



Laboratory equipment co.,limited

AUTOMATIC TRIAXIAL TESTING SYSTEM SOFTWARE

PRODUCT MANUAL



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I. Introduction

Overview

The software is a program for the control and/or data acquisition of geotechnical laboratory tests. The design of the software allows for flexibility in the way equipment is connected to the PC (i.e. RS232, IEEE, USB), and flexibility in the type of equipment that may be connected (i.e. includes equipment from a variety of manufacturers).

Features

- Flexibility in hardware configuration including “mix and match” with other manufacturers.
- Ability to choose particular test modules for your testing requirements or your International Standards requirements.
- Single piece of software for all laboratory products. This means that the testing quality will be dependent on the hardware attached, not the software
- The software may be used to acquire and manipulate data from your existing hardware where computer control is not available.

SPECIFIC ENHANCED SOFTWARE FEATURES

- Multiple stations from a single PC.
- Ability to batch (queue) multiple tests.
- Ability to dynamically change graphs displayed during the test.
- Ability to dynamically change the Live Test Data displayed during the test.
- Flexibility in choosing excel/txt format for saving test data.

What can the software do for me?

Firstly, you can modernise and automate all your existing laboratory facilities and services using the



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latest Windows-based testing software.

Secondly, you can extend the capabilities of your testing apparatus and instrumentation.

Thirdly, you can plan the future development of your laboratory within a framework which complies with national and international standards.

Finally, when purchasing new equipment, you can choose the most cost-effective options from different manufacturers, without having to worry about compatibility problems. Again, this means that the quality of the tests will be as good as the hardware connected.

How does the software work?

The software is initially purchased as a Kernel, or a 'core' program. This kernel is the initial foundation for the program.


Then purchase the suitable test module for conducting the test. Each module is purchased according to the types of test the user will be performing.


Typical modules as below:


- General Saturation and Consolidation
- General Triaxial testing (includes CU, UU and CD tests)
- Standard consolidation module
- Stress path module
- KO testing module
- Advanced loading module
- Permeability test module
- Standard triaxial test module for unsaturated soil
- 4D unsaturated stress path module
- Standard direct shear test module for unsaturated soil



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- Standard consolidation test module for unsaturated soil
- Advanced test module for unsaturated soil

The above examples highlight the flexibility of the software by allowing the user to choose exactly which test module he would like to attach to the software.

The way the software is designed, gives the user flexibility for future upgrades by adding additional test modules at any time in the future.

Device Modules

The Hardware used with the test modules is controlled using the software Device Modules. The software requires each piece of connected hardware to have available on the system its correct device module. These device modules are available free of charge for all hardware already supported by the software, or a small cost may be levied for control device modules not currently supported (from less well known manufacturers). When the software kernel is installed, all the currently available device modules at the time the setup was created will be installed.

II. Installation

The software primary installation can be obtained in two distribution formats:

- CD directly from the software
- Downloaded from the internet

If you are re-installing a completely new version of the software you should first uninstall the old version. To do this simply go to Add/Remove programs from the Windows Control Panel and remove the software.

Install the dongle

Insert the supplied U-disk (the dongle) to PC, the dongle can be connected to the PC and run correctly (If failed, the related driving software need to be installed)

Install from CD



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Insert the supplied CD in to your CD-ROM, the system is setup by default on the C drive.

Download from Internet (not currently available)

Download the software from Internet and install.

III. Running a test

How to run a test for the first time?

Click the icon on the desktop, then the software starts to run.

The main interface as below:

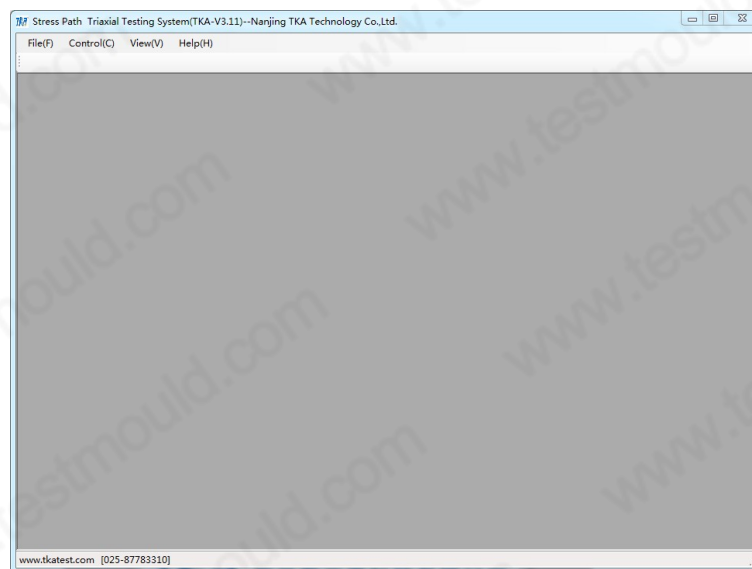


Figure 1 Main interface of the software

Checking the communication function

Before opening the software, you need to modify the serial port number, the steps are as follows:

1. If you use USB to serial port, please install the serial port driver.
2. Select "Computer", right-click, and click "Manage". The "Computer Management" interface will open.



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3. In the left directory, click "Device Manager".
4. Find the serial port number in "Ports (COM and LPT)". If the serial cable is a Prolific USB-to-serial Comm Port(Port of PVC), it is "COM7" (this is an example, please choose according to the actual situation); If the serial cable is a CH340 USB-to-serial Comm Port(Port of Master Loader), it is "COM34" (this is an example, please choose according to the actual situation).
5. Find the \ini\Config.ini file in the installation directory, open the file, find "COMPara", and change the SerialNoPVC value to 7, and change the SerialNoAxial value to 34. After saving the changes, close the file.

The software starts to run after clicking its icon on the desktop, communication checking should be exchanged between the software and instruments. There is an interface launched as below for seconds. If there are problems on the communication, a dialog box for hinting will be launched on the screen.

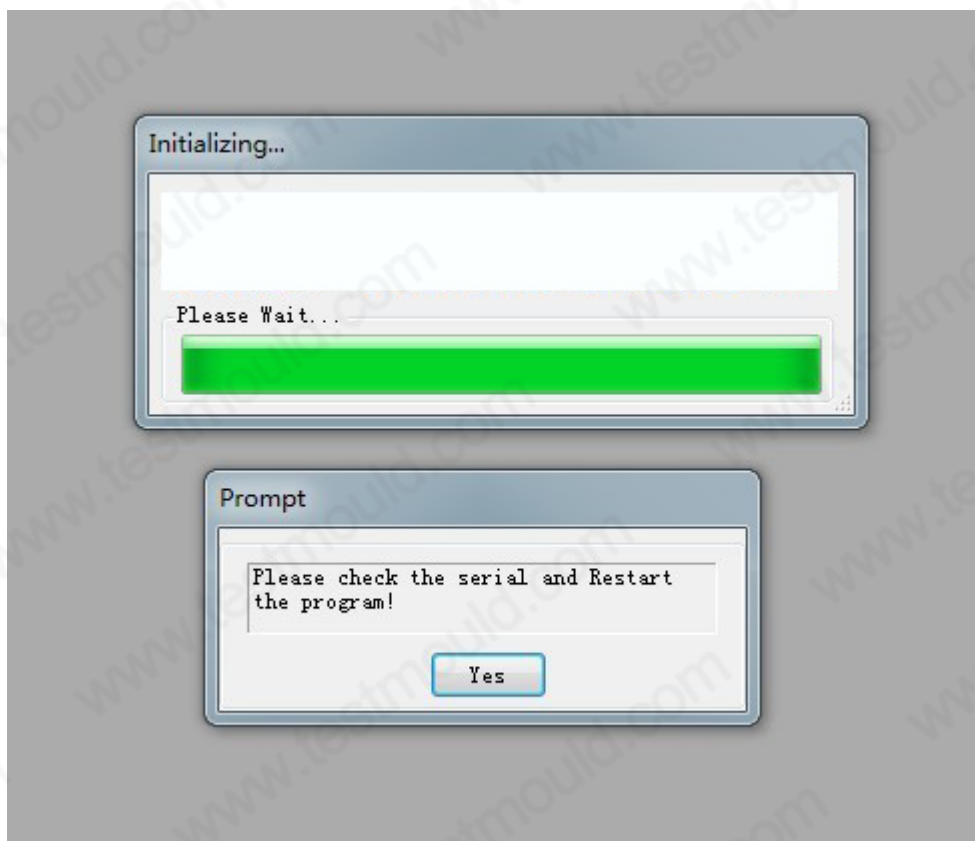


Figure 2 Communication checking



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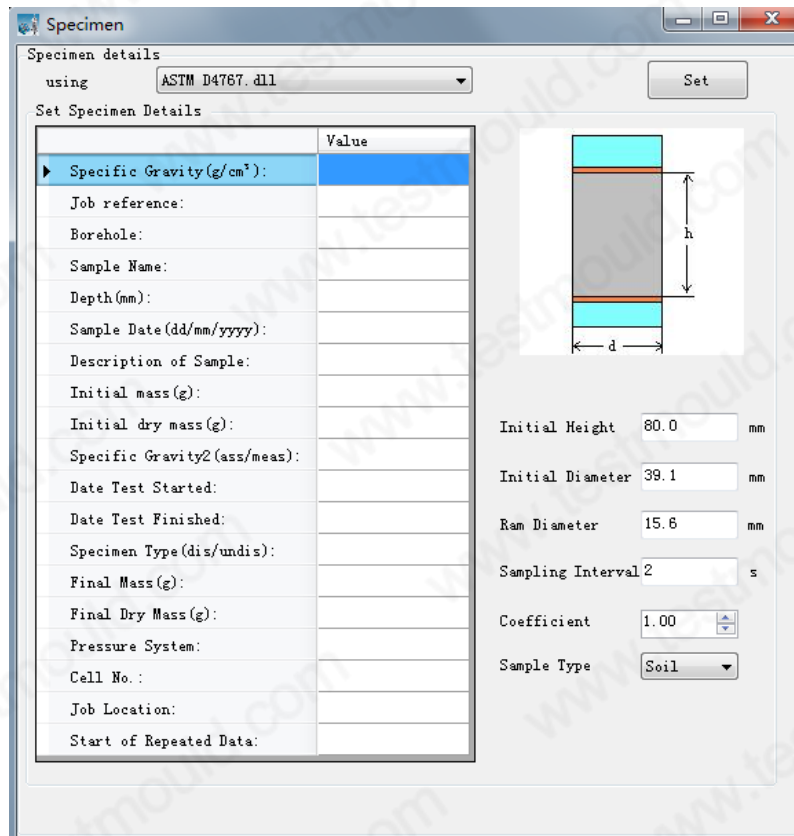
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Setup the parameter of the specimen

Before starting a test, click “create new test stage” in the “File” menu. Then a dialog box about the specimen parameter configuration as blow will appear. (Or click the left mouse button on the “specimen sets” button in the control window. The Specimen details shall be shown on the interface.



The screenshot shows a software window titled "Specimen" with a "Specimen details" section. A dropdown menu is set to "ASTM D4767.d11". Below this is a "Set Specimen Details" table with the following fields:

	Value
Specific Gravity (g/cm ³):	
Job reference:	
Borehole:	
Sample Name:	
Depth (mm):	
Sample Date (dd/mm/yyyy):	
Description of Sample:	
Initial mass (g):	
Initial dry mass (g):	
Specific Gravity2 (ass/meas):	
Date Test Started:	
Date Test Finished:	
Specimen Type (dis/undis):	
Final Mass (g):	
Final Dry Mass (g):	
Pressure System:	
Cell No.:	
Job Location:	
Start of Repeated Data:	

To the right of the table is a diagram of a cylindrical specimen with diameter 'd' and height 'h'. Below the diagram are several input fields:

- Initial Height: 80.0 mm
- Initial Diameter: 39.1 mm
- Ram Diameter: 15.6 mm
- Sampling Interval 2: s
- Coefficient: 1.00
- Sample Type: Soil

Figure 3 Test parameter

The Specimen Details page shows the default National Standard to which the specimen details are to be recorded, in this case the Standard ASTM D4767 has been selected as the standard. Other National Standard (where available) may be selected from the dropdown list.

Click the blank space of the “Setup Sample Details” with the left mouse button, and then input sample details.

Load hammer Diameter is an important factor for the test, especially when an external (outer installation type) load transducer is adopted. At this situation, the load hammer diameter is used to calculate and revise the influence caused by the pushing the load hammer because of the confining



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pressure action. If built-in type transducer is adopted, the transducer reading will not be affected with the change of confining pressure, in this case, setup the load hammer diameter as "0".

Coefficient default input 1 and Sample type default input Soil.

Once all of the required samples details have been entered then press the OK button.

Which sample height, sample diameter and with "*" sign are required, fill in the parameters, click "Settings Set" button. If the tests are to be carried out before the first test and then, you can click to remove "if the new sample" check box, the software will automatically take the most recent test data to fill in the following text box, if

not this data file, the user can fill in the path of the test data to the back of the text box.

Now, we have entered the specimen details, here we must also set our hope for the pilot phase. Click the Add pilot phase (Add Test) key to set the first experimental phase.

Docked, Undocked and new sample

To manage and calculate the information between docked and undocked, state of sample shall be transferred to software. Therefore, it's crucial important to mark out sample state. A docked test is anisotropic testing, such as Advanced Loading, KO, meanwhile, an undocked isotropic testing, such as Saturation, consolidation, B-check testing in SATCON module.

Note:

- When testing stage move from docked to undocked, current sample size is regarded as the initial size of current stage, and back volume change is set to zero. After into undocked stage, sample size shall be calculated from back volume change.
- When testing stage move from undocked to docked, current sample size is regarded as the initial size of current stage, and back volume and the axial displacement transducer are set to zero. In a docked test, sample size shall be calculated from back volume and axial displacement.
- When changing testing stage, but the docking state remains the same, there is no need to set to zero or size calculating.



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Sensor calibration

- (1) Click "Tools" → "Sensor Calibration" option, the "Sensor Calibration" interface appears.
- (2) Sensor types mainly include 1-Cell Sensor (confining pressure), 2-Back Sensor (back pressure), 3-02-Load Cell 1 Sensor (load sensor), and 3-05-Pore Sensor (pore pressure).
- (3) If the data zero point of the load cell is incorrect before the test, select the sensor type "Load Cell Sensor". After ensuring that the load cell is free from other forces, click the "calibrate zero point" button to reset the data.
- (4) If re-calibration is required, the entire calibration process needs to be completed before the start of the test, and the corresponding third-party standard equipment is required for reference. Select the sensor to be calibrated, enter the real value in "Sensor Input Value", and press the "Enter" key. At this time, the computer automatically collects the AD value and displays it in the "Sensor AD value" column. After collecting at least two points, click "Calculate Coefficient", calculate the coefficients k and b , and click the "Modify Coefficient" and "Send Parameters" buttons.
- (5) "Modify the coefficient" is to save the coefficient in the computer so that the software can display the correct data.
- (6) "Send parameters" is to send the coefficients to the instrument so that the instrument can display the correct data.
- (7) "Clear" is to clear all the data in the table.


Adding a test stage


In the software, a test stage may be a complete standard test, for example a pre-test such as saturation test or a consolidation test, or a main test such as a shearing test or a stress path test. The types of tests that are available are independent of the test modules that have been purchased, and have been subsequently installed on your system. The registered test modules are displayed in the dropdown box within the **Add Test Stage** frame. Select the test stage that you require from the drop down box and then click the **Create New Test Stage** button.


The **Test Module Details** form will be viewed according to the **Test Module** name that was selected



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from the dropdown box. The **Test Module Details** forms are different for each test module. Individual test module detail forms are explained in **Test Module Details**.

Once a **Test Module** details form has been completed and added to the **Test Plan** the test is ready to commence. Note that the **Test Module** icon has been checked and there is a “Setup” button shown on the test module icon, which means at least one test stage has been configured.

More **Test Stages** may be added to the test plan by clicking the **Create New Test Stage** button again.

If the **Test Plan** is now complete, the **Go to Test** button should be clicked to start the first **Test Stage** of the **Test Plan**.

At this stage further test stages may be created by pressing the **Create New Test Stage** button or the specimen details may be reviewed by pressing the **Review** Button.

Test Stages that have already been configured may be reviewed and edited by double clicking on the appropriate line in the test plan display.

The test may now be launched using the **Go To Test** button.

Test display window

After the **Go To Test** button has been clicked, the Test display window will be launched.

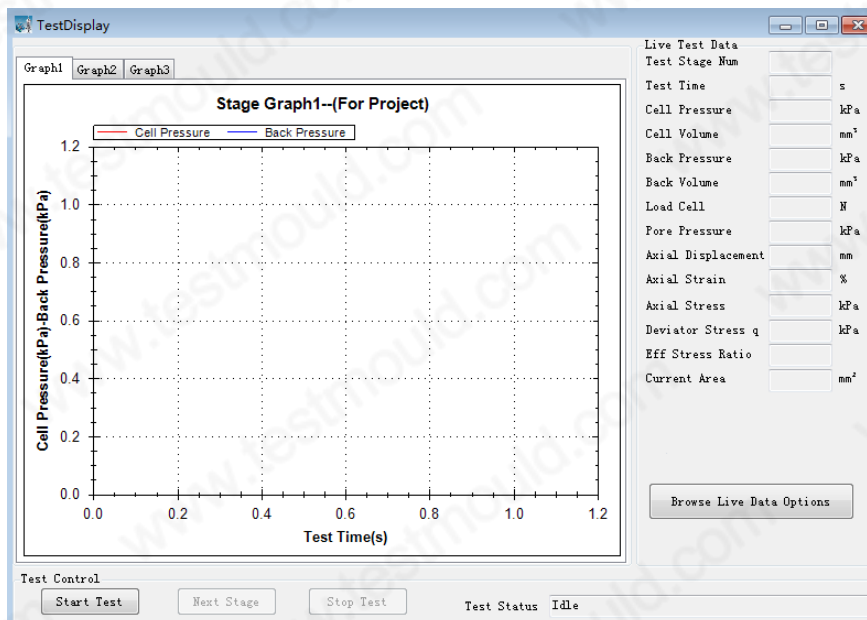


Figure 4 Test Display Window



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The Test Display window is made of a series of 3 tabs

- Graphs 1, 2 and 3

Some features are common to all of the display tabs, such as Live Test Data and the Test Control panels. The Live Test Data display is located to the right of the Test Display window.

The Test Control panel is displayed at the foot of the Test Display window. The Test Control panel contains three buttons–The Start Test button, Next Stage button and Stop Test button. These buttons may be used by click at any stage for starting or stopping a test.

The data type that is displayed in any of the graphs or the Live Test Data area maybe changed by double clicking on any of the graphs or the Live Data area or by clicking on the Browse Live Data Options.

Graphs

You can set 3 individual graphs for the 3 graph tabs. There may be 2 Y-axis for each graph.

The data sets displayed in any of the graphs may be changed by double clicking on any of the graphs and selecting the required data set.

The data tab

The data tab displays a live data grid. As data is saved during a test the saved data will be added to the Live Data grid.

Customizing the data display during a test

To customize the data display by clicking Browse Live Data. After clicking the Browse Live Data Options, Station Test Options window is opened with the Graph Selection tab selected.


Graph selection and Live Test Data options may be changed at any time during a running test.


The Graph Options are the same for all three of the graphs. The numbering of the graphs has the single graph on the Single Graph tab of the Test Display window as Graph number1, the upper and lower graphs on the Double Graph tab are graphs 2 and 3 respectively.


The options for each graph are contained in 3 dropdown boxes. The dropdown boxes for each graph control which parameter is displayed along each axis. From the list of parameters within each



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dropdown box select the required parameter. If a second Y-axis is not required select **None**. When the required parameters are all selected for each test, press OK.

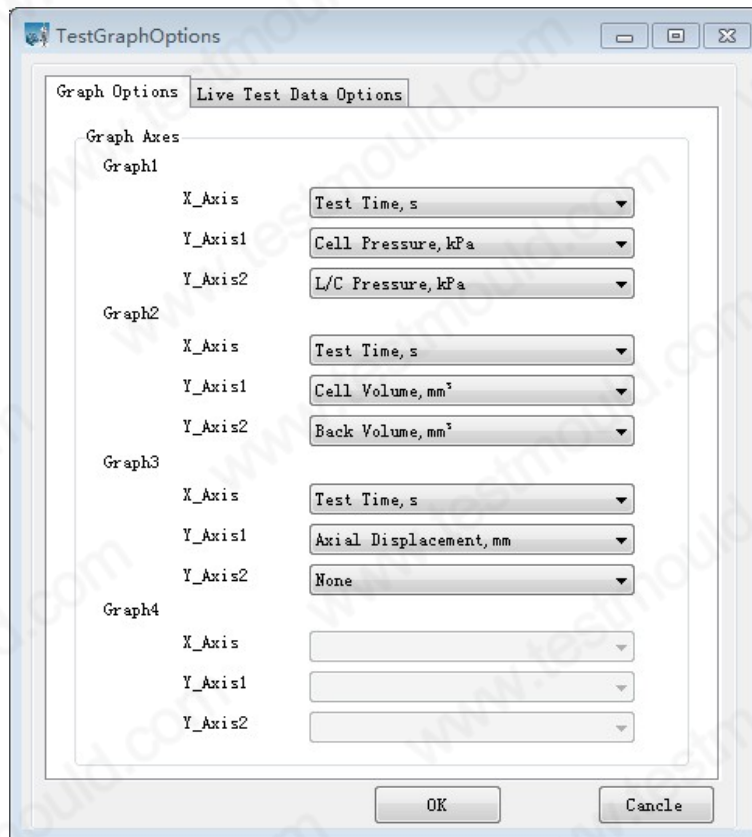


Figure 5 Test Graph Options

Customizing which parameters are displayed in the live Data Display is made using the Live Test Data Options tab. Up to a maximum of 9 parameters may be selected at any given time.

Once selection of the required parameters has been made, click the **OK** button.

If changes have been made in error the original configuration is retained if the **Cancel** button is selected.

The user may 'zoom' into any area of the graph by dragging the mouse (left button depressed) to form a rectangle onto the required area of the graph. This will cause the graph to enlarge the user-selected rectangular area. To return the graph back to its 'un-zoomed' state, double click the left mouse button.



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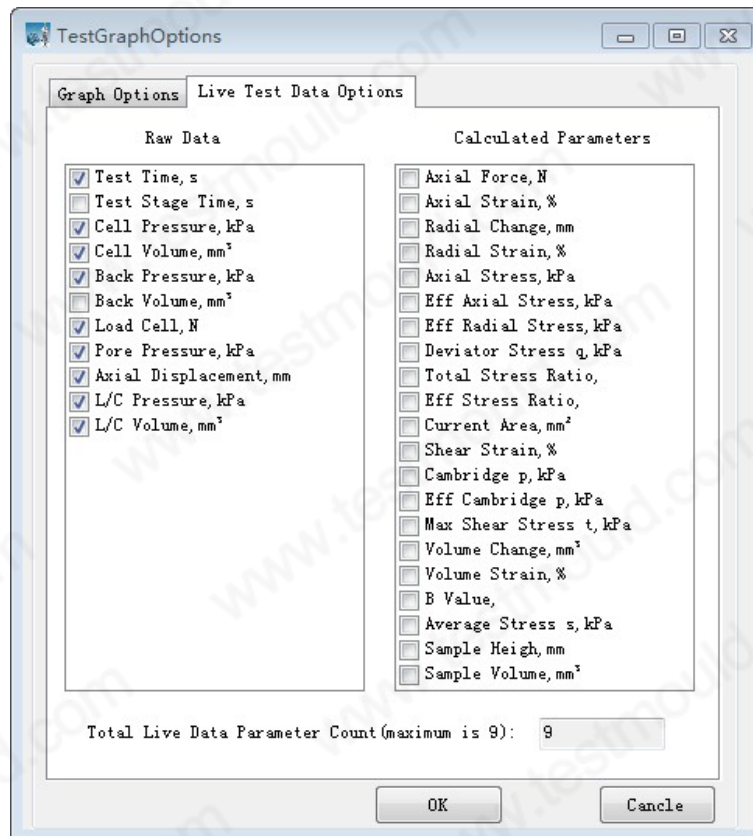


Figure 6 Live Test Data Options

Commencing a test

When the user is satisfied that all of the settings are correct and the test is ready to commence the Start Test button in the test control panel should be clicked.

IV. Setup the control parameter

Control the parameters of each pressure/volume controller, confining pressure, back pressure and the axial stress. Current value shows in the grey rectangle. When input the target value and press “Run”, the controller shall run according to the values you set up.



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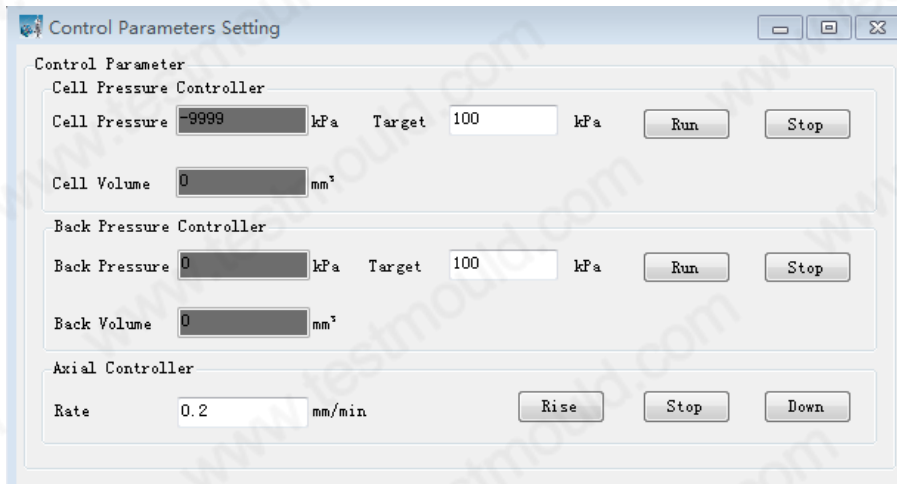


Figure 7 Control Parameter

V. Test Control Modules

Data Acquisition Test Module

The Data Acquisition Test Control Module allows general data acquisition and data logging to be conducted for triaxial and other standard tests. The Data Acquisition Test Control Module is suitable for use where none of the test hardware may be computer controlled but general data acquisition is required.

Specific data formats are included for acquiring data during different standard triaxial tests including, Saturation, Consolidation, UU, CU and CD.

Test Procedure

From the **Add Test Stage** panel from within the Station Test Plan window select the Test Control Module:

TriaxialAcquisition.dll

Click the **Create New Test Stage** button to open the **Setup**



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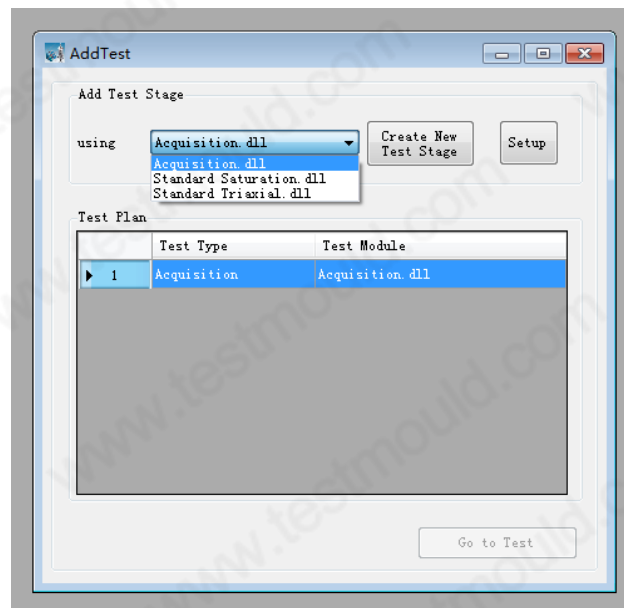


Figure 8 Add Test Stage

When the test conditions have been entered the Next button reveals the data saving and termination properties for the test. A maximum length for data acquisition may be input here. If the maximum test length is left unchecked, the test will continue indefinitely, or until the user manually ends the test.

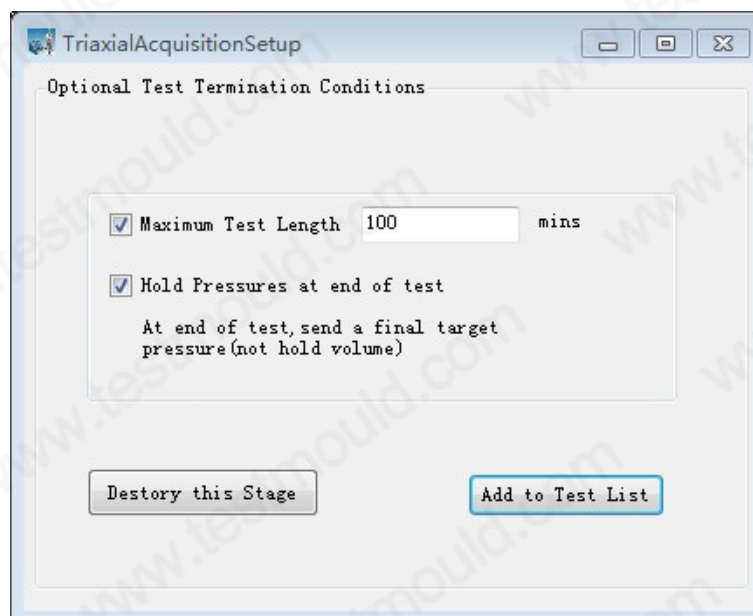


Figure 9 Acquisition Setup

Once the test details are completed, the test is added to the Test Plan by clicking the **Add to Test List**



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button. Or **Destroy this stage**-to abort the set up.

Saturation and Consolidation Test Module

Available Tests

- Saturation Ramp
- B-Check (Skempton pore pressure parameter B)
- Consolidation

Required Hardware

- Two pressure sources
- Volume Change measurement
- Cell

Test Procedure

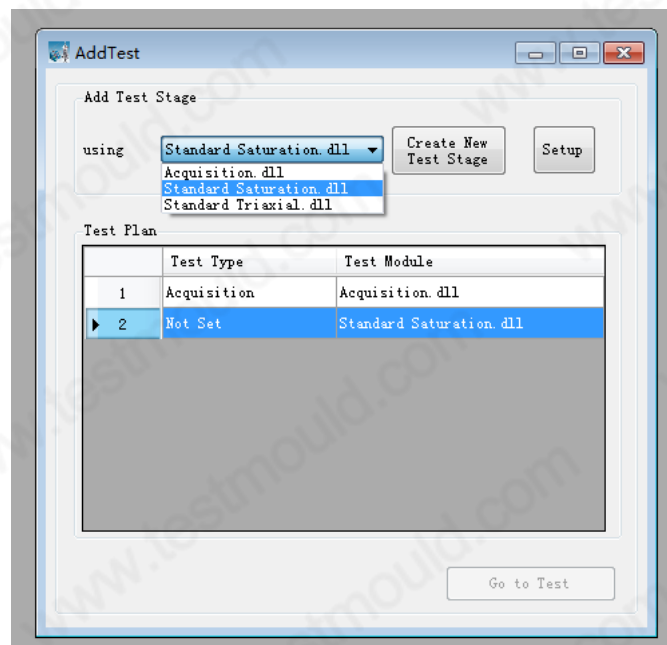


Figure 10 Add Test Stage



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From the **Add Test Stage** panel window select the Test Control Module:

Standard Saturation.dll

Click the Create New Test Stage button to open the test stage details window.

Select the required test type, either Saturation Ramp, B-Check (Skempton pore pressure parameter B) or Consolidation.

1. Saturation Ramp

Saturation ramp allows you to independently increase or decrease the Cell Pressure and the Back Pressure. The saturation ramp is used to steadily change the pressures in the system either keeping a constant effective stress or change to a desired effective stress.

The saturation ramp setup screen (below) will display the current read Cell Pressure and Back Pressure in the system. Enter the required target pressures for the Cell Pressure and the Back Pressure along with the time for each device to reach these target pressures.

Figure 11 Standard Saturation Setup

Click **Next** to proceed to the next stage.



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2. B-Check

The B-Check is a pre-test to check that the specimen is sufficiently saturated by measuring the Skempton pore water pressure parameter B. The cell pressure is increased to the specified value whilst the back pressure remains on hold volume (i.e. the undrained state). The system compares the change in pore pressure (Δu) caused by the increase in cell pressure ($\Delta \delta 3$). The value of B is calculated as $\Delta u / \Delta \delta 3$.

The B-Check setup screen (below) will display the current read Cell Pressure and Back Pressure in the system. Enter the required target pressure for the Cell Pressure.

The system will seek to the target pressure in the quickest time it can. If using the TPS-PVC controller, this may take between 0.1 and 5 minutes depending on the size of the cell and the amount of air within the water.

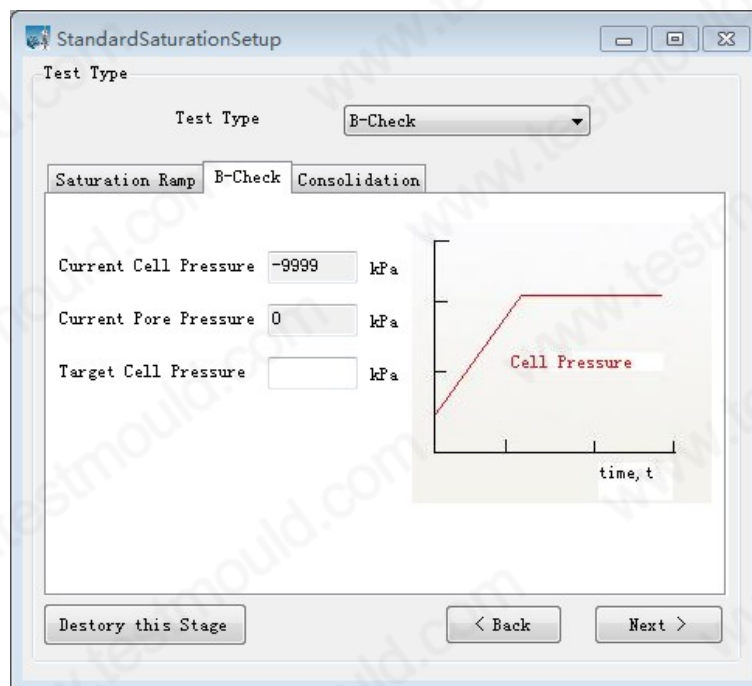


Figure 12 Saturation Setup


Click **Next** to proceed to the next stage.


3. Consolidation


Consolidation simply applies a constant Cell Pressure and a constant Back Pressure to the sample whilst monitoring the volume change within the sample.



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The Consolidation setup screen (below) will display the current read Cell Pressure and Back Pressure in the system. Enter the required target pressure for the Cell Pressure and the Back Pressure.

Figure 13 Consolidation

Click **Next** to proceed to the next stage.

4. Test Termination Screen

The final step in the test setup is the selection of the estimated test time.

Figure 14 Conditions

- End of Saturation Ramp

The test will stop (or go to the next stage if one exists) when the saturation ramp is complete.

- End of Consolidation

If the user is performing a multistage consolidation, they may want the computer to detect the end of consolidation. There is of course no perfect method for a PC to detect this, so the program works on the assumption that over any 5 minute period, if the volume change within the specimen is $< 5 \text{ mm}^3$ then consolidation is considered as complete.

- Max Skempton 'B-Value'

The test will stop (or go to the next stage if one exists) when it believes that the maximum value for Skempton 'B' has been obtained.

- Hold Pressure at end of test

Checking this box will cause the last command set to pressure sources (where computer control is possible) to be set to the final pressures. If the box remains unchecked, pressure sources will be set to hold volume (where possible).

- Maximum Test Length

If the user knows the exact length of time for the test then the maximum test length box should be checked and the test time entered in minutes. If the box remains unchecked then the test will continue until the user stops the test.

Standard Triaxial Test Module

Available Tests

- UU
- CU
- CD

Required Hardware



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1. UU, CU

- One Cell pressure source
- Axial Strain Application (i.e. Bishop and Wesley Cell + volume change control, load Frame etc)

2. CD

- One Cell pressure source
- One Back pressure source
- Axial Strain Application (i.e. Bishop and Wesley Cell + volume change control, load Frame etc)
- Volume Change measurement

Test Procedure

From the **Add Test Stage** panel from within the **Control** window select the Test Control Module:

StandardTriaxial.dll

Click the Create New Test Stage button to open the test stage details form (Set up).

Select the required test type, either Unconsolidated Undrained, Consolidated Undrained or Consolidated Drained. Then enter the requested parameters for the test type selected. Please note that the loading velocity can be entered as being either positive or negative. If you enter the loading velocity as negative you should be sure that the deviator stress on the test specimen will not become negative. If you want the deviator stress to go negative (you want to carry out an extension test) then please make sure that you are using the extension top-cap. If you are using negative loading velocity you will probably also want to enter a minimum strain value for test termination – see 6.3.4 below.


1. Unconsolidated Undrained


Unconsolidated Undrained provides the control for the shearing stage of the UU test. Constant control is maintained for the Cell Pressure while the axial velocity is maintained.


The Unconsolidated Undrained setup screen (below) will display the current read Cell Pressure in the



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system. Enter the required target pressure for the Cell Pressure and the velocity for the strain rate (mm/min).

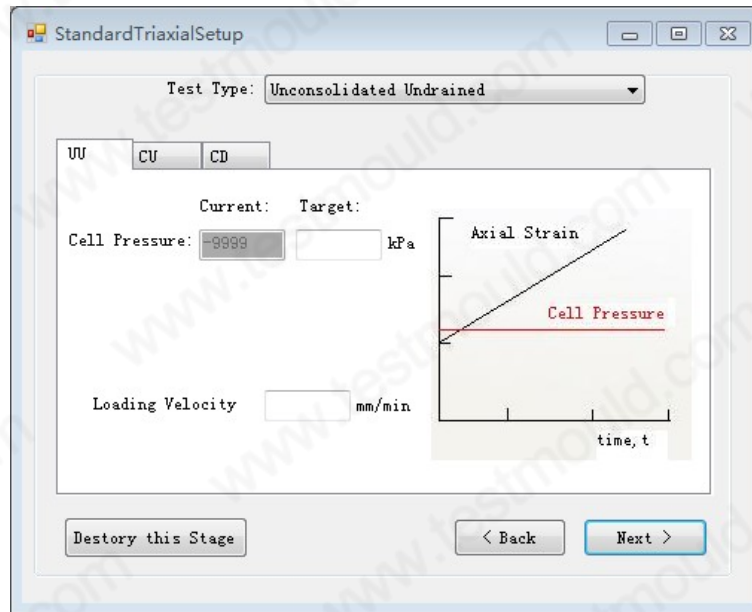


Figure 15 UU

Click **Next** to proceed to the next stage.

2. Consolidated Undrained

Consolidated Undrained provides the control for the shearing stage of the CU test. Constant control is maintained for the Cell Pressure while the axial velocity is maintained.

The Consolidated Undrained setup screen (below) will display the current read Cell Pressure in the system. Enter the required target pressure for the Cell Pressure and the velocity for the strain rate (mm/min).

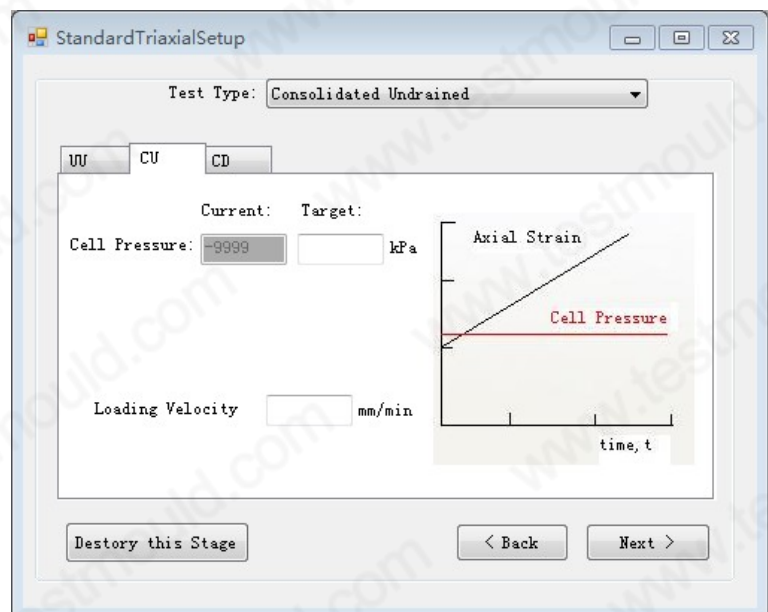


Figure 16 CU

Click **Next** to proceed to the next stage.



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3. Consolidated Drained

Consolidated Drained provides the control for the shearing stage of the CD test. Constant control is maintained for the Cell Pressure and Back Pressure while the axial velocity is maintained and the back volume change is measured.

The Consolidated Drained setup screen (below) will display the current read Cell Pressure and Back Pressure in the system. Enter the required target pressure for the Cell Pressure and the Back Pressure along with the velocity for the strain rate (mm/min).

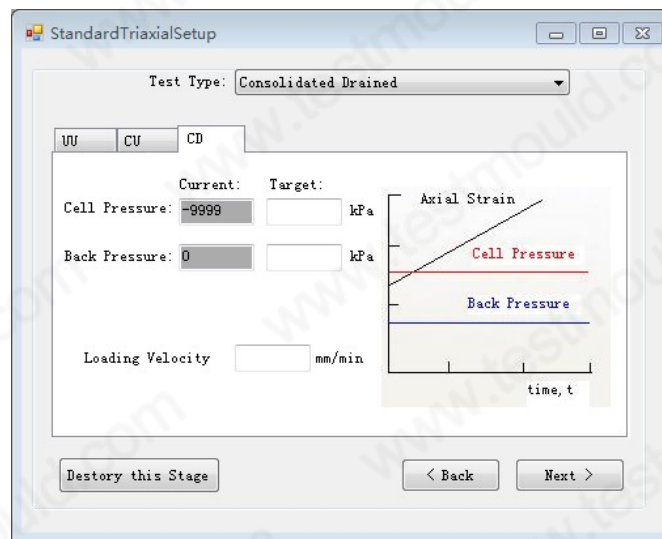


Figure 17 CD

Click **Next** to proceed to the next stage.

4. Test Termination Screen

The final step in the test setup is the selection of the estimated test time/termination options for the test.

- Maximum Axial Load

The user may enter a maximum limit for the axial load at which point the test will stop.

- Maximum Test Length

If the user knows the exact length of time for the test then the maximum test length box should be checked and the test time entered in minutes. If the box remains unchecked then the test will continue until the user stops the test.



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- Maximum Axial Strain

The user may enter a maximum limit for the axial strain at which point the test will stop. If you use this parameter the loading velocity will be positive.

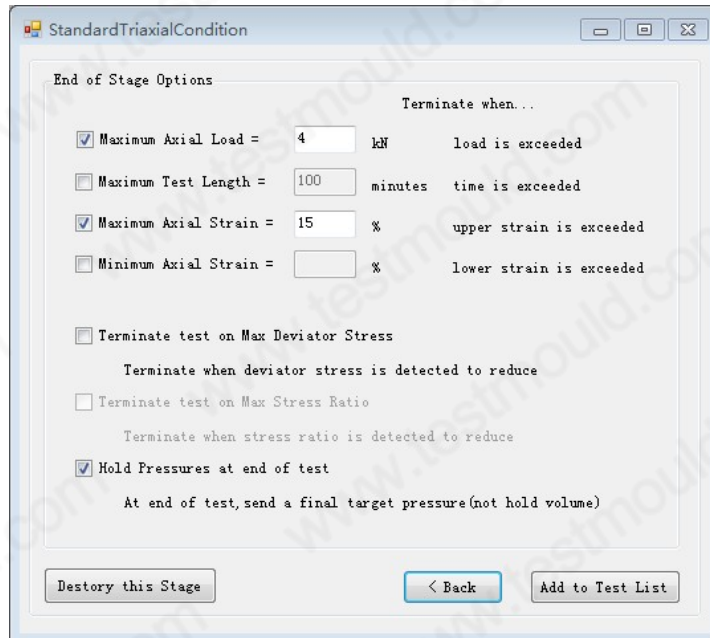


Figure 18 Condition

- Minimum Axial Strain

The user may enter a minimum limit for the axial strain at which point the test will stop (more commonly used when unloading a specimen i.e the loading velocity will be negative).

- Max Deviator Stress

The user may want the computer to detect the maximum deviator stress of the test. There is of course no perfect method for a PC to detect this, so the program works on the assumption that over any 4 consecutive readings of deviator stress, the most recent reading is the same or lower than the previous one. The maximum deviator stress will then be terminated when the 4th reading is less than the 3rd.

- Max Stress Ratio

The user may want the computer to detect the maximum stress ratio of the test. There is of course no perfect method for a PC to detect this, so the program works on the assumption that over any 4



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consecutive readings of deviator stress, the most recent reading is the same or lower than the previous one. The maximum stress ratio will then be terminated when the 4th reading is less than the 3rd.

- Hold Pressure at end of test

Checking this box will cause the last command set to pressure sources (where computer control is possible) to be set to the final pressures. If the box remains unchecked, pressure sources will be set to hold volume (where possible).

The test settings may be reviewed using the Back button.

Once the test setup is satisfactory the test should be added to the test plan.

VI. Data saving

The data collected in the test will be automatically saved in a local file, which is stored in the D:\ directory by default. The specific storage location can be modified by the "Path" parameter value in the \ini\Config.ini configuration file under the installation directory. The file is automatically named "yyyymmdd-hhmmss.tgd". The collected data is stored in binary mode, which can ensure continuous long-term test data storage.

VII. Data conversion

Since the data is saved in binary, the data file cannot be opened directly and must be converted. The steps are as follows:

1. Before data conversion, please make sure that this test has ended.
2. Click "Tools" → "Data Conversion" option, the "Open" interface appears.
3. Select the data file to be converted and click the "Open" button.
4. After the data conversion is successful, a "Prompt" dialog box appears, click "Yes".
5. The converted data is stored in the same directory, and its naming method is "yyyymmdd-hhmmss.tgd.txt", the file can be opened with Excel.



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VIII. Data Processing

The system can automatically process and analyze the test data, as follows:

1. Click "Control" -> "Data Processing" to open the data processing interface.

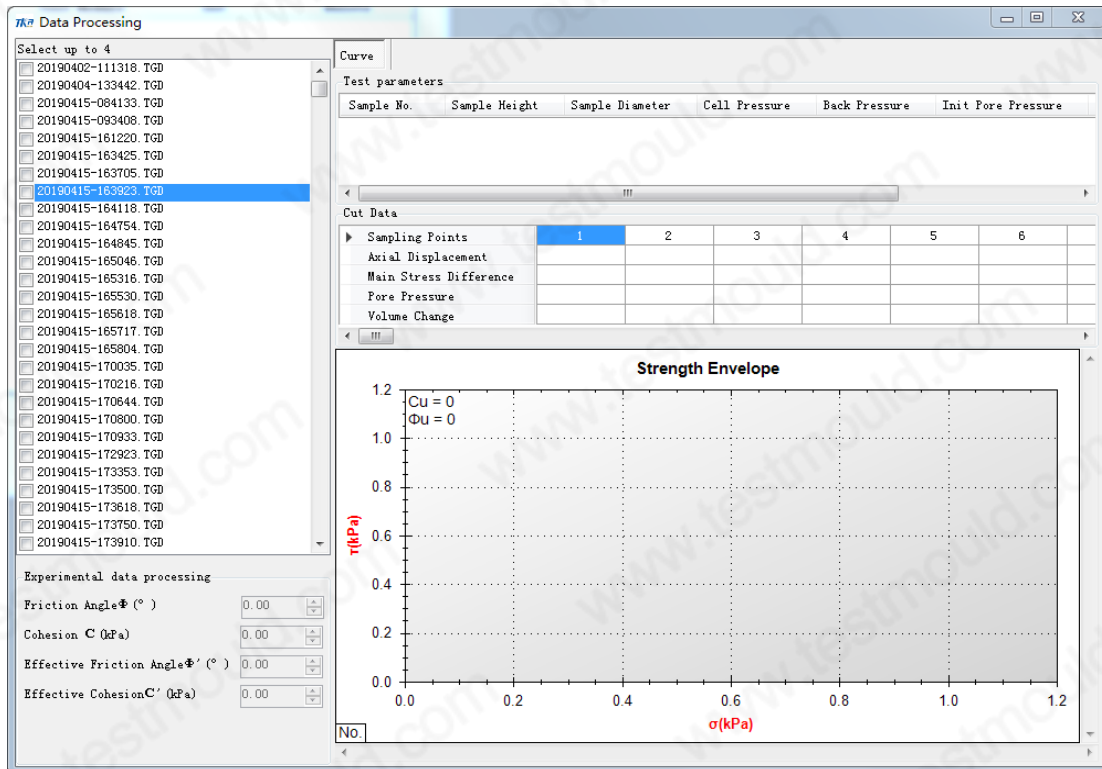


Figure 19 Data Processing

2. Select up to 4 files on the left, and the system will automatically fill in the data and draw the strength envelope in the table on the right.

IX. Solutions to common problems

System Configuration

- (1) When the operating system is Windows XP, the software cannot be run, please change the computer or operating system.
- (2) When the operating system is Windows 7, you need to install .NET for the green installation-free



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software Framework 4.0, not required for the installed version of the software.

- (3) When the operating system is Windows 10, the software can be run directly.
- (4) If 360 anti-virus software/security guard, Tencent anti-virus software/security guard is installed in the computer, it will have an adverse effect on the use of the software. It is recommended that users uninstall similar anti-virus software to ensure the normal use of the software.
- (5) If you want to collect data for a long time, please change the sleep time of the computer and the

Communication abnormal

When the computer cannot collect data, it means that the communication is abnormal. There may be two reasons for the failure, one is the software configuration problem, and the other is the hardware problem.

Failed to create file

The software saves the test data in the D:\ directory by default. If there is no D drive in the user's computer, you can change the save path by changing the "Path" in the \ini\Config.ini file under the installation directory.



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