SOFTWARE RELEASE NOTICE

1. SRN Number: GLGP-302

2. Project Title: StereoStat (version 1.2) | Project No.

3. SRN Title:

4. Originator/Requestor: Kevin Smart | Date: 12-8-2003

5. Summary of Actions

- ☑ Release of new software
- ☐ Change of access software
- ☐ Release of modified software:
- ☐ Software Retirement
  - ☐ Enhancements made
  - ☐ Corrections made

6. Validation Status

- ☑ Validated
- ☐ Limited Validation
- ☐ Not Validated Explain: _____

7. Persons Authorized Access

Name	Read Only/Read-Write	Addition/Change/Delete
Kevin Smart PC .. A227	Read-Write	

8. Element Manager Approval: Kevin J Smart for L. McKague Date: 12/8/03

9. Remarks:

CNWRA Form TOP-6 (09/01)

SOFTWARE SUMMARY FORM

01. Summary Date: 10-7-2003	02. Summary prepared by (Name and phone) KEVIN SMART	03. Summary Action: NEW
04. Software Date: 1997-2003	05. Short Title: StereoStat	
06. Software Title: StereoStat 1.2		07. Internal Software ID: N/A

08. Software Type:	09. Processing Mode:	10. Application Area
☐ Automated Data System	☑ Interactive	a. General: ☑ Scientific/Engineering ☐ Auxiliary Analyses ☐ Total System PA ☐ Subsystem PA ☐ Other
☑ Computer Program	☐ Batch	b. Specific: Structural Geology Stereonet software
☐ Subroutine/Module	☐ Combination	

11. Submitting Organization and Address:	12. Technical Contact(s) and Phone:
CNWRA/SwRI 6220 Culebra Road San Antonio, TX 78228	RockWARE 1-800-775-6745 stereostat@rockware.com 303-278-3534

13. Software Application: Visualize, analyze, and interpret geological data sets that consist of planar and/or linear data (e.g., bedding plane orientation, faults, mineral lineations). Also construct rose diagrams + contouring.

14. Computer Platform	15. Computer Operating System:	16. Programming Language(s):	17. Number of Source Program Statements:
IBM PC	Microsoft Windows 95/ME/NT/2000/XP	N/A	N/A
18. Computer Memory Requirements:	**19. Tape Drives:**	**20. Disk Units:**	**21. Graphics:**
≥16 MB RAM	N/A	≥10 MB Hard Drive	N/A

22. Other Operational Requirements

23. Software Availability:	24. Documentation Availability:
☐ Available ☑ Limited ☐ In-House ONLY	☑ Available ☐ Preliminary ☐ In-House ONLY

25.

Software Developer: N/A Date: 10/8/03 B Brian L

CNWRA Form TOP-4-1 (05/98)

CENTER FOR NUCLEAR WASTE REGULATORY ANALYSES
QA VERIFICATION REPORT
FOR
→*ACQUIRED SOFTWARE NOT TO BE MODIFIED*←

Software Title/Name: Stereo Stat

Version: 1.2

Demonstration workstation: Raistlin

Operating System: Windows XP

User: Kevin Smart

NOTE: Acquired software may or may not meet all requirements and will be evaluated on a case-by-case basis.

Installation Testing [TOP-018, Section 5.6]

Has *installation testing* been conducted for each intended computer platform and operating system?
Yes: ☑ No: ☐ N/A: ☐

Computer Platforms: PC Operating Systems: MS-XP

Location of Acceptance Test Results: Memo Smart to Brient, October 8, 2003

Comments:.

Software Output [TOP-018, Section 5.5.4]

Is software designed so that individual runs are uniquely identified by date, time, name of software and version?
Yes: ☐ No: ☑ N/A: ☐

Date and Time Displayed: NO

Name/Version Displayed: NO

Comments: Output is only graphics: See attached sample output.

NOTE: Output identification content and format is typically taken as is.

Medium Documentation [TOP-018, Section 5.5.6]

The physical labeling of software medium (tapes, disks, etc.) contains: Program Name, Module/Name/Title, Module Revision, File type (ASCII, OBJ, EXE), Recording Date, and Operating System(s)?
Yes: ☑ No: ☐ N/A: ☐

Comments:

CENTER FOR NUCLEAR WASTE REGULATORY ANALYSES
QA VERIFICATION REPORT
FOR
→*ACQUIRED SOFTWARE <u>NOT</u> TO BE MODIFIED*←

User Documentation [TOP-018, Section 5.5.7]

Is there a Users' Manual for the software and is it up-to-date?
Yes: ☑ No: ☐ N/A: ☐

User's Manual Version and Date: Version 1.2
Comments: On-line help

Are there basic instructions for the *installation* and *use* of the software?
Yes: ☑ No: ☐ N/A: ☐

Location of Instructions: readme.txt on CD.
Comments:

Configuration Control [TOP-018, Section 5.7, 5.9.3]

Is the Software Summary Form (Form TOP-4-1) completed and signed?
Yes: ☑ No: ☐ N/A: ☐

Date of Approval: 10/8/03

Is the list of files attached to the Software Summary Form complete and accurate?
Yes: ☑ No: ☐ N/A: ☐

Comments: Zip file.

Is the source code available or, is the executable code available in the case of (acquired/commercial codes)?
Yes: ☑ No: ☐ N/A: ☐

Location of Source Code: Enclosed CD
Comments: StereoStat installation is from a .zip file.

Have all the script/make files and executable files been submitted to the Software Custodian?
Only the executable files are being submitted.
Yes: ☑ No: ☐ N/A: ☐

Location of executable files: Enclosed CD
Comments:

Software Release [TOP-018, Section 5.9]

CENTER FOR NUCLEAR WASTE REGULATORY ANALYSES
QA VERIFICATION REPORT
FOR
→*ACQUIRED SOFTWARE NOT TO BE MODIFIED*←

Upon acceptance of the software as verified above, has a Software Release Notice (SRN), Form TOP-6 been issued and does the version number of the software match the documentation?

Yes: ☑ No: ☐ N/A: ☐

SRN Number: GLGP-302

Comments:

Software Validation [TOP-018, Section 5.10]

Has a Software Validation Test Plan (SVTP) been prepared for the ***range of application*** of the software?

Yes: ☑ No: ☐ N/A: ☐

Version and Date of SVTP: 1.2

Date Reviewed and Approved via QAP-002: Oct. 21, 2003

Comments:

Has a Software Validation Test Report (SVTR) been prepared that documents the results of the validation cases, interpretation of the results, and determination if the software has been validated?

Yes: ☑ No: ☐ N/A: ☐

Version and Date of SVTR: 1.2

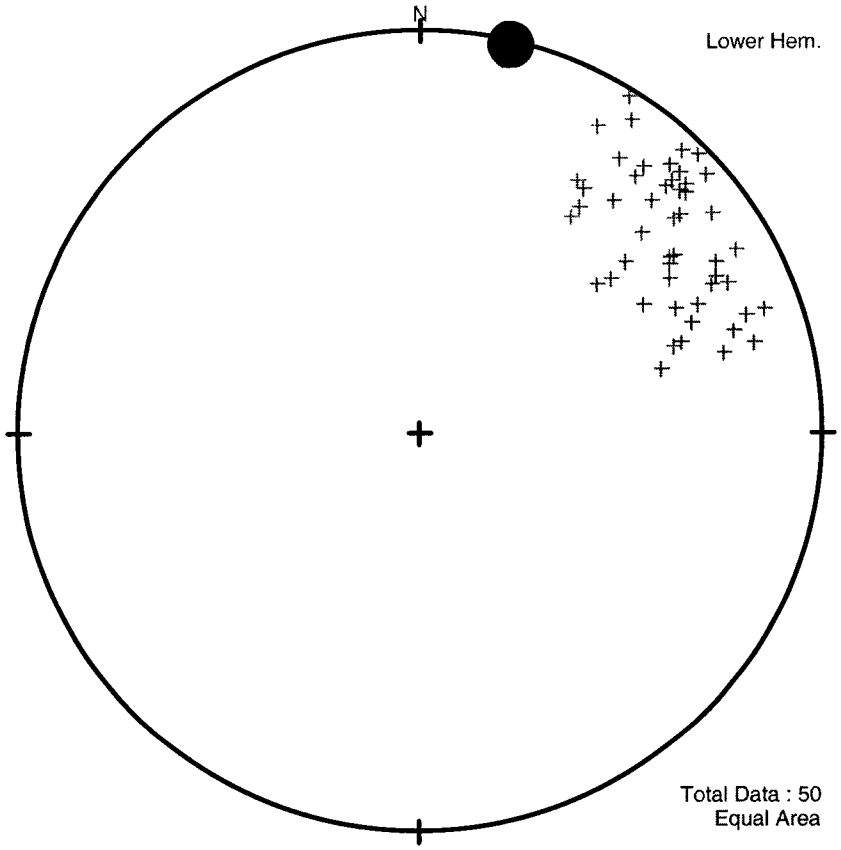
Date Reviewed and Approved via QAP-002: In review Dec 2003.

Comments.:

Additional Comments:

Kevin J. Smart 12/10/03
Software Evaluator/User/Date

Nancy Ruth 12/10/03
Software Custodian/Date



Sample Output

Dec 10, 2003

CENTER FOR NUCLEAR WASTE REGULATORY ANALYSES

MEMORANDUM

October 8, 2003

TO: Robert Brient, Director
Quality Assurance

FROM: Kevin J. Smart, Research Scientist
Geology & Geophysics

SUBJECT: Acceptance/Installation Test for *StereoStat*® (version 1.2)

StereoStat® (version 1.2) is developed and marketed by RockWare Inc., Golden, Colorado and according to TOP-018 is classified as "Acquired Software -- Not To Be Modified." This program will replace *Stereonet for Windows* (version 3.0), which is the currently-validated and QA-approved stereonet software. The replacement was necessitated by the incompatibility of *Stereonet for Windows* with the Microsoft® Windows XP operating system.

StereoStat® is designed to operate on any IBM-compatible computer running the Microsoft® Windows 98/ME/NT/2000/XP operating system. Further hardware requirements are a 200 MHz Pentium (or faster) CPU, and a minimum of 16 MB of RAM and 10 MB of hard drive space. *StereoStat*® (version 1.2) was installed on the Windows XP computer in room A227 by IMS personnel (Mr. Perry Seely and Mr. Hollen Streit) on October 2, 2003. The installation wizard was permitted to place the program files in the default directory `C:\Program Files\StereoStat.` Along with the executable (`StereoStat.exe`) and necessary DLL files, there are four folders, including "Help", "images", "Samples", and "Tutorials." The "Samples" folder contains two data sets with each available as a "gdf" file (the standard data format for *StereoStat*) or as an ASCII "txt" file.

The four data files from the "Samples" folder were each opened into the program. The files `Angelier_1979.gdf` (and `Angelier_1979.txt`) consist of 38 fault planes (strike & dip) and the associated slip vectors (trend & plunge). A stereoplot of the fault planes and slip vectors was generated and found to be a visually realistic and accurate representation of the input data file. The `Kamb_1959.gdf` (and `Kamb_1959.txt`) files consist of 112 lineation measurements (trend & plunge). A stereoplot of the lineations superimposed on Kamb contours was generated and found to be a visually realistic and accurate representation of the input data.

At this time, I therefore recommend that *StereoStat*® (version 1.2) be considered to have successfully passed the acceptance/installation test requirements. If you have any questions, please do not hesitate to contact me.

Readme

Welcome to RockWare StereoStat - Last updated September 14, 2003
Latest version : Version 1.2 (Build 108)

Contents:

****

1. Installation problems when demo version is installed

The demo version of RockWare StereoStat MUST BE UNINSTALLED BEFORE THE INSTALLATION PROCESS FOR THE FULL VERSION BEGINS. You can do this by going to "Start --> Settings --> Control Panel" and choosing the "Add/Remove Programs" option.

2. Administrative Privileges

The user MUST have Administrative Privileges during installation.

3. Display problems on high-resolution lcd screens (portables)

You may experience visualization problems in Windows 2000/XP when using a high-resolution screen (e.g., LCD displays on new Dell, Toshiba and Sony portables). If you experience problems, set your display resolution to 96 DPI by right-clicking on the desktop, and choosing Properties-->Settings-->Advanced-->DPI setting and setting to 96 dpi. For more information, please refer to Microsoft Knowledge Base article 820286 at http://support.microsoft.com/default.aspx?scid=kb;en-us;820286.

4. Documentation installed during installation

Manual and Help files are installed as HTML files. Files are included in the "Program Files\StereoStat\Help" folder. Main help file is "C:\Program Files\StereoStat\StereoStatMain.html".

5. Significant bug fixes

- Improved window updates when subsetting data.
- Fisher analysis results were not being displayed correctly after analysis.
- Data displays not updated correctly after multiple subset (create or highlight) operations.
- Text color in selected lines of data display window now opposes selection color for better visibility.
- Improved text support in dxf export including size, color & alignment.
- Improved dataset status updating with multiple datasets.
- Improved window management to better "remember" window positions.
- Plot/Data Window remember position on resize or header change.
- Plot graphics are now square.

6. New features

- Added Measured Depth (MD) to all data types for better well support.
- Added decimate tool to reduce data density. Designed for larger datasets such as well data.
- Added "Dip Dir" to display + custom format import/export for better compatibility with well data.
- Added plot labels to plot graphics. Labels can be added, modified, moved, & deleted.

- Added plot graphics exports in new raster formats including eps, jpg, pdf, png, tif.
- Added recently used file list for storing five recent files.
- Added "Unfold plane" option in Rotate Data dialog for faster data rotation (compensate for structural tilt using a single plane).
- Added "Invert selection" to main menu and data display context menu.
- Column headings in custom format dialog reflect the chosen data types.
- In dialog boxes with data type choices (e.g., analyze, decimate, contour) the dialog defaults to selected type if dataset contains only one data type to make dialog navigation faster.

Contact info:

stereostat@rockware.com
Sales line: (800) 775-6745
Tech Support: (303) 278-3534

List of files on Record copy of SterioStat, Version 1.2

```
 Volume in drive R is 030930_1330
 Volume Serial Number is F156-53C1

 Directory of R:\

09/11/2003  04:37 PM         8,435,926 StereoStat_1.2_Full.zip.zip
               1 File(s)      8,435,926 bytes

     Total Files Listed:
               1 File(s)      8,435,926 bytes
               0 Dir(s)               0 bytes free
```

Software Validation Test Plan

SOFTWARE VALIDATION TEST PLAN FOR STEREOSTAT®, VERSION 1.2

Prepared for

U.S. Nuclear Regulatory Commission
Contract NRC–02–02–012

Prepared by

Kevin J. Smart

Center for Nuclear Waste Regulatory Analyses
San Antonio, Texas

October 2003

Approved by:

H. Lawrence McKague

H. Lawrence McKague, Manager
Geology and Geophysics

10/21/03
Date

Table of Contents

1 SCOPE OF THE VALIDATION

This document establishes the Software Validation Test Plan (SVTP) to validate the installation and functionality of *StereoStat*® (version 1.2). *StereoStat*® was acquired by the Center for Nuclear Waste Regulatory Analyses (CNWRA) to support technical assistance activities to the U.S. Nuclear Regulatory Commission (NRC) in its high-level waste program. *StereoStat*® replaces the previously validated and QA-approved program, *Stereonet for Windows*, which was found to be incompatible with the Microsoft® Windows XP operating system. Also, RockWare (which now markets *Stereonet for Windows*) has indicated that it no longer plans to update or support *Stereonet for Windows*.

This SVTP is intended to validate *StereoStat*® program features that are used for visualizing, analyzing, and interpreting geological data that describe planar and/or linear features (e.g., bedding, fractures, foliation, slickenlines, etc.). Features of the software that will be validated are plotting of planes and lines, construction of rose diagrams, contouring, and statistical analysis. This SVTP uses the test plan for *Stereonet for Windows* (Wyrick, 2002) as a template, and will make use of some of the same test cases that were used in the validation report for *Stereonet for Windows* (Wyrick, 2003).

2 ENVIRONMENT

2.1 Software and Operating System Requirements

StereoStat® (version 1.2) is developed and marketed by RockWare, Inc., Golden, Colorado. Version 1.2 runs on the Microsoft® Windows 98/ME/NT/2000/XP operating systems. Other than the operating system, no other software is required for installation and use of *StereoStat*®. Data can be imported from an ASCII text file created with a text editor or standard spreadsheet, such as Microsoft® *Excel* (file format can be tab-delimited, comma-delimited, or space-delimited), or can be directly entered by the user.

2.2 Hardware Requirements

StereoStat® (version 1.2) requires a 200 MHz Pentium (or faster) processor, and a minimum of 16 Mb of RAM and 10 Mb of hard disk space. *StereoStat*® can export data and analyses in a variety of formats (Adobe® *Illustrator*® AI, BMP, WMF, and *AutoCAD*® DXF) and can print to any Windows-installed printer (including Adobe® *Acrobat*® for production of PDF files).

3 PREREQUISITES

Prerequisites for successful installation and application of *StereoStat*® (version 1.2) include an appropriate level of hardware and operating capabilities, as described in Section 2. Installation of software and license files requires administrator privileges. These privileges are not necessary to run the software once installation is complete.

4 ASSUMPTIONS AND CONSTRAINTS

Any user of *StereoStat*® is assumed to have a basic familiarity with planar and linear geologic data, and the basic types of plots (e.g., great circles, poles to planes, rose diagrams) and analysis tools (e.g., 1% contouring) that are available. The standard program installation provides an HTML-format help page that also contains a short tutorial that can be accessed from the main help menu.

5 TEST CASES

This validation plan follows CNWRA requirements as outlined in Section 5.10 of TOP-018 (CNWRA, 2003). The test cases described in this section make use of both previous test cases (Wyrick, 2002, 2003) and comparative testing against other software. Two shareware stereonet programs will be used for the comparative testing – *StereoWin* version 1.1.6 (Allmendinger, 2003) and *GEOrient*, version 9.2 (Holcomb, 2003). Both programs have been used by the author for prior research and teaching applications, and each will be used in demo/evaluation mode. The tests will be considered successful if results from the various programs and earlier test cases are the same as the results from *StereoStat*®.

5.1 Test Case 1 – Verifying Accuracy of Plotted Planes and Lines

The ability to plot planar (either as great circle traces or as poles to planes) and linear data (poles) is a fundamental aspect of stereographic analysis.

5.1.1 Test Input

The test input for this case will consist of the same five planes that were used to validate *Stereonet for Windows*. These planes are listed in Table 1.

5.1.2 Test Procedure

The test planes will be entered at a "New Dataset" in *StereoStat*®. The "Plot on Stereo Plot" option will be used to plot the planes on an equal-area, lower-hemisphere stereo plot as planes (i.e., great circle traces). The planes will then be plotted on an equal-area, lower-hemisphere stereo plot as poles (i.e., lines that are normal to the planes).

5.1.3 Test Results

The stereo plots for the planes and poles to the planes will be visually compared to both the "hand plotted" data that was used to validate *Stereonet for Windows* (Wyrick, 2003) as well as output from *StereoWin* and *GEOrient*.

5.2 Test Case 2 – Verification of Rose Diagram Functionality

Rose diagrams are the circular equivalent of traditional histograms where the number or percentage of strike values within a certain sampling window (typically 10°) are plotted graphically on a stereonet. Rose diagrams allow rapid determination of multiple modes within data set (e.g., orientation of systematic fracture sets from a suite of fracture measurements).

5.2.1 Test Input

The test input for this case will consist of the 14 planes that were used to validate *Stereonet for Windows*. These planes are listed in Table 2.

5.2.2 Test Procedure

The test planes will be entered at a "New Dataset" in *StereoStat®*. The "Plot on Rose Plot" option will be used to generate a standard bi-directional rose diagram with a 10° class bin.

5.2.3 Test Results

The output will be visually compared to the calculated percentages used to validate *Stereonet for Windows* as well as the output generated by *StereoWin* and *GEOrient*.

5.3 Test Case 3 – Verification of Contouring Functionality

Contouring of polar data is a standard technique for analyzing large amounts of orientation information (e.g., using poles bedding planes to deduce fold axis orientation). The most common contouring methods are the 1% area and Kamb methods (Kamb, 1959; Turner and Weiss, 1963). The primary difference between methods is the size of the counting circle. For the 1% area technique, the area of the counting circle is 1% of the area of the stereonet, regardless of number of data points. In contrast, the Kamb method employs a variable counting circle size that varies as a function of the number of data points.

5.3.1 Test Input

The test input for this case will consist of a portion of a previously published and analyzed set of metamorphic foliation data (Smart et al., 1996). The data (n = 50) for test case 3 are listed in Table 3.

5.3.2 Test Procedure

The test data will be written to an input text file named *test-case-3_input.txt* that will consist of two columns of data in ASCII text format. Column 1 will be the strike of each foliation and column 2 will be the dip of each foliation (right-hand rule convention). The input file will be opened into *StereoStat®*. The "Contour Plot" option will be used to generate both 1% area and Kamb contours of the poles to the foliations.

5.3.3 Test Results

The 1% area contour plot generated by *StereoStat®* will be visually compared to the output generated by *StereoWin* and *GEOrient*. Since *GEOrient* does not offer the option of Kamb contouring, the Kamb contour plot generated by *StereoStat®* will be visually compared to the output from *StereoWin*.

5.4 Test Case 4 – Verification of Statistical Algorithms

Along with contouring, statistical analysis of spherical data sets is a standard technique in structural geology. It is often necessary to determine the mean value of a population of linear data (e.g., poles of fractures). Several statistical options are normally available, including a circular distribution (Ramsay, 1967; Fisher et al., 1987) or Bingham axial distribution (Mardia and Jupp, 2000), and a principal component analysis (Watson, 1966).

5.4.1 Test Input

This test will make use of the same data set that was used for test case 3.

5.4.2 Test Procedure

The input file will be re-opened into *StereoStat®*. The "Analyze Data" option will be used to conduct a Fisher analysis (i.e., calculation of a vector mean and/or confidence interval) and a principal component analysis of the poles to the foliation planes.

5.4.3 Test Results

Output from *StereoStat®* will be compared to output generated by *StereoWin* and *GEOrient*. For the Fisher analysis, comparison will be in terms of the trend/plunge of the mean pole to foliation and the size of the 95% confidence cones (in degrees). Both *StereoStat®* and *StereoWin* also report a concentration factor (or k-value) that can be compared. For the *StereoStat®* principal component analysis, comparison will be between the eigenvalues and eigenvectors determined by the Bingham analyses from *StereoWin* and *GEOrient*.

6 REFERENCES

Allmendinger, R.W. (2003) *Stereonet for Windows*. Department of Earth and Atmospheric Sciences, Cornell University. ftp://www.geo.cornell.edu/pub/rwa/Windows/StereoWinFull116.zip

CNWRA (2003) Development and control of scientific and engineering software. *Technical Operating Procedure* **TOP-018** (revision 8, change 2). *Center for Nuclear Waste Regulatory Analyses (CNWRA)*, San Antonio, Texas. Effective date – July 03, 2003.

Fisher, N.I., Lewis, T.L., Embleton, B.J. (1987) *Statistical Analysis of Spherical Data*. Cambridge: Cambridge University Press, 329 p.

Holcomb, R. (2003) *GEOrient*. Department of Earth Sciences, The University of Queensland. http://www.earthsciences.uq.edu.au/%7Erodh/software/Downloading.html

Mardia, K.V. (1972) *Statistics of Directional Data*. London: Academic Press Ltd., 357 p.

Mardia, K.V., Jupp, P.E. (2000) *Directional Statistics*. Chicester: John Wiley and Sons, Ltd., 429 p.

Kamb, W.B. (1959) Ice petrofabric observations from Blue Glacier, Washington, in relation to theory and experiment. *Journal of Geophysical Research* **64**, 1891-1909.

Ramsay, J. (1967) *Folding and Fracturing of Rocks*. New York: McGraw-Hill Book Company, Inc., 568 p.

Smart, K.J., Pavlis, T.L., Sisson, V.B., Roeske, S.M., Snee, L.W. (1996) The Border Ranges fault system in Glacier Bay National Park, Alaska: Evidence for major Early Cenozoic dextral strike-slip motion. *Canadian Journal of Earth Sciences* **33**, 1268-1282.

Turner, F.J. Weiss, L.E. (1963) *Structural Analysis of Metamorphic Tectonites*. New York: McGraw-Hill Book Company, Inc., 545 p.

Watson, G.S. (1966) The statistics of orientation data. *Journal of Geology* **74**, 786-797.

Wyrick, D. (2002) Software validation test plan for *Stereonet for Windows*, version 3.0. *Center for Nuclear Waste Regulatory Analyses (CNWRA)*, San Antonio, Texas.

Wyrick, D. (2003) Software validation test for *Stereonet for Windows*, version 3.0. *Center for Nuclear Waste Regulatory Analyses (CNWRA)*, San Antonio, Texas.

Table 1: Planes for use in test case 1.

Strike	Dip
152°	20°
332°	40°
154°	60°
334°	80°
156°	90°

Table 2: Planes for use in test case 2.

Strike	Dip
230°	20°
055°	40°
235°	40°
052°	60°
232°	60°
058°	80°
238°	80°
055°	50°
235°	50°
152°	20°
332°	40°
154°	60°
334°	80°
156°	90°

Table 3: Foliation data for use in test case 3.

Strike	Dip	Strike	Dip	Strike	Dip	Strike	Dip	Strike	Dip
120°	77°	130°	75°	155°	65°	138°	78°	145°	66°
122°	88°	133°	80°	158°	62°	138°	85°	146°	64°
122°	63°	133°	85°	160°	80°	138°	63°	148°	62°
124°	83°	135°	70°	160°	75°	140°	48°	150°	74°
124°	62°	135°	77°	161°	56°	140°	73°	150°	54°
125°	58°	135°	75°	161°	58°	140°	71°	150°	80°
125°	55°	135°	87°	162°	71°	140°	56°	152°	72°
126°	73°	135°	80°	165°	67°	141°	51°	153°	70°
130°	72°	137°	77°	165°	75°	143°	80°	154°	74°
130°	64°	137°	79°	165°	52°	145°	66°	154°	60°