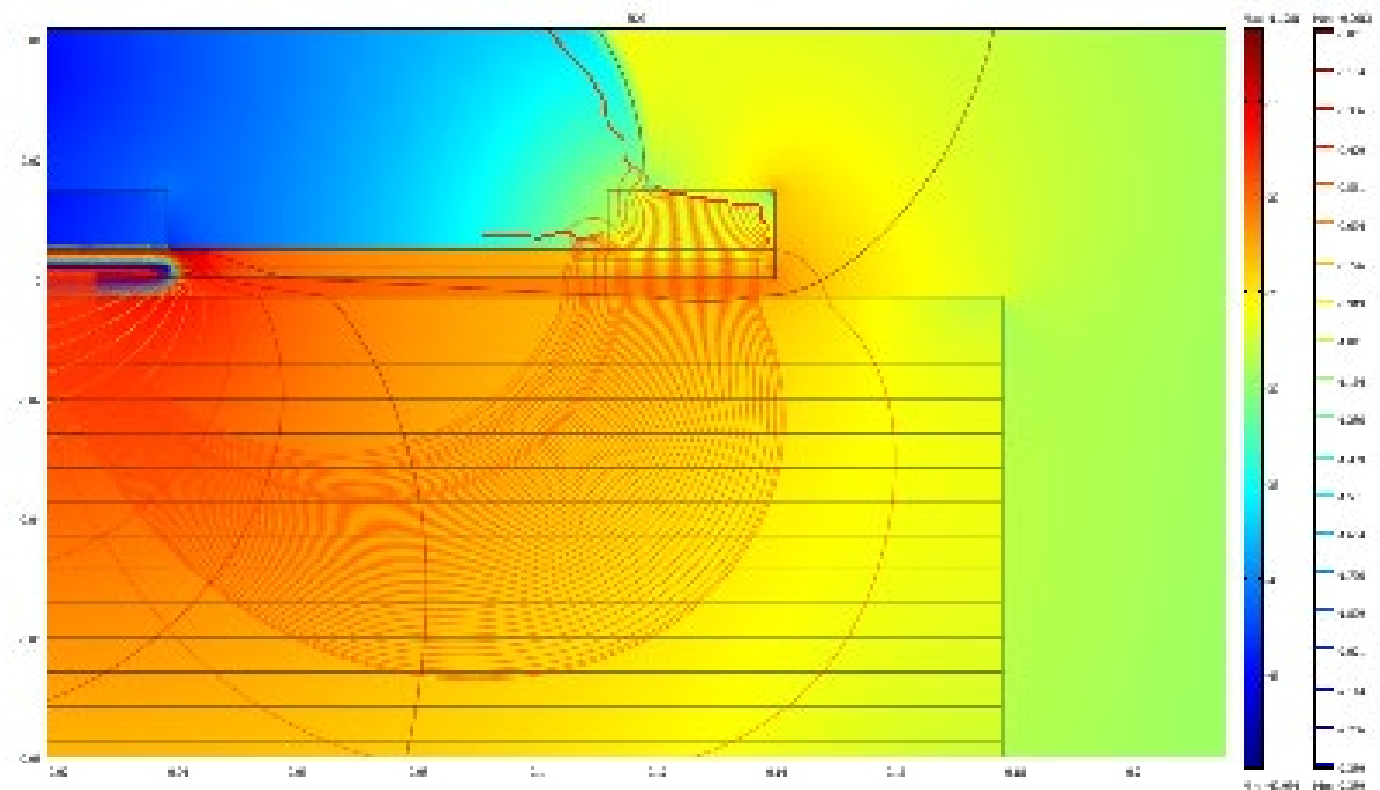
Introduction

TransTech's Soil Density Gauge (SDG) utilizes state of the art technology to get accurate soil density readings. It's primary features are:

- No special license or radioactive materials required.
- Lightweight and easy to use.
- 12 hours of portable operation.
- Measures density in common units (pcf or kg/m³).
- Measures percent moisture.
- Stores volumes of readings on internal data logger.
- Data download via USB flash drive (semicolon delimited text file format).

Measurement Technology

Using electrical impedance spectroscopy (EIS) the SDG 200's measurement permits separation of the effects of density and moisture content on the response of the soil to electromagnetic probing. The density, or compaction level, is measured by the response of the SDG 200's electrical sensing field to changes in electrical impedance of the material matrix. Since the dielectric constant of air is much lower than that of the other soil constituents, as density/compaction increases, the combined dielectric constant increases because the percentage of air in the soil matrix decreases. The SDG 200 performs a calculation on the measurement data that enables the device to report the soil's density and moisture content.



Application Summary

The SDG 200 is intended primarily for making density measurements on a standard 12 inch lift of soil during or after compaction. It is designed to measure coarse and fine grained materials common in standard soils used in civil construction projects. After configuring the gauge with soil properties from a standard particle size distribution report (ASTM D422) and Proctor test (ASTM D698 and D1557) the gauge will provide reliable and consistent measurements.

Safety

Every effort has been made to make the Soil Density Gauge SDG 200 convenient to use and inherently safe. The SDG 200 uses non-nuclear, low-voltage direct current to obtain measurements, therefore, there are no badges, licensing, storage or transport concerns. Like any instrument, however, the user should exercise care and common sense in its use to prevent mishaps.

Warning

**Do not use the unit on or near electrical wiring.
A potential shock hazard exists if contact is made with the exposed wiring.**

Warning

**Use care in handling the unit. Personal injury can occur through improper handling.
Take proper care to avoid accidentally dropping the unit.**

Warning

Unauthorized disassembly of the unit will void the warranty.

Warning

Shipping the gauge with the batteries inside is not recommended.

Caution

Charging the gauge overnight or unattended is not recommended

Caution

Turn the unit off when not in use and during transport.

Caution

**Be sure not to switch standardization plates with other gauges. Check the
Serial Numbers located on the gauge and on the plate to be sure they match.**

Operating Requirements

Temperature: -4° to 104° F (-20° to 40° C)

Relative Humidity: 10% to 90% noncondensing

Note: Exposing the equipment to high altitude OR extreme temperature may reduce life of the equipment.

Disclaimer: TransTech reserves the right to change or modify product design, construction, specifications, or materials without prior notice and without incurring any obligation to make such changes and modifications on TransTech products previously or subsequently sold.

Controls and Components

Contents

The SDG200 is packaged and shipped with the following components. Contact TransTech Systems Inc. Customer Service if any of the parts are missing.

- SDG200 unit
- Storage/shipping case
- Operators Quickstart Guide
- SDG handle
- 120/220V AC to 12V DC battery charger
- 12V DC Car Charger
- 3 battery packs



Gauge Features

On\Off Button
Turns gauge on and off

GPS Module
Location of GPS unit on the gauge (Accurate to 5+- Meters)

Faceplate
Protective bezel for touchscreen



Handle
Used to carry the gauge

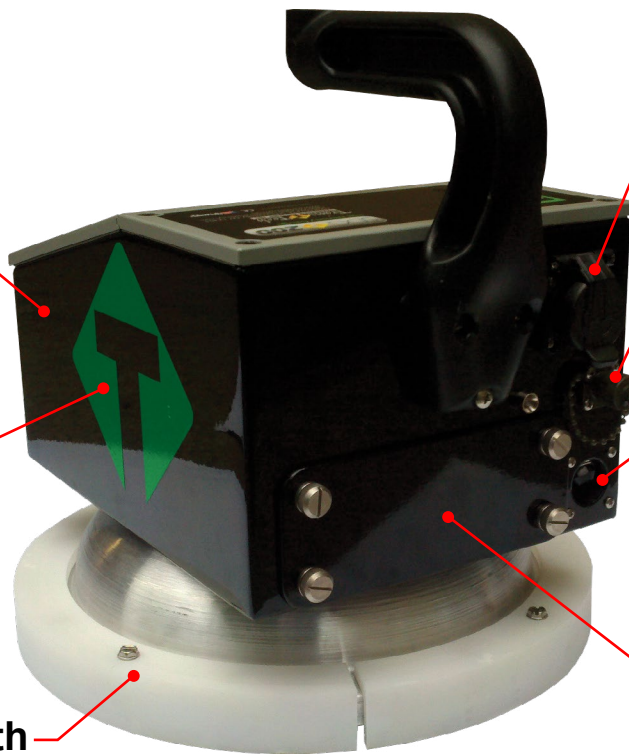
Handle Extension
Used to connect handle extension

TouchScreen
Used to input and interact with the gauge

Gauge Shell
Body of the gauge

Reflective Vinyl
safety feature for operation in dark areas

Shroud with 10" Sensor Plate
Location where sensor plate is located



USB Port
Used to allow communication between a flash drive and the gauge

Charger Port
used to connect the ac or dc charger to gauge

Infrared Temperature Sensor
Used to measure the surface temperature of the asphalt

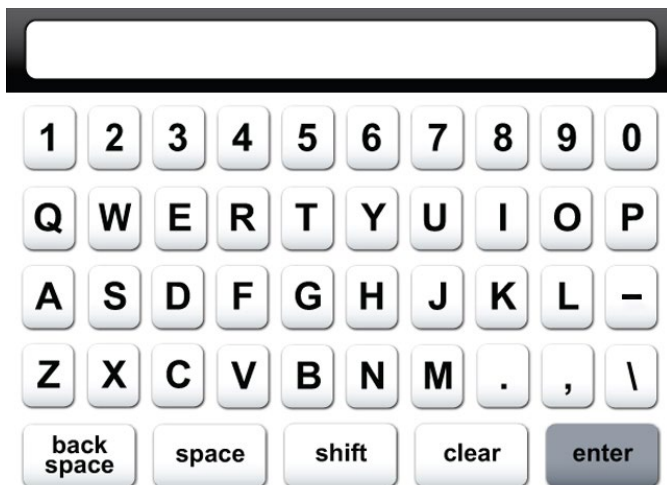
Battery Door
where the battery is located





External/Internal Controls



External controls on the SDG 200 consist of an ON/OFF switch and 480x640 VGA touch screen display for navigating through the user interface and entering alpha/numeric data.


Be sure not to drag your finger from one button to the next. A firm yet light touch is all that is needed to navigate from screen to screen.



Unique yet consistent icons are located on most screens for easy one touch navigation. When data input is required of the operator the screen will display the above keyboard. Toggle from upper to lower case letters using the **Shift** button  The upper case keyboard gives the option of a **minus sign**  while the lower case keyboard gives the **plus sign**  Once editing is completed simply **Press Enter**  to store and return to the previous screen.

External/Internal Controls

The numeric keypad as shown in this example allows for only numbers and a decimal point.

Press **Accept**  to store your entry and in most cases return to the previous screen.



The **Status Bar** is located at the bottom of the screen (excluding the keyboard screens) and will continuously update the remaining voltage of the batteries while displaying the date, time and status of the GPS and Data Logging features.

Power Save/Auto Shut Down

The SDG Model 200 has a built in power saving mode. If there are no buttons pressed after approximately 20 minutes the unit will go into a power saving mode. Pressing any key will “Wake” the SDG up for continued use. If the SDG is left “On” for an hour without any buttons being pressed, it will shut itself down, to conserve battery run time

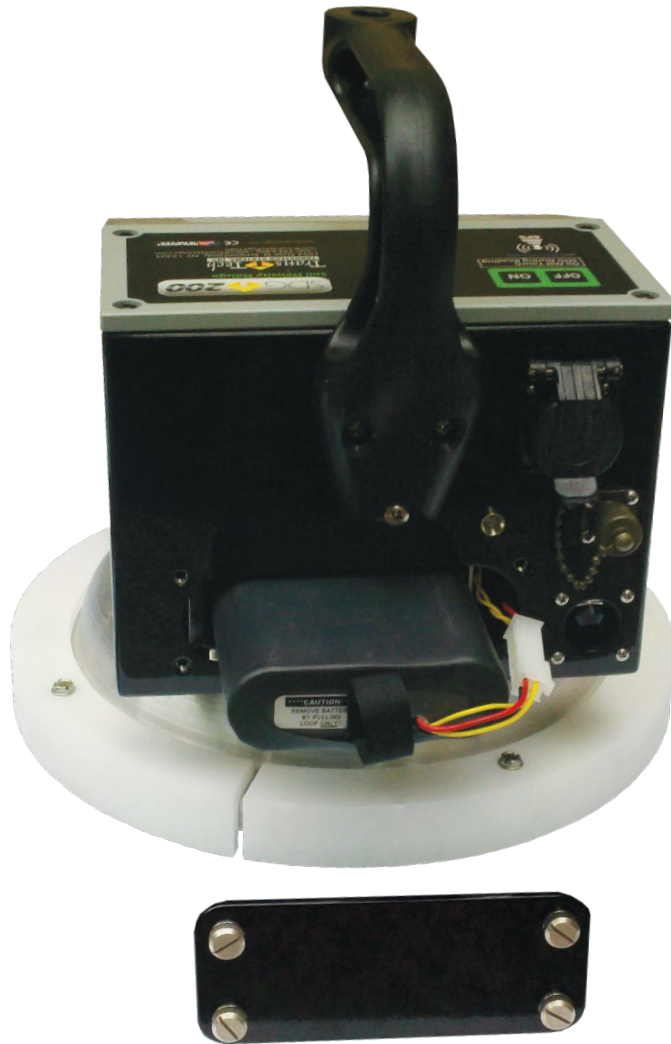
Setting up the SDG 200

Prior to using the SDG 200 for the first time the gauge will need to be configured to make measurements and record data correctly.

The following steps must be completed before operating the SDG 200:

1. Installing and Charging the Batteries
2. Starting the Software
3. Set the Local Time/Set Date
4. Set up the GPS
5. Select Units of Measurement
6. Define the material being tested (Material Details)
8. Define Project Details

Installing/Charging the Batteries



You will find a plate on the back of the SDG 200 with 4 spring loaded bolts.

- Turn each bolt approx. 2 full turns until the spring releases
- Remove the plate from the gauge
- Next you will find a wire with a connector, disconnect the battery from the gauge
- Then pull the nylon strap to slide the battery out of the compartment.
(Do Not pull the battery by the connector wire, doing so could cause damage to the battery)

Plug the gauge in and allow the LED to go from red to green for a full charge.
Approximate charge time is 4 hours.

To charge the unit, proceed as follows:

- 1) Turn the SDG 200 unit OFF.
- 2) Connect the charger to the charger connector located on the back of the SDG 200.
- 3) Plug the charger into a standard AC outlet.
- 4) The red indicator lamp will turn green to indicate that the batteries are charged.
- 5) Unplug the charger from the power source before disconnecting the charger from the SDG 200.

Installing/Charging the Batteries

Battery voltage can be viewed on the Status Bar located at the bottom of all screens. A fully charged battery will display **over 8 volts**. The battery voltage will decrease as the SDG 200 is used. A low battery icon will be displayed at approximately **6.5 volts**.



The gauge will continue to operate until the battery can not supply enough voltage to complete a measurement. Once this happens, the gauge will automatically shut down and will not restart until charged. Depending on the condition of the batteries, once the voltage drops below 6 volts, the gauge may be able to take about 12 to 15 additional readings. It is important to re-charge the battery after each use.

Starting the Software OFF ON



Turn the SDG 200 on by pressing the ON button. After a few seconds the TransTech splash screen will appear followed by the Main Menu Screen. The Main Menu screen will display six options. **Start SDG200**, **Internet (Coming Soon)**, **Calculator**, **Contact TransTech**, **GPS Control** and **Update Software**.

Main Menu



Start button when pressed will open the Control Menu Screen.



The Internet button when pressed will open a new screen. The new screen indicates that this will be an option in the future. It is not active at this time.



The Calculator button when pressed will open a screen which functions as a calculator.



The Contact button when pressed displays TransTech and distributor contact information.



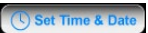

The GPS Control button when pressed will open a screen which will allow you to enable or disable the GPS.



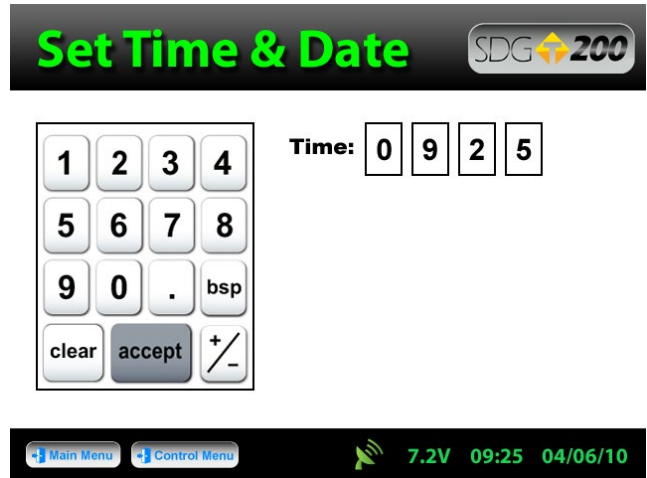
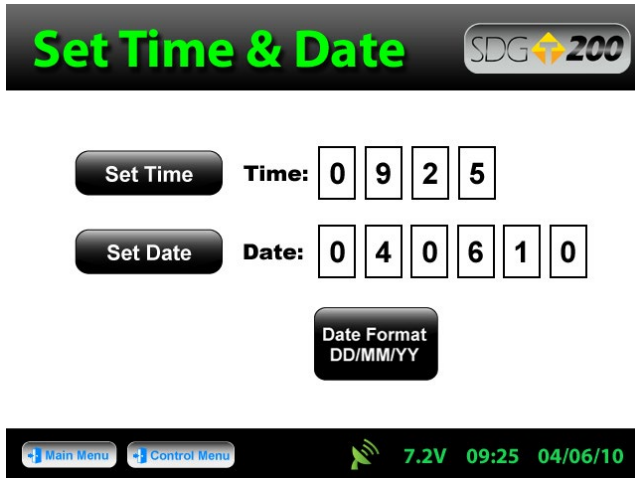
The Update Software button will be used in the event that TransTech releases an update to the software

Local Time and Change Date Format

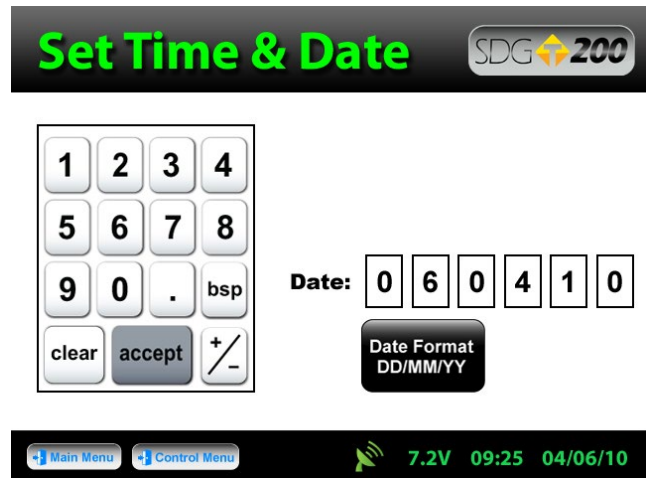
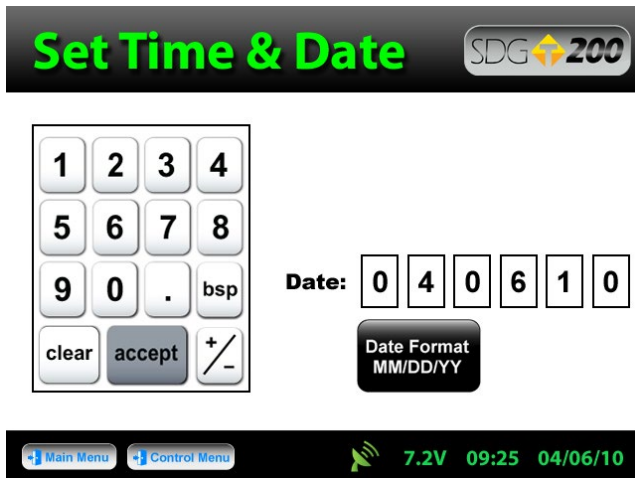


You may set the date and time in two locations. From the **Main Menu**, Press **Set Time & Date**  located on the **status bar** or from the **Control Menu** press **Date & Time**. 

Local Time and Change Date Format



To set the time, Press **Set Time**. **Set Time** Press the appropriate numbers for the time in 24 hour format. Once you are satisfied with your entry, Press **Accept** **accept** to store and return to the previous screen.





To set the date, Press **Set Date**. **Set Date** The date will display in either the DD/MM/YY or MM/DD/YY format which may be toggled from the button located on both screens. **Date Format MM/DD/YY** As you did with the time, press the appropriate numbers for the date in the format chosen. **Press Accept** **accept** to store and return to the previous screen. **(Note: Date will be preset by the factory)**

Setup the GPS

Setting up the GPS is nothing more than turning it on and waiting to connect to satellites. It can take up to 15 minutes to connect to satellites depending on your location.

From the **Main Menu**, Press **GPS CONTROL**.  GPS status can be toggled ON or OFF.  




When the GPS is **ON** the satellite dish on the status bar turns from red to green.  



GPS formatting can also be toggled from the **Universal Transverse Mercator (UTM) grid** to **Latitude/Longitude (LAT-LON)**. Initially the display will read **Sats 0** for both formats until connections have been made. The above examples show a connection to five satellites (Sats 5) in both formats. GPS locations will appear on the bottom left corner of all Reading Mode screens and will store with each reading when Data Logging is ON.

Control Menu

From the **Main Menu** Press **Start SDG 200**  to obtain the **Control Menu**. From this menu, you will find the icons listed below.



Opens the material details screen



Starts the standardization process



Opens the project details screen



Opens the diagnostics screen



Opens the data management screen. Here you can delete, download and print job files



Opens the date and time screen



Opens the units screen. Here you can toggle, kg/m^3 - lbs/ft^3 , F° - C° , in-mm



Starts the measurement process

Select Measurement Units



From the **Control Menu**, Press **Units**. Density, Temperature and Depth can be toggled independently between System International (SI “metric”) and U.S. Customary Units. For example, you can set your Density in lb/ft³ while the Temperature is set for Celsius and Depth set to Inches. Press **Control Menu** on the taskbar to return to the Control Menu.

Data Logging

The SDG 200 saves data automatically under the Project name that is current while readings are being taken. Data stored includes all Project and Mix details as well as Dry Density, Wet Density, Percent Moisture, Volumetric Moisture, Percent Compaction, Soil Temperature, Date, Time, GPS Position, GPS Time and GPS Date.


Project Details




The SDG 200 is configured to store 10 unique projects that are identified by user entered descriptions. If 10 projects have been defined in the SDG 200 and an 11th project is required, one of the original 10 will need to be modified to reflect the new project. The details of the new project will need to be input by editing the details of a previously stored project. Once the old projects are overwritten with new information, the old information is gone and the new information is saved in the gauge. Previously store data files with the old material information, however, will not be overwritten.

You may revisit each Project at any given time to continue taking readings. Data from readings taken within each project will store in the order of which they were taken. If material details change within a project or project details are added, data for readings taken after the changes will continue to store in the same data file in the order of which they were taken. Only by changing the Project Name itself will the data be stored in a separate data file.

Project Details

The default Projects stored in a new SDG 200 will have generic Project names (i.e. Project1, Project2, etc) along with generic Project details (i.e. My Street, My Road, Contact). Project Detail screens will resemble the Material Detail screen such that you are able to select your Project using the up and down arrows. 



The green highlighted project is the **CURRENT PROJECT**.  Readings taken will store in a data file using the **CURRENT PROJECT NAME**. If the gauge is shutdown, the current project prior to shutdown will remain the current project when started back up.

Keep track of your projects by entering detailed information into **Project Details**.




Editing Project Details




From the **Control Menu**, Press **Project**  for the **Project Details** screen. The project highlighted in green on the left is displayed in detail on the right. To edit the details of this project, Press **Edit Project**. 

Editing Project Details




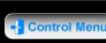

Edit Project 

 **Project:**

Location:

Location:

Contact:





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There are four black buttons labeled



By pressing one of these labeled buttons, you will enter the screen that allows you to store information for that Project.

For example Press **Project**,  a keyboard allowing you to change the default name will appear. Press **Clear**  if you would like to start over with a new name. Press **Shift**  to toggle from lower to upper case letters. Once editing has been completed, Press **Enter**. 

Define, Edit or Upload Material Properties



The density determined by the SDG 200 is highly material dependent so it is extremely important that the material properties from the Proctor Test and Gradation Report for the soil being tested are input accurately into the gauge.

The SDG 200 is configured to store 20 unique materials that are identified by user entered descriptions. If 20 materials have been defined in the SDG 200 and a 21st material is required, one of the original 20 will need to be modified to reflect the material properties of the new material. The properties of the new material will need to be input by editing the properties of a previously defined material. Once the old material properties are overwritten with new information, the old information is overwritten and the new information is saved in the gauge.

The SDG 200 will have default defined materials stored in each of the 20 unique locations. The following sequence explains how to input new material properties through the keypad or by USB upload and how to edit previously input material definitions.

Define, Edit or Upload Material Properties



Note: Be sure that the units of the gauge are set for the same units as the material you are uploading. If, for example, the gauge was set in U.S. Customary units (ex: 150 lb/ft³) and you were to upload the material in SI units (2402.8 kg/m³) the gauge will notify you that the density is out of range. However, it will continue to load the material. If you were to switch to SI units AFTER the material has been loaded, the density would convert the 2402.8 as if it were in lb/ft³ and result in 38,489.2 kg/m³. Correct this by deleting the material, change the units of the gauge and reload the material or by simply editing the density in the material setup.

See Part 5 for explanations of the Material Properties.

See Part 6 for explanations of gradation and Proctor test reports.

See Appendix A for explanations of the MTL Generator

Defining and Editing a Material



Here you may use the green up or down arrows to select a new material for editing or change an existing material. **The green highlighted material is the CURRENT MATERIAL that the gauge will use when taking readings. Prior to exiting this screen, be sure this is the material you want and the information to the right has been verified.** Press **Control Menu** on the Status Bar (bottom middle) to return to the **Control Menu**. If the gauge is shutdown, the current material prior to shutdown will remain the current material when started back up.

!! Note: The sum of %Greater than 3 inches, %Gravel, %Sand, and %Fines must add up to 100%. The default values programmed in the SDG software add up to 100%. As soon as one of those values is edited, the sum will no longer add up to 100% and an error message will be displayed, however, after the initial error the gauge will allow you to exit and begin taking readings. **THIS IS NOT RECOMMENDED AND WILL GIVE INACCURATE RESULTS!!**

!! Note that Max Dry Density and Dry Density Offset must be entered in the same units in which the gauge is configured to output results. Example: If the gauge is configured to measure in pcf, input Max Dry Density in pcf !!

Defining and Editing a Material

Edit Material

Control Menu

SDG 200

Material, Project, Data Management, Units, Standardize, Diagnostics, Date & Time, Measure

Main Menu 7.2V 09:25 04/06/10

Material Details

SDG 200


Material ID: Coarse
Description: Grainy
Max Dry Density: 129.9
Wet Density Offset: 0.0
% Moisture Offset: 0.0
% Larger than 3": 0.0
% Larger than 3/4": 1.3
% Gravel: 6.4
% Sand: 87.6
% Fines: 6.0

PL: 0.0
LL: 0.0
Cu: 4.4
Cc: 0.94

Super Fine
Coarse
Fine

Edit Material
Upload Material

Main Menu Control Menu 7.2V 09:25 04/06/10

From the **Control Menu**, Press **Material**  for the **Material Details** screen. The material highlighted in green on the left is displayed in detail on the right. To edit the details of this material, Press **Edit Material**.

Edit Material

Edit Material

SDG 200

Material ID: Soil2
Description: Grainy
Depth: 6.0
Max Dry Density: 129.9
Opt Moisture: 7.6
Wet Density Offset: 0.0
% Moisture Offset: 0.0
% Larger Than 3": 0.0

Page 2

Main Menu Control Menu 7.2V 09:25 04/06/10

Edit Material

SDG 200

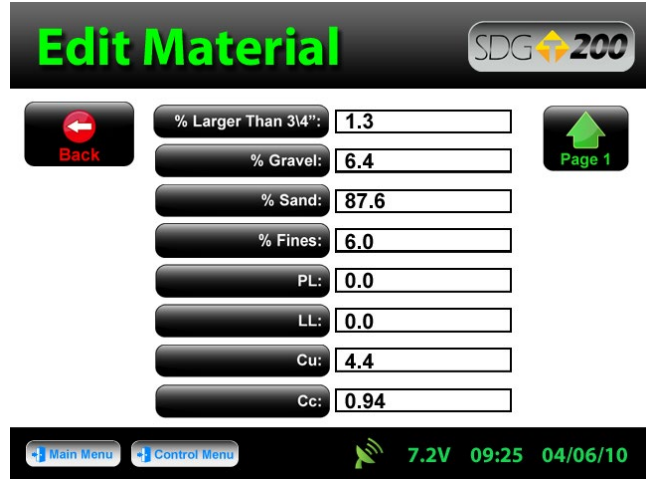
1 2 3 4
5 6 7 8
9 0 . bsp
clear accept +/-

Max Dry Density kg/m
130.0

Main Menu Control Menu 7.2V 09:25 04/06/10

There are fifteen material properties for each material. Eight of these material properties are listed on Page one of the **Edit Material Page** and the remaining seven are listed on Page 2. Each can be edited individually by pressing its corresponding label which prompts a numeric or alpha numeric keypad.

Defining and Editing a Material



Once editing is complete, Press the **Back** button located on **Page 2** to verify your changes on the **Material Details** page.



located on **Page 2** to verify your changes on the **Material Details** page.



Setting Measurement Offsets

The SDG 200 has been designed to determine the moisture and density in a compacted soil sample without the need for any offsets. The ability to measure moisture and density is based on an empirical model that was developed by studying common soil types at near optimum moisture contents with typical particle size distributions. As the SDG 200's measurement performance is based on this empirical model, there will be occasions where the soil being measured is so different from one that has been studied previously that an offset may be required to enable the SDG 200 to produce acceptable results.

Setting Measurement Offsets

Offsets for Wet Density and % Moisture can be set manually by the operator in cases where the SDG 200 does not appear to be comparing favorably to collocated measurements. The offsets are simply added to or subtracted from the Wet Density and % Moisture calculated by the SDG 200. Dry Density, Volumetric Moisture, and % Compaction are then recalculated based on the offset values of Wet Density and % Moisture.

The Wet Density and % Moisture offsets are saved in each data record with the results of the corresponding test in the .mnt file.

Wet Density and % Moisture offsets are entered into the SDG 200 as a material property and are displayed and edited identically to other material properties.

Wet Density and % Moisture Offsets can be either negative or positive. To enter a **positive offset** simply type in the offset value that will be added to the current measurement. To enter a **negative offset**, use the (-/+) key to enter a negative sign then enter the value that will be subtracted from the measured value. After the offsets are applied to the Wet Density and % Moisture, Dry Density and Volumetric Moisture are calculated by the SDG 200 as follows:

$$\text{Dry Density} = \frac{\text{Wet Density}}{1 + \left(\frac{\text{Water Content \%}}{100} \right)}$$

$$\text{Volumetric Moisture} = \text{Wet Density} - \text{Dry Density}$$

The % Moisture Offset is input as a percentage. For example, if the SDG 200 is consistently measuring % moisture as 7.5% and a collocated reference measurement is consistently measuring 5%, inputting an offset of -2.5 will adjust the SDG 200 to yield results similar to your reference measurement.

The Wet Density offset is input in units of mass/unit volume. If the gauge is set to operate in kg/m³, the offset will need to be entered in kg/m³. If the SDG 200 is configured to operate in lb/ft³, the density offset will need to be entered in lb/ft³.

The moisture, density, and compaction values displayed by the SDG 200 and logged in the .mnt file reflect the application of the user selected offsets

Failing to enter the Wet Density Offset in the same units that the SDG 200 is Configured to measure in may result in significant errors.

Determining Offset Values

Methods used to determine what offsets are appropriate will vary from application to application, but will all generally follow the same steps. In order to determine an offset, a reference measurement will be required. That reference may include one or more of the following: a Nuclear Density Gauge, Oven Dry Moisture Measurements, Speedy Moisture Measurements, Sand Cone Apparatus, Balloon Density Apparatus, Density Drive Cone or other applicable equipment.

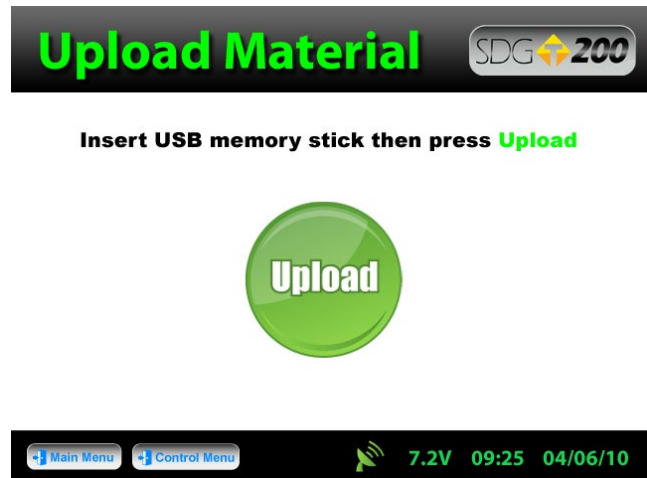
Multiple measurements should be taken at three to five representative locations with both the SDG 200 (make sure both offsets are set to 0) and your appropriate reference equipment. Note the results by each method at each location and determine the average difference between the SDG 200 results and the reference measurement results. This average difference will be your offset. If the SDG 200 measures lower than your reference measurement your SDG 200 offset will be positive. If the SDG 200 measures higher than the reference gauge, your SDG 200 offset will be negative.





At a particular location, if you are not able to get repeatable measurements with either the SDG 200 or your reference equipment, there may be an anomaly in the soil that effects the equipment and a new location should be selected.

!!Arbitrary selection of offsets is not recommended!!

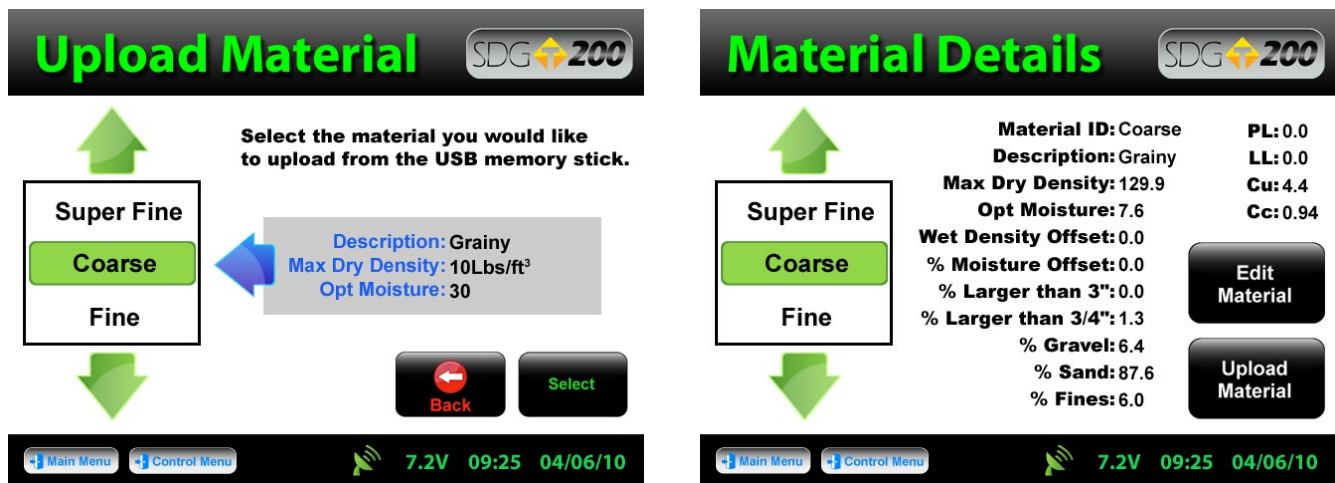
Uploading a Material



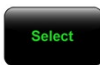

A material definition that has been set up using the SDG 200 Gradation Calculator and saved on a USB flash drive can be uploaded to the SDG 200.



From the **Material Details** screen choose the material name you wish to overwrite by pressing the up or down arrows.   The green highlighted material name displayed prior to uploading the material will be the location the new material will be stored. The information that is stored in this location will be overwritten and you will not be able to retrieve it again. Once you have made your choice, Press **Upload Material**.  Be sure to have your USB drive inserted into the USB port located on the back of the gauge. Press **Upload**. 

Uploading a Material



The file name of the materials located on the USB drive will appear on the left and some details identifying that specific material will be displayed on the right. Use the up or down arrows   to highlight the material you wish to upload. Once verified, Press **Select**  to upload the material information into the gauge. Continue to select additional materials to upload or Press **Back**  to view the material in detail.

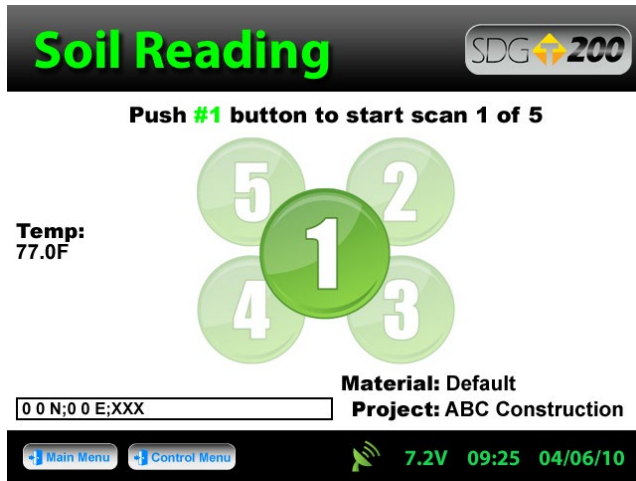
Note: Be sure that the units of the gauge are set for the same units as the material you are uploading. If, for example, the gauge was set in U.S. Customary units (ex: 150 lb/ft³) and you were to upload the material in SI units (2402.8 kg/m³) the gauge will notify you that the density is out of range. However, it will continue to load the material. If you were to switch to SI units AFTER the material has been loaded, the density would convert the 2402.8 as if it were in lb/ft³ and result in 38,489.2 kg/m³. Correct this by deleting the material, change the units of the gauge and reload the material or by simply editing the density in the material setup.

See Appendix A for explanations of the SDG MTL Generator

Part 2: Running a Test



Measurement Pattern



A complete test consists of five individual measurements taken in a “cloverleaf” pattern at the test location. Each of the five measurements takes about 10 seconds. The SDG 200 is placed in position 1 for the first measurement and moved clockwise around position 1 as indicated in the illustration above. Upon completion of each reading, the SDG 200 will prompt the operator to move to the next location.

Surface Preparation

While the SDG 200 unit stands off from the soil, surface condition is still important. It is necessary for the soil surface to be free from any loose and disturbed material, stones, large air pockets or ‘divots’ and other debris. It is also important that the soil surface be smooth. If it is not, smooth out the surface or move the unit to a location where the surface is smoother. The SDG 200 should not rock side-to-side when placed in a location to take a measurement; if it does, move to a new location or remove the obstacle that is causing the rocking being careful to not measure on top of any ‘divot’ left by removal of the object.

Large metal objects should not be within three feet of the gauge or underneath the soil while taking measurements. Measurements within ten feet of buried power lines should be avoided. When possible, measurements taken with an SDG 200 near an edge or vertical obstruction should be taken at least three inches from that edge.

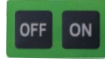
When placing the SDG 200 at a location for a measurement, do not push down on the unit to ‘seat’ the unit in place. Set the unit down on the surface and check to see if it rocks side-to-side.

Do not touch the SDG while it is taking a measurement.

Measure Density



Turn the SDG 200 on by pressing the ON button.

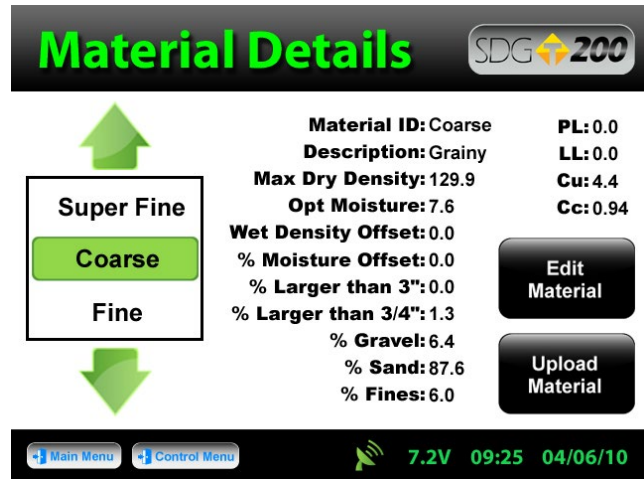


After a few seconds the TransTech splash screen will appear followed by the Main Menu screen.




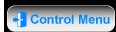
The Main Menu screen will display six options.

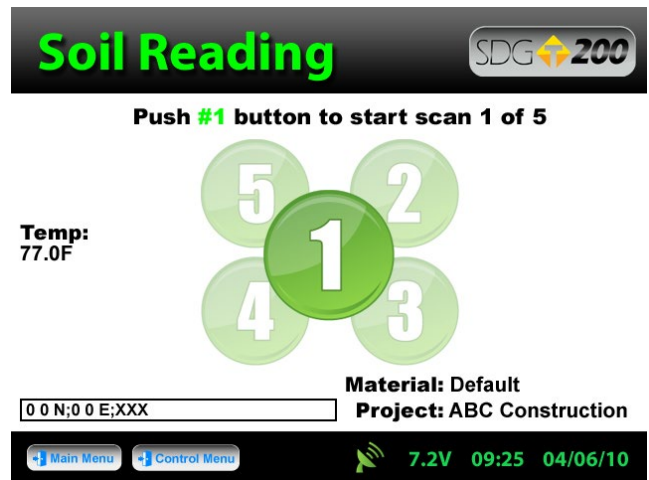
Start SDG200 Internet (Coming Soon) Calculator Contact TransTech GPS Control and Update Software.





From the **Main Menu**, Press **Start SDG 200** to get to the **Control Menu**. Press **Material** to display and verify the details of the current material that will be used for this test. Once verified, Press **Control Menu** from the status bar.

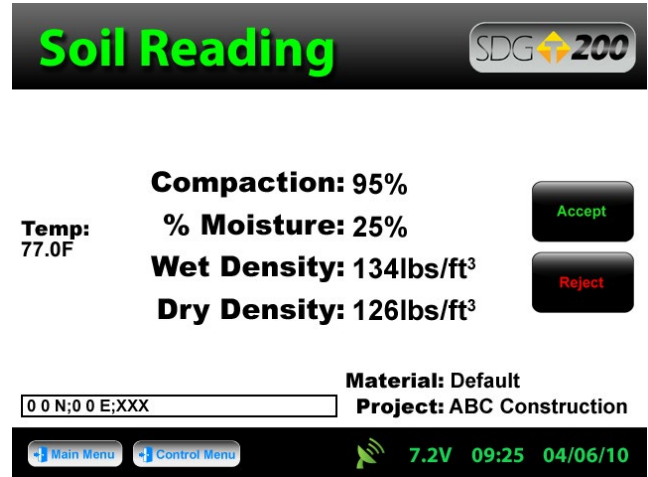
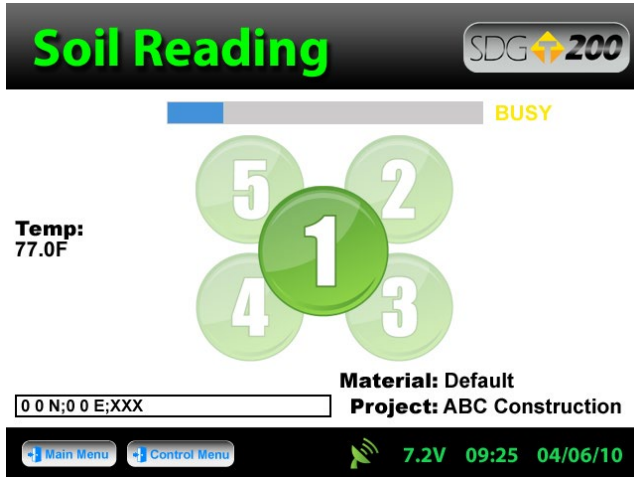


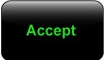

Press **Project**  to verify the Project Name that the data will store under as well as the Project Details. Once verified, Press **Control Menu**  from the status bar.

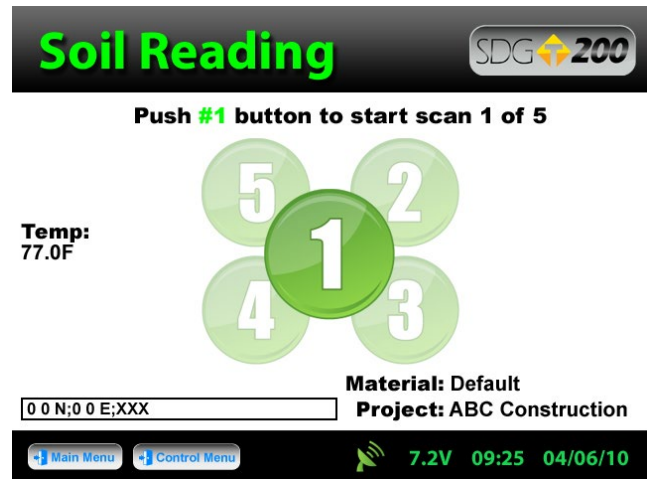
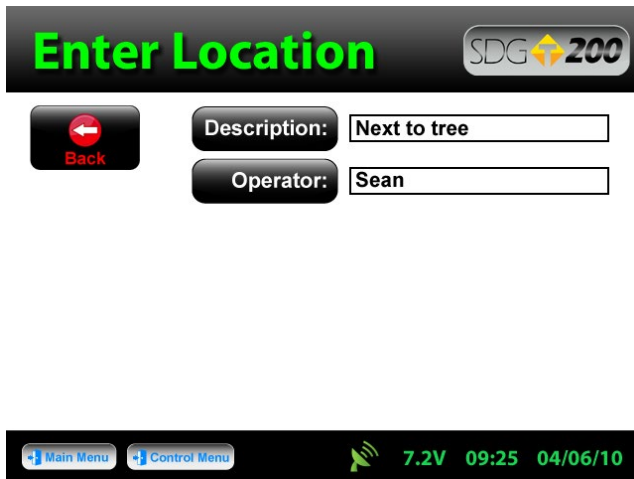


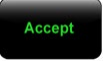


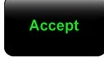
Press **Measure**,  to enter into the Soil Reading screen. In the bottom left corner, the name of the material to be tested and project are displayed for verification as well as the temperature of the soil. In the bottom right corner, the GPS information is displayed. The cloverleaf pattern is also displayed for your convenience with the highlighted position being the current position to measure. 

Measure Density



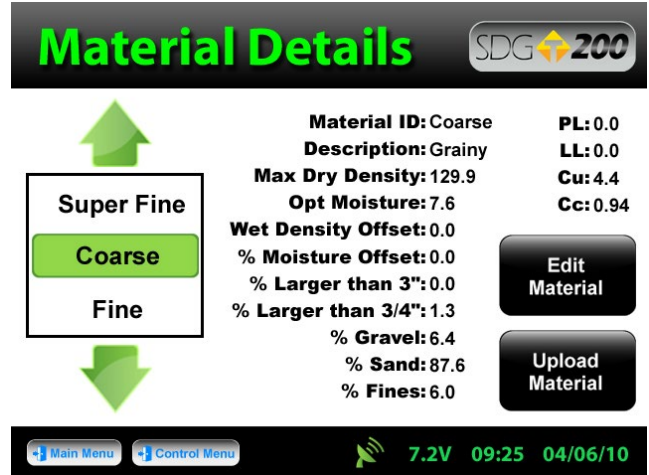
Position the gauge on the material in position 1 as it appears on the screen. Do not touch the gauge while it is busy taking a measurement. When reading 1 is complete, the green 2 will be illuminated. Move the gauge to position two and press 2. Repeat this for the five measurements. After the fifth measurement has been taken, the in place density and moisture content will be calculated and displayed on the screen. Here you can choose to “Accept”  or “Reject”  the recording of the averages into the data file.






After pressing “Accept”,  the **Enter Location** screen will appear allowing for a Description of the location to be entered as well as the Operator name. This information will be stored in the data file and will remain for future readings until edited. Once editing is complete, Press **Back**  to return to position one of the Soil Reading screen to continue taking measurements. If you chose to press “Reject”  instead of “Accept”,  the reading will not be stored and the gauge will return to position one of the Soil Reading screen.

Select a Different Material to Test

At any time you wish to go back and change the Material to be tested you may do so.



From the **Control Menu**, Press **Material**.  By using the up or down arrows   you can change the material, return to the **Soil Reading** screen and begin testing. However, keep note that these readings will be stored under the same **Project Name** that you were just using (the current Project). The data file name will be the same as the Project Name and will consist of the details on any and all materials used while that Project Name is current or active. **Only by changing the current Project Name will you receive a separate data file.**

Part 3: Data Storage and Downloading Data



The SDG 200 saves two types of data files. One file contains information that is referred to as *diagnostic* data, the other file contains information that is referred to as *measurement* data. Data files can be removed from the SDG 200 via a USB flash drive.

Measurement Data

The measurement data is a record of all of the tests performed with the instrument (a test is made up of the 5 individual measurements taken in a cloverleaf pattern). It is a semi colon delimited text file containing the following information:

Internal: Software Version; Gauge SN;

Results: Dry Density; Wet Density; Moisture Content (%);
Volumetric Moisture; % Compaction;

Special Features: Soil Temperature; SDG Time; SDG Date; GPS Position;
GPS Time; GPS Date;

Project Details: Project Name; Project Locations; Project Contact;
Description; Operator;

Material Details: Material ID; Description; Max Dry Density;
Optimum Moisture; %Greater than 3in; %Greater than ¾ in;
%Gravel; %Sand; %Fines; PL; LL; Cu; Cc; A coefficient;
B coefficient; Dry Density Offset; % Moisture Content Offset

When the measurement file is downloaded it is automatically named by the SDG 200. The following naming format is used:

Project Name:month:month:day:day:hour:hour:minute:minute.mnt
Project 103061510.mnt for Project 1 of March 6, 3:10 PM

Diagnostic Data

The diagnostic data contains all of the measurement data as well as information that indicates how the SDG 200 is performing. This data is of little interest to gauge owners and operators but will be very helpful to TransTech in the event of an instrument malfunction. Similar to the measurement data, the diagnostic data is saved at the conclusion of a complete measurement. Data from partial measurements are not logged in memory.

When the diagnostic file is downloaded it is automatically named by the SDG 200. The following naming format is used:

Project Name:month:month:day:day:hour:hour:minute:minute.dat
Project 103061510.dat for Project 1 of March 6, 3:10 PM

Storage Capacity








The SDG 200 has the capability to store up to twenty detailed projects and twenty detailed materials with an overall storage capacity of over 1000 MB for all data files. Upon completion of a set of five measurements, the complete details of the test will be written to a file and saved on the instrument **ONLY AFTER THE ACCEPT BUTTON HAS BEEN PRESSED**. This feature is new to the SDG 200 where the older 100 series saved automatically. With the 200 series, the gauge gives the operator the option to accept or decline.

On occasions that operators do not complete the series of five readings that make up a complete measurement series and either exits out of the reading routine or turns off the instrument, that incomplete record will not be stored. If the operator tries to exit out of the reading as it is being taken a warning will display: **“Attention! Measurement currently running; please stop measurement.”** Simply wait for the measurement to complete. If the operator decides to decline the completed set of readings, the gauge will not store that set.


Downloading Data

From the Control Menu, Press **Data Management**.  Project files will be stored and downloaded here.



Scroll down to the Project you would like to download using the arrows   located at the top left corner of the screen. Insert the USB flash drive into the USB port located on the back of the gauge. Press **“Download DAT & MNT”**  if you wish to download the measurement data as well as the diagnostic data. Press **“Download MNT”**  if you wish to download the measurement data only. You will be prompted to insert the USB flash drive if you haven't already and then to press **Download**.  The gauge will return to the Data Management screen which now displays **BUSY**  in the top right hand corner. Downloading is complete when the gauge displays **READY**. 

Deleting a Project File

When and if you wish to delete a Project, be sure to highlight the correct project and Press **“Delete”**.  A warning will display to be sure you wish to delete the file. Once deleted, you will no longer be able to retrieve the measurement nor the diagnostics data.

Part 4: Maintenance and Troubleshooting



In the event that the SDG 200 were to malfunction internal information about the gauge can be obtained and relayed to the factory. In the event that a repair is required, it is strongly recommended that authorized factory service be obtained. Unauthorized repair or maintenance by the user will void the unit's warranty.

Control Menu

SDG 200



Material



Project



Data Management



Units



Standardize



Diagnostics



Date & Time



Measure



Diagnostics

SDG 200

Serial Number: 1234567

SDG 200


Software Version: 1.0.763

Last Calibration Date: 12-15-2010



Factory Parameters



From the **Control Menu**, Press **Diagnostics**  and the internal information needed for the factory to track your gauge will display. This information consists of the Serial Number, Software Version and the date the gauge was last calibrated.

Maintenance

The SDG 200 has been designed to require a minimum of maintenance or service. Normal care in use should insure long and trouble free operation.

Keep SDG bottom surface clean:

For accurate readings, the SDG 200 should have a smooth interface with the surface. Try not to place the SDG 200 on top of large rocks that would cause the gauge not to sit properly. Also, do not try to “dig” the gauge into the material.

Touchscreen:


Do not clean the touchscreen with abrasive products, solvents or other harsh cleaners. Apply window cleaner to a clean soft rag and wipe the surface clean.

Factory Calibration:

Yearly recalibration of the gauge is recommended to maintain consistency and accuracy for the electronic components.

Maintenance



The **Diagnostic** button  on the Control Menu will turn red as a reminder. Only authorized distributors or the factory are able to perform this type of calibration.

Troubleshooting

The chart below provides guidance to a few suspect conditions.

Problem	Remedy
Buttons Sticking/Frozen Software	Repress the frozen button firmly for three seconds. Be sure not to drag your finger from one button to the next. If this does not work, reset the gauge by turning it off and then back on.
Incorrect Density Reading	Clean off sensor plate Check Current Material Details -be sure you have entered all details correctly (ex. Does the %Gravel, %Sand and %Fines add up to 100%?) Check Offsets -if you entered a Dry Density Offset or a %Moisture Offset be sure that the values selected make sense (see the Definitions and Calculations section of this manual) Check Units -be sure all of the values for the Density whether uploaded or entered, are in the same units Call Factory

Troubleshooting

The chart below provides guidance to a few suspect conditions.

Problem	Remedy
Battery Problems/Gauge Keeps Shutting Down/Gauge Will Not Come On	Ensure battery pack is plugged in Check battery voltage -plug gauge into charger and wait for the green LED to illuminate to indicate a full charge Call Factory
Data is not recording	Check Current Project Name -data readings will store on the Current Project only, be sure you have the correct Project name set on the gauge (Verify the name of the Project and Mix on each reading screen)
GPS Communication Errors	Call Factory

Part 5: Definitions and Calculations

Measurement Results

The following values are reported at the end of a measurement:

Wet Density is the total mass of material per unit volume in pcf or kg/m³

Volumetric Moisture is the mass of water per unit volume in pcf or kg/m³, measured by the SDG.

$$\% \text{ Moisture} = \text{water content as percent of dry density} = \left(\frac{\text{Volumetric Moisture}}{\text{Dry Density}} \right) \times 100$$

$$\text{Dry Density} = \text{Wet Density} - \text{Volumetric Moisture}$$

$$\% \text{ Compaction} = \frac{\text{Dry Density}}{\text{Max Dry Density}}$$

Definitions of Material Properties

The following descriptions and material properties need to be entered in the gauge for measurement or data reporting purposes:

Material ID: Usually a numeric entry that will associate the soil being tested with the gradation and proctor test report. Examples of soil or material ID's may include '33.1099' or '776632'. Material IDs are limited to 13 characters.

Description: Typically a brief description of the soil that allows the operator to visually identify the material being tested. Examples may include 'clayey sand red', or 'light brown silt'. Descriptions are limited to 13 characters.

Max Dry Density: This is the maximum dry density or target density or Proctor number for the material being tested. It is input in pcf or kg/m³. **Be sure the units of the gauge are in the same units you wish to enter.** This value can be found in a Proctor test report completed in accordance with ASTM D 1557 or ASTM D 698. This is used by the SDG as the value against which the measured dry density is compared to calculate percent compaction.

Opt Moisture: This is the optimum moisture content for the material being tested. This value can be found in a compaction test report completed in accordance with ASTM D 1557 or ASTM D 698.

PL: Plastic Limit. This property describes soils with a high clay and silt content. It is defined as the moisture content in percent at which the sample begins to exhibit plastic behavior as it transitions from having semi-solid properties. This value is determined as outlined by ASTM D 4318.

LL: Liquid Limit. This property describes soils with a high clay and silt content. It is defined as the moisture content in percent at which a sample begins to exhibit liquid behavior as it transitions from having plastic properties. This value is determined as outlined by ASTM D 4318.

Cu: Coefficient of Uniformity. Cu is defined as the ratio of D_{60} / D_{10} , where D_{60} is the particle diameter of which 60% of the sample is smaller, and D_{10} is the particle diameter of which 10% of the sample is smaller. Cu can be calculated from values taken from a particle size distribution plot defined by ASTM D 422.

Cc: Coefficient of Curvature. Cc is defined as $D_{30}^2 / (D_{60} \times D_{10})$. Cc can be calculated from values taken from a particle size distribution plot defined by ASTM D 422.

% Gravel: The percentage of material by mass passing a 3 in. (75mm) sieve but retained on a #4 (4.75mm) sieve. %Gravel can be taken from a particle size distribution report defined by ASTM D 422.

% Sand: The percentage of material by mass passing a #4 (4.75mm) sieve but retained on a #200 (75µm). %Sand can be taken from a particle size distribution report defined by ASTM D 422.

% Fines: The percentage of material by mass passing a #200 (75µm) sieve. %Fines can be taken from a particle size distribution report defined by ASTM D 422.

Note: Be sure that the % Greater than 3", % Gravel, % Sand and the % Fines add up to 100%.

% Greater than ¾ in: The percentage of material by mass retained on a ¾ inch (19.0mm) sieve. % Greater than ¾ inch can be taken from a particle size distribution report defined by ASTM D 422.

% Greater than 3 in: The percentage of material by mass retained on a 3 inch (75 mm) sieve. % Greater than 3 inches can be taken from a particle size distribution report defined by ASTM D 422.

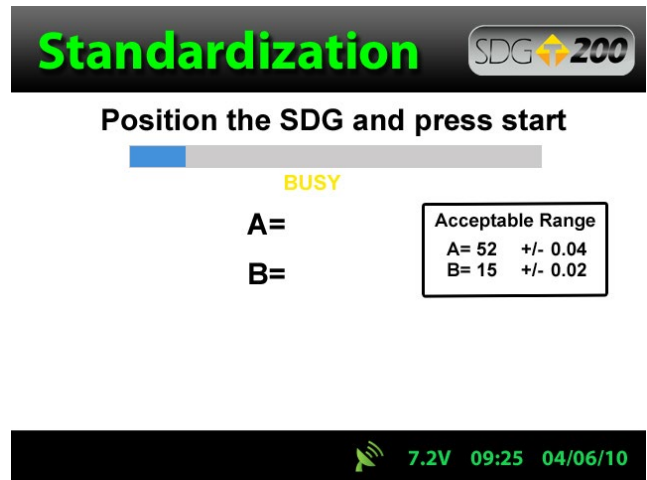
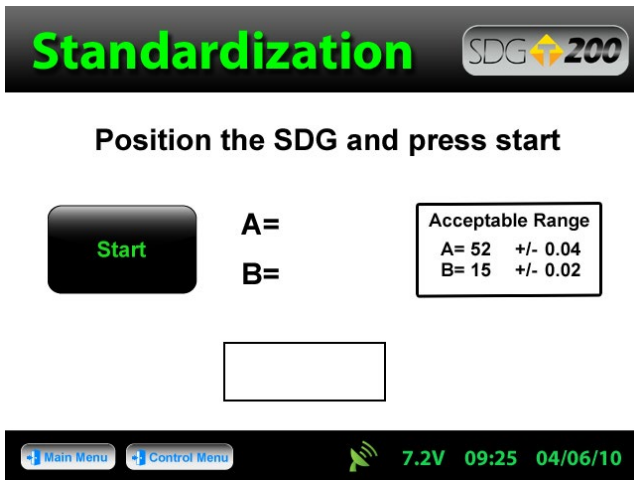
Part 6: Standardization of the SDG


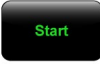


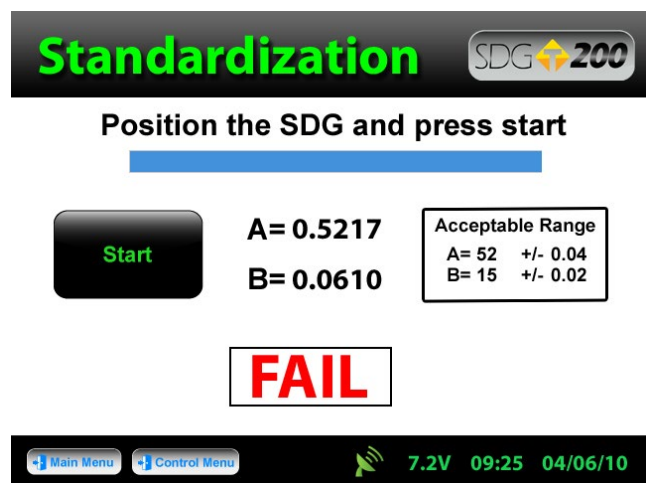
To assure that the SDG 200's ability to make consistent measurements has not been compromised, a daily measurement should be taken on a reference material and tracked day to day for any unacceptable variations. A metallic plate has been installed in the bottom of the SDG 200 carrying case that is suitable for this purpose.



Although this verification is referred to as a standardization of the gauge, the results of the standardization in no way influence the measurement of the gauge, they only serve to alert the user to a change in the way that the gauge is operating. Unexpected changes in the standardization values should be noted and discussed with Product Service at TransTech.

Standardizations are performed **inside the carry case**. Located at the bottom of the case is a steel plate. **Position the gauge on top of the plate inside the case. Be sure the gauge screen is facing you, if it is placed in the case backwards the handle will prevent proper seating you will get a false reading.** The case should not be on top of or around (10ft.) any large metal objects. Turn the gauge **ON** and proceed to the **Control Menu**.



Press **Standardize**,  to obtain the above screen. Press **Start**,  and do not touch the gauge while it is busy.



The acceptable range for the A and B values are displayed on the screen, however, the gauge will respond with a **PASS**  or **Fail**  based on these ranges automatically.

Part 6: Standardization of the SDG



If you receive a Fail, prior to calling the factory try the following:

- 1) Reposition the gauge/case to another location (outside preferably)
- 2) Be sure that you are testing the gauge inside the carry case that was provided with the SDG. The gauge and case are paired during production to determine the standardization.
- 3) Do not place the case on the back or near an automobile as well as any other large metal objects and/or wires
- 4) Be sure that no foreign objects have adhered to the bottom of the gauge or on the steel plate
- 5) Shut off all cell phones within 10ft of the gauge

WARNING: THE STANDARDIZATION OF THE SDG 200 WILL ONLY WORK WITH THE PLATE IT HAS BEEN ISSUED TO. IF YOU RECEIVE A FAIL RESULT, CHECK TO BE SURE THE SERIAL NUMBERS LOCATED ON THE GAUGE AND THE STANDARDIZATION PLATE ARE THE SAME.

WARNING: THE STANDARDIZATION OF THE SDG 200 MAY GIVE A FALSE “FAIL” IF TEST IS TAKEN TOO CLOSE TO METAL OBJECTS, POWER LINES OR OTHER ELECTRICAL DEVICES THAT MAY BE TOO CLOSE TO THE GAUGE. TURN THE GAUGE OFF AND MOVE THE GAUGE AT LEAST 10 FEET FROM THESE OBJECTS. IF AFTER THESE PRECAUTIONS ARE TAKEN THE GAUGE STILL DISPLAYS A “FAIL” CONTACT YOUR DISTRIBUTOR.

Part 7: Explanation of Gradation and Compaction Reports

All of the information needed to configure an SDG 200 to measure the density and moisture content of a material is available on Compaction Test Reports (Proctor Test) and Particle Size Distribution Reports (Gradation/Sieve Analysis) completed as outlined by ASTM D 422 and ASTM D 1557. In order to configure the gauge to operate on materials that have high clay and silt contents, results from an Atterberg limits test (ASTM D 4318) will be needed as well.

Material Details SDG 200

Material ID: Coarse PL: 0.0
Description: Grainy LL: 0.0
Max Dry Density: 129.9 Cu: 4.4
Opt Moisture: 7.6 Cc: 0.94

Wet Density Offset: 0.0
% Moisture Offset: 0.0
% Larger than 3": 0.0
% Larger than 3/4": 1.3
% Gravel: 6.4
% Sand: 87.6
% Fines: 6.0

Super Fine
Coarse
Fine

Edit Material
Upload Material

Main Menu Control Menu 7.2V 09:25 04/06/10

Part 7: Explanation of Gradation and Compaction Reports

The thirteen properties that will need to be entered through the SDG's user interface are shown on the Material Details screen above and defined below. Further definitions of these properties can be found in **Part 5** of the SDG Operators Handbook. Examples of a gradation report and compaction test are on the following pages.

The **Material ID** is any identifier that can associate the material being evaluated with its test report. A report number or sample number should be entered here. For the example shown, 08.0527 is the Soil ID. **Do not enter letters or characters as part of the Soil ID.**

The **Description** should be used to describe the material and help make a visual association with the material being tested. Dark Brown Sand is used for this example.

The **Max Dry Density** is the maximum practically achievable density a soil can have. This value is determined experimentally by performing a "Proctor" Test (ASTM D 1557). 129.9 pounds per cubic foot is taken directly from the example compaction test report.

The **Optimum Moisture Content** is the water content (%) at which the material can be compacted to its maximum dry density. This is determined experimentally by performing a "Proctor" Test (ASTM D 1557). 7.6% is taken directly from the example compaction test report.

PL and **LL** are the plastic and liquid limits used to describe the plasticity of materials with a high silt and clay content. They are determined by following the test procedure outlined by ASTM D 4318. This example is a sandy material so PL and LL are input as 0.0. If plasticity tests had been performed on this material, the results would be given on the gradation report.

Cu and **Cc** are the Coefficient of Uniformity and Coefficient of Curvature of the material. They are calculated values that are typically used to describe the particle size distribution of a soil. In this example, $Cu = 4.4$ and $Cc = 0.94$

% Gravel is the summation of the coarse and fine gravel in a sample of material. Some gradation test results will report this as a single value while others will break it down into the coarse and fine fractions. The SDG only recognizes the total percentage of gravel so the coarse and fine fractions will need to be added together before entering them. The gradation report shown breaks the gravel content out into Fine and Coarse fractions so those will need to be added together. $1.3\% + 5.1\% = 6.4\%$

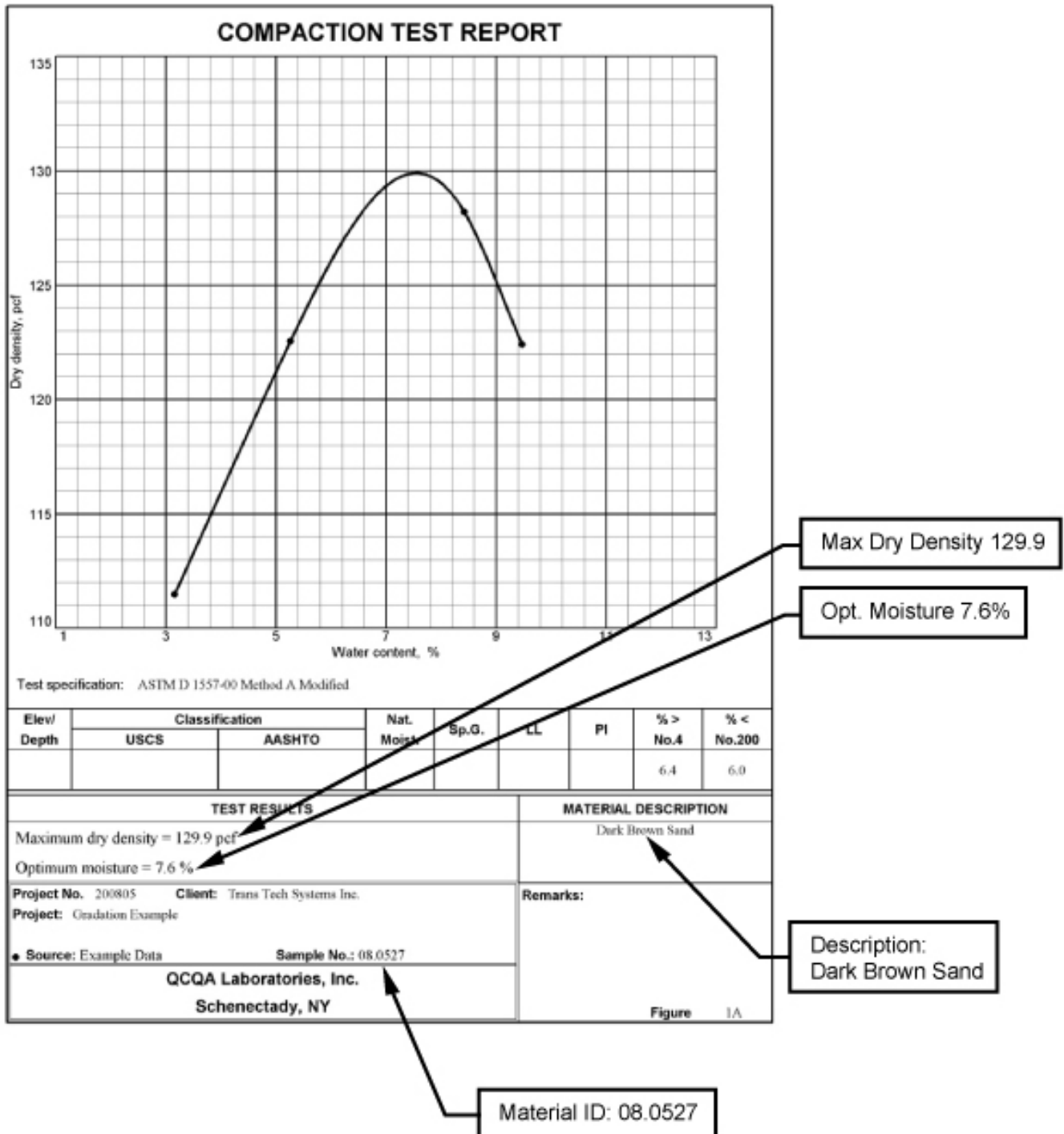
% Sand is the summation of the coarse, medium and fine sand in a sample of material. Some gradation test results will report this as a single value while others will break it down into the coarse, medium and fine fractions. The SDG only recognizes the total percentage of sand so the coarse, medium and fine fractions will need to be added together before entering them. The gradation report shown breaks the sand down into coarse, medium, and fine fractions, so the percent sand in the example shown is $8.1\% + 31.3\% + 48.2\% = 87.6\%$.

% Fines is the summation of the silt and clay in a sample of material. Some gradation test results will report this as a single value while others will break it down into the fractions of silt and clay. The SDG only recognizes the total percentage of fines so the coarse, silt and clay fractions will need to be added together before entering them. In this example, the percent fines is 6.0%.

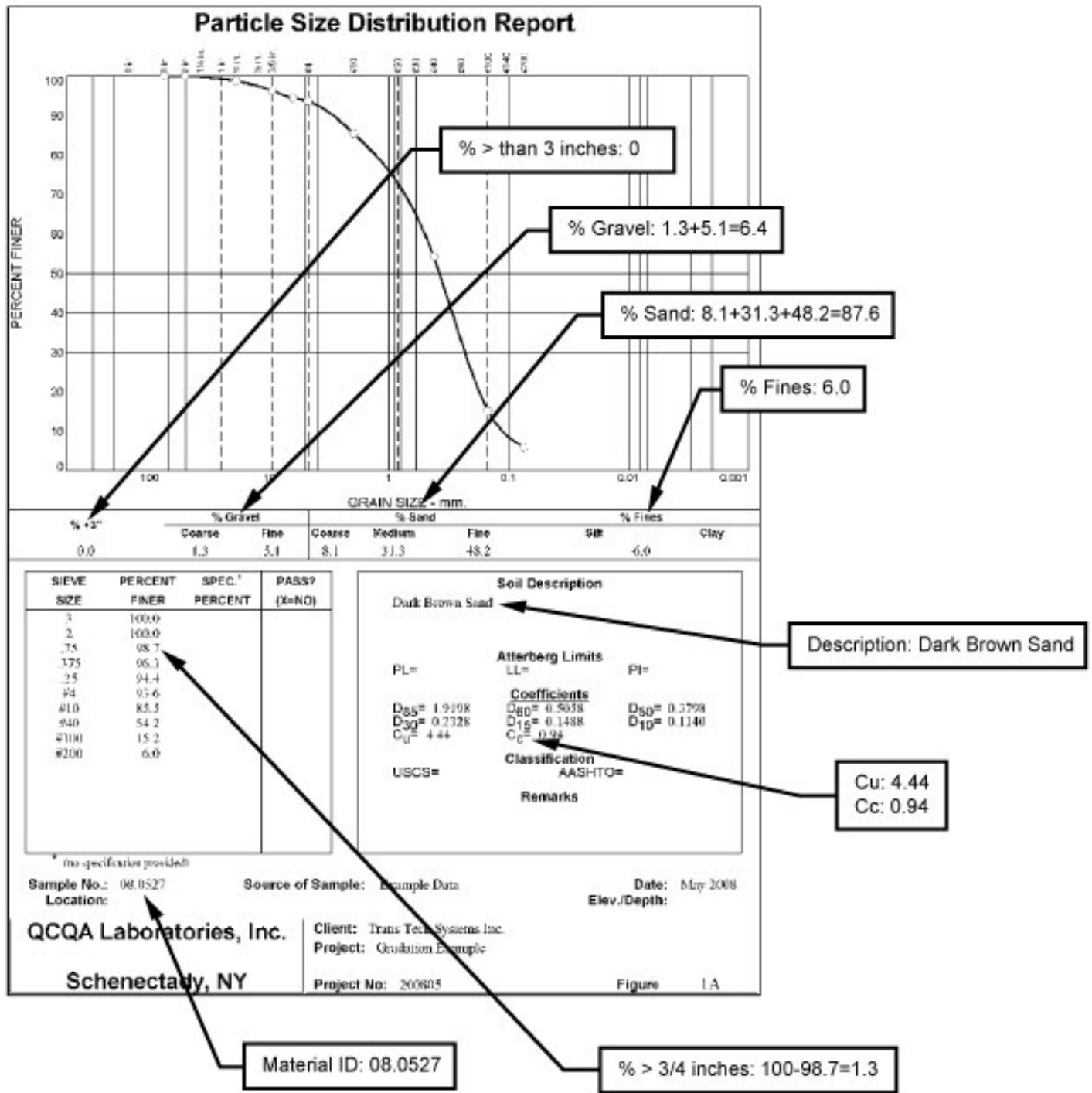
Part 7: Explanation of Gradation and Compaction Reports

% Greater than 3 inches is the percentage of the sample that is retained on the 3 inch sieve. Typical gradation tests report the “percent finer” or percentage that passes a particular sieve. In this example the percent finer for the 3 inch sieve is 100% so 0% of the sample is retained on the 3 inch sieve.

% Greater than 3/4 inch is the percentage of the sample that is retained on the 3/4 inch sieve. Typical gradation tests report the “percent finer” or percentage that passes a particular sieve. In this example the percent finer for the 3/4 inch sieve is 98.7% so 1.3% of the sample is retained on the 3/4 inch sieve.



Part 7: Explanation of Gradation and Compaction Reports



!! Note: The sum of %Greater the 3 inches, %Gravel, %Sand, and %Fines must add up to 100%. The default values programmed in the SDG software add up to 100%. As soon as one of those values is edited, the sum will no longer add up to 100% and an error message will be displayed until all of those gradation values are entered such that the sum is 100% again!!

Appendix A: Using the SDG MTL Generator

The SDG MTL Generator is a spreadsheet based application developed to determine the gradation inputs that the SDG needs to measure moisture and density of a soil in cases when the gradation performed was not done in accordance with ASTM D 422. The MTL Generator will allow users to input the gradation information that they have and will produce a particle size distribution curve from which the Cu, Cc, %Gravel, %Sand, %Fines, %>3/4” and %>3” values will be taken. Those values will be organized in a text file that can be uploaded onto the SDG via a USB flash drive.

There are two MTL applications. One application allows users to input any sieve size, in millimeters, that was used in their gradation. The second application is useful when an ASTM D 422 type gradation report is available and users simply want to type the report summary into their PC and generate a text file to upload into the SDG.

Getting Started:

The MTL applications are Microsoft Excel spreadsheets that contain macros. For the applications to operate properly, Excel will need to be configured to run macros on any computer you wish to use these on. To change the macro settings on your computer, follow these steps.

1. Open up Excel
2. Select the **Tools** menu
3. Select the **Macro** option
4. Select the **Security** option
5. Select the Security Level **Medium** and select **OK**

Once this setting is selected, Excel will ask you to confirm that you want to allow these applications to enable macros each time they are opened. Choose **enable macros** when prompted to do so.

The Gradation Calculator has two separate screens. Screen one explains the use of the calculator, contains conversion tables for US customary and metric sieve sizes, contains the inputs for the sieve sizes and percent passing those sieves and has inputs for the material descriptors that make up the material definition file.

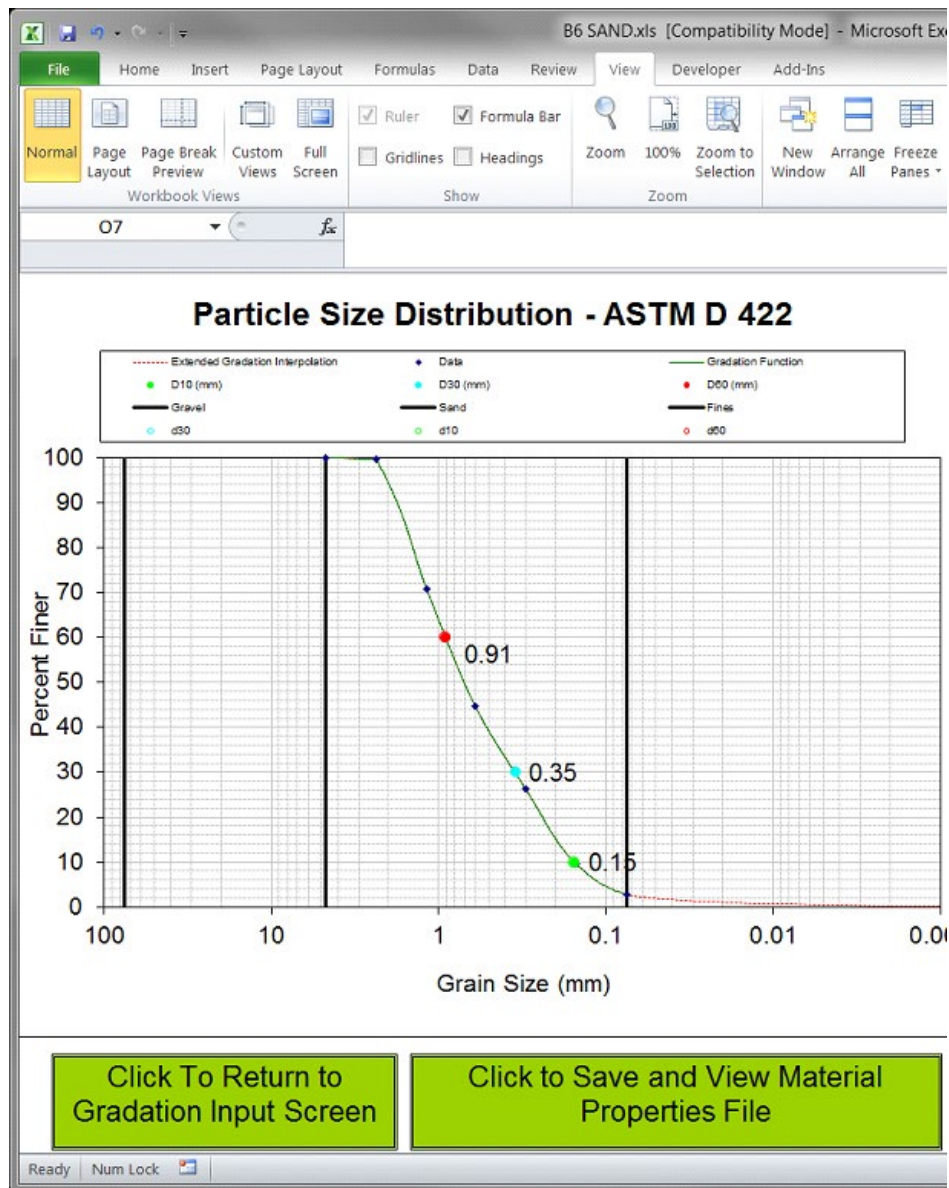
Appendix A: Using the SDG MTL Generator

Screen Two:

Once the gradation data is entered, fill in the rest of the material definition information in the yellow cells on Screen 1. The explanations and limitations for those definitions are explained on Screen 1.

Clicking on the button to view the Particle size distribution curve displays Screen 2. The gradation curve will be visible, as well as a table of all of the properties that define the material. Clicking on the button to save and view the material properties file creates a text file with a .mtl extension of your PC's desktop. **(Note: the first time you open a .mtl file on your PC, you will need to manually open it from the desktop with WordPad or similar text file editor. After that, your PC will always open .mtl files automatically.)**

The .mtl file can now be copied to a USB flash drive to be uploaded onto the SDG as explained on page 18.



The SDG will only recognize the first 20 .mtl files on the USB flash drive, and it will only recognize them if they are in the root directory of the flash drive. If .mtl files are in sub folders on your flash drive, the SDG will not recognize them.

TransTech Systems Product Warranty

The Company warrants to the Purchaser that the product delivered hereunder will be free from defects in material or workmanship and be the kind and quality designated or specified in the contract or purchase order. This warranty shall apply only to defects appearing within one (1) year from the date of shipment by the Company.

If the product delivered hereunder does not meet the above warranty and if the Purchaser promptly notifies the Company, the Company shall thereupon correct any defect, including nonconformance with the specifications, either (at the Company's option) by repairing any defective or damaged parts of the product, replacing the product, or by making available the necessary repaired or replacement parts.

The liability of the Company under this warranty, for any loss, whether the claim is based on contract or negligence, shall not in any case exceed the cost of correcting defects in the product as herein provided, and upon the expiration of the warranty period, all such liability shall terminate. The foregoing shall constitute the exclusive remedy of the Purchaser and the exclusive liability of the Company. The foregoing warranty is exclusive and in lieu of all other warranties, whether written, oral, implied or statutory.

No warranty of merchantability or of fitness for purpose shall apply. Unauthorized service shall void this warranty.

TransTech Systems Product Non-Warranty Return Policy

Non-warranty returns for TransTech Systems Inc. products must be made within twenty (20) days from the original date of shipment, unless otherwise indicated. Returned products must be in the original packaging, unused and in undamaged condition. Proof of purchase is required. Upon receipt of the product TransTech will inspect the product to the above mentioned criteria.

Unused products will be issued a credit to the Purchaser's account that was used to purchase the product. TransTech will not credit prepaid shipping cost. The original packing slip or invoice is required to be sent back with the product to be returned.

The Purchaser is responsible for shipping the product back to TransTech, carefully package the item(s) and include the packing slip and return manufacturing authorization number on the package. Prepay shipping is required – TransTech will not accept C.O.D.s.

Returns will be credited within 10 working days.

Proper Process of Warranty or Non-Warranty Shipments to TransTech Systems

For product returns (warranty or non-warranty), please follow the instructions below to assure prompt handling:

Call us for authorization (518-370-5558 or 800-724-6306), obtain a return manufacturing authorization number (RMA), and the return shipping address.

Indicate to our representative the reason for returning the product.

For Warranty Returns, Purchaser is responsible for shipping to TransTech's office. TransTech will pay ground shipping return to the Purchaser.

Notes:

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Notes:

Trans Tech

TRANSTECH SYSTEMS, INC.

**1594 State Street
Schenectady, NY 12304**

Phone: 518-370-5558

Toll Free: 1-800-724-6306

Fax: 518-370-5538

Email: inquiries@transtechsys.com

Web: www.transtechsys.com

 **Toll Free: [TransTech.Systems.Inc01](https://www.skype.com/join/TransTech.Systems.Inc01)**

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