# GEOSYSTEM® R-VALUE

## Resistance R-value Module
## for GEOSYSTEM® for Windows

### RESISTANCE R-VALUE TESTING RESULTS
### (AASHTO T 190)

| | |
|---|---|
| Date: | 10/3/01 |
| Project No.: | Project # |
| Project No.: | Project 1 |
| | Project 2 |
| Location: | STA 132+005 |
| Sample Number: | SAMPLE 1 |
| Material Description: | Material Description |
| | Line 2 |
| | Line 3 |
| Tested by: | ERK |
| Checked by: | ALV |
| Remarks: | Received on: 27.Aug.01 |
| | Tested on: 29.Aug.01 |

| Test specimen number | 1 | 2 | 3 |
|---|---|---|---|
| Compaction pressure (psi): | 5 | 10 | 15 |
| Prepared weight (grams): | 100.0 | 1000.0 | 60.0 |
| Water added (ml.): | 0.0 | 47.6 | 5.7 |
| % Moisture: | 5.0 | 10.0 | 15.0 |
| Exudation load (lbs.): | 1884 | 4398 | 7539 |
| Exudation pressure (psi): | 150 | 350 | 600 |
| Total weight (lbs.): | 3.830 | 4.270 | 2.610 |
| Mold weight (lbs.): | 2.430 | 2.200 | 0.000 |
| Sample weight (lbs.): | 1.400 | 2.070 | 2.610 |
| Initial expansion (in.): | 0.0025 | 0.0010 | 0.0000 |
| Final expansion (in.): | 0.0042 | 0.0044 | 0.0069 |
| Expansion pressure (psi): | 0.68 | 1.36 | 2.76 |
| Ph at 2000 lbs.: | 158 | 67 | 2 |
| D turns: | 3.00 | 3.50 | 2.70 |
| R: | 1.0 | 49.8 | 98.7 |
| Height (in.): | 2.30 | 2.35 | 2.40 |
| Dry density (pcf): | 79.7 | 110.1 | 130.0 |
| Corrected R: | 0.9 | 45.8 | 98.6 |

| | |
|---|---|
| Wet weight: | 100.0 |
| Dry weight: | 98.0 |
| Tare weight: | 58.0 |
| Initial moisture = | 5.0 |

R-Value at 400 psi exudation pressure = 56.6
Expansion pressure at 400 psi = 1.60

**DEMONSTRATION USE ONLY**

## R-VALUE TEST REPORT



Resistance R-Value and Expansion Pressure - AASHTO T 190

| No. | Compact. Pressure psi | Density pcf | Moist. % | Expansion Pressure psi | Horizontal Press. psi @ 160 psi | Sample Height in. | Exud. Pressure psi | R Value | R Value Corr. |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 5 | 79.7 | 5 | 0.68 | 158 | 2.30 | 150 | 1 | 0.9 |
| 2 | 10 | 110.1 | 10.0 | 1.36 | 67 | 2.35 | 350 | 49.8 | 45.8 |
| 3 | 15 | 130.0 | 15.0 | 2.76 | 2 | 2.40 | 600 | 98.7 | 98.6 |

| TEST RESULTS | MATERIAL DESCRIPTION |
|---|---|
| R-value at 400 psi exudation pressure =56.6 | Material Description |
| | Line 2 |
| Exp. pressure at 400 psi exudation pressure =1.60 psi | Line 3 |
| **Project No.:** Project # | **Tested by:** ERK |
| **Project:** Project 1 | **Checked by:** ALV |
| Project 2 | **Remarks:** |
| **Location:** STA 132+005 | Received on: 27.Aug.01 |
| | Tested on: 29.Aug.01 |
| **Date:** 8.31.01 | |
| R-VALUE TEST REPORT | |
| **DEMONSTRATION USE ONLY** | Plate No F23 |

GEOSYSTEM® is a registered trademark of VES, Inc.

Windows® is a registered trademark of Microsoft Corporation

### Terms of License Agreement

1.  The Licensee agrees not to sell or otherwise distribute the program or the program documentation.  Each copy of the program is licensed only for use at a single address.

2.  The Licensee agrees not to hold Von Gunten Engineering Software, Inc. (VES, Inc.) liable for any harm, damages claims, losses or expenses arising out of any act or occurance related in any way to the use of the program.

3.  The program is warranted to fully perform the tasks described in the program documentation.  All results of the operation of the program are subject to the further engineering judgment , prudence, and study of the user.

4.  If the program does not perform as described, VES, Inc. will replace the program or refund the fee paid in the licensing agreement, at its option.  In no event will VES, Inc. be liable for any amount greater than the total of the license fee or fees paid by the licensee.

5.  One year of free consultation and updates is included with the program.  In subsequent years, updates will be available, for a fee, at the user's option.

# 1. Introduction, Installation and Setup

The GEOSYSTEM Resistance R-value module (R-VALUE) is designed to reduce laboratory data from a resistance R-value and/or expansion pressure test. Following is a list of supported features:

⇒ ASTM D 2844, AASHTO T190 and California Test 301 test standards.

⇒ Both English and SI (metric) units.

⇒ Utilizes the GEOSYSTEM Data Manager program (GDM) for file handling: project information such as the project name and number is entered only once per project. GDM can be used to created printed lists of all of the R-VALUE tests performed for a given project.

⇒ Entry of either exudation load or exudation pressure.

⇒ Interactive modification of the R-value vs. expansion pressure and exudation vs. expansion pressure curves.

⇒ Printed summary lists all testing data and results.

⇒ Report export to .WMF (word-processor picture) and .DXF (CAD) files.

Since R-VALUE utilizes the GEOSYTEM Data Manager program (GDM) or LD4 package for all file handling, the user should review the GDM or LD4 manuals before proceeding.

## 1.1  Installation

By itself, R-VALUE is not a complete system; the program must be installed into a hard disk or network subdirectory that already contains a copy of the Data Manager or LD4 (Drilling Log) packages. (To enter a new R-VALUE test, you must first use the Data Manager or LD4 package to open or create a project file.)

⇒ If you haven't licensed the Drilling Log package (LD4), R-VALUE requires the GEOSYSTEM for Windows Data Manager (GDM) software, *version 2 or later*. GDM version 2 is supplied on two 3.5 inch discs, where version 1.x was supplied on a single disc. If you have a version 1.x disc (version 1.x disks were labeled "Data Manager", but did not list a version number), please dispose of it and install the new set of GDM disks that were sent with your R-VALUE order.

If your R-VALUE disk wasn't installed when you installed your Data Manager package, use the following steps to install the software:

1.  Insert your R-VALUE disk into drive A:

2.  Click on your Windows "Start" button then select <u>Run</u>

3.  At the following dialog, type **A:SETUP** then press Enter

4.  The installation program should say that an existing GEOSYSTEM for Windows package has been found: make sure that you install into the directory that the program suggests.  (If the installer doesn't find an existing package, make sure that you've installed the Data Manager or LD4 packages before continuing, then make sure to install R-VALUE into the same subdirectory.)

## 1.2   Configuring R-VALUE

R-VALUE includes support for a few different testing procedures – before typing in your first test set you should make sure that the package is correctly configured.  To do this, start up your GEOSYSTEM for Windows package (refer to either the GDM or LD4 manuals for instructions) then select <u>Options</u> > <u>R-VALUE Setup</u>, which displays the following dialog:
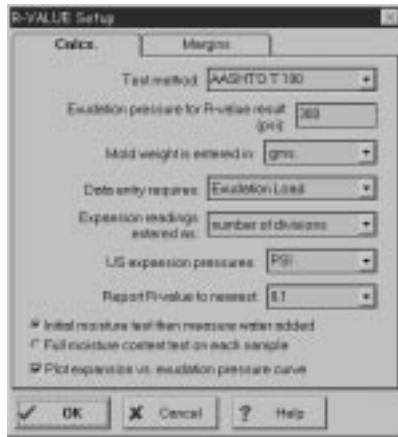


**Figure 1.2.1 -- R-VALUE Configuration Dialog**

⇒   **Test procedure** - selects the type of test performed. This has no effect on R-VALUE's calculations; it merely changes how the test is labeled on hardcopy reports and, for the Cal. Test 301 method, changes the direction of the exudation pressure scale on the R-value vs. pressure chart to be from high pressures on the left side to low pressures on the right side.

⇒ **Exudation pressure for R-value result** -- selects a pressure point on the R-value vs. exudation pressure curve drawn from your testing data: a vertical line is drawn at the selected pressure and the intersection of that line with the testing data curve is reported in the "TEST RESULTS" box on the hardcopy report (e.g., **R-value @ 300 psi exudation pressure = 21.0**).

Typically, 300 psi or 2070 kPa is used.

⇒ **Mold weight is entered in** -- allows entry of the weights for the sample and mold used for the R-value test to be in either grams or decimal pounds. This selection does not affect the units used for the moisture content test weights, which always entered in grams.

⇒ **Data entry requires** -- For the exudation portion of the test, you have the option of entering either the exudation load or the exudation pressure at each test point. (If you enter exudation loads, R-VALUE will calculate the exudation pressure; if you enter exudation pressures, R-VALUE will back-calculate the applied load.)

⇒ **Expansion readings entered as** – Selecting "inches or mms."  means that you will be entering expansion readings as inches or millimeters (depending upon what measurement units are to be used with your project); selecting "number of divisions" means that you will be entering readings directly as they are shown on the deflection gauge: a 0.0100 inch deflection will be entered as **100**.

⇒ **US expansion pressures** -- Expansion pressures calculated in projects entered with US (English) units may be reported as either PSF or PSI.

⇒ **Report R-value to nearest** -- R-values may be reported as either whole numbers or to the nearest 1 decimal place.

⇒ **Initial moisture test then measure water added** or **Full moisture content test on each sample** - R-VALUE supports two methods for obtaining the moisture content of each test sample: either A) a full moisture content test may be run on each test sample, or B) a single moisture content test may be run on a representative sample and then the amount of water added to each test sample prior to R-value testing is measured and recorded. The amount of water added to each test sample is added to the original moisture content value to obtain the moisture content of the test sample.

⇒ **Plot expansion vs. exudation curve** - In addition to plotting the R-value vs. exudation pressure curve, the package can optionally (if this selection is checked and expansion pressure data were taken for the sample) plot a curve of expansion pressure vs. exudation pressure.

**A note regarding units**: R-VALUE determines whether you are entering metric or Imperial data based upon the "Dimension Units" setting in LD4 or GDM. To change the unit selection, use the Data Manager package to open the project in question then, from the following screen, select Project > Dimension Units.

## 1.2.1 Margins

R-VALUE features two printed reports: one that summarizes your raw testing data in a tabular format (the *summary report*) and a second that reports the program's calculated results and includes a chart of the R-value vs. exudation pressure and expansion vs. exudation pressure curves (the *chart report*). (Chapter 5 includes samples of both report styles, along with directions on printing the reports.) You can change both report type's margins (the whitespace between the sides of the page and the borders around the report) by clicking on the **Margins** tab of the Setup dialog (Options > R-VALUE Setup): doing so displays a window similar to the one shown in Figure 1.2.2.



**Figure 1.2.2 -- Report Margins Selection**

⇒ **Select margins for** – This drop-down box selects for which of the two report types (summary or chart) the margin changes will apply. Prior to entering new margins, make sure that this box shows the appropriate report.

⇒ **Top**, **Left**, **Right** and **Bottom** – The measurement units that are used for the report margins (inches or centimeters) are determined by the **Regional Options** in your Windows Control Panel.

# 2. Walkthrough

Before discussing R-VALUE's capabilities in-depth, we'll introduce the package by providing a step-by-step walkthrough of the data entry process.

1. Start the GEOSYSTEM for Windows package: If you have a "GEOSYSTEM" shortcut on your desktop, double-click on it; you can also click on your "Start" button and select <u>Programs</u> > <u>GEOSYSTEM for Windows</u>.

2. On the left side of the program's screen is a directory box: navigate to the directory where the GEOSYSTEM software is installed. (If you've installed the software onto your own hard disk, this will probably be either C:\GEOSYS or C:\PROGRAM FILES\GEOSYS.)

3. In the program directory you'll 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 DEMO's testing samples were taken: double-click on "Boring B-4".

5. On the right side of the screen you should see a list of samples taken from B-4: find the data entry card for sample "S-3" and click on the **R-VALUE** link for that card.

6. You should see the R-VALUE data entry screen depicted in Figure 1.2.1. Select <u>Options</u> > <u>R-VALUE Setup</u>. In order for the tutorial to work, there are several important settings that must match the ones shown below:

   **Exudation pressure for R-value result: 300**
   **Mold weight is entered in: lbs.**
   **Data entry requires: Exudation Load**
   **US expansion pressures: PSF**

7. Make sure that **Full moisture content test on each sample** and **Plot expansion vs. exudation pressure curve** are both checked then click on the **OK** button.

8. Enter the following information:

   **Figure number: A-4**
   **Tested by: ALV**
   **Checked by: JWD**
   **Testing remarks: Sample recovered using 6 in. auger**

9. From the **Testing remarks** field, hit Tab twice. (You're skipping over the **Spring steel bar k-value** field, which will be left blank. Check Chapter 2 if you want more information on the k-value field.)

10. The cursor should be in the **Compaction pressure** row for test point number 1: Enter the following data (after entering each cell's data, you can press the Enter or down arrow keys to proceed to the next cell):

| Specimen number | 1 | 2 | 3 |
|---|---|---|---|
| **Compaction pressure** | 700 | 250 | 100 |
| **Wet weight** | 699.7 | 666.7 | 639.8 |
| **Dry weight** | 647.1 | 622.4 | 590.3 |
| **Tare weight** | 220.9 | 223.1 | 224 |
| **Exudation load** | 4150 | 7700 | 3200 |
| **Total weight** | 7.1 | 7.0 | 6.9 |
| **Mold weight** | 4.6 | 4.6 | 4.6 |
| **Initial expansion** | 0.0000 | 0.0000 | 0.0000 |
| **Final expansion** | 0.0007 | 0.0012 | 0.0004 |
| **Ph** | 109 | 82 | 124 |
| **D turns** | 4.92 | 4.12 | 4.74 |
| **Height** | 2.59 | 2.37 | 2.34 |

11. Next we'll check the curves: select Window > Curve or just hit function key F3. R-VALUE should display two curves; the one passing through the circular markers plots R-value vs. exudation pressure while the one passing through the square markers plots expansion pressure vs. exudation pressure.

12. Try reshaping the curves: select Curve > Shape R-value Curve or Shape Expansion Curve then select Curve > Add Shaping Point. Move your mouse cursor somewhere within the graph then click the left mouse button.

    You can also replace an existing point: Move your cursor directly above or below an curve point (remember, if you're shaping the R-value curve, the curve points are circles; if you're shaping the expansion vs. exudation pressure curve, the points are squares) then click your left mouse button. The curve should be redrawn passing through the point where your mouse was when you clicked the left button – it should no longer pass through the test point.

13. Return both curves to their original shapes by selecting Curve > Return to Original.

14. Check on how the printed reports will appear by pressing function keys F4 then F5.

15. Select R-VALUE > Data Summary then click on the **Output** button. When the summary has been printed, select R-VALUE> Chart and again click on **Output**.

16. Finally, if you want to try exporting data to an AutoCAD file, begin by selecting either R-VALUE > Data Summary or R-VALUE > Chart. Drop down the box next to **Output to** and select "AutoCAD .DXF File" then change the **Place files in** directory to somewhere on your hard disk and click on the **Output** button.

# 3. Data Entry

Data entry for R-VALUE is begun by filling in a data entry card on the LD4 or Data Manager screen:

1.  Create or open a project file (see Sections 2.1 and 2.2 in the GDM manual or, if you've licensed LD4, Sections 2.3 and 2.4 in the LD4 User's Guide).

2.  Create or open a material source folder (see Sections 2.5 and 2.9 in the GDM manual or Sections 2.7.1 and 2.7.2 in the LD4 User's Guide).

3.  Locate a data entry card for the sample and fill in the sample's identifying information (see Section 2.6 in the GDM manual or Section 2.9 in the LD4 User's Guide).

4.  Click on the **R-VALUE** link at the bottom of the sample's data entry card (see Section 2.7 in the GDM manual or Section 6.1 in the User's Guide).

R-VALUE's data entry screen is shown below:



**Figure 1.2.1 -- R-VALUE Data Entry Screen**

R-VALUE supports three and four point tests.  Movement through the data entry prompts is by the Tab and Shift-Tab keys – within the test data grid (on the right side of Figure 1.2.1), use the up and down arrow keys.  The program's data entry fields are listed below:

⇒ **Figure number** – whatever is typed into this field is printed at the lower-right corner of the program's chart report (see Chapter 5).   Note that the printout may not read "Figure No.": the title may be changed through the GDM's Setup dialog (see Section 1.7 in the GDM manual or Section 1.5.1 in the LD4 User's Guide).

⇒ **Steel bar spring k-value** -- is the *pressure* required to deflect the expansion-pressure apparatus' spring-steel bar 1 inch or 1 mm. For projects using US units, the value is expressed in psi, and defaults to 303 (dead-center of ASTM/AASHTO's recommended calibration range) if no value is entered. For projects using SI units, this value is expressed in kPa and defaults to 82.3 (303 psi/inch converted to kPa per mm).

**If you did not perform the recommended calibration, leave this field blank.**

⇒ Initial Moisture Content **Wet weight (grams)**, **Dry weight**, **Tare weight** -- these prompts are only enabled if you've selected **Initial moisture test then measure water added** from the program's Setup dialog (Options > Setup). The prompts provide the program with a baseline moisture content for the original sample from which every R-value test sample was taken.

⇒ **Compaction pressure** -- this is the pressure at which water was exuded from the specimen.

⇒ **Wet weight**, **Dry weight**, **Tare weight** -- moisture content test weights. The "Wet" and "Dry" weights should include both the sample and tare weight. (These prompts are only visible if you've selected **Full moisture content test on each sample** from the program's Setup dialog.)

⇒ **Prepared weight** -- is the weight of the R-value test sample, prior to mixing with water. This prompt is only visible if you've selected **Initial moisture test then measure water added** from the program's Setup dialog.

⇒ **Water added** -- this is the amount of water added to the initial R-value test sample prior to running the test. This value is added to the original sample's moisture content to obtain the moisture content of the test sample.

⇒ **Exudation load**, **Exudation pressure** -- for the exudation portion of the test, you have the option of entering either the exudation load or the exudation pressure at each test point. (If you enter exudation loads, R-VALUE will calculate the exudation pressure; if you enter exudation pressures, R-VALUE will back-calculate the applied load.) To swap from entering exudation load to exudation pressure or vice versa, select Options > Setup.

⇒ **Total weight** -- this is the weight of the R-value exudation test sample, plus the mold.

⇒ **Mold weight** -- this is the weight of the mold used for the exudation test.

⇒ **Initial expansion** -- this is the reading on the dial indicator at the start of the expansion test.

⇒ **Final expansion** -- this is the reading on the dial indicator at the end of the expansion test.

⇒ **Ph** -- is the horizontal pressure at the specified vertical load (2000 lbf or 8900 N).

⇒ **D turns** -- is the number of turns of the stabilometer pump handle required to raise the horizontal pressure from 5 to 100 psi (34 to 690 kPa).

⇒ **Height** -- is the height of the R-value test sample, which must be between 2.3 and 2.7 inches (58.4 and 68.5 mm).

⇒ **Corrected R** -- is determined from the calculated test point R-value by making an adjustment for samples that are less than 2.45 inches (62 mm) or greater than 2.55 inches (65 mm) tall. (Section 6.5 covers R-VALUE's correction calculations.)

## 3.1 Deleting R-VALUE Data

To remove all of the data that you've entered for a test, refer to Section 2.8 in the GDM manual or Section 6.2 in the LD4 User's Guide.

# 4. Curve Viewing and Shaping

After completing the entry of testing data, you'll want to check the R-value vs. exudation pressure and expansion pressure vs. exudation pressure curves: data entry errors are often highlighted from a quick glance at these curves. To show the curves, click on the **Curve** tab on the bottom of the screen, or select <u>Window</u> > <u>Curve</u> or just press function key **F3**.
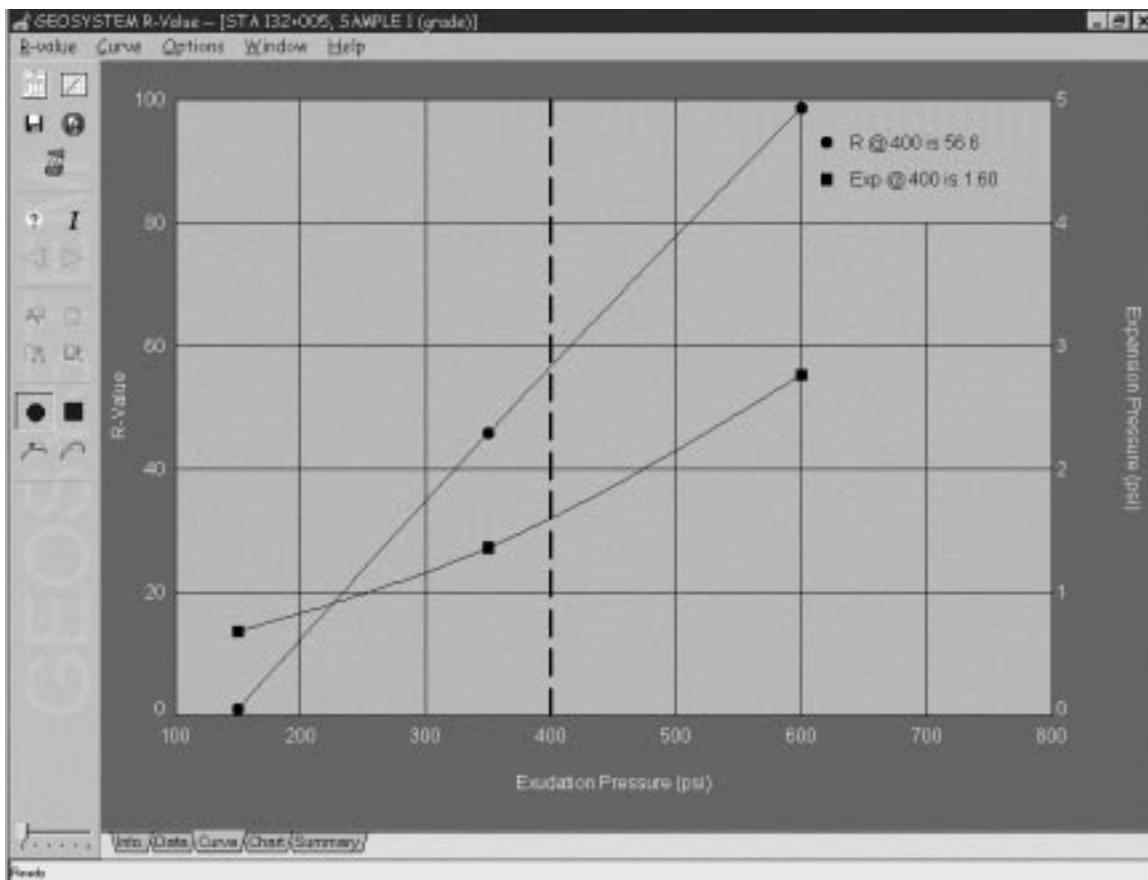


**Figure 3.1.1 -- Curve Preview Screen**

⇒ The curve with the circular markers plots R-value vs. exudation pressure; the square marker curve shows expansion pressure vs. exudation pressure. (The latter curve won't be displayed unless you've selected **Plot expansion vs. exudation curve** from the program's Setup dialog as discussed in Section 1.2.)

## 4.1   Reshaping the Curves

If one of the two curves isn't drawn as desired it may be reshaped:

1.  Select <u>Curve</u> then either <u>Shape R-value Curve</u> or <u>Shape Expansion Curve</u>.  (You can tell which curve is currently selected for shaping by looking at the toolbar on the left of the screen, where buttons with a circle and a square on them are shown – the button that is depressed indicates the curve that is selected for shaping.)

2.  Select <u>Curve</u> > <u>Add Shaping Point</u>.

3.  Move your mouse cursor to a point through which the curve is to pass, then click the left mouse button.

In addition to forcing the curve to pass through a new point, you can also replace one of the original testing points:

1.  Select which curve is to be shaped (<u>Curve</u> > <u>Shape R-value Curve</u> or <u>Shape Expansion Curve</u>).

2.  Select <u>Curve</u> > <u>Add Shaping Point</u>.

3.  Move the mouse so that it is directly over or under the testing point to be replaced – vertically, the mouse should be at the new location for the curve.

4.  Click the left mouse button when you have the mouse located correctly.  **The actual testing point will not be moved**; rather, the curve will no longer pass through the point.

To delete a shaping point:

1.  Select either <u>Curve</u> > <u>Shape R-value Curve</u> or <u>Shape Expansion Curve</u>.

2.  Select <u>Curve</u> > <u>Delete Shaping Point</u>.

3.  If the curve had just a single shaping point, you're done.  Otherwise, you'll need to indicate which point is to be deleted: move the mouse cursor over the point to be removed then click the left mouse button

⇒  You can return a curve to its original shape by selecting either <u>Curve</u> > <u>Shape R-value Curve</u> or <u>Shape Expansion Curve</u> then selecting <u>Curve</u> > <u>Return to Original</u>.

# 5. Printing Reports

R-VALUE plots two varieties of reports, depicted below:
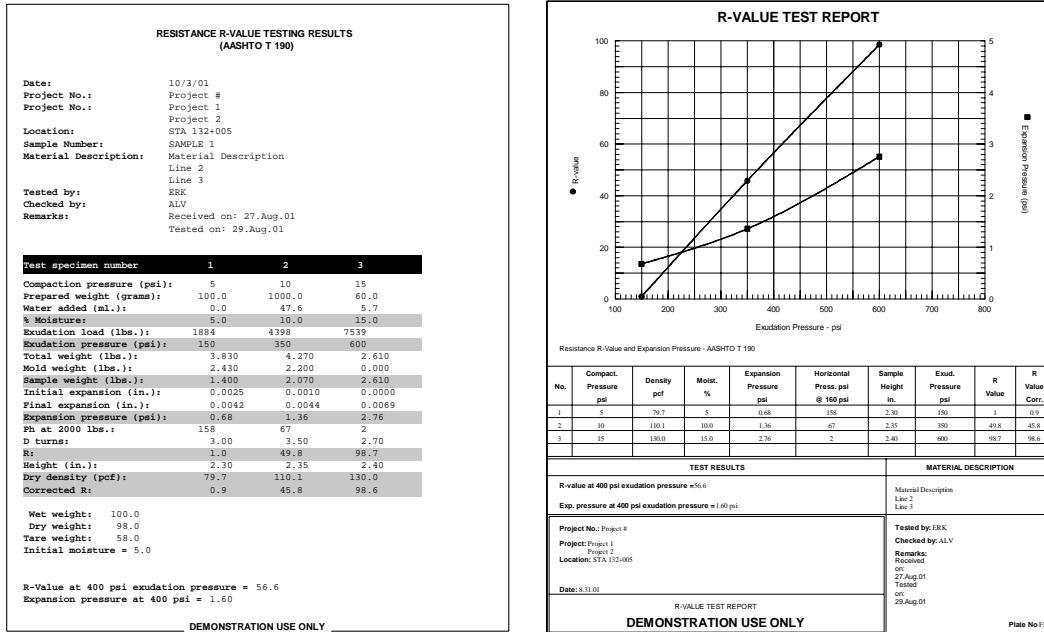


**Figure 4.1.1 -- R-VALUE Testing Data Summary and Chart Reports**

These reports may be previewed on-screen, printed to a printer, or exported into a CAD file (.DXF) or word-processor picture file (.WMF).

⇒ **To preview the testing data summary** you can either: right-click on the **R-VALUE** link at the bottom of your sample's data entry card from the Data Manager or LD4 screens (see Section 2.7 in the GDM manual or Chapter 6 in the LD4 manual) and select <u>Summary Preview</u>, or you can click on the **Summary** tab at the bottom of the R-VALUE data entry screen, or select <u>Window</u> > <u>Data Summary Preview</u>.

⇒ **To preview the testing chart report** you can either: right-click on the **R-VALUE** link at the bottom of your sample's data entry card from the Data Manager Screen and select <u>Report Preview</u>, or you can click on the **Chart** tab at the bottom of the R-VALUE data entry screen, or select <u>Window</u> > <u>Data Chart Preview</u>.

⇒ **To print the data summary or chart report**: select either <u>R-VALUE</u> ><u>Data Summary</u> or <u>R-VALUE</u> > <u>Chart</u> then click on the **Output** button.

# 5.1   Exporting Charts or Summaries to AutoCAD Files

The testing data summary and chart reports depicted in Figure 4.1.1 may be exported to AutoCAD-compatible .DXF files, which provides a handy, compact means of supplying reports to clients.  To do this, select either <u>R-VALUE</u> ><u>Data Summary</u> or <u>R-VALUE</u> > <u>Chart</u>.  Either selection displays the dialog shown below:
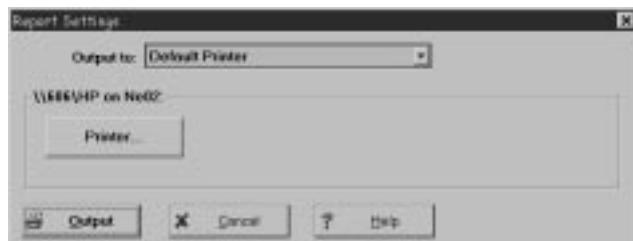


**Figure 5.1.1 -- Output Options Dialog**

Drop down the **Output to:** box and select "AutoCAD .DXF File".  You'll see the following dialog:
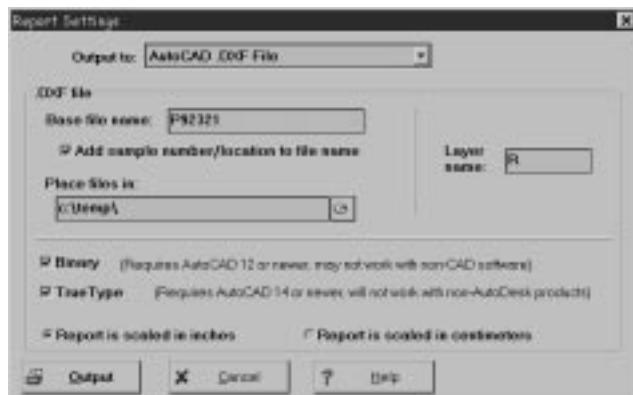


**Figure 5.1.2 -- AutoCAD File Export Dialog**

When creating .DXF files there are a number of options available:

⇒ **Base file name** -- when R-VALUE creates your .DXF file, the file's name will start out with whatever you enter into this field.

⇒ **Add sample number/location to file name** -- Without this option, R-VALUE's .DXF file names will be whatever you've selected as the **Base file name**, plus something like " page 1" at the end.  Using Figure 5.1.2 as an example, if the **Add sample number/location to file name** option wasn't selected, the first chart report exported would be named **P92321 page 1.DXF**, the second chart report exported would be named **P92321 page 2.DXF** and on.  A client looking at a list of submitted .DXF files would have no way of telling which .DXF file corresponds to which tested sample.

Checking the **Add sample number/location to file name** box alters how R-VALUE names the .DXF files: the program adds the sample number and/or sampling location to the **Base file name**.  Using our previous example, with the box checked, R-VALUE would create, for example, CAD files named
**P92321 Sample S-4_Boring B-3.DXF**
**P92321 Sample S-1_Test Pit TP-2.DXF**
etc.

Between **Base file name** and **Add sample number/location to file name**, you can come up with some useful options.  For example, you could leave **Add sample number**... unchecked and enter the sample number/location as part of the **Base file name** – of course, this means that when you export the next chart, you'd have to change the **Base file name** to reflect the new sample                                                           number.

As another example, if you've created a hard disk subdirectory just to hold .DXF files for a given project, you may not need to include the project number as part of each .DXF file name: instead of being called, for example,

**P92321 Sample S-4_Boring B-3.DXF**

(**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.DXF**

⇒ **Place files in** -- gives the directory where R-VALUE will place the exported .DXF file.

⇒ **Layer name** -- specifies the name of the CAD drawing layer that will be shared by all of the CAD files generated.  Layer names may be any combination of alphabetic and numeric characters -- however, many CAD programs don't like layer names that include spaces. ( **MYLAYER** is OK, **MY LAYER** is not.)  Since your chosen layer name will be repeated throughout the .DXF files that R-VALUE creates, the shorter you make the name the smaller your .DXF files will be.

⇒ **Binary** -- R-VALUE also supports AutoDesk's binary .DXF format. This format, used by AutoCAD starting with version10, reduces the size of the resulting .DXF files by 25 to 50 percent.  Very few word processing or Paint programs will work with binary .DXF files: If a graphics program will not import an R-VALUE-generated .DXF file, re-generate the file after first making sure that the Binary option is turned off.

⇒ **TrueType** -- normally, R-VALUE-generated .DXF files use a monospaced font (similar to this) for everything on the form, meaning that .DXF reports don't look much like 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.

⇒ **Report is scaled in** (inches/centimeters) -- R-VALUE-created .DXF files will either measure either 10 units vertically (when scaled in inches) or 25.4 units vertically (when scaled in centimeters).  This selection doesn't affect the report's appearance within the .DXF file; rather, it just affects the coordinates given to each line and piece of text on the report.

## 5.2   Exporting Charts or Summaries to .WMF Files

R-VALUE charts and data summaries may also be exported to .WMF (Windows MetaFile) files – these files are easily imported into word processors and drawing programs.  To do this, select either <u>R-VALUE</u> ><u>Data Summary</u> or <u>R-VALUE</u> > <u>Chart</u>.  Either selection displays the dialog shown in Figure 5.1.1.  Drop down the **Output to:** box and select "Windows Metafiles". You'll see a dialog like the one below:
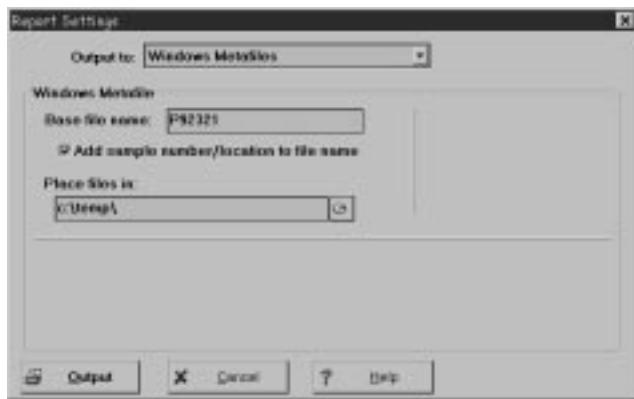


**Figure 5.2.1 -- .WMF File Export Dialog**

See Section 5.1 for a discussion of the dialog's prompts.

## 5.3   Listing Results from Multiple R-value Tests

R-VALUE includes a sample data export/summary configuration file that may be used with the Data Summary and Export tool discussed in Chapter 4 of the GDM manual and Appendix C of the LD4 User's Guide.  The configuration file, called **R-VALUE.LFG**, can be used by selection Tools > Data Summary and Export from the GDM or LD4 menu, then selecting File > Recall Existing Configuration and double-clicking on **R-VALUE.LFG**.

⇒   If you've purchased LD4, you can use **R-VALUE.LFG** to view an on-screen list of the R-value tests performed for a project: From the LD4 screen, select Project > Browse and choose **R-VALUE**.

# 6. Technical Specifications

R-VALUE strictly follows the ASTM D 2844 standard for all of its calculations. AASHTO T190 and California Test 301 (CT301) employ identical calculations – CT301 calculations being specified in metric units.

$\Rightarrow$ When dealing with projects entered in metric units, R-VALUE converts all data internally to English units and processes the results using D 2844's recommended calculation methods. A table of conversion factors is presented at the end of this chapter.

The following sections detail the calculations performed by the software.

## 6.1 Moisture Content

$$WC = \frac{W_W - W_D}{W_D - W_T}$$

where: WC = the water content, in percent

$W_W$ = the combined tare and moist soil weight (gms.)

$W_D$ = the combined tare and dry soil weight (gms.)

$W_T$ = the tare weight (gms.)

R-VALUE supports two methods for calculating the moisture content of individual test samples – settings on the program's Setup dialog (Section 1.2) determine which method is used. One method requires that a complete moisture content determination be performed on each R-value test sample. The second method entails performing an initial moisture content test with a representative soil sample then measuring the amount of water added to each R-value test sample. The sample's moisture content is then determined as follows:

$$WC = \frac{(100 + WC_I) * M_W}{M_S}$$

where: WC = the R-value test sample water content, in percent

$WC_I$ = the moisture content, in percent, of the original representative sample

$M_W$ = the mass of the R-value test sample (gms.)

$M_S$ = the mass of water added to the sample (gms.)

## 6.2 Dry Density

$$DD = \frac{W_S * 453.59 \frac{gms.}{lb.}}{MV * (1 + \frac{WC}{100})}$$

where: DD     = dry density (pcf)

$W_S$      = the weight of the sample (gms.)

*453.59 = converts grams to pounds

$$MV = H_s * \frac{D_M{}^2 * \pi}{4} * \frac{1}{12 * 12 * 12} \frac{in^3}{ft^3}$$

where: MV     = the test mold volume ($ft^3$)

$H_S$      = the height of the sample (in.)

$D_M$      = the diameter of the mold (assumed to be 4 in.)

$\dfrac{1}{12 * 12 * 12}$ = converts from $in^3$ to $ft^3$

## 6.3 Expansion Pressure

$$P = (D_F - D_I) * k$$

where: P      = expansion pressure (psi)

$D_F$      = the final reading on the expansion dial

$D_I$      = the initial reading on the dial (usually 0)

k      = the spring constant of the steel deflection bar.  Contrary to what the ASTM specification might say, k is given in psi/in., not in psi/.001in.)  R-VALUE  uses a default of 303, which is dead-center of ASTM's recommended calibration table:

$$\frac{\frac{8}{0.0021}}{(D_M * D_M * \pi / 4)}$$

(8 psi deflects the bar 0.0021 inches)

## 6.4 R-value

$$R = 100 - \cfrac{100}{\cfrac{2.5}{D} * (\cfrac{160}{Ph} - 1) + 1}$$

where: R      = resistance R-value
        D      = the number of turns recorded on the stabilometer
        Ph     = the horizontal pressure

Due to a continuing misprint in the ASTM standard, you will find that the above equation does not match the specification.  Our version is correct.

## 6.5 Corrected R-value

Strictly speaking, the R-value equation given in the last section is only valid for a test sample that is 2.5 inches high.  For samples between 2.3 and 2.45, and 2.55 and 2.7, the program corrects the calculated R-values using a polynomial approximation to the D 2844 correction chart.

## 6.6 Metric Conversion Factors

The following metric conversion factors are utilized by the software:

centimeters per inch = 2.54
kPa per psf = $1000/(98.067*453.59*(2.54*12)^2)$
kg/m$^3$ per pcf = $1000/453.59*(.3048)^3$

## 6.7   Values Available for Data Summaries

For each entered test, R-VALUE calculates several different values that may be used on data summaries created by the GDM "Data Summary and Export" tool (see Chapter 4 in the Data Manager manual or Appendix C in the LD4 User's Guide).  The following table lists the names and a short description of all the calculated values provided by R-VALUE, plus those used during data entry.

| Item Name | Description |
|---|---|
| RVALUE | Resistance R-value at the exudation pressure selected from the program's setup dialog (see Section 1.2) |
| RVEXP | Expansion pressure corresponding to the exudation pressure selected from the program's setup dialog |
| RVTESTED_BY | Tester |
| RVCHECKED_BY | Report inspector |
| RV_REMARKS | Testing remarks |
| RV_SPRING | Spring steel bar k-value |