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01/5050 NexygenPlus 4.1 User Manual

Issue 1.2

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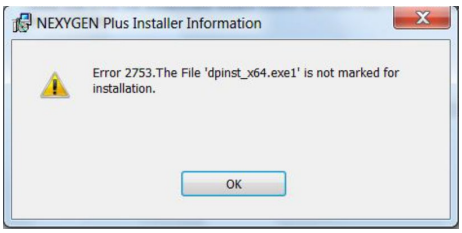
GENERAL

Welcome to NexygenPlus V4.1. This program has been designed for ease-of-use and meets a wide range of applications. It has several "Built-In" test methods for various types of physical testing and incorporates a test configurator and a scripting feature that makes it ideal for performing complex testing applications.

If you have not used a previous version of NexygenPlus, please refer to the Creating a New Test Setup section for details about how to create a new test.

Upgrading from a previous version of NexygenPlus

If you are upgrading from a previous version of NexygenPlus, this **MUST** be uninstalled using the Windows "Add and Remove Programs" feature. If this is not done, error messages like the one shown below, may be seen during the installation process.



Previous users of NexygenPlus will see that most of the screen layouts are similar to the previous versions. NexygenPlus 4.1 onward, introduces the new Quick Access Toolbar and the Ribbon Bar.

Upgrading from NEXYGEN MT (with or without the batch tester)

If you are upgrading from Nexygen MT (program using ".BCH" Files) with the Batch Tester, please refer the "Batch Tester Operation" section for details of how a similar testing system can be created.

SUPPORTED MACHINES

At the time of writing, the following machines are supported:

- LF Plus
- LRX Plus
- EZ20, EZ50
- LR Plus Series - LR5K Plus, LR10K Plus, LR30K Plus, LR50K Plus, LS100, LR100K Plus, LR150K Plus
- LS series – LS1, LS2.5, LS5
- LD Series LD5, LD10, LD30, LD50, LD100

MINIMUM PC REQUIREMENTS

MINIMUM PC SPECIFICATIONS

- Windows® 10 Professional
- Processor - Intel i5 (or equivalent)
- 8 GB RAM
- 256 GB SSD drive
- 1 free USB port
- HD resolution Monitor
- Internet access during installation for license activation
- Network connection LAN minimum 100 Mbit/s

MICROSOFT OFFICE

Microsoft Excel is required for the "Exporting to Excel" function but not for CSV export.

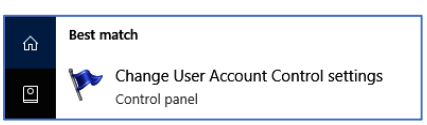
Microsoft Word is required to create a "Dedicated" Report Template, but this Template can be created on a different PC. Direct printing to a printer or to a PDF document does not require Microsoft Word.

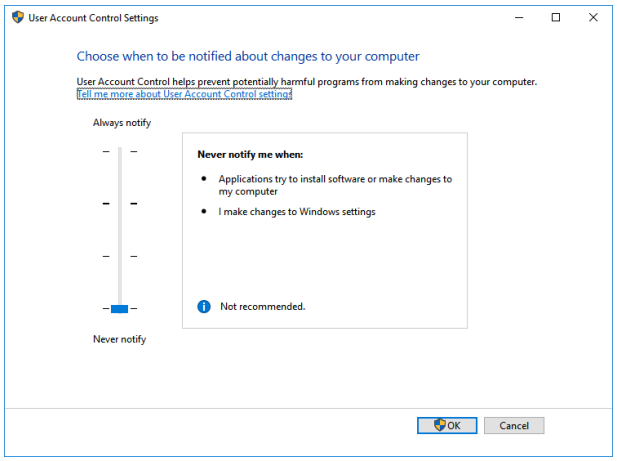
SOFTWARE REGISTRATION

Follow the instructions in the email provided at time of ordering for download and registration instructions.

INSTALLATION

NexygenPlus stores configuration information in the Windows Registry so the User Access Control (UAC) must be set to minimum and the user performing the installation must have full administration rights to the PC. Enter "UAC" in the Windows "Search" area in the Taskbar then click on "Change User Account Settings" to display the UAC control.



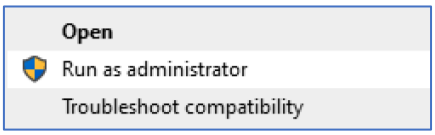


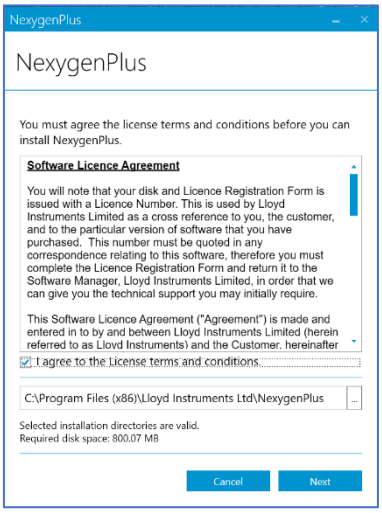
Slide the UAC slider to the bottom. Note that this can be reset to the company policy setting after installation.

Copy the installation file from the USB drive supplied to the local PC

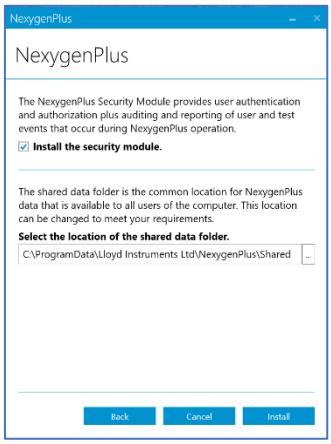
Right-mouse click on the file and select "Run as administrator"

Note: You may need to consult your local administrator or IT personnel to be given required access levels.





Check the "I agree to the license terms and conditions". The dialog shows the recommended location for the software installation, and this can be changed if required. Note that the software can be installed to a different location on the local drive but must **NOT** be installed onto a network drive. Click on "Next" to continue.

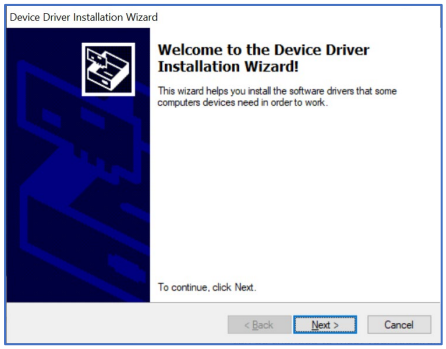


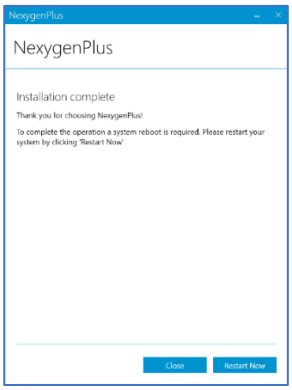
Only check the box 'Install the security module' if you have purchased the optional advanced security module.

The dialog shows the recommended location for the "Data Folder" and this can be changed if required. Note that although the Data Folder can be set to a network drive, this may cause performance issues, especially for long duration tests or if the "Test Automation" option is used. For best performance, it is recommended to use a local Data Folder and archive finished test files to the network drive.

Click on "Install" to install the software.

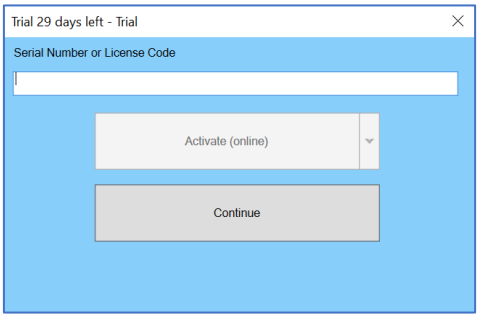
The machine requires drivers, and these are installed using the separate Dialogs as shown below. Click on "Next" for each Dialog to complete the installation.





A "Reboot" of the PC is required after the software has been installed and this will occur when "Restart Now" is clicked.

The program will now display the "Licence Code" dialog ready for the Activation Key.

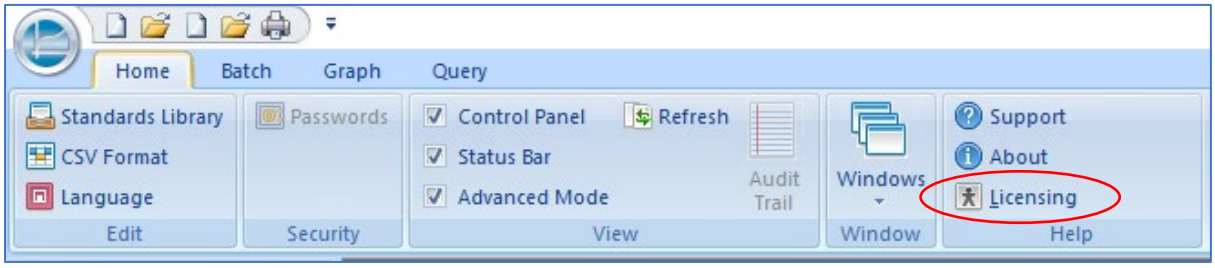


If the Activation Key has already been received, enter it now then click on "Activate (online). Note that the PC will need internet access. The PC may need to be taken to a different location to activate the software.

If the Activation Key has not yet been received, click on "Continue" to allow the program to be used with no restrictions.

Note: The user will have 30 days access without license and will then be restricted from using the software until a valid license key is entered.

When the Activation Key is received, enter it by clicking on the "LICENSING" Icon on the "HOME" ribbon bar to display the "Licence Code" dialog.

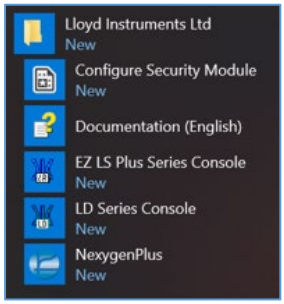


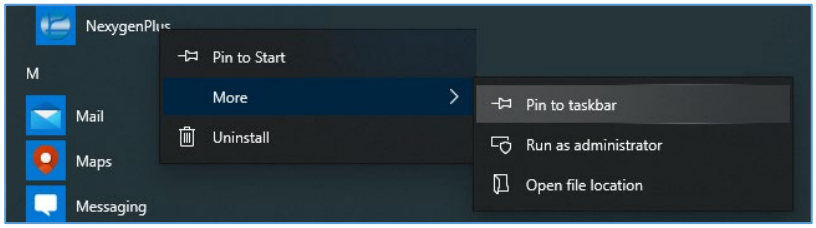
STARTING THE SOFTWARE

Select the Windows Icon in the left-hand corner of the screen



Scroll down the list of applications and then click on “Lloyd Instruments Ltd”. Then click on "NexygenPlus".





Note that a "Shortcut" can be added to the Windows "Start" menu and / or the taskbar by right-mouse clicking on "NexygenPlus" then selecting "Pin to Start" or by selecting "More", then "Pin to taskbar".

CONNECTING TO THE TESTING MACHINE

At the time of writing, the following Materials Testing Machines are supported: -

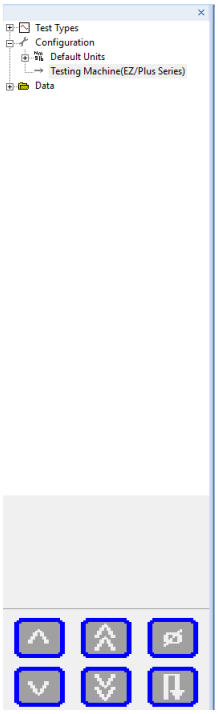
LF Plus	COM Port Connection	EZ/Plus Series Console
LRX Plus	COM Port Connection	EZ/Plus Series Console
EZ20, EZ50	COM Port Connection	EZ/Plus Series Console
LR Plus Series	COM Port Connection	EZ/Plus Series Console
LS series – LS1, LS2.5, LS5	USB Connection	EZ/Plus Series Console
LD Series LD5, LD10, LD30, LD50, LD100	USB Connection	LD Series Console

If the machine has a COM (Serial) Port connector and the computer does not have a COM Port connection, then a USB to COM Port Adaptor cable must be fitted to an unused USB Port on the PC. An example cable is shown below. The COM Port cable supplied with the Testing Machine is fitted to this adaptor cable.



If the machine has a USB connector, connect the supplied USB cable to an unused USB port on the PC.

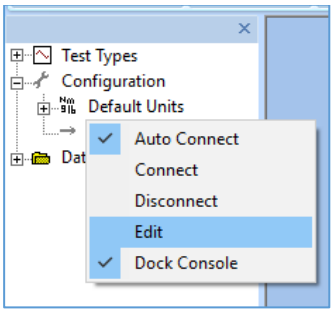
Switch the Materials Testing Machine on, press the yellow Safe-Line button then start NexygenPlus. Locate the Control Panel along the left-hand side of the screen, click on the "+" to the left of CONFIGURATION then click on "Testing Machine". Now right-mouse click on "Testing Machine" and select "Dock Console" to display the "Testing Machine" screen at the bottom of the Control Panel".

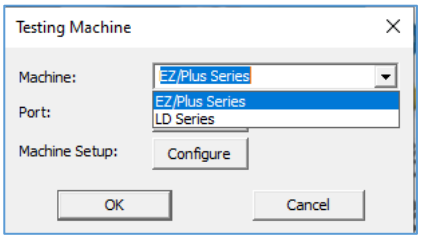


Right-mouse click on "Testing Machine" again and select "Edit" to display the Console Editor screen.

Select "EZ/Plus Series" in the "Machine" drop down selector for all machines except for the LD Series.

Click on the "Port" Configure button and select the required Port. The "Console" at the bottom of the Control Panel" should now display load and extension values.





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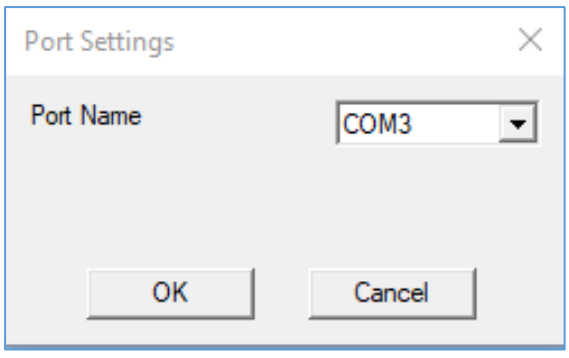
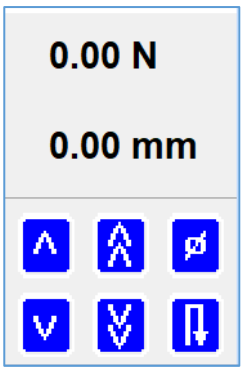
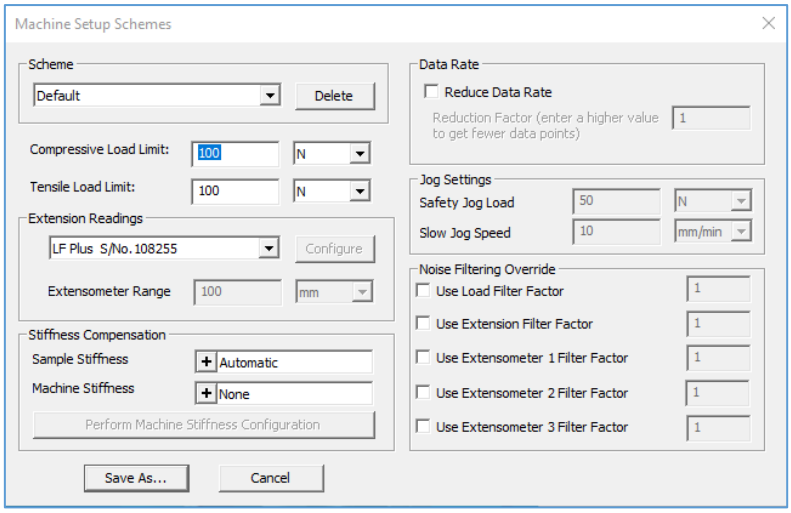




Click on the "Machine Setup" Configure button to display the "Machine Setup Schemes" screen and set the "Compressive Load Limit" and "Tensile Load Limit" values to the Materials Testing Machine load capacity, e.g., 5000N for an LS5.

Note: that these values default to 100N for safety so the initial values will stop a test at 100N.

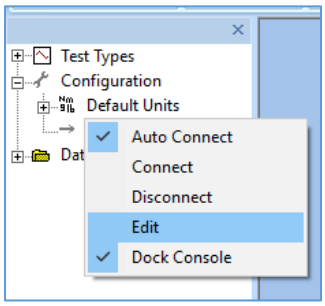
All other settings can be left at the initial values and are explained later in this document.



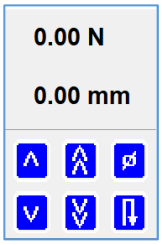
Click on the "Save As" button, then click the "OK" button to accept the initial name of "Default".

Click on the "OK" button to close the "Testing Machine" Dialog.

The "Console" is fixed to the bottom of the Control Panel, but this can made to "float" by right-mouse clicking on "Testing Machine" and unchecking "Dock Console". The console may be initially hidden by Windows, so double click on the dark blue "Console" Icon at the right-hand side of the Windows Taskbar to display it.







If the Icon is not displayed, right-mouse click on the Taskbar and select "Taskbar settings". Locate and click on the text "Select which Icons appear on the taskbar" then switch on the option for the MTEZCON or LDCON as appropriate.



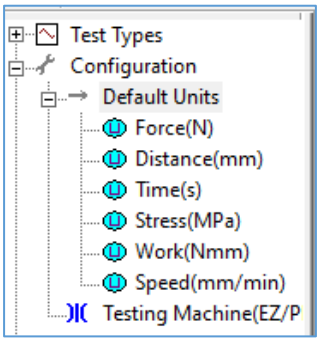
Ensure that a loadcell is connected to the Testing Machine and ensure that the moving crosshead is free from obstacles. Click and hold the double arrow button pointing ‘UP’ on the "Console" and check that the machine crosshead moves upwards. Release the mouse button and check that the machine stops. Check that the extension reading shows a value with an up arrow displayed.

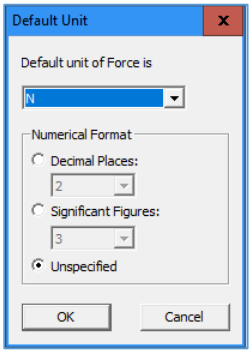
SETTING DEFAULT UNITS AND RESULT FORMATTING

The "Default" result units are initially set as N (Force in Newtons), mm (Extension in millimetre), s (Time in seconds), MPa (Stress in Megapascal), Nmm (Work in Newton millimetre) and mm/min (Speed in millimetre per minute).

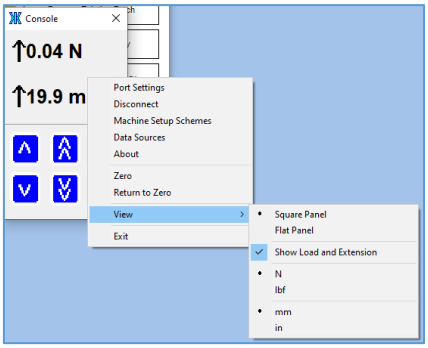
These units can be changed in individual test files as shown later, but if ALL test files require different units, the units should be configured before the program is used. The "Default" result formatting is not specified so if all extension results are required with 2 decimal places, this can be set as the default formatting.

Locate the Control Panel along the left-hand side of the screen, click on the "+" to the left of CONFIGURATION then click on the "+" to the left of DEFAULT UNITS. Click on the unit to change, e.g., "Force". Now right-mouse click on "Force" and select EDIT to display the "Default Unit" dialog. Select the required unit from the drop-down control, e.g., "lbf" and select the required formatting, e.g., 2 decimal places. Click on the OK button to close this dialog then repeat for the other units.





The "Console" display is independent of the result units and only has options of N, lbf, mm and in. The "default" display shows N and mm, but these can be changed by right-mouse clicking on the "Console", then selecting VIEW.



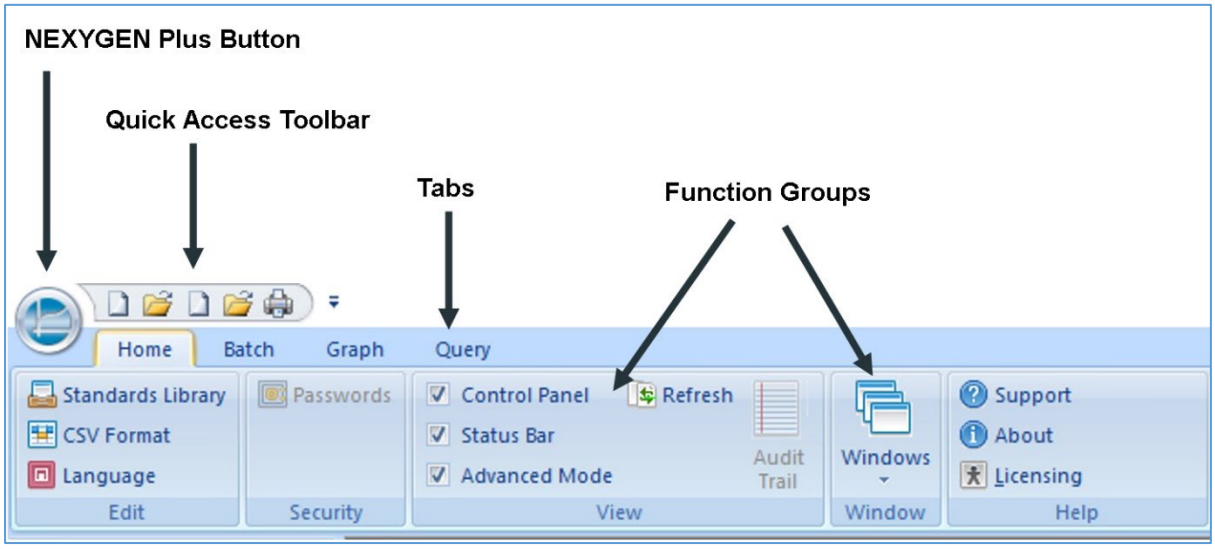
CHANGING THE DISPLAYED LANGUAGE

Click on the HOME tab then click on Language to display a list of available languages. Select the required language from the drop-down menu and press OK.



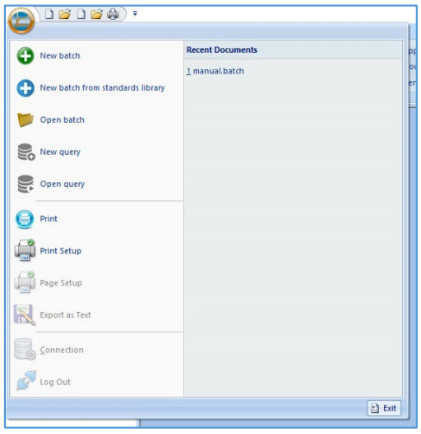
Note: The language chosen will not display automatically. Close and re-start the NexygenPlus program for the new language to take effect.

NEXYGENPLUS RIBBON BAR



NexygenPlus utilises a Ribbon Bar control to give a cleaner and easier-to-use menu interface. This contains the circular NexygenPlus Button, the Quick Access toolbar, Tabbed toolbars, and function groups. The tabs are context sensitive and automatically change depending upon the task being performed by the user.

Clicking on the "NexygenPlus Button" displays a dialog with the commonly used file operations, such as New or Open together with a list of recently used test files or MRU (Most Recently Used) files.

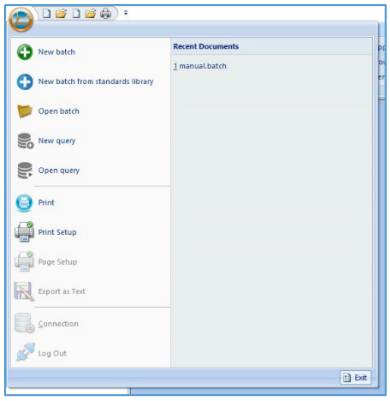


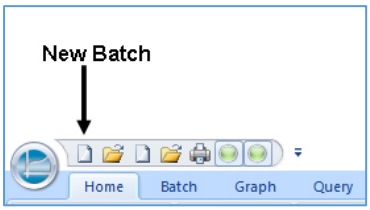
CREATING A NEW TEST

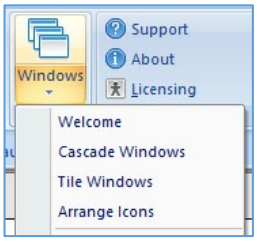
A New Test can be created by: -

1 Clicking on the "NexygenPlus Button" then selecting "New Batch"
2 Clicking on the "New Batch" Icon on the "Quick Access Toolbar"
3 Clicking on the "Windows" group on the "Home" tab to display the Welcome Screen

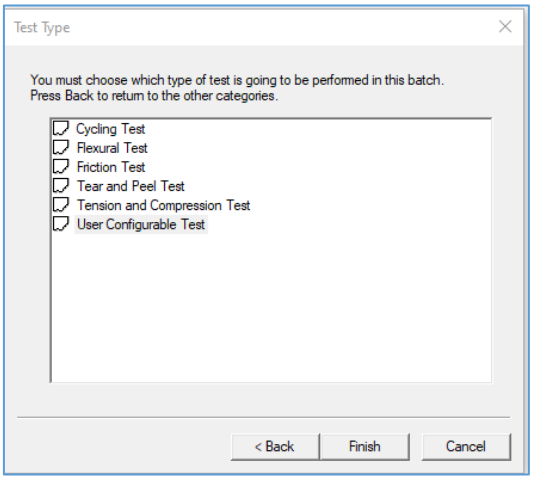
The Welcome screen is initially displayed when the program is started and will be automatically displayed when closing all batches. To display the Welcome screen at all other times, click on the HOME tab then select WINDOWS, WELCOME.



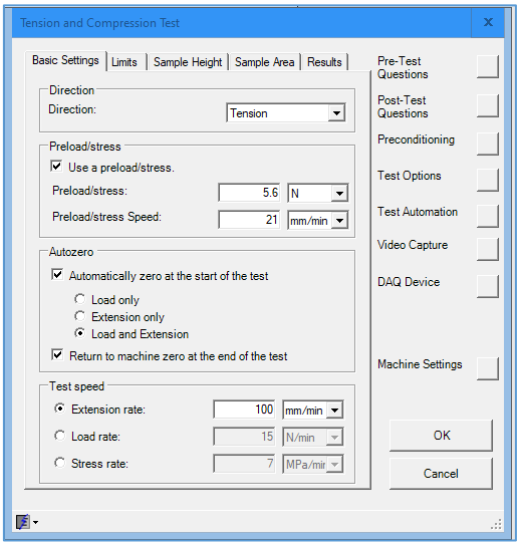




In all cases, a "Save As" dialog is displayed ready for the filename. Enter a suitable name then click on the "Save" button to display a list of Test Types.



Select the required Test Type then click on the "Finish" button to display the Test Setup Editor.



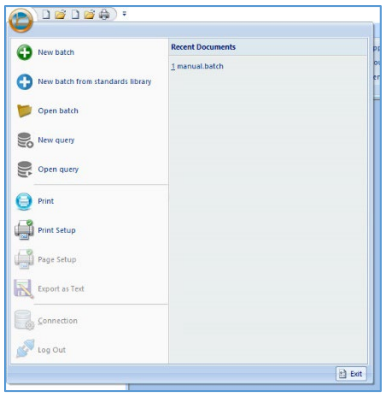
Note that the Test Setup Editor shown above is for the Tension and Compression Test and the other test types use different editors. The Test Setup Editors are shown later in this document. If you are new to NexygenPlus, please refer to these sections for details.

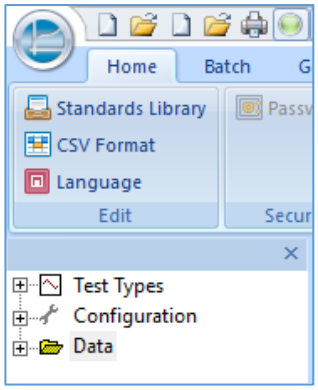
OPENING AN EXISTING BATCH FILE

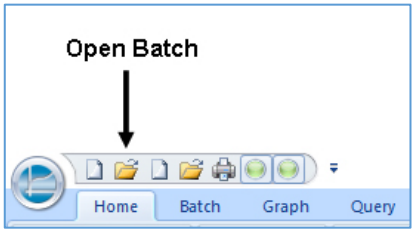
An existing Test file (Batch file) can be opened by: -

1 Clicking on the "NexygenPlus Button" then selecting "Open Batch"
2 Selecting it in the Data folder in the left-hand CONTROL PANEL
3 Clicking on the "Open Batch" Icon on the "Quick Access Toolbar"
4 Clicking on the "Windows" group on the "Home" tab to display the Welcome Screen

Note that the "NexygenPlus Button" also displays a list of recently used test files. Clicking on one of these filenames opens this file ready for use.





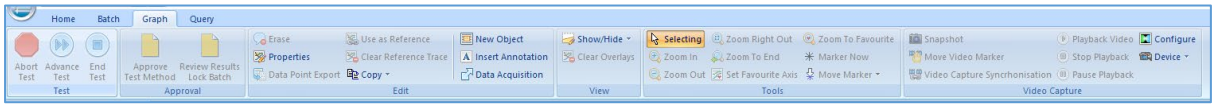


If the CONTROL PANEL is not visible, it can be displayed by clicking on the HOME tab then checking the "Control Panel" checkbox.

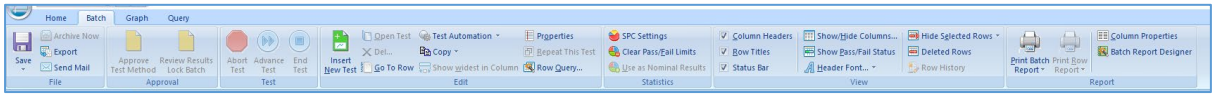
If the WELCOME SCREEN is not displayed, click on the HOME tab then select WINDOWS, WELCOME.

RIBBON BAR FUNCTIONS

When a Test (Batch) file is opened, the ribbon bar automatically displays the relevant Icons depending upon whether the test data or a test graph is displayed. Clicking on the GRAPH tab along the bottom of the screen displays the GRAPH ribbon bar.

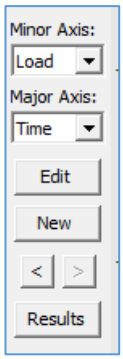


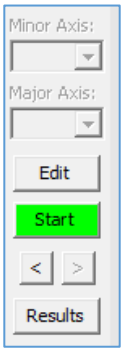
Clicking on any other tab along the bottom of the screen displays the BATCH ribbon bar.



PERFORMING A TEST

A test can only be performed if a "New Test" is created in the data table (Batch Table). If the GRAPH screen is displayed, click on the "NEW" button to the left of the graph to create a "New Test". The "New" button will now show "Start" with a green background.

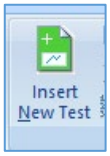




If any other screen is displayed, there are 2 ways to create a New Test: -

1 Select the GRAPH screen using the tab along the bottom of the screen, then click on the "NEW" button as shown above.

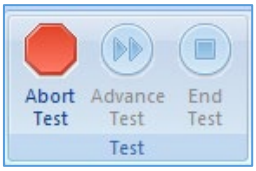
2 Click on the "INSERT NEW TEST" Icon on the ribbon bar. This both creates a new test and displays the graph screen with the green "Start" button ready for testing.



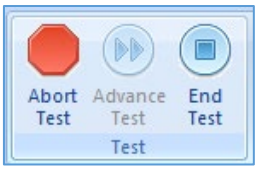
TEST FUNCTIONS

When a test is running, the GRAPH ribbon bar always displays a red "Abort Test" button. **This button is an "EMERGENCY STOP" button**. If this is clicked, the test immediately ends, and the machine stops moving.

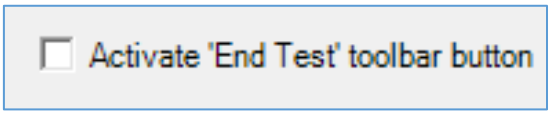
Note that the machine will not drive back to the start of test position even if "Auto Return" is selected in the test setup.



The GRAPH ribbon bar also has blue "End Test" button which also ends the test when it is clicked. However, this does not act as an "Emergency Stop" so the machine will drive back to the start of test position if "Auto Return" is selected in the test setup.



Every "Built-in" test type (except for the "User Configurable Test") has a checkbox option in the Test Setup screens to enable the blue "End Test" button.



A "User Configurable Test" (UCT) may also enable the blue "End Test" button by using an "ENDON" method in the Test Script, BEFORE defining the machine movement using a STAGE command e.g.

```
ENDON
STAGE [100mm], [100mm/min]
```

The GRAPH ribbon bar also has blue "Advance Test" button which may be enabled in a "User Configurable Test" (UCT) by using an "ADVANCEON" statement in the Test Script. This button allows the operator to partially control the test operation, noting that clicking this button may not cause the test to end depending upon the test script.



Clicking on the "Advance" button stops the running stage and prevents ANY OTHER STAGE in the test from running. If the test has only one stage, the "Advance" button has the same action as the "end" button. The main use of this button is to allow the user to control a multiple stage test. Consider the Test script below

```
ADVANCEON
FOR Cycle = 1 to 100
        STAGE [10mm], [500mm/min]
        STAGE [0mm], [500mm/min]
NEXT
STAGE [1kN], [500mm/min]
```

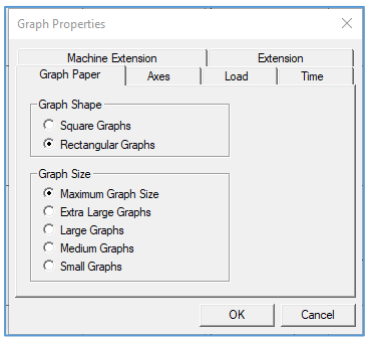
This script performs 100 cycles then pulls the sample to break. The idea is that the sample is repeatedly loaded and unloaded (cycled) until a visual change occurs. When the operator observes this change, clicking on the blue "Advance Test" button will immediately end the cycling stages (For - Next) and apply an increasing force to break the sample. However, this action will not occur because clicking on the "Advance Test" button prevents ANY stage from running so the test ends. The last stage is required to run, so the "Stage Prevention" needs to be disabled, and this is done using an "ADVANCEOFF" statement as shown below.

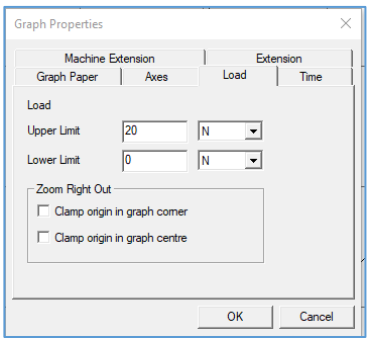
```
ADVANCEON
FOR Cycle = 1 to 100
        STAGE [10mm], [500mm/min]
        STAGE [0mm], [500mm/min]
NEXT
ADVANCEOFF
STAGE [1kN], [500mm/min]
```

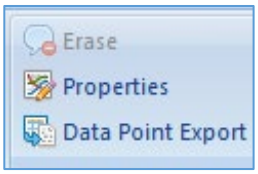
This statement disables the "Advance" button ands allows the subsequent stages to run. Note that "ADVANCEON" and "ADVANCEOFF" statements can be used many times during a test depending upon the required test action.

GRAPH SIZE, UNITS AND RANGES

The graph size, ranges and units can be configured by right-mouse clicking on the graph screen and selecting PROPERTIES to display the "Graph Properties" screen. The "Graph Properties" screen can also be displayed by clicking on the PROPERTIES Icon on the GRAPH ribbon bar.



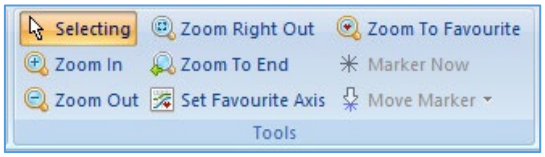




Each Axis can be configured to show the required range and units. Note that changing the units on the graph does not change the units in the Results Data Table

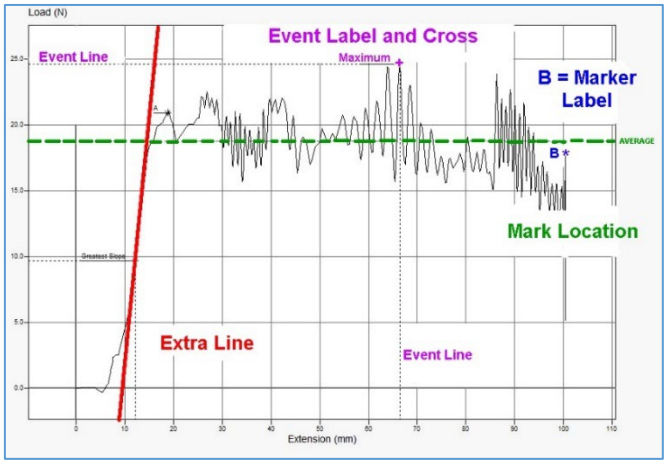
GRAPH ZOOMING

The visible part of the graph trace can be changed by using the "Zoom In", "Zoom Out" and "Zoom Right Out" (Zoom to Best Fit) Icons on the GRAPH ribbon bar. Pressing the "HOME" key on the keyboard also selects the "Zoom Right Out" feature.

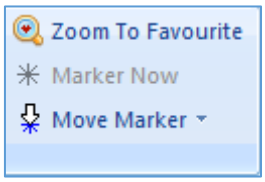


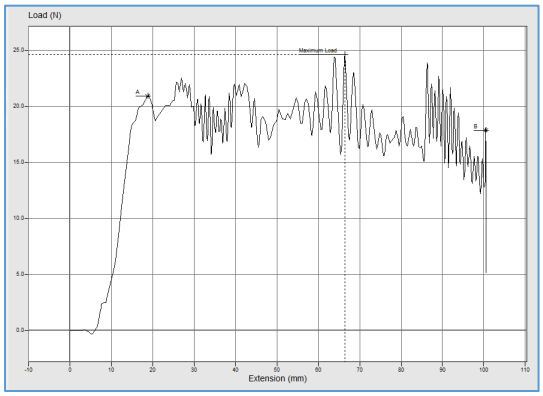
GRAPH MARKINGS

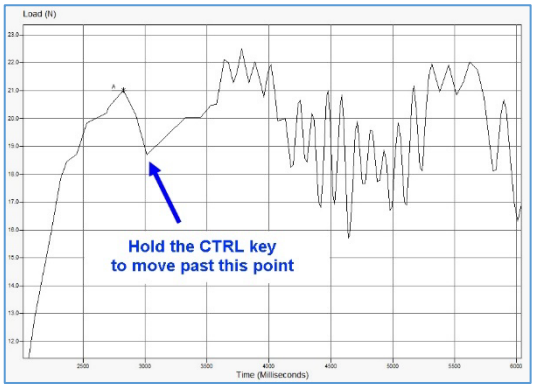
Some tests may display a fixed "Event" (shown with a "+"), a movable "Marker" (shown with a "*") or other lines.



Consider the graphs shown for a peel test. One requirement is to calculate the average load over a region of the graph between the 2 markers, "A" and "B". Each marker can be moved in turn by clicking on the "Move Marker" Icon on the GRAPH ribbon bar to change the mouse cursor to a "Move Marker" down arrow. Position the cursor over the marker then click and hold the left-mouse button to drag the marker to the required location.

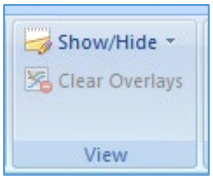


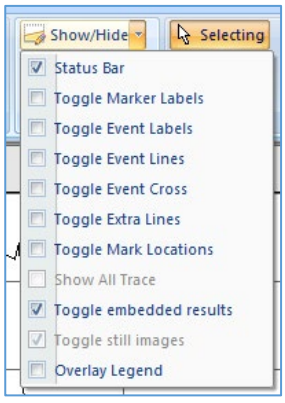




Note that because the marker is normally positioned in a suitable location, it cannot be moved around a "large" corner. If the marker is required in a completely different location, hold down the CTRL key while moving with the mouse.

Any graph "Events", "Markers" or "Additional Lines" can be hidden or displayed by clicking on the drop-down arrow to the right of the "SHOW/HIDE" Icon on the GRAPH ribbon bar, then checking or unchecking the relevant checkbox.





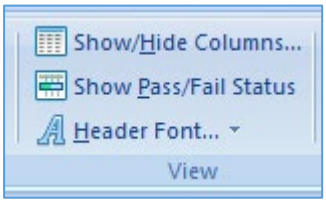
ANALYSING TEST DATA

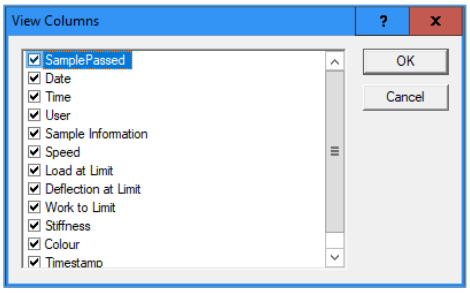
Clicking on the RESULTS tab along the bottom of the screen displays the Results Data Table. The data columns are determined by the type of test and the selected test results. Each column can be configured in various ways to alter the view as required.

	Sample...	Date	Time	User	Sample Information	Speed	Load at Limit	Deflection at Limit	Work to Limit	Stiffness	Colour
1	True	10/01/2...	11:03:01	keepingc	Rubber Band	500.000...	2.34 N	20.00 mm	29.3 Nmm	0.320 N/mm	Red
2	True	10/01/2...	11:03:14	keepingc	Rubber Band	500.000...	2.33 N	20.00 mm	29.3 Nmm	0.471 N/mm	Yellow
3	True	10/01/2...	11:03:26	keepingc	Rubber Band	500.000...	2.28 N	20.00 mm	28.6 Nmm	0.294 N/mm	Blue
4	True	10/01/2...	11:03:39	keepingc	Rubber Band	500.000...	2.27 N	20.00 mm	28.5 Nmm	0.219 N/mm	Green
5	True	10/01/2...	11:03:51	keepingc	Rubber Band	500.000...	2.30 N	20.00 mm	28.6 Nmm	0.206 N/mm	White
6	True	10/01/2...	11:04:04	keepingc	Rubber Band	500.000...	2.32 N	20.00 mm	28.8 Nmm	0.292 N/mm	Orange
7	True	11/01/2...	11:04:17	keepingc	Rubber Band	500.000...	2.31 N	20.00 mm	28.5 Nmm	0.595 N/mm	Red
8	True	11/01/2...	11:04:31	keepingc	Rubber Band	500.000...	2.29 N	20.00 mm	28.7 Nmm	0.222 N/mm	Yellow
9	True	11/01/2...	11:04:44	keepingc	Rubber Band	500.000...	2.29 N	20.00 mm	28.3 Nmm	0.224 N/mm	Blue
10	True	11/01/2...	11:04:57	keepingc	Rubber Band	500.000...	2.34 N	20.00 mm	29.3 Nmm	0.302 N/mm	Green
11	True	11/01/2...	11:05:12	keepingc	Rubber Band	500.000...	2.30 N	20.00 mm	28.9 Nmm	1.096 N/mm	White
12	True	11/01/2...	11:05:28	keepingc	Rubber Band	500.000...	2.34 N	20.00 mm	29.1 Nmm	0.226 N/mm	Orange

The columns can be re-ordered by clicking and holding the left mouse down on the column heading, horizontally dragging the column to the new position, then releasing the mouse button.

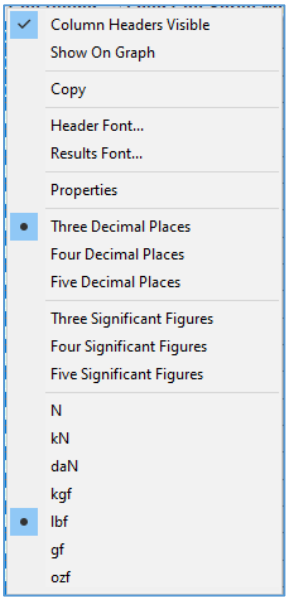
Each column can be hidden or displayed by clicking on the "SHOW/HIDE COLUMNS" Icon on the BATCH ribbon bar to display a "View Columns" dialog.

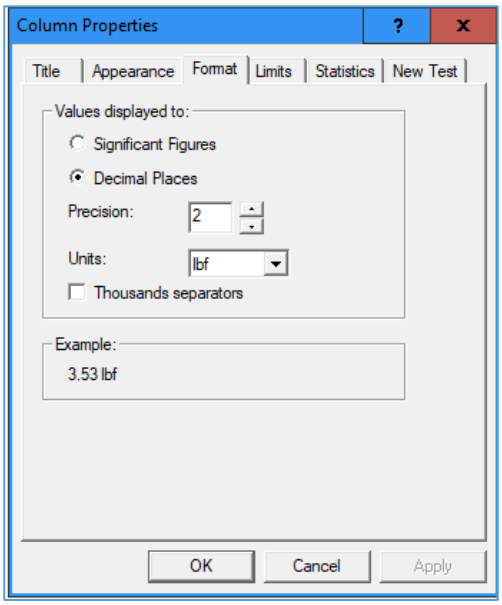




The measured results are displayed using the units and formatting set as the "Default Units" in the Control Panel. If a test result is required with different units and / or formatting, right-mouse click on the required column heading and select the required format (e.g., "Three Decimal Places" and "lbf").

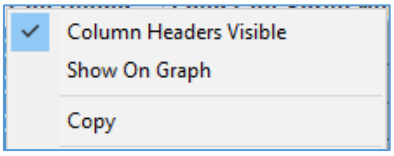
Note that this dialog only directly displays Three, Four and Five Decimal places but other formatting is available by clicking on the PROPERTIES entry of this dialog then selecting the "Format" tab.



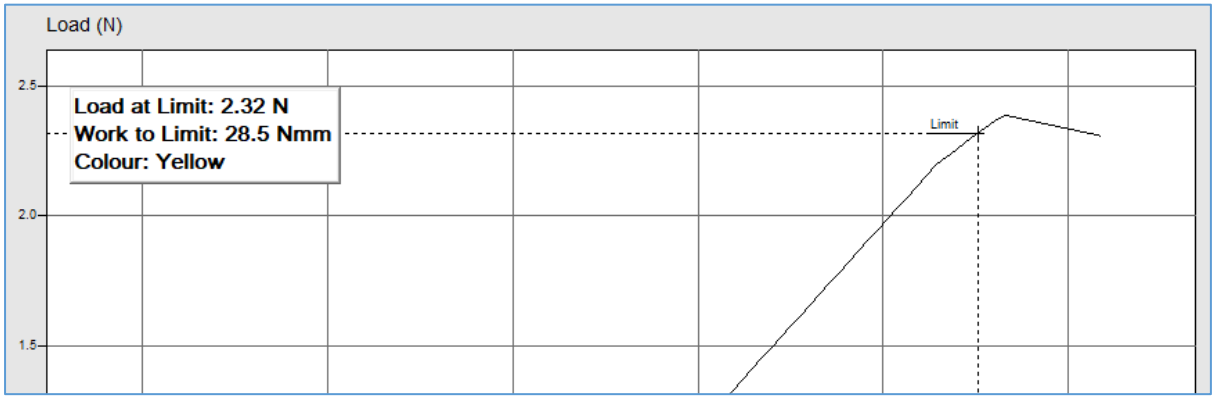


SHOW TEST RESULTS ON GRAPH

Selected test results can be displayed on the graph screen at the end of each test to assist the operator. Decide which results are required on the graph (e.g., Test Date, Lot Number etc.) then right mouse on each of the required column headings and select "Show On Graph".



The results are displayed in a moveable "box" on the graph screen. The order that these results are listed is determined by the column order in the data table.



TEST STATISTICS

Clicking on the STATISTICS tab along the bottom of the screen displays the Test Statistics, e.g., Maximum, Minimum, Mean, Median Standard deviation values etc. in the same units and format as each result column.

	Maximum	Minimum	Mean	Median	Coefficient of Variance	Standard Deviation (N)	Standard Deviation (N-1)	True
SamplePassed								100.00%
Speed	500.000 mm/min	500.000 mm/min	500.000 mm/min	500.000 mm/min	0.00%	0.000 mm/min	0.000 mm/min	
Load at Limit	2.37 N	2.24 N	2.29 N	2.29 N	1.14%	0.03 N	0.03 N	
Deflection at Limit	20.01 mm	20.00 mm	20.00 mm	20.00 mm	0.01%	0.00 mm	0.00 mm	
Work to Limit	29.6 Nmm	27.8 Nmm	28.7 Nmm	28.7 Nmm	1.30%	0.4 Nmm	0.4 Nmm	
Stiffness	2.787 N/mm	0.134 N/mm	0.433 N/mm	0.324 N/mm	74.85%	0.324 N/mm	0.325 N/mm	
Timestamp								
Number of Rows that Passed	228							
Number of Rows that Failed	0							

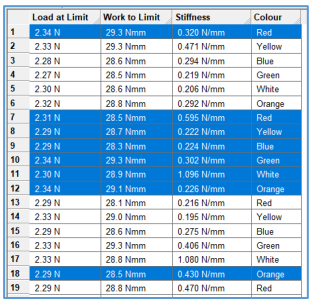
Note that this screen calculates the statistics for all VISIBLE rows and VISIBLE columns in the data table and the number or rows (tests) is shown at the bottom of the table (i.e., 228). The statistics can also be restricted to specified columns by hiding the unwanted columns.

	Maximum	Minimum	Mean	Median	Coefficient of Variance	Standard Deviation (N)	Standard Deviation (N-1)	True
Load at Limit	2.37 N	2.24 N	2.29 N	2.29 N	1.14%	0.03 N	0.03 N	
Deflection at Limit	20.01 mm	20.00 mm	20.00 mm	20.00 mm	0.01%	0.00 mm	0.00 mm	
Work to Limit	29.6 Nmm	27.8 Nmm	28.7 Nmm	28.7 Nmm	1.30%	0.4 Nmm	0.4 Nmm	
Stiffness	2.787 N/mm	0.134 N/mm	0.433 N/mm	0.324 N/mm	74.85%	0.324 N/mm	0.325 N/mm	
Number of Rows that Passed	228							
Number of Rows that Failed	0							

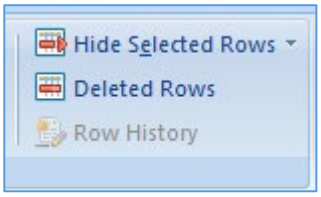
The statistics can also be restricted to specified rows by hiding the unwanted rows. The unwanted rows can be selected manually or automatically by using a Row Query.

To hide certain rows, return to the data table by clicking on the RESULTS tab along the bottom of the screen.

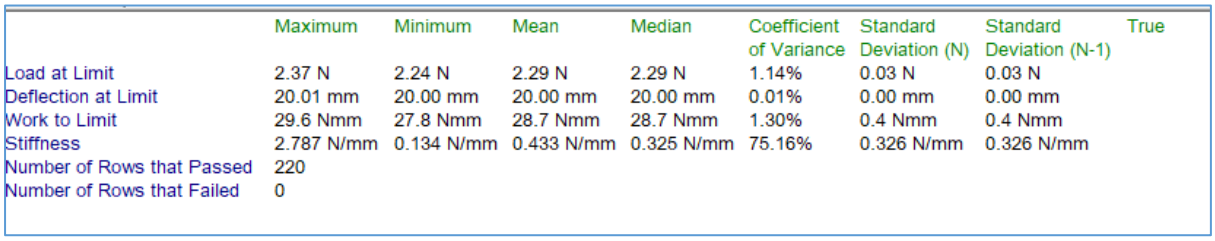
If there are only a small number of rows in the batch data table, the rows to be hidden can be selected by holding the CTRL key and clicking on each unwanted row in turn, noting that the unwanted rows are shown in blue. Click on the HIDE SELECTED ROWS Icon on the BATCH ribbon bar to hide these rows.



	Load at Limit	Work to Limit	Stiffness	Colour
1	2.34 N	29.3 Nmm	0.320 N/mm	Red
2	2.33 N	29.3 Nmm	0.471 N/mm	Yellow
3	2.28 N	28.6 Nmm	0.294 N/mm	Blue
4	2.27 N	28.5 Nmm	0.219 N/mm	Green
5	2.30 N	28.6 Nmm	0.206 N/mm	White
6	2.32 N	28.8 Nmm	0.292 N/mm	Orange
7	2.31 N	28.5 Nmm	0.595 N/mm	Red
8	2.29 N	28.7 Nmm	0.222 N/mm	Yellow
9	2.29 N	28.3 Nmm	0.224 N/mm	Blue
10	2.34 N	29.3 Nmm	0.302 N/mm	Green
11	2.30 N	28.9 Nmm	1.096 N/mm	White
12	2.34 N	29.1 Nmm	0.226 N/mm	Orange
13	2.29 N	28.1 Nmm	0.216 N/mm	Red
14	2.33 N	29.0 Nmm	0.195 N/mm	Yellow
15	2.29 N	28.6 Nmm	0.275 N/mm	Blue
16	2.33 N	29.3 Nmm	0.406 N/mm	Green
17	2.33 N	28.8 Nmm	1.080 N/mm	White
18	2.29 N	28.5 Nmm	0.430 N/mm	Orange
19	2.29 N	28.8 Nmm	0.470 N/mm	Red

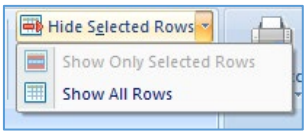


Click on the STATISTICS tab along the bottom of the screen to view the new statistics, noting that the restricted number of rows used for the current visible selection is displayed at the bottom of the table (i.e., 220).



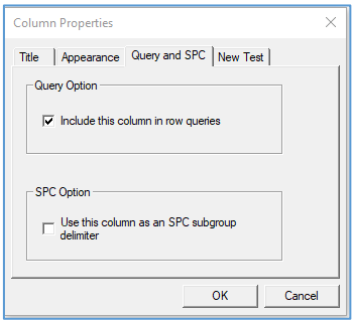
	Maximum	Minimum	Mean	Median	Coefficient of Variance	Standard Deviation (N)	Standard Deviation (N-1)	True
Load at Limit	2.37 N	2.24 N	2.29 N	2.29 N	1.14%	0.03 N	0.03 N	
Deflection at Limit	20.01 mm	20.00 mm	20.00 mm	20.00 mm	0.01%	0.00 mm	0.00 mm	
Work to Limit	29.6 Nmm	27.8 Nmm	28.7 Nmm	28.7 Nmm	1.30%	0.4 Nmm	0.4 Nmm	
Stiffness	2.787 N/mm	0.134 N/mm	0.433 N/mm	0.325 N/mm	75.16%	0.326 N/mm	0.326 N/mm	
Number of Rows that Passed	220							
Number of Rows that Failed	0							

To view all rows in the data table again, click on the RESULTS tab along the bottom of the screen then click on the drop-down arrow to the right of the "Hide Selected Rows" Icon on the BATCH ribbon bar then click on "SHOW ALL ROWS".

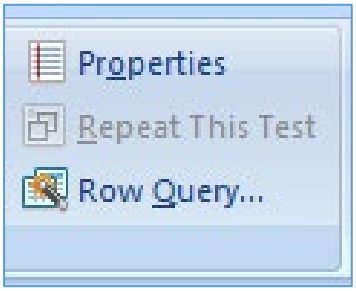


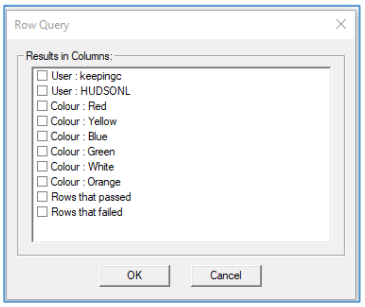
If there are many rows in the batch data table, the ROW QUERY feature may be easier to use. Decide what search criteria is required (e.g., Test Date, Colour, Lot Number etc.) then configure this column for Searching.

To search by "Colour", right-mouse click on the "Colour" column, select PROPERTIES, click on the "Query and SPC" tab, check the "Include this column in row queries" checkbox then click on the "OK" button. Additional columns can be added to the search criteria if required.



To use the search criteria, click on the "ROW QUERY" Icon on the BATCH ribbon bar to display a "Row Query" dialog. Check all options that apply (e.g., "Colour : Red") then click on the OK button.





The data table now shows the filtered rows, i.e., the rows containing the "Red" samples. Click on the STATISTICS tab along the bottom of the screen to view the new statistics, noting that the restricted number of rows used for the statistics is shown at the bottom of the table (i.e., 38 red samples were tested).

	Maximum	Minimum	Mean	Median	Coefficient of Variance	Standard Deviation (N)	Standard Deviation (N-1)	True
Load at Limit	2.35 N	2.25 N	2.30 N	2.30 N	1.15%	0.03 N	0.03 N	
Deflection at Limit	20.00 mm	20.00 mm	20.00 mm	20.00 mm	0.00%	0.00 mm	0.00 mm	
Work to Limit	29.5 Nmm	28.0 Nmm	28.8 Nmm	28.8 Nmm	1.45%	0.4 Nmm	0.4 Nmm	
Stiffness	2.787 N/mm	0.134 N/mm	0.514 N/mm	0.333 N/mm	91.78%	0.471 N/mm	0.478 N/mm	
Number of Rows that Passed	38							
Number of Rows that Failed	0							

SETTING PASS/FAIL LIMITS

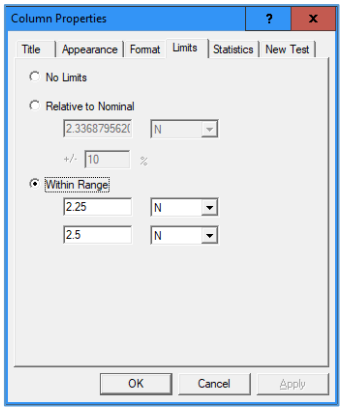
The Results Data Table normally displays the Test Data with a white background.

	Load at Limit	Work to Limit	Stiffness	Colour
1	2.34 N	29.3 Nmm	0.320 N/mm	Red
2	2.33 N	29.3 Nmm	0.471 N/mm	Yellow
3	2.28 N	28.6 Nmm	0.294 N/mm	Blue
4	2.27 N	28.5 Nmm	0.219 N/mm	Green
5	2.30 N	28.6 Nmm	0.206 N/mm	White
6	2.32 N	28.8 Nmm	0.292 N/mm	Orange
7	2.31 N	28.5 Nmm	0.595 N/mm	Red
8	2.29 N	28.7 Nmm	0.222 N/mm	Yellow
9	2.29 N	28.3 Nmm	0.224 N/mm	Blue
10	2.34 N	29.3 Nmm	0.302 N/mm	Green
11	2.30 N	28.9 Nmm	1.096 N/mm	White
12	2.34 N	29.1 Nmm	0.226 N/mm	Orange

To assist the operator, each row can be coloured either red or green to indicate the Pass/Fail status of each test. This feature requires the Pass/Fail criteria to be entered into the required columns.

Assume that the sample specification requires the "Load at Limit" value to be between 2.25N and 2.5N. Right-mouse click on the "Load at Limit" column, select PROPERTIES, click on the "Limits" tab then select the "Within Range" option.

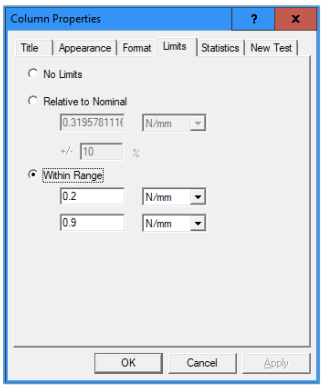
Enter the Lower and Upper values for this column, e.g., 2.25N and 2.5N then click on the "OK" button.



The Results Data Table is now coloured to show the Pass/Fail status of each test. Any row that does not meet the specification is shown in red and all other rows are shown in green.

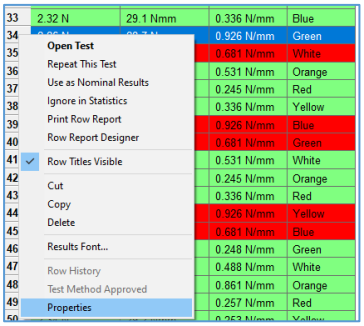
	Load at Limit	Work to Limit	Stiffness	Colour
33	2.32 N	29.1 Nmm	0.336 N/mm	Blue
34	2.26 N	28.7 Nmm	0.926 N/mm	Green
35	2.24 N	28.6 Nmm	0.681 N/mm	White
36	2.31 N	28.9 Nmm	0.531 N/mm	Orange
37	2.31 N	29.3 Nmm	0.245 N/mm	Red
38	2.32 N	29.1 Nmm	0.336 N/mm	Yellow
39	2.26 N	28.7 Nmm	0.926 N/mm	Blue
40	2.24 N	28.6 Nmm	0.681 N/mm	Green
41	2.31 N	28.9 Nmm	0.531 N/mm	White
42	2.31 N	29.3 Nmm	0.245 N/mm	Orange
43	2.32 N	29.1 Nmm	0.336 N/mm	Red
44	2.26 N	28.7 Nmm	0.926 N/mm	Yellow
45	2.24 N	28.6 Nmm	0.681 N/mm	Blue
46	2.34 N	29.3 Nmm	0.248 N/mm	Green

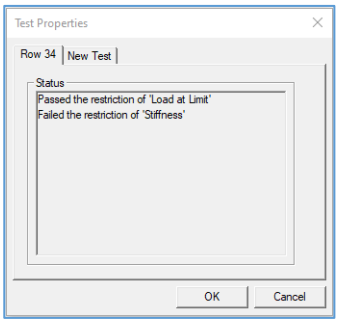
Additional columns can be added to the Pass/Fail criteria if required. Assume that the sample specification also requires the "Stiffness" value to be between 0.2N/mm and 0.9N/mm. Right-mouse click on the "Stiffness" column, select PROPERTIES, click on the "Limits" tab then select the "Within Range" option. Enter the Lower and Upper values for this column, e.g., 0.2N/mm and 0.9N/mm then click on the "OK" button. The Results Data Table now shows any row that does not meet either specification.

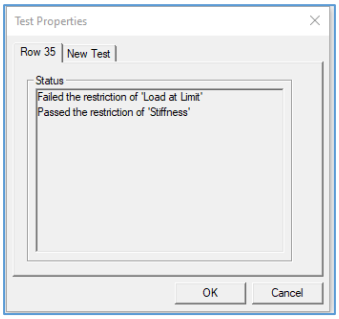


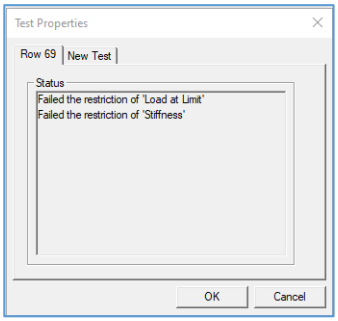
	Load at Limit	Work to Limit	Stiffness	Colour
33	2.32 N	29.1 Nmm	0.336 N/mm	Blue
34	2.26 N	28.7 Nmm	0.926 N/mm	Green
35	2.24 N	28.6 Nmm	0.681 N/mm	White
36	2.31 N	28.9 Nmm	0.531 N/mm	Orange
37	2.31 N	29.3 Nmm	0.245 N/mm	Red
38	2.32 N	29.1 Nmm	0.336 N/mm	Yellow
39	2.26 N	28.7 Nmm	0.926 N/mm	Blue
40	2.24 N	28.6 Nmm	0.681 N/mm	Green
41	2.31 N	28.9 Nmm	0.531 N/mm	White
42	2.31 N	29.3 Nmm	0.245 N/mm	Orange
43	2.32 N	29.1 Nmm	0.336 N/mm	Red
44	2.26 N	28.7 Nmm	0.926 N/mm	Yellow
45	2.24 N	28.6 Nmm	0.681 N/mm	Blue
46	2.34 N	29.3 Nmm	0.248 N/mm	Green

To view the reason why a test failed, right-mouse click on the required row number at the left of the data table for a failed test and select PROPERTIES. The dialog shows the status of each Pass/Fail column.





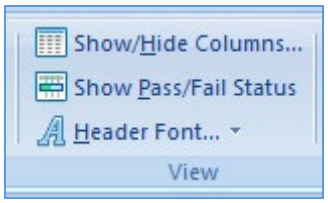




Clicking on the STATISTICS tab along the bottom of the screen displays the Test Statistics with the number of failed rows (tests) shown at the bottom of the table (i.e., 35 Failed).

	Maximum	Minimum	Mean	Median	Coefficient of Variance	Standard Deviation (N)	Standard Deviation (N-1)	True
Load at Limit	2.37 N	2.24 N	2.29 N	2.29 N	1.14%	0.03 N	0.03 N	
Work to Limit	29.6 Nmm	27.8 Nmm	28.7 Nmm	28.7 Nmm	1.30%	0.4 Nmm	0.4 Nmm	
Stiffness	2.787 N/mm	0.134 N/mm	0.433 N/mm	0.324 N/mm	74.85%	0.324 N/mm	0.325 N/mm	
Number of Rows that Passed	193							
Number of Rows that Failed	35							

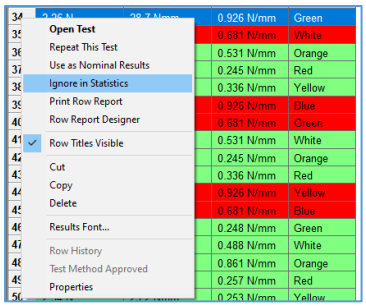
The Pass/Fail status in the Results Data Table can be toggled between Off and On by clicking on the "SHOW PASS/FAIL STATUS" Icon on the BATCH ribbon bar noting that this does not remove the Pass/Fail limits set in each column.

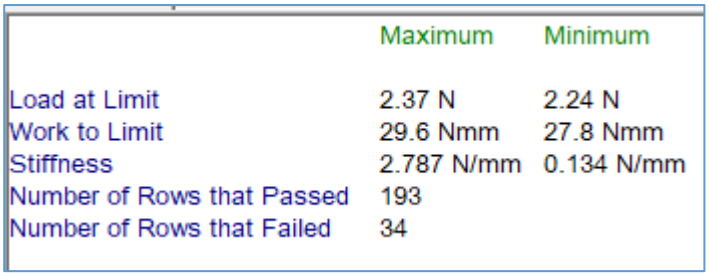


IGNORING OR DELETING "INVALID" TESTS

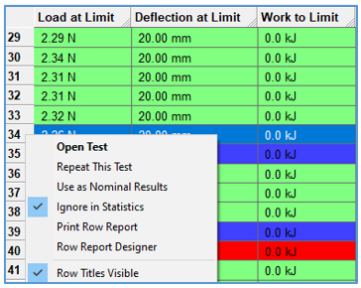
An obviously "Invalid" test (e.g., grips not tight so the sample slipped during the test) can be either removed from the statistics and printed reports or completely deleted from the batch data table.

To remove an "Invalid" test, right-mouse click on the required row number at the left of the data table and select IGNORE IN STATISTICS. Clicking on the STATISTICS tab along the bottom of the screen displays the Test Statistics with the number of failed rows (tests) shown at the bottom of the table (i.e., 34 Failed).





Rows that have been selected to be ignored from statistics will be highlighted to the user in a dark blue colour.

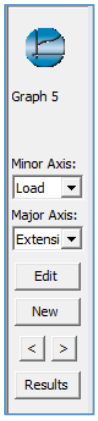


To permanently delete a row, right-mouse click on the required row number at the left of the data table and select DELETE. A dialog is displayed to confirm this deletion. Note that the local laboratory policy may require all data to be retained for traceability purposes.

MOVING BETWEEN GRAPHS

When more than one test has been performed, the previous tests can be viewed in sequence by clicking on the "Left-Arrow" at the left-hand side of the screen. Also, the later tests can be viewed in sequence by clicking on the "Right-Arrow" at the left-hand side of the screen. This feature allows tests to be viewed quickly without having to display the RESULTS tab.

Clicking on the "Results" button at the left-hand side of the screen immediately displays the RESULTS tab with the test row selected with a blue background.



	Load Cell Rating	Load at Maximum Load	Extension from preload at Maximum Load	Stiffness
4	500.000 N	40.005 N	98.359 mm	685.34 N/m
5	500.000 N	40.045 N	99.505 mm	693.64 N/m
7	500.000 N	46.186 N	413.42 mm	135.60 N/m
8	500.000 N	1.9721 N	46.474 mm	57.148 N/m

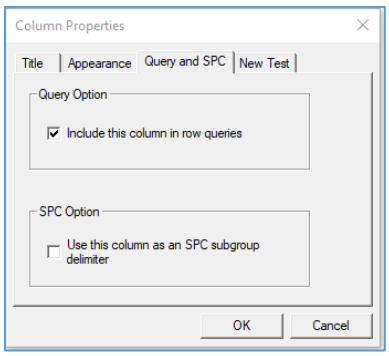
OVERLAY GRAPHS

Selected Test Graphs can be displayed together, as an overlay, to view the consistency or repeatability of the specimen characteristics.

If there are only a small number of rows in the batch data table, the graphs to be overlaid can be selected by holding the CTRL key and clicking on each required row in turn, noting that the selected rows are shown in blue. Press the ENTER key on the keyboard then confirm this action to display these graphs together.

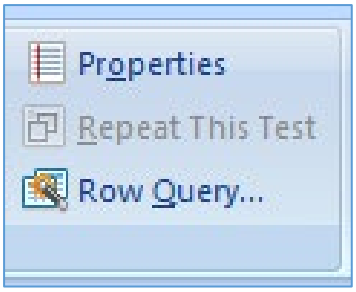
If there are many rows in the batch data table, the ROW QUERY feature may be easier to use. Decide what search criteria is required (e.g., Test Date, Colour, Lot Number etc.) then configure this column for Searching.

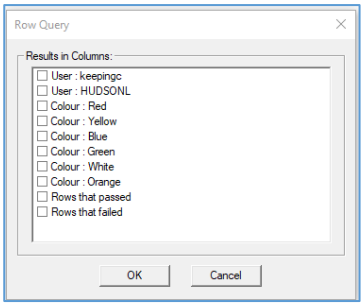
To search by "Colour", right-mouse click on the "Colour" column, select PROPERTIES, click on the "Query and SPC" tab, check the "Include this column in row queries" checkbox then click on the "OK" button.



Additional columns can be added to the search criteria if required.

To use the search criteria, click on the "ROW QUERY" Icon on the BATCH ribbon bar to display a "Row Query" dialog. Check all options that apply (e.g., "Colour : Red") then click on the OK button.



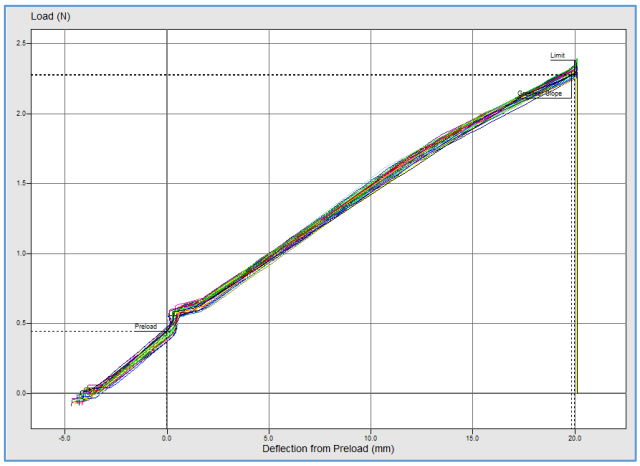


The data table now shows the filtered rows, i.e., the rows containing the "Red" samples.

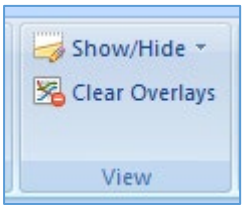
Click on the data table, press and hold CTRL-A to select all the rows.

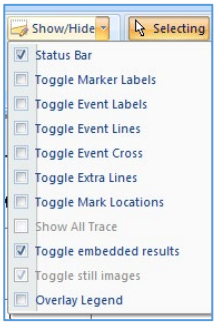
Press the ENTER key on the keyboard then confirm this action to display these graphs together.

Note that the graph screen may become very difficult to view if an excessive number of tests are displayed.

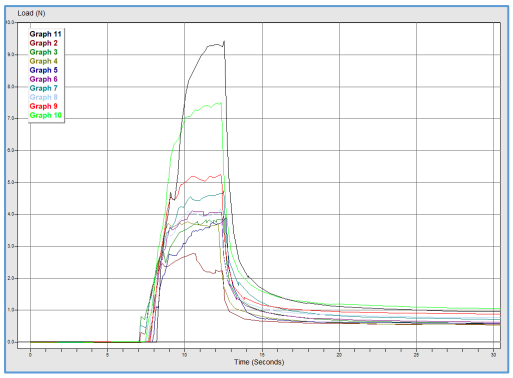


If the overlay consists of a small number of graphs, each graph can be identified using an Overlay Legend. Click on the "SHOW/HIDE" Icon on the GRAPH ribbon bar to display a list of view options then check the "Overlay Legend" checkbox. This feature makes it easy to identify the test samples.

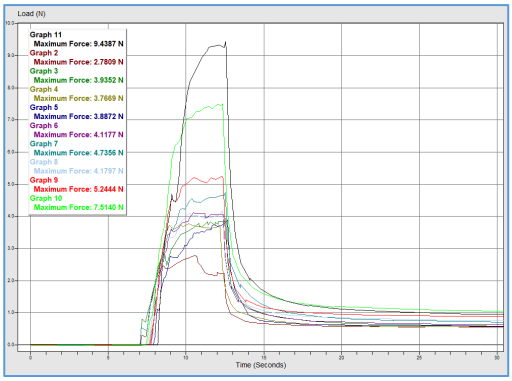




If Test Results are displayed on the graph, these are also shown on the Overlay Legend.

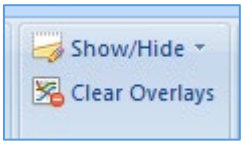


Legend with no results



Legend with test results

Note that saving a test file with an overlay will increase the file size so if the overlay is not required to be permanently displayed on a graph, it is recommended to clear the overlay before saving. To clear an overlay, click on the "CLEAR OVERLAYS" Icon on the GRAPH ribbon bar.

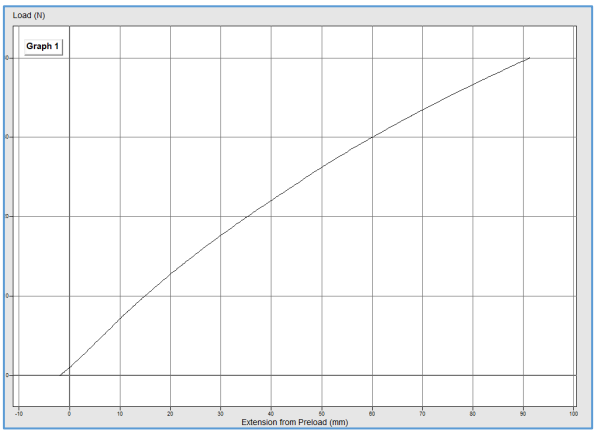


REFERENCE TRACE

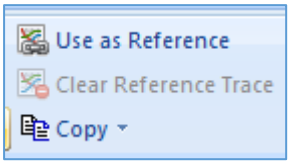
An "Ideal" trace can be displayed on a new test graph, like an overlay, to view the consistency of the sample characteristics.

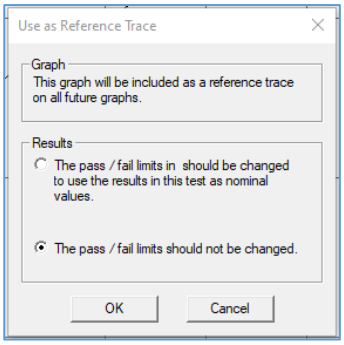
A "Good" or "Reference" sample is required, and the graph is used as the "Reference" trace.

Perform a test using a "Good" or "Reference" sample then set the graph Axes and Ranges as required.



Click on the "USE AS REFERENCE" Icon on the GRAPH ribbon bar to display an "Options" dialog to allow the Pass/Fail limits to be defined.



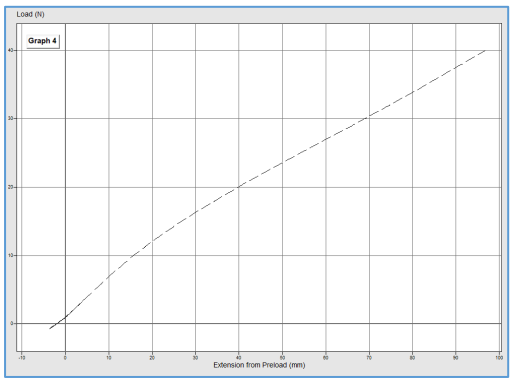


Select "The pass / fail limits should not be changed" if Pass/Fail limits have already been manually defined or are not required.

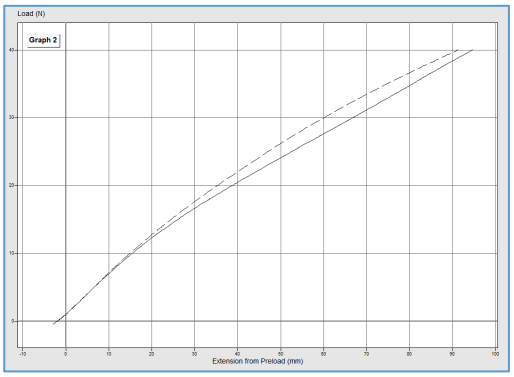
However, if this is the first test in a batch file, then the "The pass / fail limits should be changed…" option can be used to automatically add Pass/ Fail limits for ALL measured results. The "Reference Trace" value for each test result (e.g., Load at Maximum Load) is used as the NOMINAL value and the limits are set to +10% and -10% of this value. This 10% limit can be changed in each result column if required.

Start a new test. The "Reference Trace" is shown as a dotted line and the current sample trace is shown as a solid line.

This feature provides the operator with a quick visual indication of sample performance.

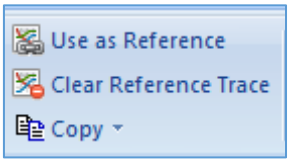


Start of Test



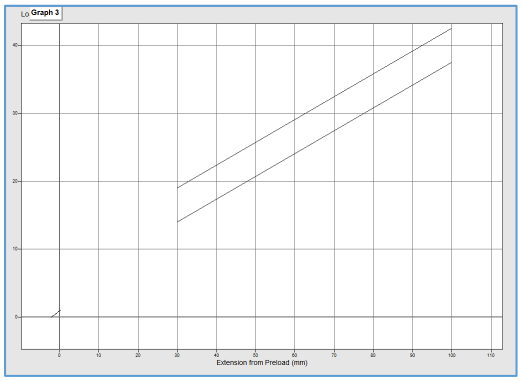
End of Test

This "Reference Trace" is shown on all subsequent tests but may be disabled by clicking on the "CLEAR REFERENCE TRACE" Icon on the GRAPH ribbon bar.

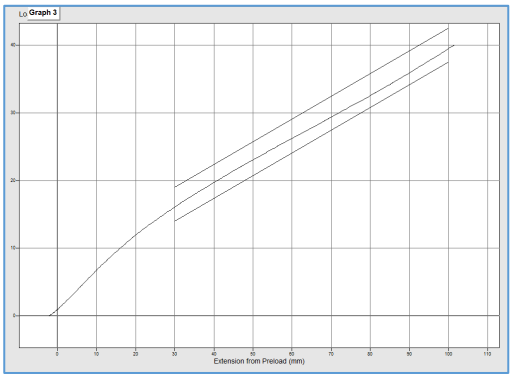


UCT MARKLINES

A similar idea can be created in a "User Configurable Test" (UCT) by creating 2 MARKLINES in the Test Script. These lines define an acceptance "range" and the sample trace should lie within these lines.



Start of Test



End of Test

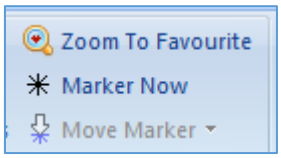
An example script is: -

```
Set PE = PreloadExtn
LoadAxis.Recorderaxis.Markline "A", [14N], [37.5N]
ExtnAxis.Recorderaxis.Markline "A", [ [30mm] + PE], [ [100mm] + PE]
LoadAxis.Recorderaxis.Markline "B", [19N], [42.5N]
ExtnAxis.Recorderaxis.Markline "B", [ [30mm] + PE], [ [100mm] + PE]
```

(Line "A" has XY co-ordinates of 30mm / 14N and 100mm / 37.5N)
(Line "B" has XY co-ordinates of 30mm / 19N and 100mm / 42.5N)

USER MARKERS

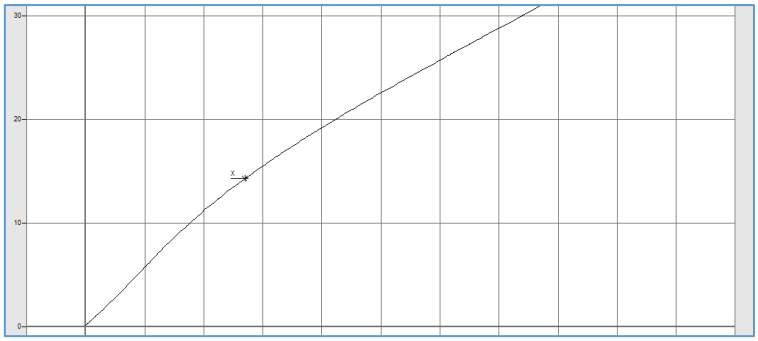
A "User Marker" can be defined in a "User Configurable Test" (UCT) script to allow the operator to mark a position on the graph during a test and this can be used where some visual change in the sample occurs. When the test is started the "Marker Now" Icon on the GRAPH ribbon bar is enabled. When the operator observes a visual change, a marker is placed at this location on the graph trace by clicking on the "Marker Now" Icon.



An example script is: -

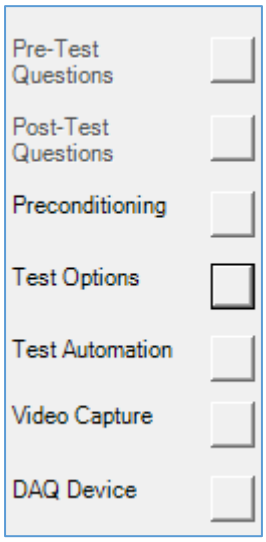
```
USERMARKERON "X"
STAGE [100mm], [100mm/min]
```

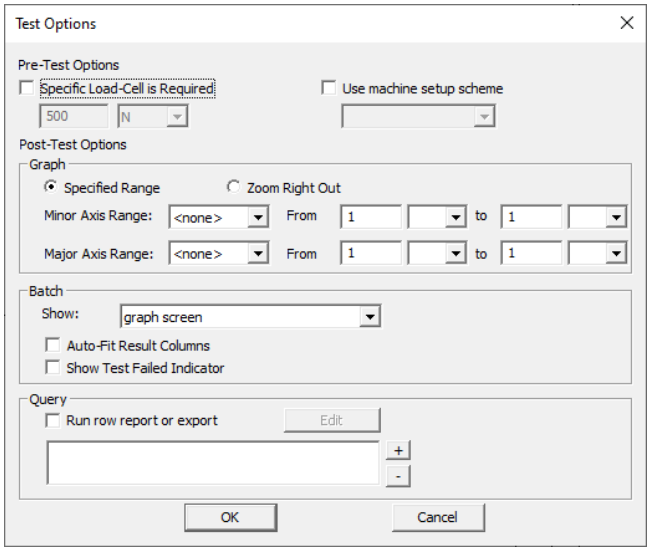
(The Marker Label is defined in quotes, e.g. "X")



TEST OPTIONS

Every Test Setup has a series of buttons on the right-hand side of the editor and one of these is labelled "Test Options". Clicking on this button displays the "Test Options" dialog.



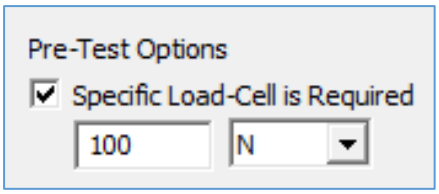


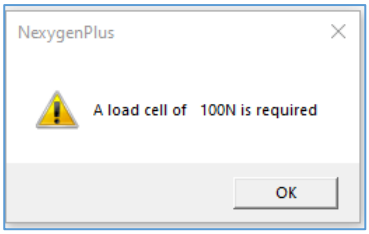
SPECIFIED LOADCELL

For validation purposes, it may be a requirement that the correct capacity loadcell is used for testing. Consider the case where a 50kN Materials Testing Machine, fitted with a 50kN loadcell, is used to test the breaking strength of a rubber band. Assume that the loadcell has a calibrated range from 500N to 50,000N (1% to 100%). If the rubber band breaks at (say) 42N, this is below the calibrated range of the loadcell, so the results are not traceable. Therefore, this test should be performed with (say) a 100N or 500N loadcell.

To ensure that the machine is configured correctly for this test, the test file can be restricted so that a test can only be performed when the correct capacity loadcell is fitted to the machine.

If this feature is required, check the "Specific Load-Cell is Required" checkbox then enter the loadcell value. Note that this does not restrict the test to a specified loadcell, i.e., if the laboratory has two 100N loadcells, then either can be used to perform this test. A warning dialog is displayed if a test is started with an incorrect value loadcell fitted



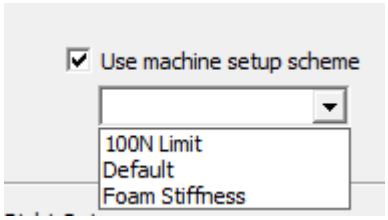


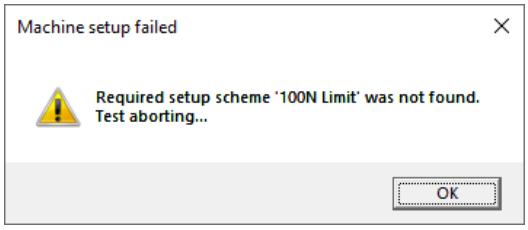
SPECIFIED MACHINE SETUP SCHEME

Certain tests may require a specific machine setup scheme, e.g., using sample stiffness, grip protection, machine stiffness etc. (see the Machine Setup Scheme section). To ensure that the machine is configured correctly for this test, the test file can be configured so that the correct setup scheme is automatically selected when this test is used.

If the test requires a specified scheme, click on the "Use machine setup scheme" checkbox and select the required scheme from the drop-down list. Note that the machine must be switched on and the console connected before this list can be populated with scheme names. A warning dialog is displayed if a test is started when the required scheme is not present, i.e., the scheme has been deleted or renamed.

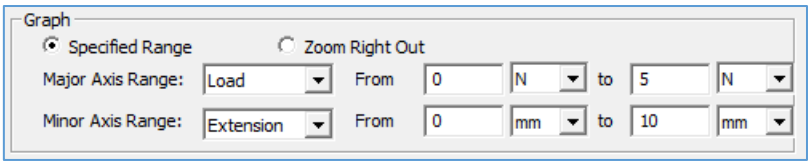
Note that the console setup schemes are stored on the local PC and are not part of the test setup. Therefore, if a test file is configured to use a specific console setup scheme, this scheme must be re-created on all applicable PC's if this test file is copied to another PC. The easiest way to do this is to print a "Screen Dump" of the required console setup scheme as a visual template.



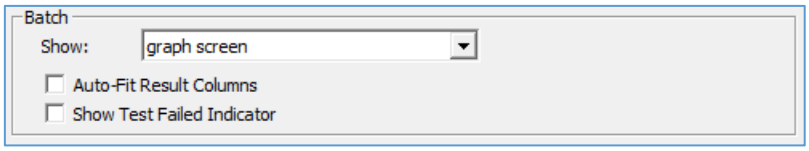


GRAPH RANGES AND DISPLAY OPTIONS

If specific graph axes and / or ranges are required, define them using the "Graph" controls. Typically, the "Zoom right out" option is suitable for most tests. If specified axes or ranges are required, a test must be performed first to obtain a test graph. Select the Major and Minor Axes using the drop-down controls, noting that these controls do not directly show all axes, so the up/down arrows may need to be used.
Enter the required ranges and units for each axis. All subsequent tests will display these ranges at the end of the test. Note that the graph can be zoomed during the test but will revert to the specified ranges at the end of the test.



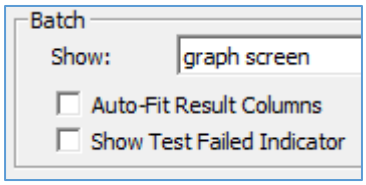
If a specific tab is to be shown at the end of each test, e.g., Statistics, this screen can be selected in the "Show" drop-down control noting that this control does not directly show all options, so the up/down arrows may need to be used. Typically, the "Graph Screen" option is suitable for most tests.

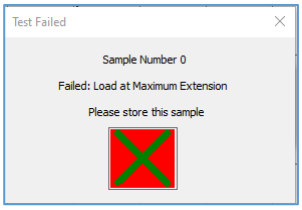


TEST FAILED INDICATOR

If Pass/Fail Limits are set, the test status can be viewed by viewing the row colour in the Data Table. For operator convenience, a "Test Failed" dialog can be displayed at the end of each test if the sample did not meet the Pass/Fail requirements.

Check the "Show Test Failed Indicator" to display a dialog at the end of the test if the sample "Failed" the Pass/Fail Limits. Note that this dialog shows the reason for the failure, noting that more than one result column can cause this failure.



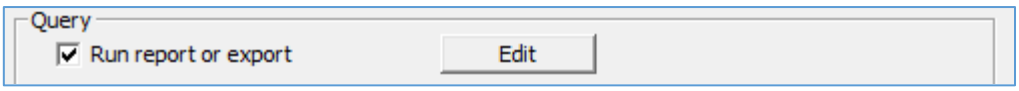




Click on the large coloured "X" to close this dialog ready for performing the next test.

REPORT OR EXPORT

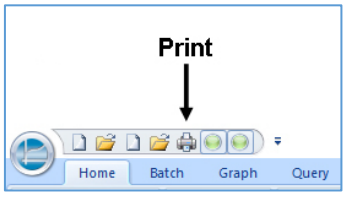
The software can automatically print a report and / or export data at the end of each test. However, if the report and / or data export is only required at the end of the test sequence (e.g., 5 samples from a production run), then the "TEST AUTOMATION" may be used and the "end of each test" feature may not be required.
To produce a Report and / or data export, check the "Run report or export" checkbox then click on the "Edit" button to define the output. The "Report" and "Export" configuration screens are shown later.



SIMPLE "SCREEN DUMP" PRINTOUTS

The Batch Data Table can be printed in a format like a "Screen Dump". Click on the RESULTS tab along the bottom of the screen to display the Results Data Table then click on the "Printer" Icon on the "Quick Access Toolbar" to select the required printer.

A Graph can be printed in a format like a "Screen Dump". Select the required graph by either double clicking on a row in the Batch Data Table or by using the "<" and ">" arrows on the left-hand side of the Graph Screen. Click on the "Printer" Icon on the "Quick Access Toolbar" to select the required printer.



Note: more specialised reports can be created using the Batch Report Designer.

PRINTING TEST DATA REPORTS

All test reports require a previously defined "Template" and the test results and optional graphs are printed using these templates. The reports can either be printed directly to a printer or created as a PDF document.

There are 2 types of Test Reports.

1 Row Report - Always prints the test graph
2 Batch Report - Test graphs are optional

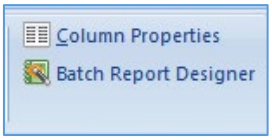
A Row Report prints a single graph and the relevant test results.

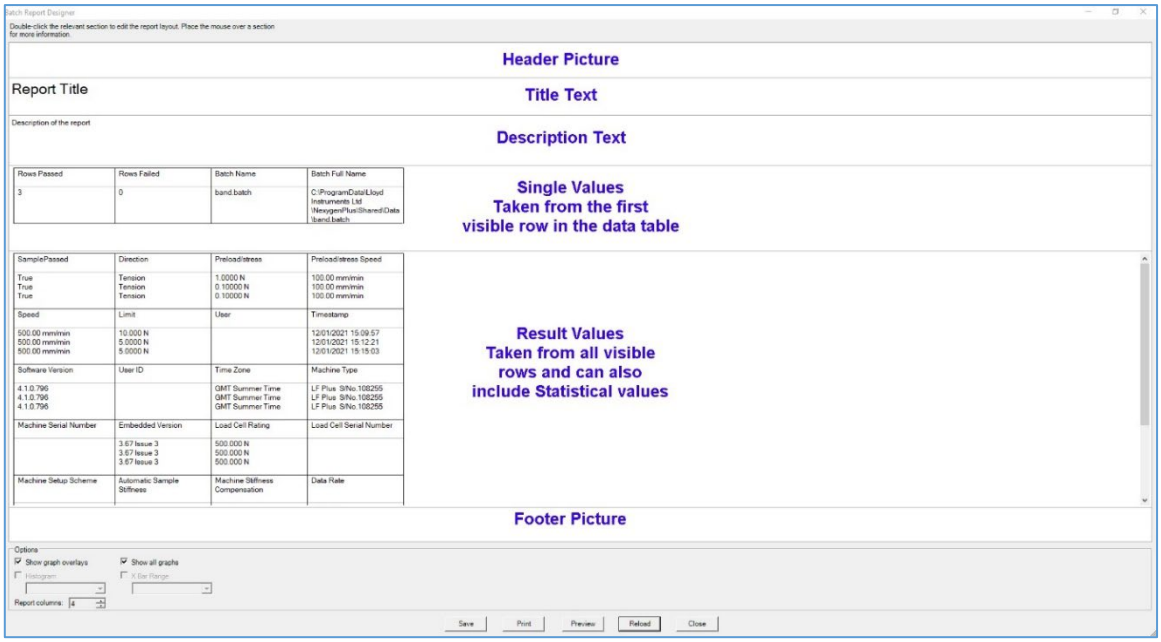
A Batch Report prints the VISIBLE rows in a batch and optionally the test graphs, overlay graphs and statistical graphs. Because this report only includes visible rows, the data can be filtered using the methods shown in the "Statistics" section.

Basic test report templates can be easily created using the "Batch Report Designer" and these can be customised using Microsoft Word if required. Alternatively, more specialised test reports can be directly created using Microsoft Word.

BATCH REPORT DESIGNER

Open a test file then view the data table by clicking on the RESULTS tab along the bottom of the screen. Click on the "Batch Report Designer" Icon on the BATCH ribbon bar to display the "Batch Report designer" screen.



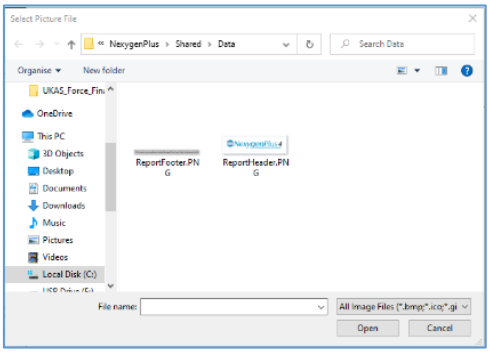


The Batch Report Designer allows the report to select ALL batch columns, even if the columns are hidden in the data table. To simplify the layout, the screen only shows a maximum of 3 samples (3 rows).

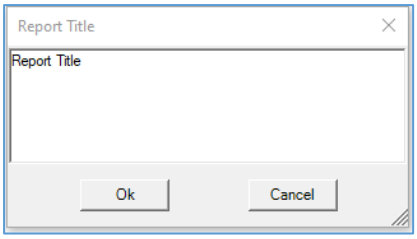
The designer consists of 6 sections: -

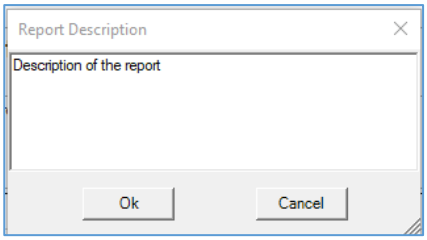
- Header Picture
- Title Text
- Description Text
- Single Values
- Result Values
- Footer Picture

To select a Header or Footer Picture file, double click on the Header or Footer area to display a "File Open" dialog. Select the required picture file, noting that only one picture can be inserted in each area then click on "Open". There is no provision for inserting text in these areas.



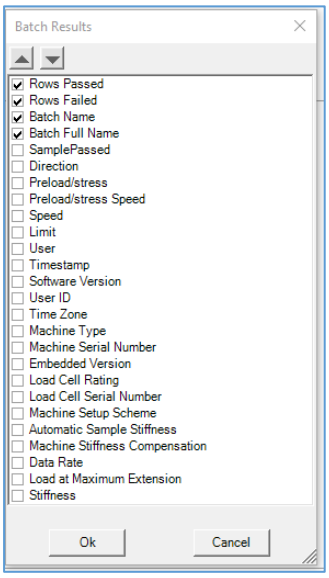
To change the Title Text or Description Text, double click on the Title or Description area to display a "Text Editor" dialog. Enter the required text then click on "OK".

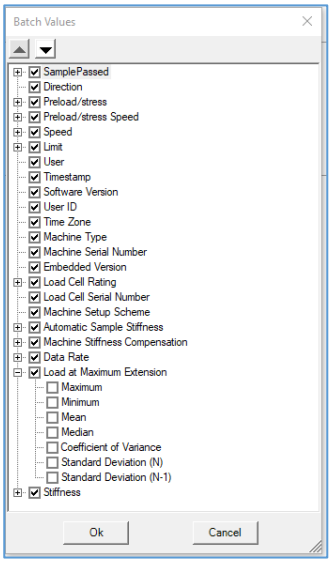




The "Single Value" area is designed to report values that are common for each test. Normally, each test in a sequence is performed using the same test parameters, e.g., Pre-Load Value, Test Speed etc so these are common values and only to be reported once. Check the checkboxes to select the required parameters then click on "OK".

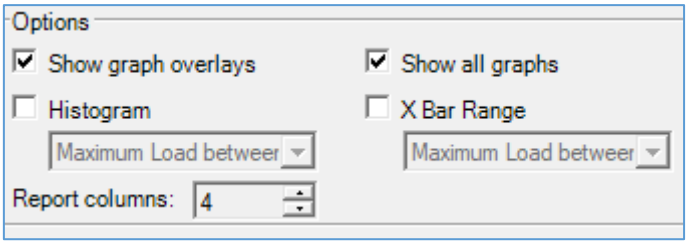
The "Result Values" area is designed to report values for each test and this can also report Statistical values, e.g., Mean, Maximum, Standard Deviation etc. for numerical test results. Check the checkboxes for each required result. If statistical values are required for a numerical result, click on the "+" to the left of the result name and check the relevant statistical checkboxes.





The designer screen shows some rows with the selected results in a table with 4 columns, but the number of columns can be changed using the "Report Columns" selector at the bottom left of the screen.

Check the checkboxes at the bottom left of the screen to include each of the Graph or Chart options noting that the "Histogram" and "X Bar Range" charts are only available if Pass/Fail limits have been defined for this batch file.



The Report (Template plus data) will be printed to the "Default" printer by clicking on the "Print" button along the bottom of the screen.

The Report (Template plus data) can be previewed by clicking on the "Preview" button along the bottom of the screen, noting that Microsoft Word must be installed on this PC to use this feature.

When the Template is correct, save it by clicking on the "Save" button and enter a suitable name. Note that this report will be available for use with any test file but may not be applicable to all test files so a good naming convention is recommended. A dialog with the option to edit the template in Microsoft Word will be shown and this may be used to modify the template for more specialised reports.

If another new Template is required, click on the "Reload" button to reset the screen.

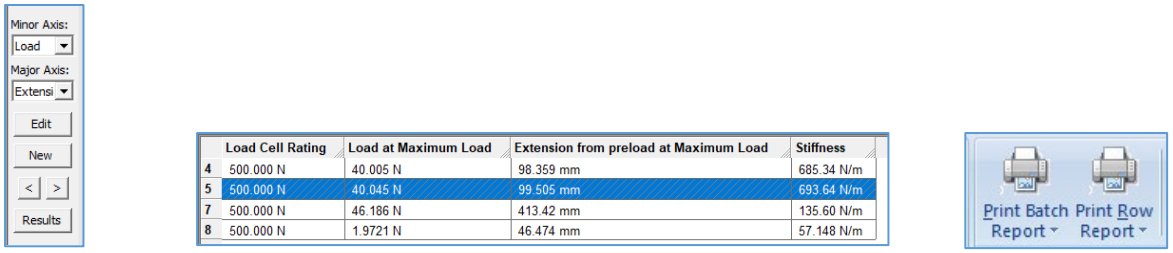
Click on the "Close" button to close the Batch Report Designer.

MANUALLY PRINTING A ROW REPORT

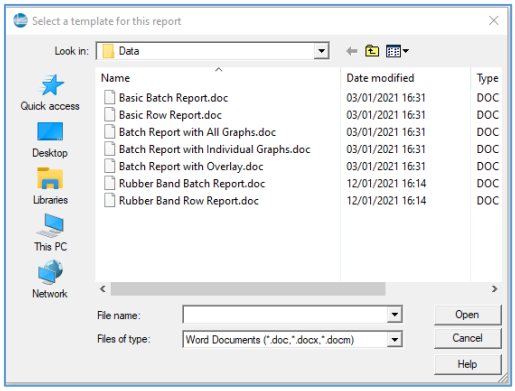
A Row Report is printed for a "selected" row (test). Therefore, the required row must be selected in the batch data table so that the complete row is shown with a blue background.
If the RESULTS screen is displayed, select the required row by clicking on the row number at the left-hand side of the data table. The complete row will be shown with a blue background.

If the GRAPH screen is displayed, click on the "Results" button at the left-hand side of the graph to view the RESULTS screen with the required row automatically selected and shown with a blue background.

When the row is selected, the Row Report is printed to the "Default" printer by clicking on the "Print Row Report" Icon on the BATCH ribbon bar.



The Row Report requires a previously defined "Template" for printing. The first time that a Row Report is printed in this batch, a "Template selector" dialog is displayed to select the required template, e.g., "Rubber Band Row Report".

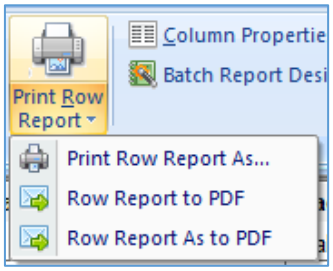


This report is now stored in the batch file as the "Default" Row Report Template so is automatically used whenever the "Print Row Report" Icon is clicked in future. Note that a "Default" template is required for every batch file. If a different report template is required later, click on the drop-down arrow to the right of the

"Print Row Report" Icon and select "Print Row Report As" to redisplay the "Template selector" dialog, noting that the newly selected template now becomes the "Default" Row Report Template.

The Row Report can also be created as a PDF Document if the "Default" printer is a physical printer. To create a PDF document using the "Default" template, click on the drop-down arrow to the right of the "Print Row Report" Icon and select "Row Report to PDF".

To create a PDF document using a different template, click on the drop-down arrow to the right of the "Print Row Report" Icon and select "Row Report As to PDF" to redisplay the "Template selector" dialog. Select the required template, noting that this template now becomes the "Default" Row Report Template.

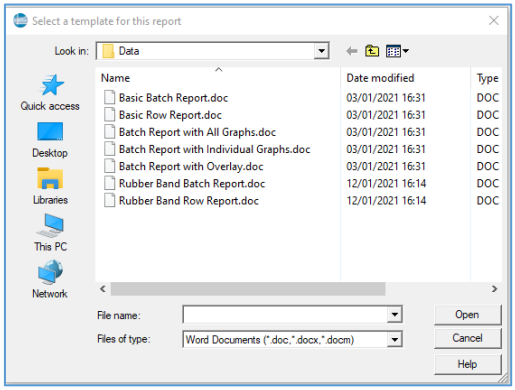


MANUALLY PRINTING A BATCH REPORT

A Batch Report is printed for all VISIBLE rows in a batch so the data can be filtered before printing by using the methods shown in the "Statistics" section.

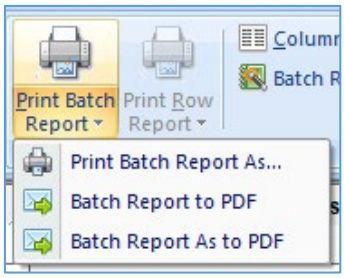
When the required batch data is selected, the Batch Report is printed to the "Default" printer by clicking on the "Print Batch Report" Icon on the BATCH ribbon bar.

The Batch Report requires a previously defined "Template" for printing. The first time that a Batch Report is printed in this batch, a "Template selector" dialog is displayed to select the required template, e.g., "Rubber Band Batch Report".



This report is now stored in the batch file as the "Default" Batch Report Template so is automatically used whenever the "Print Batch Report" Icon is clicked in future. Note that a "Default" template is required for every batch file. If a different report template is required later, click on the drop-down arrow to the right of the "Print Batch Report" Icon and select "Print Batch Report As" to redisplay the "Template selector" dialog, noting that the newly selected template now becomes the "Default" Batch Report Template.
The Batch Report can also be created as a PDF Document if the "Default" printer is a physical printer. To create a PDF document using the "Default" template, click on the drop-down arrow to the right of the "Print Batch Report" Icon and select "Batch Report to PDF".

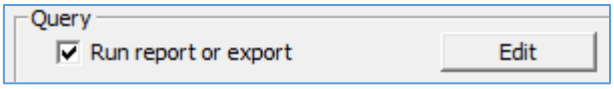
To create a PDF document using a different template, click on the drop-down arrow to the right of the "Print Batch Report" Icon and select "Batch Report As to PDF" to redisplay the "Template selector" dialog. Select the required template, noting that this template now becomes the "Default" Batch Report Template.

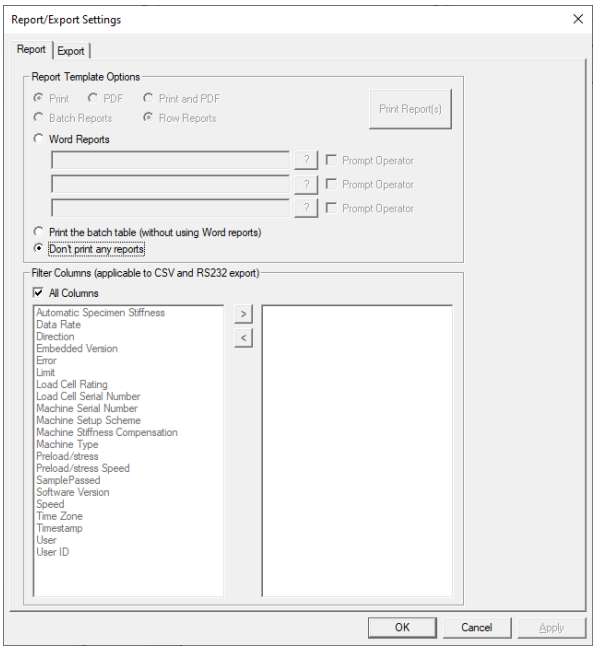


AUTOMATICALLY PRINTING A ROW REPORT

A Row Report can be automatically printed at the end of every test by using the "Test Options" feature in the test setup. Create a new test in the batch file then click on the "Edit" button at the left-hand side of the graph screen to display the Test Editor. Click on the TEST OPTIONS button along the right-hand side of the screen to display the "Test Options" dialog.

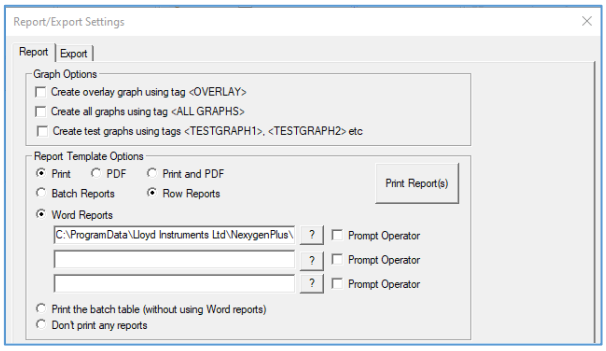
Check the "Run report or export" checkbox then click on the "Edit" button to display the Report/Export settings" screen.





Select "Word Reports" and ensure that the "Row Reports" option is selected. Click on the "?" to the right of the first field under "Word Reports" to display a "Template selector" dialog then select a previously defined template, e.g., "Rubber Band Row Report". Up to 3 Row Reports can be selected using the 3 "?" buttons.

A "Test" report can be printed to the "Default" printer, if required for checking purposes, by clicking on the "Print Report(s)" button. Click on the "OK" button to close the dialog.



A Row Report will now be automatically printed to the "Default" printer at the end of every test.

AUTOMATICALLY PRINTING A BATCH REPORT

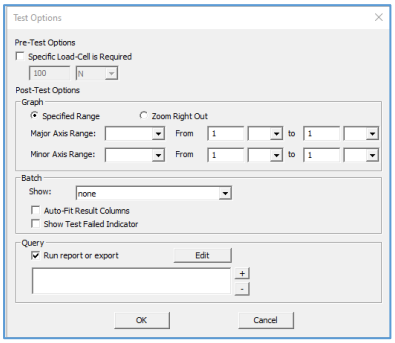
A Batch Report can be automatically printed at the end of every test sequence if the "Test Automation" feature is used for the batch file. This feature is shown in the "Test Automation" section.

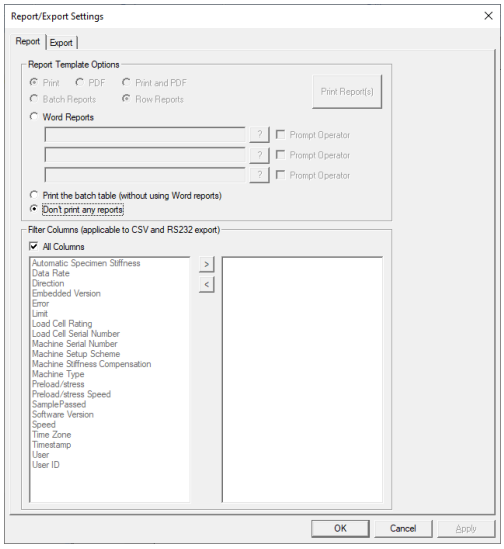
EXPORTING TEST DATA TO EXCEL OR A CSV FILE

The test data, and optionally the test graphs, can be exported to Microsoft Excel, noting that Excel must be installed on the PC. The Export can be performed either manually at any time (Manual Batch Export), at the end of every test (Automatic Row Export) or at the end of a test sequence (Automatic Batch Export).

MANUAL BATCH EXPORT

To manually export ALL data in a batch file, click on the drop-down arrow to the right of the "TEST AUTOMATION" Icon on the BATCH Ribbon bar then select "TEST OPTIONS" to display the Test Options" dialog. Check the "Run report or export" checkbox then click on the "Edit" button to display the Report/Export settings" screen.

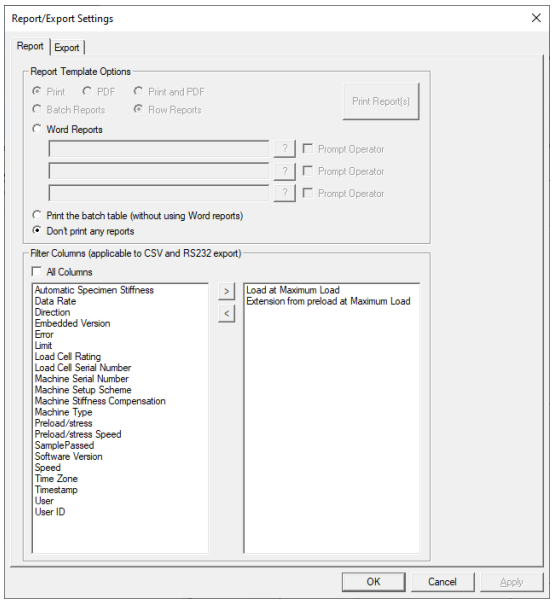


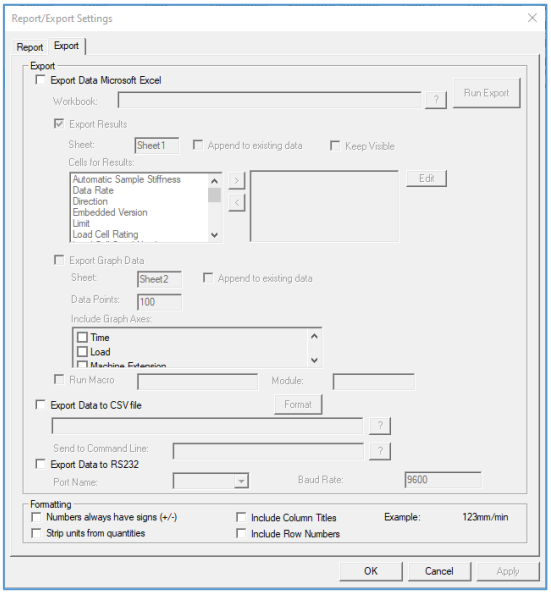


The "Filter Columns" dialog displays ALL batch columns, even if the columns are hidden in the data table. The export will contain data for ALL columns unless the columns are restricted on this screen.
To select the required columns, uncheck the "All Columns" checkbox then either double-click on a column name in the left-hand selector or single-click on a column name then click on the ">" arrow. In both cases, the column is transferred from the left-hand selector to the right-hand side selector.

To remove a previously selected column from the right-hand selector, either double-click on a column name in the right-hand selector or single-click on a column name then click on the "<" arrow.

When the required columns have been selected, click on the "Export" tab to display the export settings.





There are 3 types of export:

1. EXCEL EXPORT - Test results and / or graph data points
2. CSV EXPORT TO TEXT FILE - Test results only
3. CSV EXPORT VIA RS232 - Test results only

EXCEL EXPORT

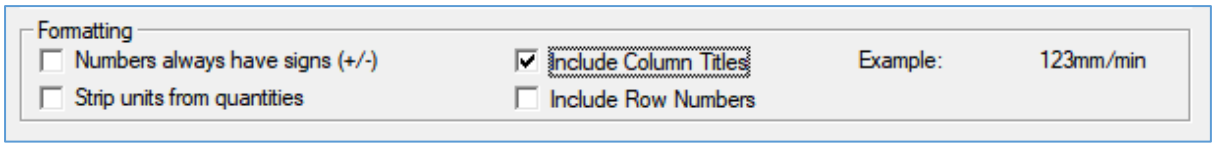
To export to Excel, check the "Export Data to Microsoft Excel" option then click on the "?" to the right of the "Workbook" field to display a "File Open" dialog. To use an existing Workbook, navigate to the required folder then select the Workbook. To create a new Workbook, navigate to the required folder, right-mouse click in the dialog, select NEW then select "Microsoft Excel Worksheet". Rename this Workbook as required then select this new Workbook.

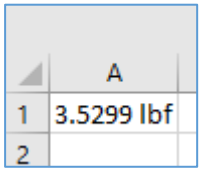
Test Results

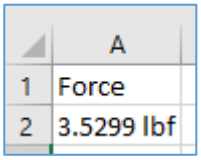
To export Test Results, check the "Export Results" checkbox and enter the name for the Worksheet (the default name is "Sheet 1").

The test data is transferred to specified cells in the workbook in the same format and units as used in the data table. The "Default Start" Cells are "A1", "B1", "C1" etc. therefore, it is recommended that the test results are selected in the order they are to appear in the workbook, noting that this order can be changed after selection. Note that the "Default Start" Cell is the uppermost cell in a column and each result will be entered below this Cell. Therefore, if 10 tests were performed and cell "A1" is selected, the results will be stored in cells "A1", A2", A3" etc up to "A10".

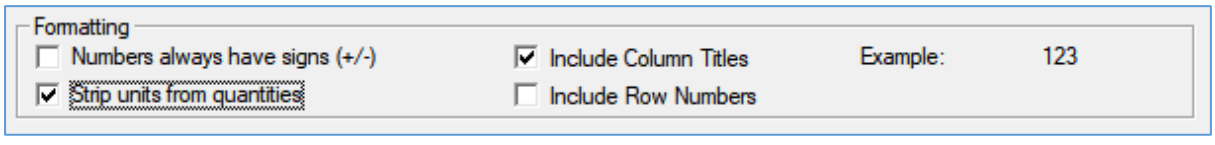
There is an option to include the Column Title in the export and this is selected in the "Formatting" section at the bottom of the screen. If the Column Title is not selected, the first test result is stored in designated Excel Cell. If the Column Title is selected, the Title is stored in designated Excel Cell and the test results are stored in the Cells below the Title Cell.

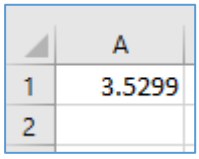


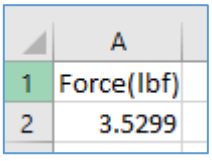




When numerical data is transferred to Excel, it is transferred as TEXT because the units are exported as part of the data, e.g., 3.599 lbf. Excel cannot perform calculations on this TEXT data so if calculations are required, the data must be converted to NUMERICAL. This is achieved by checking the "Strip units from quantities" checkbox at the bottom of the screen. The Cell Title (if used) now includes the unit.



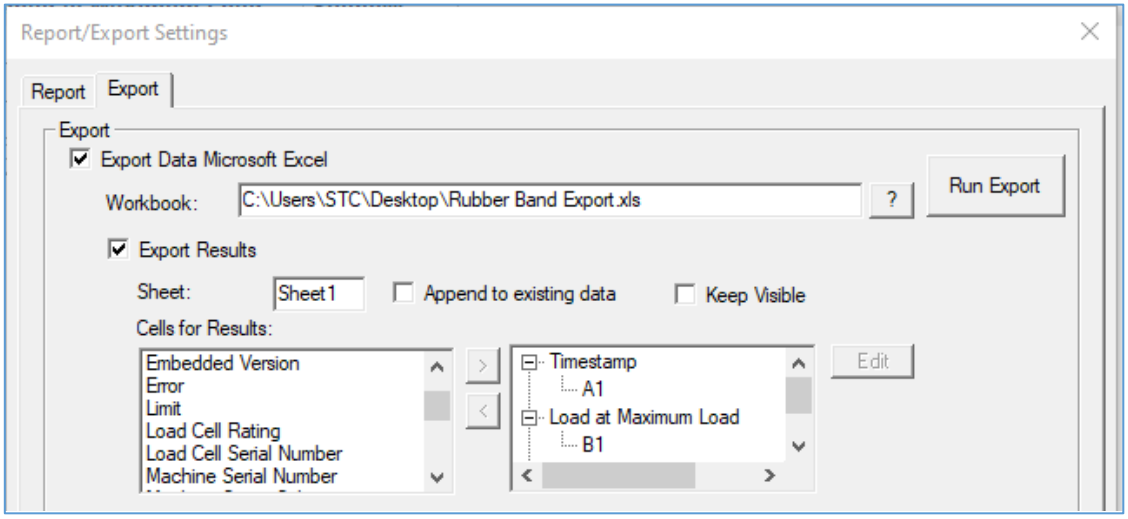




To select the required columns, either double-click on a column name in the left-hand "Cells for Results" selector or single-click on a column name then click on the ">" arrow. In both cases, the column is transferred

from the left-hand selector to the right-hand side selector and the designated Excel Cell is displayed under the selected column name (e.g., "Timestamp / A1").
To remove a previously selected column from the right-hand selector, either double-click on a column name in the right-hand selector or single-click on a column name then click on the "<" arrow.

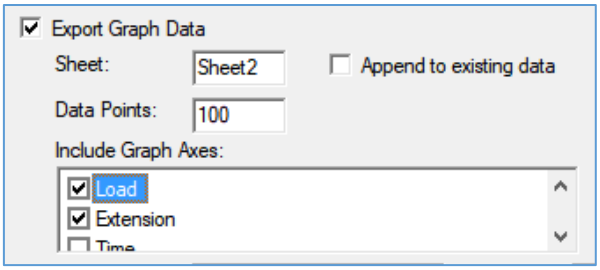
To change the designated Excel Cell for a selected column, click on the Cell legend (e.g., "A1") then click on the "Edit" button to the right of the selector and enter the required cell (e.g., "H5").



Click on the "Run Export" button at the top right of the screen to Export this data.

Graph Data Points

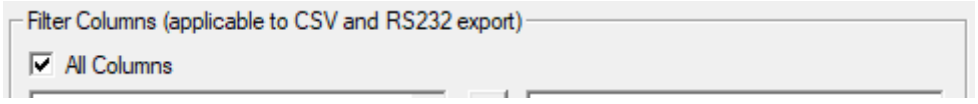
To export the graph data points, check the "Export Graph Data" checkbox and enter the name for the Worksheet (the default name is "Sheet 2"). Enter the required number of graph data points to be exported (the default value is 100) then select every axis to be exported. Every axis will be exported to its own column starting from column "A".



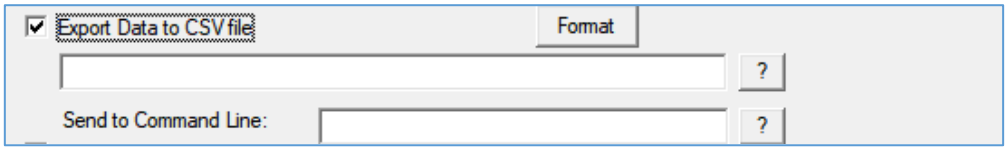
Click on the "Run Export" button at the top right of the screen to Export this data.

CSV EXPORT TO TEXT FILE

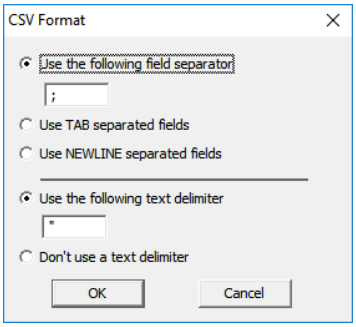
The CSV Export will contain ALL results unless these have been restricted on the previous screen.



To export the test results to a CSV file, check the "Export Data to CSV file" checkbox.



Click on the FORMAT button then configure the formatting options.



Click on the "?" to the right of the "first" blank field to display a "File Open" dialog then select an existing CSV file.

Click on the "Run Export" button at the top right of the screen to Export this data.

Note that only one CSV file can be specified so this will be overwritten by the next export. If all CSV files are required, this can be achieved by using a Windows Batch File (.BAT) with the "Send to Command Line" feature as shown below.

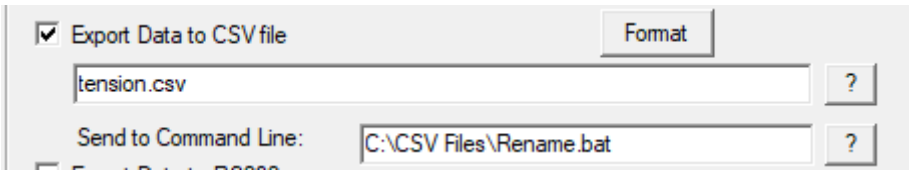
Send to Command Line

The command line allows a Windows Batch File (.BAT) to be used to rename the exported CSV file after it has been created. A typical example is to rename the file with the Date/Time as shown below.

1 Create the required Data Export folder, e.g., **C:\CSV Files**.
2 Create a TEXT file in this folder with a suitable name, e.g., "**Rename.txt**"
3 Rename this txt file with a bat suffix, e.g., "**Rename.bat**"
4 Edit this text file by adding the following text.

```
@echo off
for /f "tokens=2 delims==" %%a in ('wmic OS Get localdatetime /value') do set "dt=%%a"
set "YY=%dt:~2,2%" & set "YYYY=%dt:~0,4%" & set "MM=%dt:~4,2%" & set "DD=%dt:~6,2%"
set "HH=%dt:~8,2%" & set "Min=%dt:~10,2%" & set "Sec=%dt:~12,2%"
set fullstamp=%YYYY%%MM%%DD%_%HH%%Min%%Sec%
set filename = %~n1
ren %1 %~n1_%fullstamp%.csv
```

5 Select this text file by clicking on the "?" to the left of "Send to Command Line"
6 Enter a suitable "Prefix" name for the CSV File, e.g. "**Tension.CSV**"

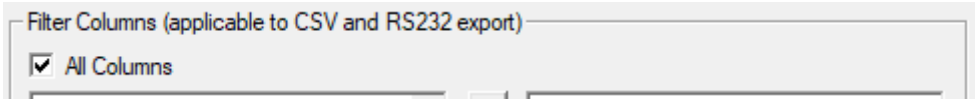


The workings of this DOS Batch script will not be explained fully here but uses "Standard" DOS Batch file commands.

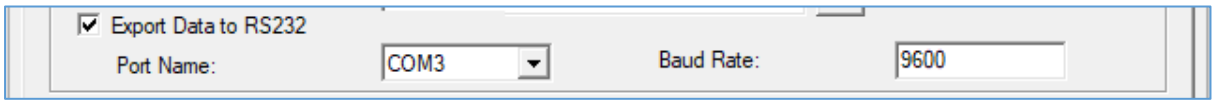
Assume the specified CSV file is called "**Tension.CSV**". The DOS Batch script above reads the filename "Tension" from the specified CSV filename then adds the current datetime in the format yyyyMMdd_hhmmss so the CSV file will be renamed to (e.g.) "**Tension_20210119_124324.CSV**". Note that a new CSV file will be created every time this export is performed because the filename includes seconds. This can be modified as required.

CSV EXPORT VIA RS232

The CSV Export will contain ALL results unless these have been restricted on the previous screen.



To export the CSV test results down an RS232 COM Port, check the "Export Data to RS232" checkbox.



Select the COM Port, noting that this cannot be the same COM Port as used by the Materials Testing Machine. Select the Baud rate, noting that this Defaults to 9600.

Click on the "Run Export" button at the top right of the screen to Export this data.

AUTOMATICALLY EXPORTING A SINGLE TEST

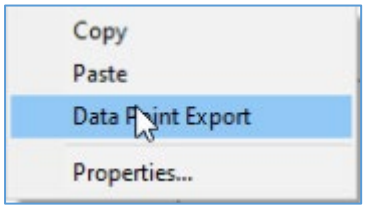
The Test Data for a single test can be automatically exported at the end of every test by configuring the Export as shown in the "MANUAL BATCH EXPORT" section. The difference is that the Export is not Manually performed by clicking on the "Run Export" button, but automatically occurs at the end of each test.

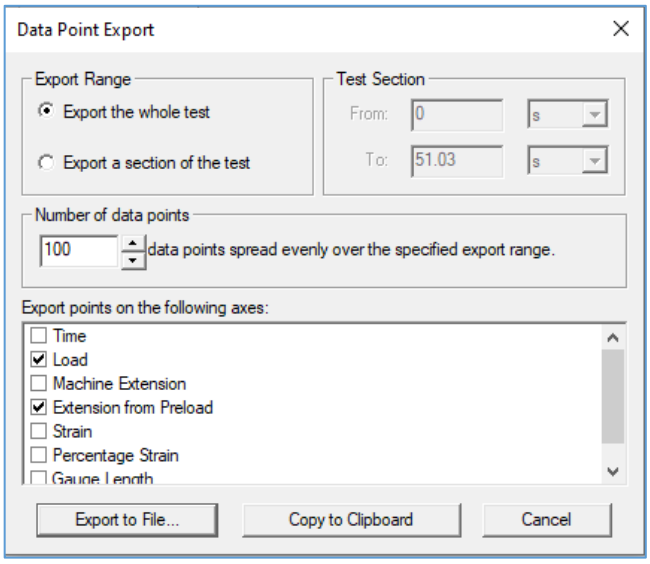
AUTOMATICALLY EXPORTING BATCH DATA

This export requires the "Test Automation" feature to be used. Please see the relevant section.

MANUALLY EXPORTING GRAPH DATA POINTS

To export graph data points manually, select the GRAPH view tab in NexygenPlus for a completed test. Right click with the mouse inside the graph window and select ‘Data Point Export’.





The export data can be sent for the "Whole Test" or by selecting a "Section", defined start (from) and end (to) times can be set.

The "Number of Data Points" is user definable, but caution should be use when requesting larger numbers of data points, as data integrity and file size can be compromised. As a rule, this number should not exceed the maximum data capture rate of 1000Hz (reading very 1ms). This is dependent on the total length of time the test ran for.

Select appropriate axes from the data sources listed and use the check boxes to tick the required options.

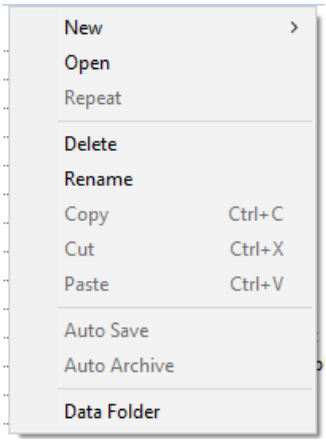
Use "Export to File" to create a text file (.txt) and use the explorer window to define the filename and destination location.

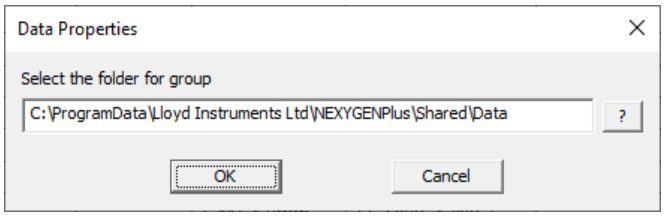
Use "Copy to Clipboard" to copy the data ready to paste to a suitable location of file type.

CONTROL PANEL FEATURES

The "Control Panel" at the left-hand side of the screen shows the data folder and all the test files contained within this folder.

The "Default" data folder is usually "C:\ProgramData\Lloyd Instruments Ltd\NEXYGENPlus\Shared\Data" but this can be changed by clicking on the data folder option then right mouse clicking and selecting "Data Folder".





Click on the "?" at the right of the dialog to display a folder browser the select the required folder.

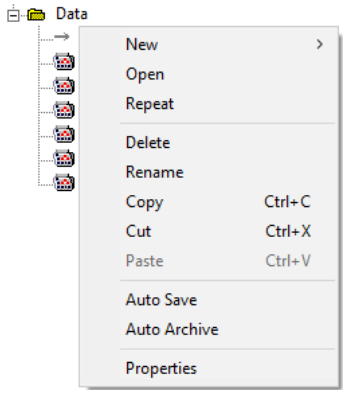
Note that although the Data Folder can be set to a network drive, this may cause performance issues, especially for long duration tests or if the "Test Automation" option is used. For best performance, it is recommended to use a local Data Folder and archive finished test files to the network drive as shown later.

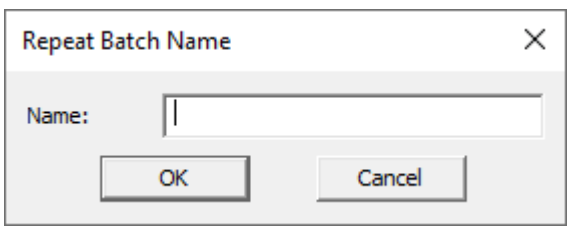
REPEAT

The computer may become slow when a batch file becomes excessively large, especially if each test takes several minutes to perform. The maximum recommended number of test rows is 1000 but this should be reduced for longer duration tests.

The "Repeat" feature creates a new "blank" copy of a test file which contains an identical test set up configuration, i.e., the same test action and required test results. There will be no data in the data table and the first row in the new table will be labelled with a Row Title of "1".

Click on the batch file in the control panel, right-mouse click to select the context menu then select "Repeat". A dialog is displayed to enter the name of the new batch file.



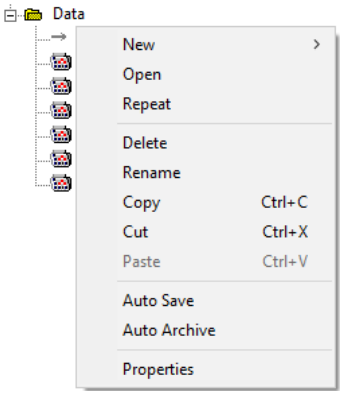


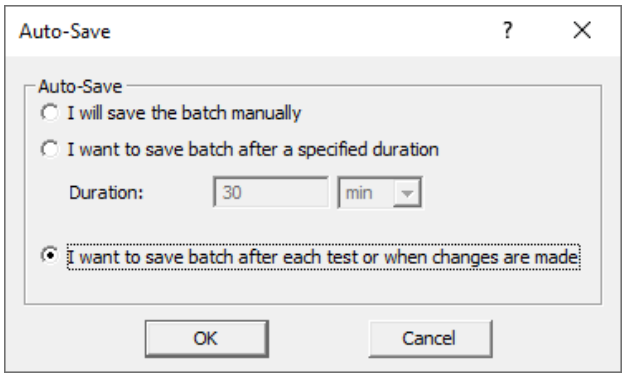
AUTO SAVE

The default "Auto Save" action is "Auto Save" and this will automatically save the batch file at the end of each test or when any changes are made to the test setup or results.

The auto save can be disabled or set to save at intervals when long duration tests are performed.

Click on the batch file in the control panel, right-mouse click to select the context menu then select "Auto Save". A dialog is displayed to select the required action.





AUTO ARCHIVE

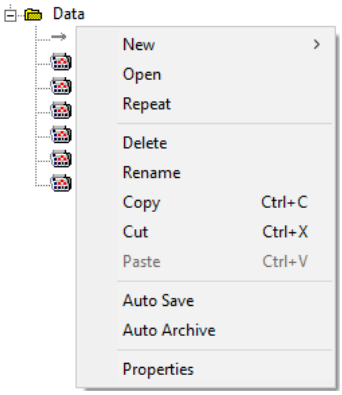
Also see the "Test Automation" Section for additional Archiving options.

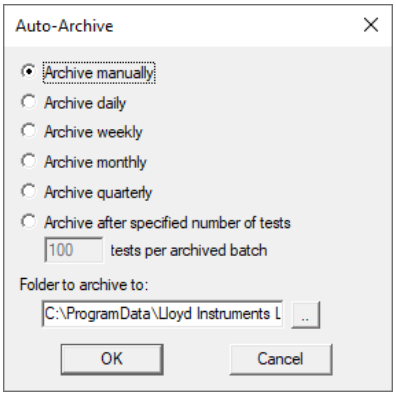
The "Archive" function performs 3 actions.

1 Renames the original batch file with a suffix of the date/time of the first test and the date/time of the last test
2 Creates a new "blank" batch file with the name of the original batch file. This file has the test setup and results preconfigured, so this test is ready to continue testing
3 Transfers the renamed batch file to the Archive folder so this cannot be used for testing again.

The "Default" Auto Archive action is "Manually Archive" but other options are "Archive daily", "Archive weekly", "Archive monthly", "Archive quarterly" and "Archive after a number of tests". In all cases, the archive folder must be specified.

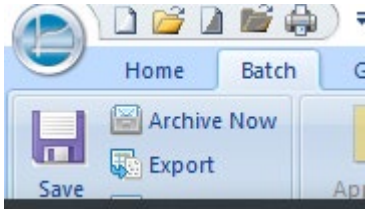
Click on the batch file in the control panel, right-mouse click to select the context menu then select "Auto Archive". A dialog is displayed to select the required action.

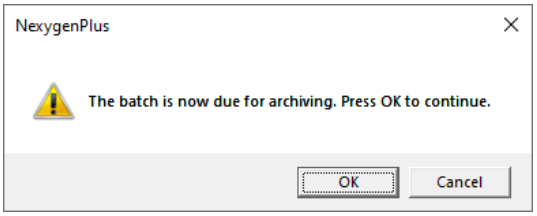




To archive the file manually, open the batch file then display the batch table.

The "Batch" ribbon bar displays an "Archive Now" option. Clicking on this icon displays a warning message. Click OK to archive the file.





The "auto" functions operate as below.

If the file is set to archive daily, it does not archive until a new test is performed on a different day, i.e., it does not archive at midnight because the program will not be running. It will also archive if the test file has not been used for several days because it is a change of date that triggers the archive.

The same is true for weekly, monthly etc.

If the file is set to archive after a specified number of tests, e.g., 100 then it will archive when that number of tests have been performed, i.e., at the end of test 100.

AUTO ARCHIVE FILENAME

Assume that the test file is called, "Lot653.batch".

When the test file is archived, it is renamed with the original name followed by an underscore, the date/time of the first test, another underscore then the date/time of the last test, e.g.

Lot653_05012022 103305_07012022 1230837.batch

This simplifies data analysis later because the date/time range of all tests contained in that file are visible.

The new batch file starts with Row Title "1".

TEST FEATURES

All Test Setups have "Common" features to simplify their use, and these are shown below. Some Test Setups have specific features, and these are shown in the relevant Test Setup sections.

PRE-TEST AND POST-TEST QUESTIONS

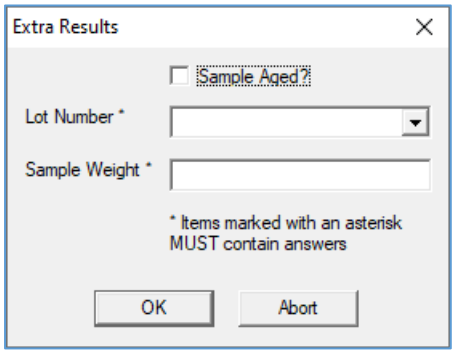
Pre and Post test questions are provided to allow the operator to add extra information for each test. This information can be sample information (e.g., "Cavity Number"), process information (e.g., "Lot Number") or any value that is to be reported, (e.g., "Sample Aged") etc. Each question will automatically create a new result column with the question as the column title.

All Pre-Test questions are displayed at the start of each test and all Post-Test questions are displayed at the end of each test.

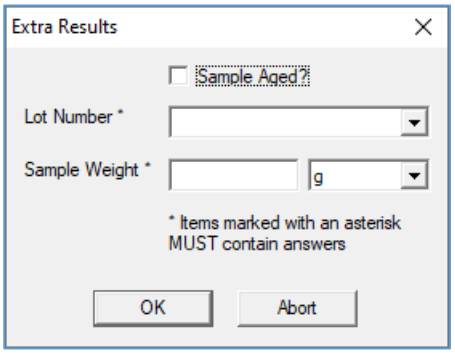
There are 3 types of questions.

1	Yes/No	displays a checkbox and stores a Boolean result
2	Text	displays a text box and stores a text result
3	Numerical	displays an entry box or and entry box with optional unit selector

Example Pre-Test or Post-Test question dialogs are shown below.

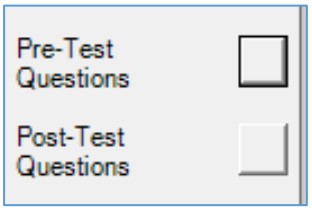


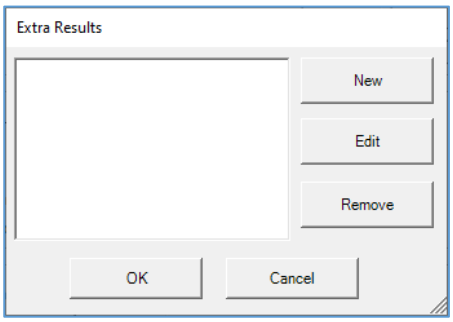
Yes/No, Text and Numerical Data



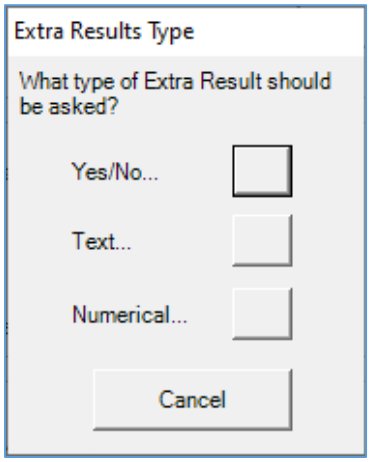
Yes/No, Text and Numerical Data with Units

The Questions are defined by clicking on the "Pre-Test Questions" or "Post-Test Questions" buttons on the right-hand side of the editor to display the "Extra Results" dialog.

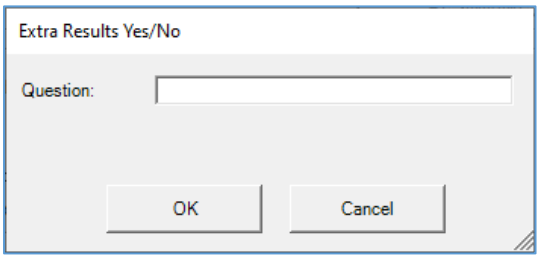




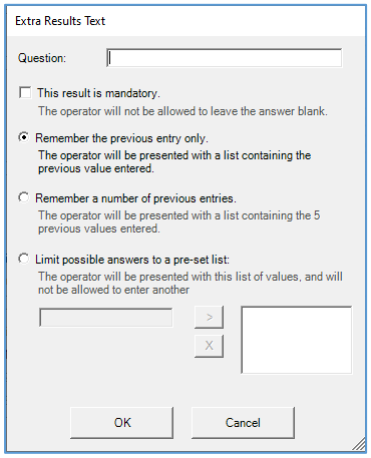
Click on the "New" button, select the type of question then configure as required.



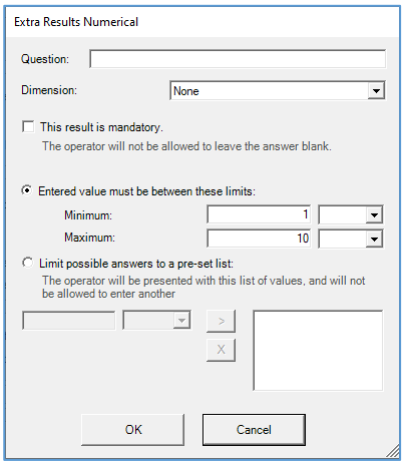
Question Type



Yes/No



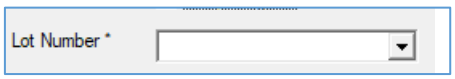
Text



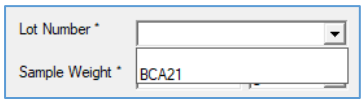
Numerical

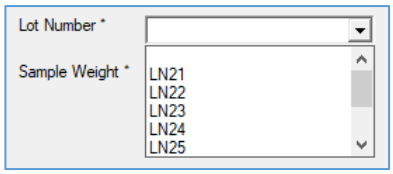
A **Text Question** displays a drop-down control and the text stored and displayed in the control depends upon the configuration.

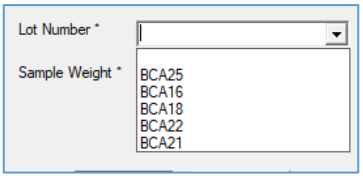
If the "This result is Mandatory" checkbox is checked, the Pre-Test question dialog will always display a blank entry to ensure that the operator provides an answer.



Clicking on the drop-down arrow to the right of the control will either show the last answer, a list of the last 5 answers or a pre-defined list of answers depending upon the option buttons. A new answer can be added unless the "Limit possible answers to a pre-set list" option is selected.

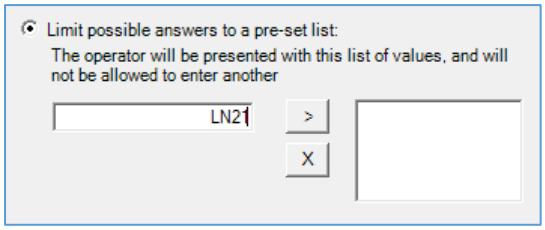


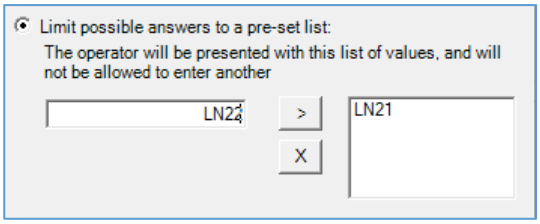




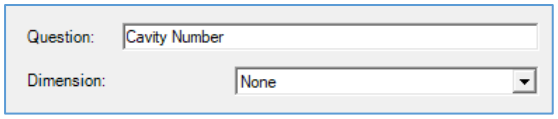
If the "This result is Mandatory" checkbox is not checked, the Pre-Test question dialog will always display the first answer in the drop-down control.

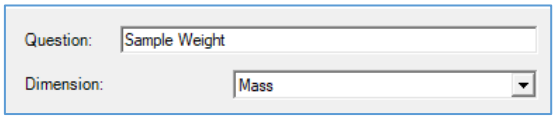
A pre-set list of answers is created by selecting the "Limit possible answers to a pre-set list" option then adding each entry and clicking on the ">" button to add the entry to the list.



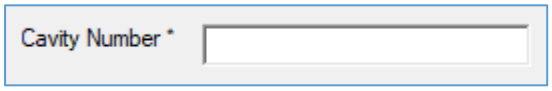


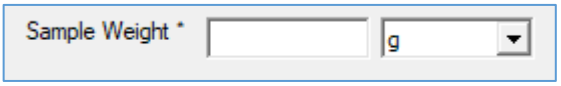
A **Numerical Question** displays an entry field and an optional "Units" selector. The values stored and displayed in the control depends upon the configuration. Values without units, e.g., "Cavity Number" is defined with a "Dimension" of "None". Values with units, e.g., "Sample Weight" is defined with a "Dimension" of "Mass".



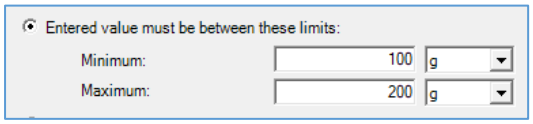


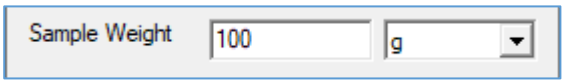
If the "This result is Mandatory" checkbox is checked, the Pre-Test question dialog will always display a blank entry to ensure that the operator provides an answer.



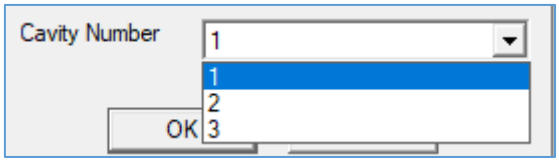


If the "Entered value must be between these limits" option is selected, an acceptable range can be defined. This ensures that an operator cannot enter (say) 1500 instead of 150.





If the "Limit possible answers to a pre-set list" option is selected, clicking on the drop-down arrow to the right of the control will show the pre-defined list of answers



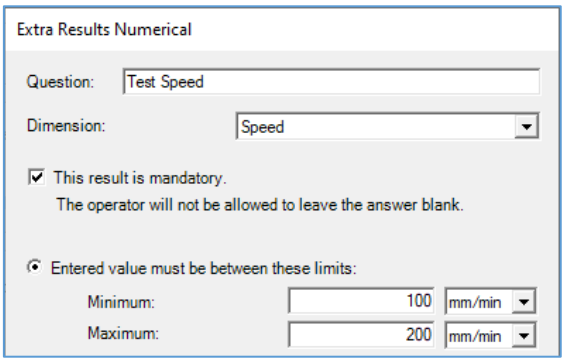
If the "This result is Mandatory" checkbox is not checked, the Pre-Test question dialog will always display either the lowest acceptable value or the first answer in the drop-down control.

USING PRE-TEST QUESTIONS IN A UCT SCRIPT

One or more Pre-Test Questions can be used to control a UCT (User Configurable) Test by using a script. All answers to Pre-Test questions are stored in the Batch Data Table before the test starts so these answers can be used in the script. An answer is read using the GETEXTRARESULT method and this answer could be used to define the Test Speed or control the test action etc.

Pre-Test Question for Test Speed

A Pre-Test question can be used to allow the operator to specify the test speed, within a pre-set range, without using the Test Editor. Create a **Mandatory** Numerical Question with suitable text for the Question Name (e.g., **"Test Speed"**) and select a "Dimension" of "Speed".



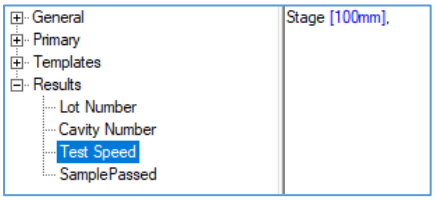
The UCT Test Script reads the speed answer and sets the test speed as shown in the example script.

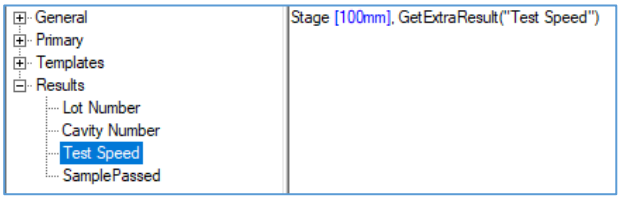
```
Stage [100mm], GetExtraResult("Test Speed")
```

Note that the answer can also be stored in a variable (using SET because the answer contains Units) so that it can be used in more than one place.

```
Set S = GetExtraResult("Test Speed")
Stage [100mm], S
```

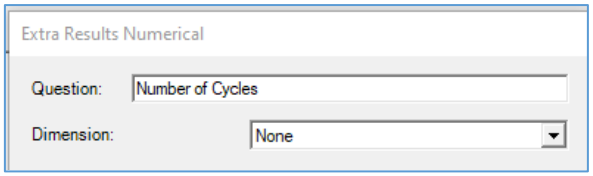
Note that the question name (within quotes) is case sensitive and must be entered correctly. The UCT editor provides an easy way to add this result. Type the required text in the editor (e.g., **Stage [100mm]**) ensure that the cursor is at the correct position in the script then double-click on the "Result Name" under the "Results" heading in the left-hand panel. The editor will add the GETEXTRARESULT with the correct spelling and case.





Pre-Test Question for Number of Cycles

A Pre-Test question can be used to allow the operator to specify the Number of Cycles, within a pre-set range, without using the Test Editor. Create a **Mandatory** Numerical Question with suitable text for the Question Name (e.g. **"Number of Cycles"**) and select a "Dimension" of "None".



The UCT Test Script reads the Number of Cycles answer and sets the For - Next loop to define the number of cycles as shown in the example script:

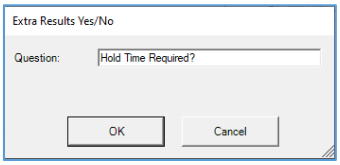
```
For Cycle = 1 to GetExtraResult("Number of Cycles")
        Stage [10mm], [100mm/min]
        Stage [0mm], [100mm/min]
Next
```

Note that the answer can also be stored in a variable (does not use SET because the answer has no Units) so it can be used in more than one place:

```
C = GetExtraResult("Number of Cycles")
For Cycle = 1 to C
        Stage [10mm], [100mm/min]
        Stage [0mm], [100mm/min]
Next
```

Pre-Test Yes/No Question to Control the Test Action

A Pre-Test question can be used to allow the operator to define 2 actions, e.g., apply a force or apply a force and hold this force for a time duration. Create a Yes/No Question with suitable text for the Question Name (e.g., **"Hold Time Required?"**).



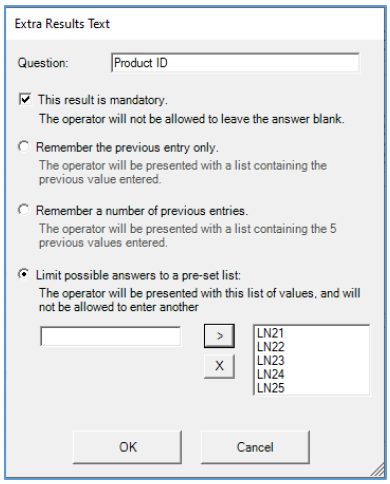
The UCT Test Script reads the Boolean answer and defines the test action as shown in the example script.

```
If GetExtraResult("Hold Time Required?") then
        StageHold [10mm], [500mm/min], [5s]
Else
        Stage [10mm], [500mm/min]
End If
```

If the operator does not check the checkbox at the start of the test, the "Stage" is run. If the operator checks the checkbox at the start of the test, the "StageHold" is run.

Pre-Test Text Question to Control the Test Action

A Pre-Test question can be used to allow the operator to define several actions by using a pre-defined list. This can be used for different products or materials where a test parameter may change, e.g., Test Speed. Create a **Mandatory** Text Question with suitable text for the Question Name (e.g., **"Product ID"**) and define a list of applicable product codes, e.g., "LN21, LN22, LN23, LN24".



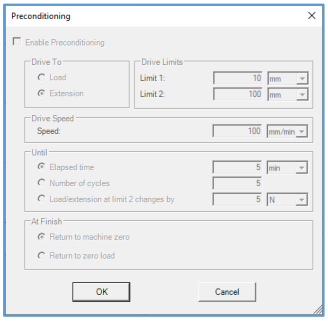
The UCT Test Script reads the Text answer and defines the test speed using a SELECT CASE Statement as shown in the example script. Note that the text in each CASE condition is case sensitive and must be entered exactly as defined in the Pre-Test question dialog. Note that the CASE ELSE condition is not strictly required because the user cannot enter any text, but this feature is shown for information. The Speed is set to [100mm/min] if a text match is not found by the SELECT CASE Statement.

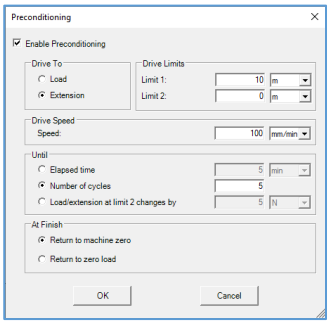
```
Select Case GetExtraResult("Product ID")

        Case "LN21"
                Set Speed = [100mm/min]
        Case "LN22"
                Set Speed = [150mm/min]
        Case "LN23"
                Set Speed = [200mm/min]
        Case "LN24"
                Set Speed = [250mm/min]
        Case "LN25"
                Set Speed = [300mm/min]
        Case Else
                Set Speed = [100mm/min]
End Select

Result "Test Speed", Speed

Stage [10mm], Speed
```

PRECONDITIONING

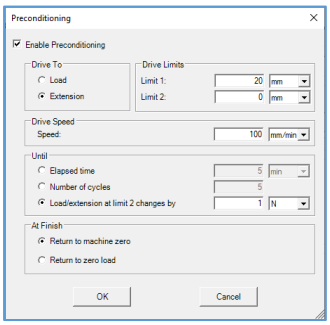
Preconditioning is where the sample is loaded and unloaded (cycled) to "work" the sample before the actual test starts. There is no graph drawn during the preconditioning and no test results are produced.

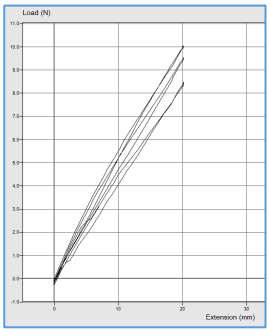
The optional Preconditioning is defined by clicking on the "Preconditioning" button on the right-hand side of the editor to display the "Preconditioning" dialog. Check the "Enable Preconditioning" checkbox then define the cycle action and stop condition. A simple stop condition is cycle for a time or cycle for a defined number of cycles.



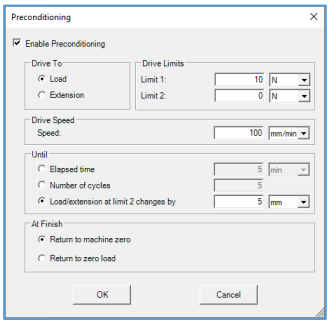


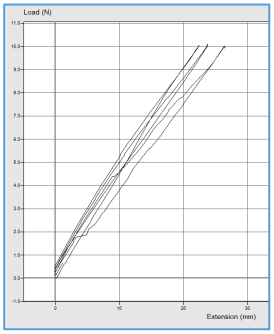
The number of cycles can also be determined by the sample behaviour. The example below stops the cycling when the load at the limit on the current cycle is 1N lower than the load at the limit on the first cycle. The principle is shown in the example graph, noting that no graph is drawn during the preconditioning.





Another example below stops the cycling when the extension at the limit on the current cycle is 5mm more than the extension at the limit on the first cycle. The principle is shown in the example graph, noting that no graph is drawn during the preconditioning.

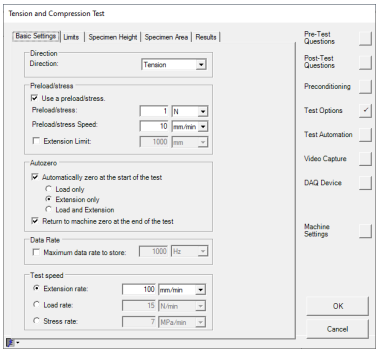


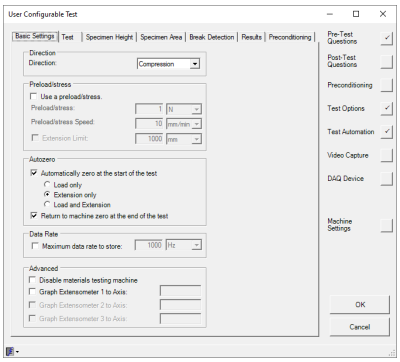


A UCT Test also has a Preconditioning Tab and this is shown in the User Configurable Test section.

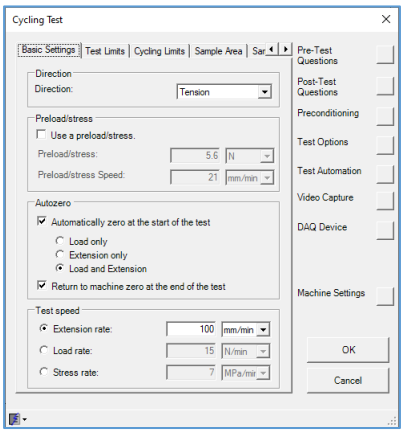
BASIC SETTINGS

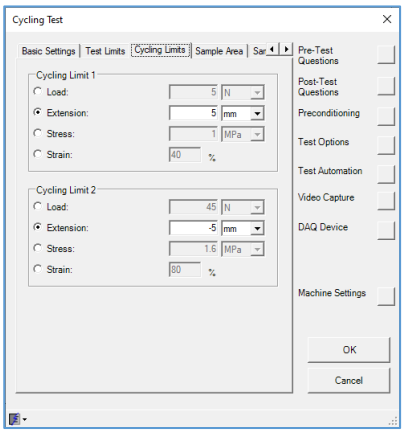
The Basic Settings screen defines the Test Direction (Tension or Compression), the optional Preload, optional Auto Zero, optional Auto Return, Maximum Data Rate and other features depending upon the test type.

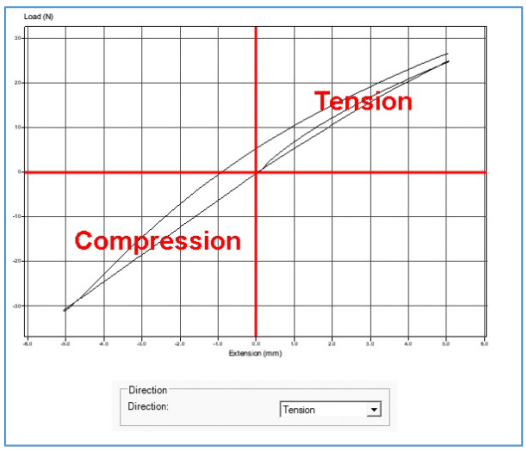


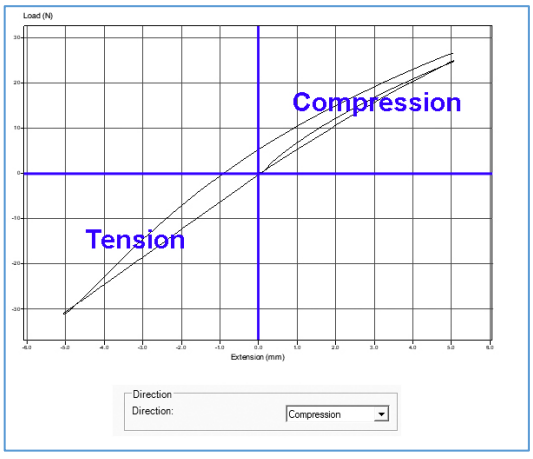


Note that the direction defines the positive load and positive extension values on the graph. Therefore, a Compression Test will show compression load as a positive load and downwards crosshead travel as a positive extension. Most test types only apply force in one direction but the Cycle Test and the UCT (User Configurable Test) can apply forces in both directions, i.e., the test can cycle through zero load and / or zero extension. In this case, the positive quadrant on the graph displays the Tension Load or the Compression Load as defined by the Direction selector. The test limits can therefore be a positive or a negative value.







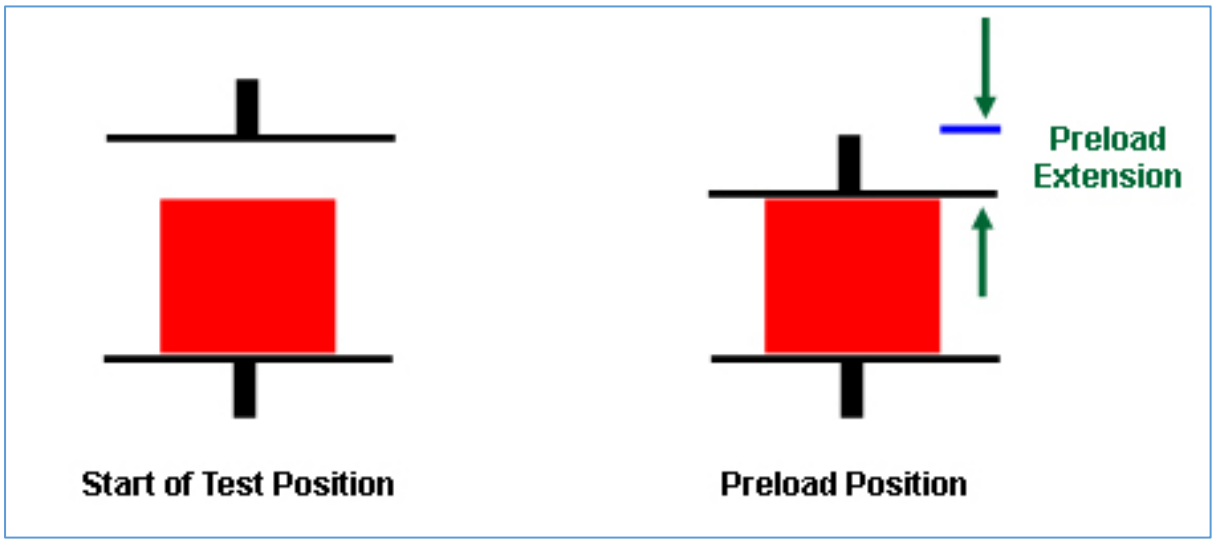


PRELOAD

A Preload is usually essential for a compression test but can also be used in a tension test. The principle is that the extension measurement is zeroed when the load value reaches the preload value.

Consider a compression test where a sample is compressed between 2 flat compression plates. The plates are normally positioned to give a plate separation (grip separation) greater than the height of the sample to allow the operator to easily slide the sample onto the bottom compression plate. Assume that the test requires the force at (say) 10mm compression and the top compression plate is 6mm above the top of the sample. If the crosshead moves down and stops at 10mm, this position will only compress the sample by 4mm. The downwards movement to contact the sample is not part of the test and is called "Preload Extension".

NEXYGEN Plus is designed to start the test when the top compression plate touches the top of the sample with a defined "Preload" force and this position is called the "Preload Position".



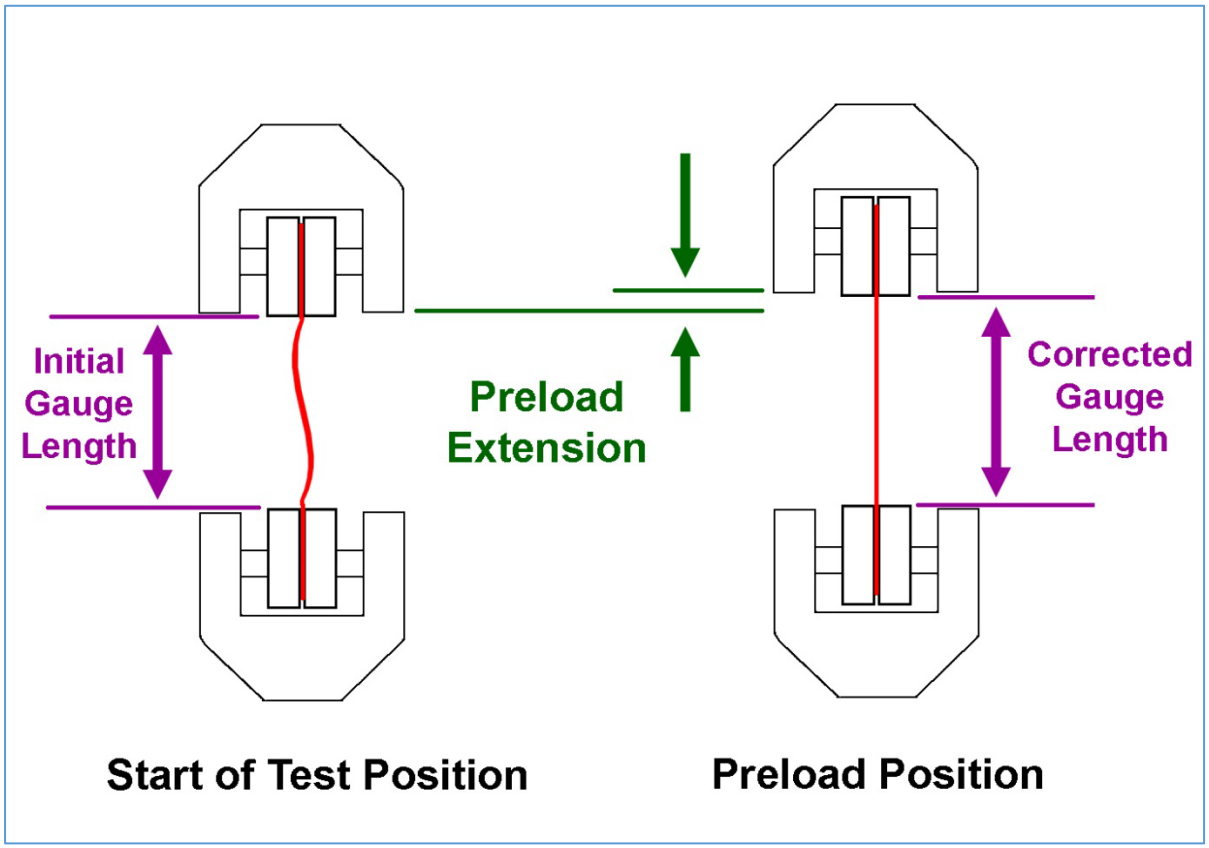
The graph contains 2 extension axes: - "Machine Extension" and "Extension from Preload". The "Machine Extension" axis is zeroed at the start of the test, but the "Extension from Preload" axis is zeroed when the preload force has been applied to the sample.

All "Test" movement is defined from the "Preload position" so the 10mm downward movement starts from the "Preload position" so the sample is compressed by 10mm.

If Auto Return is selected, the crosshead will return to the "Start of Test Position" at the end of the test to allow the sample to be replaced by a new sample.

This feature, together with the "Datum" feature, can be used to automatically measure the sample height as shown in the Sample Height section. The height of every sample is automatically measured at the start of the test then the % compression distance (e.g., 10% compression) is automatically calculated to move the crosshead to the required distance.

Consider a Tension test where very thin samples are tested, i.e., paper or film. It can be difficult to fit the sample to ensure that it is straight but not under a tensile force.



The grips are normally positioned to give a known grip distance between the jaw faces (Gauge Length). Assume that the gauge length is 100mm and the test requires the force at (say) 25mm stretch. If the sample is "slack" prior to starting a test, the crosshead may have to move up by (say) 5mm before the sample is pulled tight.

If the crosshead moves up and stops at 25mm, this position will only stretch the sample by 20mm. The upwards movement to pull the sample straight is not part of the test and is called "Preload Extension". NEXYGEN Plus is designed to start the test when a defined "Preload" force is applied to the sample and this position is called the "Preload Position".

The graph contains 2 extension axes: - "Machine Extension" and "Extension from Preload". The "Machine Extension" axis is zeroed at the start of the test, but the "Extension from Preload" axis is zeroed when the preload force has been applied to the sample.

All "Test" movement is defined from the "Preload position" so the 25mm upward movement starts from the "Preload position" so the sample is stretched by 25mm.

If Auto Return is selected, the crosshead will return to the "Start of Test Position" at the end of the test to bring the grips back to the required gauge length position.

This feature, together with the "Initial Grip Separation" feature, can be used to automatically correct the gauge length as shown in the Sample Dimensions section. The height of every sample is automatically corrected at the start of the test then the % elongation distance (e.g., 25% elongation) is automatically calculated to move the crosshead to the required distance.

AUTO ZERO AND AUTO RETURN

The operator can zero the testing machine crosshead position and the applied load by pressing the zero button on the machine console (or handheld device) or by clicking on the Zero button on the software console. To simplify the testing process, NEXYGEN Plus can also zero the crosshead and/or load by selecting one of the "Auto Zero" options.

Care must be taken when using this option because errors can be introduced depending upon the specimen and test type as shown below.

1 A rigid sample is clamped using wedge action grips. The wedges can apply a compressive force to the sample when they are closed, and this applies a true force to the sample. If Auto Zero "Load" is used, this force is zeroed so all load related results will have this zero "Offset" error.

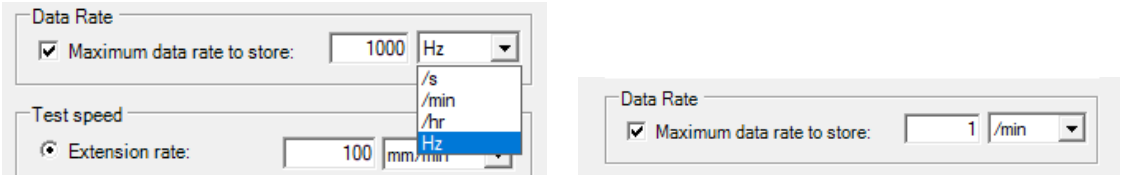
2 A large number of specimens are to be tested in a sequence. The crosshead will return to the start of test position within a few microns at the end of each test either by the "Auto Return" option or by the operator pressing the Return button on the machine console (or handheld device) or by clicking on the Return button on the software console. If Auto Zero "Extension" is used, any slight crosshead extension value is zeroed so the crosshead "Start of Test" position may "creep" away from the required zero position.

The "Auto Return" option automatically brings the crosshead back to the "Start of Test" position at the end of the test. This simplifies the testing process, but care must be taken not to use this feature when testing rigid materials in the tension mode. This is because the specimen will be stretched during the test and a compressive force will be applied when the crosshead returns to the "Start of Test" position.

MAXIMUM DATA RATE TO STORE

The testing machine sends data to NEXYGEN Plus at 1000Hz, i.e., 1000 readings per second. All of this data is stored in the batch file, so the file size increases with test duration. When a very long duration test is performed, e.g., a creep test (constant loading of the sample) over several days, then the file can become excessively large.

A creep test graph typically does not show much change over time, so a high data rate is generally not required. The Maximum Data Rate option allows a data point to be stored at a specified time interval to drastically reduce the file size. The time intervals are seconds, minutes and hours as shown below.

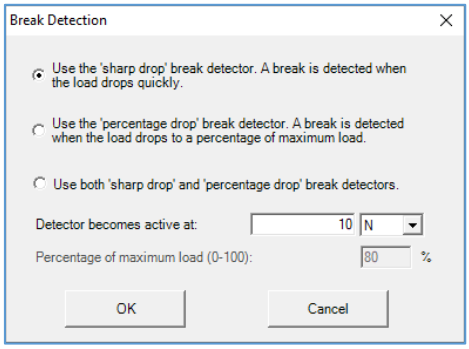


To store all data points, or use a slightly reduced data rate, select the "Hz" option then enter the required number of data points per second.

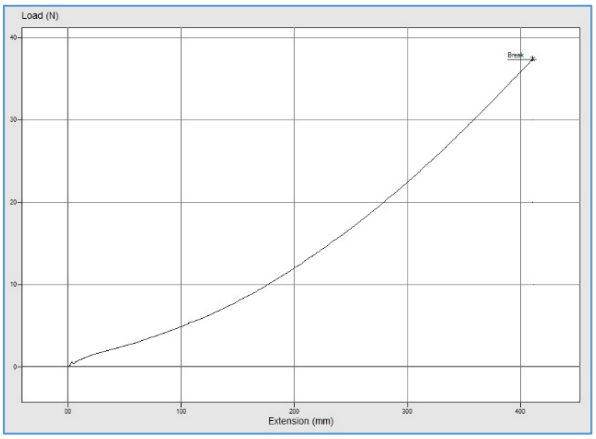
To store a greatly reduced amount of data, select the "/s", "/min" or "/hr" option then enter the number of data points per second, minute, or hour.

BREAK DETECTOR

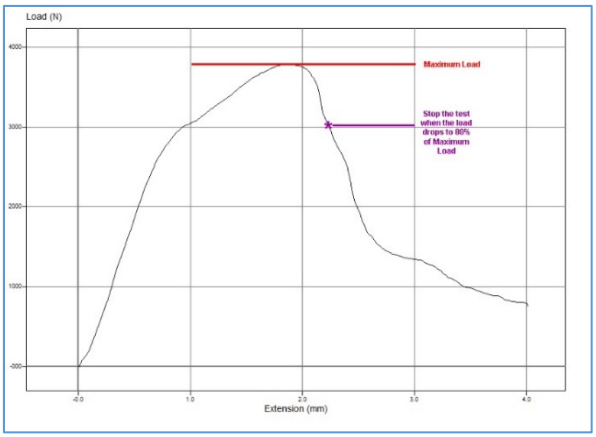
A "Break Detector" is normally used to stop the test when the sample breaks. There are 2 types of break detector which can be used depending upon the sample characteristics.



If the sample breaks into 2 or more pieces so the force very quickly drops down to a very low value, the test can be stopped by using a "Sharp Drop" break detector. This type of break detector is normally used for a Tension test. The "Load at Break" is a valid result because this is the force that caused to sample to break.



If the sample "cracks" but the force does not drop down to a very low value, the test can be stopped by using a "Percentage Drop" break detector. This type of break detector is normally used for a Compression test or a bending test where the sample cracks before fully breaking and the test is to stop at the first sign of cracking. Note that the "Load at Break" is NOT a valid result because this force is simply a percentage of the Maximum Load.



In all cases, the "Activation" force must be specified and a "reasonable" activation force is about 10% to 20% of the expected Maximum Load.

SAMPLE DIMENSIONS

The testing machine measures force and extension. If the test action or test results require Stress or Strain, then the dimensions of the sample are required.

Stress is defined as	Force over unit area, so is N/mm^2 (MPa) or lbf/in^2 (PSI)	
Strain is defined as	Change in Gauge Length / Original Gauge Length (unitless) Change in Height / Original Height (unitless)	or
Percentage Strain is	Strain * 100	

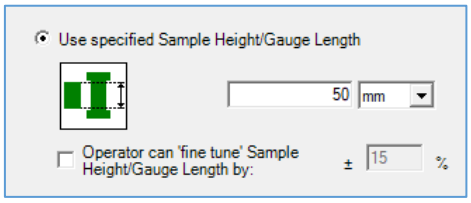
SAMPLE HEIGHT

The Sample Height screen provides 3 different options to enter the sample Gauge Length (Height). In all cases, check the "Interested in Sample Height/Gauge Length" checkbox then select the required option as shown below.

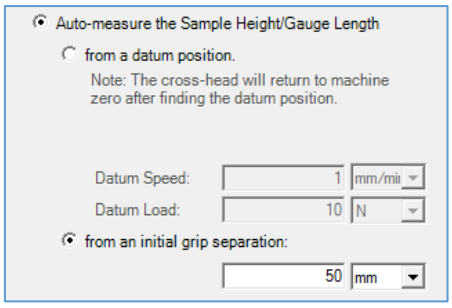
1. Fixed Gauge Length
2. Corrected Gauge Length
3. Auto Measured Gauge Length

In all cases, additional graph axes of "Strain", "Percentage Strain" and "Gauge Length" (Tension) or "Height" (Compression) are automatically created.

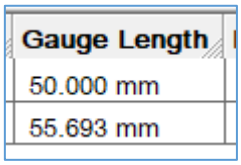
The "**Fixed Gauge Length**" option uses a defined gauge length and makes no corrections to this value for a slack sample etc. Select the "Use Specified Sample Height/Gauge Length" option and enter the required gauge length. This option is normally used with a "fixed" gauge length, but there is an option to allow the operator to change this value if required.

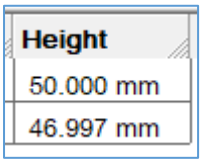


The "**Corrected Gauge Length**" option requires a "Preload" so a suitable Preload value must be defined as shown in the "Preload" section.

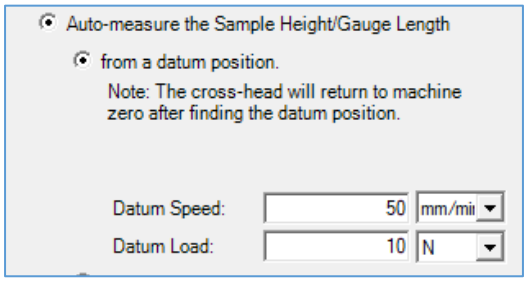


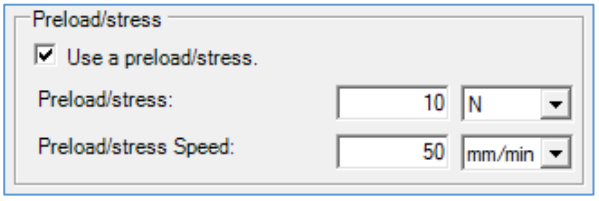
Any movement between the start of test and the Preload Position is automatically added to the Initial Gauge Length (Tension Mode) or automatically subtracted from the Initial Height (Compression Mode).





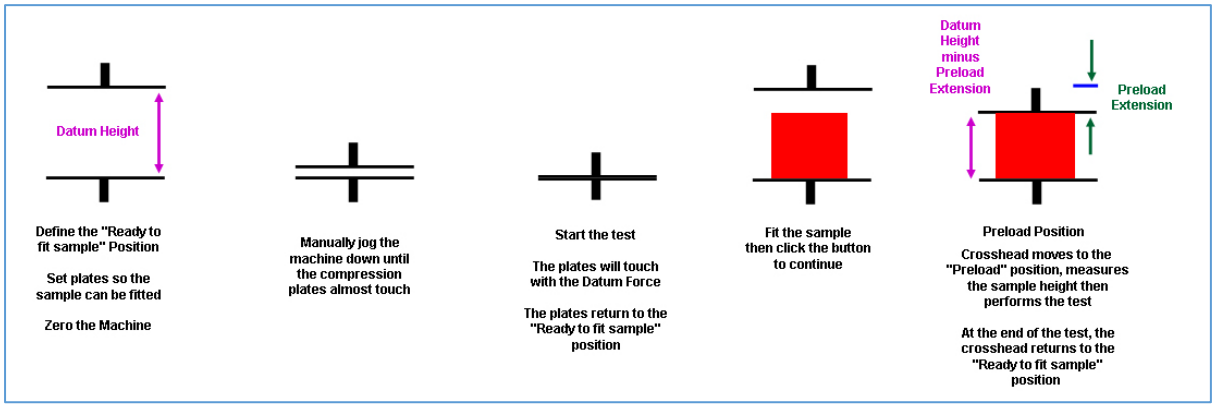
The "**Auto Measured Gauge Length**" option is normally used for a compression test, and this uses a "Preload" and a "Datum". It is recommended to use the same load and speed values for both items.





Ensure that Auto Zero is not enabled in the Test Options.

The "Auto Measured Gauge Length" option uses a defined Test Sequence as shown below.



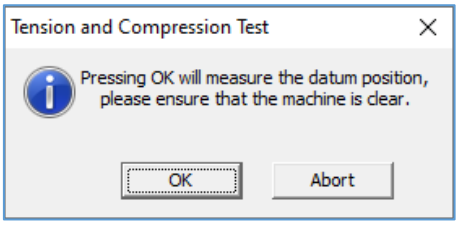
1. Manually position the top compression plate so that there is a suitable distance between them to fit the sample, i.e., the "Datum Height" is greater than the Sample Height. This is the "Ready to fit sample" position.

2. Zero the machine but do **not** zero the machine again during the test sequence. Ensure that Auto Zero is **not** enabled in the Test Options.

3. Manually jog the machine until the compression plates are almost touching.

4. Click on the green "Start Test" button to start the datum and test sequence.

5. A dialog is displayed indicating that the "Datum" position will be found. Click OK to perform this action.

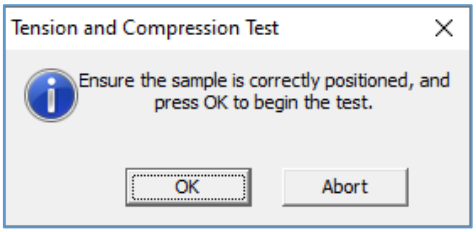


6. The crosshead moves down to touch the plates together with the Datum force.

7. The crosshead will move back to the "Ready to fit sample" position.

8. A dialog is displayed indicating that the sample should now be fitted.

9. Position the sample on the lower compression plate then click OK to perform the actual test.

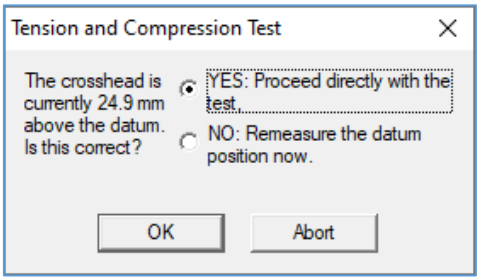


10. The crosshead moves down to touch the sample with the Preload force, measures the sample height and creates a "Height" test result.

11. At the end of the test, the crosshead returns to the "Ready to fit sample" position.

12. Replace the sample with a new sample then click on the green "Start Test" button to start the test.

13. A dialog is displayed indicating that the datum position is known. Click OK to perform the test.



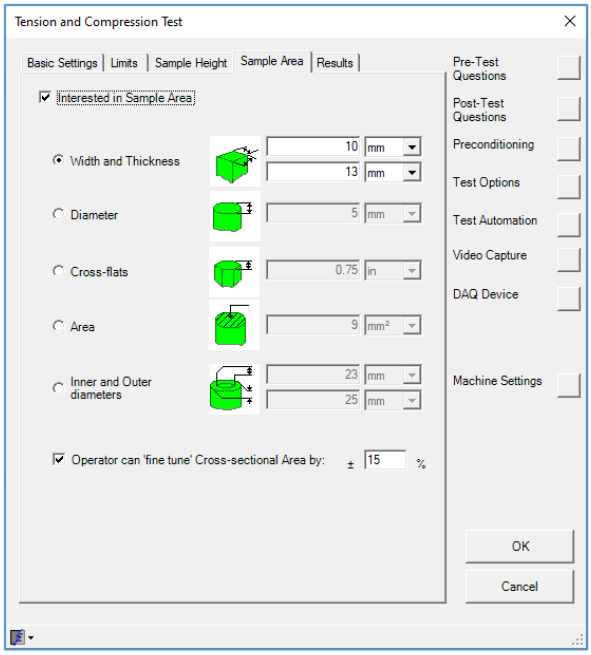
Note: A different "Datum" method can be defined if a User Configurable Test (UCT) is used. Please refer to the UCT section for details

SAMPLE AREA

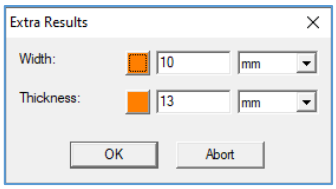
The Sample Area screen provides 5 different sample cross-sections to enter the sample Area. Check the "Interested in Sample Area" checkbox then select the required cross-sectional option as shown below.

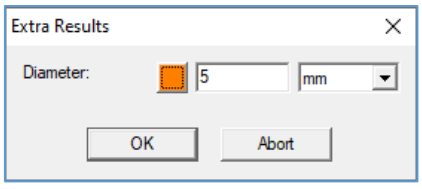
1	Rectangular	Enter Width and Thickness
2	Circular	Enter Diameter
3	Hexagonal	Enter the distance across the flats
4	Area	Enter Area directly - Mainly used for irregular shapes
5	Tubular	Enter Inner and Outer Diameters

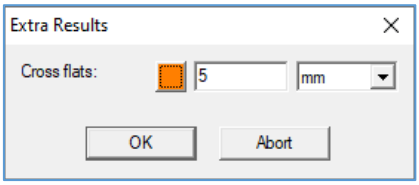
In all cases, enter the "Typical" sample dimensions. It is usual for the sample area to vary slightly between samples, so the "Operator can 'fine tune' the area" option is enabled by default.

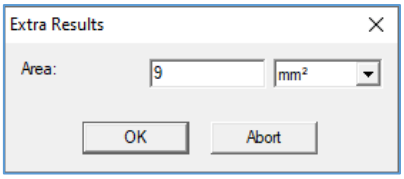


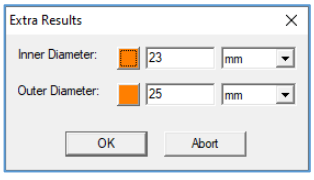
If the "Operator can 'fine tune' the area" option is enabled, a dialog is displayed at the start of every test to allow the operator to manually measure and enter the dimensions.



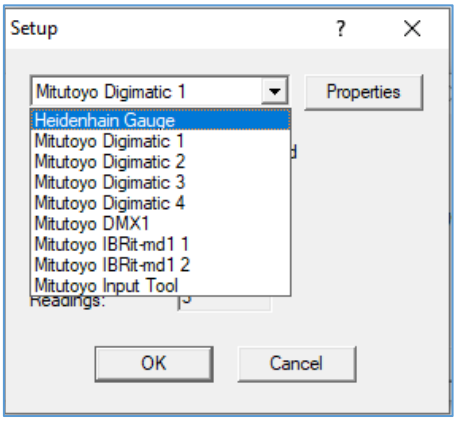








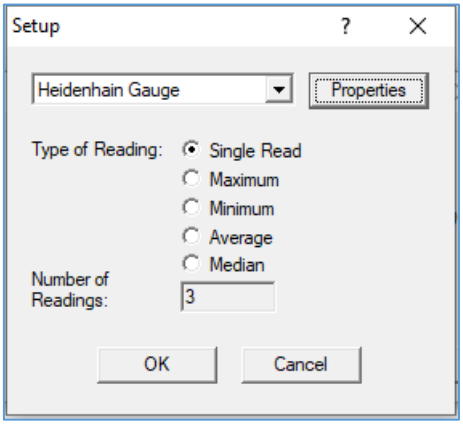
Each sample dimension has an orange button displayed next to it to allow the dimension to be automatically entered from an external device. Click on the Orange button then click on SETUP to select and configure the device. The devices currently supported are shown in the list below, noting that these are all RS232 devices.



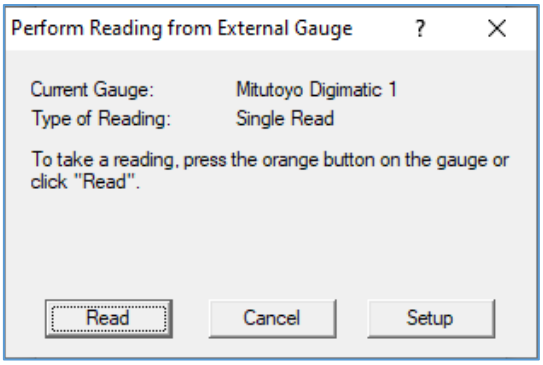
Note that most devices require adaptor cables (e.g., MUX2 or MUX4 interface lead) so please check with the device manufacturer for details.

The device RS232 port is configured by clicking on the Properties button to display the Port selector screen.

Select whether the system is to read a single measurement or the Maximum, Minimum, Average or Median of a specified number of readings. Click on the OK button to return to the read gauge screen.



Fit the sample into the gauge then transfer the reading to the software by either pressing the orange button on the gauge or by clicking on the Read button on the screen.

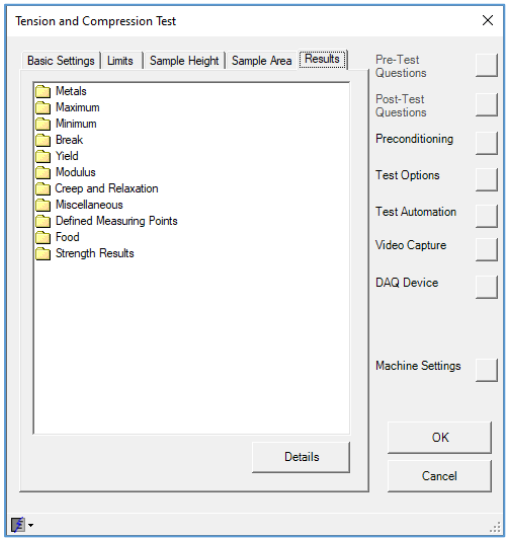


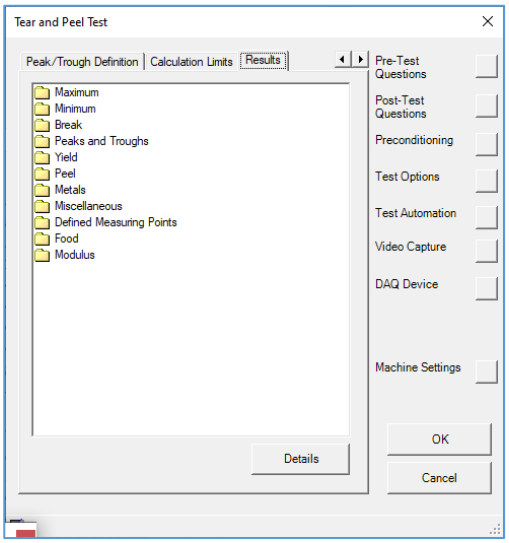
TEST RESULTS

The Results screen defines the automatically calculated test results. Each result is contained within a group, e.g., "Maximum", Minimum" etc for ease of use, noting that not all groups are available depending upon the Test Type.

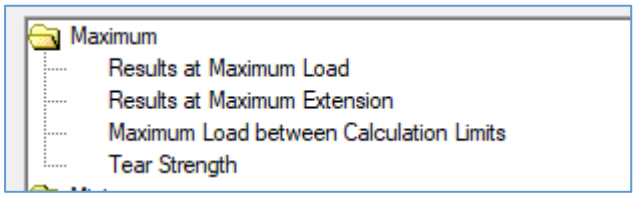
Therefore, a "Tear and Peel" Test does not provide "Creep and Relaxation" results and a "Tension or Compression" Test does not provide "Peak and Troughs" or "Peel" results.

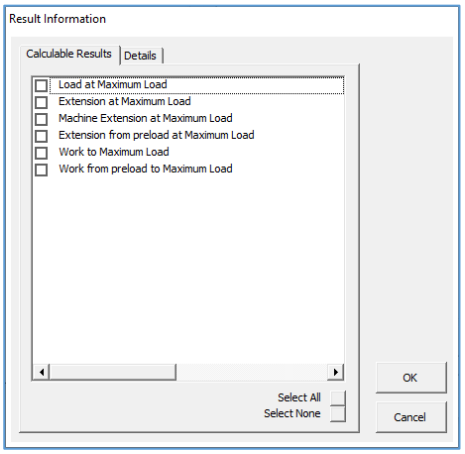
This section outlines the "Common" groups and the specialised ones are covered under the section for each Test Type. Some Results Tab screens are shown below.





Select the required group, e.g., Maximum" to display a list of applicable result categories,





To select any results in the "Results at Maximum Load" category either double click on the "Results at Maximum Load" category or select this category then click the Details button.

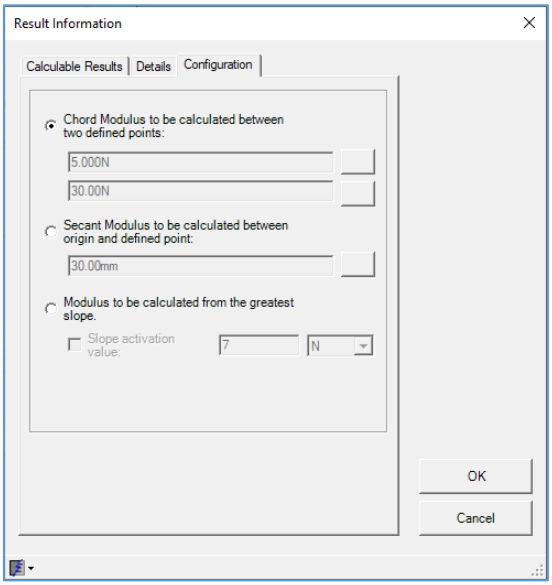
Check the checkbox for each required result.

Note that there are 3 extension results available. The "Machine Extension" values are the direct readings from the machine and are always present, e.g., "Machine Extension at Maximum Load".

If the test has a Preload defined, the "Test" extension is zeroed at the preload position, so the extension is the change in sample length, e.g., "Extension from Preload at Maximum Load". Therefore, this result will be blank if a preload was not defined in the test setup.

If the test does not have a Preload defined, the "Extension" value is the same as the "Machine Extension" value. Therefore, this result will be blank if a preload was defined in the test setup.

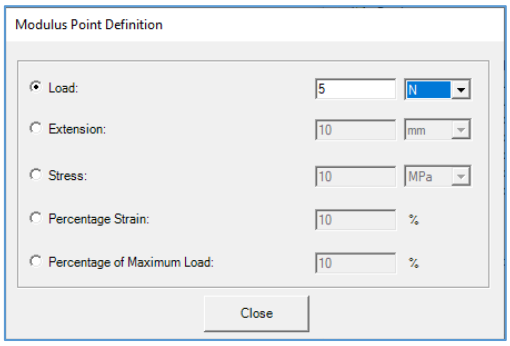
Some categories, e.g., "Results at Maximum Load", do not require any additional parameters to calculate the test results. However, other categories, e.g., "Modulus", do require additional parameters and these are entered using the Configuration tab.



The Modulus result can be calculated in 3 different ways.

1 Chord Modulus - Calculate the slope between 2 defined points
2 Secant Modulus - Calculate the slope between the origin and a defined point
3 Greatest Slope - Find the greatest slope during the test

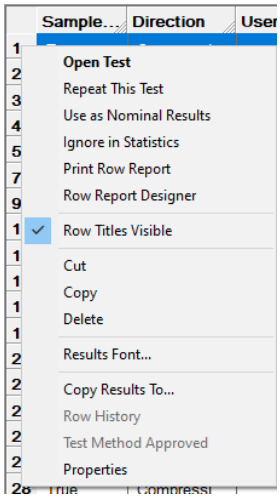
The Chord and Secant modulus results require the points to be defined. Click on the square button to the right of the value to display the "Definition Screen" the n enter the required values.

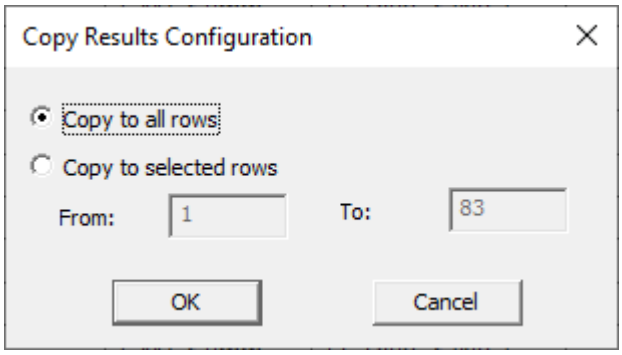


COPYING THE REQUIRED TEST RESULTS

When the required test results have been selected, this test and all subsequent tests in this batch file will calculate and display these Results. However, each test is individual so different results can be selected for each test. This means that if an additional result (or results) is required after the testing has taken place, then this result must be selected for each test.

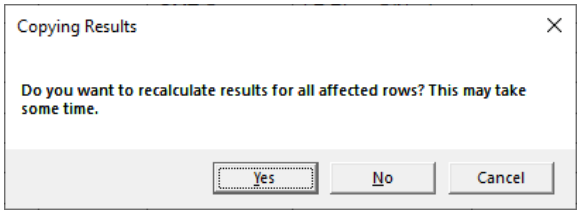
This can take an operator some time to do, especially if many specimens have been tested, so an automatic feature is provided. Select the first test in the batch file that requires the new result then display the graph. Click on EDIT and configure the results as required. Close the editor and allow the system to calculate the new results. Display the batch table the right mouse-click on this test row to display the context menu.

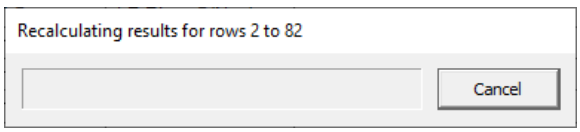




Select "Copy results to" and select which rows need updating to calculate the new result.

Click on OK and a message warns that this operation may take several minutes depending upon the type of test result and the number of test rows in the batch file. A progress indicator is provided to show the test status.





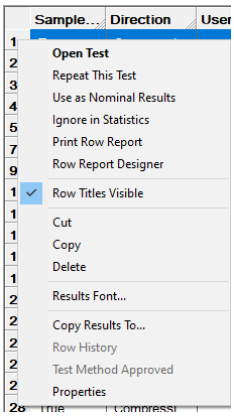
Note that this feature works with any type of test, including the User Configurable test in which case all UCT script in the Results area is copied.

REPEAT THIS TEST

The test action and required test results are automatically transferred from the last row in a batch file to a new test when a new test is created. This is the "normal" test sequence operation, so this action is suitable for production testing.

However, when test trials are being performed, or a UCT script is being developed for a new product, then each test may have different test actions and / or test results. The final required action and/or results may not be contained in the last row.

The required test action and test results can be copied from a specified row to a new test row by right mouse-clicking on this test row to display the context menu.

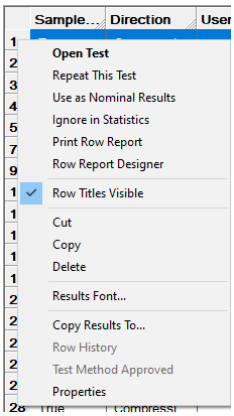


Select "Repeat this Test". A message warns that this operation will change the information in the new test.

ROW TITLES VISIBLE

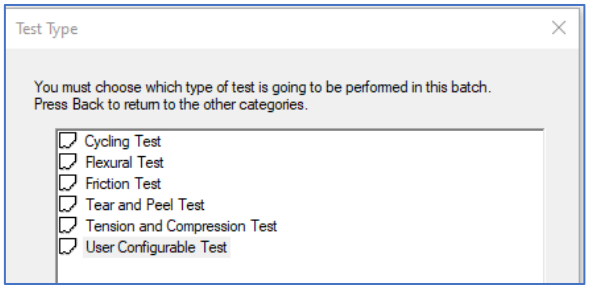
The column at the left-hand side of the batch table shows "unique" row numbers which are used by the internal database. These numbers do not indicate specimen numbers or test numbers etc. and may have "missing" numbers depending upon the batch view and row history.

The row numbers can be removed by right mouse-clicking on any test row to display the context menu then de-selecting the "Row Titles Visible" option.



TEST TYPES

A list of available test types is displayed when a new test is created.



Select the required Test Type then click on the "Finish" button to display the Test Setup Editor as shown below.

TENSION AND COMPRESSION TEST

This Test Type is used for a Tension or Compression test and can also put the machine into a Constant Load Mode, so is applicable for the following types of tests.

1. Pull to Limit
2. Pull to Break
3. Compress to Limit
4. Compress to Break
5. Constant Load (Creep Test)
6. Constant Extension (Relaxation Test)

The Test Speed can be

1. A fixed speed = Constant Velocity, CRE = Constant Rate of Extension, CRT = Constant Rate of Traverse
2. Load Rate Control
3. Stress Rate Control (requires Sample Area).

Basic Settings Tab

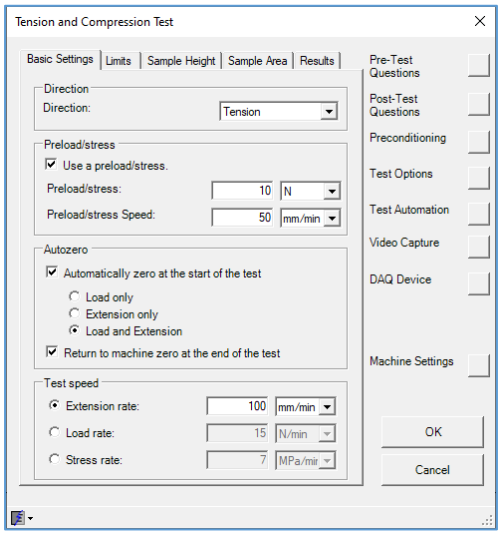
This tab is used to define the Direction, optional Preload, Optional Auto Zero, optional Auto Return and Test Speed.

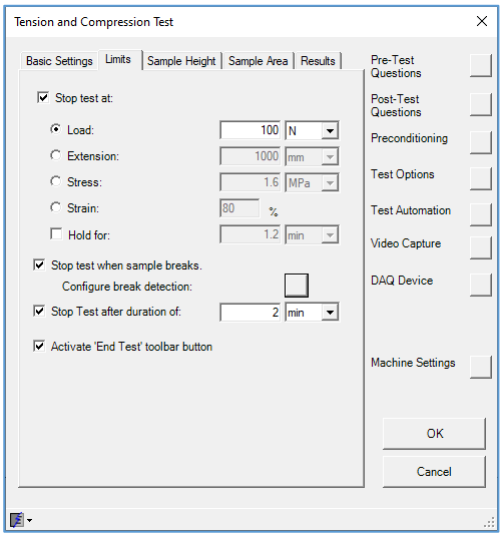
Limits Tab

This tab is used to define the stop conditions. The conditions are

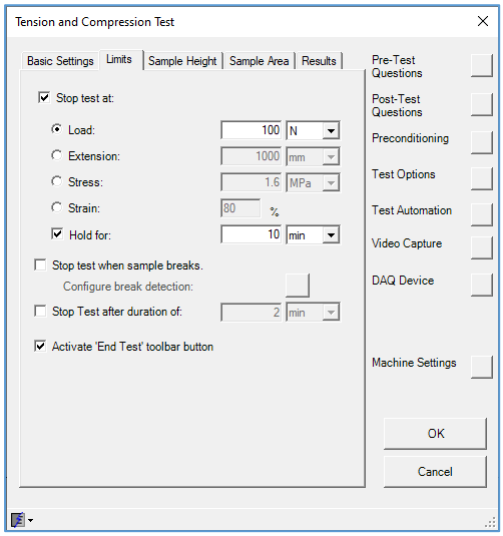
1. Stop at a load value (Limit)
2. Stop at an extension value
3. Stop at a Stress Value (requires Sample Area)
4. Stop at a Strain value (requires Sample Height)
5. Stop when sample breaks
6. Stop at a time duration
7. Stop when user clicks on the "End Test" button on the graph screen

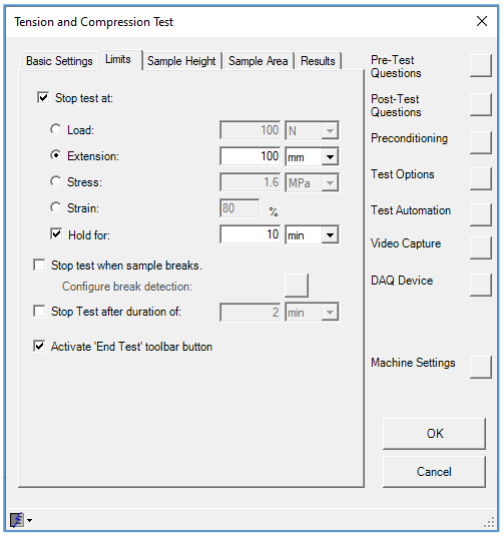
Note that these conditions can be combined so a test can be defined for example, to automatically stop if the load reaches 100N, or when the sample breaks or if the test takes longer than 2 minutes.





A Creep test is defined by selecting a Load Limit then defining the Hold Time and a Relaxation test is defined by selecting an extension Limit then defining the Hold Time.





Results Tab

The Maximum, Minimum, Break, Yield", Modulus and Strength categories show the "Common" results.

The "Total Elongation" results (e.g., "Percentage Total Elongation at Maximum Force") report the actual extension value at the selected point on the graph.

The "Percentage Non-Proportional Elongation" results (e.g., "Percentage Non-Proportional Elongation at Maximum Force") report the permanent elongation (plastic elongation) at the selected point on the graph. i.e., the elastic elongation is removed. This requires the "Linear Portion" to be defined in the Metals category.

The "Offset Yield" results require the "Modulus" to be defined in the Modulus category. The "Strength" results are force / Sample Width.

The "Results at X% Modulus", "Results at 25% Modulus" etc are mainly used in the rubber industry to report the stress at a given elongation (see ISO 37). Therefore, care should be taken to avoid confusion with the other use of modulus which is used to report the slope of the stress-strain curve at a given elongation.

The Creep and Relaxation test results are available under the "Creep and Relaxation" category on the Results tab.

CYCLING TEST

This Test Type is used for different types of Cyclic Test, so is applicable for the following types of tests.

1 Cycle for a specified number of cycles
2 Cycle until the sample weakens or breaks
3 Cycle for a time

The cycle limits can be a combination of Load, Extension, Stress or Strain and includes the cycling through zero facility.

Basic Settings Tab

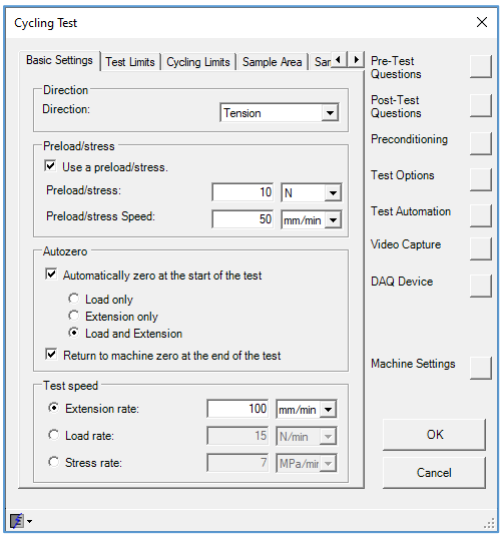
This tab is used to define the Direction, optional Preload, Optional Auto Zero, optional Auto Return and Test Speed.

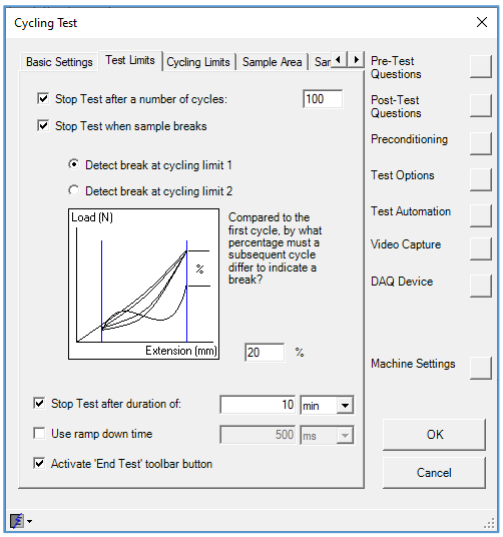
Test Limits Tab

This tab is used to define the stop conditions. The conditions are

1 Stop after a defined number of cycles
2 Stop when the sample breaks (or weakens)
3 Stop after a time duration
4 Stop when user clicks on the "End Test" button on the graph screen

Note that these conditions can be combined so a test can be defined to automatically stop after 100 cycles, or when the sample breaks or if the test takes longer than 10 minutes.





The cycle test does not use a "Normal" Break Detector" but measures the load or extension at the end of each movement to decide when to stop the test.

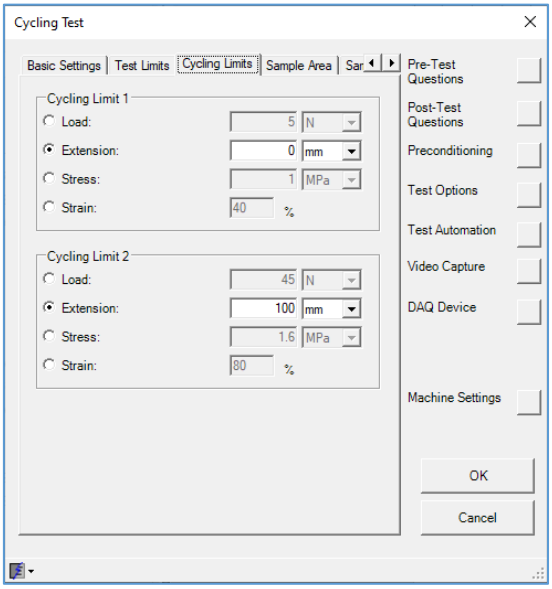
Assume the test has a load limit and returns to zero extension, e.g., 50N and 0mm. The extension at 50N during the first cycle is measured and stored as a reference extension. The extension at 50N on the following cycles is measured and the test will end when this extension exceeds the reference extension by the specified percentage value.

Assume the test has an extension limit and returns to zero extension, e.g., 100mm and 0mm. The load at 100mm during the first cycle is measured and stored as a reference load. The load at 100mm on the following cycles is measured and the test will end when this load drops below the reference load by the specified percentage value.

The test can be ended after a time duration but note that the time is only measured at the end of a cycle. Therefore, if the stop condition is to end the test after 10 minutes and a cycle starts at 9 minutes 55 seconds, the test will continue past the 10-minute period but stop at the end of the cycle when the time is measured and now exceeds the required 10 minutes.

Cycling Limits Tab

This tab is used to define the cycle conditions. Note that cycling limit 1 is the return position so to cycle from 0mm to 100mm then back to 0mm again, enter 0mm for Cycling Limit 1 and 100mm for Cycling Limit 2.



Results Tab

The common results for a cycling test are listed under the "Cycles" category and these provide the results measured during the first cycle and the results measured during the last cycle.

FLEXURAL TEST

This Test Type is used for different types of Flexure (Bending) Tests, so is applicable for the following types of test.

1 3-Point Bend
2 4 -Point Bend

This Test Type can also put the machine into a Constant Load Mode.

The Test Speed can be

1 A fixed speed = Constant Velocity, CRE = Constant Rate of Extension, CRT = Constant Rate of Traverse
2 Load Rate Control

Basic Settings Tab

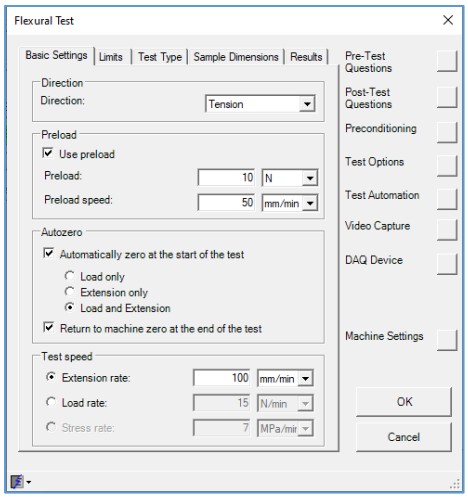
This tab is used to define the Direction, optional Preload, Optional Auto Zero, optional Auto Return and Test Speed.

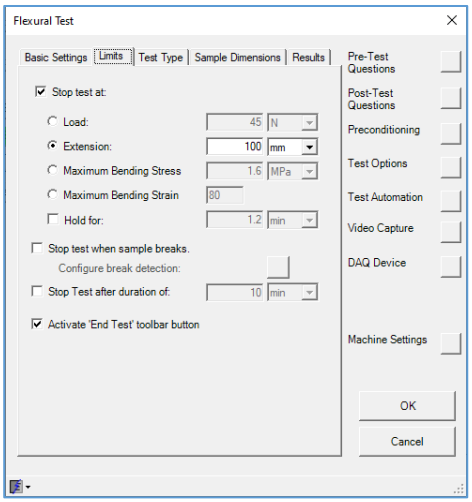
Limits Tab

This tab is used to define the stop conditions. The conditions are

1 Stop at a load value (Limit)
2 Stop at an extension value
3 Stop at a Bending Stress Value (requires Sample Area)
4 Stop at a Bending Strain value (requires Sample Height)
5 Stop when sample breaks
6 Stop at a time duration
7 Stop when user clicks on the "End Test" button on the graph screen

Note that these conditions can be combined so a test can be defined to automatically stop if the load reaches 100N, or when the sample breaks or if the test takes longer than 2 minutes.



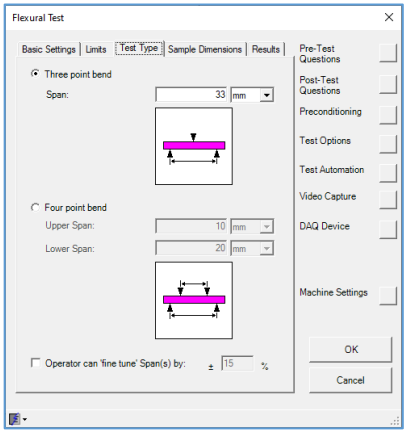


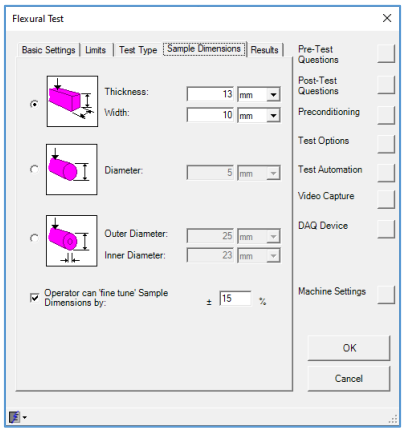
Test Type

This tab is used to define the span for a 3-point bend fixture or the spans for a 4-point bend fixture.

Sample Dimensions

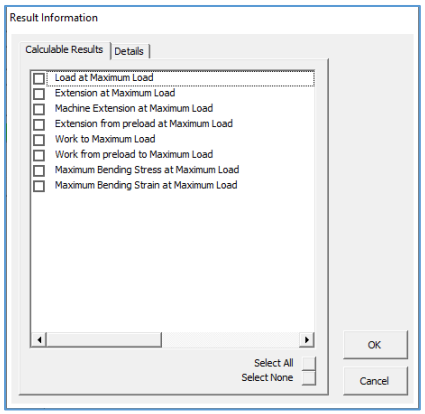
This tab is used to define the sample cross-sectional area.

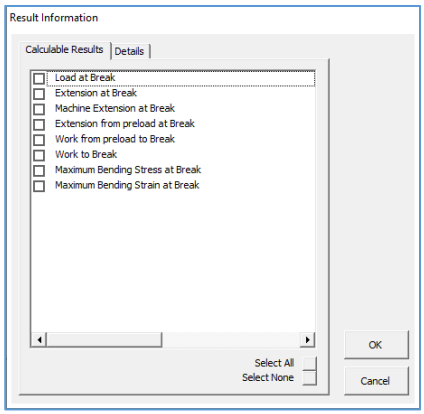


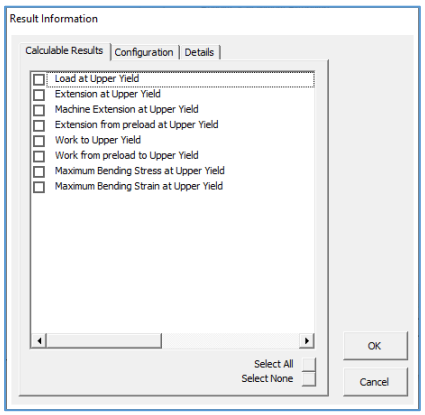


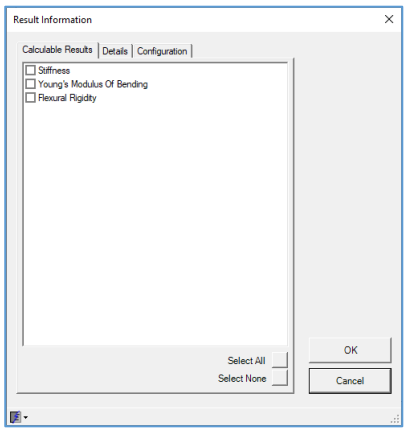
Results Tab

The common results are listed under the "Maximum", "Minimum", "Break", "Yield" and "Modulus" categories and each of these categories have additional "Bending" results









FRICTION TEST

This Test Type is used for a Tension or Compression test where there is an initial peak force followed by a series of additional peaks, so is applicable for the following types of tests.

1 Sliding Friction Test
2 Needle Insertion
3 Needle Insertion and Extraction

Basic Settings Tab

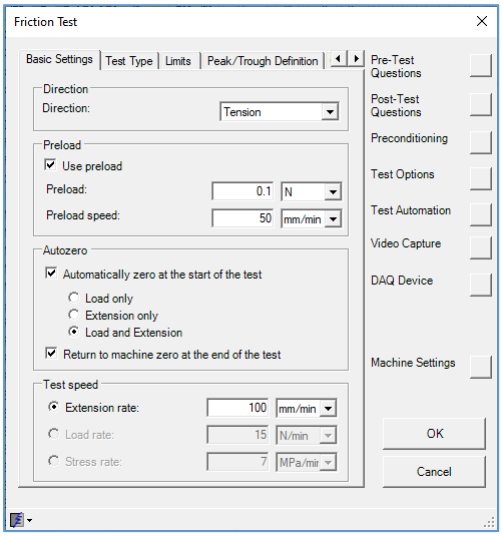
This tab is used to define the Direction, optional Preload, Optional Auto Zero, optional Auto Return and Test Speed.

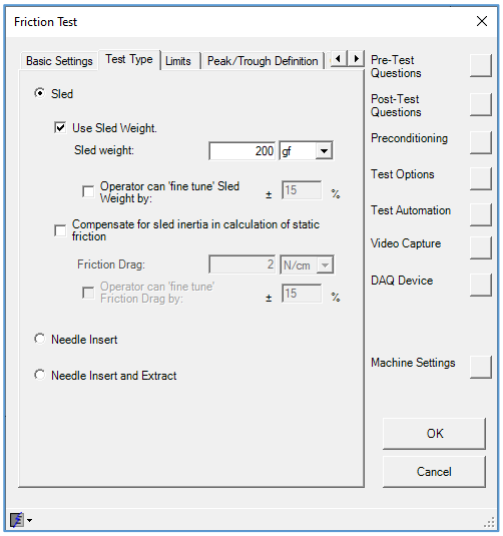
Test Type Tab

This tab is used to define the type of test.

1 The "Sled" option is used for a Sliding Friction test, so the "Use Sled Weight" option is normally required and the sled is normally 200g. The test moves to the extension limit then stops.
2 The "Needle Insert" option is used for a needle pushing into a membrane. The test moves to the extension limit then stops.
3 The "Needle Insert and Extract" option is used for a needle pushing into a membrane then pulling back out again. The test moves to the extension limit, returns to the start of test position at the same speed then stops.

Some Sliding Friction standards require a spring to be fitted between the sled and the drive cord to accurately measure the Static Friction value. If this type of test is performed, check the ""Compensate for sled inertia…" checkbox and enter a value for the spring (normally 2N/cm). Note that the spring may cause force oscillations to occur after the first peak so 2 tests may be required. Test 1 is performed with a spring to measure the Static Friction. Test 2 is performed without a spring to measure the Dynamic (Kinetic) Friction.



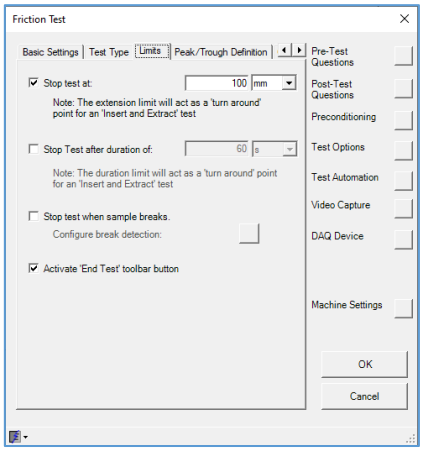


Limits Tab

This tab is used to define the stop conditions. The conditions are:

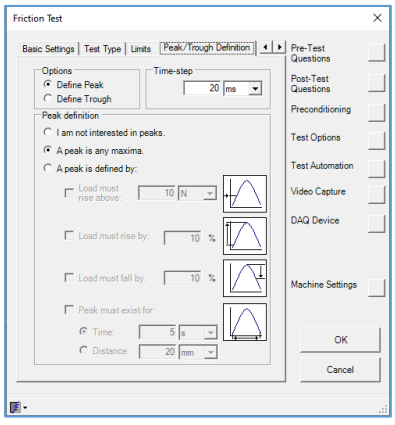
1. Stop at an extension value (or return at this value for the extraction part of the test)
2. Stop at a time duration
3. Stop when sample breaks
4. Stop when user clicks on the "End Test" button on the graph screen

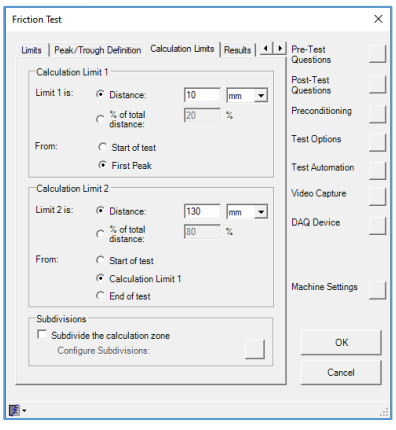
Note that these conditions can be combined but this is unusual for this type of test.



Peak/Trough Definition Tab and Calculation Limits Tab

These tabs are used together to define the Peak and Trough results. The test is expected to show an initial peak force followed by a series of additional peaks so suitable definitions are shown below. The settings below define the Static Friction as the first peak after the start of the test and the Dynamic (Kinetic) Friction is measured between 10mm after the first peak and 140mm after the first peak.





Results Tab

The common results are listed under the "Friction" category.

The "Load at Calculation Limits", "Average Load between Calculation Limits", "Kinetic Force", "Midpoint Force" and Instantaneous Force" are normally used for Needle tests.

The "Coefficient of Kinetic Friction" and the "Coefficient of Static Friction" are normally used for sliding friction tests.

TEAR AND PEEL TEST

This Test Type is used for a Tension test where there are many peaks in the force graph, so is applicable for the following types of tests.

1 Tear Test
2 180-degree Tear Test
3 90-degree Tear Test
4 T-Peel Test
5 90-degree Peel Test
6 180-degree Pell Test
7 Climbing Drum Test

The Test Speed can be:

1. A fixed crosshead speed = Constant Velocity, CRE = Constant Rate of Extension, CRT = Constant Rate of Traverse
2. A propagation speed

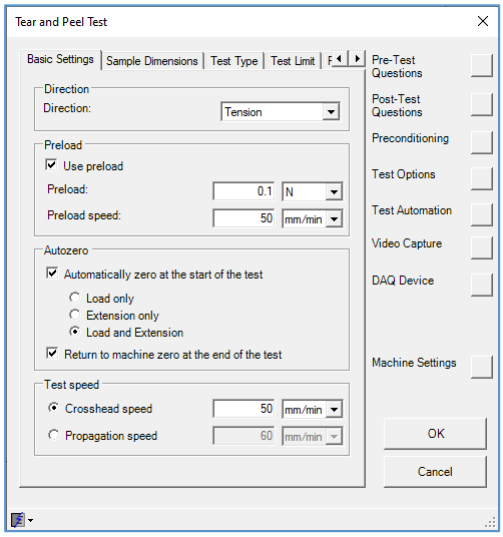
The propagation speed is the speed of the tear or peel through the sample and is normally the same speed as the crosshead speed. However, this is not the case for a "180-degree Tear" test or a "T-Peel" test where the propagation speed is half of the crosshead speed.

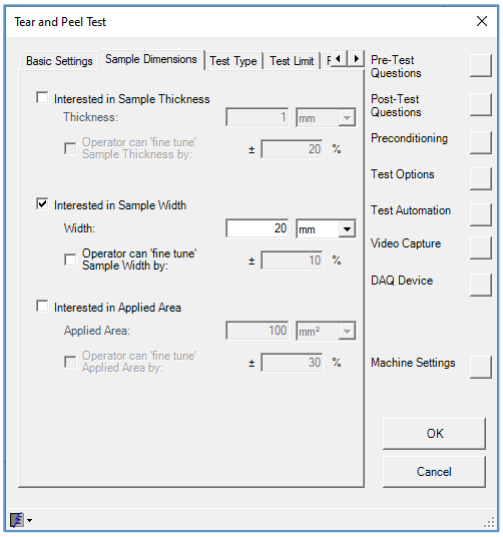
Basic Settings Tab

This tab is used to define the Direction, optional Preload, Optional Auto Zero, optional Auto Return and Test Speed (crosshead speed or propagation speed).

Sample Dimensions Tab

This tab is used to define the sample dimensions. A tear test may require the sample thickness to calculate results. A peel test may require the sample width to calculate results.





Test Type Tab

This tab is used to define the type of test. The test types are

1 Plain Tear
2 180-Degree Tear (Trouser Tear)
3 90-Degree Tear
4 T-Peel
5 90-degree peel
6 180-degree peel
7 Climbing Drum

Note that the test type selection determines the test speed and the test limit.

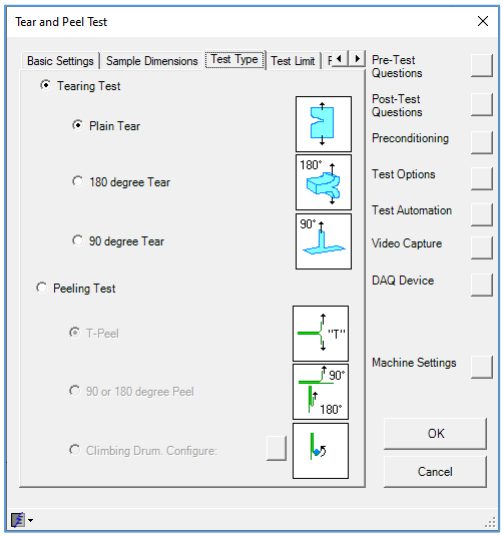
Test Limit Tab

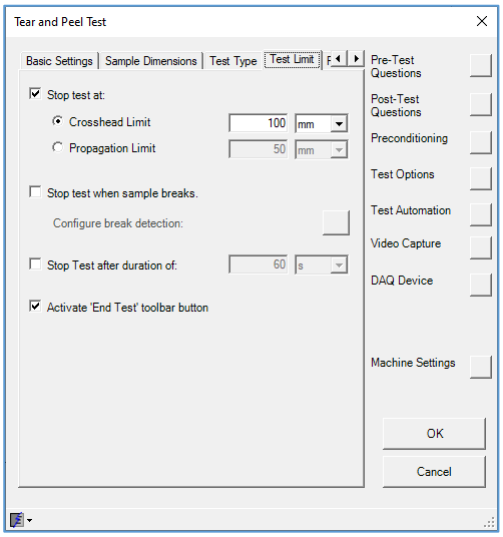
This tab is used to define the stop conditions. The conditions are

1 Stop at a crosshead limit (machine extension limit)
2 Stop at a propagation limit (tear or peel travel limit)
3 Stop when sample breaks
4 Stop at a time duration
5 Stop when user clicks on the "End Test" button on the graph screen

The propagation limit is the distance that the tear or peel moves through the sample and is normally the same distance as the crosshead travel. However, this is not the case for a "180-degree Tear" test or a "T-Peel" test where the propagation distance is double the crosshead travel.

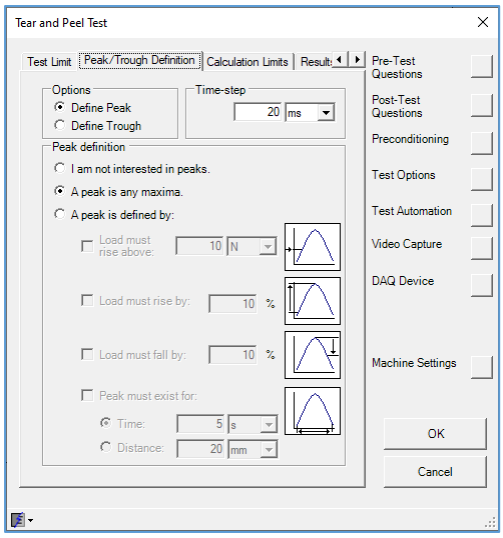
Note that these conditions can be combined so a test can be defined to automatically stop at 100mm crosshead travel, or when the sample breaks or if the test takes longer than 2 minutes.

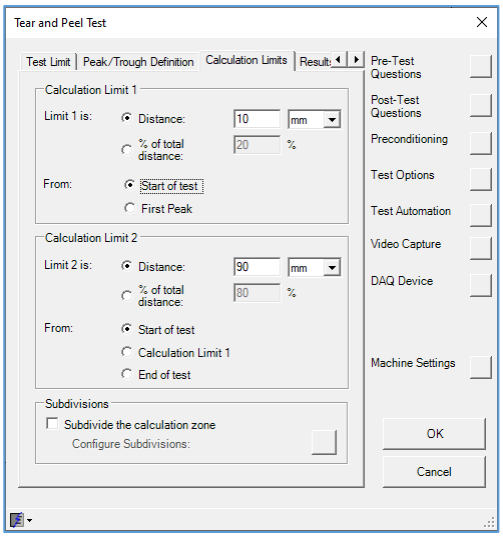




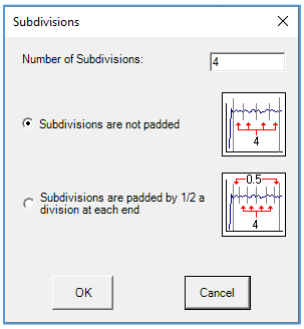
Peak/Trough Definition Tab and Calculation Limits Tab

These tabs are used together to define the Peak and Trough results. The test is expected to show many peaks in the force graph and suitable definitions are shown below. The settings below calculate the peaks between 10mm after the start of the test and 90mm after the start of the test, assuming that the test moves to 100mm crosshead limit.





Some tests require the graph to be "split" into equal parts (Subdivisions) and results calculated per subdivision. This action is enabled by clicking on the "Subdivide the calculation zone" checkbox then clicking on the small square button to define the subdivisions.



Results Tab

The common results are listed under the "Peaks and Troughs" and the "Peel" categories.

Most of these results can report the values between the calculation limits or for each subdivision if this feature is requested.

The "Results at X Peaks" etc. reports the specified number of highest peaks. Click on the "Configuration" tab to define the required number of peaks.

The "Peel Resistance" (Peel Strength) is the average load divided by the sample width.

The "Midpoint Force" is the average of the highest peak and the lowest trough (minimum) between the calculation limits.

The "Green Strength" is the load divided by the extension at a specified time (normally 60 seconds).

USER CONFIGURABLE TEST

The NexygenPlus "Built-In" Tests shown above are very flexible and comprehensive and most types of tests can be performed using these "Standard" test set-ups.

However, there will always be a requirement for specialised tests that cannot be performed using the "Built-In" test set-ups, but these can be created using the User Configurable Test (UCT) set-up.

The User Configurable Test uses a combination of VB Script (Visual Basic) and UCT commands to define the test action and a "Test Configurator" is provided to assist with Test Script generation. The "Built-In" test results can also be supplemented by VB Script results.

Differences between NEXYGEN Plus UCT and NEXYGEN MT with ONDIO

If you are upgrading from NEXYGEN MT with ONDIO, most of the UCT functions are the same as for ONDIO except for the differences listed below.

1 The PRIMARY Script is now called the **TEST** script and is displayed by clicking on the TEST tab. This screen initially shows the "TEST CONFIGURATOR" but also contains a Script Window with a "List of Commands".

2 The SECONDARY Script is now called the **RESULTS** script and is displayed by clicking on the RESULTS tab then clicking on the CALCULATIONS button. Note that this Script Window also contains a "List of Commands".

3 The word FOUNDATION is no longer used, so Foundation.Graph is now **Graph**, e.g., Foundation.Graph.Abort is now **Graph.Abort**.

4 The Console is referenced directly, so Foundation.C is now **Console**, e.g., Foundation.C.Load is now **Console.Load**.

5 The **EXTRALOADAXIS** and **EXTRAEXTENSIONAXIS** methods now require quantity-based scaling factors

6 The console now supports **Zero**, **ZeroLoad** and **ZeroExtension** methods

7 The sample Breadth is now replaced by **Thickness**

8 **GLOBAL** is used to store a value into a Global variable and **GETGLOBAL** is used to read a value from a Global variable. ONDIO used Global to both store and read a value. This feature is used to "pass" a value "forwards" from one screen to another during a test. A value measured in the Preconditioning script can be passed to the Test Script and to the Results Script. A value measured in the Test Script can be passed to the Results Script.

Store a Global Value

```
Global "Name", Value
```

Read a Global Value

```
Set V = GetGlobal("Name")
```

Brackets mean return a value

9 The UCT has an additional **TimeAtPreload** property.

```
If Graph.Note("PreloadStage.Finished").Value = True Then
    Set PT = Graph.Note("TimeAtPreload").Value
End If
```

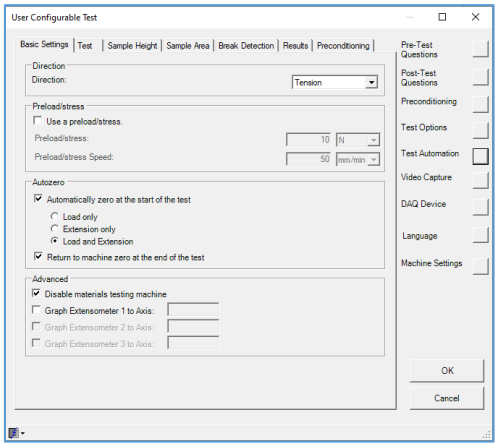
10 There are 3 types of Graph Axes. ONDIO did not show these differences so an Axis function may give an error if the function was not applicable to that axis. NEXYGEN Plus now groups these Axes into "**DATA SOURCE**" Axes, "**VIRTUAL**" Axes and the "**TIME**" Axis. A reference to a GRAPH AXIS OBJECT may require an "**AXIS IDENTIFIER**" to indicate the type of Axis.

11 The OPTIONAL PRECONDITIONING script can be used to "work" the sample before testing noting that no graph is shown or stored

12 The OPTIONAL PRECONDITIONING script can also be used to provide a specialized Datum function

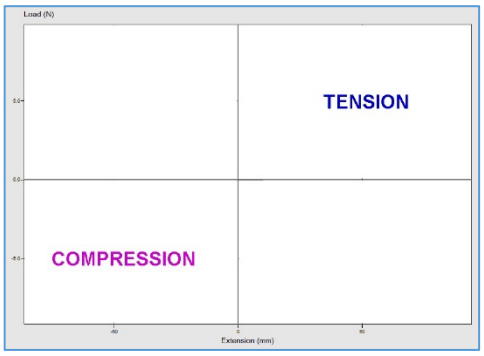
Basic Settings Tab

This tab is used to define the Direction, optional Preload, optional Auto Zero, optional Auto Return and any Additional Extensometers. Note that the Test Speed is not defined on this tab because each machine movement can use a different speed.

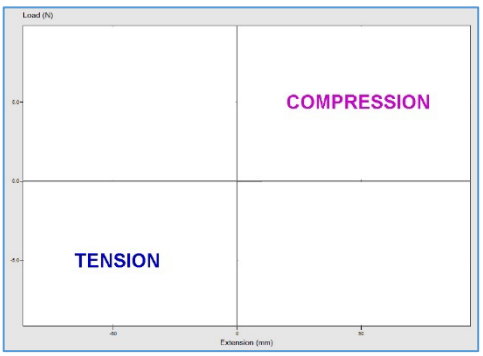


Note that if a "Cycle through Zero" test is performed, the direction selector determines the sign of the Limit and the sign of the positive quadrant. When Tension is selected, a positive Limit (e.g., 10mm or 10N) moves to a position above 0mm or applies a tensile force and a negative Limit (e.g. -10mm or -10N) moves to a position below 0mm or applies a compressive force.

When Compression is selected, a positive Limit (e.g., 10mm or 10N) moves to a position below 0mm or applies a compressive force and a negative Limit (e.g. -10mm or -10N) moves to a position above 0mm or applies a tensile force.



Tension



Compression

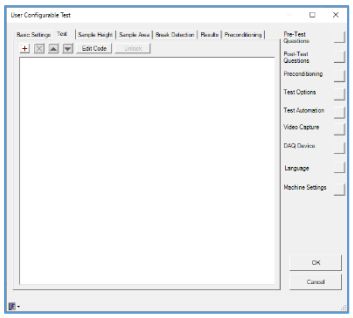
Test Tab

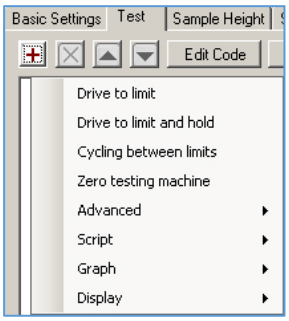
This tab is used to define the machine movement, e.g., limit and speed. A test can be a single movement or may use many movements.

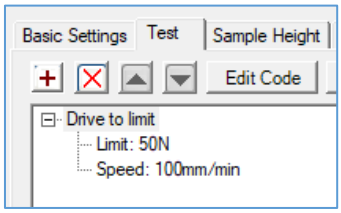
Test Configurator

Click on the TEST tab to view the "Test Configurator" screen shown below. Note that script CANNOT be typed directly into this area. Click on the "+" at the top left-hand side of the screen to display the "Test Configurator" which contains a list of test actions.

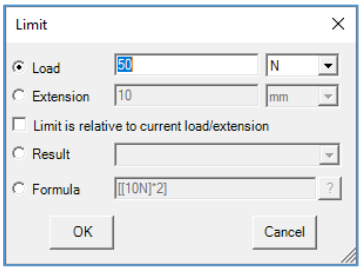
To create a "Simple" limit test, select the "Drive to Limit" option then the screen will show a "Drive to Limit" entry with a default test action

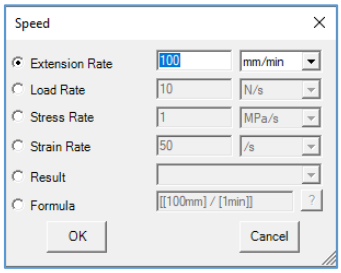


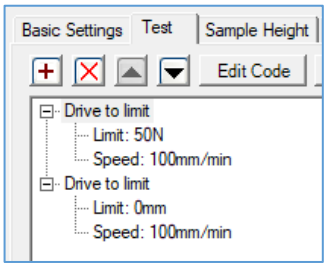




To define the test limit, double click on the LIMIT text to display a Limit dialog. To define the test speed, double click on the SPEED text to display a Speed dialog. Further test actions can be added by clicking on the "+" and selecting the action. The screens below show a single cycle.





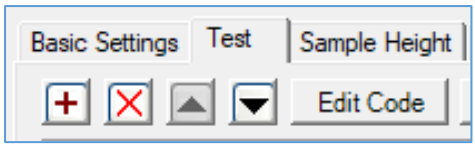


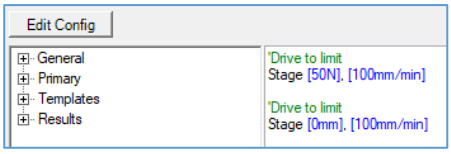
Any test action that is no longer required can be deleted by selecting the action heading (e.g., "Drive to Limit") then clicking on the "X". The test actions can be re-ordered by selecting the action heading then clicking on the "Up Arrow" or "Down Arrow"

The finished test can be performed without any further typing. Click on the OK button to close the UCT Test Editor ready for testing

Script Editor

The text created by the "Test Configurator" is VB Script and this script can be viewed by clicking on the EDIT CODE button.





The script can be modified as required or a completely new script can be created without using the "Test Configurator".

The example script shows 4 lines. Lines 1 and 3 are shown in green and are "comments", i.e., are not part of the test action. Any line can be made into a "comment" line by typing an apostrophe (') at the beginning of the line so that the complete line is shown in green.

Lines 2 and 4 contain the word "STAGE" and these lines control the testing machine. The STAGE method requires 2 parameters of "WHERE TO" and "HOW FAST", e.g.

Stage [50N], [100mm/min]

Note the comma separating the 2 parameters. The parameter values contain numbers and "Units" text and MUST be enclosed by square brackets. The complete parameter (including the brackets) is displayed in blue and this shows that this parameter is a QUANTITY OBJECT, which is a special variable for storing QUANTITIES (values with units). These OBJECTS require special handling in VB Script because VB Script does not know how to use them. All QUANTITY OBJECTS are created by NEXYGEN Plus by enclosing the text within square brackets.

The units must be the internationally recognised units, e.g., "**N**" and not "**n**" for Newtons noting that the script will be shown in red if it is incorrect, e.g.

Stage [50n], [100mm/min]

VB can perform calculations using numbers, e.g., 2 + 3 but it cannot calculate using Quantity Objects, e.g., 2N + 3N. To calculate using QUANTITY OBJECTS, enclose the COMPLETE calculation in square brackets, e.g.

[[2N] + [3N]] **Note the colours**

A QUANTITY OBJECT can be stored for use later in the script using the SET method, e.g.

Set Speed = [100mm/min]

The value is this variable can be used later in the script, but the variable is not enclosed in square brackets. However, any calculation using this value must be totally enclosed in square brackets, e.g.

Set Speed = [100mm/min]
Stage [200N], Speed
Stage [0mm], [Speed * 2]

Note that a Variable Name CANNOT start with a NUMBER, e.g. **1Speed**. In this case, use **Speed1**.

To summarise,

1 All user defined QUANTITY OBJECTS are created by enclosing the text in square brackets
2 Any QUANTITY OBJECTS provided by NEXYGEN Plus are NOT enclosed in square brackets
3 Any calculation using QUANTITY OBJECTS is fully enclosed in square brackets
4 All other brackets are circular brackets ( )
5 Use the SET method to store QUANTITY OBJECTS

When more than one stage method is used, the script will wait on the STAGE line until the Stage has finished before moving to the next line. Therefore, the script is unable to perform any further actions when a Stage is running. Also note that each stage can drive the machine at a different speed if required.

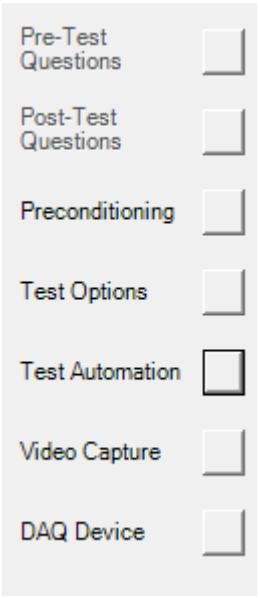
Results Tab

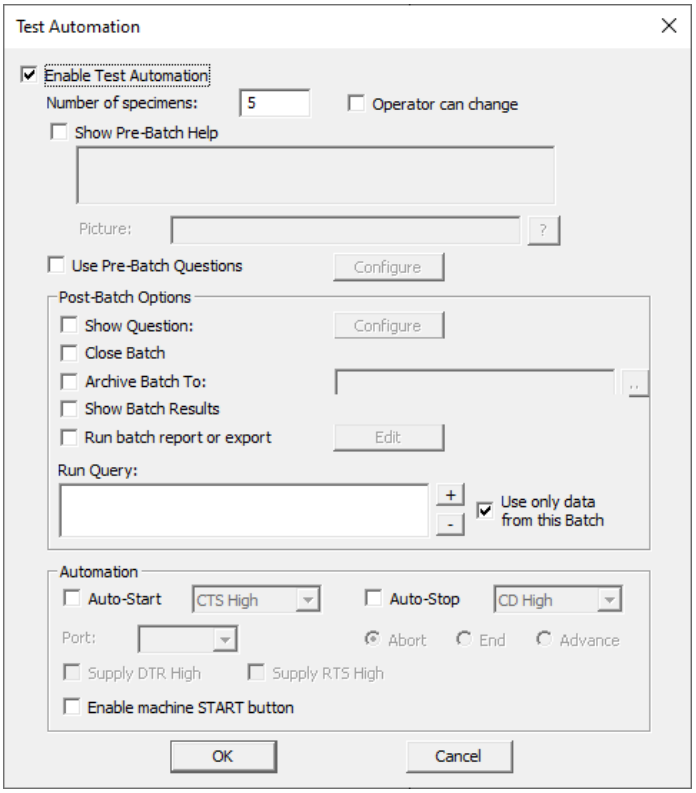
The "Built-In" results can be selected in the same way as for any other test setup.

However, the UCT engine provides many properties and methods to allow specialised results to be obtained and this is covered in a separate UCT manual.

TEST AUTOMATION

Every Test Setup has a series of buttons on the right-hand side of the editor and one of these is labelled "Test Automation". Clicking on this button displays the "Test Automation" dialog.





PRINCIPLE OF OPERATION

The test automation feature is used to simplify the testing process, especially for production line purposes.

There are several ways that this feature can be used as shown below.

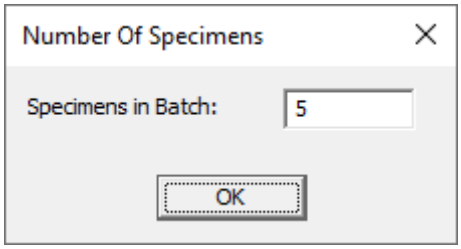
1 The operator must test a specified number of specimens then automatically print a report or perform a data export, e.g., export to Excel.

2 The operator must test a specified number of specimens and automatically print a report or perform a data export, e.g., export to Excel, then the batch file is archived so further tests cannot be performed in this file. This requires the use of Templates.

3 The testing machine is controlled by or is controlling some external device, e.g., a sample placement system. This requires a separate COM Port which is additional to the testing machine COM Port.

In all cases, the "Enable Test Automation" checkbox must be checked, and a "Default" number of specimens entered.

If the number of specimens may change (or is unknown), check the "Operator can change" checkbox so a dialog is displayed for the operator to enter the number at the start of the test sequence.

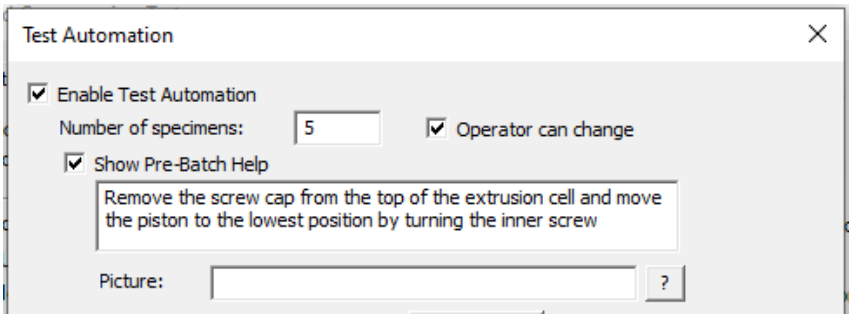


Each specimen is automatically numbered in a test sequence and the number resets to 1 when the test sequence is repeated, e.g., if 5 specimens are tested per shift.

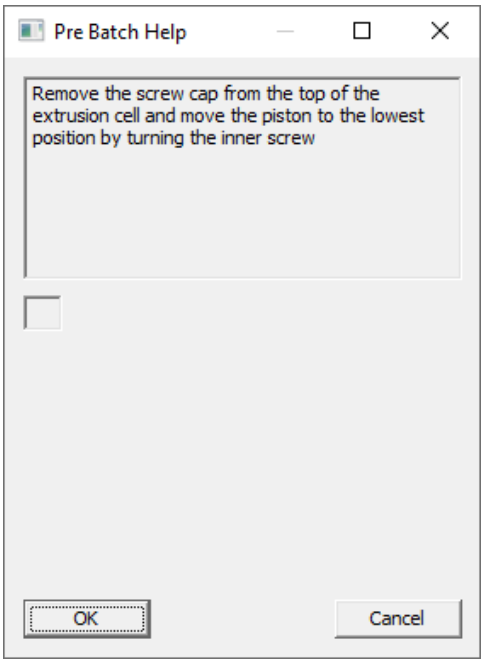
PRE-BATCH HELP

If the testing system has several grips or fixtures, or if the operator must perform a specific action for this test, "help" text and an optional picture may be displayed for guidance.

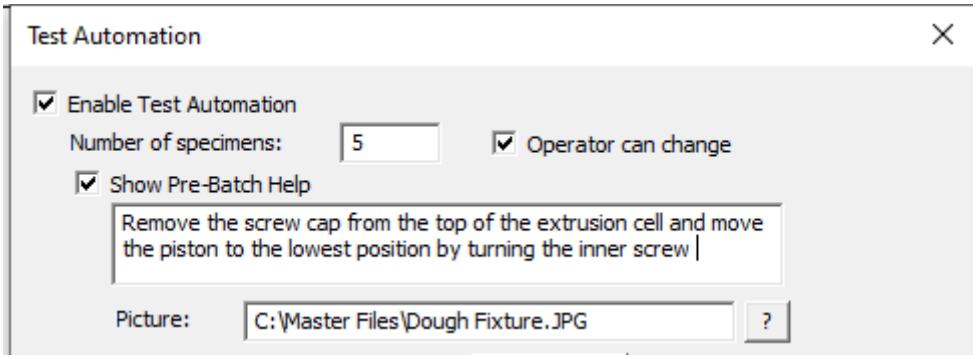
Check the "Show Pre-Batch Help" checkbox then enter the required text.



A "Help" dialog is displayed at the start of the test sequence as shown below.



If a picture is required, click on the "?" to the left of "Picture" and select the picture file.



A "Help" dialog with the picture is displayed at the start of the test sequence as shown below.

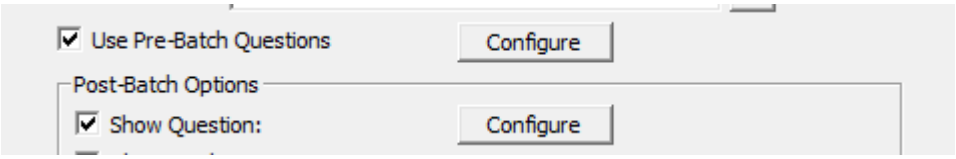


PRE-BATCH AND POST-BATCH QUESTIONS

Pre-Test questions are provided to allow the operator to add extra information for each test as already shown in the "Pre-Test and Post-Test Questions" section.

These questions are displayed for every specimen in the test sequence, but this may not be necessary, e.g., all the specimens may be from the same "Lot Number".

Pre and Post Batch questions are selected by checking the respective checkbox and defining the questions in the same way as shown in the "Pre-Test and Post-Test Questions" section.



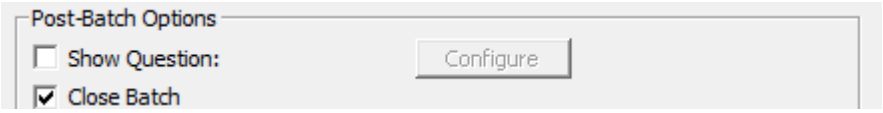
The Pre-Test questions are displayed at the start of the test sequence and the answers are automatically entered into each test of this sequence, i.e., for every specimen.

The Post-Test questions are displayed at the end of the test sequence and the answers are entered into the first test of this sequence to allow the <FIRST ??> tag to display these results in a "Batch" report.

Specimen	Comments	Lot No	Load at Maximum Load
1	Sample 2 was discoloured	A761	14.044 N
2		A761	13.875 N
3		A761	13.893 N
4		A761	13.878 N
5		A761	13.653 N

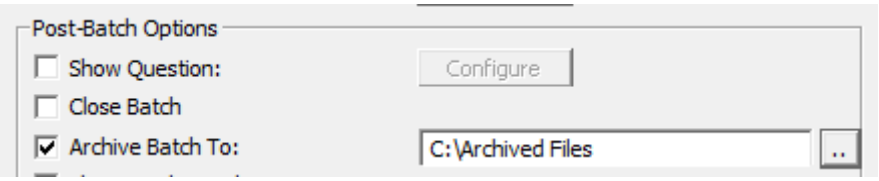
AUTOMATICALLY CLOSING THE BATCH

When a test sequence has finished, the batch file stays displayed on the screen. This may be useful if the same test file is always used for testing or if the test results require post-test analysis. If different batch files are required during the testing process, it might be easier for the operators if the batch file automatically closes, and this action occurs when the "Close Batch" checkbox is checked.



AUTOMATICALLY ARCHIVING THE BATCH

When a test sequence has finished, the batch file can be automatically archived so no further tests can be performed in this file. This feature is used together with the Templates feature. Check the "Archive Batch To" checkbox then select the required Archive Folder which can be on a network drive.



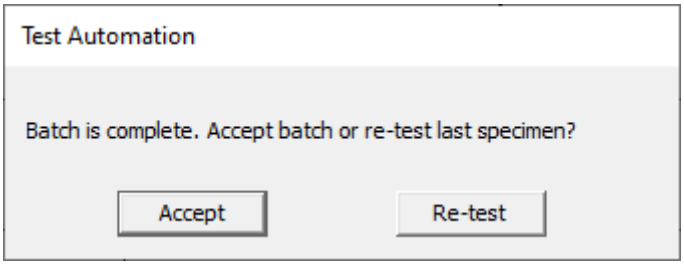
The folder can also be configured to protect these archived files. The access rights can be set to allow files to be initially copied (archived) into this folder by NEXYGEN Plus but the file cannot then be modified, deleted, or renamed. This prevents any further tests from being performed. This feature is provided as part of the Windows operating system and is not part of NEXYGEN Plus and does require that an "Operator" has a different log-on to the computer than a "Supervisor".

SHOW BATCH RESULTS

When a test sequence has finished, the last graph is displayed on the screen. If the Batch Results screen is required at the end of each test sequence for analysis purposes, check the "Show Batch Results" checkbox.



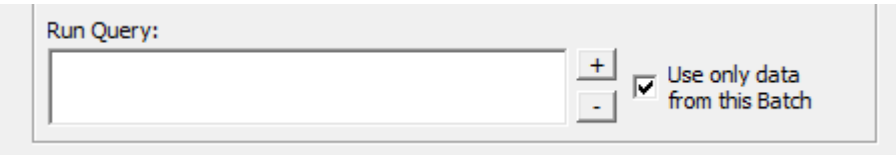
When then last specimen of the test sequence has been tested, the graph screen is displayed together with a "Batch Complete" dialog.



Clicking on "Accept" will then display the Batch Results table.

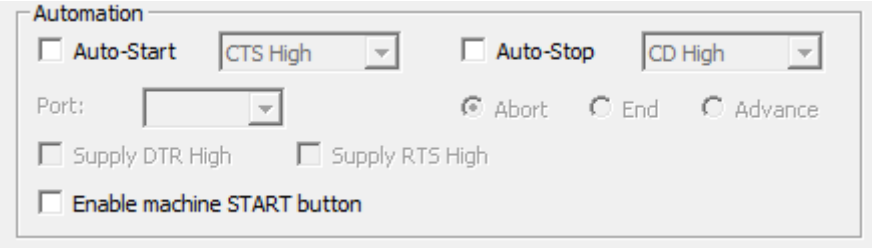
BATCH REPORTS AND EXPORT

The Batch Reports and Exports operate the same way as shown in the Test Options section. It is "usual" to only report the data for the current test sequence so the "Use only data from this Batch" checkbox should be checked. If it is not checked, the all the data in the Batch file will be reported or exported.



AUTO-START AND AUTO-STOP

The "Automation" section contains the controls for the Auto-Start and Auto-Stop features.



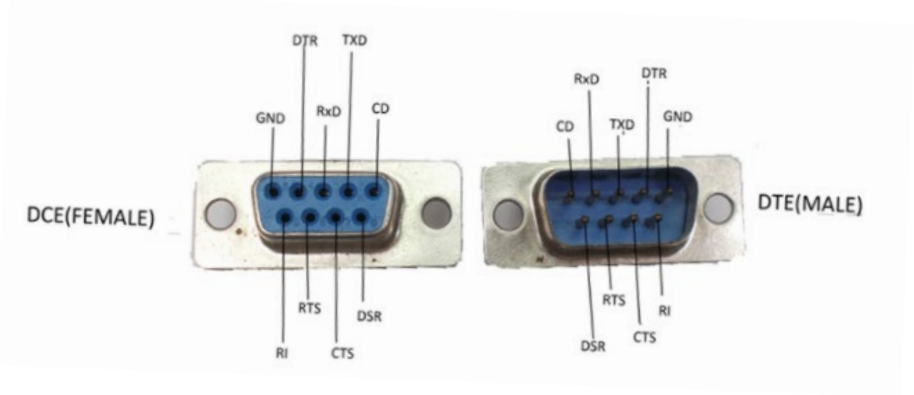
The 2 features are

1 Auto Start / Auto Stop a test using an additional COM Port digital signal
2 Start a test by pressing the GO key on console (LS and LD machines ONLY)

AUTO-START AND AUTO-STOP USING A COM PORT SIGNAL

A "simple" remote start system consists of a second COM Port and a normally open (N/O) switch. A "Power Supply" is created by checking the "Supply DTR High" checkbox. The "Auto-Start" line is selected by checking the "Auto-Start" checkbox and selecting which line is required for the Auto-Start signal, e.g., "CTS High".

The N/O switch is connected between the DTR line and the CTS line. The test will start when the switch is closed. The picture below shows the pin numbers and signal names for 9 Way "D" Type connector.



A running test can be stopped or controlled by a COM Port signal in the same way using a second N/O switch. The "Auto-Stop" line is selected by checking the "Auto-Stop" checkbox and selecting which line is required for the Auto-Start signal, e.g., "CD High". The required action, (Abort, End or Advance) is then selected using the selectors and this action occurs when this switch is closed.

In all cases, select the required Port drop-down selector.

AUTO-START USING THE MACHINE GO BUTTON

The LS and LD firmware allows a test to be started by pressing the GO button on the machine console or handheld device. This feature requires that the "Enable Machine Start Button" checkbox is checked on the Test Automation configuration screen.

TEST AUTOMATION AND UCT SCRIPT

The specimen number can be used to control a UCT (User Configurable) Test by using a script.

The current specimen number is read by

Graph.Batch.SampleNumber

The required number of specimens is read by

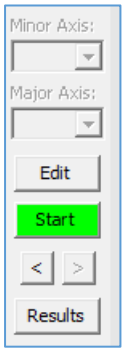
Graph.Batch.AutomationSamples

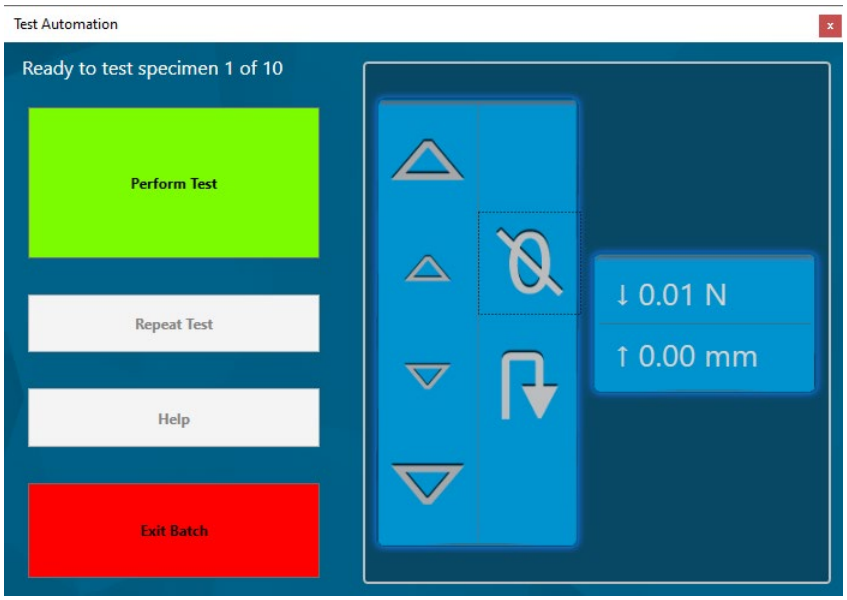
To perform a different action for the first sample of a test sequence, use

```
If Graph.Batch.SampleNumber = 1 then
        'do action 1
Else
        'do action 2
End if
```

PERFORMING A TEST

Start the test sequence by clicking on the green "Start Test" button to the left of the graph to display the "Test Automation" screen.



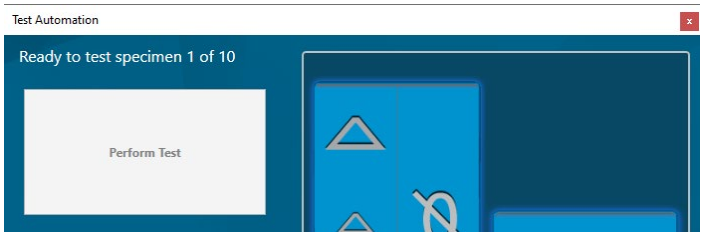


Note that the buttons on the Software Console are disabled when the "Test Automation" screen is displayed so the crosshead cannot be moved or zeroed using these buttons, i.e., the Software Console cannot be used to position the crosshead. It does continue to display the current load and extension values. However, the "Test Automation" screen includes separate Jog keys so the crosshead can be positioned using these keys.

Click on the green "Perform Test" button to test each specimen in the sequence.

If the "Enable Machine Start Button" checkbox is checked on the Test Automation configuration screen, each test can be started using the machine console or handheld device. This simplifies the testing by allowing the operator to fit a specimen in the machine then pressing the key on the local control console instead of having to use the computer mouse.

If the "Auto Start" checkbox is checked on the Test Automation configuration screen, each test can be started using an external switch (or voltage level) on a second COM Port. Note that the "Perform Test" button is disabled when this option is selected.



At the end of the test, the "Test Automation" screen is re-displayed ready for the next specimen and the heading will show the sequence number, e.g., "Ready to test specimen 2 of 10".

However, assume that a test was invalid, e.g., the grips were not tightened when the "perform Test" button was clicked. The specimen is still ready for testing, but the sequence counter has automatically increased. This untested specimen can be tested by clicking on the "Repeat Test" button to decrease the specimen counter to allow this specimen to be tested.

PERFORMING A TEST WITH EXTERNAL SIGNALS

A testing system may require external signals to indicate the test status, e.g., when connected to a specimen placement system. The specimen placement needs a status signal to inform when the machine is performing a test and when the machine is ready to receive a new specimen.

The "Supply DTR High" and "Supply RTS High" signals both go high (if selected) when the "Test Automation" screen is displayed. This signal can therefore be used to inform the external device that the machine is testing so a new specimen cannot be placed in position. When the test is started, these lines go low for about one second then return high again and stay high until the end of the test when they go low.

Note that the end of the test occurs before the "Auto-Return" takes place so the lines may go low before the crosshead has returned to the start of test position. This can be corrected in a User Configurable test by adding a "return Stage" in the script, e.g.,

Stage [100mm], [100mm/min]
Stage [0mm], [1000mm/min]

DAQ DEVICE

GENERAL

The testing machine measures the force and crosshead extension during a test and plots these values on the graph. If an optional extensometer is connected to the machine, this "normally" replaces the crosshead extension unless a User Configurable test is used when both extensions can be plotted.

Some tests may require additional inputs to be plotted and this can be achieved by using a National Instruments DAQ device.

All test types can plot additional analogue signals, but a "User Configurable Test" can also be controlled by the value of an analogue signal or by the level of a digital signal using methods in the Test Script.

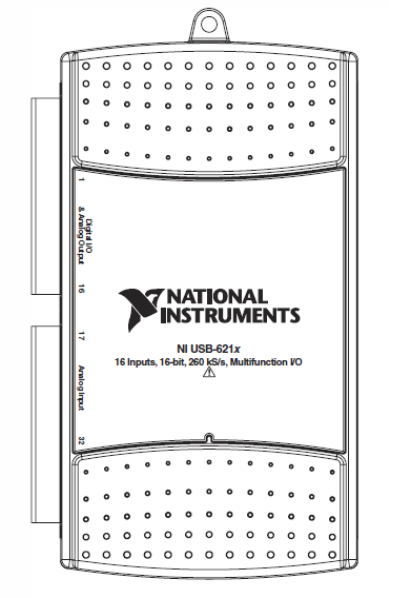
The older DAQ devices fit into a PCI slot in the PC. These devices are now obsolete but still operate with NexygenPlus. The supported devices are

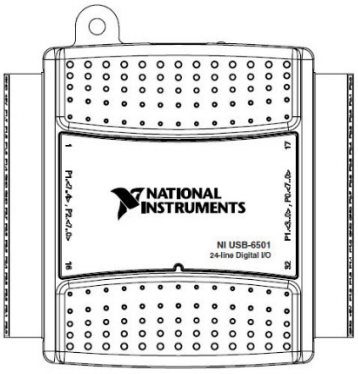
NI-6013
NI 6023
NI 6034.

The current DAQ devices connect to the PC via USB.

An example Analogue / Digital device is the NI USB 6210.

An example Digital only device is the NI USB 6501 but this is only suitable for use with a User Configurable Test.

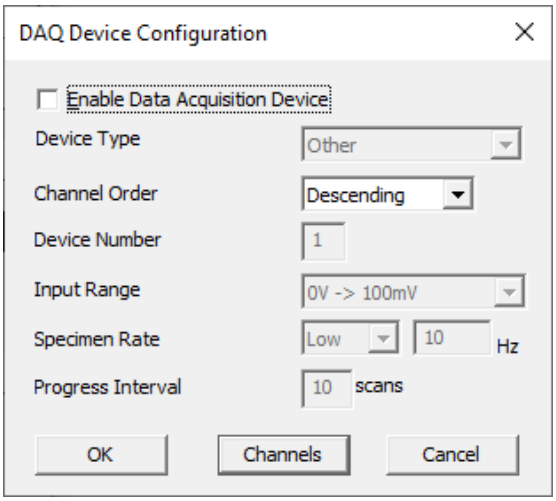




In all cases, the NI drivers must be installed on the PC before the DAQ device can be used.

CONFIGURATION

Every Test Setup has a series of buttons on the right-hand side of the editor and one of these is labelled "DAQ Device". Clicking on this button displays the "DAQ Device Configuration" dialog.



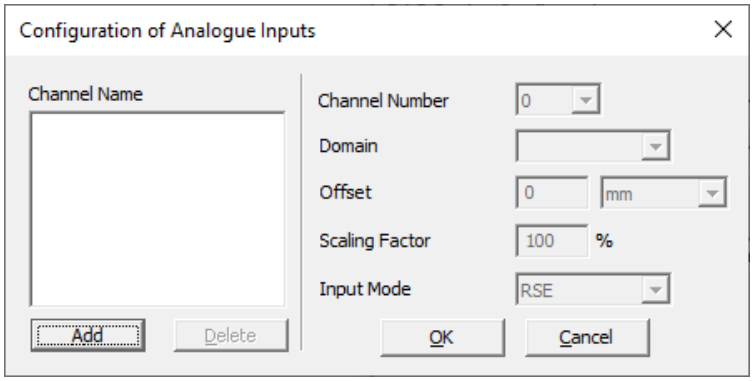
Check the "Enable Data Acquisition Device" checkbox then select the Device Type from the "Device Type" drop-down list, noting that "OTHER" must be selected for any USB device. The "Channel Order" and "Device Number" are set to default values and do not normally require changing.

ANALOGUE SIGNALS

Decide what input range is required for the Analogue input signal (see the NI datasheet for details).

Most devices have a -10V to 10V range and some may also have -5V to 5V and -1V to 1V. Select the required range using the "Input Range" drop-down list, noting that all ranges shown in the list may not be applicable to the device used. Select "High" in the "Sample Rate" drop-down list and accept "10" as the "Progress Interval".

Click on the "Channels" button at the bottom of the dialog.



Example 1

Assume it is required to create a pressure graph from a pressure transducer that has a 0V to 10V output voltage range for 0 Bar to 10Bar input.

Click on the "ADD" button at the bottom left of the screen to display "New Channel" as the "Channel Name". Right-mouse click on "New Channel", select RENAME then change the name to "Pressure". Accept "0" as the default "Channel Number". Click on the "Domain" drop down list then select "Pressure".
The output is 10V for 10Bar, so the "Scaling Factor" is 100%, i.e., 1V = 1Bar.

Select "RSE", "NRSE" or "Differential" depending upon how the transducer is connected to the DAQ device (see the NI datasheet for details).

Click on the OK button 2 times to return to the main configuration screen.

Example 2

Assume it is required to create a voltage graph from a pressure transducer that has a 0mA to 20mA output current range for 0 Bar to 10Bar input. This device requires a "loading" resistor to convert current into voltage. This resistor is connected between the output and ground of the transducer and the DAQ device measures the voltage developed across this resistor.

A "suitable" resistor is 250 Ohm, 0.25W, metal film 0.05% or 0.1% tolerance. This will develop 5V when the transducer gives a full-scale output of 20mA.

Click on the "ADD" button at the bottom left of the screen to display "New Channel" as the "Channel Name". Right-mouse click on "New Channel", select RENAME then change the name to "Pressure". Accept "0" as the default "Channel Number". Click on the "Domain" drop down list then select "Pressure".

The output is 5V for 10Bar, so the "Scaling Factor" is 200%, i.e., 1V = 2Bar.

Select "RSE", "NRSE" or "Differential" depending upon how the transducer is connected to the DAQ device (see the NI datasheet for details).

Click on the OK button 2 times to return to the main configuration screen.

Other external devices that may be used to plot their signals are thermometers, loadcells etc noting that each device will require an amplifier unit to provide DC voltage or current.

When the NexygenPlus test is started, the additional axis is automatically created using the units specified in the DAQ configuration, e.g., Bar.

DIGITAL SIGNALS

A "User Configurable Test" can be controlled by the level of digital inputs using methods in the Test Script. The test can use several stages and each stage can be controlled separately by the level of a digital inputs.

A digital output can also be produced by the DAQ device to control another external device, e.g., a gas valve, noting that this will also require a separate power supply and switching interface (transistor or relay).

USING ANALOGUE SIGNALS TO CONTROL THE TEST ACTION

A "User Configurable Test" can be controlled by the value of analogue signals using methods in the Test Script. The test can use several stages and each stage can be controlled separately by the value of analogue signals.

The current stage and **All** subsequent stages, will be terminated when an analogue signal increases above a value by using an **INPUTGTON** ("Input Greater Than") method, which requires the "Axis Name" and the "Signal Level" e.g.

InputGTOn "Pressure", [1.5Bar] **Pressure Axis**
Or
InputGTOn "Volts", [2V] **Voltage Axis**

An example test is

InputGTOn "Pressure", [1.5Bar]
Stage [100N], [100mm/min] **The pressure is expected to increase above 1.5Bar at 100N**

The test moves to apply 100N but stops when the measured pressure exceeds 1.5Bar. The crosshead will return to 0mm if Auto-Return is selected in the test setup.

However, the test cannot use another stage in the sequence unless the "Stop Condition" is reset by using an **INPUTGTOFF** method which requires the "Axis Name".

An example test is

InputGTOn "Pressure", [1.5Bar]
Stage [100N], [100mm/min]
INPUTGTOFF "Pressure"
Stage [0mm], [100mm/min]

The test moves to apply 100N then reverses when the measured pressure exceeds 1.5Bar. Note that the crosshead returns to 0mm at a controlled speed.

The current stage and **All** subsequent stages, will be terminated when an analogue signal falls below a value by using an **INPUTLTON** ("Input Less Than") method, which requires the "Axis Name" and the "Signal Level" e.g.

InputLTOn "Pressure", [1.5Bar] **Pressure Axis**
Or
InputLTOn "Volts", [2V] **Voltage Axis**

An example test is

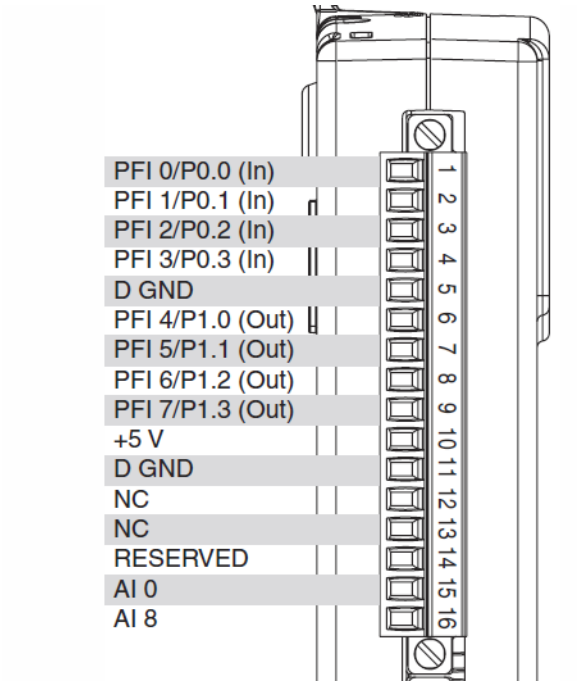
Stage [100N], [100mm/min] **The pressure is expected to increase above 1.5Bar at 100N**
InputLTOn "Pressure", [1.5Bar]
Stage [0mm], [100mm/min]
INPUTLTOFF "Pressure"
Stage [100Nm], [100mm/min]
Stage [0mm], [100mm/min]

The test moves to apply 100N then reverses to remove this force. However, when the pressure falls below 1.5Bar, the crosshead reverses to re-apply 100N then finally returns to 0mm at a controlled speed.

USING DIGITAL INPUTS TO CONTROL THE TEST ACTION

A "User Configurable Test" can be controlled by the level of digital inputs using methods in the Test Script. The test can use several stages and each stage can be controlled separately by the level of digital inputs.

The digital lines for the USB 6210 are dedicated, i.e., they are assigned as either input or output by the device.

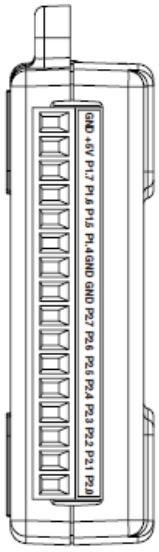
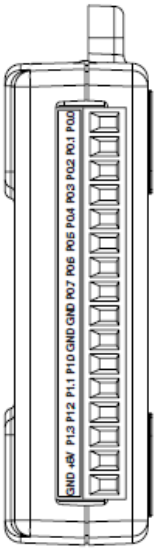


Pins 1 to 4 are all Inputs

Pins 6 to 9 are all outputs

However, the digital lines for the USB 6501 can be assigned as either input or output by the script.

Table 1. Digital Terminal Assignments

Module	Terminal	Signal	Module	Terminal	Signal
	1	GND		17	P0.0
	2	+5 V		18	P0.1
	3	P1.7		19	P0.2
	4	P1.6		20	P0.3
	5	P1.5		21	P0.4
	6	P1.4		22	P0.5
	7	GND		23	P0.6
	8	GND		24	P0.7
	9	P2.7/PFI 0		25	GND
	10	P2.6		26	GND
	11	P2.5		27	P1.0
	12	P2.4		28	P1.1
	13	P2.3		29	P1.2
	14	P2.2		30	P1.3
	15	P2.1		31	+5 V
	16	P2.0		32	GND

The current stage and **All** subsequent stages, will be terminated when an digital input goes HIGH using a **DIGITALHIGHON** method, which requires the "Port Number" and the "Line Number" e.g.

DigitalHighOn 0,0

This is Pin 1 for a USB6210 or Pin 17 for a USB 6501.

An example test is

DigitalHighOn 0,0
Stage [100N], [100mm/min] **The logic level is expected to go high before 100N**

The test moves to apply 100N but stops when the digital signal goes High. The crosshead will return to 0mm if Auto-Return is selected in the test setup.

However, the test cannot use another stage in the sequence unless the "Stop Condition" is reset by using a **DIGITALHIGHOFF** method, which requires the "Port Number" and the "Line Number" e.g.

An example test is

DigitalHighOn 0, 0
Stage [100N], [100mm/min]
DigitalHighOff 0, 0
Stage [0mm], [100mm/min]

The test moves to apply 100N then reverses when the digital signal goes high. Note that the crosshead returns to 0mm at a controlled speed.

The current stage and **All** subsequent stages, will be terminated when an digital input goes LOW using a **DIGITALLOWON** method, which requires the "Port Number" and the "Line Number" e.g.

DigitalLowOn 0, 0

This is Pin 1 for a USB6210 or Pin 17 for a USB 6501.

An example test is

DigitalLowOn 0, 0
Stage [100N], [100mm/min] **The logic level is expected to start high and go low before 100N**

The test moves to apply 100N but stops when the digital signal goes Low. The crosshead will return to 0mm if Auto-Return is selected in the test setup.

However, the test cannot use another stage in the sequence unless the "Stop Condition" is reset by using a **DIGITALLOWOFF** method, which requires the "Port Number" and the "Line Number" e.g.

An example test is

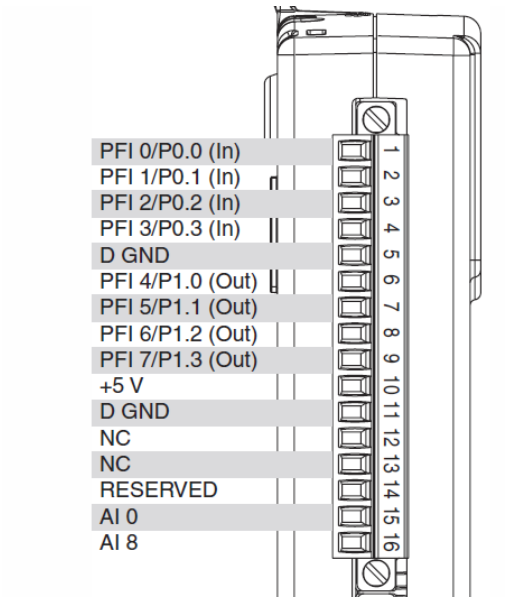
DigitalLowOn 0, 0
Stage [100N], [100mm/min]
DigitalLowOff 0, 0
Stage [0mm], [100mm/min]

The test moves to apply 100N then reverses when the digital signal goes Low. Note that the crosshead returns to 0mm at a controlled speed.

PRODUCING DIGITAL OUTPUTS DURING THE TEST

A "User Configurable Test" can set digital outputs High or Low during the test using methods in the Test Script.

The digital lines for the USB 6210 are dedicated, i.e., they are assigned as either input or output by the device.

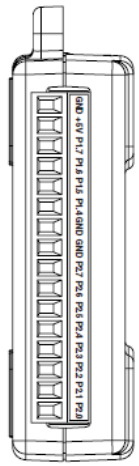
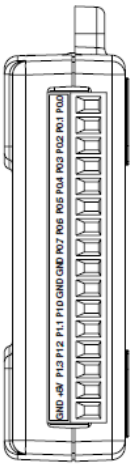


Pins 1 to 4 are all Inputs

Pins 6 to 9 are all outputs

However, the digital lines for the USB 6501 can be assigned as either input or output by the script.

Table 1. Digital Terminal Assignments

Module	Terminal	Signal	Module	Terminal	Signal
	1	GND		17	P0.0
	2	+5 V		18	P0.1
	3	P1.7		19	P0.2
	4	P1.6		20	P0.3
	5	P1.5		21	P0.4
	6	P1.4		22	P0.5
	7	GND		23	P0.6
	8	GND		24	P0.7
	9	P2.7/PFI 0		25	GND
	10	P2.6		26	GND
	11	P2.5		27	P1.0
	12	P2.4		28	P1.1
	13	P2.3		29	P1.2
	14	P2.2		30	P1.3
	15	P2.1		31	+5 V
	16	P2.0		32	GND

A digital output can be set High by using a **SETDIGITALHIGH** method, which requires the "Port Number" and the "Line Number" e.g.

SetDigitalHigh 1, 0

This is Pin 6 for a USB6210 or Pin 27 for a USB 6501.

A digital output can be set Low by using a **SETDIGITALLOW** method, which requires the "Port Number" and the "Line Number" e.g.

SetDigitalLow 1, 0

An example test is

SetDigitalHigh 1, 0	**Close the pneumatic grips**
Stage [100N], [100mm/min]	
Stage [0mm], [100mm/min]	
SetDigitalLow 1, 0	**Open the pneumatic grips**

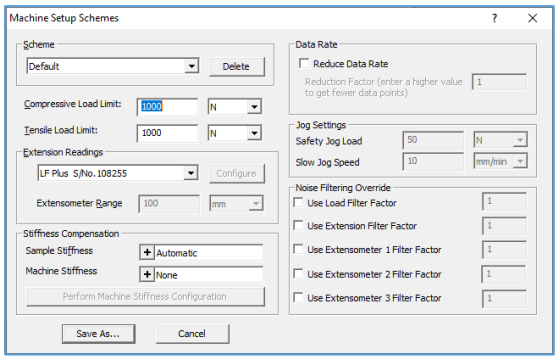
CONSOLE SETUP SCHEMES

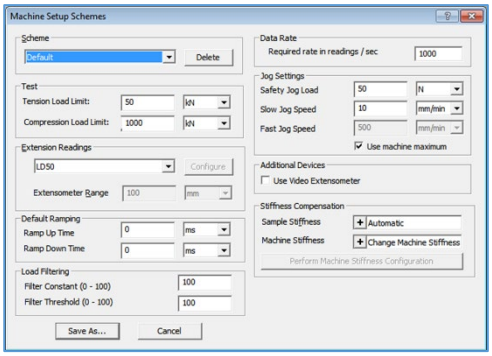
The Software Console is the connection between the NEXYGEN Plus Graph and the Materials Testing Machine. Each "Type" of machine uses a different communication protocol so different consoles are provided.

At the time of writing, the following Materials Testing Machines are supported: -

LF Plus, LRX Plus, EZ20, EZ50, LR Plus Series, LS Series
LD Series LD5, LD10, LD30, LD50, LD100

EZ/Plus Series Console
LD Series Console





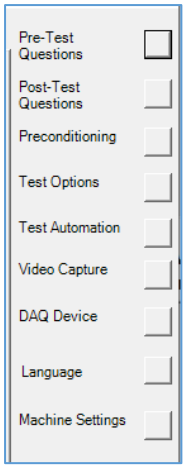
EZ/Plus Series Console

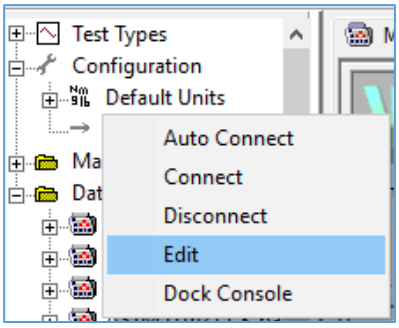
LD Series Console

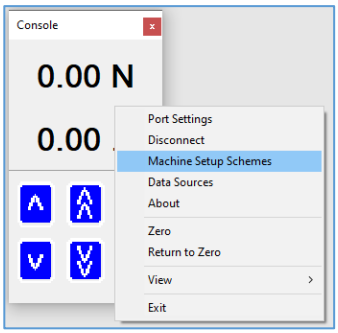
The Software Console defines the Load Limits, Extension Source, Stiffness Compensation Settings, Reduced Data Rate, Jog Speed and Safety Load and Additional Filtering.

The Software Console can be configured by:

1. Clicking on the "Machine Settings" button at the right-hand side of the Test Setup Editor
2. Right-Mouse clicking on "Testing Machine" in the Explorer Pane then selecting EDIT
3. Right-Mouse clicking on the Software Console then selecting MACHINE SETUP SCHEMES





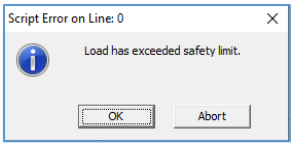


Console Setup Scheme Location

The console setup schemes are stored on the local PC and are not part of the test setup. Test files can be transferred between PC's, e.g., 2 or more machines can use copies of the same test file but note that the console setup scheme is not transferred as part of the test file. Therefore, if a test file is configured to use a specific console setup scheme, this scheme must be re-created on all applicable PC's. The easiest way to do this is to print a "Screen Dump" of the required console setup scheme as a visual template.

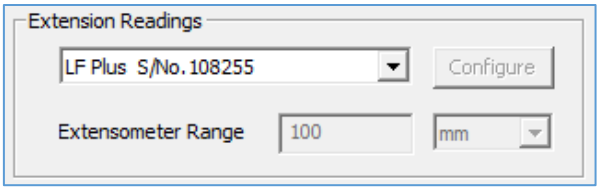
Load Limits

Load limits can be set to prevent damage to grips and fixtures. Assume that a 5kN loadcell is used on a 5kN machine with grips that are only rated at 1kN. The grips could be damaged if the force exceeds 1kN during a test. Therefore, a scheme can be created to stop the machine at a force of 1kN, noting that different values can be set for Tension and Compression if required. If the load exceeds the load limit, the machine will stop, and the PC will display a "Load has exceeded Safety Limit" error message.



Extension Source

The graph normally uses the machine extension for the extension data source. If an external extensometer is connected to the machine, this is not connected to the graph unless it is selected in the Console Scheme.



Note that most extensometers have a fixed range, e.g., an STGA, EX250 etc, but other extensometers may have switchable ranges and the required range is defined using the Extensometer Range entries.

Note that only one extensometer can be used during a test unless a special UCT test is created.

SAMPLE STIFFNESS

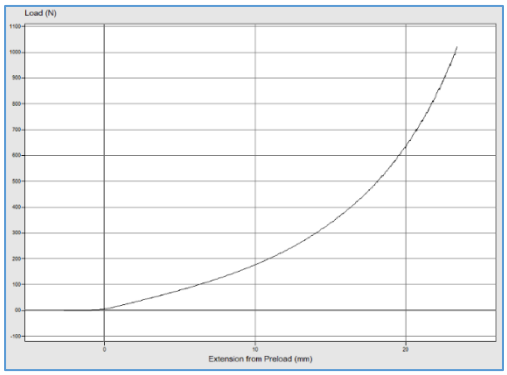
When the machine is required to run at a fixed speed, (e.g., CRE or CRT), the motor speed is controlled by the change in extension, either from the crosshead or from an extensometer. This automatically corrects any change in speed due to sample loading or sample stretch when using an extensometer.
However, when the machine is required to run under load rate control (or stress rate control), the motor speed is controlled by the change in load. This automatically corrects any change in speed due to sample weakening. SAMPLE STIFFNESS is the "Change in Load / Change in Extension" and this value (N/mm) is automatically measured during a test and is used as an "**Inverse Gain**" value for the motor drive system. A low value of sample stiffness gives a high control loop gain, so gives a faster machine response - Too high may give instability. A high value of sample stiffness gives a slower machine response.

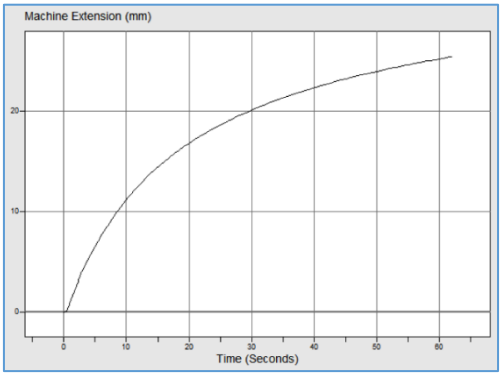
Therefore, it is important to use a Preload when Load Rate control is required. This is because the sample may be slack in the grips during a tension test or may not be initially compressed during a compression test. This means there will be no change in the initial load so the motor gain will be very high, and the crosshead will run at maximum speed. and may be difficult to control.

If the sample has a rapid change in sample stiffness during the test, the automatic gain measurement may not be sufficient to fully control the speed. In this case, perform one test and manually measure the sample stiffness (Change in Load / Change in Extension) at the most important part of the test.

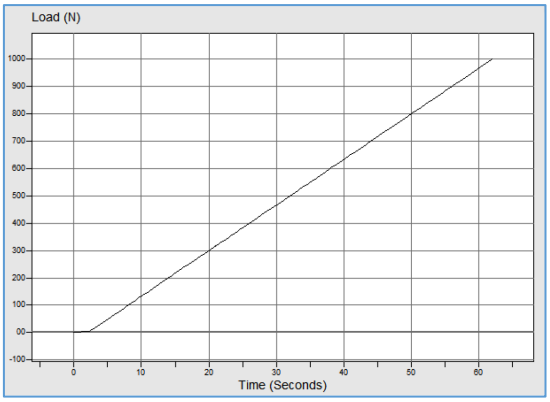
Typical tests are bending (flexural) tests on roofing tiles and flooring timber - The load is uniformly increased until the sample breaks.

The first graph below shows a sample where the change in load increases during the test. The second graph shows how the crosshead speed is reduced when load rate control is selected.





The graph below shows the change in load against time. The linear graph trace shows that the load increased linearly with time at 1000N/minute.



Sample Stiffness is also required when the machine is set to maintain a load value for a time. The machine initially moves at the specified initial speed until the required load is applied then the motor drive system moves the crosshead as necessary to maintain the load for the specified time.

This is a "Creep" (Constant Load) test and can be used to measure the change in extension that occurs when a sample is loaded.

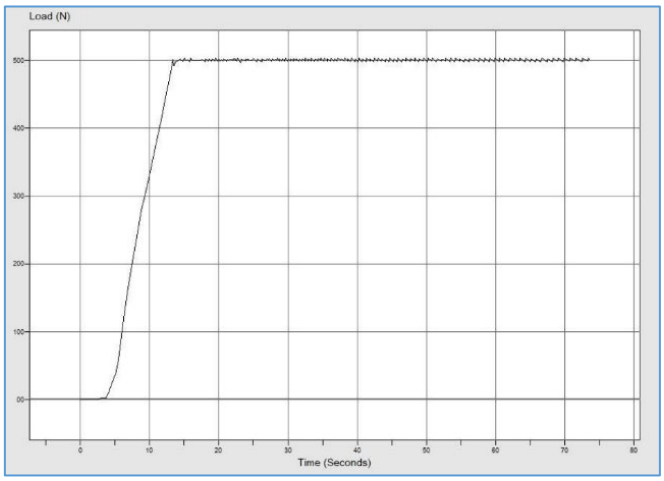
Typical tests are foam tests, carton tests, paint cans, seal strength go/no go etc. The test checks that the sample can withstand the force for a time or measures the change in sample size over the time.

Note that a "Relaxation" test (Constant Extension) does not require Sample Stiffness because the machine moves to the required extension and then stops, i.e., no further crosshead movement occurs.

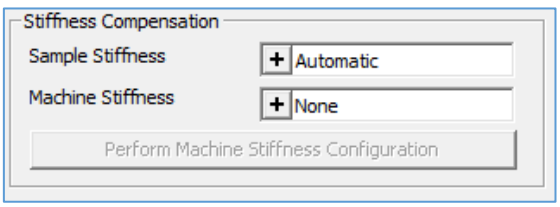
The first graph below shows that the load stays constant at 500N for 60 seconds. The second graph shows how the crosshead moves during the 60 seconds to keep the load at a constant value.

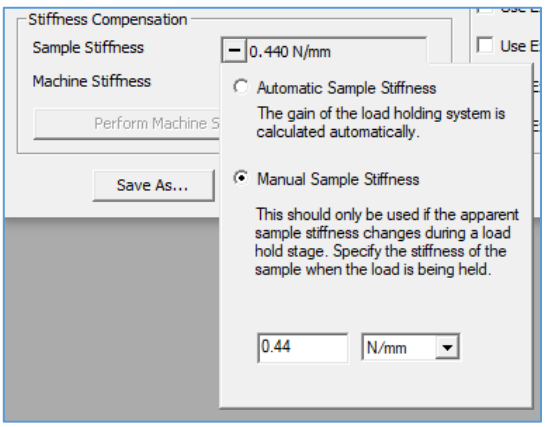
Using "Manual" Sample Stiffness

The Software Console is normally set to use "Automatic" sample stiffness and this value normally provides an acceptable Load Rate Control or Constant Load Holding performance as shown below.



However, sometimes the automatically calculated value is not able to achieve acceptable Load Rate Control or Constant Load Holding performance, especially if the sample stiffness characteristics change during the test. In this case, the "Manual" setting should be used. Calculate the Sample Stiffness from the "Change in Load / Change in Extension" at the required load value then enter this stiffness value into the sample stiffness field.





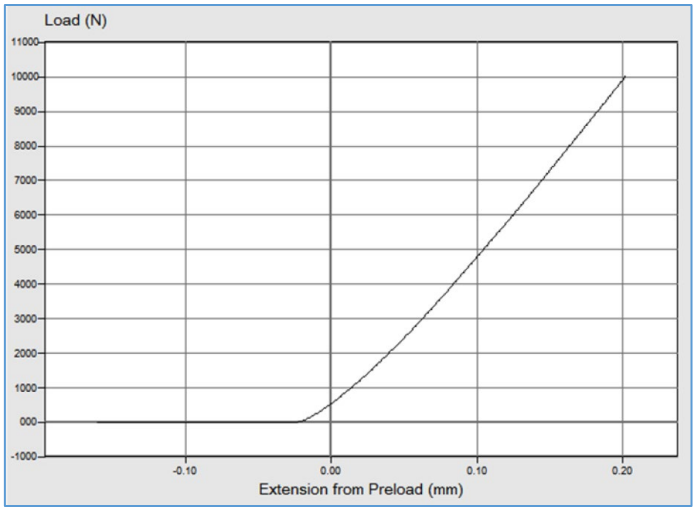
MACHINE STIFFNESS

When very small extensions are measured, the extension readings will have an error due to any movement in the machine unless an extensometer is used. These movements are mainly due to the loadcell (approximately 200 microns bend at full load) but also occur due to bend in the machine and grips. This unwanted movement can cause large errors in the Modulus and Proof Stress results because the machine extension values will be larger than the actual sample extension values.

Therefore, the extension values can be compensated (reduced) by using the "Machine Stiffness Compensation" feature, but it is always advisable to use an additional high accuracy displacement device such as an LVDT (Linear Variable Displacement Transducer) or extensometer if possible.

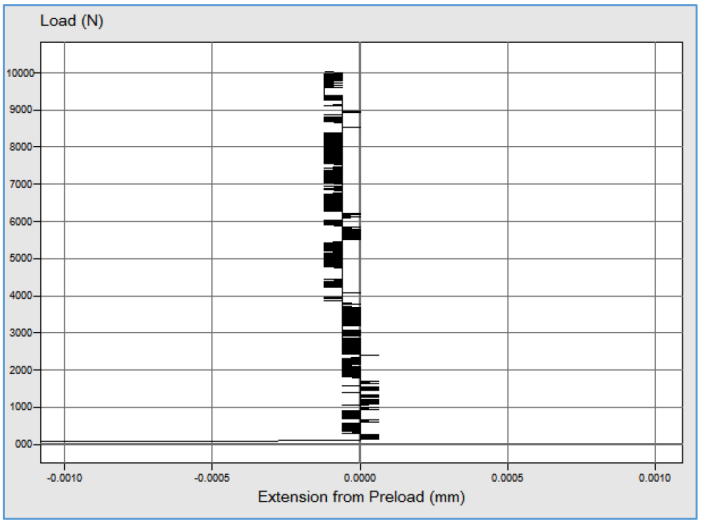
Note: "Machine Stiffness Compensation" should not be used with an extensometer.

The graph below shows a compression test using a 10kN loadcell



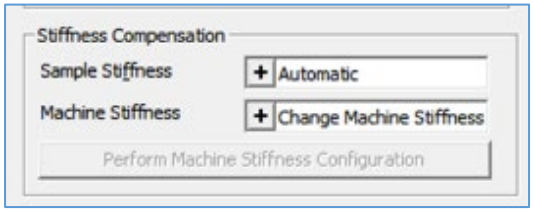
The loadcell and machine deflection is approximately 200 microns at 10kN with a 10kN loadcell.

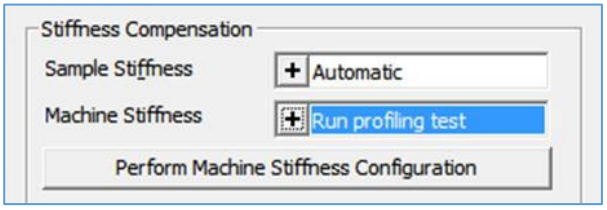
The graph below shows the same test conditions with Stiffness Compensation. This graph has been "Zoomed" to show the actual extension error which is less than 0.25 microns.



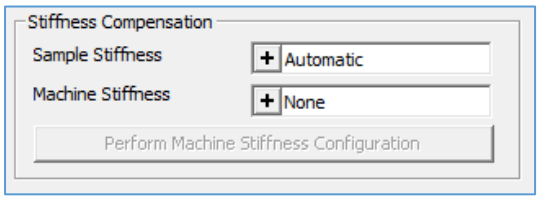
Defining Stiffness Compensation

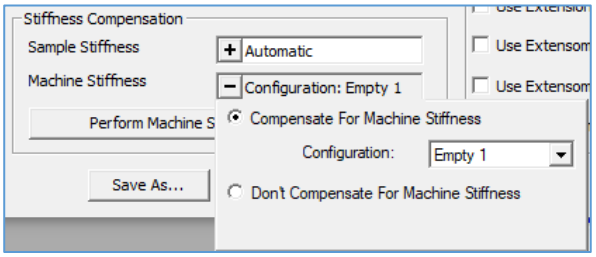
The machine must be configured using the same loadcell and grips as those which will be used for testing. For a Tension test, fit the largest metal sample that will fit in the grips, so that "sample" stretch is minimised. For a Compression test, do not fit a sample so that the compression plates can touch together.
On an LD machine, click on the "+" by "Machine Stiffness" then select "Run Profiling Test" to enable the "Perform Machine Stiffness Configuration" button.



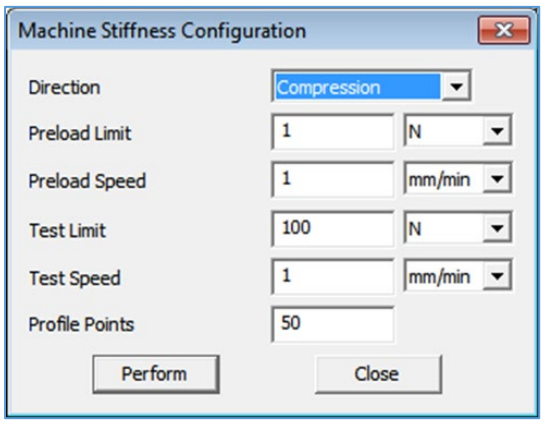


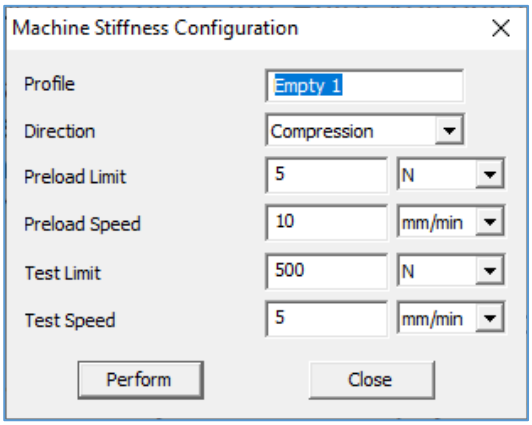
On all other machines, click on the "+" by "Machine Stiffness" then select a configuration (Empty 1 to Empty 10) to enable the "Perform Machine Stiffness Configuration" button.





Click on the "Perform Machine Stiffness Configuration" button to display the settings. Set the test limit to the required load for the test.





LD Console **EZ/Plus Console**

Note that the name can be changed on an EZ/Plus Console because the compensation table is stored in the machine's memory. However, the compensation table is stored in the LD Console as part of the Machine Setup Scheme so is automatically named the same as the scheme name. When a Stiffness Compensation scheme is selected, the compensation points are downloaded to the machine.

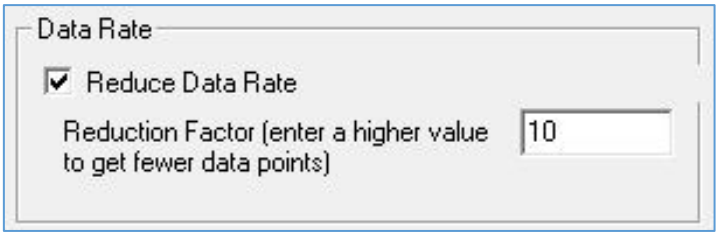
The Stiffness Compensation consists of 2 "Cycles". The first cycle applies the requested load and measures the total extension (bend) in the system. The second cycle creates a "Lookup Table" of force/extension.

Using Stiffness Compensation

When Stiffness Compensation is operating, all crosshead extension readings are corrected by a factor depending upon the current load. This means that the machine console and NEXYGEN Plus both receive compensated extension readings. This can be checked by applying force to the loadcell by hand and checking that the extension readings change by a small amount.

Reduced Data Rate

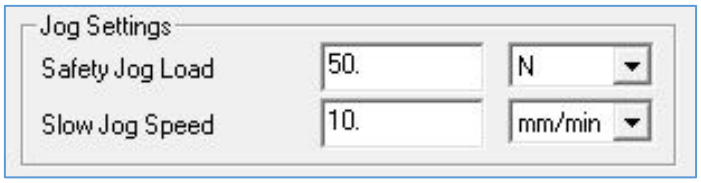
All machines feed load, extension, and time values to the graph at 1000Hz (1000 data points per second). This value is suitable for most tests but can produce very large data files (Batch Files) for long duration tests. To reduce the file size, check the "Reduce Data Rate" checkbox and enter a suitable "Data Rate Reduction Factor". This value is a division factor so a value of 10 gives 100Hz, a value of 20 gives 50Hz, a value of 100 gives 10Hz and a value of 1000 gives 1Hz etc.



Jog Speed and Safety Load

The Safety Jog Load is used to prevent injury to the operator and damage to the load cell or fixtures during manual jogging of the crosshead using the Jog Keys

The Jog Speed allows the user to adjust the speed of the crosshead when the SLOW JOG key is pressed.
The FAST JOG speed is not adjustable.



SPC

GENERAL

The purpose of SPC control charts is to detect significant process changes when they occur. There are several types of SPC charts but the most used are the X Bar (Mean), Range and Histogram (Tally Chart or Normal Distribution). These charts allow the process to be examined for stability so can be used to show any "shift to shift" variation, "operator to operator" variation, "machine to machine" variation etc.

The Histogram is the most important distribution in statistics and shows a typical symmetrical bell shape.

The X Bar and Range charts display averages of measurements instead of individual measurements because this is better at detecting process changes quickly, therefore the test results are split into sub-groups.

If the sub-group size is too small, then meaningful process shifts may go undetected. If the sub-group size is too large, then chart signals may be produced from insignificant process shifts.

Therefore, a sub-group size of 5 is commonly used.

The X Bar and Range charts calculate and display "control limits" shown as a shaded area. This area indicates where "statistically reasonable" measurements should occur so each point plotted on these charts should ideally be within this shaded area. "Statistically reasonable" means being likely to occur during natural variation and this is different from a quality control "acceptable" value.

In statistics, the 68 - 95 - 99.7 rule, also known as the three-sigma rule or empirical rule, states that nearly all values lie within three standard deviations of the mean in a normal distribution. 68.27% (2 thirds rule) of the values are within one standard deviation of the mean, 95.45% of the values are within two standard deviations and nearly all (99.73%) of the values are within three standard deviations.

Therefore, "control limits" are used at 3 standard deviations (3 sigma) above and below the mean.

Note that Pass/Fail limits must be set on the required result column to produce the SPC Charts.

X BAR CHART

An X BAR chart (Means chart) measures the variation in average value from sub-group to sub-group and shows the CALCULATED upper and lower CONTROL LIMITS. Note that the Control Limits are NOT the same as the specification upper and lower limits.

The Lower Control Limit is	X Bar Bar - (A2 * R Bar)	(A2 = 0.577 for sub-group of 5)
The Upper Control Limit is	X Bar Bar + (A2 * R Bar)	(A2 = 0.577 for sub-group of 5)

Where X Bar Bar is the mean of all the mean values and R Bar is the mean of all the range values

The A2 values for subgroup sizes are shown below.

Subgroup Size	2	3	4	5	6	7	8
A2	1.880	1.023	0.729	0.577	0.483	0.419	0.373

Therefore, the X Bar chart shows the arithmetic mean of all the measured values plotted against time.

RANGE CHART

A RANGE chart shows the spread of measured values so shows the variability of the process. It also shows the CALCULATED upper and lower CONTROL LIMITS. Note that the Control Limits are NOT the same as the specification upper and lower limits.

The Lower Control Limit is	D3 * R Bar	D3 = 0.00 sub-group of 5
The Upper Control Limit is	D4 * R Bar	D4 = 2.11 sub-group of 5

Where R Bar is the mean of all the range values

The D3 and D4 values for subgroup sizes are shown below.

Subgroup Size	2	3	4	5	6	7	8
D3	0.00	0.00	0.00	0.00	0.00	0.076	0.136
D4	3.267	2.574	2.282	2.114	2.004	1.924	1.864

Therefore, the Range chart shows the spread of all the measured values plotted against time.

HISTOGRAM CHART

A Histogram (Process Capability) chart is used to determine whether the process is "capable", i.e., the product meets the requirements as defined by the upper and lower specification limits.

All measured values are grouped into half standard deviation ranges from -4 to +4 standard deviations from the mean value and the number of measured values in each range defines the relative height of the displayed bar. A "normal" bell-shaped curve is drawn over the bars on the histogram chart to indicate the "expected" normal distribution curve.

The lower range of the Histogram is the smallest value of either 4 standard deviations below the mean value or the lower specification limit.

The upper range of the Histogram is the largest value of either 4 standard deviations above the mean value or the upper specification limit.

Vertical lines are drawn on the histogram chart at the lower specification limit (LSL), the mean value (//X) and the upper specification limit (USL).

Therefore, the Histogram chart shows the "frequency distribution" of the measured values.

CP AND CPK VALUES

The CAPABILITY INDEX (Cp) indicates the RANGE of the process compared with the specification upper and lower limits, i.e., indicates the potential performance of a process.

It is calculated by:

$$\frac{\text{(specification upper limit - specification lower limit)}}{6 * \text{Standard Deviation}}$$

The PERFORMANCE INDEX (Cpk) indicates both the RANGE of the process and its MEAN compared with the specification upper and lower limits, i.e., indicates the performance of a process at a given instant of time.

It is calculated by the positive value of

$$\frac{\text{(Mean - closest specification limit)}}{6 * \text{Standard Deviation}}$$

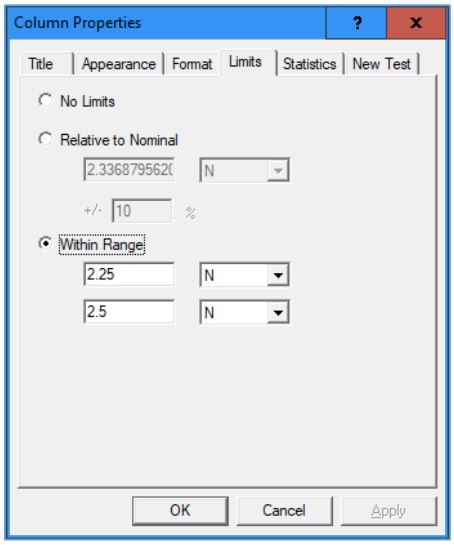
If the MEAN (X Bar) is the same value as the central value for the specification, then Cp is the same as Cpk

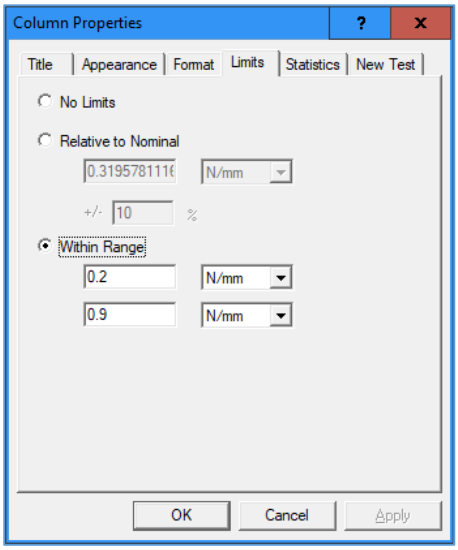
The minimum Cpk index for no failures is 1.0. Lower values indicate that defects are being produced as below.

Cpk	0.9	0.8	0.7	0.6	0.5	0.4
% Failed	0.4	1	2	4	7	12

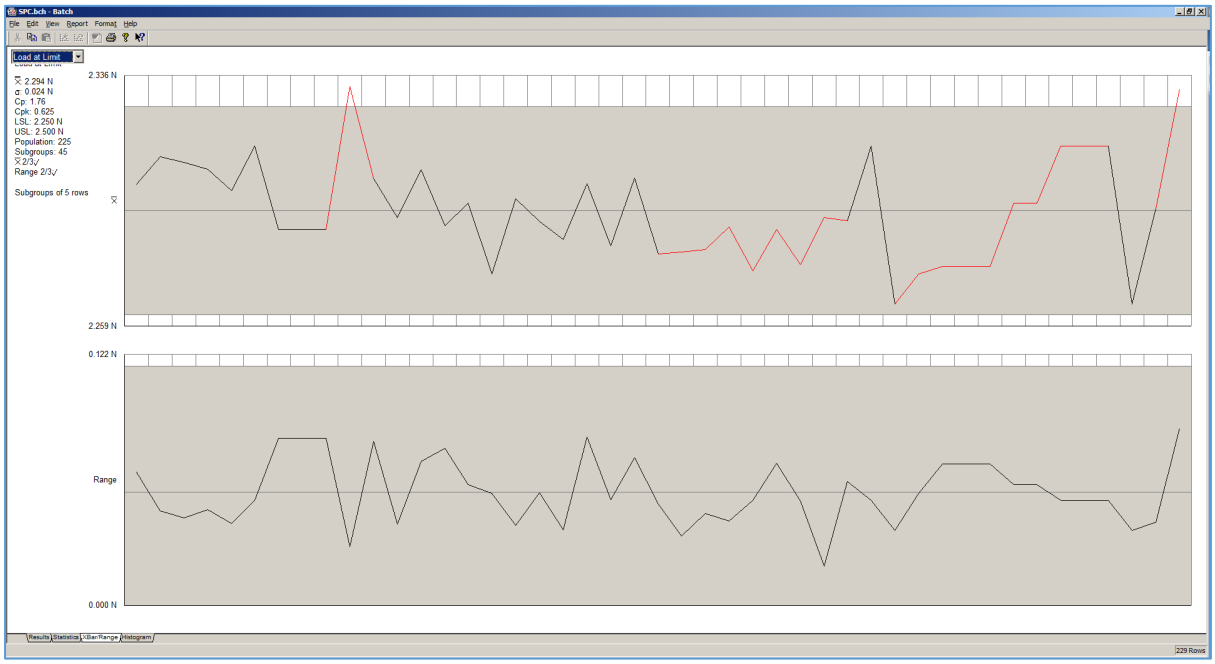
SAMPLE CHARTS

Assume that the sample specification requires the "Load at Limit" value to be between 2.25N and 2.5N and the "Stiffness" value to be between 0.2N/mm and 0.9N/mm as shown in the "Setting Pass/Fail Limits" section shown earlier.





Clicking on the X BAR/RANGE tab along the bottom of the screen displays the X Bar and Range charts.



Note that all "Warning Areas" are shown in red and are explained in the next section.

SPC RULES

A process is not in a state of statistical control if: -

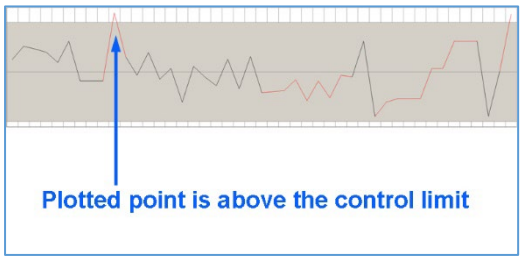
1 Any plotted point is above or below the control limits.

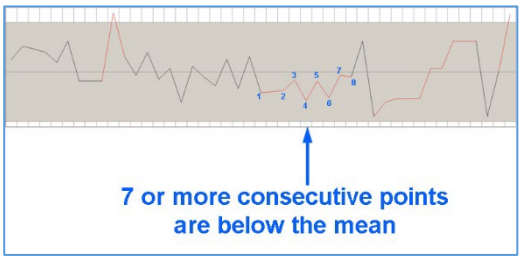
2 7 or more consecutive points are above or below the mean.

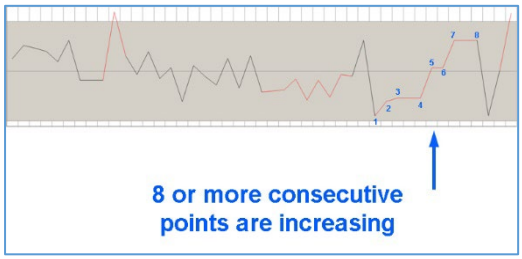
3 8 or more consecutive points are increasing or decreasing.

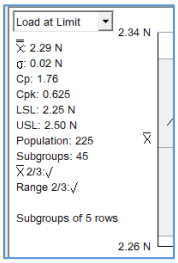
4 Less than 2/3 of the points are in the centre 1/3 of the chart.

Consider the X Bar charts shown above which show these rules.



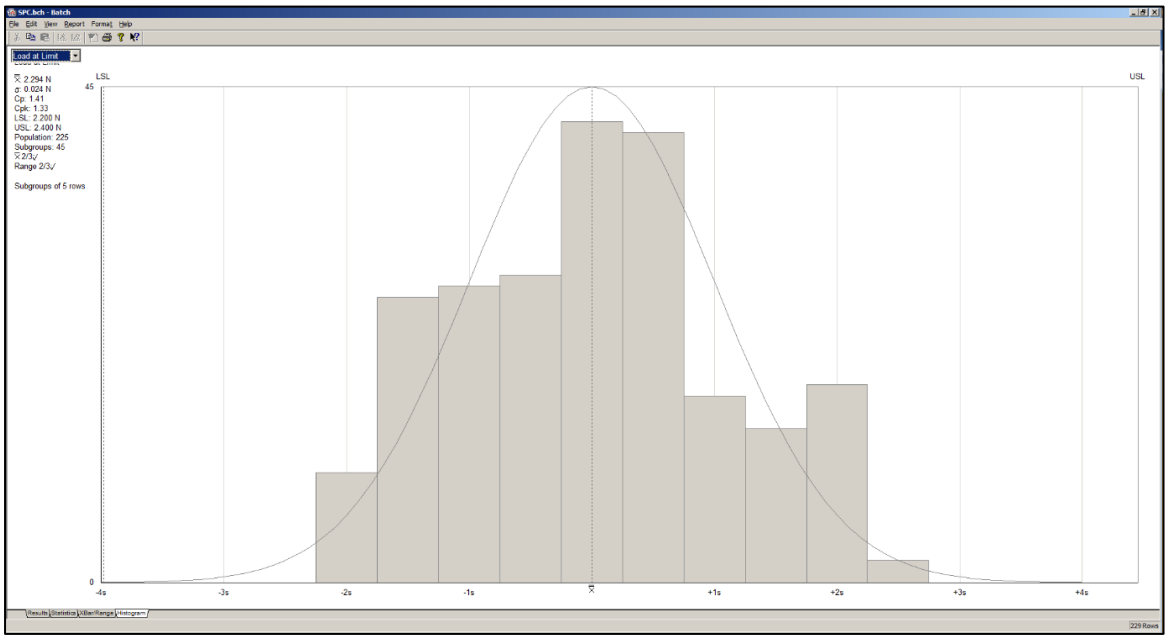






The 2/3 rule is good

Clicking on the HISTOGRAM tab along the bottom of the screen displays the Histogram chart.

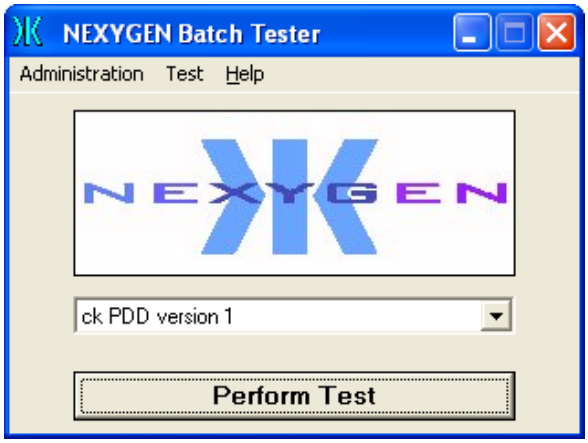
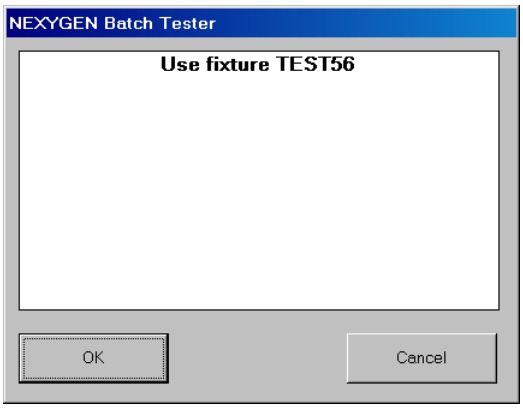
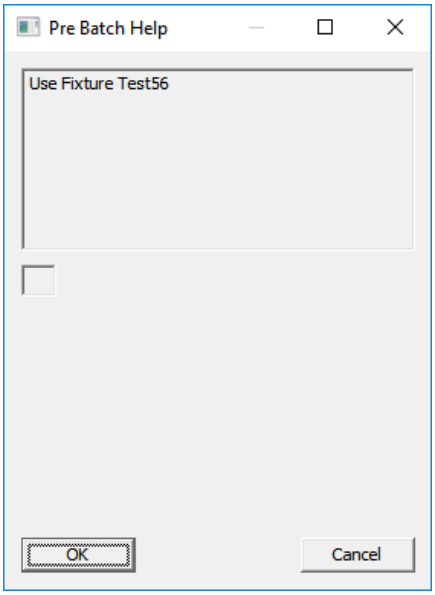


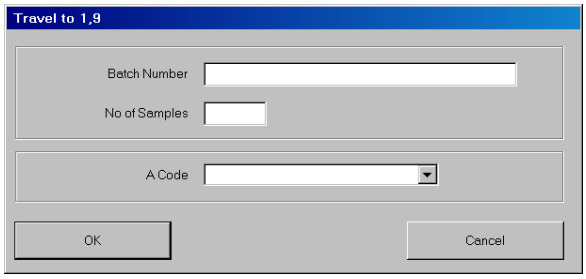
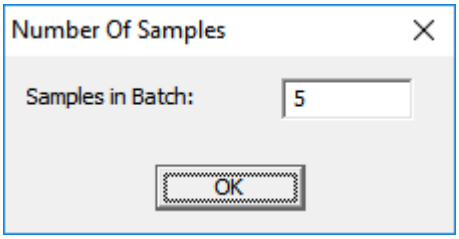
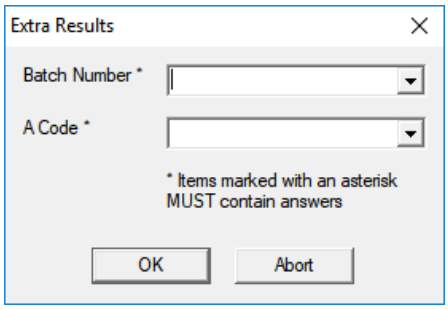
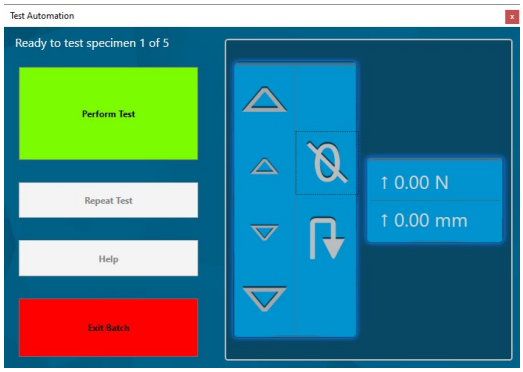
ADDENDUM

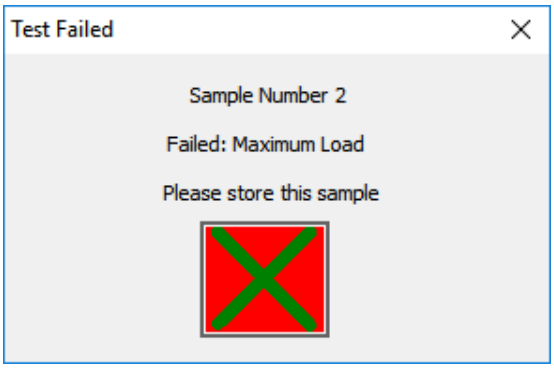
BATCH TESTER OPERATION

The Batch Tester was designed to simplify the operation of NEXYGEN MT. NexygenPlus cannot use the Batch Tester but a similar testing system can be created by using the features within NexygenPlus.

The following screen shots show the differences in the user operation between NEXYGEN / Batch Tester and NexygenPlus.

Batch Tester / NEXYGEN	NexygenPlus
Select the test file from the drop-down list.  	Select the test file from the "Create New Batch from Templates" button 
If a help message has been defined, the help screen will be displayed.  	If a help message has been defined, the help screen will be displayed. 

Batch Tester / NEXYGEN	NexygenPlus
Enter any pre-test information.  	Enter any pre-test information - Note that the number of samples question is now on a separate dialog.  
The Start Test dialog is displayed.  	The Start Test dialog is displayed. 
Click on the Perform Test button to start the test.	Click on the Perform Test button to start the test. Note that this dialog also displays the current load and extension values. Also note that the Software Console is disabled when using Test Automation so the console cannot be used to position the crosshead. However, the Start Test dialog includes separate Jog keys so the crosshead can be positioned prior to the test using these keys.

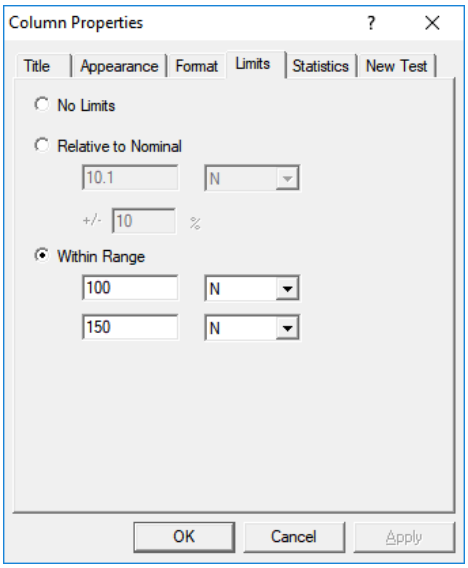
Batch Tester / NEXYGEN	NexygenPlus
If the test passes any pass/fail parameters, the Start Test dialog is re-displayed. If the test fails any pass/fail parameters, the "Failed" dialog is displayed.  At the end of each test and / or the end of the test sequence, a report and / or a data export can automatically occur.	If the test passes any pass/fail parameters, the Start Test dialog is re-displayed. If the test fails any pass/fail parameters, the "Failed" dialog is displayed.  At the end of each test and / or the end of the test sequence, a report and / or a data export can automatically occur.

CONFIGURING THE NEXYGEN PLUS "BATCH TESTER" FEATURES

Create a new test file as normal then configure the test action and results selection as normal.

Perform one test to check the test action and test result generation.

Define any pass/fail parameters on the relevant result columns. Click on the RESULTS tab to display the result table, right-mouse click on the required result column then select PROPERTIES to display the COLUMN PROPERTIES screen.



Click on the LIMITS tab then enter the required Pass / Fail limits, e.g., 100N to 150N.

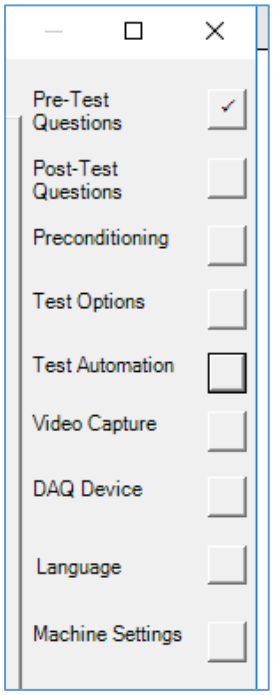
Note that more than one column can have Pass / Fail limits defined, e.g., Maximum Load and Extension at Break.

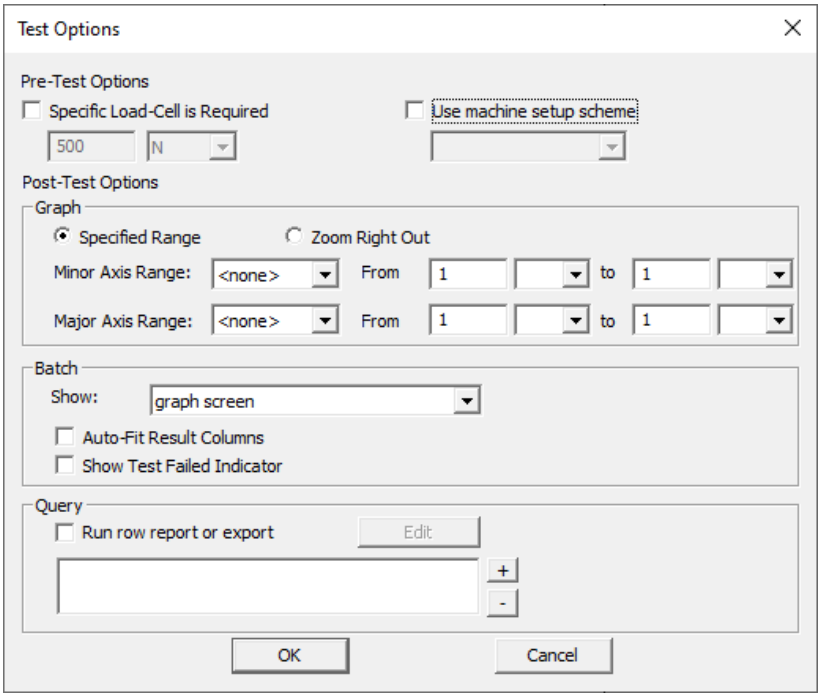
Create a new test in this Batch file by clicking on the "New" button on the graph screen then click on the "Edit" button to display the test editor.

DEFINING THE NEXYGEN PLUS "BATCH TESTER" FEATURES

Note that this is a combination of using the Test Options, Test Automation and Templates features.

Click on the "Test Options" button on the right-hand side of the test editor screen to display the Test Options Screen.





If a specific load cell is required, check the "Specific Load-Cell is Required" checkbox and enter the load cell value.

If a specific machine setup scheme is required, check the "Use machine setup scheme" checkbox and select the scheme name from the drop-down list.

If specific graph axes and / or ranges are required, define them using the "Graph" controls.

Click on the "Batch" Show drop down control and select "Graph Screen". Note that this is at the bottom of the list, so the scroll bar needs to be pulled to the bottom.

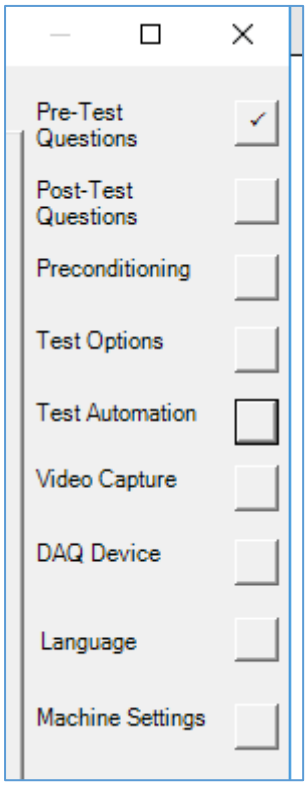
Check the "Show Test Failed Indicator" checkbox. This will show the dialog at the end of each failed test. Note that a Pass / Fail limit MUST be specified for one or more result columns before this feature can be used.

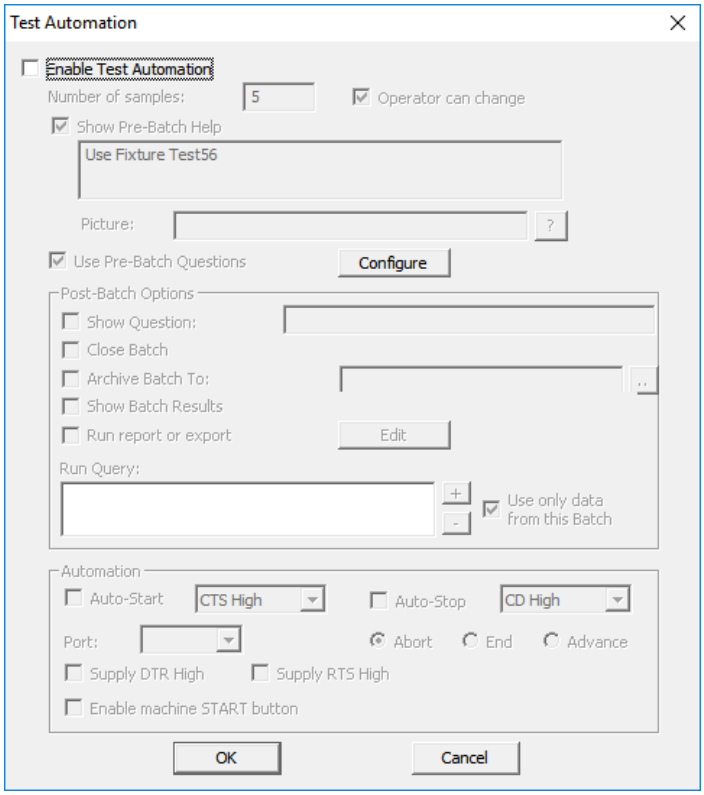
If any report or export is required at the end of **each test**, check the "Run report or export" checkbox then click on the EDIT button to display the "Report/Export Settings" screen.

Note that most reports or exports are required at the end of the test sequence so this "end of each test" feature may not be required. The "Report or Export" configuration screen is shown later.

Click on the OK button to close the Test Options Screen.

Click on the "Test Automation" button on the right-hand side of the test editor screen to display the Test Automation Screen.





Click on the "Enable Test Automation" button to enable any of the features on this screen.

Enter the number of samples to be tested in a "Test Sequence", noting that the operator can alter this number before testing if the "Operator can Change" option is selected.

Also note that a "Test Sequence" can be ended before the specified number of samples has been tested if necessary.

Help text (with or without a picture) may be displayed before the test sequence is run if the "Show Pre-Batch Help" option is selected. The picture is selected using the small button labelled "?".

"Pre-Batch" questions can be defined by selecting the "Use Pre-Batch Questions" option then clicking on CONFIGURE.

Note that these questions are the same type as the Pre-Test Questions.

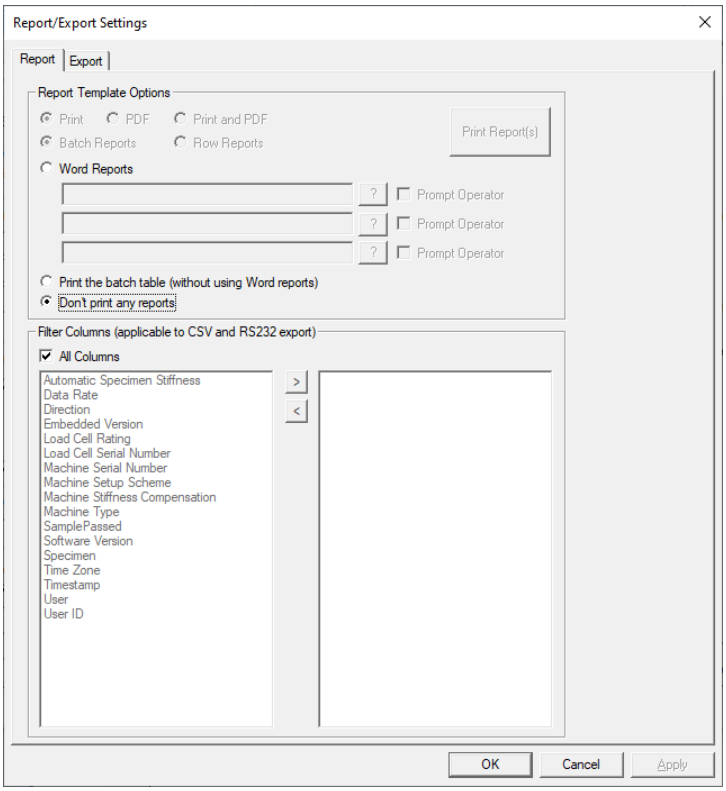
These questions are useful when the same answer is required for ALL the samples in a "Test Sequence", e.g., Colour.

A single "Post-Batch" TEXT question can be defined by selecting the "Show Question" option then entering the question in the field. This question can be used to enter any comments regarding the "Test Sequence".

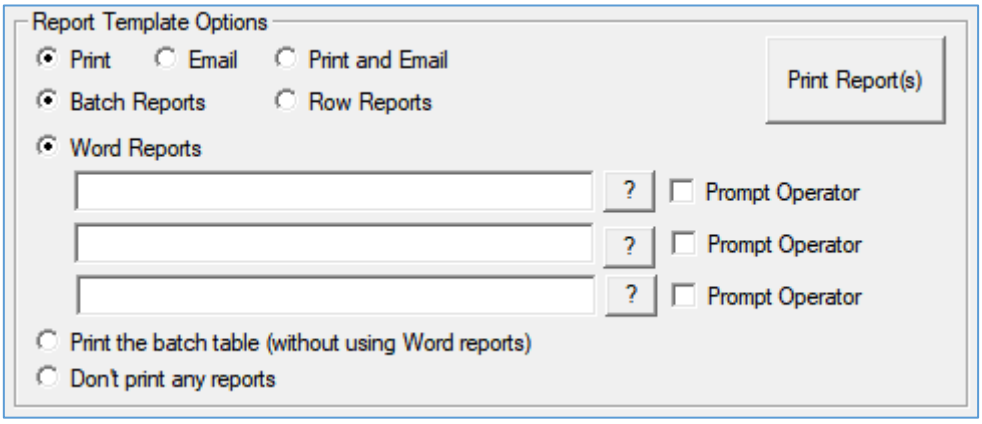
Check the "Close Batch" checkbox.

Check the "Archive Batch To" checkbox then select the Archive folder, which can be on a network. The test file will be automatically archived to this folder at the end of the test sequence so no further tests can be performed in this batch.

If any report or export is required at the end of the **test sequence**, check the "Run report or export" checkbox then click on the EDIT button to display the "Report/Export Settings" screen.

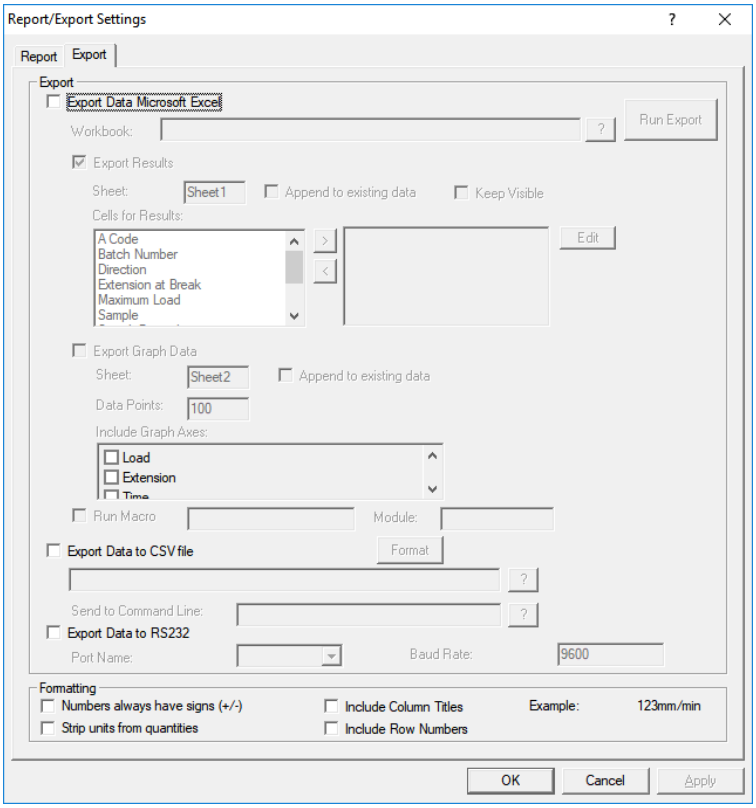


If a Word Report is required, select the Word Reports" option to enable the controls.



Select the "Batch Reports" option, click on the upper small button labelled "?" then select the required Word Report Template. Note that up to 3 different reports may be printed if required.

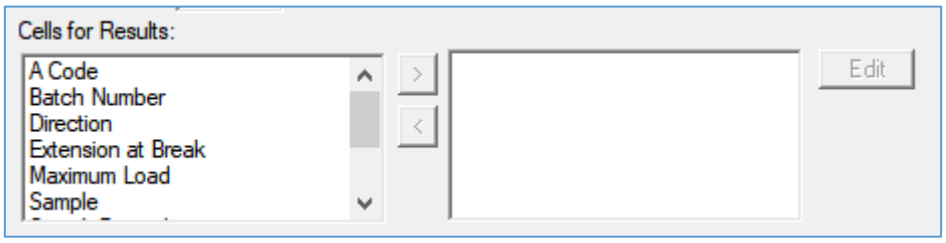
If a Data or Graph export is required, click on the EXPORT tab at the top of the screen to display the Export screen.



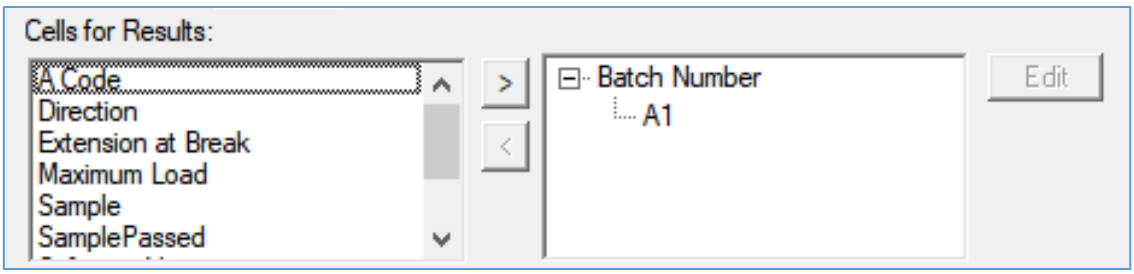
To export to Excel, check the "Export Data to Microsoft Excel" option then select the Workbook by clicking on the small button labelled "?".

To export the test results to Excel, check the "Export Results" checkbox and enter the name for the Worksheet (the default name is "Sheet 1").

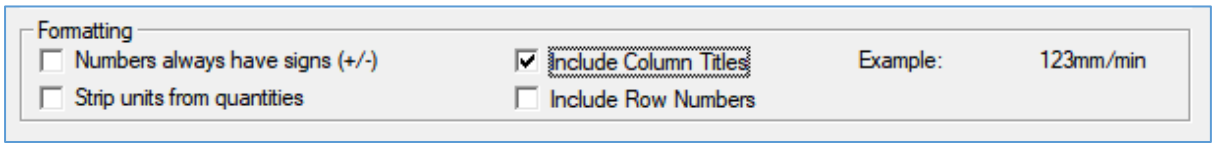
The "Cells for Results" control is used to select the required test result columns and to specify which Excel cell will contain this data.



Select a result in the left-hand area and "transfer" it to the right-hand column using the button labelled ">".

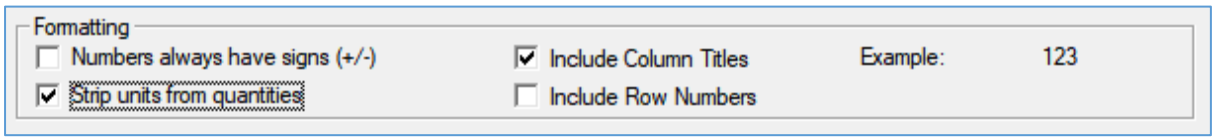


Cell A1 will be specified for this result but this can be changed by clicking on the "A1" then clicking on the EDIT button on the right-hand side. Note that the specified cell is the uppermost cell in a column and each result will be entered below this cell. Therefore, if 10 tests were performed and cell "C6" is selected, the results will be stored in cells "C6", C7", C8" etc up to "C15". However, this will be slightly different if the "Include Column Titles" feature is selected at the bottom of the screen.

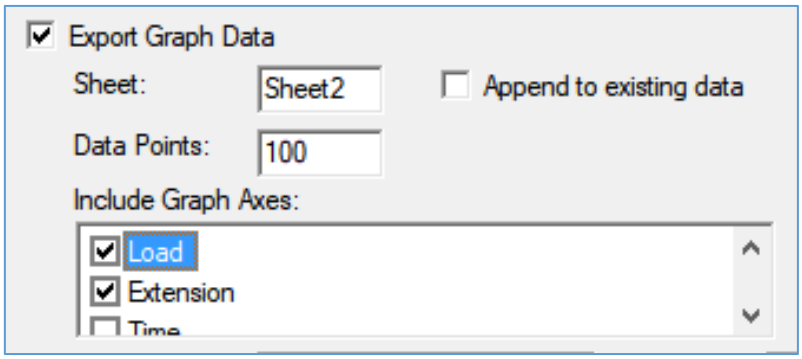


In this case, the result "Title" will be stored in cell "C6" and the results will be stored in cells C7", C8" etc up to "C16".

When numerical data is transferred to Excel, it is stored as TEXT because the units are exported as part of the data, e.g., 638.8 N. Excel cannot perform calculations on this TEXT data so if this is required, the data must be converted to NUMERICAL. This is achieved by checking the "Strip units from quantities checkbox at the bottom of the screen.



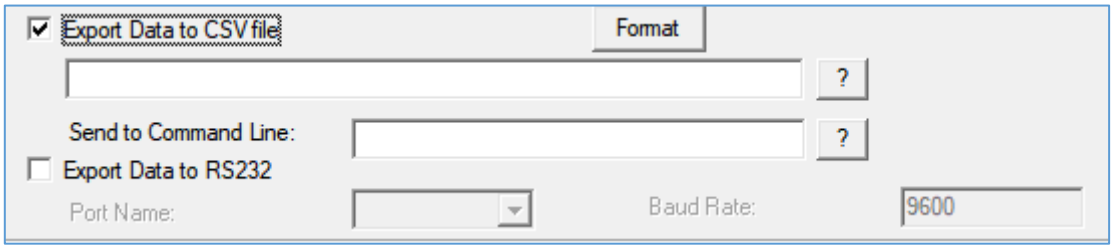
To export the graph data points to Excel, check the "Export Graph Data" checkbox and enter the name for the Worksheet (the default name is "Sheet 2").



Select the required graph axes. Every axis will be exported to its own column starting from column "A".

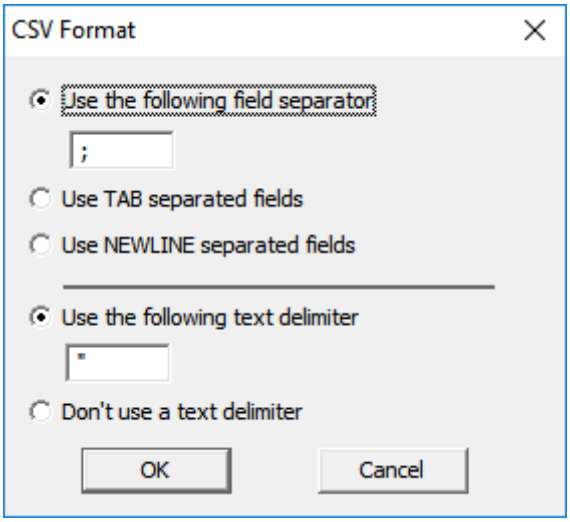
The data can also be exported to a CSV file (ASCII Text file) or can be sent down an RS232 link to certain databases.

To export the test results to a CSV file, check the "Export Data to CSV file" checkbox and enter the filename.



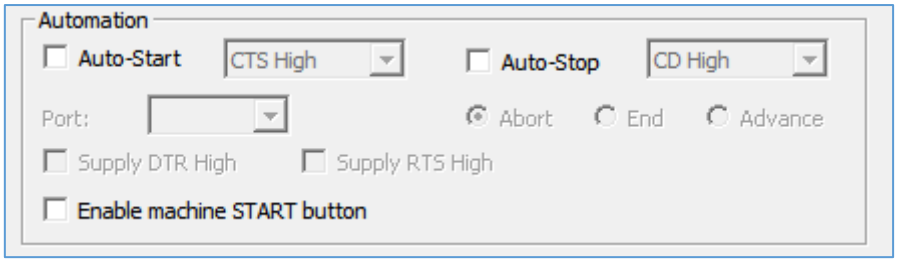
To export the test results down an RS232 link, check the "Export Data to RS232" checkbox and select the COM Port and Baud Rate.

In both cases, click the FORMAT button then configure the formatting options.



The tests can be started using a COM Port signal or the GO (►) key on the control console or hand-held remote of an LS or LD machine.

To start a test using a COM Port signal, check the "Auto Start" checkbox in the Automation controls section at the bottom of the Test Automation Screen.



Select the appropriate signal line and COM Port.

The 9-way RS232 connector pin numbers are: -

CD = Pin 1	CTS = Pin 8	DSR = Pin 6
DTR = Pin 4	RTS = Pin 7	GND = Pin 5

To start a test using the GO (►) key on the control console or hand-held remote of an LS or LD machine, check the "Enable machine START button" checkbox in the Automation controls section at the bottom of the Test Automation Screen.

This feature is easier for the operator and reduces testing time when testing many samples because the operator does not have to move between the machine and the PC for every test.

Also note that the STOP key ALWAYS operates on the control console or hand-held remote of an LS or LD machine.

Note: The GO and STOP keys do not work with a PC test on older machines.

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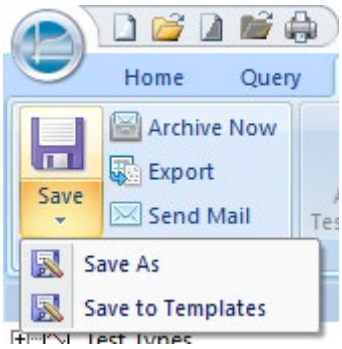
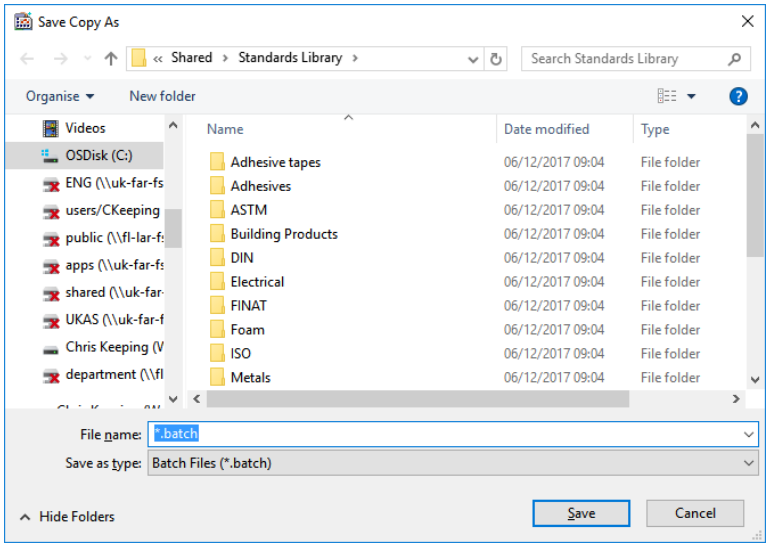
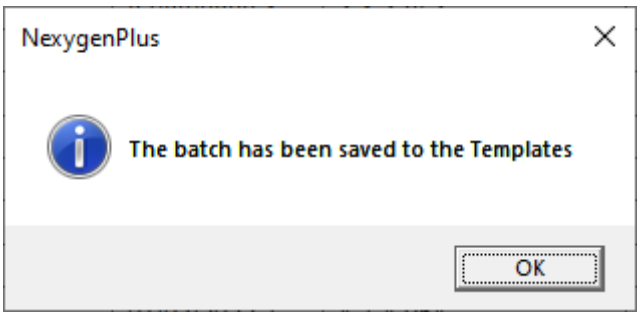
STORING THE TEST AS A TEMPLATE

When the test is fully configured, click on the BATCH Tab then click on the downwards facing arrow in the SAVE section then select SAVE TO TEMPLATES.



Enter a suitable name for this "Template" batch file then click on SAVE.



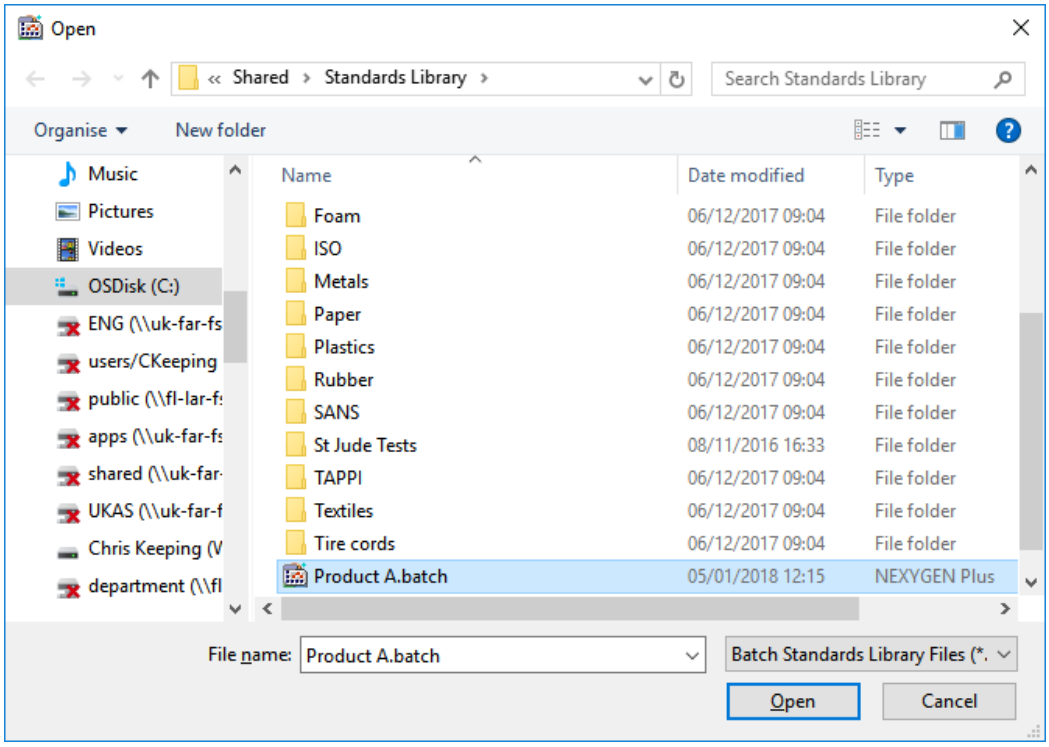


This test file is now a "Template" file and operates in a similar way to a Batch Tester "Master" file.

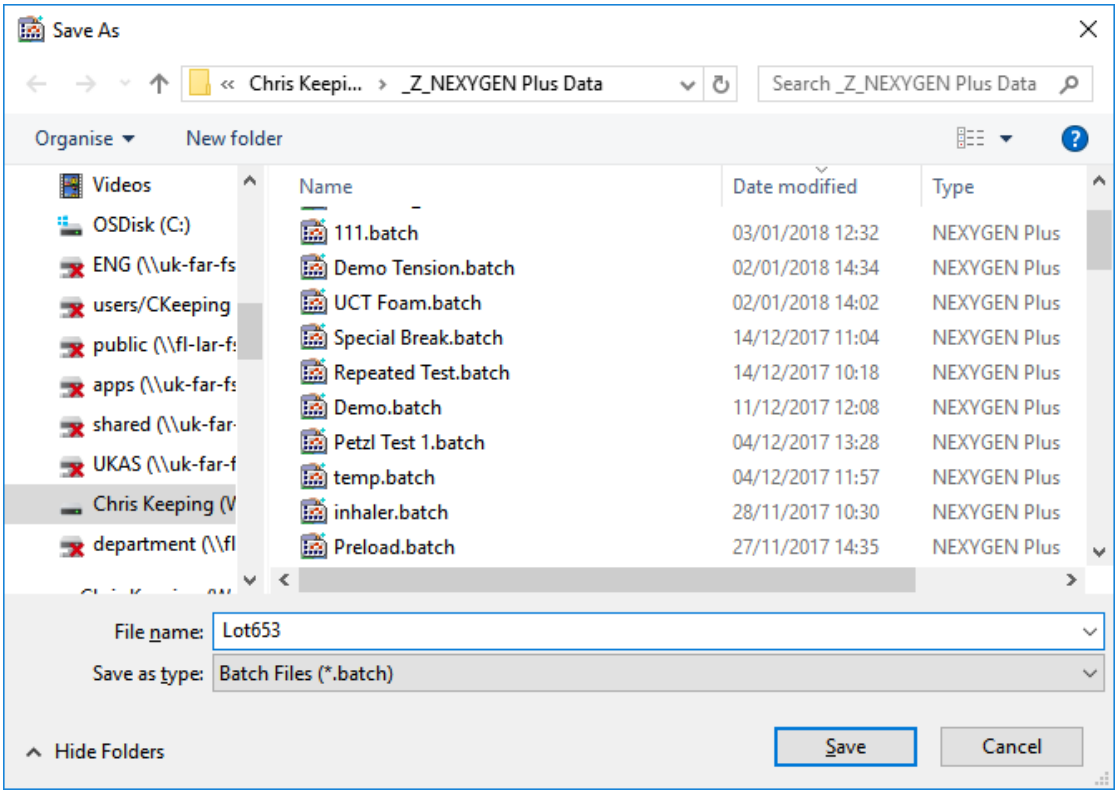
The user starts NEXYGEN Plus and the "Welcome" screen is displayed.



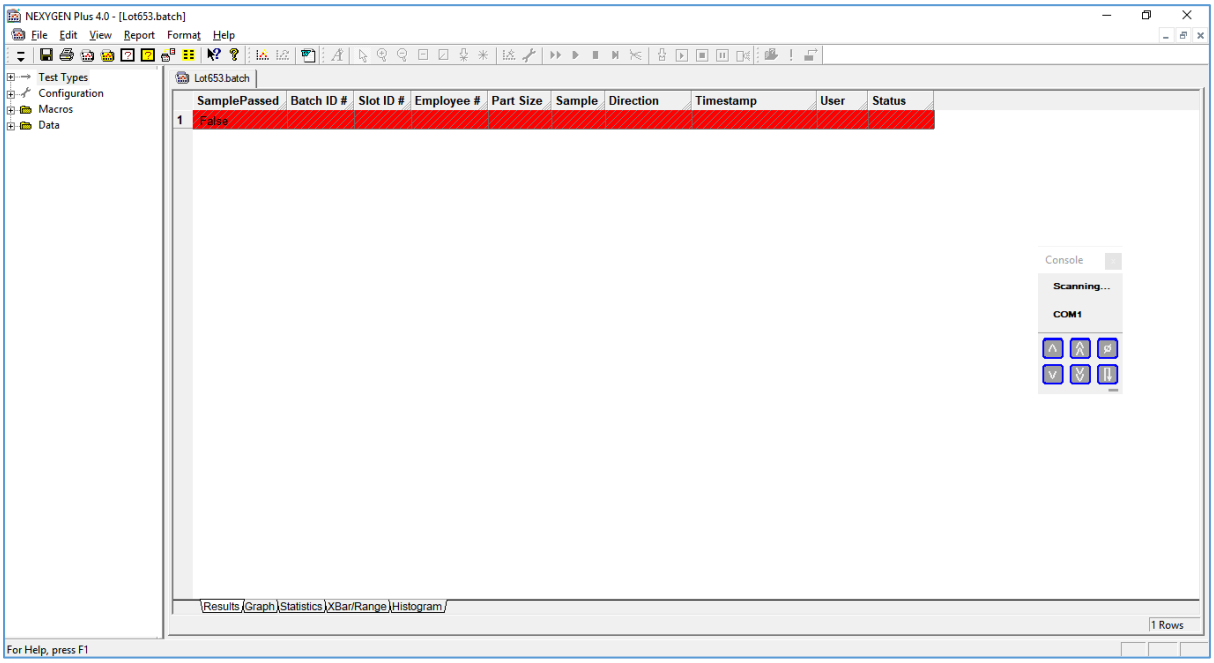
The user clicks on the "Create New Batch from Templates" button, selects the required test then clicks on the "Open" button.



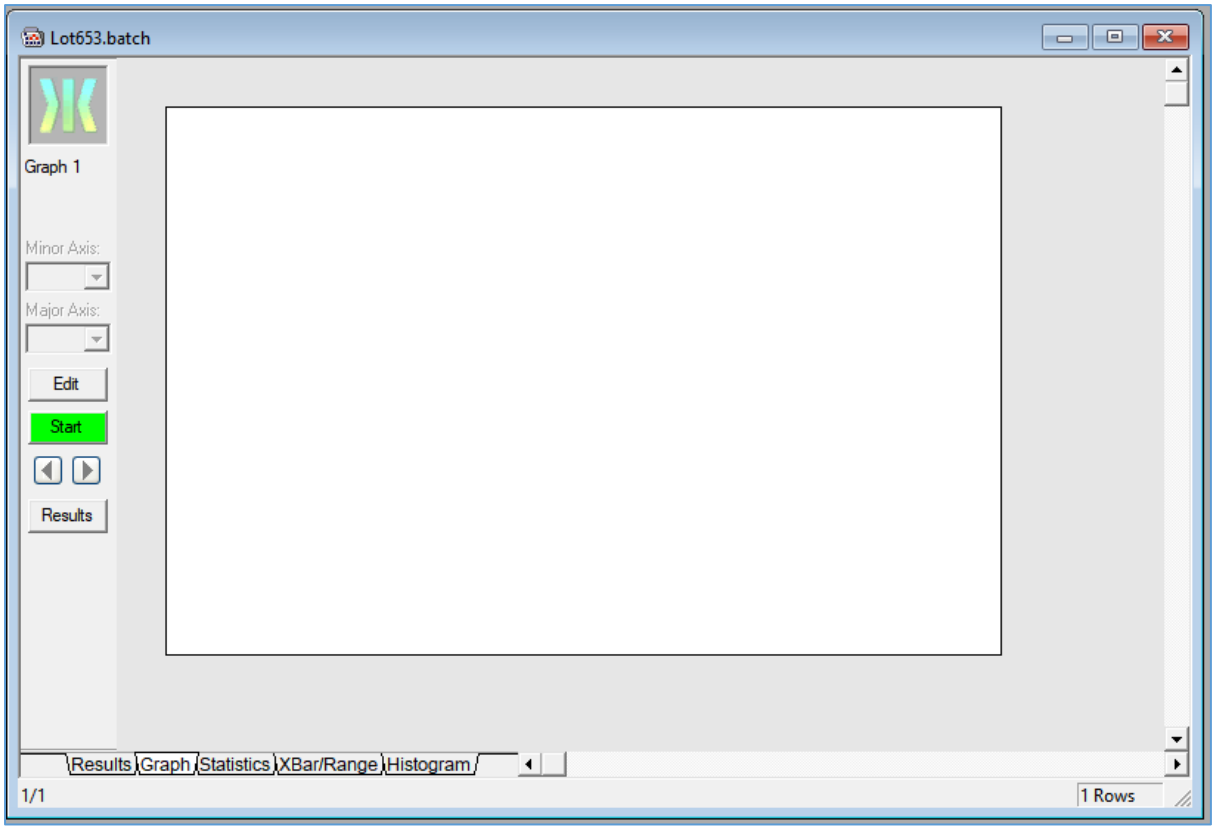
Another dialog is displayed requesting the new filename. Enter a suitable name, e.g., the batch number or lot number (**Lot653**) then click on the "Save" button.



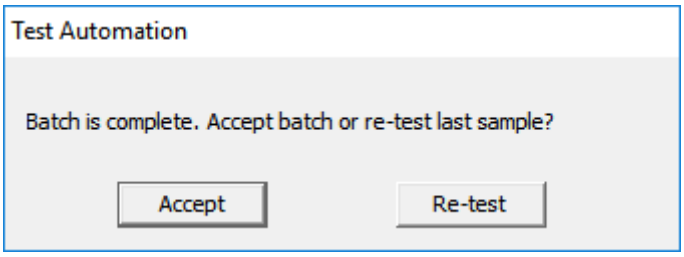
The Batch Table is displayed.



Click on the "Graph" tab at the bottom of the screen then click on the green "Start" button at the left-hand side of the graph to start the test sequence.



Perform all the tests in the sequence then a confirmation dialog is displayed.



Click on the "Accept" button to continue.

If a report or export is defined, this will automatically occur.

The test file is automatically closed and archived to the specified archive folder with the user specified name followed by the date/time of the first test and the date/time of the last test, e.g.

Lot653_05012018 103305_05012018 1230837.batch

The "Welcome" screen is re-displayed ready for the next test sequence.

The required test file is created using the same the "Create New Batch from Templates" procedure.

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