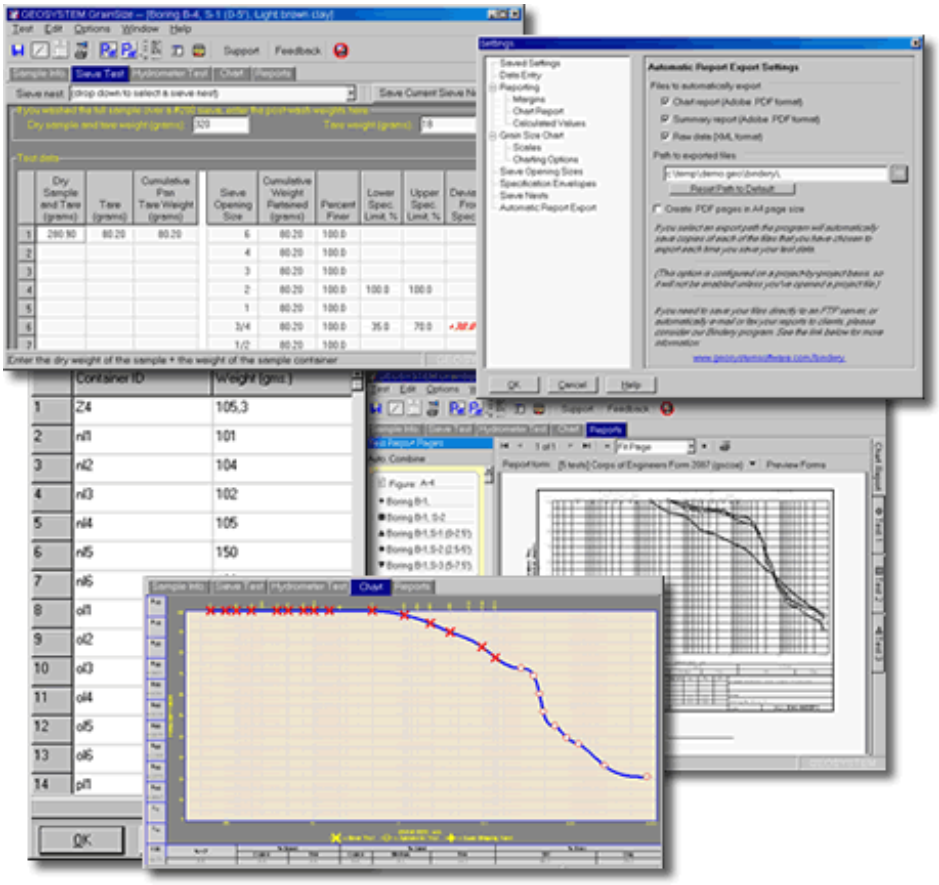
GEOSYSTEM® LabSuite4

**Software for Atterberg Limits, Grain Size Distribution Tests,
Soil Classification and
Moisture-Density Tests**

User's Guide



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1. Introduction

LabSuite reduces and reports data from moisture-density (i.e., "Proctor" or "compaction" tests), Atterberg limits and sieve and hydrometer grain-size distribution tests and classifies the soil based upon USCS, AASHTO, Burmister, USDA and Australian Standard (AS) 1726 standards.

⇒ The software's moisture-density test calculations are compliant with ASTM D 698 and D 1557, AASHTO T 99 and T 180 and California Test method 216 (CT-216). Oversize (rock) correction of test results can be performed according to ASTM D 4718, AASHTO T 224 and CT-216.

⇒ Sieve and hydrometer test calculations are compliant with ASTM D 422, D 1140, C 136 and C 117 standards and AASHTO equivalents (AASHTO T 27 and T 11), and Australian standards 1141.11, 1141.12 and 1289.3.6.1.

⇒ Atterberg limits test calculations are compliant with ASTM D 4318, AASHTO T 89, and Australian Standards AS 1289.3.1.1, 1289.3.2.1 and 1289.3.3.1.

⇒ Supported soil classification methods are: ASTM D 2487 (USCS), AASHTO M 145 (ASTM D 3282), USDA, Burmister and Australian Standard AS 1726.

1.1 Program Features

This section provides a list of some of ***LabSuite***'s features that might go unnoticed without closely reading the program's manual.

- Test data can be printed in a variety of different formats, including one that includes all of your raw test readings, which is handy for archiving your test data in paper form.
- Grain size data may be entered as either raw testing data or as final calculated test results (i.e., sieve size and percent passing). The latter option allows you to chart pre-calculated grain size tests without having access to the original testing data.
- Several different sieve testing methods (i.e., weighing each sieve and its retained material, or weighing a cumulative pan) are supported.
- Sieves may be entered as numbered (e.g., #10), inch-sized (e.g., 1") and/or millimeter-sized (e.g., 75mm.).
- Automatic determination of hydrometer temperature correction values from a single correction reading eliminates ASTM D 422 Section 7.2 multiple correction values requirement.
- Both 151H and 152H hydrometers are supported.
- Interactive curve shaping facility can be used to remove poor data points from the grain size distribution curve.

- Fineness modulus, percentage diameters (e.g., D_{10}, D_{30} and D_{60}), coefficient of uniformity (C_u) and curvature (C_c), and fractional components (e.g., the percentage of cobbles, gravel, sand, silt and clay in the material tested) are calculated.
- Both the standard multi-point (up to 6 test points) liquid limit test and the ASTM D 4318 Method B (one-point) test are supported.
- Up to 4 plastic limit moistures may be entered.
- A second oven-dried liquid limit test may be entered if an organics check is necessary: ASTM D 2487, otherwise known as the USCS classification method, requires a second liquid limit test after oven-drying if the sample is suspected to contain significant amounts of organics.
- Calculated liquid and plastic limits results are also automatically used to classify the soil using ASTM, AASHTO, USDA, Burmister and Australian Standard (AS 1726) methods.
- Atterberg limits calculations include support for one-point liquid limit tests and calculation of plasticity and liquidity indices.
- Optional automatic averaging of two moisture content tests per compaction point.
- Compaction test specification editor supports adding new, modified or updated compaction test specifications to the program's list of supported test types.
- Automatic adjustment of compaction test results to account for oversize material (i.e., "rock correction") via ASTM D 4718, AASHTO T 224 or CT-216.
- Limited support for creating a compaction curve from a single moisture-density test point.
- If the GEOSYSTEM Boring Log Drafting program is licensed, calculated results such as the percent passing the #200 sieve, Atterberg limits and soil classification results are available for inclusion on boring log reports.

1.1.1 New Features in Version 4

We've been collecting requests for new features since releasing our first DOS programs in 1984. The new program finally puts check marks next to many of the items on our most-wanted list:

Direct creation of .PDF files

.PDF files are great for e-mailing reports to your clients because your client receives an exact picture of the printed report. However, Adobe's Acrobat program (which is typically used to create these files) is expensive, difficult to use and must be licensed for every computer that needs to create .PDF files. ***LabSuite***'s ability to directly create .PDF files of chart and summary reports means that you won't need to pay Adobe for a separate .PDF package.

Multiple sample splits

Older GEOSYSTEM grain size programs supported 1 split of the sample during sieve testing; the new program supports an unlimited number of splits per test.

Container weight database

LabSuite may be set up to keep a list of sample container IDs and weights. You can use this feature avoid weighing:

- The container used for hygroscopic moisture content tests.
- The container used to weigh the sieve test sample.
- The pan used for cumulative weight retained sieve tests.
- Moisture content test sample containers.

New Particle Diameter Calculations

LabSuite adds reporting for D_{20}, D_{80}, D_{90} and D_{95}.

Support for U.S.D.A., Burmister, AASHTO, Australian Standard 1726 and Wentworth classifications

Each soil classification system specifies different particle sizes for breaking down material into component fractions; e.g., Burmister's sand classification extends from #10 to #200 while the USCS/ASTM sand size ranges from #4 to #200. ***LabSuite*** allows you to specify which classification to use on a project-by-project basis.

Specifications can include tolerances

Each sieve in a specification envelope can be provided with a tolerance; e.g.,
`#200: 10%–15%, ±2%`
Test results falling within the tolerance will not be flagged as failing.

New particle size chart types

You can now choose from semi-log, x^.45, Wentworth (Phi scale), log(size) vs. probability and linear particle size distribution charts.

Selectable minimum and maximum diameters for the particle distribution chart

Choose a 9-inch to 42-inch scale for plotting riprap, or a .1mm. to 75mm. scale for aggregates, etc.

Selectable particle size distribution chart scale labels

E.g., ***Percent Finer*** or ***Percent Passing***; ***Grain Size in mms.*** or ***Particle Diameter, mm.***, etc.

Particle distribution charts can plot either percent retained or percent passing

You can also plot charts showing percent passing (i.e., percent finer) on the left side and percent retained on the right.

Curves may be plotted in color

When printed on a color printer, ***LabSuite*** can draw each test's curve in a different color.

Specification envelopes may be omitted from particle distribution charts

This is useful if your specification includes just a few points: the envelope will not be shown on the chart, but the program will still report whether the calculated percentages pass the specification.

New report form designed for filter media tests

The new GSFILTER report form omits all soil-specific information, such as the classification, Atterberg limits, % gravel, sand, silt, clay, etc. GSFILTER also supports specification ranges for C_u and D_{10}; e.g., D_{10} should be between 10 and 20 %.

Reports can include a disclaimer

Your reports can include a disclaimer such as ***This report contains test results of a randomly selected sample and may not be indicative of the properties of similar materials used or sampled from the same site. This report shall not be altered or reproduced without the expressed written consent of the testing laboratory.***

Reports can include an area for reporting (or signing) by the test technician and report reviewer

(I.e., "Tested by" and "Checked by".)

Fully automatic export of test reports

Whenever you enter a test or modify its data, ***LabSuite*** can automatically generate a .PDF version of the test report in a directory of your choosing. You can use this feature to maintain an archival copy of a project's reports (it's always better to store your data in as many formats as is possible if you want to be able to review your results many years down the road), or (if your webserver's directories are available on your local network) make your reports web-accessible.

Testing data may be exported to XML files

Microsoft Excel XP can directly read these files, so your clients who want to do their own data processing with a spreadsheet can import your testing data directly into Excel.

Selectable margins for all printouts

This feature can be used to make space at the top of the page for printing your reports on letterhead.

Reports can be copied to the Windows clipboard

From the clipboard, you can paste your test reports directly into Word documents.

User-Specified Sieve Opening Sizes

If you certify your sieves' opening sizes with a statistical measurement process you can now use each sieve's measured opening size instead of the standard opening size. For example, ***LabSuite*** normally uses an opening size of 2 mm. for a #10 sieve: if your sieve's openings averages 1.994 mm. with an optical measurement device, you can report the diameter of particles passing that sieve as 1.994 mm. instead of 2 mm.

Natural Moisture and Liquidity Index Calculations

The software can calculate a soil's liquidity index based upon the soil's natural moisture content and liquid and plastic limits.

Maximum Density/Optimum Moisture Point Shown Directly on Proctor Charts

Moisture-density curves can now optionally denote the point of maximum density and optimum moisture directly on the chart as required by, e.g., ASTM D 698 §12.1.11.

Current Compaction Test Support

LabSuite adds support for ASTM D 698-07, D 1557-02 and AASHTO T 224-01.

Data-averaging Compaction Curve Plotting Option

As an option, compaction curves can be drawn using a "data-averaging" mathematical model: These curves average the distance between the curve and each test point, which can be used to smooth out compaction test errors.

Selective Omitting of Test Points from the Compaction Curve

Bad compaction test points can be dropped from the compaction curve while still including the test data on summary reports for documentation purposes.

New Combined Grain Size and Moisture-Density Report Form

The program includes a new report form that combines moisture-density and grain size test data onto a single report page.

Per-Test Specification Results Rounding

Different moisture-density test specifications feature different calculated results rounding requirements (e.g., ASTM D 698 requires reporting the maximum dry density to 0.1 pcf, while ASTM D 1557 requires rounding to 0.5 pcf); ***LabSuite*** now allows you to select the rounding criteria for maximum density and optimum moisture results on a per-test specification basis.

When a tested sample is taken from a borehole, the sample descriptions may now be different than the boring log soil layer description.

Many times, at the depth where a sample was taken the material description entered into the boring log may be something like **`Same as above`**. With older GEOSYSTEM programs, you'd see **Same as above** in the **Material Description** block of your test report, so you'd need to go back to the boring log data entry screen, change **`Same as above`** to whatever the material layer's description was, print the lab. test report, then change the description back to **`Same as`**

above. The new program allows you to pick the sample's description from a list of material descriptions entered for the borehole, without changing the sample's description in the boring log (e.g., the lab. test reports could print **Silty, sandy clay** as the material description, while the boring log continues to show **Same as above**).

1.2 Tutorial

If you're just starting out with the software, consider taking the program's thirty minute tutorial:

1. Start the GEOSYSTEM for Windows package: If you have a "GEOSYSTEM" shortcut on your desktop, double-click on it; if you don't have the shortcut, click on your "Start" button and select Programs > GEOSYSTEM > GEOSYSTEM for Windows.
2. On the left side of the program's screen is a directory box: navigate to the directory where your GEOSYSTEM programs are installed. (If you've installed the software onto your own hard disk, this will probably be **C:\PROGRAM FILES\GEOSYS**.)
3. In the program folder you will find a file called DEMO: double-click on it.
4. The software should display the contents of the DEMO project. On the left side of the screen is a yellow box listing the material sources from which the DEMO project's testing samples were taken: click on either **Boring B-4** or **B-4**.
5. On the right side of the screen you should see a list of samples taken from Boring B-4: find the data entry card for sample **S-4** and click on the underlined **GrainSize** at the bottom of that card.
6. Select Help > Tutorial, and the program will begin displaying a series of yellow tutorial cards at the bottom of the data entry window.

1.3 Contacting Technical Support

If you have any questions on installing or operating our software, please feel free to contact GEOSYSTEM technical support. We do not charge for support, though we can only help with software that we are currently selling (we cannot answer questions about older versions our programs). You can contact us through our support page at http://www.geosystemsoftware.com/support.htm.

⇒ If you think that the program's calculated results "don't look quite right", please give us something more to work with: do the calculations by hand and fax your calculations to + 1 970/223-8788 prior to submitting a support question.

2. Configuration

LabSuite features a number of configurable options for data entry, test results calculation and report generation. Before typing in your first test set you should make sure that the package is correctly configured for your specific testing and reporting standards. To do this, select Options > Program Setup.

⇒ Note that these settings affect every test entered into the current project file.

2.1 Data Entry Options

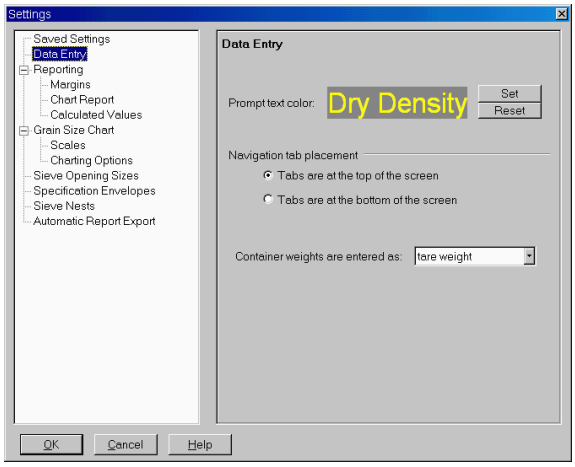


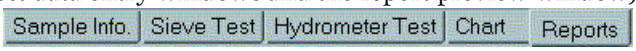
Figure 2.1: Data Entry Settings

Selecting Options > Program Setup then clicking on **Data Entry** in the navigation list at the dialog's left side provides you with the following options:

Prompt text color

Sets the color of all data entry prompts. Click **Set** to select a color or **Reset** to restore the program's default color.

Navigation tab placement

Navigation tabs allow you to change from one window to another (for example, between the test data entry windows and the report preview window). The tabs look like this: 

Navigation tabs may be placed at either the top or the bottom of the screen by selecting one of the **Navigation tab placement** options.

Container weights are entered as

LabSuite can be set up to keep a list of container IDs and associated weights – when entering moisture content data, instead of entering the container weight you can enter the container ID and the program will look up the associated weight. To do this, select **Tare ID** in this box then enter your list of container IDs and weights into the program's container database (Options > Container List).

2.2 Reporting Options

The following subsections cover settings that affect the program's printed reports.

2.2.1 Printout Margins

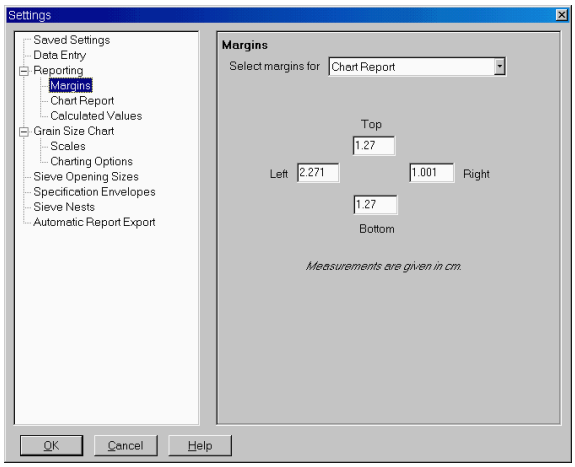


Figure 2.2: Setting the Report Margins

The **Margins** selection on the Setup dialog (Options > Program Setup then click on **Margins** in the navigation list at the dialog's left side) allows you to select the whitespace used at the top, bottom, left and right sides of chart and summary reports.

⇒ The measurement units (inches or cms.) used for specifying margins are determined by the Regional settings in the Windows Control Panel.

2.2.2 General Chart Report Options

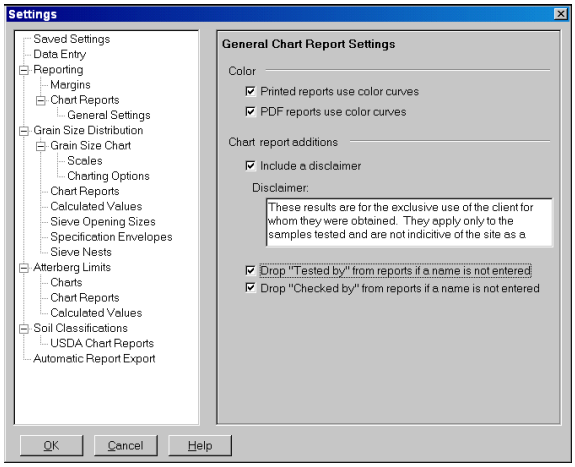


Figure 2.3: General Chart Report Settings

The basic appearance of *all* chart reports generated by ***LabSuite*** may be customized by selecting Options > Program Setup and then clicking on **General Settings** underneath **Chart Reports** in the navigation list at the dialog's left side.

⇒ Additional settings that cover grain size distribution chart reports may be found in § 2.3.3.

⇒ Additional settings that cover Atterberg limits chart reports may be found in § 2.4.2.

⇒ Additional settings that cover the chart reports created for USDA soil classifications may be found in § 2.5.1.

⇒ Additional settings that control the appearance of moisture-density reports may be found in § 2.6.1.

Printed reports use color curves

If selected, curves plotted on chart reports are shown in a program-selected color.

⇒ Note: the first curve printed on a chart is *always* black, so the checkbox has no effect unless the chart includes more than one curve.

PDF reports use color curves

Determines whether chart reports exported as .PDF files show curves in program-selected colors.

Include a disclaimer

If selected, a disclaimer is printed down the left margin of chart reports. The disclaimer is listed in the Disclaimer field directly below the checkbox, and may be modified after checking the **Include a disclaimer** box.

⇒ The figure shown on page 36 includes a sample of how the disclaimer is printed on a chart report.

Drop "Tested by" from reports if a name is not entered

The Sample Info. window includes a data entry field titled **Tested by**. This field, along with the **Drop "Tested by" from reports if a name is not entered** checkbox on the program's setup dialog affects the appearance of chart reports:

- If you do not fill in the **Tested by** data entry field and **Drop "Tested by" from reports if a name is not entered** is *not checked*, "Tested by" will appear below chart report's bottom margin, along with an area for a signature.
- If you do not fill in the **Tested by** data entry field and **Drop "Tested by" from reports if a name is not entered** is *checked*, "Tested by" will NOT appear below chart report's bottom margin.
- If the **Tested by** data entry field is filled in: "Tested by" will appear below chart report's bottom margin, followed by the name entered into the **Tested by** data entry field.

Drop "Checked by" from reports if a name is not entered

Is similar to **Drop tested by**... discussed above. Leaving this box unchecked and leaving the **Checked by** data entry field blank provides an area below chart reports' bottom border for the report's reviewer to sign the page.

Preferred classification system

Several moisture-density report formats include room for only a single soil classification; for these forms, the **Preferred classification system** box selects which classification will be included on the report.

2.2.3 Automatically Exporting Reports

LabSuite can automatically export versions of its test reports into a selected hard disk subdirectory. This feature can be used to maintain an archival copy of a project's reports (which is useful because it's always better to store your data in as many formats as is possible if you want to be able to review your results many years down the road), or, if your webserver's directories are available from your local network, you can make your test reports web-accessible by configuring ***LabSuite*** to automatically store copies of each test report in a webserver directory.

⇒ If your webserver is not accessible from your local network, you can use the GEOSYSTEM Bindery program to export your grain size test reports to the web and notify your clients via e-mail that new reports are available for review. The program can also fax and e-mail your reports directly to clients.

For more information, please see www.geosystemsoftware.com/bindery.

If you select Options > Program Setup then click on **Automatic Report Export** in the left-hand navigation panel, you'll be presented with the following dialog and options:

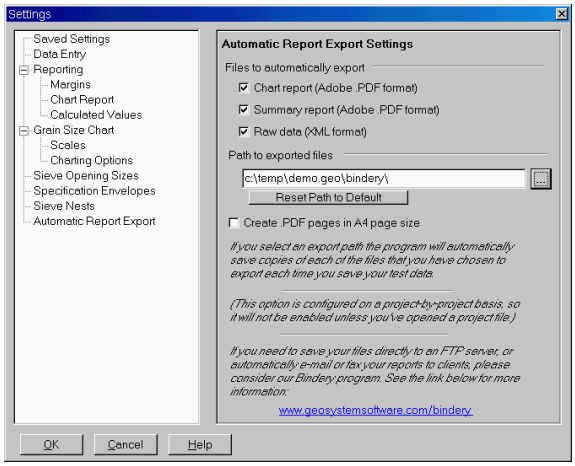


Figure 2.4: Automatic Report Export Dialog

Chart report (Adobe .PDF format)

If this option is checked, ***LabSuite*** will automatically export the test's chart report in a format readable by Adobe Acrobat Reader.

Summary report (Adobe .PDF format)

If this option is selected, ***LabSuite*** automatically exports the test's summary report into an Adobe Acrobat .PDF file.

Raw data (XML format)

If this option is selected, ***LabSuite*** exports an XML file listing the test's data and calculated results.

Path to exported files

This is the file path to where you want to store your exported files. If the path does not exist, the program will offer to create it for you when you click on the dialog's **OK** button.

Reset Path to Default

This sets the **Path to exported files** to be a directory called "Bindery" stored *inside* your project's data file folder, which is useful if you want to export your reports as an archival copy of your data.

Create .PDF pages in A4 page size

If this box is *not* checked, ***LabSuite*** will export your reports as letter-sized (8.5" x 11.0") pages; if the box *is* checked, the .PDF reports will be created as A4-sized (210mm. x 297mm.) pages.

⇒ ***LabSuite*** starts the test report exporting process when you select Save and Exit or when you click on the program's close button. This may delay the program for a few seconds while exiting.

⇒ ***LabSuite*** does not have a soil classifications summary report. It does have a chart report featuring the USDA textural triangle, but because this report is not a necessity for most organizations, it's not enabled by default (even if the **Chart report (Adobe .PDF format)** option is selected). Click on **USDA Chart Reports** underneath **Soil Classifications** in the left-hand navigation panel to enable USDA chart report exporting.

2.3 Grain Size Distribution Configuration

The following sections cover configuration options that affect the entry and reporting of grain size distribution test data.

2.3.1 Grain Size Chart Scales

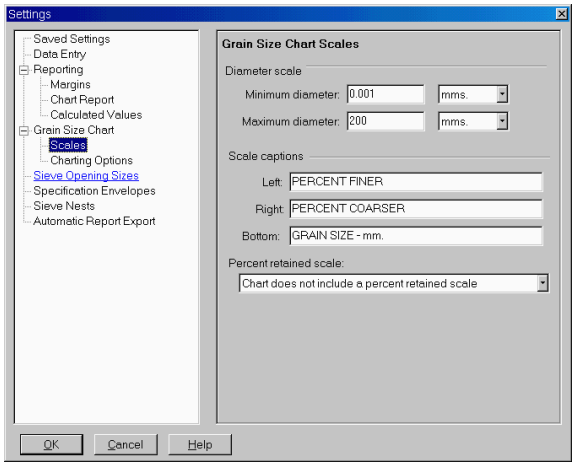


Figure 2.5: Chart Scale Settings

Selecting Options > Program Setup and clicking on **Scales** underneath **Grain Size Chart** in the navigation list at the dialog's left side allows you to modify the scales shown on the sides of grain size distribution charts:

Minimum diameter
Maximum diameter

These fields select the extent of the particle diameter scale on the grain size distribution chart. Values may be specified in either inches or millimeters; use the units selection box just to the right of the minimum and maximum diameter fields to specify the units that you're using.

You do not need to use the same units for the maximum diameter and minimum diameter values; for example, most soil sample chart scales extend from 6" to 0.001mms., so the minimum diameter would be `0.001` with the units selection being set to `mms.`; the maximum diameter would be specified as `6` with the maximum diameter units selection set to `inches`.

Scale captions

Use the **Left**, **Right** and **Bottom** scale captions fields to change the captions printed next the scales printed on a grain size distribution chart. Note that the **Right** scale caption is not printed unless the **Percent retained scale** option is set to **`Left is percent finer, right is percent retained`**.

Percent retained scale

This selection offers the following options for the grain size distribution chart:

- **Chart does not include a percent retained scale**: The left-hand chart scale is of percent finer and no scale is shown on the chart right side
- **Percent retained on chart left side**: The left-hand chart scale is of percent retained, while no scale is shown on the right side of the chart
- **Left is finer, right is percent retained**: The chart includes a percent finer scale on the left side and a percent retained scale on the right side

⇒ Note that this option has no effect on log(size) vs. probability charts.

2.3.2 Grain Size Charting Options

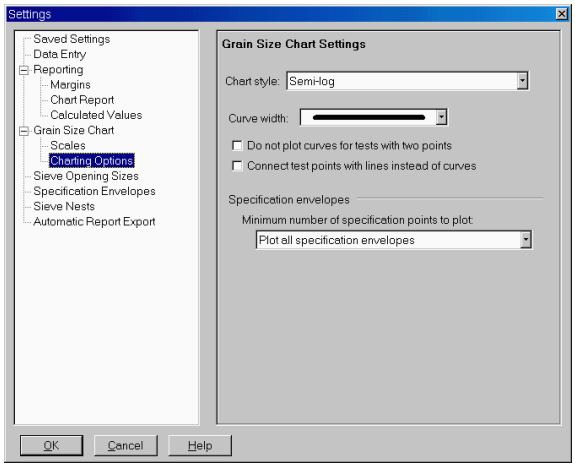


Figure 2.6: Charting Options

If you select Options > Program Setup then click on **Charting Options** underneath **Grain Size Chart** in the navigation list at the dialog's left side you can change several options that affect how grain size distribution charts are drawn:

Chart style

LabSuite supports five types of grain size distribution charts:

- **Semi-log**: Plots percent retained or passing vs. $\log_{10}$(grain diameter). This is the customary chart used for reporting soil grain size distribution test results.
- **Log(size) vs. probability**: Plots $\log_{10}$(grain diameter) vs. probability (i.e., the standard normal distribution). Log(size) vs. probability charts are normally used for plotting filter media test results.
- **Linear**: Plots percent retained or passing vs. grain diameter. This chart style is sometimes used when plotting filter media test results.
- **Diameter^0.45**: Plots percent retained or passing vs. grain diameter raised to the 0.45 power. Typically used for plotting pavement aggregate size distributions.
- **Phi (Wentworth)**: Plots percent passing or retained vs. -$\log_2$(grain size diameter). Wentworth-classified materials are typically plotted using this chart style.

Curve width

Determines the width of the grain size distribution curve.

Do not plot curves for tests with two points

If selected, tests performed with only two sieves (or tests performed with a single sieve and a #200 wash) are plotted using only graph markers (e.g., circles, triangles, squares, etc.) without a line connecting the markers. Avoids having a straight line connect the two test points.

Connect test points with lines instead of curves

If selected, connects points on the grain size distribution chart with straight lines instead of spline curves.

Minimum number of specification points to plot

When given a material specification with a small number of control points such as:

```
#40 sieve:  80%–100% finer
#200 sieve:  0%–5% finer
```

it isn't usually desirable to plot the resulting specification envelope on the grain size distribution chart because the small number of control points do not make for a usable "envelope". Use the **Minimum number...** box to select the minimum number of control points that ***LabSuite*** will use to plot specification envelopes. Specification sets with less control points will still be used to show whether the test is in or out of spec.; they just won't be shown graphically on the grain size distribution chart.

2.3.3 Grain Size Chart Reports

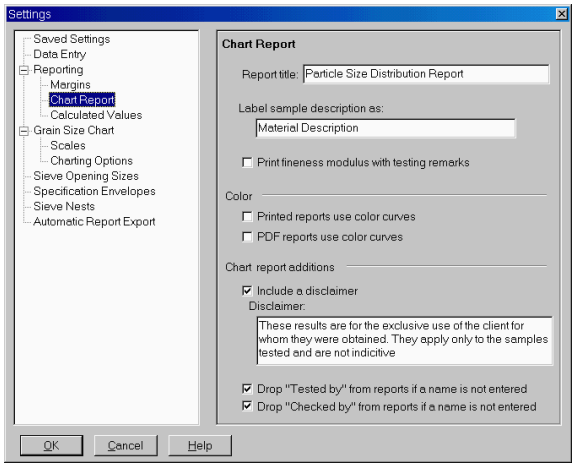


Figure 2.7: Chart Report Settings

Particle size distribution chart reports may be customized by selecting Options > Program Setup and then clicking on **Chart Reports** underneath **Grain Size** in the navigation list at the dialog's left side:

Report title

The chart report title is a single line of text shown at the top of the report. Typically the title reads **`Particle Size Distribution Report`** or **`Grain Size Distribution Report – ASTM D 422`**.

Label sample description as

Chart reports usually include an area for reporting a description of the sample (e.g., **`Brown sandy clay`**) with a title such as **`Soil Description`**. If the material being tested is aggregate, the sample description may be labeled **`Type of Aggregate`** (or alternatively, a more generic title such as **`Material Description`**) by entering the new label into the **Label sample description as** field.

Print fineness modulus with testing remarks

This option appends the calculated fineness modulus (see ASTM C 136 or AASHTO T 27) to the end of the testing remarks on test reports. Note that the user is responsible for selecting a sieve nest that corresponds to AASHTO's specification – ***LabSuite*** adds the total percentage of material retained on any of the following sieves: 6", 3" 1.5", 3/4", 3/8", #4, #8, #16, #30, #50 and #100 and divides the sum by 100. If sieves are missing from the list, the resulting fineness modulus will not be compliant with C 136.

2.3.4 Grain Size Test Calculation Options

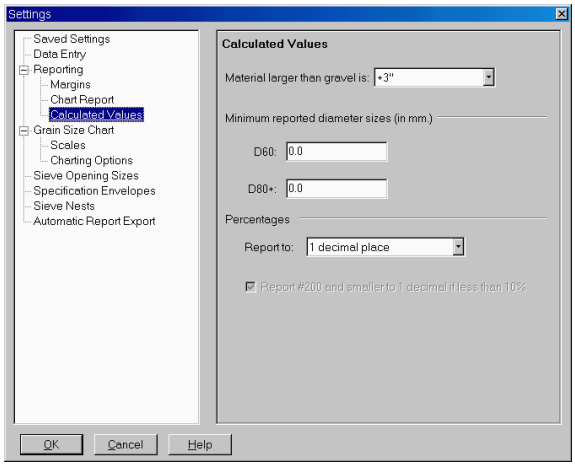


Figure 2.8: Calculated Values Settings

The **Calculated Values** selection on the Settings dialog (Options > Program Setup then click on **Calculated Values** underneath **Grain Size Distribution** in the navigation list at the dialog's left side) includes several options that affect how grain size distribution calculated results are reported:

Material larger than gravel is

When reporting the percent of material larger than gravel, the program can label the percentage as either $+3$", $+75mm$, or *Cobbles*. (The difference is purely semantical and does not result in any change in calculated results.)

Minimum reported diameter sizes (in mm.): D60

Specifies the smallest calculated diameter that will be reported for D_{60}. If the diameter calculated as D_{60} is smaller than the specified minimum reported diameter size, the software will not report a D_{60} value.

Minimum reported diameter sizes (in mm.): D80+

Specifies the smallest calculated diameter that will be reported for D_{80}, D_{85}, D_{90} and D_{95}. If the calculated diameter is smaller than the specified minimum reported diameter size, the value will not be reported.

Percentages: Report to

Determines the number of decimals to which percent finer/percent coarser (i.e., percent passing/percent retained) values will be reported.

Report #200 and smaller to 1 decimal if less than 10%

ASTM C 136 and AASHTO T 27 specifies that material percentages are to be reported to the nearest whole number, with the exception that if the percentage passing the #200 sieve is less than 10% it should be reported to the nearest 0.1%. If the **Report #200 to 1 decimal place if less than 10%** option is selected, the program reports the #200 percentage, *and smaller sieves and all hydrometer results*, to 1 decimal place if the percentage is less than 10. This option is unavailable if *all* percentages are reported to 1 place (see above).

2.3.5 Sieve Opening Size Measurements

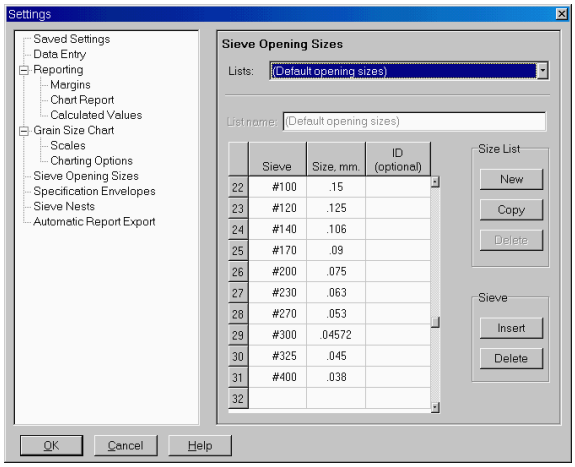


Figure 2.9: Specifying Sieve Opening Sizes

If you certify your sieves' opening sizes with a statistical measurement process you can use each sieve's statistically measured opening size instead of the program's default opening sizes. For example, ***LabSuite*** normally uses an opening size of 2 mm. for a #10 sieve: if your sieve's openings averages 1.994 mm. with an optical measurement device, you'll want to report the diameter of particles passing that sieve as 1.994 mm. instead of 2 mm.

To use the as-measured opening sizes for the sieves used for a particular sieve test, you'll need to enter that test's list of sieves into ***LabSuite***'s Sieve Opening Sizes database:

1. Select Options > Program Setup then click on **Sieve Opening Sizes** in the left-hand navigation panel.

2. If you've already entered a similar opening sizes list, you can drop down the **Lists** box, select your opening sizes list from the box and click on the **Copy** button.
   Alternatively, if you do not already have a similar opening sizes list:
   Click on the **New** button in the **Size List** box on the right side of the dialog.

3. Next, at the **Name** prompt, enter a unique name for your opening sizes list (i.e., not used for one of the opening sizes lists already stored in the program's database).

4. After you've entered your list name, pressing Enter brings you to the opening sizes grid: For each sieve you've measured, enter the sieve's designated size (e.g., **`#4`** or **`1.5in.`** or **`2mm.`**) into the **Sieve** column then enter the measured sieve size in the **Size, mm.** column. The right-most column, labeled **ID**, can be used to enter a sieve tracking number or label. ***LabSuite*** doesn't use IDs: they're included as a convenience so that you can correlate a sieve to its measurement papers.

⇒ You can list your sieves in any order (i.e., by increasing or decreasing opening size).

⇒ Because an opening sizes list contains the measurements for a specific stack of sieves, you'll end up entering some sieves' measurements in more than one opening sizes list as they're used in different sieve stacks.

⇒ For reference, ***LabSuite*** includes a list of its default opening sizes that you can view by selecting **`(Default opening sizes)`** from the list selection box. This list may not be edited.

2.3.6 Grain Size Specification Envelopes

Specification envelopes provide upper and lower percentage boundaries for various particle sizes. For example, your client may specify that a given delivered material consist 100 % of particles smaller than 3/8", and contain a total of 10 % to 20 % particles smaller than the #200 sieve.

LabSuite uses specification envelopes to flag (during data entry and on printed reports) tests that do not pass your or your client's requirements. For example, some chart reports such as GSPASS include a table listing the percent finer for each sieve size, along with the specification (if any) for that opening size and whether the test passes the specification.

Specification envelopes can be shown visually on particle distribution charts, as you can see in the following sample:

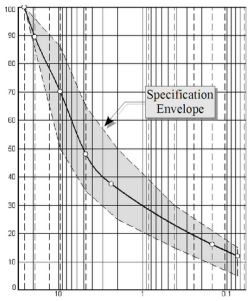


Figure 2.10: Grain Size Distribution Chart with Specification Envelope

⇒ You can stop the program from drawing the gray specification envelope on the chart report using the **Minimum number of specification points to plot** selection in the **Charting Options** page of the program's Settings dialog.

⇒ Specification envelopes are always optional; you don't have to provide a material specification in order to enter a grain size test.

LabSuite is shipped with a database of standard specification envelopes taken from ASTM, AASHTO, Superpave and ISSA (International Slurry Surfacing Association) standards. You can also add your own envelopes to the database:

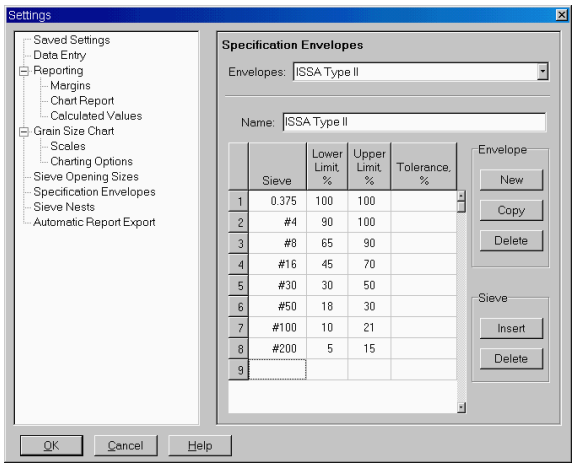


Figure 2.11: Specification Envelopes Dialog

1. Select Options > Program Setup, then click on **Specification Envelopes** in the left-hand navigation panel.
2. Click on the **New** button in the **Envelope** box on the right side of the dialog.
3. At the **Name** prompt, enter a unique name for your envelope (i.e., not used for one of the specification envelopes already stored in the program's database).
4. After you've entered your envelope name, pressing Enter brings you to the specifications grid. For each sieve in your specification, enter the sieve's opening size and the specification's lower and upper boundaries.

⇒ Opening sizes should be entered as follows: use a "#" sign for numbered sieves (e.g., **`#40`**); measured sieve openings should normally be entered in dimension units appropriate for the project file on which you're working (i.e., if you've configured the project to use SI units, enter your sieve opening sizes in millimeters; for a US unit project, enter your sieve opening sizes in inches). If you need to enter a millimeter size into an envelope used for a US unit project, add **`MM.`** to the end of the measurement (e.g., **`2MM.`**).

⇒ Lower and upper limits should be entered as percentages (e.g., **`30`** is 30 percent).

⇒ You can also enter a tolerance for each opening size so that any tested sieve falling *outside* the specification's lower and upper limit boundaries by less than the specified tolerance will be considered by the program to be passing the specification. Alternatively, you can leave the **Tolerance** column empty for any of the sieves in your envelope and the program will consider the tolerance to be 0 %.

⇒ Material specifications are normally given in terms of a lower and upper limit (e.g., *the material should have between 10 % and 40 % finer than the #40 sieve*); however, an alternative specification is given in terms of: *X % of the material should*

be larger than the Y sieve size (e.g., *50 % of the material is to be larger than the #200 sieve*). To enter a specification such as this, enter the required percentage as the specification's lower limit and enter **`100`** as the specification's upper limit.

⇒ If you're given a specification such as: *X % of the material should be smaller than the Y sieve size*, enter X-.01 as your upper limit (e.g., if your specification says *50 % of the material should be smaller than the #200 sieve*, enter **`49.99`** as your upper limit), and enter **`0`** as your lower limit. **There is one exception to this rule:** if the largest sieves in your specification require 100 % smaller (e.g., *100 % of the material must be smaller than the 3" sieve*), enter **`100`** as both the lower and upper limits for the sieve.

2.3.7 Sieve Nests

LabSuite can be configured to save a list of the sieves used in a particular sieve nest. When you start a new test, the program can automatically fill in the test's sieve sizes from the list of sieves in your saved sieve nest. The program's Sieve Nest editor allows you to enter and delete these lists.

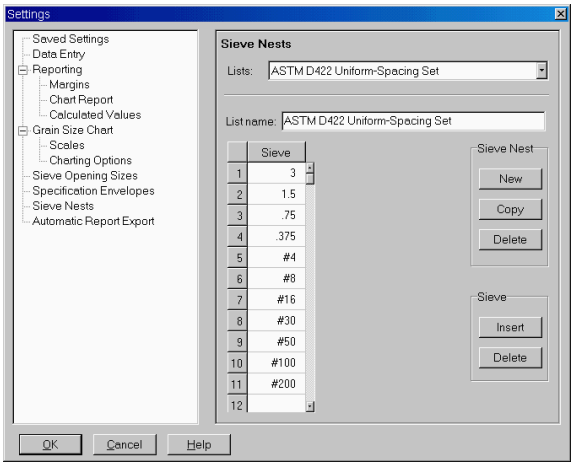


Figure 2.12: Sieve Nest Dialog

To create a list of sieves:

1. Select Options > Program Setup then click on **Sieve Nests** in the left-hand navigation panel.
2. Click on the **New** button in the **Sieve Nest** box on the right side of the dialog.
3. At the **Name** prompt, enter a unique name for your list (i.e., not used for one of the sieve nests already stored in the program's database). Names may be anything that describes the set of sieves that you'll be entering: as an example, here are a couple of the predefined sieve nests shipped with the program:
   `ASTM D422 Uniform-Spacing Set`
   `ASTM D422 Recommended Sieve Set #1`

4. After you've entered your sieve nest name, pressing Enter brings you to the sieve sizes grid. Enter the size of each sieve in your sieve nest, in order of decreasing opening size (e.g., 3", 2" 1.5", etc.).

   ⇒ Enter sieve sizes as follows: use a "#" sign for numbered sieves (e.g., **#40**); measured sieve openings should normally be entered in dimension units appropriate for the project file on which you're working (i.e., if you've configured the project to use SI units, enter your sieve opening sizes in millimeters; for a US unit project, enter your sieve opening sizes in inches). If you need to enter a millimeter size into an envelope used for a US unit project, add **MM.** to the end of the measurement (e.g., **2MM.**).

§ 3.2.7 provides instructions on using your sieve nest as a starting point for entering a new sieve test.

2.4 Atterberg Limits Configuration

The following sections cover configuration options that affect the entry and reporting of Atterberg limits test data.

2.4.1 Plasticity and Blows vs. Moisture Chart Settings

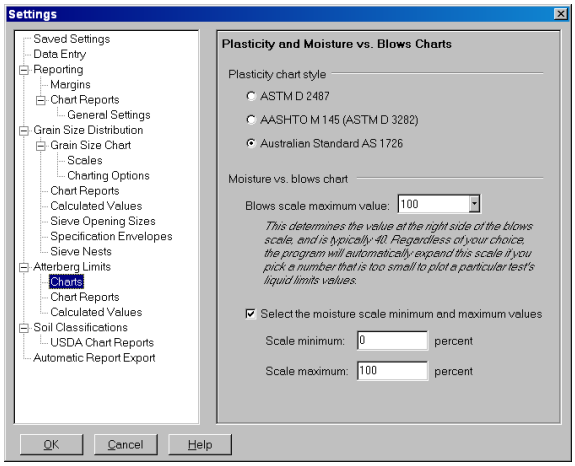


Figure 2.13: Limits Chart Settings

Selecting Options > Program Setup and clicking on **Charts** underneath **Atterberg Limits** in the navigation list at the dialog's left side allows you to modify the appearance of the Atterberg blows vs. moisture and plasticity charts:

Plasticity chart style

The ASTM D 2487 (USCS), AASHTO M 145 and AS 1726 soil classification standards incorporate a chart of liquid limit vs. plasticity index; the format of this chart is unique to each standard. **Plasticity chart style** selects which type of plasticity chart will be shown on Atterberg limits chart reports. After selecting the plasticity chart type, make sure to select the option to show the plasticity chart on reports instead of the blows vs. moisture chart.

Blows scale maximum value

This determines the value at the right side of the blows scale, and is typically 40. Regardless of your choice, the program will automatically expand this scale if you pick a number that is too small to plot a particular test's liquid limits values.

Select the moisture scale minimum and maximum values

Checking this box allows you to manually select the minumum and maximum moisture content scale values on the blows vs. moisture chart. If this box is *unchecked*, the program will select the scale for you.

2.4.2 Atterberg Limits Chart Reports

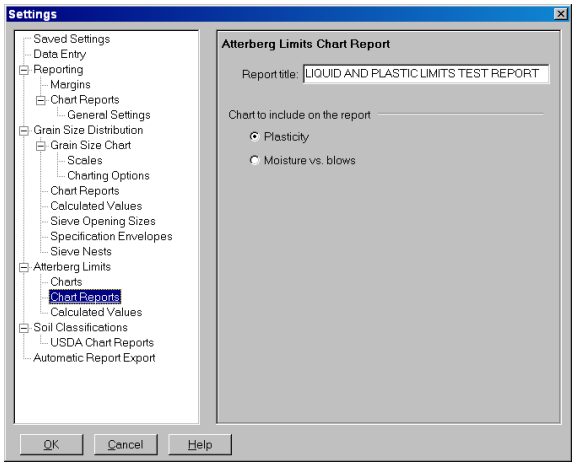


Figure 2.14: Limits Chart Report Settings

Selecting Options > Program Setup and clicking on **Chart Reports** underneath **Atterberg Limits** in the navigation list at the dialog's left side allows you to modify the appearance of the Atterberg limits chart reports:

Report title

The chart report title is a single line of text shown at the top of the Atterberg limits chart report. Typically the title reads **`Atterberg Limits Test Report`** or **`Atterberg Limits Test Results - ASTM D 4318`**.

Chart to include on the report

Atterberg limits chart reports include a space for a chart plotting either blows vs. moisture or plasticity (liquid limit vs. plasticity index).

2.4.3 Atterberg Limits Calculation Options

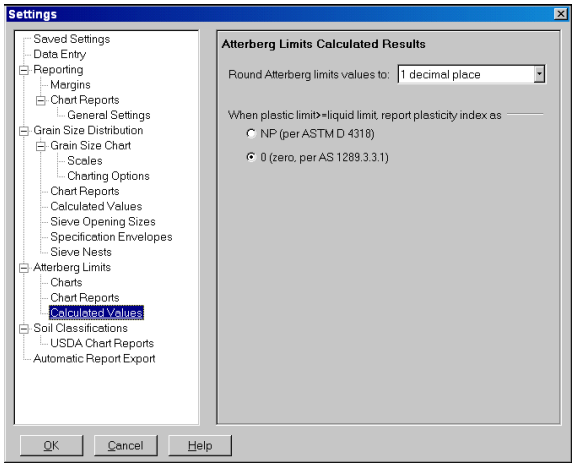


Figure 2.15: Limits Calculated Values Settings

The **Calculated Values** selection on the Settings dialog (Options > Program Setup then click on **Calculated Values** underneath **Atterberg Limits** in the navigation list at the dialog's left side) includes several options that affect how Atterberg limits results are reported:

Round Atterberg limits to

Determines the number of digits to the right of the decimal that will be printed when reporting the liquid and plastic limit, plasticity index and liquidity index. (Note that ASTM D 4318, AASHTO T 89, and Australian Standards AS 1289.3.x.1 all specify that Atterberg limits values are to be rounded to the nearest whole number.)

When plastic limit > = liquid limit, report plasticity index as

ASTM D 4318 and AS 1289.3.3.1 disagree on how the plasticity index is to be reported if the sample's plastic limit is larger than its liquid limit: ASTM indicates that the soil should be reported as NP (see Section 18.1.1), while the Australian Standard indicates that the plastic limit is to be reported as 0 (see Section 5, note c). The **When plastic limit>=liquid limit, report plasticity index as** selection allows you to choose between the two reporting options.

2.5 Soil Classifications Configuration

LabSuite features a minimal amount of configuration options for soil classification results, as covered in the next section.

2.5.1 USDA Chart Report Settings

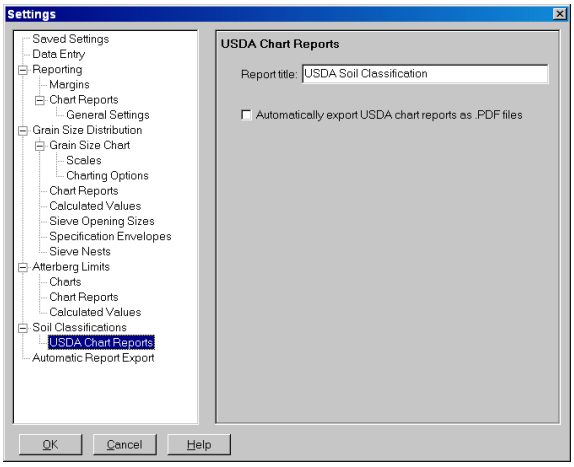


Figure 2.16: USDA Chart Report Settings

LabSuite can produce chart reports featuring the USDA textural triangle. The software offers a single feature for customizing the report: The chart report title, which is a single line of text shown at the top of the report, can be changed by selecting Options > Program Setup and then clicking on **USDA Chart Reports** underneath **Soil Classifcations** in the navigation list at the dialog's left side.

⇒ Typically the title reads **`USDA Soil Classification`** or **`Soil Classification Report`**.)

LabSuite can be set up to automatically export a .PDF version of the USDA chart report whenever the sample's classification changes (i.e., because you've changed the sample's grain size distribution or Atterberg limits data). To do this:

1. Begin by turning on the program's automatic chart report exporting option: Select Options > Program Setup then click on **Automatic Report Export** in the left-side navigation list, and make sure that the **Chart report (Adobe .PDF format)** option is selected.

2. Next, turn on the option to export USDA chart reports (the automatic USDA chart report export is a separate option because most users do not need these reports): Click on **USDA Chart Reports** underneath **Soil Classifcations** in the navigation panel, then make sure that the **Automatically export USDA chart reports as .PDF files** box is checked.

2.6 Moisture-Density Test Configuration

The following section covers configuration options that affects the reporting of moisture-density test data.

2.6.1 Moisture-Density Report Settings

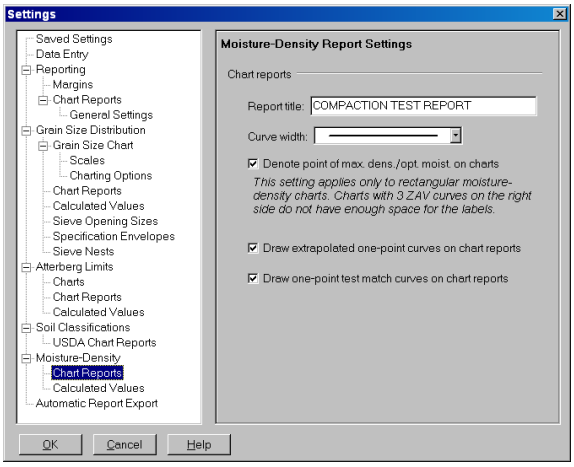


Figure 2.17: Moisture-Density Report Settings

Selecting Options > Program Setup and clicking on **Chart Reports** underneath **Moisture-Density** in the navigation list at the dialog's left side allows you to modify the appearance of reports produced for moisture-density tests:

Report title

The chart report title is a single line of text shown at the top of the moisture-density chart report. Typically the title reads, e.g., **`Compaction Test Report`** or **`Moisture-Density Test Results`**.

Curve width

Determines the width of the moisture-density curve when drawn on a moisture-density chart report.

Draw extrapolated one-point curves on chart reports
Draw one-point test match curves on chart reports

LabSuite supports a simplified version of the AASHTO T 272 one-point test matching procedure that extrapolates a one-point test's compaction curve from a pair of existing tests' compaction curves. For one-point tests that have an extrapolated compaction curve, ***LabSuite*** can be configured to plot the extrapolated compaction curve (by checking the **Draw extrapolated one-point curves on chart reports** box) and/or the pair of existing tests' compaction curves (by checking the **Draw one-point test match curves on chart reports** box).

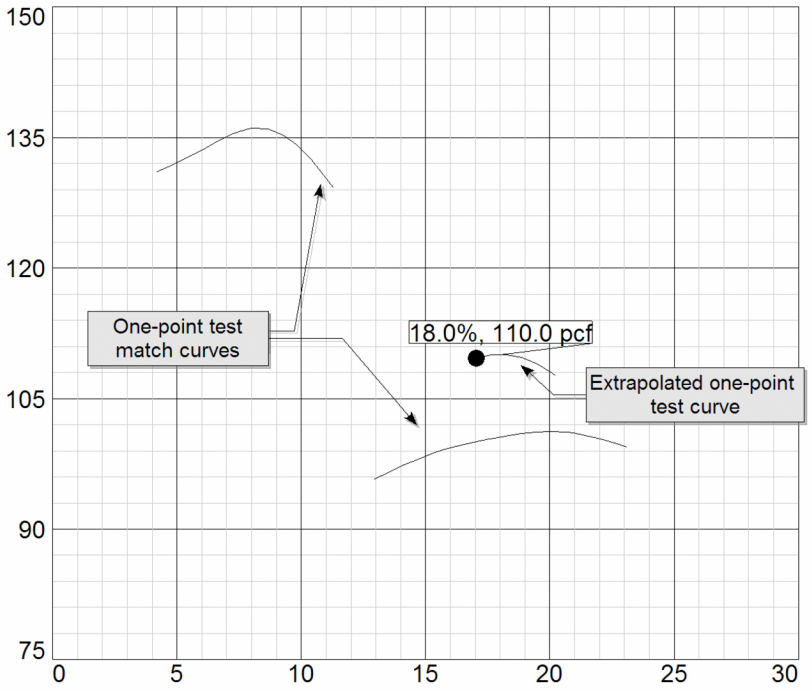


Figure 2.18: Synthesized One-Point Test Curve and Match Curves

Denote point of max. dens./opt. moist. on charts

Selecting this option adds a small call-out box to the moisture-density chart pointing to the point of maximum density/optimum moisture. The selection is required by many test standards (e.g., ASTM D 698).

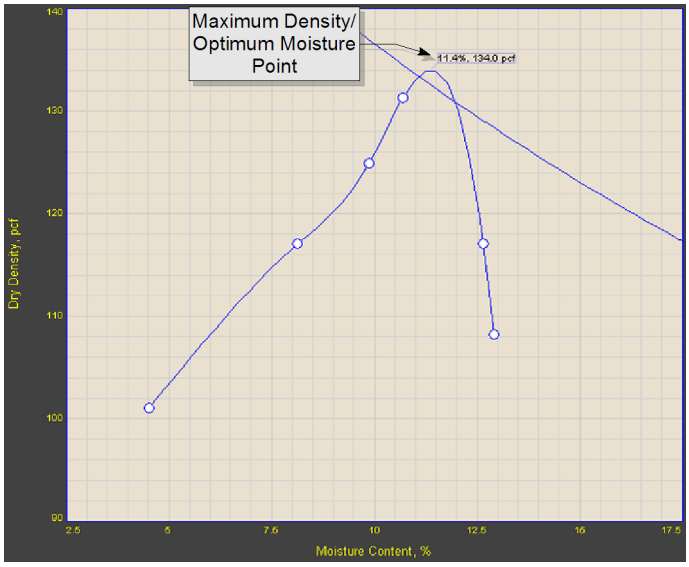


Figure 2.19: Moisture-Density Chart with Call-Out Box

2.6.2 Moisture-Density Calculation Options

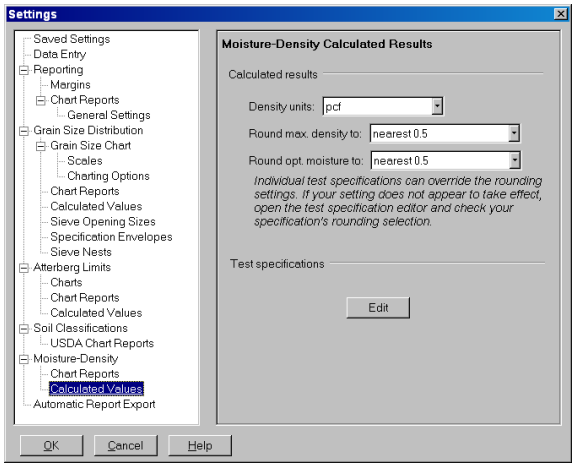


Figure 2.20: Moisture-Density Calculated Values Settings

The **Calculated Values** selection on the Settings dialog (Options > Program Setup then click on **Calculated Values** underneath **Moisture-Density** in the navigation list at the dialog's left side) includes several options that affect how moisture-density test results are reported:

Density units

This selection changes the units to be used to report calculated densities, *regardless of the units used to enter the compaction test data*.

Round max. density to

This selection box controls the program's rounding of calculated maximum density values. Note that the list of available rounding options changes depending upon which density units have been selected.

Round opt. moisture to

This selection box controls the program's rounding of calculated optimum moisture content percentages.

⇒ Using the Test Specification editor (see § 2.6.3) you can override the rounding selection on a per-test specification basis: This can be useful for setting the test results rounding selection for particular moisture-density test specifications that mandate a specific rounding procedure for test results. If your **Round max. density to** and **Round opt. moisture to** selections are not reflected in your reported test results, use the Test Specification editor to check to see if your test specification overrides the default rounding settings.

Test specifications

Clicking on the **Edit** button brings up the Moisture-Density test specification editor, covered in § 2.6.3

2.6.3 Moisture-Density Test Specifications

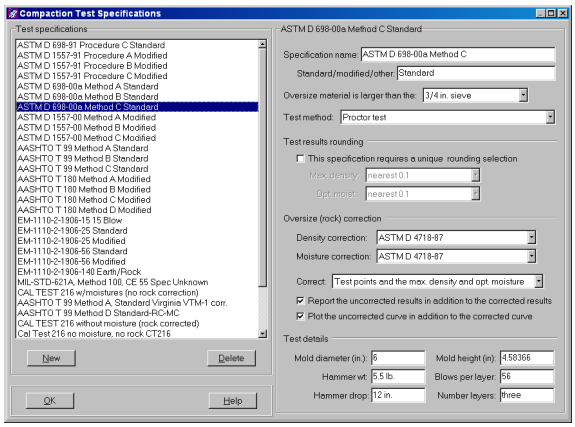


Figure 2.21: Test Specification Editor

LabSuite incorporates a list of different moisture-density test specifications, which consists of:

- The physical requirements of the test, such as the dimensions of the mold, the number of soil layers and blows per layer and the hammer weight and drop.
- Oversize correction requirements such as the size of sieve used to separate out oversize material and the oversize moisture and density correction method.
- Unique reporting requirements, such as whether to report the non-oversize corrected test results as well as the corrected test results.

Each moisture-density test entered into the system must be associated with a test specification from this list.

To edit the program's test specification database, select Options > Program Setup then click on **Calculated Values** underneath **Moisture-Density** in the navigation list at the dialog's left side, then click on the **Edit** button.

To edit a test specification:

Test specifications currently stored in the database are listed on the left-hand side of the panel: To view or edit a specification in the list, simply click on the specification's name.

To create a new test specification:

You can add a new test specification by clicking on the **New** button, or you can start with an existing test specification and save it under a new name by clicking on the test specification in the left-hand list, then click on the **Copy** button.

To remove a test specification from the database:

Click on the test specification's name in the specification list then click on the **Delete** button.

A moisture-density test specification includes the following information:

Specification name

Each specification must be associated with a unique name that describes the test method. A typical specification name would be **`ASTM D 698-91, Method A`**.

Standard/modified/other

Two test specifications may share the same name if different values are entered into the **Standard/modified/other** field for the two specifications: for example, there may be two **`ASTM D 698-91, Method A`** test specifications - one **`Standard`**, the other **`Modified`**.

Oversize material is larger than

For test procedures that require an oversize material correction, this selection specifies the sieve opening size that denotes the oversize material boundary.

Test method

Select **`Proctor test`** for a normal moisture-density test not involving the California Test Method 216 (CT-216) procedure.

For CT-216 tests, ***LabSuite*** supports two test methods: a modified CT-216 test procedure where moisture contents are taken at each test point (this method is labeled as **`CT-216 with added moisture content tests`** in the test method selection box), and a by-the-book CT 216 procedure without moisture contents (labeled **`California Test 216`** in the selection box).

This specification requires a unique rounding selection

The software has maximum dry density and optimum moisture content rounding settings (**Round max. density to** and **Round opt. moisture to**, covered in § 2.6.2) that affect *almost* every test specification; however, you can choose to override these settings for individual test specifications. This can be useful for setting the test results rounding selection for particular moisture-density test specifications that mandate a specific rounding procedure for test results (e.g., ASTM D 698 requires reporting the maximum dry density to 0.1 pcf, while ASTM D 1557 requires rounding to 0.5 pcf).

If you would like to require a particular rounding procedure for a given test specification, check the **This specification requires a unique rounding selection** box, then select the proper rounding option in the **Max. density** and **Opt. moist.** boxes.

Max. density

These options control the rounding of the maximum density and optimum moisture content results calculated by the program for a test using the current test specification. *The selection boxes are only available if the* ***This specification requires a unique rounding selection*** *box is checked*; otherwise, the program rounds the results for tests using the test specification according to the rounding settings chosen in § 2.6.2.

Density correction

Selects the method by which density results from tests using the specification are to be corrected for the presence of oversize material (i.e., rock). Select **`No oversize density correction`** if you do not want to correct the calculated densities.

Moisture correction

Selects the method by which moisture content results from tests using the specification are to be corrected for the presence of oversize material. Select **`No oversize moisture correction`** if you do not want to correct the calculated moisture contents.

⇒ You can stop the program from correcting the moisture and density results for any given test, even if the test's specification requires corrections: Simply do not enter a percentage for the oversize material, or a bulk specific gravity.

Correct

LabSuite can apply the density and moisture oversize corrections to each test point or just to the calculated maximum dry density and optimum moisture content.

⇒ The only real difference between the two options is that if the option to apply the corrections to each test point is chosen, you can opt to have the program plot both the corrected and uncorrected curves as part of the hardcopy reports; if the option to apply the corrections only to the final results is chosen, the corrected maximum density/optimum moisture content will be reported, but charts will only include the uncorrected curve.

Report the uncorrected results in addition to the corrected results

When an oversize correction is applied, the program can be configured to report uncorrected maximum dry density/optimum moisture values in addition to the corrected test results. This selection affects both the data summary report and the chart report. For example, the following figures demonstrate the effect of selecting and unselecting this option on the PRGEOSYS chart report:

ROCK CORRECTED TEST RESULTS
Maximum dry density = 136.7 pcf
Optimum moisture = 12.9 %

Figure 2.22: Chart Report Test Results Box Showing Corrected Results

ROCK CORRECTED TEST RESULTS	UNCORRECTED
Maximum dry density = 136.7 pcf	131.3 pcf
Optimum moisture = 12.9 %	10.7 %

Figure 2.23: Chart Report Test Results Box Showing Corrected and Uncorrected Results

Report the uncorrected curve in addition to the corrected curve

When this option is selected, ***LabSuite*** will plot two curves on moisture-density charts: One curve will be plotted using the original, uncorrected, test results, while the second curve will be plotted using the test's density and moisture results after correcting for the presence of oversize material.

⇒ This option will not be available if you select **`Only the max. density and opt. moisture`** in the **Correct** box because there is no corrected curve: The uncorrected is plotted to calculate an uncorrected maximum density and optimum moisture content, then the oversize correction is applied to the results.

Mold diameter
Mold height

For non-CT-216 tests, ***LabSuite*** utilizes the mold diameter and height required by the selected test specification to calculate a mold volume that is used during data entry as a default for each compaction point's **Mold volume** test data entry field.

Hammer wt.
Hammer drop
Blows per layer
Number layers

These fields are optional. If data are entered for all four prompts, it will be included as part of the test specification listed on chart reports.

⇒ Because ***LabSuite*** does not automatically include measurement units as part of the specification listing, make sure to add **`lb.`** or **`kg.`** to the hammer weight and **`in.`** or **`cms.`** to the hammer drop.

2.7 Saving Sets of Configuration Settings

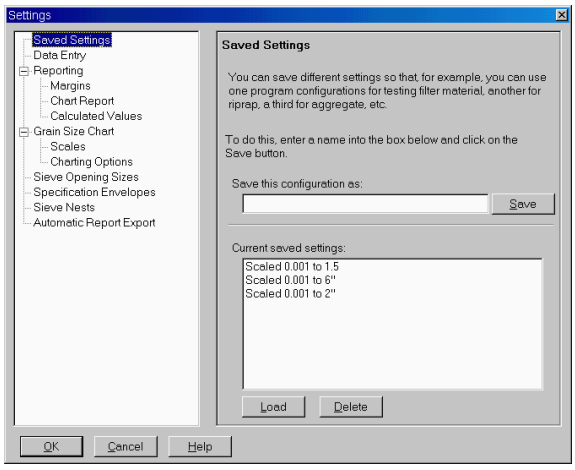


Figure 2.24: Saving Configuration Settings

If you perform several different grain size test procedures, or test radically different types of materials (such as riprap and filter media), you'll find yourself constantly switching between different grain size test settings. For example:

- Riprap may require the chart scales to stretch from 3" to 42".
  while
  Filter material is plotted on a log(size) vs. probability chart
  and
  Soil tests are conventionally plotted on a log(size) vs. percent retained chart.

LabSuite allows you to save your grain size settings selections: before entering data for a new test you can recall a saved group of settings to ensure that the program is properly configured for the type of material tested. For example, you can load the *Riprap* settings before entering a riprap test, or load the *Filter* settings before entering a filter test, etc.

⇒ Every test entered into a given GEOSYSTEM project file shares the same configuration settings. Because of this, if the tests that you've performed for a given project need several different configurations, you'll need to create a new project file for each different configuration.

To save your current program settings:

1. Select Options > Program Setup then click on **Saved Settings** in the navigation list at the dialog's left side.
2. In the **Save this configuration as:** field, enter a name: When you start a new test that uses the same settings, you load them from the **Current saved settings:** list by clicking on your chosen name.

To use your saved settings for a new test:

1. Open the Settings dialog (Options > Program Setup).
2. Click on **Saved Settings** in the navigation list at the dialog's left side.
3. Click on your settings name in the **Current saved settings:** box then click on the **Load** button.

⇒ To delete a saved batch of settings click on the settings name in the **Current saved settings:** box then click on the **Delete** button.

2.8 The Container List

LabSuite may be set up to keep a list of sample container IDs and weights. You can use this feature avoid weighing:

- The container used to weigh the grain size sieve test sample.
- The pan used for cumulative weight retained sieve tests.
- The container used for hygroscopic moisture content tests.
- The container used for Atterberg limits moisture content tests.
- The container used for the moisture content tests performed as part of a moisture-density (Proctor) test.

Instead of weighing your containers every time they're used, you can enter their weight and ID (any label that can uniquely identify the container) into the program's container weight database. When you use an ID'd container for a test, record the container's ID as part of your testing information and enter the ID into ***LabSuite*** instead of the container weight.

To set up the container list, select Options > Container List.

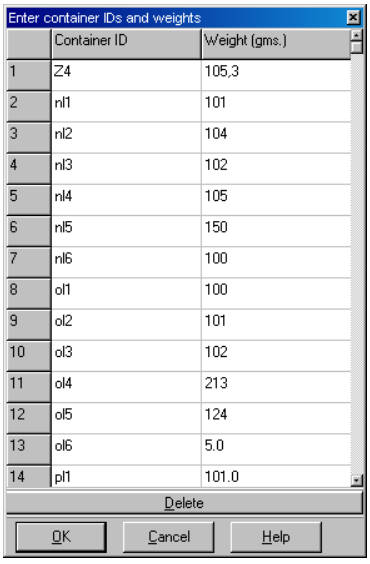


Figure 2.25: The Container List Dialog

To add a new container to the list:

Click on the first blank row in the list and enter the container ID and container weight.

⇒ Container IDs may be any combination of alphabetic and numeric characters; e.g., ACD or 123. IDs that differ only by case (e.g., 3A and 3a) are considered identical.

⇒ Container IDs may be added to the list in any order.

To remove a container from the list:

Click in either the Container ID or Weight columns of the row you want to delete then click on the **Delete** button.

⇒ The container list is always optional: if you run a test with a container that is not on your container list, you can skip entering a container ID and instead enter the container's weight.

After you're through entering your container weights, close the dialog then select Options > Program Setup, click on **Data Entry** in the Setup dialog's left-hand navigation panel, then select **`Tare ID`** in the **Container weights are entered as** box.

3. Entering Grain Size Test Data

Data entry for a grain size distribution test is split into three steps:

- Sample and test background information, which covers basic information about the grain size distribution test and the sample tested.
- Sieve test data entry.
- Hydrometer test data entry.

Begin by selecting Test > Enter GrainSize Data. The following sections discuss each subsequent data entry step in further detail.

3.1 Sample and Test Information

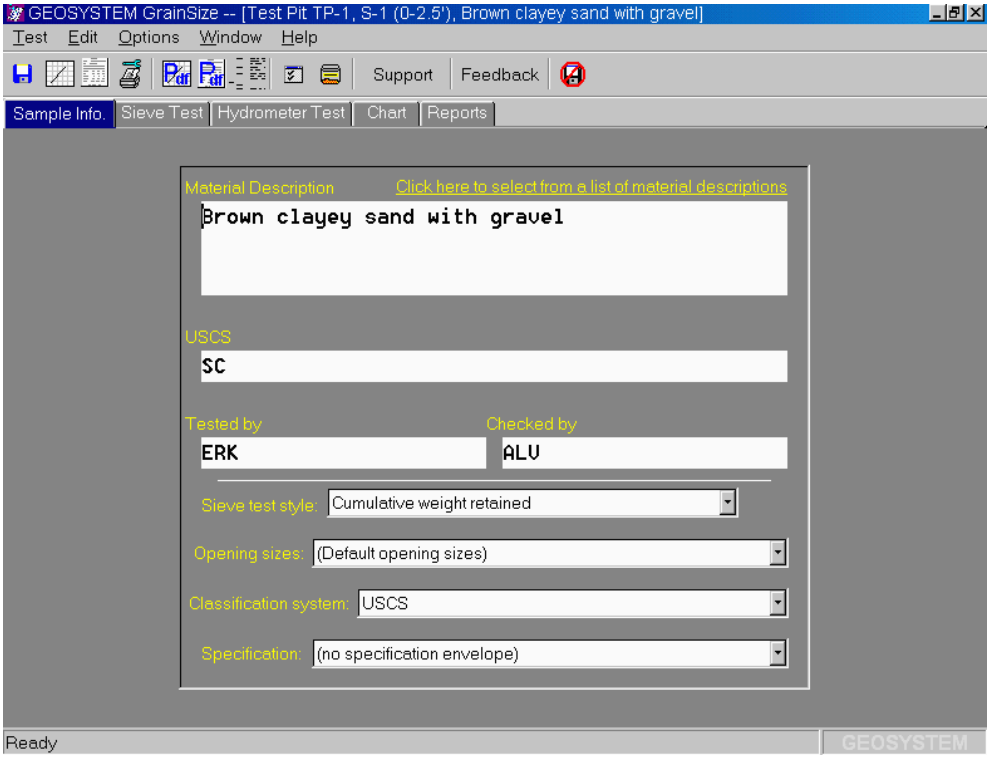


Figure 3.1: Sample Info. Window

The grain size test initial data entry window covers basic information about the test and the sample tested. This window is displayed by clicking on the **Sample Info.** navigation tab, or by selecting Window > Sample Info.

Some items on the window may be automatically filled in by other data reduction modules. (For example, the sample's USCS classification is automatically calculated after the percent passing

the #4 and #200 sieves and the soil's plastic and liquid limit are determined.) Leave these fields blank; after you've completed data entry for the lab tests, the missing information will be automaticalled filled in.

⇒ Because ***LabSuite*** supports a number of different report formats, the information requested on this screen varies according to which report format is selected; e.g., some formats may include a place for listing the sample's USCS classification, while others may omit this information.

You can select from the program's different report forms with the **Report form** toolbar at the top of the report preview window (Window > Report Preview).

While most of the information requested on the Sample Info. window is self-explanatory; a few require further definition:

Tested by
Checked by

If you fill in either of these fields, the information that you enter will be shown below the border of the test's chart report, as the following figure demonstrates:

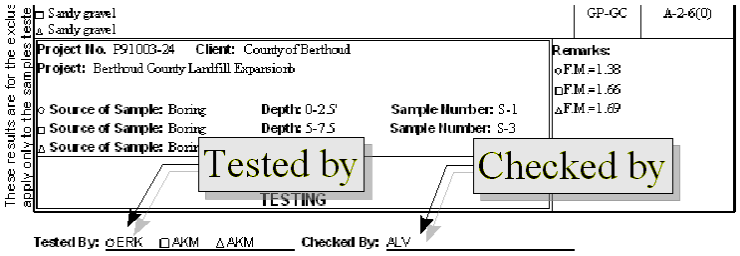


Figure 3.2: Report With Tested By and Checked By

⇒ When printing more than one test per page, ***LabSuite*** will use the "Checked by" name entered for the first test placed on the page.

Material description

LabSuite normally uses the material description that you entered into the **Material Description** field on the Data Manager window (that's the window with the numbered sample cards where you entered the sample's number, depth, etc.). However, if you're entering boring log data, the material description at the depth where you took your lab. test sample may only be something like:

`grades to slightly silty`

with the full stratigraphy description entered at some depth above the lab. test sample. If this is the case, you can either override the default description or click on the link that reads **Click here to select from a list of material descriptions**: this drops down a box listing all of the material descriptions entered into the current source folder. Double-click on one of the descriptions to select it.

Sieve test style

This selection box is used to specify how you weighed the material retained on each sieve:

- **Cumulative weight retained** indicates that after shaking the sieves you emptied each sieve into a common pan; the pan should have been weighed after each sieve's retained material was added. ("Cumulative" means that you're accumulating the material retained on each sieve into a single pan.)
- **Per-sieve weight retained** indicates that you've weighed each sieve when empty; after shaking the sieves, each sieve was weighed a second time along with the material retained on the sieve.
- Selecting **Precalculated** lets you enter your own percentages. This option is useful if you need to graph sieve sizes and percentages provided by a client.

⇒ **Note:** if you change this selection after entering sieve test data, any grain size test data that you've already entered for the sample will be erased.

The following table lists the data requested for each sieve that you test:

Sieve Test Style	What You Need to Enter
Cumulative weight retained	Cumulative pan weight (entered once per test) Sieve size Cumulative weight retained
Per-sieve weight retained	Sieve size Combined weight of the sieve and the material retained on the sieve Sieve weight
Precalculated	Sieve size Percent finer

Opening sizes

If you certify your sieves' opening sizes with a statistical measurement process ***LabSuite*** gives you the ability to precisely specify the opening size of each sieve that you use in your test. (For example, a #10 sieve is normally considered to have a 2 mm. opening size; if your sieve's openings averages 1.994 mm. with an optical measurement device, you can have ***LabSuite*** report the diameter of particles passing that sieve as being smaller than 1.994 mm. instead of 2 mm.) ***LabSuite*** does this by keeping a list of the sizes of the various *sets* of sieves that you use for your tests (one set = all of the sieves used for a given test).

If you've set up this list through the program's Setup dialog, use the **Opening sizes** selection box to choose the sieve sizes list for the test that you'll be entering.

If you haven't set up the sieve sizes list, or if you used sieves that you haven't entered into the sizes list, select **`(Default opening sizes)`** from the opening sizes selection box.

Classification system

Each method used to classify soil (i.e., USCS, Burmister, Wentworth, etc.) subdivides material into gravel, sand, silt and clay at different particle sizes. (For example, the USCS system defines sand as material between #4 and #200 in size, while Burmister defines sand as being between #10 and #200.) You can select your preferred classification system for the test that you'll be entering at the **Classification system** box.

Your selection affects the percentages reported for gravel, sand, silt and clay, as well as the appearance of most of the program's chart reports. Following is a section of a GSGEOSYS report form printed for a test using different classification system selections:

%+3"	% Gravel		% Sand			%Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	4.5	85.7	5.4	1.9	2.2	0.3	

Figure 3.3: **USCS**

%+3"	% Gravel	% Sand	% Silt	% Clay
0.0	90.2	9.5	0.3	

Figure 3.4: **USCS without coarse/medium/fine divisions**

	%+3"	% Pebbles	% Granules	% Sand					% Silt				% Clay
				V. Crs.	Crs.	Med.	Fine	V. Fine	Crs.	Med.	Fine	V. Fine	
	0.0	91.6	4.0	0.9	0.8	0.9	0.8	1.0					

Figure 3.5: **Wentworth**

%+3"	%Gravel			% Sand			%Fines
	Coarse	Medium	Fine	Coarse	Medium	Fine	
0.0	0.0	50.3	45.3	1.5	1.1	1.5	0.3

Figure 3.6: **Burmister**

⇒ There's two USCS selection options:
USCS without coarse/medium/fine divisions
and
USCS
The latter option reports Gravel and Sand percentages without subdividing the gravel size into "coarse" and "fine" and the sand into "coarse", "medium" and "fine".

⇒ We'll be posting more particle classification systems on our website as they're requested by ***LabSuite***'s users. Click on the **More...** button to view an updated list.

Specification

Specification envelopes provide upper and lower boundaries for some of the sieves in your test; for example, your client may require that a given delivered material test with 100 % of its particles smaller than the 3/8" sieve, and with between 10 % and 20 % of its particles smaller than #200 sieve. The program maintains a database of specification envelopes taken from ASTM, AASHTO, Superpave and ISSA (International Slurry Surfacing Association) standards; you can also add your own envelopes to the database through the **Specification Envelopes** window on the program's Setup dialog (Options > Program Setup).

If you have a specification envelope that you'd like to associate with the test that you'll be entering, use the **Specification** box to select your envelope. If you do not want to use a specification envelope, select **(no specification envelope)** from the **Specification** box.

3.1.1 Sample Info. Selection Lists

If you find that you're typing the same information into one of the data entry fields on the Sample Info. window for test after test, you can use the program's *Selection List* feature to turn the field into a popup list of selections that can be inserted into the field with a simple mouse click. There are a couple of cases where this feature can be especially useful:

⇒ You can set up a list of standard entries for fields such as "Tested By", "Checked By", etc. so that you can select – with a single mouse click – from a list of personnel instead of typing in the same names over and over for every test you enter.

⇒ Selection Lists can also be used to easily insert boilerplate text into, for example, the testing remarks field. This can be very handy if the same basic text is always typed into a particular data entry field.

To create a selection list for a field:

Right-click on the field and select Make a Selection List. This shows an empty selection list box that you'll need to fill with selection entries (such as personnel names, or your test remarks boilerplate text):

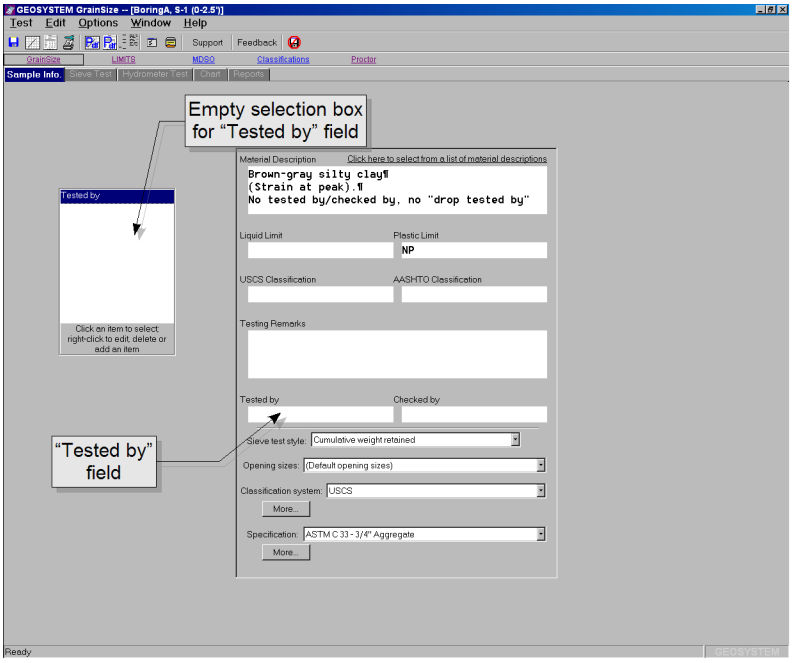


Figure 3.7: Empty Selection List for "Tested by"

Next, right-click within the empty selection list and select Edit, Delete and Add Entries. When you've done this ***LabSuite*** will show the Selection List Editor dialog:

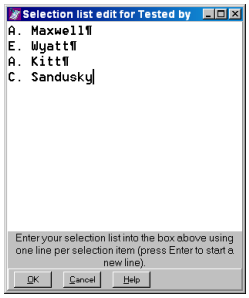


Figure 3.8: Selection List Editor

(The editor box above has already been filled in with a number of testing personnel names.)

Each selection that you want to appear is typed on a separate line: Type a selection, then follow by pressing the Enter key (this will show up as a ¶ sign at the end of the entry). (You can delete entries by simply deleting the line of text that defines the entry, including the ¶ sign at the end of the line.) When you're finished, click **OK** to save the list.

To use a selection list

Once you've created a selection list for a given data entry field, that list will automatically appear when you click in the data entry field, at which point you can either click on one of the items in the list (which will automatically fill in your data entry field with that item), or manually type data into your field.

The figure below shows a sample "Tested by" selection list:

Figure 3.9: Sample Selection List

To delete a data entry field's selection list:

Right-click on the data entry field then select Delete the Selection List. *This action can be undone:* You can make your selection list reappear by right-clicking within the data entry field and selecting Make a selection list again (the program will have preserved your original selection list entries).

3.2 Sieve Test Data Entry

The sieve test data entry window may be viewed by selecting Window > Sieve Test, or by clicking on the **Sieve Test** navigation tab.

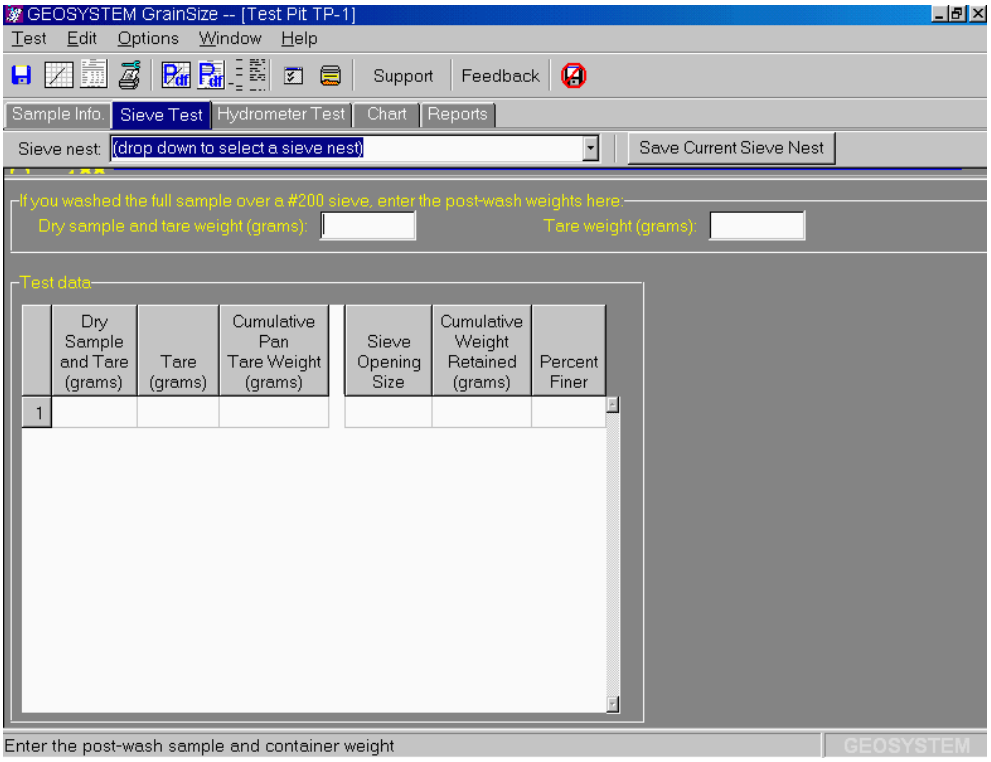


Figure 3.10: Sieve Test Data Entry Window

The following sections cover the data entry process for sieve tests.

3.2.1 #200 Wash Test

If the sample was washed on a #200 sieve prior to performing a standard sieve test, begin data entry for your sieve test by entering the after-wash sample weights into the **If you washed the sample over a #200 sieve, enter the post-wash weights here** box. ***LabSuite*** uses your #200 wash data as follows:

- The amount washed through the sieve is printed on data summary reports as an alternate #200 percentage value.
- The weight of the material washed out is used in calculating percent-retained values for post split-sample sieves (see the program's technical documentation for details).
- If you do not enter data for a #200 sieve as part of your sieve test data, ***LabSuite*** will use the percent washed out when it charts your test data – that percentage will be charted as the percent passing the #200 sieve.

⇒ If you did not wash the *complete* sample over a #200 sieve prior to performing a standard sieve test, press Enter without typing anything into the **Dry sample and tare weight (grams)** field.

3.2.2 Entering the Sample Weight

Before entering any sieve data you'll need to enter the weight of the sample that you tested: In the **Dry Sample and Tare (grams)** column on the first row of the grid, type in the total weight of the sample and its container, then press Enter and type the container weight into the **Tare (grams)** column. Enter **0** for the container weight if you "tared out" the scale with the sample container.

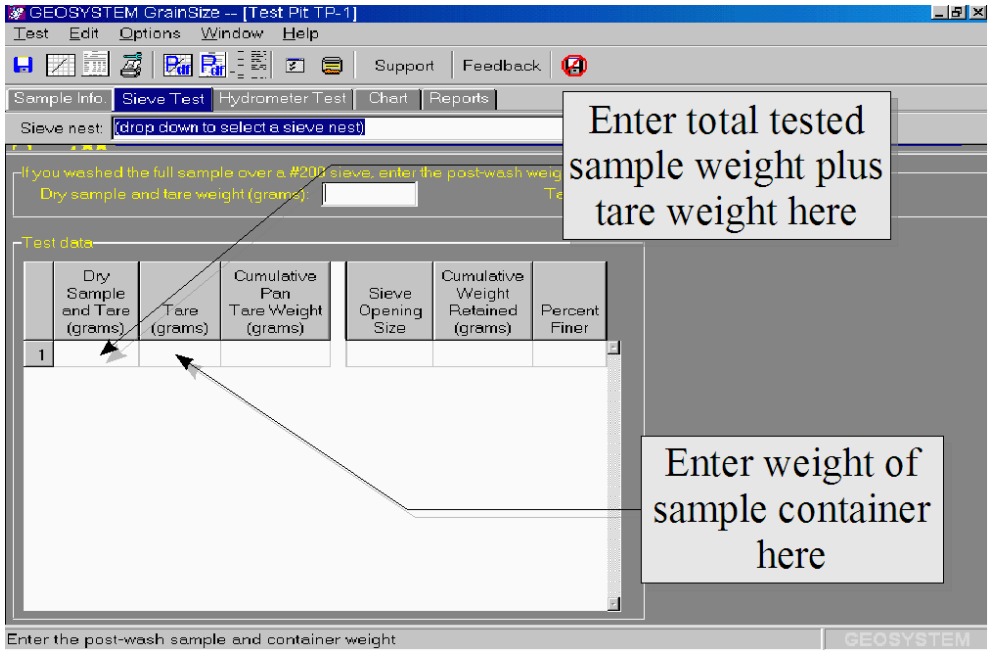
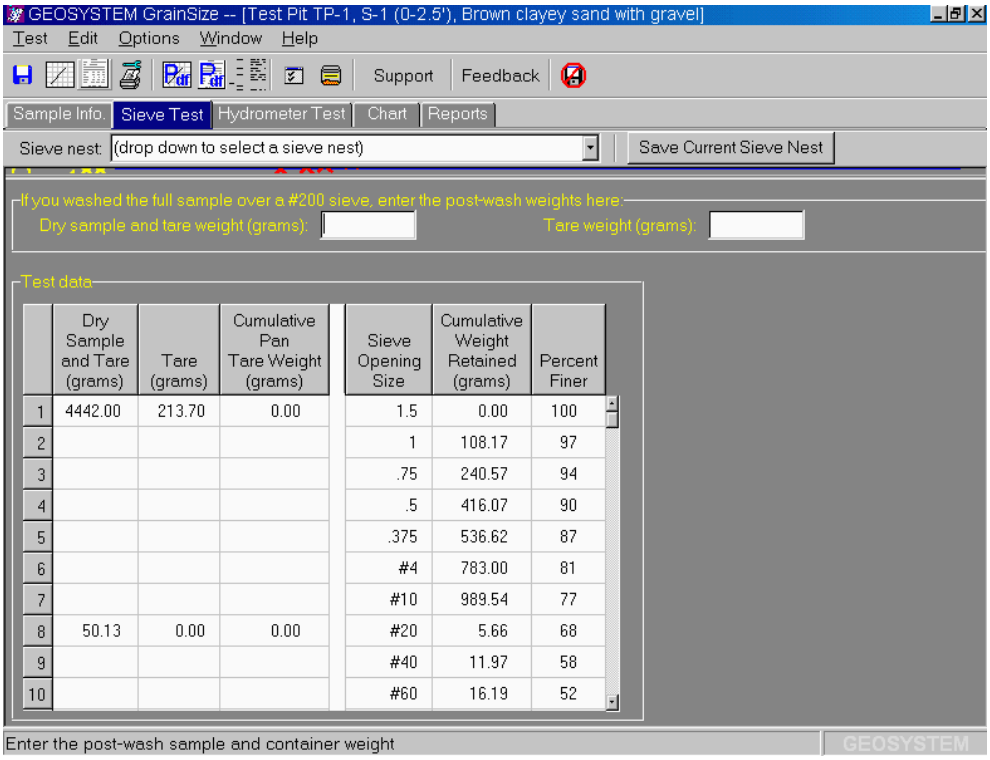


Figure 3.11: Sample Weights Entry

⇒ If the sample was washed over a #200 sieve prior to sieving, the total sample weight that you'll be entering is the dry weight of the sample *prior* to washing.

You only need to fill in the **Dry Sample and Tare (grams)** and **Tare (grams)** columns on the first row of the grid. On subsequent rows, leave these two columns blank, unless the sieve that you'll be entering on that row was the first sieve tested with a smaller (split) sample, in which case you'll need to fill in the **Dry Sample and Tare (grams)** and **Tare (grams)** columns with the weights of the split sample and its container.

The following image may help explain the situation:



	Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer
1	4442.00	213.70	0.00	1.5	0.00	100
2				1	108.17	97
3				.75	240.57	94
4				.5	416.07	90
5				.375	536.62	87
6				#4	783.00	81
7				#10	989.54	77
8	50.13	0.00	0.00	#20	5.66	68
9				#40	11.97	58
10				#60	16.19	52

Figure 3.12: Completed Sieve Test Data Entry Form

- Row 1 of the grid lists the weight of the original sample and tare weight (**`4442.0`** and **`213.7`**, respectively, which means that the sample weighed 4228.3 grams) and the weight of the cumulative pan, which was **0** because the scale was zeroed after the cumulative pan was placed on it.
- Rows 2-7 do not list sample or cumulative pan weights, so ***LabSuite*** knows that the 1.5", 1", .75", .5", .375", #4 and #10 sieves were all tested using the full 4228.3 gram sample.
- Row 8 indicates that the sample was split and that a 50.13 gram sample was sieved through the #20, #40, #60, etc. sieves.

⇒ After you've entered the initial sample weights, when you start a new row on the data entry grid the editing cursor will proceed directly to the **Sieve Opening Size** column. If you split the sample before testing the sieve whose data you'll be entering on that grid row, press the left arrow key to jump to the **Dry Sample and Tare (grams)** column then enter the split sample's weights.

⇒ If you're upgrading to ***LabSuite*** from an older GEOSYSTEM Grain Size Distribution program, you may be interested to know that the program now supports more than one sample split per sieve test.

3.2.3 Cumulative Pan Weight

If you've chosen the **Cumulative weight retained** test style, after the sample tare weight you'll be asked to enter the **Cumulative Pan Tare Weight**: In this column you need to enter the weight of the pan in which you accumulated the material retained on each sieve.

⇒ If you "tared out" the scale after placing the cumulative pan on it, enter **`0`** as the **Cumulative Pan Tare Weight**.

⇒ If you split your sample, ***LabSuite*** assumes that the cumulative pan is emptied before the first post-split sieve is weighed.

3.2.4 Entering Sieve Sizes

The term *opening size* refers to the dimension of the openings in a wire mesh sieve. When you enter sieve test data, the program will need to know the opening size of each sieve used in the test – this information is entered into the **Sieve Opening Size** column on the sieve test grid.

⇒ Measured sieve openings should normally be entered in dimension units appropriate for the project file on which you're working: If you've configured the project to use SI units, enter your sieve opening sizes in millimeters; for a US unit project, enter your sieve opening sizes in inches. (To change your project's dimension units, start your GEOSYSTEM program, open the project, then select Project > Dimension Units.

To enter a metric opening size into a US unit project, add an **`mm.`** to the end of the measurement (e.g., **`0.075mm.`**). Similarly, to enter an opening size in inches into a SI unit project, add **`in.`** to the end of your measurement (e.g., **`1 in.`**).

⇒ You can enter fractional sizes such as "one half" as either a decimal number (e.g., **`0.5`** or just **`.5`**) or by using the "/" symbol as the fraction mark (e.g., **`1/2`**, or **`1-1/2`** for a 1.5 inch sieve).

⇒ The first numbered sieve should be entered with a "#" sign; e.g., **`#4`**. For subsequent sieves you can drop the "#" because ***LabSuite*** will assume that all sieves smaller than the first numbered sieve are also numbered sieves.

The dimensions of numbered sieves are taken from reference standards; your sieves' openings may be slightly larger or smaller than the reference sizes. For example, the standard opening size for a #10 sieve is 2mm., but if you were to average the opening sizes of a given sieve's mesh, you might come up with 1.98mm. If you were to use our hypothetical sieve in a sieve test, you might prefer that ***LabSuite*** program mark the percent retained on that sieve against 1.98mm. on the particle size distribution chart.

As an example, the following image is taken from a section of a particle size distribution chart. The standard sieve sizes listed at the top of the chart are always drawn at the hypothetical exact opening size (4.7mm. for the #4, 2mm. for the #10 and 0.85mm. for the #20). Within the chart are three points from a curve: notice that the left and right points fall directly on the vertical lines that ***LabSuite*** drew to denote the exact #4 and #20 opening sizes, while the point in the middle falls somewhat to the right of the #10 line: When this test was entered, the measured dimension of the #10 sieve used for the test was noted as being 1.9mm.; the #4 and #20 sieves were left as-is.

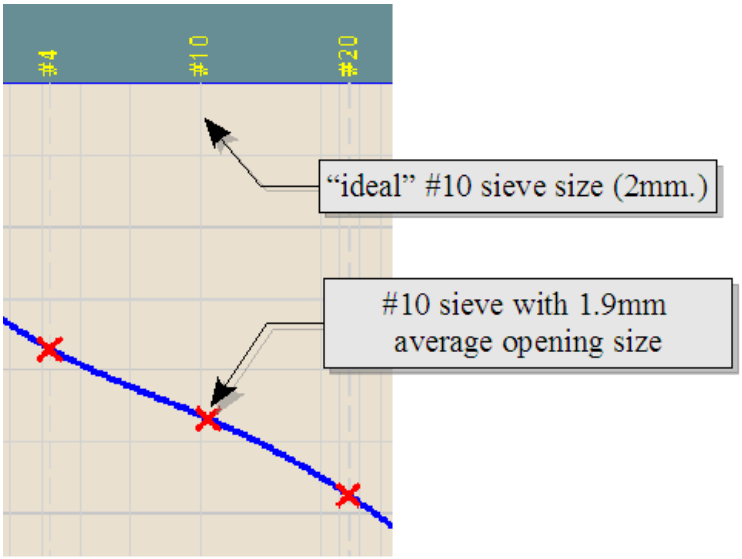


Figure 3.13: Selecting the Size of a Numbered Sieve

If you've had your sieves' opening sizes measured and would like to use the measured sizes:

1. Use the program's sieve opening sizes tool to specify the measured opening sizes of a batch of sieves that you'll be using.
2. On the Sample Info. window displayed when you begin data entry for a new test, select your opening size list from the **Opening sizes** box.

3.2.5 Entering Sieve Weights

After entering each sieve's opening size, you'll need to enter the weight of material retained on that sieve:

- If you're using the cumulative weight retained test style, you'll need to enter the weight of the cumulative pan with the sieve's retained material.
- If you're using the per-sieve weight retained test method, you'll need to enter two weights: a) the weight of the sieve along with the material retained on the sieve, and b) the weight of the empty sieve.

3.2.6 Split Samples

As you're entering your sieve test data you may come to a point where the sample was split and only a portion of the original sample was passed through the smaller sieve sizes. At this point you need to let the program know that a smaller portion of the original sample was used for the sieve that you'll be entering (as well as for subsequent sieves). To do this:

1. When you reach the point where you'll be entering the opening size for the first post-split sieve, instead of entering the sieve's opening size, press the left arrow key: this will bring you back to the **Dry Sample and Tare** column.

2. Enter the total weight of the post-split sample and its container, then press Enter and enter the container weight.

3. Next, if you're using the cumulative weight retained test method, enter the weight of the post-split cumulative pan.
   Important note: If you're using the same cumulative pan for both the original and the post-split sample, you **must** empty the pan before adding the material from the first post-split sieve.

4. Finally, enter your first post-split sieve's data. Enter this sieve's data on the same grid row as your post-split sample weights (see row 8 in the following picture).

⇒ Note that previous GEOSYSTEM grain size programs allowed at most a single sample split per test. The current version allows an unlimited number of sample splits.

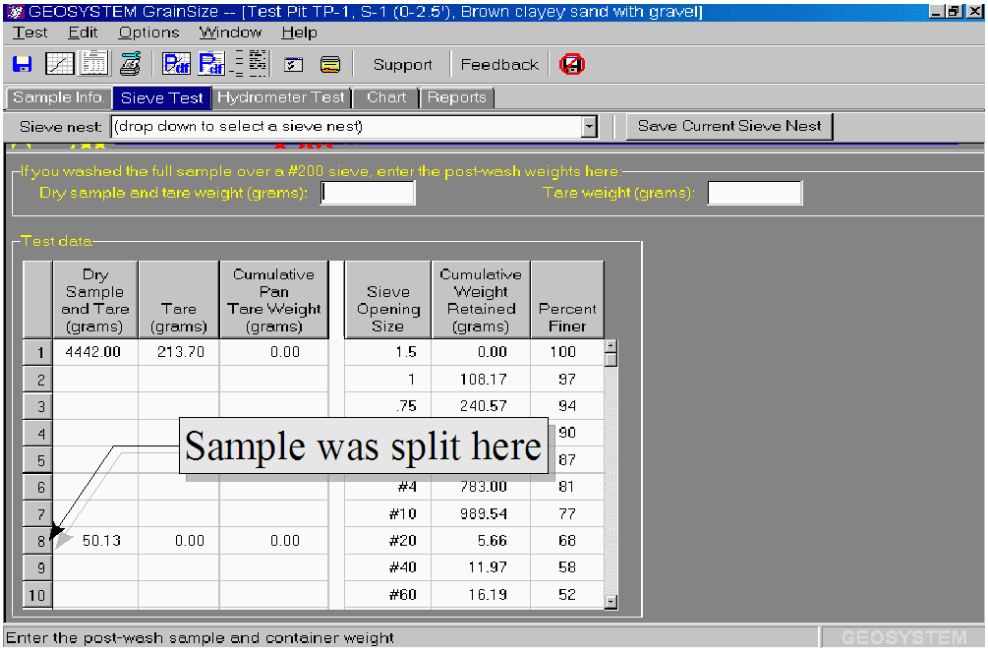


Figure 3.14: Test with Sample Split on Material Passing on #10 Sieve

3.2.7 Saving the Current Test as a Sieve Nest

After you've entered your sieve test you can save the list of sieves that you've entered as a *sieve nest*: Before entering another test that uses the same set of sieves, if you select your saved sieve nest from the dropdown **Sieve nest** box you can avoid entering the test's sieve sizes because ***LabSuite*** will fill them in for you.

To save a test's list of sieves as a sieve nest:

1. After you've entered the sieve test data, click on the **Save Current Sieve Nest** button in the toolbar at top of the sieve test data entry window.
2. Enter a name into the **Sieve nest name** field. There are no restrictions on what you can use as a name, but the program will display a warning message if you try to use a name that's already used by another sieve nest.
3. After you've entered a name for the list of sieves, click the **Save** button.

⇒ If you find that there's already a name entered into the **Sieve nest name** field, it means that ***LabSuite*** has found a sieve nest that exactly matches the one that you're trying to save – since the exact same sieve nest is already entered into the program's list, you may not want to save it a second time.

⇒ You can delete and modify saved sieve nests through the program's Setup dialog: Select Options > Program Setup then click on **Sieve Nests** in the left-hand navigation panel.

Once you've added your sieve nest to the program's sieve nest database, when you begin data entry for a new sieve test, start by selecting your sieve nest from the drop-down **Sieve nest** list in the toolbar at the top of the screen: ***LabSuite*** will fill in the test's **Sieve Opening Size** column with your saved sieve sizes, meaning that you can skip entering the size of each sieve. As an example, the following screenshot shows the sieve test data entry screen after the built-in *ASTM D422 Uniform-Spacing Set* sieve nest was selected:

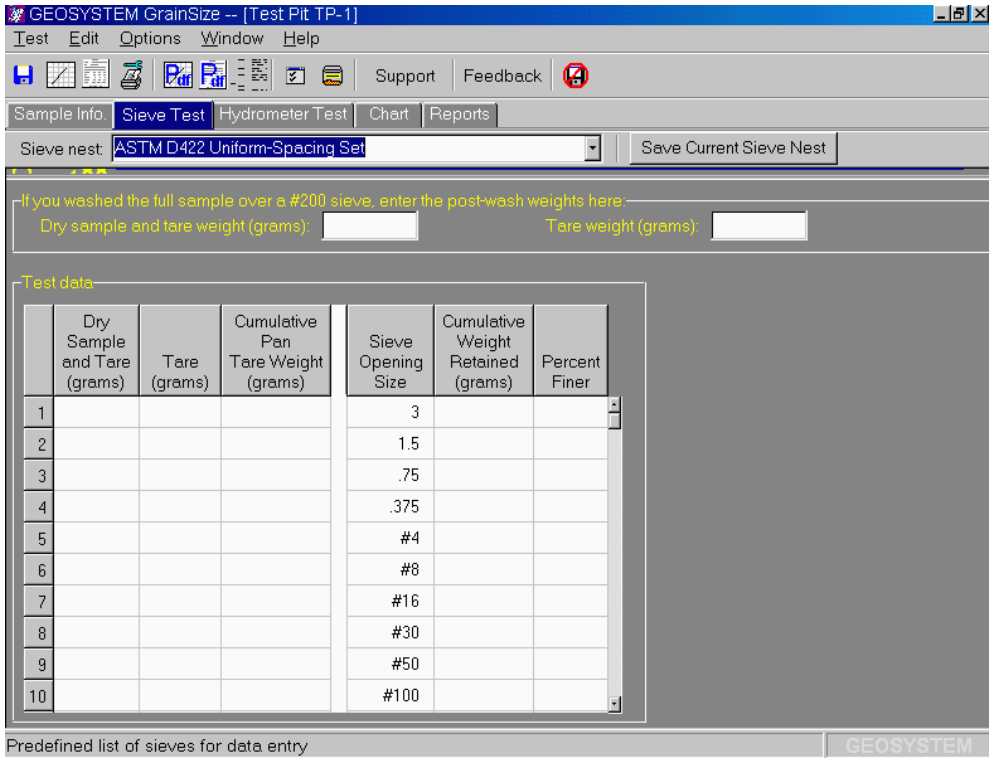


Figure 3.15: Sieve Test Data Entry Screen After Sieve Nest Selection

If you were entering data for this test, you'd be asked to enter the **Dry Sample and Tare** and **Tare** weights, followed by the weight retained on the 3 inch sieve. The **Sieve Opening Size** column is automatically skipped because it has already been filled in for you. When you press Enter after entering the weight retained on the 3 inch sieve, you'll be asked for the weight retained on the 1.5 inch sieve – the 1.5 inch **Sieve Opening Size** column is skipped.

⇒ **If you need to enter data for a sieve not listed in the sieve nest that you selected:** When you reach the sieve test grid row for the first sieve *smaller* than the missing sieve, select Edit > Insert Data Row.

⇒ **If the sieve nest lists sieves that you did not use in your test:** In the sieve test grid, click on the unneeded sieve enter, then select Edit > Delete Data Row.

3.3 Hydrometer Test Data Entry

The hydrometer test data entry screen may be viewed by selecting Window > Hydrometer Test, or by clicking on the **Hydrometer Test** navigation tab.

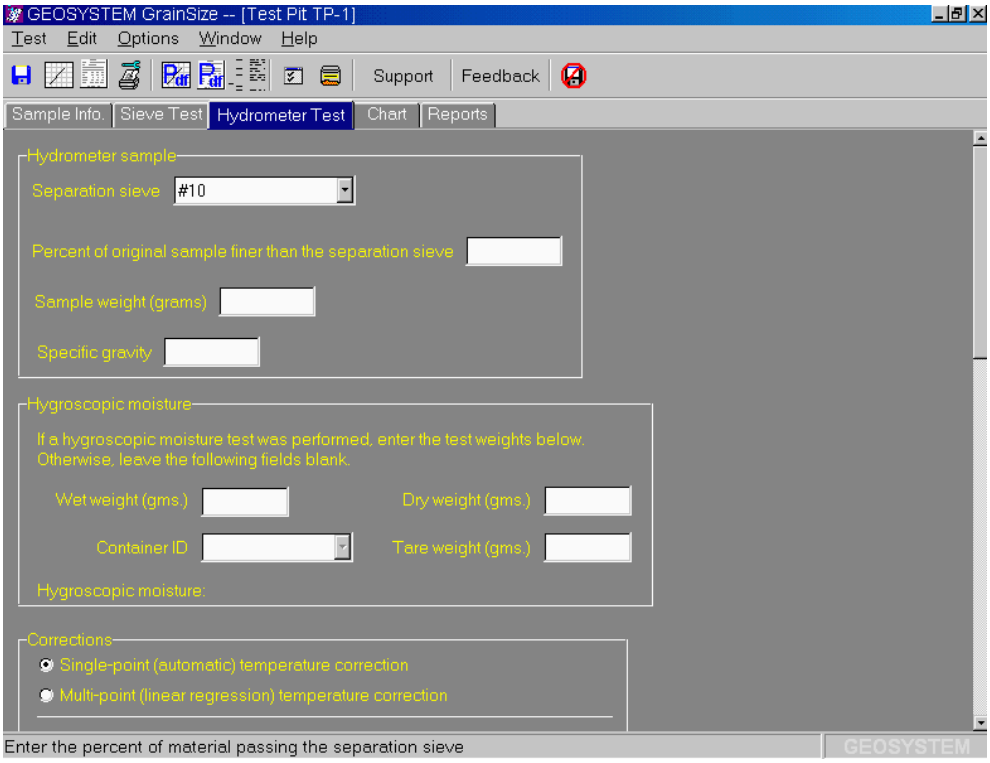


Figure 3.16: A Portion of the Hydrometer Test Data Entry Window

3.3.1 Test Background Information

Before entering your hydrometer test readings, you'll need to enter a little background information on the test:

Separation sieve

The separation sieve is the sieve used to separate the material used in the sieve test from the material to be used in the hydrometer test. Typically (i.e., per ASTM D 422) the #10 sieve is used.

Percent of original sample finer than the separation sieve

The program usually calculates the percent passing the separation sieve from the sieve test data that you've entered; however, if you did not enter sieve test data, use this field to enter the percent finer as a number between 0 and 100.

Sample weight (grams)

This is the weight of the hydrometer sample, *not* the weight of the material passing the separation sieve.

Specific gravity

Enter the specific gravity of the sample.

Hygroscopic moisture

If you performed a hygroscopic moisture test on your hydrometer sample, enter the test weights into the **Hygroscopic moisture** box.

⇒ The **Container ID** field is used if you've entered container weights and IDs into the program's container list: Rather than entering the weight of the container that you used for the hygroscopic moisture test, you can enter the ID of the container ***LabSuite*** will look up the corresponding weight. **Container ID** is not enabled unless you've selected `tare ID` at the **Container weights are entered as** prompt on the program's Setup dialog (Options > Program Setup then click on **Data Entry** in the left-hand navigation panel).

⇒ ***LabSuite*** will assume zero percent hygroscopic moisture uptake if you do not enter any hygroscopic moisture data.

Single-point (automatic) temperature correction
Multi-point (linear regression) temperature correction

ASTM D 422 specifies that hydrometer readings are to be corrected for differences due to temperature, meniscus, and dispersing agent specific gravity: A graph of correction vs. temperature is prepared and each hydrometer test reading is adjusted based on the correction value read off the graph at the test fluid temperature.

LabSuite also offers a alternative to ASTM's multi-point correction procedure: If you take a single correction measurement at a fluid temperature of 20° centigrade, ***LabSuite*** can use a standard formula for the change in fluid density as a function of temperature to determine appropriate correction values at other temperatures.

- To use the ASTM D 422 correction procedure, select **Multi-point (linear regression) temperature correction**. You'll be asked to enter up to six hydrometer readings and the corresponding temperature (in °C) of the fluid at each reading.
- To use ***LabSuite***'s single correction point procedure, select **Single-point (automatic) temperature correction**. You'll be asked to enter a correction measurement taken at a fluid temperature of 20° centigrade.

⇒ Hydrometer correction readings should be taken from the top of the meniscus using the liquid solution (without soil!) that will be utilized for the actual test.

⇒ **Hydrometer correction values are the negative of the readings that you take (e.g., if your reading was 6, enter -6)**.

⇒ Corrections for 151H hydrometers should be entered as the number of thousands; e.g., **-6.0** instead of **-0.006**.

Meniscus correction

This value is the height of the meniscus, and should be **0** if all hydrometer test readings were taken at the bottom of the meniscus; otherwise, it should be a positive number indicating the height of the meniscus in hydrometer gradations (e.g., for 152H, usually between +.5 and +1). For the 151H hydrometer, make sure to enter the correction as the number of thousands (e.g. **0.3** instead of **0.0003**).

151H
152H

Check either **151H** or **152H**, depending upon the type of hydrometer used for your test.

Effective depth equation

In almost all cases, the default values given for the equation should be accepted as-is. Before modifying these values, consult ASTM D 422's *Diameter of Soil Particles* calculation section (currently Section 15), and the program's Technical Documentation chapter.

⇒ The default values for a 151H hydrometer are
L = **16.294964** - **0.2645***Rm
The default values for a 152H hydrometer are
L = **16.294964** - **0.164***Rm

3.3.2 The Hydrometer Test Readings Grid

For each hydrometer reading, enter the elapsed time (in decimal minutes; e.g., 1 minute thirty seconds should be entered as **1.5**), the temperature (in °C) and the hydrometer reading. 151H readings should be entered as the number of thousands (e.g. if the reading is 1.0279, enter it as **27.9**).

⇒ Use the Enter key to change between cells on the grid; e.g., after you've typed in an elapsed time, press Enter to jump to the temperature column.

⇒ After you've typed in the elapsed time, you can skip entering the fluid temperature if it's the same as the temperature on the row above the one on which you're typing: press Enter twice to skip the temperature column.

4. Viewing and Modifying the Particle Size Curve

To display a chart of the particle size distribution curve, select Window > Chart, or click on the **Chart** navigation tab.

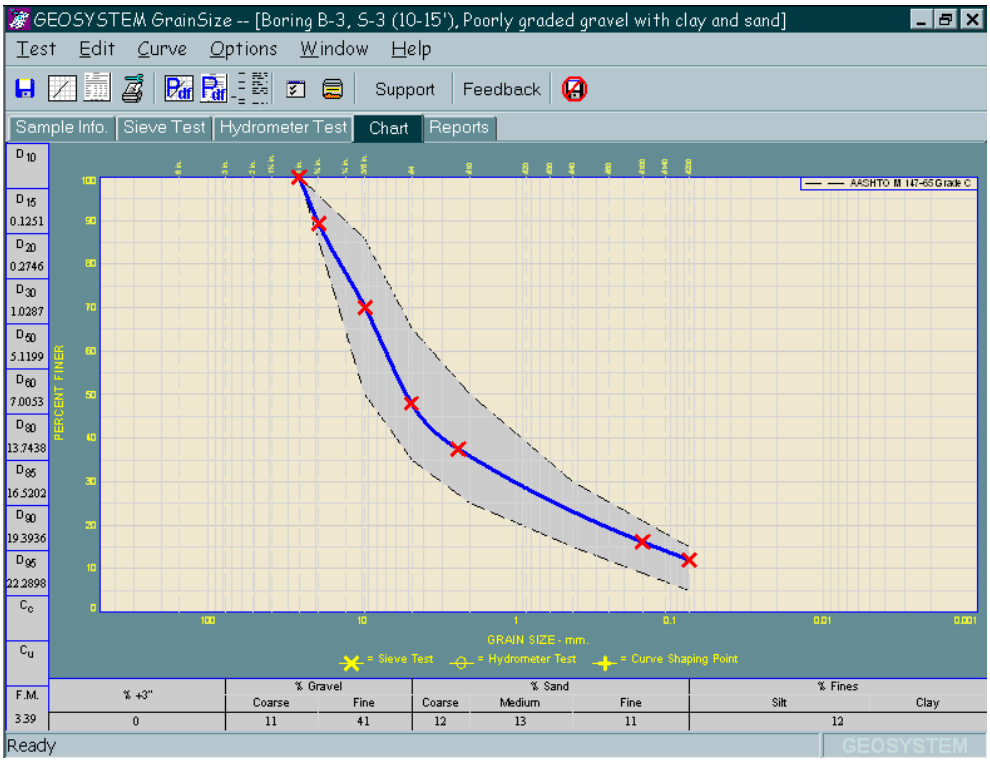


Figure 4.1: Particle Size Chart Review Window

⇒ (FYI: "C_u" stands for *Coefficient of uniformity*; "C_c" stands for *Coefficient of curvature* and "F.M." stands for *Fineness Modulus*.)

If you find that your test data has resulted in an irregularly shaped curve, you can reshape it from this screen:

To reposition the curve:

The shape of the curve may be adjusted by forcing it to pass through a new point. To do this, select Curve > Add Shaping Point. When the mouse cursor changes to a cross, move the cursor to the location desired for the curve to pass through, then click the left mouse button. The new point (called a *shaping point*) will be marked with a "+".

When shown on a chart report, the curve will pass through the new point, although no marker will be plotted to mark the point.

To delete a shaping point:

To remove a shaping point, select Curve > Delete Shaping Point, then move the mouse cursor close to the shaping point (remember, shaping points are drawn with markers that look like " + " signs) then click the left mouse button.

To remove all shaping points:

Select Curve > Delete All Shaping Points.

If the curve's shape cannot be adjusted satisfactorily, you can select Curve > Do Not Draw Curve: This stops the program from drawing the curve on the chart report. Markers showing the position of each test point will still be drawn.

4.1 Selecting the .45-Power Curve Maximum Density Line

When plotting a diameter^0.45 grain size chart, the program can be configured to draw a maximum density line from the chart origin to 100 % finer at a selectable maximum particle size.

To select a maximum particle size:

Drop down the toolbar list box labeled **Max. dens. size** and choose a sieve size from the list.

To turn off the maximum density line:

Select « `omit` » in the **Max. dens. size** toolbar list box.

4.2 The Chart Calculator

When you're previewing the grain size chart chart, selecting Curve > Calculator opens a dialog where you can check the percent of material smaller than a given particle size, or determine the particle size that corresponds to a particular percentage.

⇒ To calculate the percent of material smaller than a particular particle size, enter the size into the dialog's **Particle size** box. If you're working with a project using US dimensions add `mm.` at the end of the particle size if you're entering a size in millimeters. Conversely, if you're working with an SI-dimensioned project, add `in.` to enter a size in inches. Numbered sieves need to have `#` at the front; e.g., `#200`.

⇒ To calculate the particle size corresponding to a particular percentage, enter the percentage into the **Percent smaller** or **Percent larger** box.

5. Entering Atterberg Limits Test Data

Data entry for an Atterberg limits test involves two steps:

- Sample background information, which covers basic information about the sample tested.
- Atterberg test data entry, which involves the actual liquid and plastic limit test data, along with, optionally, natural moisture data.

Begin by selecting Test > Enter LIMITS Data. The following sections discuss each subsequent data entry step in further detail.

5.1 Atterberg Limits Sample Information

The initial Atterberg limits data entry window covers basic information about the tested sample. This window is displayed by clicking on the **Sample Info.** navigation tab, or by selecting Window > Sample Info. The display is similar to the grain size test sample information window covered in § 3.1.

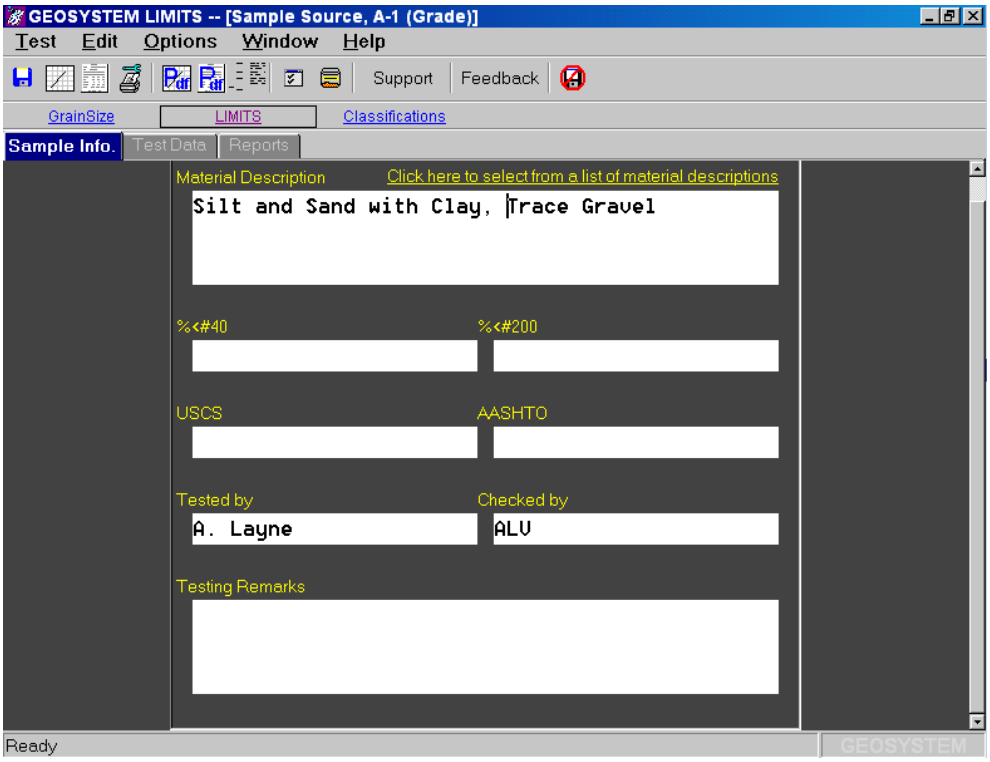


Figure 5.1: Atterberg Limits Sample Information Window

5.2 Atterberg Limits Test Entry

LabSuite's Atterberg test data entry window may be viewed by selecting Window > Test Data or by clicking on the **Test Data** navigation tab.

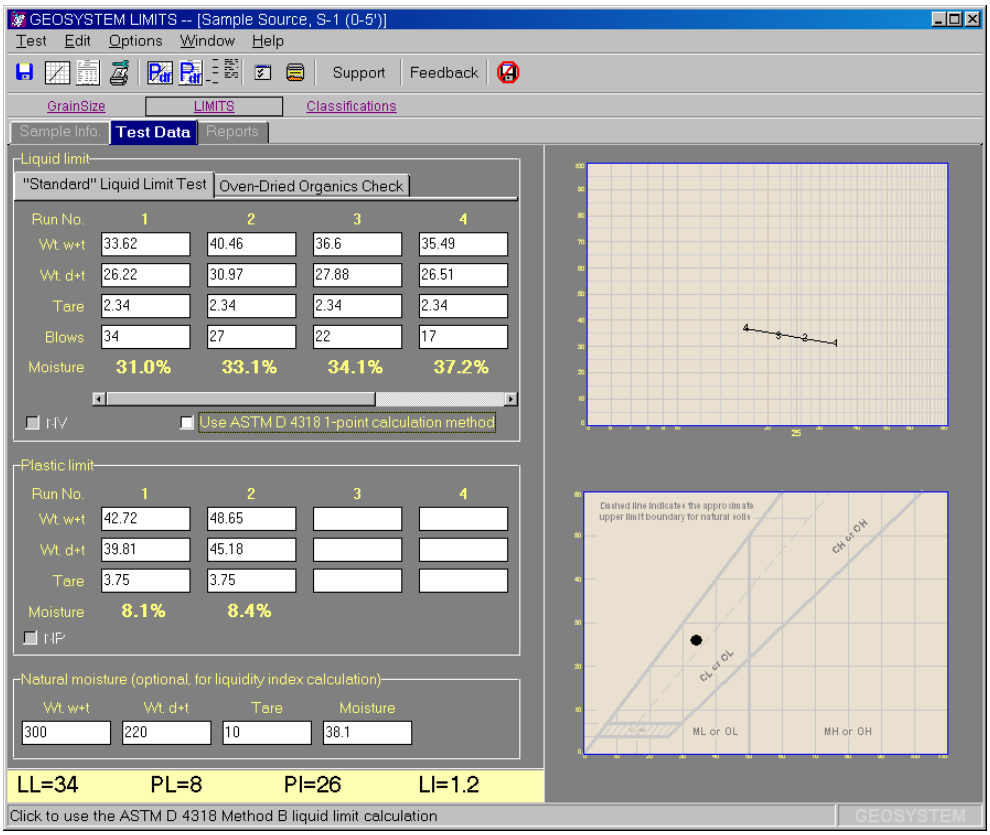


Figure 5.2: Atterberg Limits Test Data Entry Window

Data entry for the liquid limit, plastic limit and natural moisture tests is covered in the following sections.

5.2.1 Liquid Limit Test Data Entry

LabSuite supports *two* distinct liquid limit tests per sample: one on the as-received sample and a second (*optional*) test on an oven-dried portion of the sample. (The oven-dried test is used as an organics check by the ASTM D 2487 (USCS) classification.) Before entering liquid limit data, click on the **"Standard" Liquid Limit Test** tab. Afterwards, if you need to enter an oven-dried liquid limit test, click on the **Oven-Dried Organics Check** tab then enter your oven-dried liquid limit data.

Tare ID

If the option to enter container weights as tare IDs has been selected, data entry begins by selecting an ID from the drop-down tare ID list. Once an ID is chosen, **Tare** box will be filled in with the weight corresponding to that container.

⇒ If you haven't yet entered the container and its weight into the program's container list, see § 2.8 for instructions on adding it. Alternatively, the tare ID field may be left blank and a tare weight may be manually entered.

Wt. w + t
Wt. d + t
Tare

These are, respectively: the weights (in grams) of the wet soil and container, dry soil and container and the container by itself.

Blows

Enter the number of blows required to close the grooved soil.

NV

Check this box if the liquid limit could not be determined.

Use ASTM D 4318 1-point calculation method

If the liquid limit test is to be calculated by the ASTM one-point method, click on this check box.

Note that the one-point option may be selected for either the natural or oven-dried liquid limit or both – the check box lists the selection for the soil type (natural or oven-dried) currently selected. For example, to select the one-point method for the oven-dried sample, first click on the **Oven-Dried Organics Check** soil-type tab, then click on the **Use ASTM D 4318 1-point calculation method** check box.

5.2.2 Plastic Limit Test Data Entry

LabSuite supports up to 4 plastic limit moisture content tests. Data entry is similar to the liquid limit procedure covered above.

NP

Check this box if the plastic limit could not be determined (the check box is only available if you haven't entered any plastic limit data).

5.2.3 Natural Moisture Test Data Entry

The software also accepts data for a natural moisture content test used to calculate the soil's liquidity index.

⇒ Natural moisture content entry is optional; it's not required in order to calculate the soil's liquid or plastic limit or the plasticity index.

6. Soil Classifications

After you've entered your grain size and Atterberg test information, you may want to check the soil classification values that the program has calculated for your data. Begin by selecting Test > Enter Classifications Data, then use the various menu selections underneath Window (e.g., Window > USCS or Window > AASHTO, etc.) to view the program's classification windows.

⇒ Although the program will normally extract the sieve percentages and Atterberg limits values needed to classify your soil directly from your grain size and Atterberg test data, you can also opt to skip entering testing data and directly enter your own sieve percentages and Atterberg values into the program's classification windows.

6.1 USCS Classification

Select Window > USCS to view the USCS classification window.

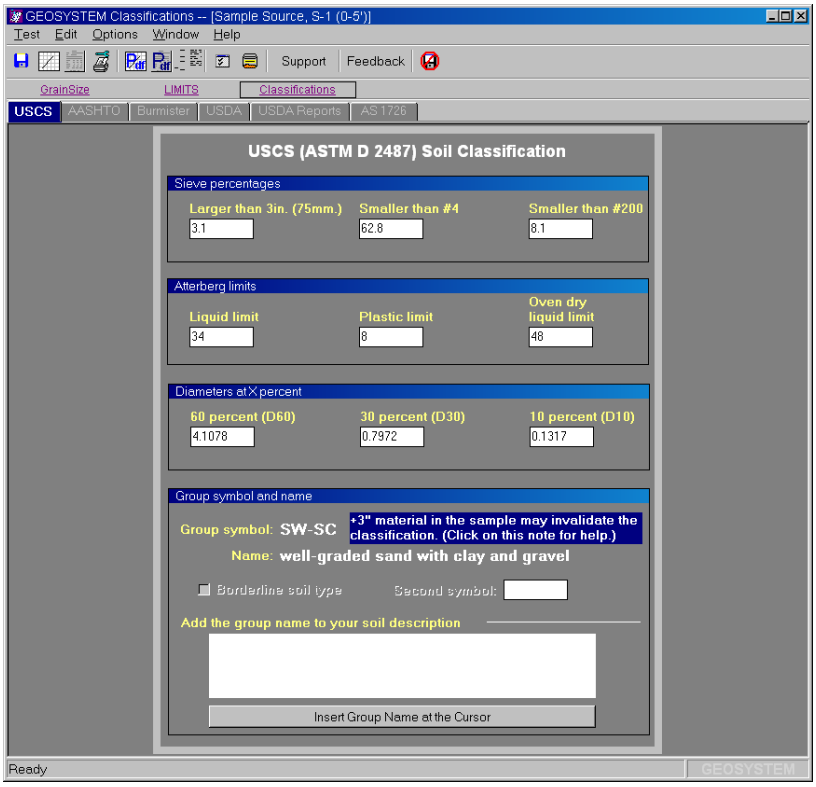


Figure 6.1: USCS Classification Data Entry Window

Sieve percentages

Enter these values as numbers between 0 and 100.

⇒ The first field requires the percentage *retained* on the sieve, while the other sieve percentages reflect the percent *passing* each sieve.

Atterberg limits

Enter the liquid and plastic Atterberg limits for the soil.

⇒ The oven-dry liquid limit is used only for classifying possibly organic fine-grained soils (i.e, when 50 percent or more of the sample is fines). The oven-dry liquid limit field may be left blank when classifying coarse-grained soils, or fine-grained soils where the organic content is known to be minimal.

Diameters at X percent

These values, which represent the grain-size in millimeters at which 60, 30, and 10 percent of the sample is finer.

⇒ Diameters are required only when classifying coarse-grained soils.

⇒ If, after entering your grain size test data, the D10 value is blank, and a coarse-grained soil is being classified, select Test > Enter GrainSize Data then select Window > Chart. Next, add a shaping point on the right-side of the curve that extends the curve below the 10 % scale line (this interpolates a D10 value), then return to your classification window (Test > Enter Classifications Data. (Again, since D10 is used only when classifying coarse-grained soils, this procedure is not required if 50 % or more of the sample consists of fines.)

Borderline soil type
Second symbol

The software allows you to enter a second classification symbol if you think that the soil is on a borderline between two classifications (see ASTM D 2487, Section 1.1). Doing so assigns the soil a dual classification such as "CL/CH" or "GM/SM": the first classification is the one selected by the program, and the classification after the slash is the one you choose.

If you want to assign a *dual classification* to the soil, click on the **Borderline soil type** check box, then enter the soil's second classification into the **Second symbol** box. (Note that the slash "/" is automatically added so you do not need to enter it as part of the second classification.)

⇒ The **Borderline soil type** check box will be disabled if the program classifies your soil using a dual symbol such as **GP–GM** or **CL–ML**.

Add the group name to your soil description

Insert Group Name at the Cursor

The box underneath **Add the group name to your soil description** lists your current soil description: if you'd like to insert the classification group symbol into the description, click inside the box, move the editing cursor to the position where the group symbol is to be located, then click on the **Insert Group Name at the Cursor** button.

6.1.1 Classifying Soil with +3 Inch Material

When your sample contains material larger than 3 inches the program's classification system recalculates the **Smaller than #4** and **Smaller than #200** values to remove the influence of the plus 3 inch material (i.e., the #4 and #200 values are calculated based on a sample that has *no* material larger than 3 inches). This is done because the ASTM D 2487 classification is based exclusively on material smaller than 3 inches.

⇒ The calculation is:

$$biased\ \#4\ material = \frac{actual\ \#4\ material}{100 - plus\ 3\ inch}$$

While the program can remove the influence of the plus 3 inch material from the #4 and #200 sieve percentages, it cannot do the same for the **Diameters at X percent** values, so the D_{60}, D_{30} and D_{10} values will continue to reflect the numbers calculated for the whole sample (including plus 3 inch material); the #4 and #200 values will reflect a sample without any material larger than 3 inches. This may or may not cause the program's classification to be invalid (the D_x values are only used to distinguish between **GW** and **GP** and between **SW** and **SP**).

6.2 AASHTO Classification

Select Window > AASHTO to view the AASHTO M 145 classification window.

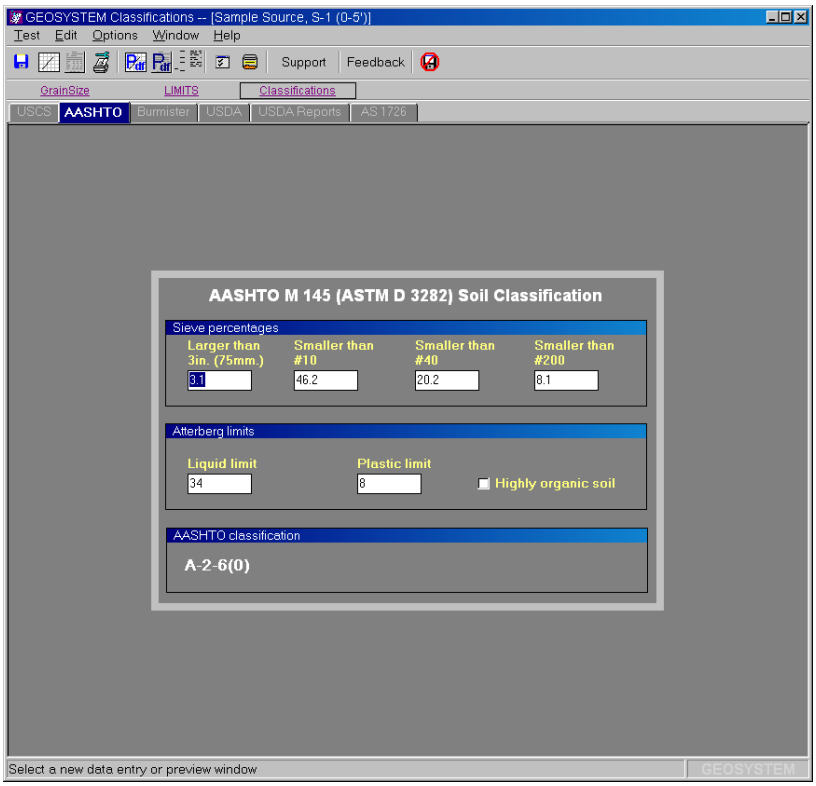


Figure 6.2: AASHTO Classification Data Entry Window

Sieve percentages

Enter these values as numbers between 0 and 100.

⇒ The first field requires the percentage *retained* on the 3 inch/75 mm. sieve, while the other sieve percentages reflect the percent *passing* the various sieves.

Atterberg limits

Enter the liquid and plastic Atterberg limits for the soil.

Highly organic soil

Checking this box forces the soil's classification to be **A–8**.

6.3 Burmister Classification

Select Window > AASHTO to view the AASHTO M 145 classification window.

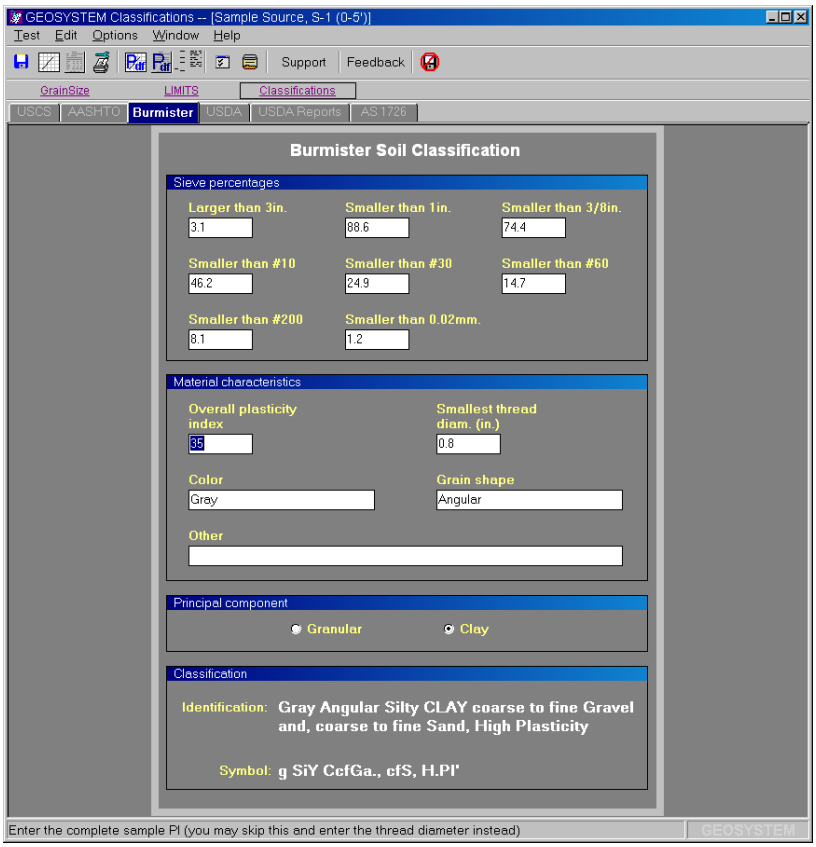


Figure 6.3: Burmister Classification Data Entry Window

Sieve percentages

Enter these values as numbers between 0 and 100.

⇒ The first field requires the percentage retained on the 3 inch/75 mm sieve, while the other sieve percentages reflect the percent passing the various sieves.

⇒ Note: All fields require data; if all material is smaller than a particular sieve enter 100 as the percent passing, if all material is larger, enter 0 as the percent passing.

Overall plasticity index

This is the plasticity index of the entire specimen.

Smallest thread diameter

This is the diameter (in inches) of the smallest thread that could be rolled at the ball moisture of the specimen.

Color

Used to briefly describe the soil color.

Grain shape

Use this field to enter a brief description of the grain shape (e.g., water worn, angular, etc.).

Other

Use this field to enter any additional information that you want to add to the end of the identification.

Principal component

Select either **Granular** or **Clay** as the component of primary influence on the behavior of the soil. This is based on engineering judgment.

Add the ID or symbol to your soil description

Insert at the Cursor

The box underneath **Add the ID or symbol to your soil description** lists your current soil description: if you'd like to insert the either the Burmister identification or symbol into the description, click either **Insert ID** (to insert the identification) or **Insert symbol** (to insert the symbol), then click inside the description box, move the editing cursor to the position where the group symbol is to be located, then click on the **Insert at the Cursor** button.

6.4 USDA Classification

Select Window > USDA to view the USDA classification window.

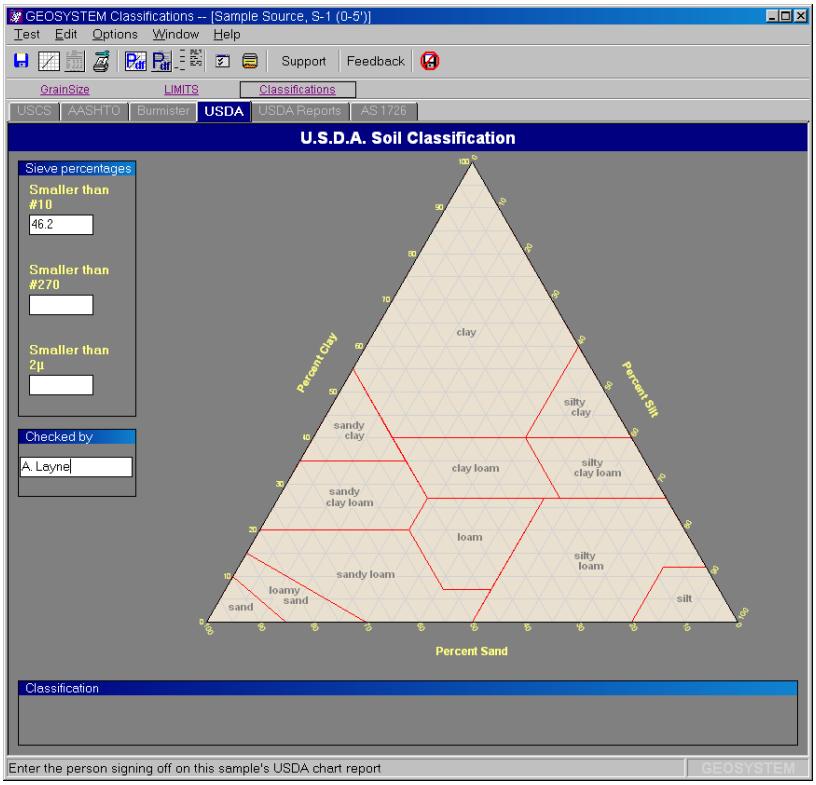


Figure 6.4: USDA Classification Data Entry Window

Sieve percentages

Enter these values as numbers between 0 and 100.

⇒ Note: All fields require data: if all material is smaller than a particular sieve enter 100 as the percent passing, if all material is larger, enter 0 as the percent passing.

Checked by

LabSuite includes a USDA chart report showing the textural triangle and the classifications for a number of soil samples; below the border of the report you can list the name of a the person who has reviewed the classification data by entering that person's name into the **Checked by** field.

⇒ When printing a USDA chart report that includes multiple soil samples on a single page, ***LabSuite*** will use the "Checked by" name entered for the first sample placed on the report page.

6.5 AS 1726 Classification

Select Window > AS1726 to view the Australian Standard 1726 classification window.

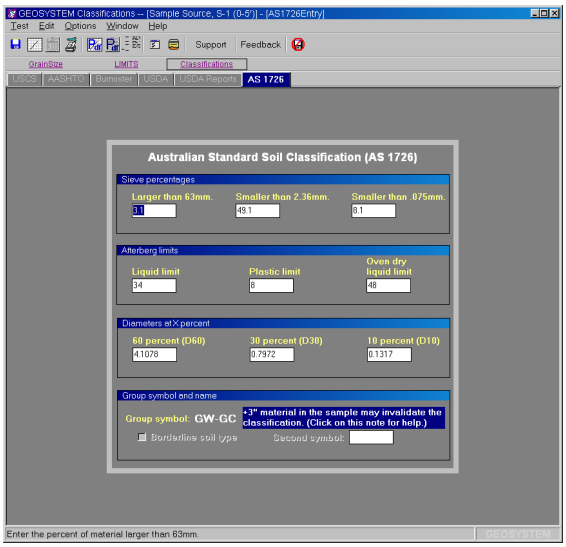


Figure 6.5: AS 1726 Classification Data Entry Window

The AS 1726 data entry fields are identical to those described in the USCS Classification section.

7. Entering Moisture-Density Test Data

Data entry for a moisture-density test involves two steps:

- Sample background information, which covers basic information about the sample tested.
- Test data entry, which involves entering the actual compaction test data.

Begin by selecting Test > Enter Proctor Data. The following sections discuss each subsequent data entry step in further detail.

7.1 Moisture-Density Sample Information

The initial moisture-density data entry window covers basic information about the tested sample. This window is displayed by clicking on the **Sample Info.** navigation tab, or by selecting Window > Sample Info. The display is similar to the grain size test sample information window covered in § 3.1.

7.2 Moisture-Density Test Entry

LabSuite's moisture-density test data entry window may be viewed by selecting Window > Test Data or by clicking on the **Test Data** navigation tab.

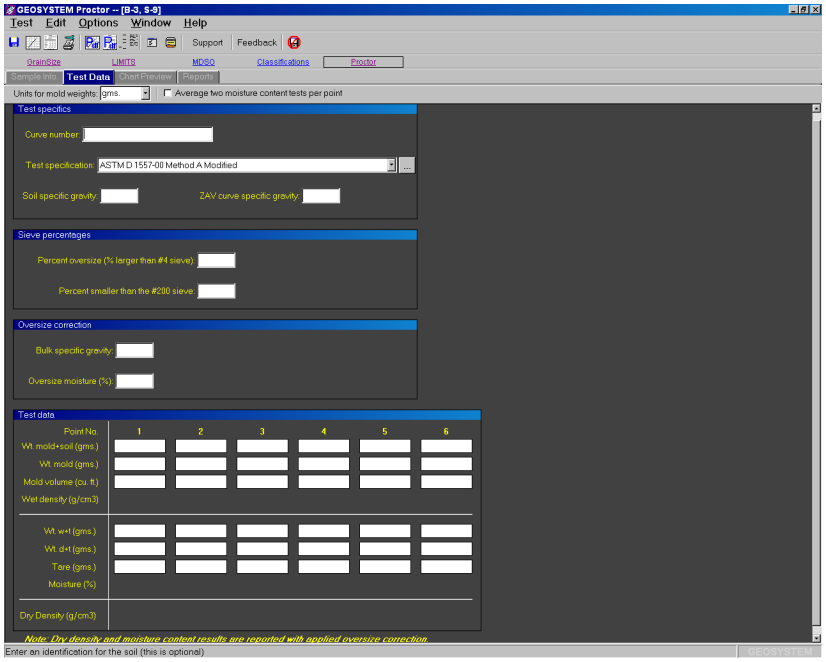


Figure 7.1: Moisture-Density Test Data Entry Window

The following subsections cover each section of the data entry window in detail.

7.2.1 Test Specifics

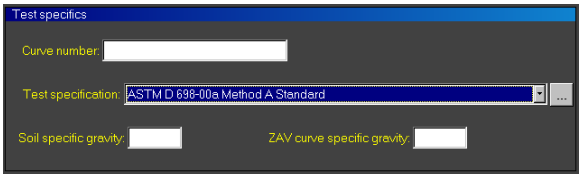


Figure 7.2: Moisture-Density Test Specifics Box

Curve number

This is an optional item. If entered, the curve number be used as follows:

- It will appear on the test's printed reports.
- ***LabSuite*** will use the number for identifying the soil during the one-point curve matching process.
- If licensed, the GEOSYSTEM Quality Control - Density (QC-Density) program uses this number as a reference for determining the maximum dry density associated with a particular field density test.

Test specification

Use this box to select the specification used to perform the test (e.g., ASTM D 698 Method A). This selection is important: it determines the sieve used for denoting oversize material, the oversize correction method, the default test mold volume, etc.

⇒ If your test's specification isn't in the drop-down list, use the program's test specification editor to add it before continuing.

Soil specific gravity

This is an optional item that will be reported on hardcopy printouts if entered. The sample specific gravity is not utilized in any of the program's calculations.

ZAV curve specific gravity

Several chart report formats offer the option to draw a single zero air voids (ZAV) curve that represents the upper moisture-density boundary for a saturated soil at a particular specific gravity. The **ZAV curve specific gravity** field allows you to select the specific gravity used in the ZAV curve drawing equation.

⇒ Other chart report formats, such as PRCOE, include three pre-defined ZAV curves representing specific gravities of 2.6, 2.7 and 2.8. ***LabSuite*** ignores the contents of the **ZAV curve specific gravity** when one of these formats are used.

⇒ ***LabSuite*** offers prompts for both the sample and ZAV curve specific gravity so that in situations where a specific gravity test has not been performed on a sample, the user may estimate the specific gravity for the purposes of drawing the ZAV curve.

⇒ Entering **0** for the ZAV curve specific gravity or leaving the field blank will cause the program to omit the ZAV curve from reports featuring a single, user selected ZAV curve.

7.2.2 Sieve Percentages

Figure 7.3: Moisture-Density Sieve Percentages Box

Percent oversize

For test specifications requiring an oversize material correction, the correction calculation requires the percent retained on a specific sieve representing the boundary between the oversize material and the material used for the compaction test. The **Percent oversize** field should be used to enter the percentage of material larger than whatever sieve is specified as being the oversize sieve by the test specification (see § 2.6.3 for details on setting up a new test specification).

Percent smaller than the #200 sieve

This is an optional item that will be reported on hardcopy printouts if entered. The value is not utilized in any of the program's calculations.

⇒ If grain size test data have been entered for the sample, the program will automatically obtain the oversize and #200 sieve percentages from the grain size distribution curve.

7.2.3 Oversize Correction

Figure 7.4: Moisture-Density Oversize Correction Box

Bulk specific gravity

This is the specific gravity (typically the SSD bulk specific gravity) of the oversize material. You do not need to enter this value if you are not correcting your test results for the presence of oversize material.

Oversize moisture

This is the moisture content of the oversize material; again, you do not need to enter this value if you are not correcting your test results for the presence of oversize material.

7.2.4 Proctor Test Data

Test data

Point No.	1	2	3	4	5	6
Wt. mold+soil (lbs.)	17.46	18.1	18.34	18.73	18.75	18.55
Wt. mold (lbs.)	8.21	8.21	8.21	8.21	8.21	8.21
Mold volume (cu. ft.)	.075	.075	.075	.075	.075	.075
Wet density (pcf)	123.3	131.9	135.1	140.3	140.5	137.9
Wt. w+t (gms.)	652.2	776.6	900.8	635.8	827.4	842.9
Wt. d+t (gms.)	628.4	726.6	832.9	582.5	746.6	755.1
Tare (gms.)	90.3	80.5	87.3	102.2	110.3	105.8
Moisture (%)	4.4	7.7	9.1	11.1	12.7	13.5
Dry Density (pcf)	125.2	129.1	130.4	132.6	131.2	128.3

Figure 7.5: Moisture-Density Test Data Grid

LabSuite accepts data for up to six moisture-density test points, with one or two moisture-content evaluations per test point. (Checking the **Average two moisture content tests per point** option in the toolbar at the top of the window allows you to enter two moisture contents per test point: the program averages the results of the two moisture content tests to determine the test point's moisture content.) Except in the one-point test case, the program requires a minimum of three test points, with each point requiring the following data:

Wt. mold + soil

Wt. mold

These fields are used by the program to determine the soil density. Note that the weights may be entered in either grams or pounds: The **Units for mold weights** selection in the toolbar determines which units will be used.

⇒ Because the same mold is normally used for all of the test points, the **Wt. mold** entered for the first test point is automatically repeated for the other test points. If the mold weight does change, a new weight may be entered for any point.

Mold volume

LabSuite requires the volume of the compaction mold, in either cubic feet or liters, depending upon the dimension units assigned to the project file on which you're working: If you've configured the project to use SI units, enter the mold volumes in liters; for a US unit project, enter your mold volumes in cubic feet. (To change your project's dimension units, start your GEOSYSTEM program, open the project, then select Project > Dimension Units.)

⇒ ***LabSuite*** automatically selects a default mold volume based upon the mold diameter and mold height given for the test specification chosen in the **Test specifics** box. The default volume may be changed for any point.

Tare ID

If the option to enter container weights as tare IDs has been selected, data entry for the moisture content portion of the test begins by selecting an ID from the drop-down tare ID list. Once an ID is chosen, **Tare** field will be automatically filled in with the weight corresponding to that container.

⇒ If you haven't yet entered the container and its weight into the program's container list, see § 2.8 for instructions on adding it. Alternatively, the tare ID field may be left blank and a tare weight may be manually entered.

Wt. w + t
Wt. d + t
Tare

These are, respectively: the weights (in grams) of the wet soil and container, dry soil and container and the container by itself.

⇒ If the **Average two moisture content tests per point** toolbar check box is selected and data are not available for a second moisture content test, leave the second moisture content test fields blank; ***LabSuite*** will utilize only the data entered for the first (and only) moisture content test.

⇒ To delete a given test point's data, click the mouse in one of the test point's data entry fields, then select Edit > Delete this Test Point.

7.2.5 California Test Method 216 Test Data

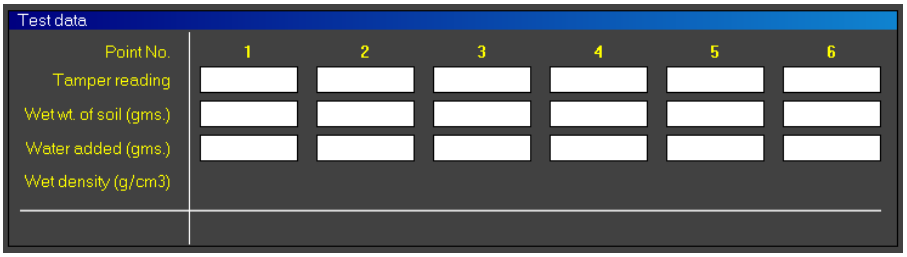


Figure 7.6: CT216 Test Data Grid

For California Test 216 tests, the following data are required:

Tamper reading
Enter the tamper shaft graduation reading here.

Wet wt. of soil
Enter the weight of the soil sample *minus the tare weight*. Note that the units used can be toggled between grams and pounds by changing the **Units for soil weights** box in the top toolbar.

Water added
Enter the amount of water added or subtracted to the tested sample. (For samples that have had moisture removed via aeration, enter the amount of water removed as a negative number.)

⇒ If you've selected a test specification that uses the **`CT-216 with added moisture content tests`** test method, the test data grid will also include prompts for entering each sample's moisture content. See the discussion on entering moisture contents for a standard Proctor test for more information.

8. Viewing and Modifying the Moisture-Density Curve

To preview a chart of the test's moisture-density curve, select **Window** > **Chart** or click on the **Chart** navigation tab. From this window you can:

- Reshape the moisture-density curve by moving or removing test points from the curve, or by adding additional points to the curve.
- Choose between two different styles of curves.
- Choose to plot the compaction curve with or without test points, or to omit the curve and just plot the test points.
- View moisture-density curves entered into the same project that are similar to the current test's curve.
- Synthesize a full compaction curve from a single moisture-density test point.

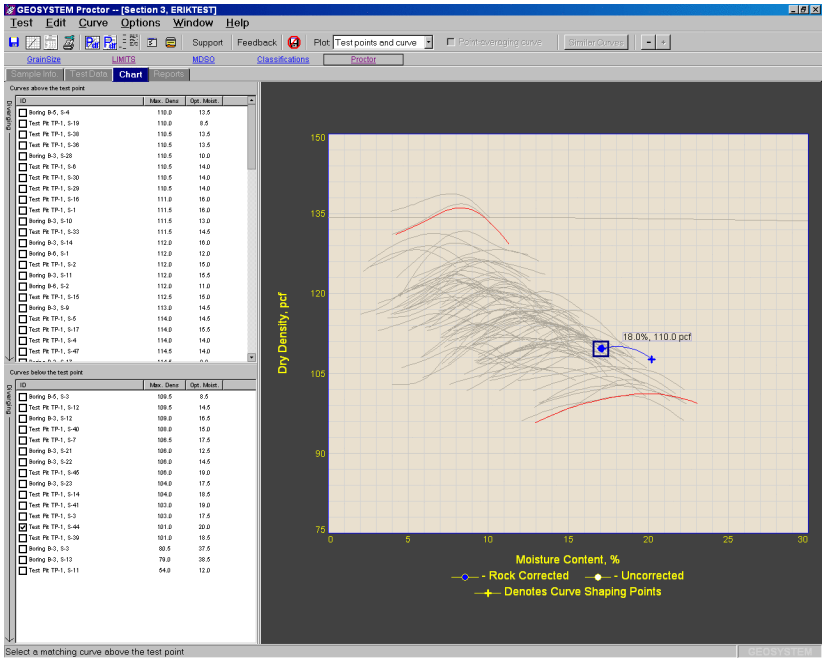


Figure 8.1: Moisture-Density Chart Review Window with One-Point Test Curve Selection Panes

⇒ The Chart Review window will display both an oversize-corrected and an uncorrected curve if:

- The test data includes oversize information (e.g., % oversize, bulk specific gravity, etc.).
- The specification used by the test includes an oversize correction applied to each test point instead of applying the correction only to the maximum dry density and optimum moisture values.
- The test's specification uses the **Report the uncorrected curve in addition to the corrected curve** option.

Otherwise, a single curve will be displayed.

8.1 Toolbar Controls

Figure 8.2: Moisture-Density Chart Review Window Toolbar

The toolbar at the top of the curve preview window contains the following controls:

Plot:
Determines whether the program plots the curve and test points, the curve only, or the test points only. See § 8.3 for further details.

Data-averaging curve
Selecting this option produces a smoother curve, but one that doesn't necessarily pass directly through every test point. Refer to § 8.3 for further details.

Similar Curves
Clicking this button causes the program to display moisture-density curves from the same project that have maximum dry density/optimum moisture contents close to the current test's maximum dry density and optimum moisture.

⇒ The button is disabled for one-point tests because the program *always* shows the similar curves for these tests.

"+" and "-" buttons
Clicking on the "-" button increases the moisture and density scale steps (i.e., the chart is zoomed out), while the "+" button decreases the scale steps (i.e., the chart is zoomed in).

8.2 Reshaping the Curve

You can change the shape of the compaction curve by adding *shaping* points (additional curve points added merely to force the curve to pass through a particular moisture/density location), moving test points or by choosing to omit test points generated from bad data, as shown in the following examples:

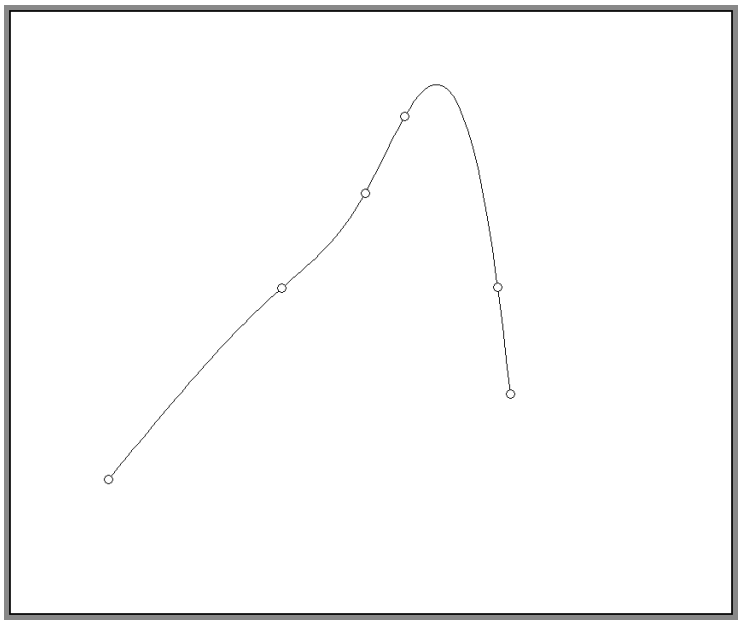


Figure 8.3: Original Moisture-Density Curve

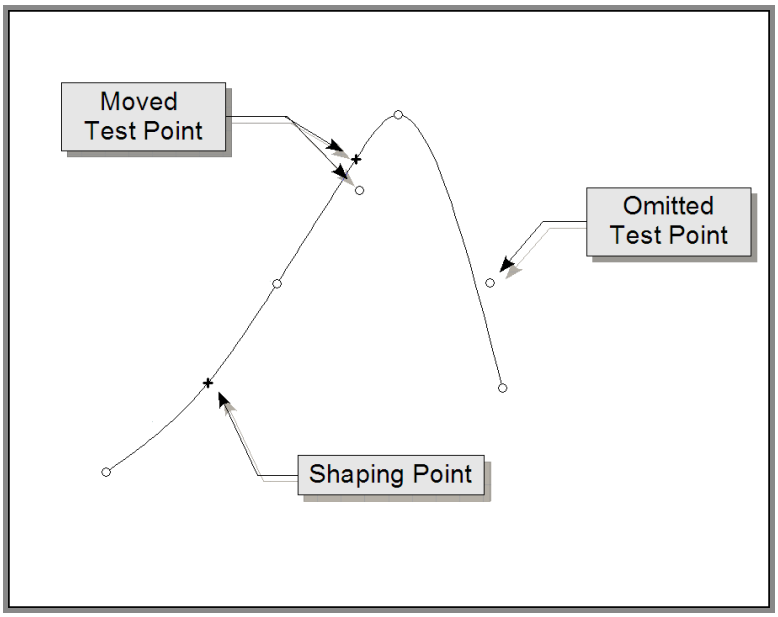


Figure 8.4: Same Test Data; Added Shaping Point and Moved and Omitted Data Points

To reshape the curve by adding a shaping point:

The shape of the curve may be adjusted by forcing it to pass through a new point. To do this, select Curve then either Shape Curve (if the window shows a single curve) or Shape Corrected Curve or Shape Uncorrected Curve. Next, move the mouse cursor to the location desired for the curve to pass through, then click the left mouse button. The new point will be marked with a " + ", which will not be shown on charts included on hardcopy reports.

To remove a shaping point:

Move the mouse cursor over the shaping point, then click the right mouse button and select Delete this Point from the popup menu.

You can also remove all shaping points by selecting Curve > Delete All Shaping Points.

To move a shaping point:

Once you've placed a shaping point you can move it: Place the mouse cursor over the shaping point, click the right mouse button and select Move this Point. Move the mouse cursor to the desired position for the shaping point then click the left mouse button.

⇒ Shaping points cannot be added to data-averaged curves.

You can also reshape the curve by moving or hiding test points:

To move a test point:

Move the cursor over the test point then click the right mouse button and select Move this Point, then move the mouse cursor to the desired position for the test point then click the left mouse button.

⇒ Note that the test point itself will continue to be shown in its original position, although the compaction curve will no longer pass through it. If you do not want to have the test point shown on the chart, use the procedure covered below.

To omit a test point from the chart:

Sometimes it may be necessary to remove a test point from the compaction chart because the testing data for the point is obviously not correct. To remove the point from the chart, move the mouse cursor over the bad point, right-click and select Include this Point on Curve to uncheck the option. (The point will still show up on the chart review window and on data summary reports, but it will not appear on chart reports.)

If the test point's data appears to have been entered incorrectly, the data can be corrected by moving the mouse cursor over the test point, then right-clicking and selecting Edit this Point's Data.

8.3 Changing How the Curve is Displayed

LabSuite includes several options for changing how the compaction curve is plotted:

You can omit the curve from chart reports:

If your compaction curve cannot be modified into an acceptable shape you can choose to have ***LabSuite*** plot just the test points, omitting the curve. (You can then draw the curve by hand on the hardcopy report.) To omit the curve, select Curve > Plot Test Points Only. Note that this option also causes the calculated maximum dry density and optimum moisture values to be omitted from the report (you'll need to work out your own values based upon the curve you've hand-drawn).

You can omit the test points from chart reports:

Selecting Curve > Plot Curve Only omits the test points from the chart, leaving only the curve.

The compaction curve can be plotted using a data-averaging curve model:

If your test data doesn't form a smooth compaction curve, Curve > Data-Averaging Curve can be used to draw a compaction curve formed using a *least-squares linear regression* mathematical model. In simplified terms, these curves average the distance between the curve and each test point, making for a smoother curve, but one that may not actually pass directly through each test point. As an example, the following figure shows a compaction curve that's somewhat oddly-shaped because the points on the wet side of the curve do not make a smooth curve:

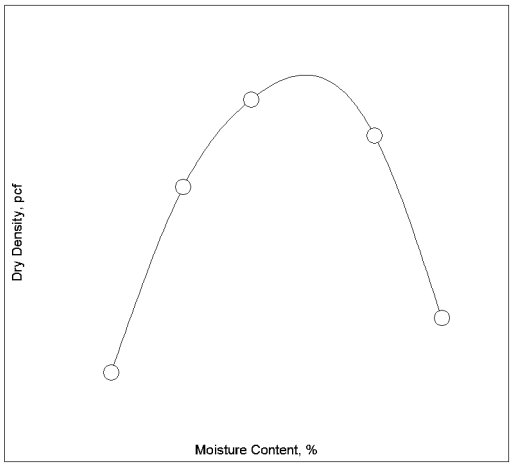


Figure 8.5: Moisture-Density Curve Drawn Using the Default Curve Plotting Method

Selecting the Data-Averaging Curve option produces a smoother curve shape:

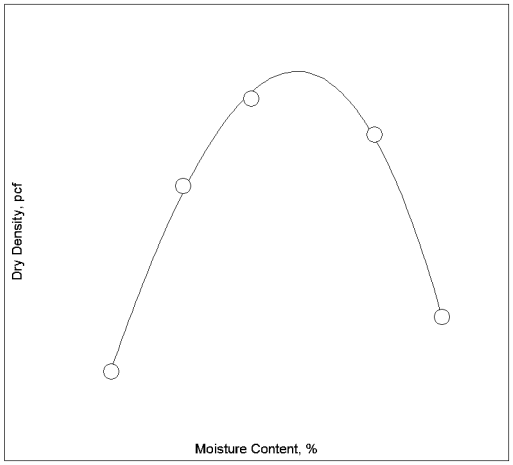


Figure 8.6: Moisture-Density Curve Drawn Using the Data Averaging Method

Note that the second curve does not exactly pass through each test point: For the top two points on the wet side of optimum moisture, the curve essentially "splits the difference" between the two points by passing on the right side of one and on the left side of the second. The resulting curve appears smoother.

⇒ The data-averaging curve model is not a panacea for cleaning up all misshapen curves. Some curves may benefit more by moving test points, removing bad data points from the curve, or by adding curve shaping points. Additionally, curves with five or six test points do not tend to plot very well using the data-averaging approach.

8.4 Creating Curves for One-Point Tests

LabSuite supports a simplified version of the AASHTO Family of Curves test method (T 272). The program may be used to match up the single test point of a one-point compaction test against the closest already-entered compaction curves above and below the point: a new curve passing through the single test point is synthesized from a combination of the two existing curves.

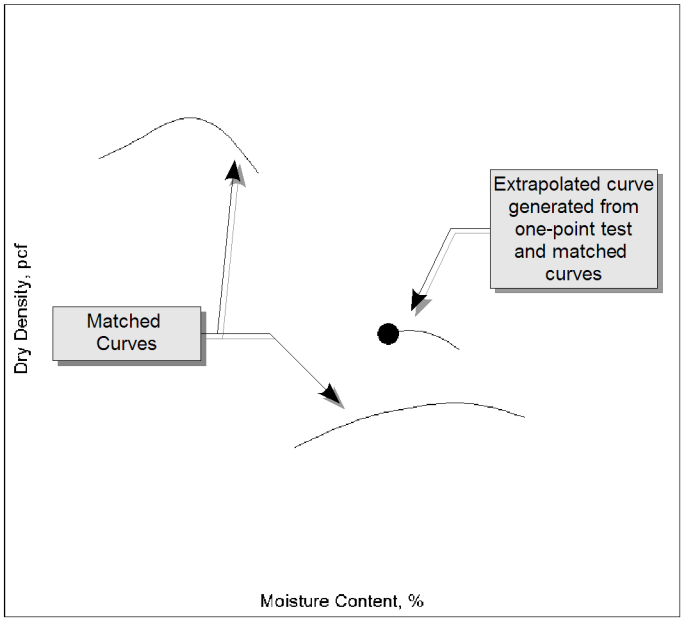


Figure 8.7: One-Point Test with Extrapolated and Matching Curves

LabSuite's one-point curve generation differs from the AASHTO standard in that the program only takes into account one curve above and one curve below the test point, while the standard requires that the behavior of an entire family of curves be accounted for when extrapolating the new curve.

To create a curve for a one-point test, begin by entering the data for the single test point, then select Window > Chart. When the Chart Review window is displayed, a pane will be added to the left-hand side listing compaction curves above and below the test point.

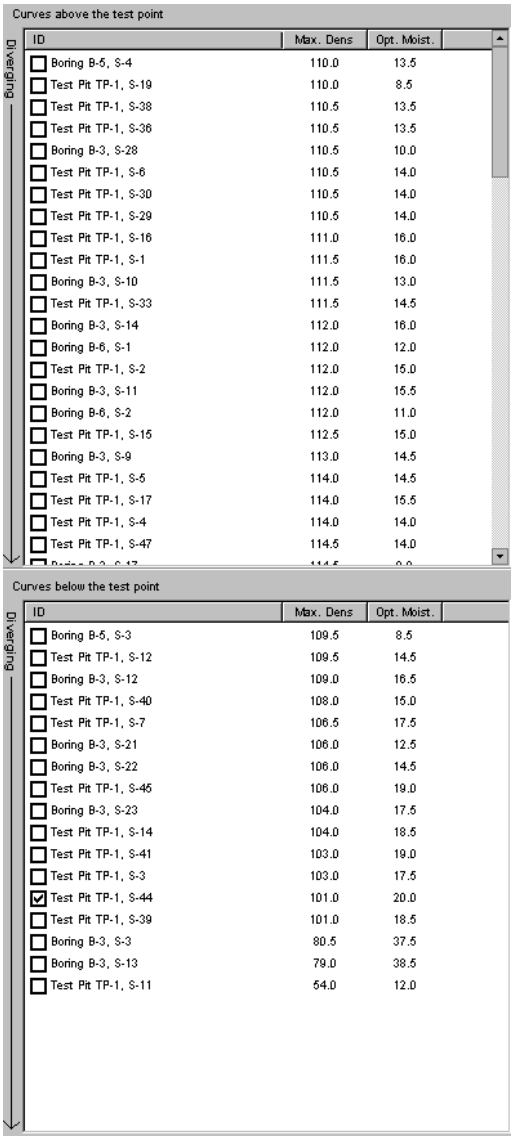


Figure 8.8: One-Point Match Curves Pane

⇒ Curves are ordered in the list by how close they are to the single test point.

The pane includes two lists of curves: one list contains curves that fall *above* the one-point test and the other list contains curves that fall below the one-point test. Clicking on the checkbox for one curve from *each* list causes the program to synthesize a curve passing through the test point and roughly matching two match curves.

⇒ The synthesized curve can be erased by unchecking the curve selections in the **Curves above the test point** and **Curves below the test point** boxes.

⇒ If oversize moisture or density corrections are applied, the test specifications used by both the match curves and the one-point test curves should use identical settings for the **Correct** correction application test specification setting.

9. Reporting Your Data

LabSuite features three methods for reporting your data:

XML Files

XML files contain a listing of both your raw testing data (such as the weights retained on each sieve during a grain size sieve test), as well as various values calculated by the software such as D_{10}, C_u, etc. XML files are saved on-disk and may be viewed by a web browser or by versions of Microsoft Excel newer than Excel2000. This is an ideal format for e-mailing testing data and results to your clients in a format that incorporates both a means of presentation (through a web browser) as well as a means of manipulating the raw data (through a spreadsheet).

Data Summary Reports

Summary reports list the raw data taken from your test. They may be sent to a printer or saved on disk.

Chart Reports

Chart reports are more formalized than summary reports: for example, a grain size chart report typically includes, in addition to a chart of particle size vs. percentage, a block listing your company name, along with tables listing various calculated percentages and other values. Unlike summary reports, chart reports do not list raw testing data such as the weight retained on each sieve.

⇒ Another difference between chart and summary reports is that ***LabSuite*** ships with several different chart reports from which you can select, while there's only one format for the summary report.

⇒ Chart and summary reports can be saved to a file in .PDF, .EMF, .PNG or .DXF format.

⇒ Through the Windows clipboard, you can also export chart reports to programs that can paste pictures into their documents (such as word processors or paint programs). To do this, select Edit > Copy Entire Test: once on the Windows clipboard, you can paste the chart into, for example, a word processing document by starting the word processor and selecting Edit > Paste.

9.1 Chart Reports

Chart reports may be reviewed and printed by selecting Window > Reports (Window > USDA Reports to view the USDA chart report), or by clicking on the **Reports** navigation tab. From this window you can:

- Combine tests from several samples onto a single report page.
- Change a report page's figure number.
- Select a different format for printing chart reports.
- Preview and print chart and summary reports.

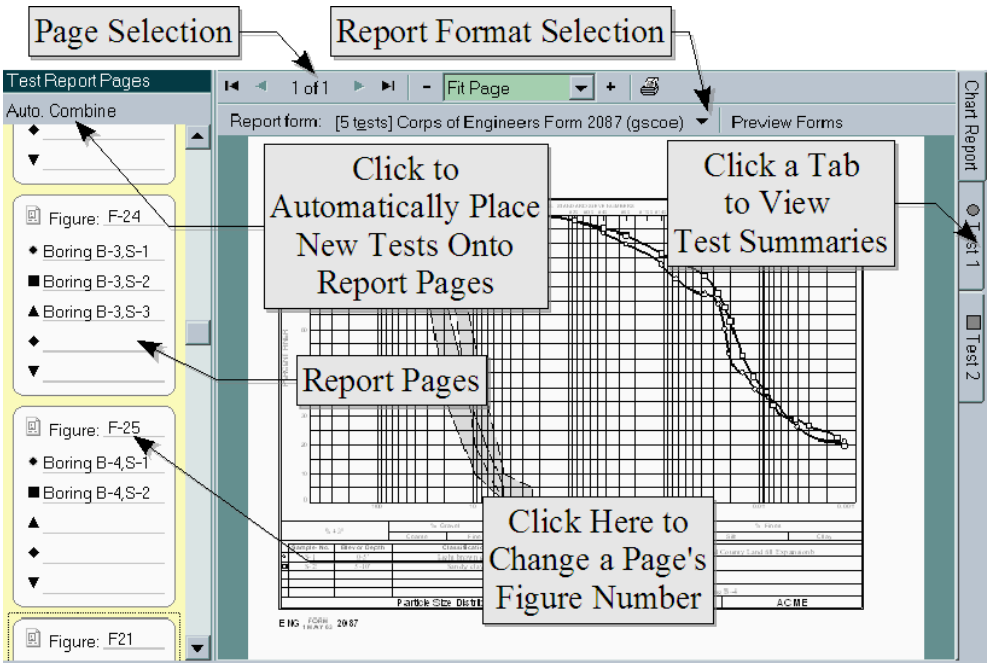


Figure 9.1: The Report Preview Window

On the left side of the screenshot is a box listing the ***LabSuite*** chart report pages that have been set up for the current project: each sample tested will be shown on one of these pages. Some chart report formats can support printing more than one sample's test on a single page (for example, each page in the screenshot supports up to 5 tests – one page in the sample is currently set up to print three tests (Boring B-3, samples S-1, S-2, and S-3) and the other holds two tests from Boring B-4).

⇒ Tests shown in gray will not be printed on the report because the report form that you've selected does not have room for them. (This happens when you create a page with, e.g., 5 tests, and then change to a report format that has room for, say, a single test per page.) **You should drag these tests onto a different page or move them to their own report page; otherwise they will never print.** (If you click on the **Auto. Combine** button, the program will fix the problem for you.)

Following is a list of actions that you can take from this window:

You can move tests from one page to another

The program adds a new report page to the list for every test that you enter. So, after you've entered all of your project's tests, you'll have a list of report pages, with one test on each page. Since most report ***LabSuite*** report formats can show more than one test on a single page, you may want to combine several tests onto one report page. To do this, drag the test (such as, e.g., the **`Boring B-4,S-1`** test in the screenshot) from its own report page and drop it on another page.

You can have the program automatically combine tests onto report pages

Rearranging tests onto different report pages can be tedious...fortunately, computers excel at tedious tasks! If you click on the **Auto. Combine** button, ***LabSuite*** will try to combine as many tests onto a single report page as possible, with one caveat: ***LabSuite*** will only combine tests onto a single page if they were taken from the same material source.

You can assign a figure number to a report page

Each report page can list a figure number. To set a page's figure number, click in the underlined area next to the word **Figure** at the top of the report page in the left-hand list, then type in your figure number.

You can move a test onto its own report page

To do this, drag the test off of its current report page onto the yellow area at the left side of the screen (i.e., drop the test anywhere but on another report page).

You can move a test into a new position on the report page

Drag and drop the test to a higher or lower position on its current report page in the page list.

You can change the format of the report pages

The software ships with many different chart report formats that you can use for printing your test data. (You can view samples of all of the program's report formats by clicking on the **Preview Forms** button.) To select a new report format, click on the button shown in the following figure:

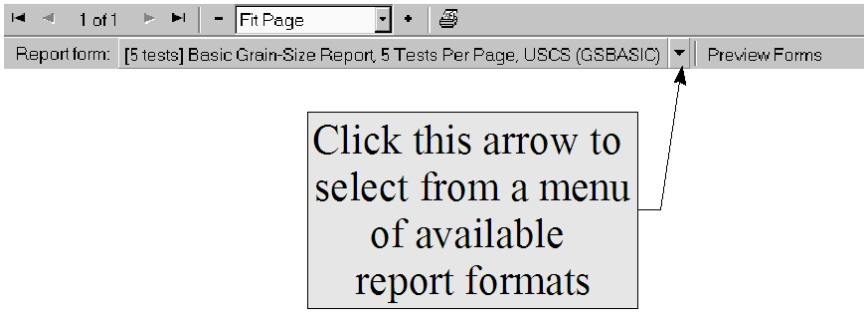


Figure 9.2: Selecting a Chart Report Form

9.1.1 Selecting a Scale for Moisture-Density Reports

You can alter the moisture and density scale used on a *specific* moisture-density chart report by previewing the report then selecting Report > Chart Report Scale. Doing so brings up the moisture-density chart scaling dialog shown below:

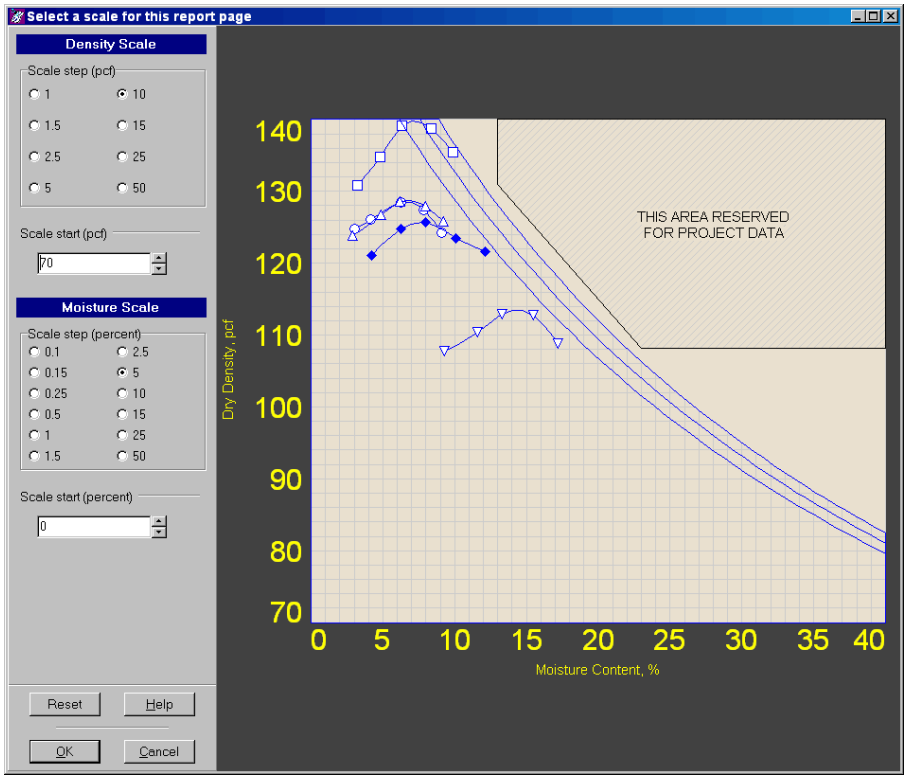


Figure 9.3: Moisture-Density Chart Scale Dialog

This dialog lets you change the start and increment for the scales used on the moisture-density graph included on the report that you're currently previewing. The choices you make on this dialog do not affect the moisture-density curve preview window, nor do they affect the small chart shown on the test's data summary report. Any changes made using this dialog affect only the test report page that you're previewing when Report > Chart Report Scale is selected.

Scale step

The moisture and density **Scale step** box lets you select the distance (in percentage and units of density) between scale labels on the chart.

Scale start

The **Scale start** box selects a value for the left side of the moisture content scale and the bottom of the density scale.

Reset

Clicking on this button resets both moisture and density scales to the program's default selection.

⇒ If the currently selected report format includes three zero air voids (ZAV) curves at specific gravities of 2.6, 2.7 and 2.8, the program will reserve some space immediately to the right of the 2.8 ZAV curve in order to display information on the project and test specification. (The preceding screen shot shows the reserved area, labeled "This area reserved for project data".) This reserved area places some constraints on the scale that you choose because some combinations of density and moisture scale starts and scale steps would not leave enough room for the program to display the right-hand project and test specification information.

If you adjust the chart scale so that the 2.8 ZAV curve runs through the hashed "This area reserved for project data" area, clicking the **OK** button causes the program to shift your scale so that the hashed area is no longer intersected by the ZAV curve; you will then need to click **OK** a second time to exit the dialog.

9.1.2 Printing Your Reports

After you've arranged your tests onto report pages you can preview or print each page: Locate and click on the page in the page list shown in the yellow box on the left side of the screen then select Test > Output Chart Report. You'll be presented with the printer settings dialog:

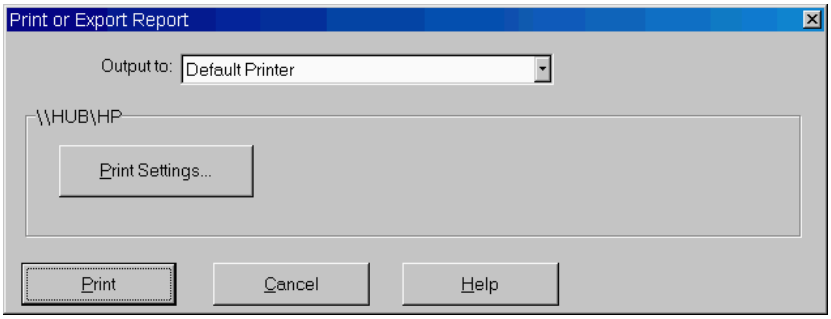


Figure 9.4: Printer Output Settings Dialog

Print Settings

Click this button to select a different printer or to change the printer's page size, resolution, etc.

Print

Click this button to print your report.

9.1.3 Selecting a Chart Report Format

You can view samples of the report forms shipped with the program by clicking on the **Preview Forms** button. Browse through the forms by clicking on the left and right arrow buttons in the toolbar; when you've settled on a new report format, click on the **Select this Format** button.

⇒ If you'd like printed samples of all of the report formats shipped with the program, click on the **Print Samples** button.

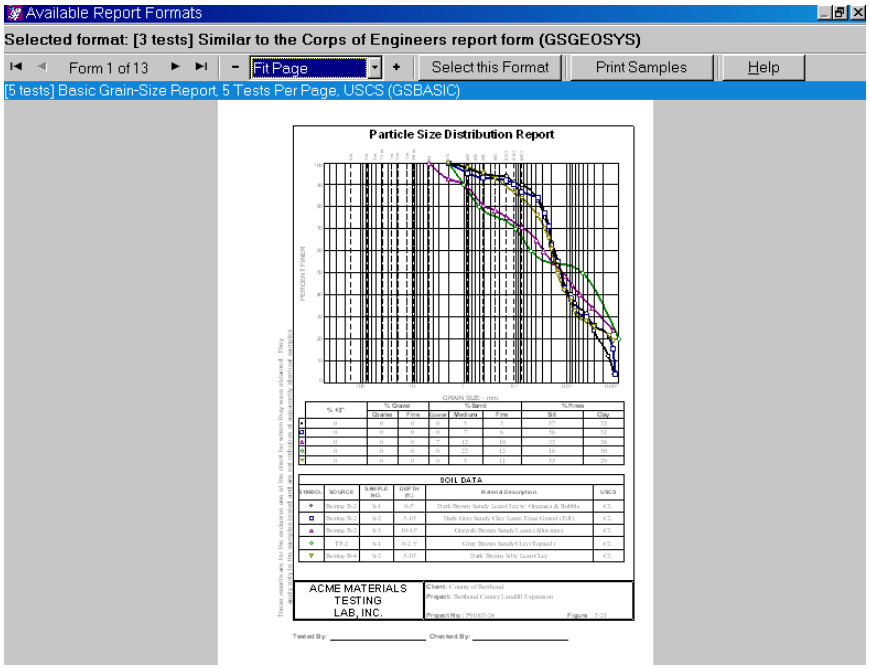


Figure 9.5: Selecting a Chart Report Form

9.2 Data Summary Reports

Data summary reports list the raw data taken from a single lab. test (e.g., specimen weights, test readings, etc.). You can print a summary report or export it to a file by selecting Test > Output Data Summary Report.

⇒ The Classifications screens (i.e., ASTM, AASHTO, USDA, etc.) do not generate data summary reports.

GRAIN SIZE DISTRIBUTION TEST DATA

Client: County of Berthoud
Project: Berthoud County Landfill Expansionb
Project Number: P91003-24
Location: Boring 2

Sieve Test Data

Post #200 Wash Test Weights (grams): **Dry Sample and Tare =** 26577.10
Tare Wt. = 5189.00
Minus #200 from wash = 7.8%

Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
28394.60	5189.00	6	0.00	0.00	100.0
		4	487.30	0.00	97.9
		3	232.10	0.00	96.9
		2	487.30	0.00	94.8
		1.5	510.50	0.00	92.6
		3/4	1763.60	0.00	85.0
		3/8	2459.80	0.00	74.4
		#4	2691.80	0.00	62.8
3721.80	0.00	#8	927.61	0.00	49.1
		#16	785.40	0.00	37.5
		#30	853.12	0.00	24.9
289.50	0.00	#50	142.18	0.00	16.5
		#100	98.37	0.00	10.7
		#200	44.10	0.00	8.1

Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
3.1	11.9	22.2	34.1	16.6	26.0	12.1	54.7			8.1

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
0.1312	0.2564	0.4183	0.7973	2.4788	4.1078	13.5548	19.0498	28.9572	52.3790

Fineness Modulus	C_u	C_c
4.50	31.30	1.18

ALV Engineers

Figure 9.6: First Page of a Sample Summary Report

9.3 Exporting Reports To Files

You can save ***LabSuite***'s testing data summary and chart reports for posting to a web server or for e-mailing to clients. The program supports several different export formats:

- **Adobe Acrobat .PDF:** Universal format for Internet document distribution. Requires the Adobe Reader program to display the files.
- **AutoCAD .DXF:** Format for interchange among CAD programs.
- **Windows Metafile (.EMF):** These files can be inserted as a picture into a word processing document or manipulated with a vector-drawing program such as Adobe Illustrator.
- **Portable Network Graphics (.PNG)** and **JPEG File (.JPG):** These files are "bitmap" files that can be inserted into word processing documents or edited with a raster-drawing program such as Windows Paint or Photoshop.

To save a chart or summary report as a file, select either Test > Output Data Summary Report or Test > Output Chart Report, then, from the **Output to** box on the next dialog, select one of the file formats outlined above.

If you've chosen the **Adobe Acrobat .PDF File**, **Windows Metafile (.EMF)**, **Portable Network Graphics (.PNG)** or **JPEG File (.JPG):** options you'll see the following dialog:

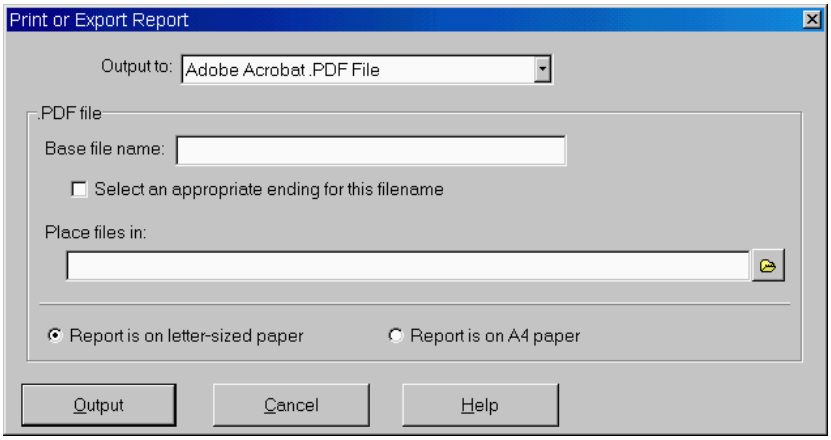


Figure 9.7: .PDF, .EMF, .PNG and .JPG Output Settings Dialog

.DXF files are somewhat more complicated: if you select the **AutoCAD .DXF File** you'll see this dialog:

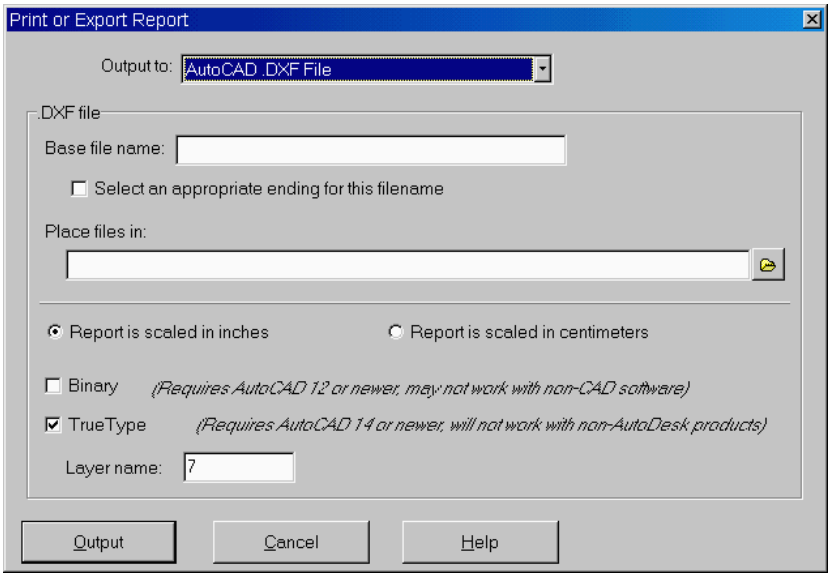


Figure 9.8: .DXF Output Settings Dialog

There are a number of options available for selecting where and how the reports are generated:

Base file name

When the program creates a file from one page your report (for .DXF, .EMF, .PNG and .JPEG files), or from your *entire* report (for .PDF files), the file's name will start with whatever is entered into this field.

Select an appropriate ending for this filename

Without this option, the names of the files created will be whatever you have selected as the **Base file name**. Checking the **Select an appropriate ending for this filename** box alters how the program names the report files: the sample number and/or sampling location is added to the **Base file name**, followed by the test type ("GS" or "LM" etc.) and either "ChartReport" or "TestData". For example, with the **Select an appropriate ending for this filename** box checked, the program may create .PDF files with names like:

```
P92321 Sample S-4 Boring B-3 GS TestData.PDF
P92321 Sample S-1 Test Pit TP-2 GS ChartReport.PDF
```

etc.

⇒ With **Base file name** and **Select an appropriate ending for this filename** you can come up with some useful file naming variations. For example, you could leave **Select an appropriate ending for this filename** unchecked and enter the sample number/location as part of the **Base file name** - of course, this means that when you export the next report, you'd have to change the **Base file name** to reflect the new sample number.

As another example, if you have created a hard disk subdirectory just to hold

.PDF files from a certain project, you may not need to include the project number as part of each .PDF file name: instead of being called, for example, **`P92321 Sample S-4 Boring B-3.`**
(P92321 being the project number), by leaving the **Base file name** field blank you can get export files with names like **`Sample S-4_Boring B-3.PDF`**

Place files in

Sets the directory where your exported files will be placed.

Report is on letter-sized paper ***(.PDF, .EMF and .PNG files only)***
Report is on A4 paper ***(.PDF, .EMF and .PNG files only)***

Selects the paper size to be used for the exported report image.

Report is scaled in inches ***(.DXF files only)***
Report is scaled in centimeters ***(.DXF files only)***

Reports exported as CAD files either measure either 10 units vertically (when scaled in inches) or 25.4 units vertically (when scaled in centimeters). This selection does not affect the report's appearance; rather, it just affects the coordinates given to each line and piece of text on the report. (As such, the selection is only important when the exported report is to be edited by an illustration or CAD program.)

Binary ***(.DXF files only)***

Binary .DXF files will be smaller (by 25 to 50 percent) and open faster in AutoCAD. The reports will appear the same when viewed in a CAD program no matter if this option is selected or not. Note that very few illustration programs will read binary .DXF report files.

TrueType ***(.DXF files only)***

If this option is unselected, .DXF report files use a monospaced font (**`similar to this`**) for everything on the form, meaning that .DXF reports are less attractive than their printed counterparts. The TrueType option allows you to generate .DXF files that look exactly like the printed versions – however, TrueType .DXF files are only supported on AutoCAD versions 14 and newer; additionally, many other drawing and CAD programs do not support TrueType files.

Layer name ***(.DXF files only)***

Specifies the name of the CAD drawing layer on which your report will be drawn. Layer names may be any combination of alphabetic and numeric characters – however, many CAD programs cannot handle layer names that include spaces. (**`MYLAYER`** is OK, **`MY LAYER`** is not.) Since your chosen layer name will be repeated throughout the .DXF report files, the shorter you make the name the smaller in size your .DXF files will become.

9.4 Exporting XML Files

The XML file format provides a means of exporting your testing data and calculated test results into a format readable by a web browser and by newer Excel spreadsheet programs (XP or later). This makes XML files a natural method for posting testing results to a Web or FTP site or for e-mailing directly to clients.

To export an XML file, select Test > Export XML File

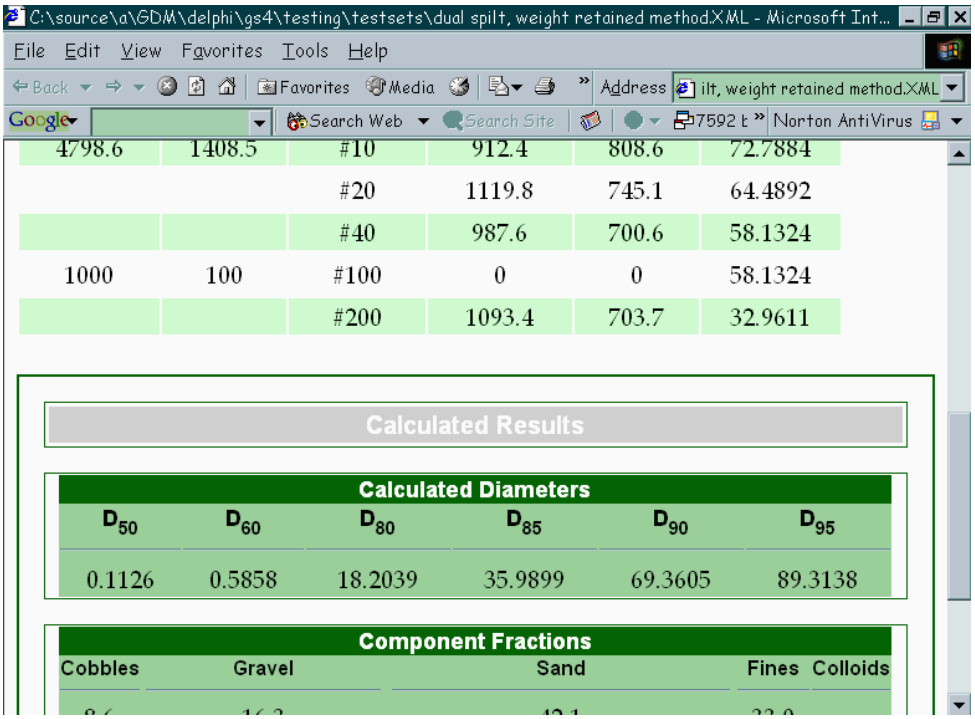


Figure 9.9: Portion of an XML Report Viewed in Internet Explorer

9.5 Listing the Results From Multiple Tests

The Data Summary and Export tool discussed in Chapter 4 of the GDM manual and Appendix C of the LD4 User's Guide may be used to summarize the results of multiple lab. tests. Several stock configuration files can be used by selecting Tools > Data Summary and Export from the GDM or LD4 menu, then selecting File > Recall Existing Configuration and selecting one of the listed configuration files:

- To list grain size distribution test results, select **GSFRACS.LFG** or **GSFRACS2.LFG**
- To list Atterberg limits test results, select **LIMSUM1.LFG**

⇒ If you've purchased LD4, you can use the configuration files to view an on-screen list of the tests performed for a project: From the LD4 screen, select Project > Browse and choose one of the listed configuration files.

9.5.1 Grain Size Test Results Calculated by the Program

As an alternative to using the stock **GSFRACS.LFG** and **GSFRACS2.LFG** summary and export files, you can also create your own summaries with data values calculated by the program. These values (or "variables") can also be referenced in boring logs created with the GEOSYSTEM LOGDRAFT program.

The following table lists the names of all of the calculated grain size variables provided by ***LabSuite*** and gives a short description of each variable.

Table 9.1: Grain Size Test Results for Summaries and Boring Logs

Item Name	Description
GS_CC	Provides the coefficient of curvature
GS_CC	Provides the coefficient of curvature
GS_CU	Provides the coefficient of uniformity
FINENESSMOD	Fineness modulus
D95, D90, D85, D80, D60, D50, D30, D20, D15 and D10	Provides the material diameter at which 95, 90, 85, 80, 60, 50, 30, 20, 15 and 10 percent of the material is smaller.
DIDMECH	"Y" if a mechanical test was performed on the sample. This is useful for counting the number of mechanical tests performed.
DIDHYD	"Y" if a hydrometer test was performed on the sample.
PER6IN	Percent of material smaller than 6 inches.
PER5IN	Percent of material smaller than 5 inches.
PER4IN	Percent of material smaller than 4 inches.
PER3IN	Percent of material smaller than 3 inches.
PERTWO5	Percent of material smaller than 2.5 inches.
PER2IN	Percent of material smaller than 2 inches.
PERONE5	Percent of material smaller than 1.5 inches.
PERONEANDQUARTER	Percent of material smaller than 1.25 inches.
PER1IN	Percent of material smaller than 1 inch.
PERTHREEQ	Percent of material smaller than 3/4 inches.
PERFIVEEIGHT	Percent of material smaller than 5/8 inches.
PERHALFIN	Percent of material smaller than 1/2 inch.
PER375	Percent of material smaller than 3/8 inches.
PERFIVESIXTEEN	Percent of material smaller than 5/16 inches.
PERONEQ	Percent of material smaller than 1/4 inch.

Continued on the next page

Item Name	Description
PER4, PER5, PER6, PER7, PER8, PER10, PER12, PER14, PER16, PER18, PER20, PER25, PER30, PER35, PER40, PER45, PER50, PER60, PER70, PER80, PER100, PER120, PER140, PER170, PER200, PER230, PER270, PER300, PER325, PER400	Provides the calculated percentage passing various standard sieve sizes: for example PER4 provides the percent passing the #4 sieve.
PER074MM	Percent of material smaller than .074 mm.
PER005MM	Percent of material smaller than .005 mm.
PER001MM	Percent of material smaller than .001 mm.
GS_SPECENV	Gives the name of the specification envelope selected for the test.

SI sieve tests export the following results:

PER200MM	Percent of material smaller than 200 mm.
PER75MM	Percent of material smaller than 75 mm.
PER53MM	Percent of material smaller than 53 mm.
PER37.5MM	Percent of material smaller than 37.5 mm.
PER26.5MM	Percent of material smaller than 26.5 mm.
PER19MM	Percent of material smaller than 19 mm.
PER13.2MM	Percent of material smaller than 13.2 mm.
PER9.5MM	Percent of material smaller than 9.5 mm.
PER6.7MM	Percent of material smaller than 6.7 mm.
PER4.75MM	Percent of material smaller than 4.75 mm.
PER2.36MM	Percent of material smaller than 2.36 mm.
PER1.18MM	Percent of material smaller than 1.18 mm.
PER.6MM	Percent of material smaller than .600 mm.
PER.425MM	Percent of material smaller than .425 mm.
PER.3MM	Percent of material smaller than .3 mm.
PER.15MM	Percent of material smaller than .15 mm.
PER.075MM	Percent of material smaller than .075 mm.

Each classification system selection such ASTM D 2487, Burmister and Wentworth also makes additional values available, such as the percentage of sand, silt and clay. Which values are calculated depends upon the classification system you've chosen: For example, the Wentworth classification defines a **Very Coarse Sand** particle size, while the USCS classification does not, so, if you select the USCS classification system when entering a grain size test you will not be able to summarize the percentage of **Very Coarse Sand**. The table below lists definitions for *all* of the possible particle size ranges, while the table after lists which size ranges are defined for each of the supported classification systems.

Table 9.2: Particle Size Ranges

Item Name	Description
BOULDER	Boulders
COBBLES	Cobbles
PEBBLE	Percentage of pebbles (Wentworth classification only)
GRANULE	Percentage granules (Wentworth classification only)
COARSE_GRAVEL	Coarse gravel
MEDIUM_GRAVEL	Medium gravel
FINE_GRAVEL	Fine gravel
GRAVEL	Total gravel percentage. For USDA, GRAVEL = COARSE_GRAVEL plus MEDIUM_GRAVEL plus FINE_GRAVEL; for USCS, GRAVEL is COARSE_GRAVEL plus FINE_GRAVEL (because USCS does not define a "medium gravel" size range)
VCOARSE_SAND	Very coarse sand
COARSE_SAND	Coarse sand
MEDIUM_SAND	Medium sand
FINE_SAND	Fine sand
VFINE_SAND	Very fine sand
SAND	Total sand percentage
COARSE_SILT	Coarse silt
MEDIUM_SILT	Medium silt
FINE_SILT	Fine silt
SILT	Total silt percentage
CLAY	Percentage of material smaller than silt
FINES	Percentage of material smaller than sand
COLLOIDS	Percentage of fine clay

Table 9.3: Size Ranges Supported by Classification System

Classification System	Supported Range Values
USCS	COBBLES, COARSE_GRAVEL, FINE_GRAVEL, GRAVEL, COARSE_SAND, MEDIUM_SAND, FINE_SAND, SAND, SILT, CLAY, FINES, COLLOIDS
USCS with .002mm. instead of .005 silt/clay division	same as USCS
USCS without coarse/medium/fine divisions	COBBLES, GRAVEL, SAND, SILT, CLAY, FINES, COLLOIDS
USCS, lists fines instead of silts/clay	COBBLES, COARSE_GRAVEL, FINE_GRAVEL, GRAVEL, COARSE_SAND, MEDIUM_SAND, FINE_SAND, SAND, FINES, COLLOIDS
AASHTO	COBBLES, GRAVEL, COARSE_SAND, FINE_SAND, SAND, SILT, CLAY, FINES, COLLOIDS

Continued on the next page

Classification System	Supported Range Values
Wentworth	BOULDER, COBBLES, PEBBLE, GRANULE, VCOARSE_SAND, COARSE_SAND, MEDIUM_SAND, FINE_SAND, VFINE_SAND, SAND, COARSE_SILT, MEDIUM_SILT, FINE_SILT, VFINE_SILT, SILT, CLAY
Burmister	COBBLES, COARSE_GRAVEL, MEDIUM_GRAVEL, FINE_GRAVEL, GRAVEL, COARSE_SAND, MEDIUM_SAND, FINE_SAND, SAND, FINES
USDA	BOULDER, COBBLES, COARSE_GRAVEL, MEDIUM_GRAVEL, FINE_GRAVEL, GRAVEL, VCOARSE_SAND, COARSE_SAND, MEDIUM_SAND, FINE_SAND, VFINE_SAND, SAND, COARSE_SILT, FINE_SILT, SILT, CLAY
USDA, #270 sand/silt division instead of .05mm.	same as USDA
Australian Sandard AS 1726	BOULDER, COBBLES, COARSE_GRAVEL, MEDIUM_GRAVEL, FINE_GRAVEL, GRAVEL, COARSE_SAND, MEDIUM_SAND, FINE_SAND, SAND, COARSE_SILT, MEDIUM_SILT, FINE_SILT, SILT, CLAY
Canadian Soil Information System 1982	BOULDER, COBBLES, COARSE_GRAVEL, MEDIUM_GRAVEL, FINE_GRAVEL, GRAVEL, VCOARSE_SAND, COARSE_SAND, MEDIUM_SAND, FINE_SAND, VFINE_SAND, SAND, SILT, CLAY, COLLOIDS
ISSS	COBBLES, GRAVEL, COARSE_SAND, FINE_SAND, SAND, SILT, CLAY
British Sandard 5930	BOULDER, COBBLES, COARSE_GRAVEL, MEDIUM_GRAVEL, FINE_GRAVEL, GRAVEL, COARSE_SAND, MEDIUM_SAND, FINE_SAND, SAND, COARSE_SILT, MEDIUM_SILT, FINE_SILT, SILT, CLAY

9.5.2 Atterberg Limits Test Results Calculated by the Program

The following table lists the names of all of the calculated Atterberg limits variables provided by ***LabSuite***.

Table 9.4: Atterberg Test Results for Summaries and Boring Logs

Item Name	Description
LL	Liquid limit
PL	Plastic limit
PI	Plasticity index
LL_OVEN	Oven-dried liquid limit
NM	Natural moisture
LI	Liquidity index

9.5.3 Soil Classification Results Calculated by the Program

The following table lists the names of all of the calculated soil classification variables provided by ***LabSuite***.

Table 9.5: Calculated Soil Classification Values

Item Name	Description
USCS	ASTM D 2487 (USCS) soil classification
STRATA_DESC	D 2487 group name
AASHTO	AASHTO M 145 soil classification
AS1726	Australian standard 1726 soil classification
USDA	USDA soil classification
USDA_SANDFRAC	USDA calculated sand fraction
USDA_SILTFRAC	USDA calculated silt fraction
USDA_CLAYFRAC	USDA calculated clay fraction
BURMISTER	Burmister soil identification
BURMSYM	Burmister soil symbol
PCPriComp	Burmister primary component
PIBURM	Burmister overall plasticity index
THREADBURM	Burmister thread diameter
COLORBURM	Burmister soil color
SHAPEBURM	Burmister grain shape
OTHERBURM	Burmister misc. material characteristics

9.5.4 Moisture-Density Results Calculated by the Program

The following table lists the names of all of the calculated moisture-density variables provided by ***LabSuite***:

Table 9.6: Calculated Moisture-Density Values

Item Name	Description
PRCURVENO	Curve number
MAXDENS	Maximum dry density (uncorrected for oversize material)
OPTMOIST	Optimum moisture content (uncorrected for oversize material)
CORRMAXDENS	Maximum dry density (corrected for oversize material)
CORROPTMOIST	Optimum moisture content (corrected for oversize material)
PRTEST_SPEC	Test specification name
PROVSPER	Percentage of material larger than the oversize sieve
OVSPG	Bulk specific gravity
OVSMOIST	Oversize material moisture content
SPECGR	Sample specific gravity

9.6 Technical Documentation

In the past each GEOSYSTEM program manual concluded with a chapter covering (in great detail) the methods used by the program to calculate each test result. This had the effect of making the manual thicker and thus more threatening looking to the casual user. To combat this perception (and to save paper), we've moved the documentation chapters to our web site.

- Grain size calculations are documented here:
  http://geosystemsoftware.com/products/gs4/downloads/gs4calculations.pdf
- Atterberg limits calculations are documented here:
  http://geosystemsoftware.com/products/clsuite4/downloads/limits4calculations.pdf
- Moisture-density calculations are documented here:
  http://geosystemsoftware.com/products/pr4/downloads/pr4calculations.pdf

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