Mecmesin
testing to perfection

Emperor™ Programming for Mecmesin-*xt* Force and Torque Test Systems

Mecmesin
FORCE & TORQUE TEST SOLUTIONS
www.mecmesin.com

431-389-07

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xt Systems

This document relates to *-xt* system software V1.18-408. The .chm HELP file is derived from Operating manual document number 431-389-07.

The Mecmesin-*xt* testing systems have been specifically designed as an easy-to-use tension and compression or torque testing solution for production areas, where throughput, productivity and minimal training are vital and where the use of a computer is not always suitable, or for routine repeat testing. They are easy to operate via the touch-screen console, and are ideally suited to routine testing of components, materials and products with the ability to store and recall a library of customised test programs.

Warranty

The *-xt* console is pre-configured at Mecmesin for use with the respective test stand. With the exception of the Advanced Builder Option, which requires a configuration change to the console, any unauthorised changes to the console configuration and set-up will invalidate the warranty.

The 24-month end user warranty for console itself is with a third party. Please contact your local Mecmesin agent for assistance with this warranty.

Scope

This reference manual covers the following products and their derivatives:

Force testing stands		
Single-column stands	MultiTest	0.5-*xt*
	MultiTest	1-*xt*
	MultiTest	2.5-*xt*
	MultiTest	5-*xt*
Twin-column stands	MultiTest	10-*xt*
	MultiTest	25-*xt*
	MultiTest	50-*xt*
Torque testing stand		
	Vortex-*xt*	Torque cell capacities: 0.3, 1.5, 3, 6, 10 N.m
	Helixa-*xt*	0.1, 0.3, 1.5, 3, 6 N.m

Safe Operation of Mecmesin-*xt* Systems

Before using your test stand, you must read the Manual: *A Guide to the Safe Use of Mecmesin Mains Powered Test Frames* on safe use of this product. Test systems delivered into the European Union will have a copy of this section translated into a language appropriate for your country, supplied by your Mecmesin distributor.

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Part no. 431-389-07

Contents

1. System Overview

MultiTest-*xt*, Vortex-*xt*, and Helixa-*xt* test systems are touch-screen console-controlled test systems for tension and compression or torque measurement, based on the following key components: the test stand, an intelligent measuring cell, and a touch screen console. The following stylistic conventions are used in the text:

Onscreen Button or keyboard character to press.

Program Set-up > *Calculations* for directions via a sequence of menu options.

[Report Templates] for the tab name for a particular page of settings.

'Graph Title' for the name of a data entry field/box.

1.1 Force test stands

The MultiTest 0.5-*xt*, 1-*xt*, 2.5-*xt* and 5-*xt* have a single column with a precision ball screw drive. The MultiTest 10-*xt*, 25-*xt* and 50-*xt* have twin columns with dual precision ball screw drives. The test stand provides a stable platform for the attachment of grips, holders and other fixtures.

The **crosshead** is the part of the stand that moves up and down. The **intelligent loadcell** (ILC) is attached to the crosshead. The loadcell is the part of the test system that measures the force applied to the sample. ILCs are available that measure a wide range of force, from millinewtons to 50 kN.

ILC-S and compression plate fitted to a MultiTest 1-*xt*

The Mecmesin intelligent loadcell (ILC) stores the loadcell range, its serial number, calibration data and other information that can be read by the controlling console. This means that you can quickly swap intelligent loadcells, and the console will recognise the new sensor with its serial number and calibration information.

Intelligent loadcells are called ILC where the sensor is contained within the loadcell housing, or ILC-S for the S-beam configuration. Where the loadcell is mounted directly onto a twin-column test system, it is called ILC-T.

Jog buttons on the membrane keypad on the front of the test stand are used for moving the crosshead up and down so that grips can be fitted, and samples can be positioned before a test is started. Each time a jog button is held down, the crosshead will move a fixed distance and stop until the jog button is held down again. The red **emergency stop** button will always stop the movement of the crosshead, overriding any command from the console.

1.2 Torque test stands

Vortex-*xt* consists of a twin-column test frame with a precision-driven motor that can rotate clockwise or anticlockwise.

Interchangeable **crossheads** mounted on the columns are available with an integral intelligent torque cell (ITC). A range of these is available to measure static torque ranging from millinewton-metres to 10 N.m. The ITC stores the cell measurement range, its serial number and calibration data in a form that can be read by the **console**.

Helixa-*xt* is a precision torque tester with a single vertical column and counterbalanced moving crosshead carrying the ITC, which can range from 0.1 N.m to 6 N.m.

A **top-loading** facility is available to apply a fixed load during torque testing, where pressure and turning are required together, as in testing child-resistant closures.

Jog buttons will rotate the rotary **drive** clockwise or anticlockwise for alignment of the sample. Each time a jog button is held down, the drive will rotate a fixed amount and stop until the jog button is held down again. The red **emergency stop** button will always stop the rotation, overriding any command from the console.

1.3 The console

The console is a touch-screen tablet computer running the Microsoft® Windows operating system and the Emperor™-*xt* control and analysis program. All commands to run test programs, view, print and export data, are made here, and results are stored on the internal hard drive. It may be networked for wider access, and a series of USB ports on the underside of the unit are available to connect the console to peripheral devices.

The touch screen is pressure sensitive, unlike many mobile devices, so light pressure is required. Simply press the area or item on screen as you would click a mouse.

1.3.1 The pop-up on-screen keyboard

An on-screen touch keyboard is available for entering information, whether logging on, entering a sample number, or setting up test programs. Whenever a keyboard may be needed (i.e. input is required), press the keyboard icon that will appear in the bottom right of the screen.
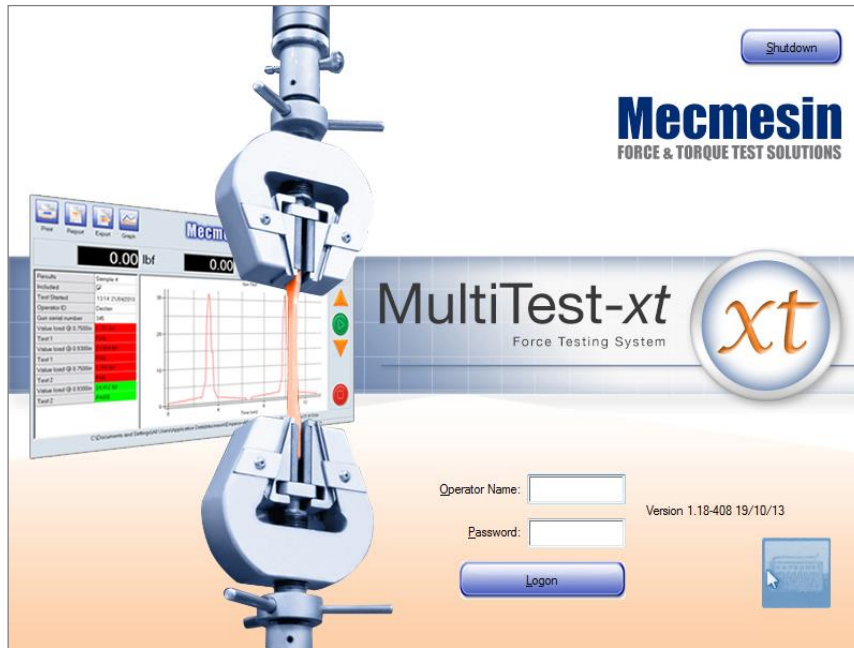
The 'splash screen'. Bottom right is the icon that provides the onscreen keyboard, below.
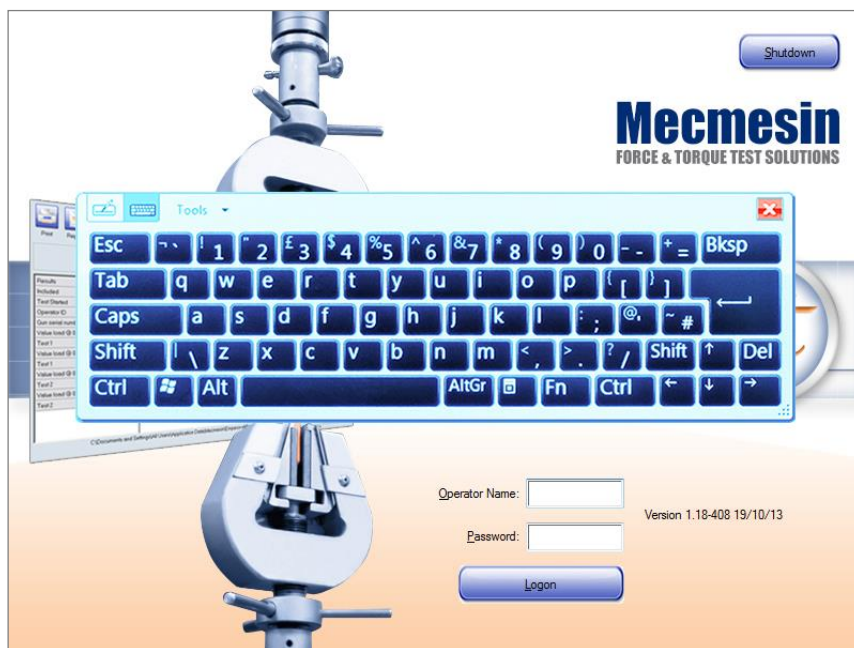
The keyboard: entries can be made using a finger or a stylus. Close it with the red cross.

Both the icon and the keyboard may be dragged to any place on the console screen. Keys are pressed as for a normal keyboard, but combination keys are *sequential* (e.g. for Ctrl+C to copy, press Ctrl followed by C; for a capital, press Shift followed by the letter). You can use a stylus to 'tap' the screen if you find it easier. The keyboard itself is resizeable by dragging the bottom-right corner out.

> **Caution**: using a stylus or pointed implement may reduce the life of the touch screen. Under no circumstances should a sharp instrument be used to operate the touch screen.

1.3.2 Using the pop-up keyboard

To enter numbers or text, first press the field box you want to type into. Then press the keyboard icon and use the keyboard. When the entry is complete, tap on the next entry box to be filled in, or go to the next field with the $\boxed{\text{Tab}}$ key. The $\boxed{\leftarrow}$ or $\boxed{\text{Enter}}$ key has been disabled in the *-xt* system: you will not need it. Use the red cross to close the keyboard.

Corrections can be made by using the $\boxed{\leftarrow}$ $\boxed{\text{Backspace}}$ key or the $\boxed{\text{Del}}$ key. You can position the cursor over the character you want to change by using the arrow cursor keys.

1.4 Screen elements
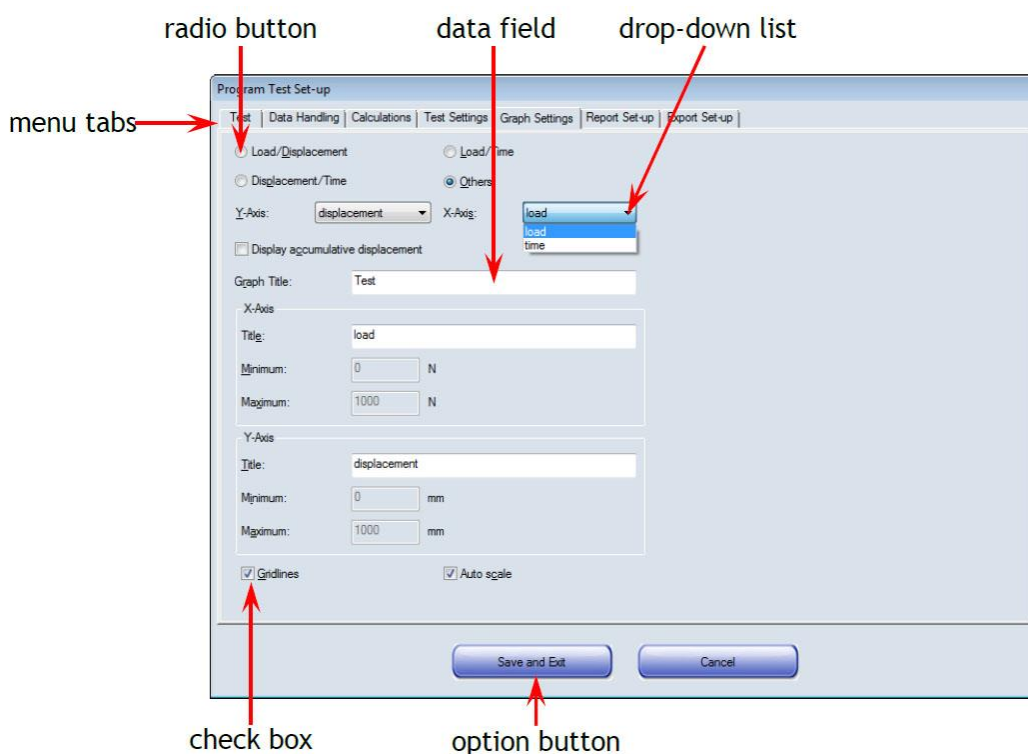
Menu tabs lie along the top of screen layouts under System Settings. Think of them as overlaid pages, and press the page tab you need.

Radio buttons allow only one item of several to be selected.

Check (tick) boxes allow multiple selections.

Data fields are used to enter text or numbers.

Drop-down lists offers a range of options from which one item can be selected.

Option buttons complete one action and may start another.

2. Getting Started

2.1 Switching on

Switch on the stand and console. Stand switches are on the back panels (or the right-hand side of twin column MultiTest stands), and the console switch is a small button on the underside, to the right of the power lead.

After a few seconds you will see the 'splash screen'. When you start the *-xt* system you will see the 'splash screen' which has entry boxes for 'Operator name' and 'Password' and a button to Logon . These names are case sensitive. Because input is required, the keyboard icon is present.

Factory default operator names and passwords

Status	User Name - case sensitive	Password - case sensitive
Operator	operator	operator
Master	supervisor	supervisor

You can create your own user accounts with passwords, which will allow or restrict access to different parts of the *-xt* system—see Section 14.2: *User accounts*.

Use the pop-up keyboard to enter a user name and password. Press Logon .

The main front screen has a number of option buttons that take you to a Quick Test , a Program Test or one of five previously stored Favourite Tests .
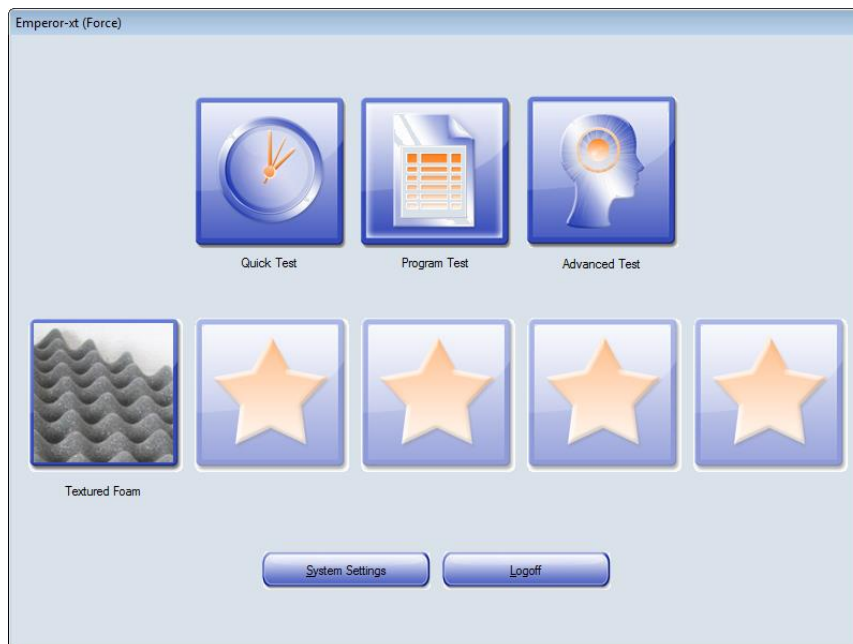
The $\boxed{\text{Advanced Test}}$ function is optional and enables you to run more sophisticated programs created using the advanced program building capabilities of the full Emperor software.

The $\boxed{\text{System Settings}}$ button is available to master users who have access to the administrative area.

2.2 Switching off

From running tests

When all sample tests have been run, press the $\boxed{\text{Exit}}$ button on the Live Test Run screen. You will be asked if you want to save the current results in the same file (i.e. overwrite it), or provide a new filename. You will then be returned to the front screen.

From the front screen

When the session is complete, return to the front screen and press the $\boxed{\text{Logoff}}$ button.

From the splash screen

Press the $\boxed{\text{Shutdown}}$ button to see the shutdown options:

$\boxed{\text{Administrative Tasks}}$ are performed in Windows, and a master user and password will close the Emperor-*xt* software and leave the console running at the Windows desktop where normal Windows maintenance, file movements or administrative tasks can be performed. You will find the Emperor-*xt* shortcut on the Windows desktop: double tap it to restart the test system. Windows and the console can be closed down normally.

$\boxed{\text{Shutdown}}$ closes the Emperor-*xt* software, then Windows, and switches off the console. It is advisable to do a complete shutdown regularly for Windows self-maintenance.

$\boxed{\text{Sleep}}$ Puts the *-xt system* into stand-by mode. The touch screen will go blank. The system can be quickly restored to Emperor-*xt* by pressing the console power switch.

$\boxed{\text{Cancel}}$ Takes you back to the splash screen.

Switch off the test stand

Switch off the stand using the main switch on the rear of single column stands, or on twin-column stands, the right-hand side.
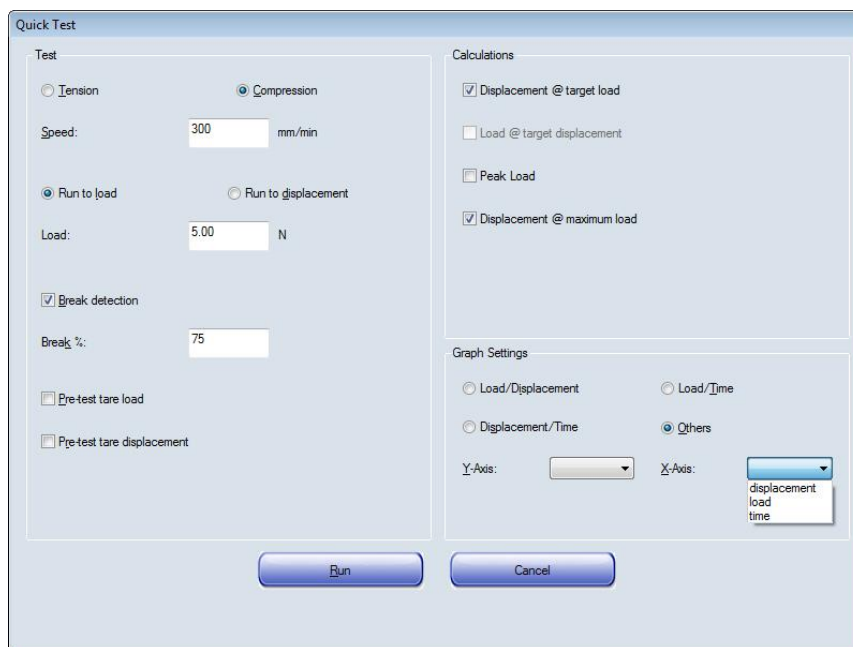
3. Running a Quick Test

A Quick Test is accessible to master users and authorised operators only. Control is limited so a certain amount of care is required. The first time you enter the Quick Test mode there are no values entered in the number entry boxes. You will be alerted for where values are required in order to perform a valid test.

> If the Quick Test has been used (run) before, the last test settings will have been retained, but you cannot save a quick test for future use.

3.1 Setting the test conditions

The force Quick Test screen

The torque Quick Test screen

Note that for torque testing the displacement component is 'Run to angle' which can be set to degrees or revolutions in 'Angle units' on the *System Settings > General Settings* tab. Rotational speed is always entered as 'rev/min'. The pre-defined calculations also reflect the rotational nature of the test.

The Quick Test provides a simple way of performing a test with a limited range of pre-defined calculations. To perform a Quick Test, choose from the options and enter a speed, force or distance/angle.

- choose between **Tension** and **Compression** (force)/**Clockwise** and **Anticlockwise** (torque)

- choose between **Run to load**, and **Run to displacement** (force)/**angle** (torque)

- use the pop-up keyboard to enter a speed in the **Speed** number entry box.

If you enter a load or speed that is greater than the maximum capacity for the stand or loadcell, or as set in 'Limits' in *System settings* > [General settings] tab, a warning message will appear when you press the Run button. Press the message OK and correct the entry.

3.2 Break detection

When turned on by selecting the break detection check box, the run will stop when the force detected has fallen from the maximum to the amount (percentage) entered in the **Break** % entry box. This could be a very sharp fall, perhaps in the case of a brittle material, or it could take some time if plastic deformation is occurring.

In Quick Test, you can alter the sensitivity of the detection by entering a number in the Break % number entry box. The default value is 75% (of maximum load achieved). Due to the complexity, break **calculations** are not included in Quick Test, only in Program and Advanced Tests (see Appendix D).

3.3 Tare the load or the extension

Tick the check boxes to tare the load or the extension or both before starting the test.

3.4 Quick Test pre-configured calculations

With Quick Test you can choose from a list of pre-defined calculations. The availability of calculations is dependent upon which test mode you have selected. For example, if you have chosen to 'Run to load', then you cannot select 'Load @ target displacement/angle'.

Use the check boxes to choose from:

Force	Torque	Result
Displacement @ target load	Angle @ target load	Available if 'Run to load' is selected. Returns the value for displacement/angle when the target load is reached.
Load @ target displacement	Load @ target angle	Available if 'Run to displacement/angle' is selected. Returns the value for load when the target displacement/angle is reached.
Peak load	Peak load	Returns the maximum load.
Displacement @ maximum load	Angle @ maximum load	Returns the maximum displacement/angle at maximum load.

3.5 Choosing the graph settings

Use the radio buttons and drop-down boxes to choose the graph axes you require.

3.6 Running a Quick Test

Press Run to perform the test (*your settings will be remembered*) or

press Cancel to leave Quick Test mode (*changes to settings will **not** be remembered*).

You are now in the Live Test Run screen, with stand control buttons on the right, navigation buttons along the top, and a results area in the middle.

The jog buttons on the front panel of the MultiTest-*xt* stand or on the touch screen console can be used to move the crosshead to a convenient place so that samples can be attached to the grips.

To start the test, press the green Start button.
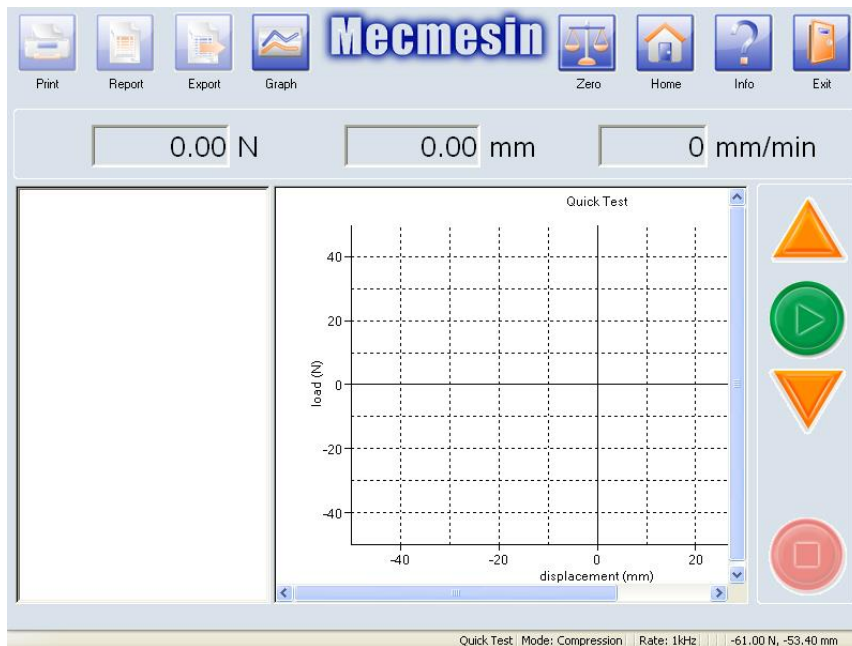
The Live Test Run screen

3.7 At the end of the Quick Test

Once the test has finished, the results for any pre-defined calculations selected will be displayed in the result grid.

In Quick Test, the crosshead will stop once the test has finished. Press the Home button to move to the last position tare, or use the jog buttons to move the crosshead to a convenient location to remove the last sample and prepare for the next.

3.8 Viewing the results

As each test is completed, the results of the pre-defined calculations selected on the Quick Test screen will appear on the Results grid. Use the graph on/off toggle button to display only the results, or the result and graph of one sample. To select which sample graph is displayed, first toggle to the Results grid alone, where all sample results are shown, and click on the sample name required. Toggle to Graph view to see the results and graph for the selected sample.

3.9 Reporting Quick Test results

Pressing the Report button will place the results into a default report template. In Quick Test you do not have the option to select a different report template. The report can be viewed on the screen, printed, or saved as a .pdf file.

Note: Quick Test results cannot be saved as data to file.

4. The Program Test Library and Results
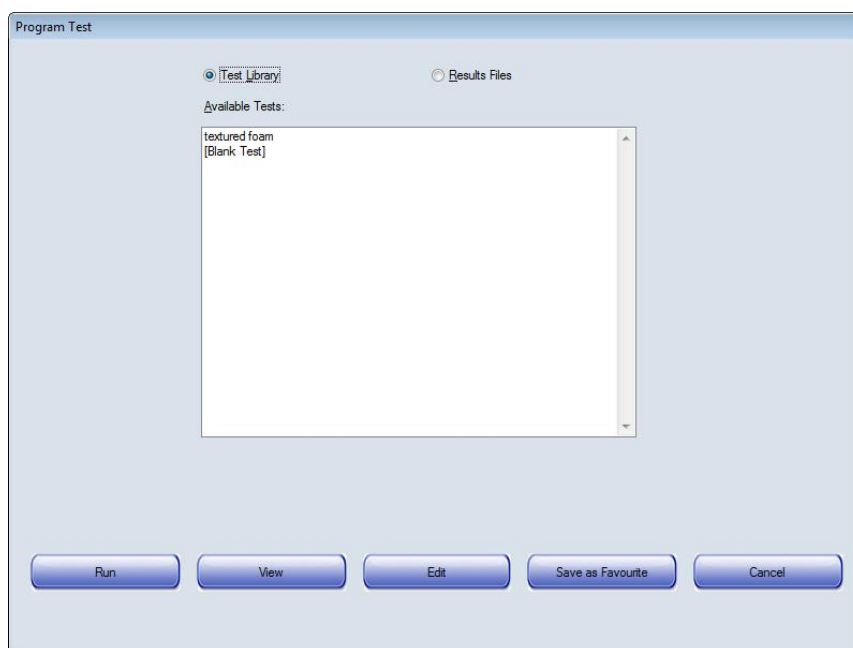
The Program Test screen. Here a new program has been written and appears in the list.

4.1 Test library

Select [Blank Test] and Edit to begin writing a new program. When you have completed all the entries, save the test with a new name.

- Once a test has been run and some sample results accumulated, these can be saved, and will be listed in the Results Files page.

- Once a Test Program has been written and saved, it can be reviewed or edited.

- Results files retain the test settings at the time they were run.

- Rerunning a test via the Results Library will append sample data using the original test settings, but any changed calculations will be performed or recalculated on all sample data in the file.

Note: If you change the calculations in a library file, be careful how you compare old and new results files from a test of the same name.

4.1.1 Run

This will run the selected test.

4.1.2 View

This takes you to the Program Test Set-up screen which contains the settings for the test. You can see all the settings, but they cannot be altered in View mode. Pressing the OK or Cancel buttons will take you back to the Program Test screen.

4.1.3 Edit (master users and operators assigned permission)

Pressing this button takes you to the Program Test Set-up screen. In Edit mode you can alter any of the settings. You can save the test with the same or a new name.

Pressing the Cancel button abandons any entries you have made and takes you back to the Program Test screen.

4.1.4 Save as favourite (master user only)

See Section 8, *Saving Tests as Favourites*, for instructions on how to allocate tests to the five Favourite buttons with related button images.

4.2 Results files

Selecting the Results library instead of the Test library displays a list of previously saved tests. These can be viewed, but also edited to allow different calculations on the measurements taken.

- The original test settings can be seen, but only Calculations may be edited.

- Results may be reviewed, displayed and reported graphically.

- Rerunning a test from the results library allows new samples to be appended to the results file, based on the same test settings.

- Calculations are performed on all samples and edited calculations are used to recalculate all results in the file.

4.2.1 Run

Pressing the Run button loads the previous results and settings for the test selected, then takes you to the Live Test Run screen to display the results. This allows you to add further samples to previous results by running the test program.

If you prefer to test samples for a new set of results and save them separately, load the Library *Test*, not the Library *Results*.

4.2.2 View

This takes you to a protected view of the Program Test Set-up screen where you can see all the test settings, but not alter anything. Pressing either the OK or Cancel buttons will take you back to the Program Test screen.

4.2.3 Edit (master users and operators with permission)

Pressing the Edit button takes you to the Program Test Set-up pages. In Edit mode you cannot alter the parameters of the test settings. The main purpose of editing is to alter calculations on the captured data, or outputs from the results file.

After editing, press the OK button. You will be asked if you want to save the file (same data, results reflecting any changed calculations), and asked if you want to replace the existing file or rewrite to a new results file.

Pressing the Cancel button abandons any changes you have made and takes you back to the Program Test screen.

5. Setting Up Program Tests

Select [Blank Test] and Edit to begin writing a new program. Available to master users, and operators with permission, the Program Test Set-up screen contains seven tabs:

| Test | Data Handling | Calculations | Test Settings | Graphic Settings | Report Set-up | Export Set-up |

Pressing the Cancel button at any time will abandon any entries you have made, and take you back to the Program Test screen.

5.1 Test tab

The [Test] tab is used to set the test conditions. The six buttons on the left are used to enter variables and choose options.
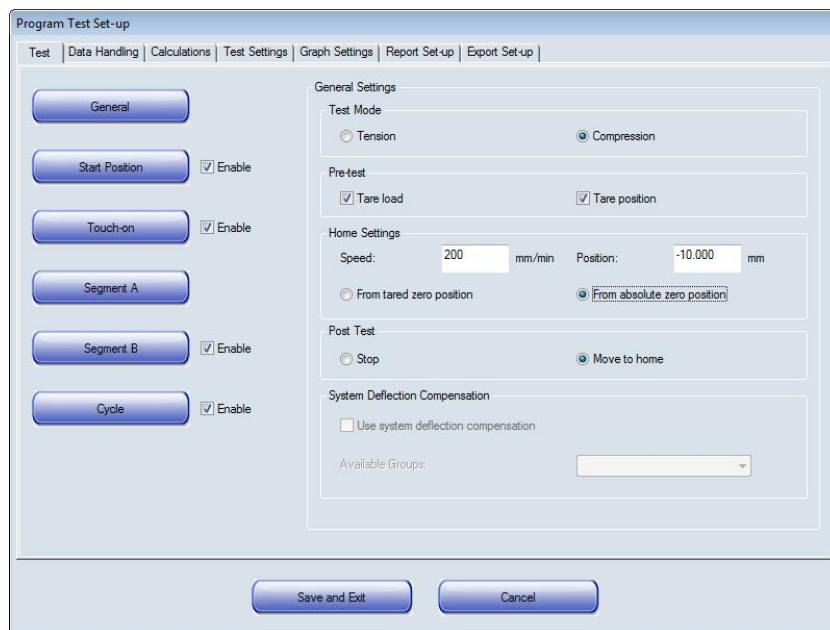
Force Program Test, [Test] tab

The Program Test [Test] tab for torque is very similar, but with the options for direction of Clockwise and Anti-clockwise. Speed is entered in rev/min, and Position in degrees or revolutions:
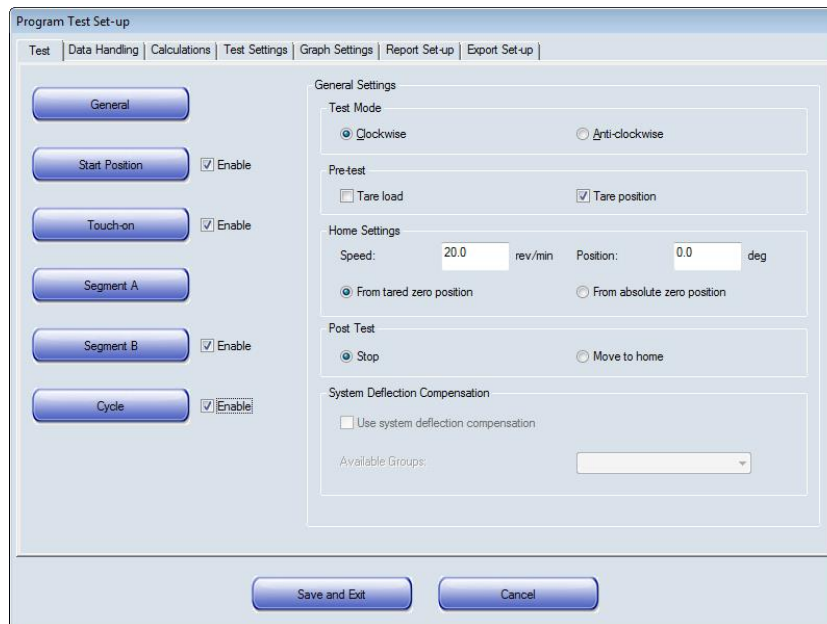
Torque Program Test: [Test] tab

The Program Test can have one or two stages, called **Segment A** and **Segment B**. You can set different parameters in each segment. If you use both segments, you also have the option to cycle from the end of Segment B back to the start of Segment A. You can set how many cycles are performed.

5.1.1 General

Test mode

Use the radio buttons to set the test mode (primary direction of measurement) to **Tension** or **Compression** (force) or **Clockwise** or **Anti-clockwise** (torque). Programs are written with positive and negative movements in relation to this.

Pre-test

Ticking the **Tare** boxes will zero the load or the displacement, or both, before the test starts, *where the crosshead currently is*.

Home settings

> See Section 10: *Relative and Absolute Positions: Zero, Home and Start* for clarification of absolute and relative positioning.

The 'Home' location can be defined relative to the *last tared position in the program as run*, as a place to send the crosshead or platen at the end of a test, or relative to the absolute zero position held in the stand.

Absolute position: The 'Home' location is defined from absolute zero (as set in the Live Test Run screen).

Speed: The crosshead or platen will move to the 'Home' position at the speed entered here.

Position: The distance or angle from either the last position 'tare' or absolute zero. Remember that distances such as offsets from zero positions are relative to the main direction of travel. A negative distance from zero for a compression test is upwards, for example.

Post-test

When the test is finished you can leave the crosshead or platen where it stopped, or send it to the 'Home' position, ready for the next sample.

System Deflection Compensation

See Section 14.6 'System Deflection Compensation (SDC' for an explanation about the system deflection compensation. To use System Deflection Compensation, tick the check-box and select the accessories group from the drop-down box.

5.1.2 Start Position

A tick box **enables** the optional 'Start Position'. The start position is the place the crosshead or platen will move to before the test begins its sequence.
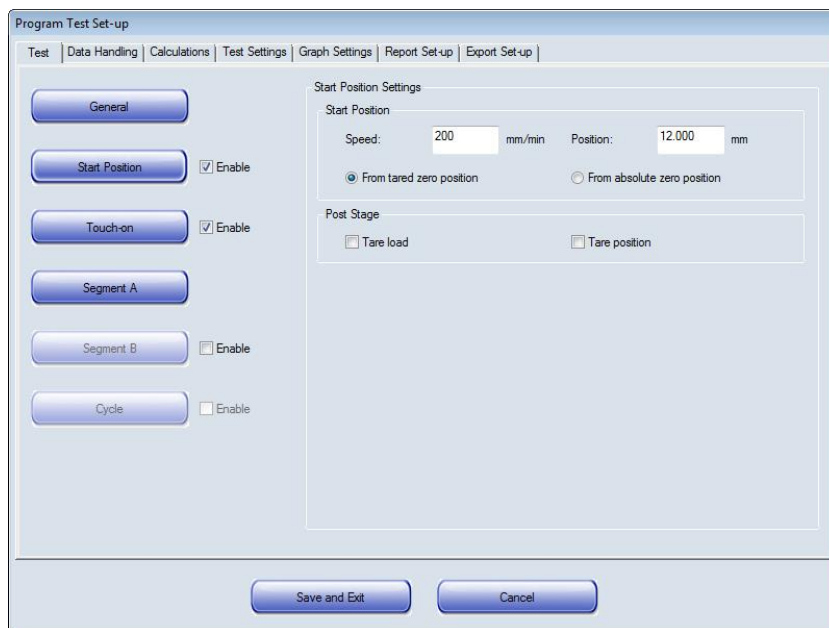
The speed at which the crosshead or platen will travel to the start position can be set here (direction is determined by where the crosshead or platen is in relation to the zero position).

The start position can be relative to the last tared position, or to absolute zero, and this new position itself can be made the new tared position.

Post Stage

After reaching the start position you can tare (zero) the load and the position.

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5.1.3 Touch-on

A tick box **enables** 'Touch-on': the point at which contact with a sample can be detected.
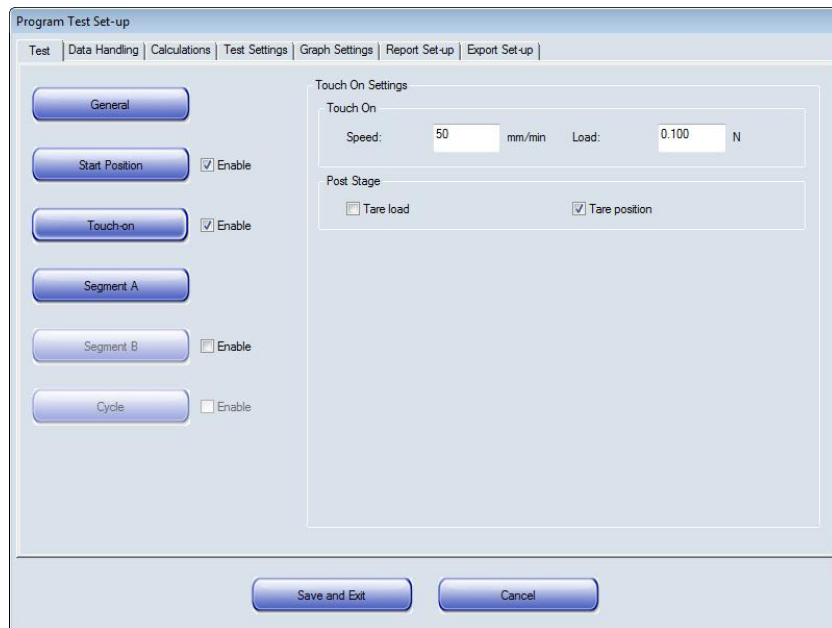
Program Test Set-up: Touch-on

In a compression test, for example, you can find the top of a sample by moving the crosshead at a slow speed until it touches the sample, or in a torque test, the point at which a torsion spring engages—and a very small load is detected. You can then tare the load and the position if you wish.

You can calculate the length of a sample by adding a 'Free Height' calculation in a Program test. Set Absolute zero as touching the anvil plate, and tare the Touch-on to the sample. Free Height displays the difference in distance between Absolute zero and the Touch-on position.

Speed

Set the touch-on speed—for accuracy, move slowly.

Load

Set the load. Choose a low value to locate the starting point without distorting the sample.

5.1.4 Segment A

Force Program Test Set-up: Segment A
(Torque tests show 'Angle' in place of 'Position' and 'Hold at Position' instead of 'Load')

Run to

Use the radio buttons to choose to run to a 'Load' or a 'Position/Angle' or a 'Time'. Enter the required values for each as appropriate. Remember to work out maximum travel available for this time at this speed.

For torque, load is entered in torque units, and Angle in degrees or revolutions, as set in the *Program Test Set-up* > [Test settings] tab.

Speed

Set the run speed for this segment.

Direction

This is only necessary and available when running to 'Time'.

Break detection and Break calculation in Program Test

The purpose of **break detection** (seen also in Quick Test) is solely to stop the machine force or torque drive. When turned on by selecting the Break detector check box, the run will stop when the applied force or torque falls to a percentage of the maximum, as entered in the 'Break %' entry box. This could be a very sharp fall, perhaps in the case of a brittle material, or it could take some time if plastic deformation is occurring. The default break detection value is 75% but you can alter the sensitivity.

The **actual break point** of a sample must be **calculated**, since there is a final period of deformation, with duration dependent on the sample material, and the point on this curve regarded as the break point must be defined. A calculated break can be based on

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the 'Sharp' break or 'Percentage' break definitions as given in Appendix A.4 by comparing consecutive data points.

> **Note:** the calculated break point will not coincide with the point where the break detector has operated.

Hold

You can also choose to hold (maintain) a load (force) or a position (torque). Enter the value needed.

Use the Time entry box to set the duration of the hold. This time will start only when the desired Load or Position has been reached.

Hold is not available if you have chosen to run to 'Time'.

Sample material

If the system is holding to a load, the sample may continue to respond by relaxing or restoring to form, thus altering the net applied load. To enable the system to follow, drag the slider representing sample resilience left or right (0 mm/min, representing inflexible, to 120 mm/min representing most elastic) to adjust the hold sensitivity for different sample types.

5.1.5 At the end of the segment

If you are using only Segment A on its own, when the requested condition has been reached (i.e. the desired load, position/angle or time has been reached), or if a break is detected, the crosshead will either stop or, if you have selected this option in the 'General' button settings, return to the 'Home' position.

If you have programmed a Segment B, then the run will continue with the settings you have made for Segment B.

5.1.6 Segment B

A tick box enables the addition of Segment B.

For Segment B you have the same choices of Load, Position or Time run settings as in Segment A. Suppose that for a MultiTest-*xt*, for example, you have chosen a compression test in the General Settings, and Segment A commands the crosshead to run downwards to compress the sample to 125 N and maintain (hold) this load for 10 seconds. Segment B can be a different load, perhaps 35 N, and this load might be maintained for 8 seconds. In this case it is only necessary to tick the Segment B check-box and enter the new load, speed and hold duration for Segment B. MultiTest-*xt* will determine the direction of movement of the crosshead. Similarly, for a Vortex-*xt* or Helixa-*xt*, you might want to run to a 90° rotation clockwise in Segment A, hold for 10 seconds, then run to a 180° rotation anticlockwise in Segment B.

As in Segment A, the hold timer will start only when the desired Load or Position has been reached.

5.1.7 Test triggers

Another way of reducing the volume of data collected is to set triggers to act as limits, outside of which data are not saved. Triggers can be set as:

Time Test Triggers: you can collect data from the start of the test, or after an interval that you set. The data can be collected until the end of the test, or you can set a time to stop collecting data.

Position Test Triggers: you can collect data from the start position, or from a value that you set. Data can be collected until the test stops, or up to a second position that you set.

Load Test Triggers: you can collect data from the start of the test, or from a load value that you set. Data can be collected until the test stops, or up to a second load value that you set.

Data Capture Window: you can set the duration of a window during which data are collected. For example, if the events that you are interested in occur at the end of a long test, you could set the window duration to be, say, 1 minute. This restricts data capture to a moving window, and only data for the previous 1 minute is retained. This will ensure that you record the events of interest without acquiring a large amount of unnecessary data.

Once you have entered a sampling rate and any triggers that you want, press Save and Exit to save these settings and return to the Program Test screen.

Press on Cancel to abandon any entries and return to the Program Test screen.

5.1.8 Cycle

Cycling is only available if you are using both 'Segment A' and 'Segment B'. Tick the check box to enable cycling, and use the entry box to set the number of cycles required. At the end of Segment B, the program will return to the start of Segment A. This will be repeated for the specified number of cycles. The crosshead will then stop or return to the 'Home' position' if you have selected this option in the *Program Test > Program Test Set-up >* General button.
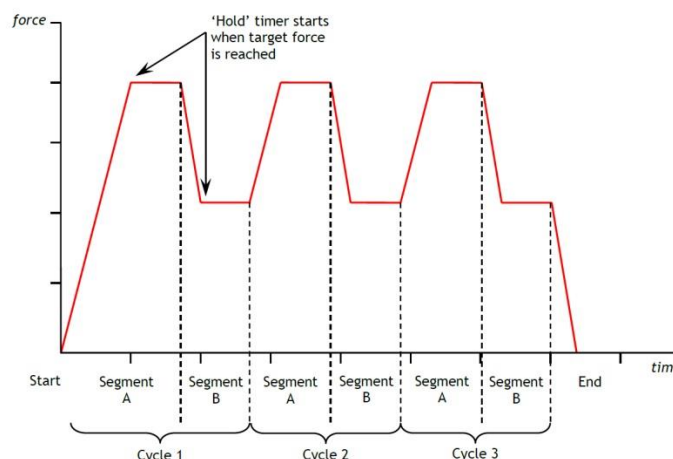
Graphical representation of segments and cycles

5.2 Data Handling tab

5.2.1 Sampling rate

The sampling rate is the frequency with which data points are recorded. A sampling rate of 1000 Hz means 1000 results are sampled and recorded every second. With a long test and a high sampling rate, large amounts of data can be recorded, which can make data files very large. For example, when recording at 1000 Hz, a test lasting 4 minutes and 10 seconds will generate 250,000 data points.

Care should be taken when selecting sampling rate. Bigger is not always better.

Program test [Data Handling] tab: determines the scope of your data

5.3 Calculations tab

See Section 7: *Program Test Calculations* for a description of the available calculations in the drop-down list, and Appendix A for full explanations.

To add a calculation to a test, select the calculation name in the 'Available Calculations' drop-down list, then press Add .

Some calculations will need additional information to be entered. As you add a test, relevant data entry boxes will be presented.
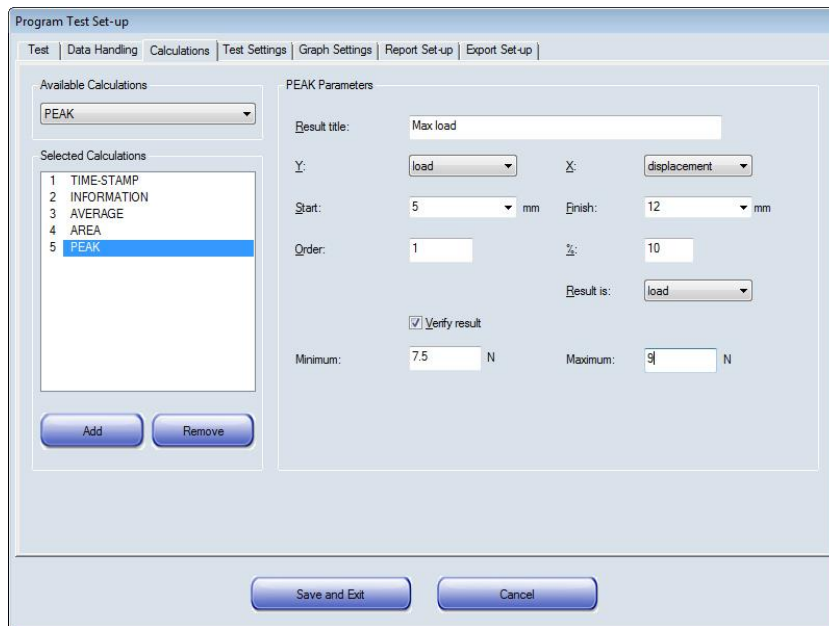
Program test [Calculations] tab.
Here a sample will pass or fail based on a peak load tolerance of 7.5 to 9.0 N

When all the required calculations have been selected and any additional information has been entered, press Save and Exit to save the settings and return to the Program Test screen.

Pressing on Cancel will abandon any selections that have been made and return you to the Program Test screen.

5.4 Test Settings tab

5.4.1 Test units

Here you can set the units that will be used for displaying results, in calculations and in reports. Use the drop-down boxes to select from the available options:
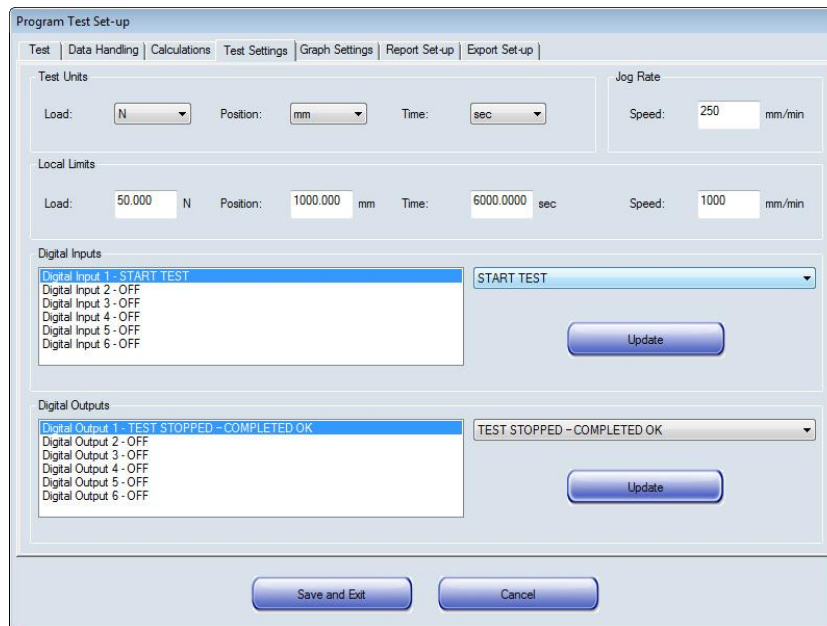
MultiTest-*xt* Program Test [Test settings] tab, also showing Digital I/O settings

	Force	**Torque**
Load	mN, N, kN, gf, kg.f, ozf, lbf	gf.cm, kg.f.cm, lbf.ft, lbf.in, mN.m, N.cm, N.m, ozf.in
Position/Angle	mm, in	deg, rev
Time:	h, min, sec	h, min, sec

5.4.2 Local limits

The default settings are automatically entered as the lowest value for the test stand and loadcell connected. They can be adjusted for a further margin of safety or protection.

5.4.3 Jog rate

Set the speed at which the crosshead will move when an on-screen jog button is pressed and a Program Test is loaded. (**Note:** this is not the same as when running a Quick test, where the jog buttons increase and decrease speed incrementally.)

5.4.4 Digital inputs and outputs

See Appendix F for details of the digital inputs and outputs and their associated commands and notifications.

See Appendix G for details of the pin-out configuration of the digital inputs and outputs.

5.5 Graph Settings tab

This tab is used to set the options for how the results will be presented graphically. Use the radio buttons and drop-down boxes to choose the graph axes.

Display accumulative displacement. Ticking the check box will plot the displacement on the graph from the beginning of the test, i.e. displacement will be shown as increasing regardless of the direction of travel of the crosshead. This is useful when calculating area, average and slope.

The selection of graph axes suitable for torque testing is similar. **Display accumulative angle** can be used to show the total angle, regardless of the direction of travel or rotation beyond 360 degrees.

A **graph title** is optional. The X and Y axis titles will be filled in according to the radio button selected, but you can overwrite these if preferred.

Use the check box to include the **gridlines**.

When a test is running, the graph is **auto-ranging**—it will be re-drawn so that the trace is always visible. Ticking the Auto scale check box will cause the graph to be re-drawn *at the end of the test* with the axes scaled to display all the data collected.

If you un-tick the **Auto Scale** check box, the greyed-out boxes become available and you can manually enter the X and Y axes maximum and minimum scales. At the end of the test, the graph will be re-drawn using these scales.

5.6 Report Set-up tab

This tab allows you to name a report based upon a report template that you have previously created. See Section 14.3 *Report templates* for details of how to create and save report templates.

Report Title: Enter a title to appear on the report for this test when printed.

Report Template: Use the drop-down box to select a report template.

Header and Footer: Tick the check box to include header and footer info.

Results: Tick the 'Results' check box to include results in the report. Results are the product of calculations added to the Selected Calculations list in the [Calculations] tab of the Program Test Set-up screen. The results are presented in the order in which the calculations appear in the Selected Calculation list.

Graphs: Tick the check box to include graphs in the report. If this check-box had been checked, you can select how many samples are displayed on each graph up to a maximum of eight.

Legends: Tick the check-box to add a colour-coded legend when more than one sample per graph has been selected.

Press `Save and Exit` to save the Report settings and return to the Program Test Set-up screen.

5.7 Export Set-up tab

To export data, either use the default settings (and see how it meets your needs) or set up an export format Scheme that may be more suitable (see Section 14.5: *Schemes* for more details). Choose to set up for each combination to send either sample results, or all data points (raw data) to file or transmit to another device via a Comm port:

	Results	Raw Data
Export	to file	to file
Transmit	to Comm port	to Comm port
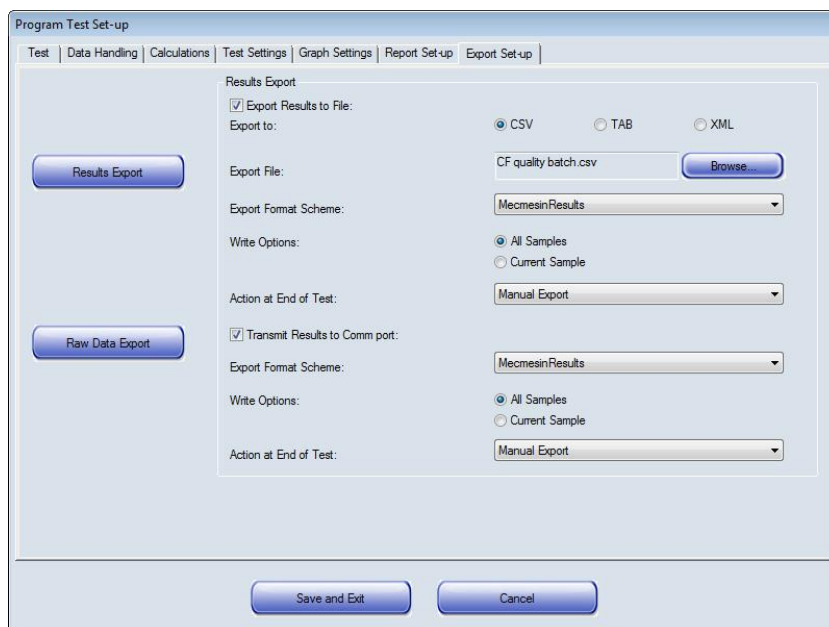
Program set-up Export Set-up screen

Use the option button to choose Results Export or Raw Data Export . The options on the right are the same for each, except that for Raw Data you can arrange data horizontally (samples side by side).

Tick the check boxes to export the information to a file on the console or transmit the results to a Comm port.

Use the radio buttons to choose the file format: CSV, TAB or XML.

Press the Browse button to pick an existing file or create a new file name that will be used to store the exported information.

Use the drop-down box to select an Export Format Scheme that has been previously been created. See Section 14.5: *Schemes* for information on creating an export scheme.

Use the radio buttons to send information on:

- All samples
- Last sample—caution, if you do not change the file name, the file will be over-written with just the last result each time the information is sent.

Use the drop-down box to select the Action at the end of the test:

- Manual export—by pressing the Export button on the Live Test Run screen.
- Automatic export—information is sent as soon as the test is completed.

Press Save and Export to save the Export settings and return to the Program Test Set-up screen. You will be asked if you want to save the Program file, and also be asked if you want to use the existing name or enter a new name.

6. Running a test program

Select a test from the test library and complete all the entries to start a new file with a new name, or select an existing test from the Results file list.

Press Run . You will be taken to the Live Test Run screen.

Use the jog buttons on the front of the test stand or on the Live Test Run screen to move the crosshead to an appropriate position to attach the sample.

Start the run by pressing the green start button. If you have Graph view selected you can see the test proceeding. If you have the Results Grid selected you will see the calculations updated at the end of the test. See Section 12: *Running Tests*.

At the end of the each sample.

The crosshead will stop or move to the 'Home' position if you have set this in the *Program Test Set-up* > [Test] tab.

At the end of the session

See Section 2.2: *Switching off* for details of shutting down the *–xt* test stand.

7. Program Test Calculations

The following calculations are available for tests made using Program Test. Full descriptions are given in Appendix A.

- **Area** : the area under a graph between two x-axis values

- **Average** : the average value on the y-axis between two x-axis values

- **Break** : the point where a sharp or percentage break in a sample is detected

- **Free Height** (Force systems only) : the touch-on height measurement of a sample

- **Information** : add information for a test (reason stopped; operator; SDC status)

- **Peak** : maximum value on the y-axis between two x-axis values (or 2nd, 3rd peak etc.)

- **Print-When** : true and false messages when a test condition is met, or not

- **Slope** : the gradient of a line between two points, or its y-axis intercept value

- **Time Stamp** : test start or finish time

- **Trough** : opposite of peak; minimum values on the y-axis between two x-axis values

- **Value** : value on the y-axis for a given value on the x-axis

7.1 Selecting calculations

Calculations are selected from the [Calculations] tab of the *Program Test Set-up* screen. Use the Available Calculations drop-down box to select the calculation, and then press ⌈Add⌉ to include the calculation in the Selected Calculation list. Most calculations will need additional information such as 'Start' and 'Finish' values to be entered, and the relevant input boxes will be revealed as each calculation is added to the list of Selected Calculations.

As each calculation is added, it is automatically given a calculation line number. Results will be presented in the order in which they appear in the Selected Calculation list.

Verify result: Minimum, Maximum: Ticking the check box in the *Program Set-up > Calculation* tab, and entering minimum and maximum values, will be used to colour code the result displayed in the Results Grid. If the calculated result lies between the minimum and maximum, the result will be printed with a green background in the Results Grid, and in green text in a report. Results that are below the minimum or greater than the maximum will be printed with a red background in the Results Grid, and in red text in a report.

Overall result. If you have selected at least one calculation to be Verified, then a final row is added to the list of calculations on the Results Grid, called **Overall result**. Overall result is 'Pass' if all the verify results are met. i.e. all results are in green. If any of the verified results are not met i.e., if any of the results are in red, then Overall Result is 'Fail'.

To continue adding calculations, select from the available Calculations drop-down box.

When all the calculation needed have been selected and the additional variables entered, press OK to go to the Program Test screen.

If you press Cancel any entries you have made will be abandoned, and you will be taken to the Program Test screen.

8. Saving Tests as Favourites

Up to five test programs may be allocated to the **Favourite** buttons that appear on the front screen. In either the **Program Test** screen or the **Advanced Test** screen, first select the test you want to allocate as a Favourite, and then press Save as Favourite to be taken to the Favourite Button Set-up screen.
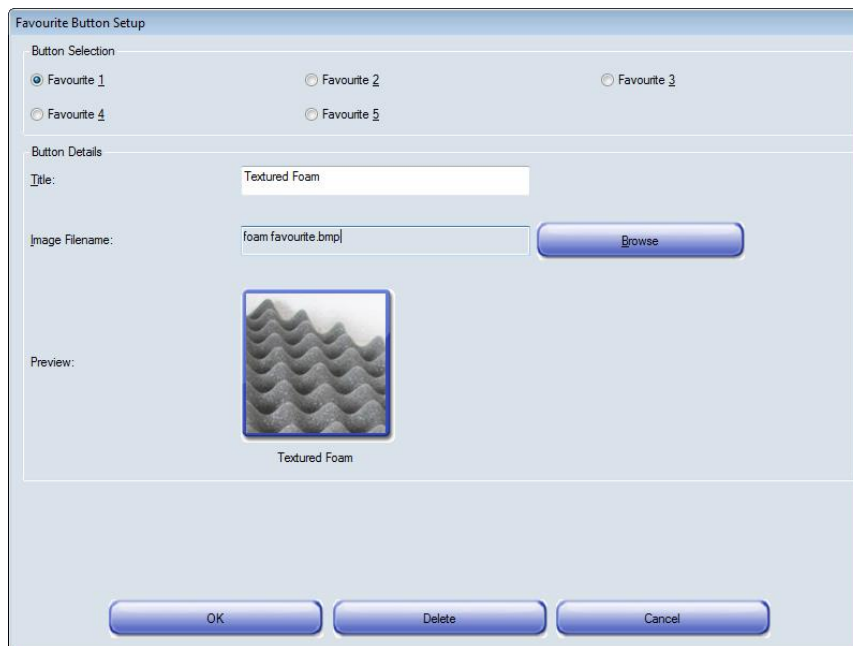
Favourite Button Set-up screen

Select a Favourite button. If this has already been used, the Title, Image Filename and a preview will be displayed. You can overwrite these with a new choice, or select an unused Favourite button. To delete a Favourites from the list, select and press Delete .

Add a Title to your Favourite. This can be the same as the Test name, or a new description, and will appear below the button.

Add an Image to the button. Organise images for your favourites and copy them first into the right file folder: \Program Data\Emperor-*xt*\Force(or Torque)\Favourites

The Browse button will take you to this 'Favourites' folder where the images must be stored. These must be in bitmap format, i.e. *filename*.bmp and ideally sized at 150 × 150 pixels.

Press OK to store the favourite. When you next return to the front screen, the Favourite button will display the new image and test title. Pressing on a Favourite button will load the test settings and take you directly to the Live Test screen ready to start.

9. Using Advanced Tests
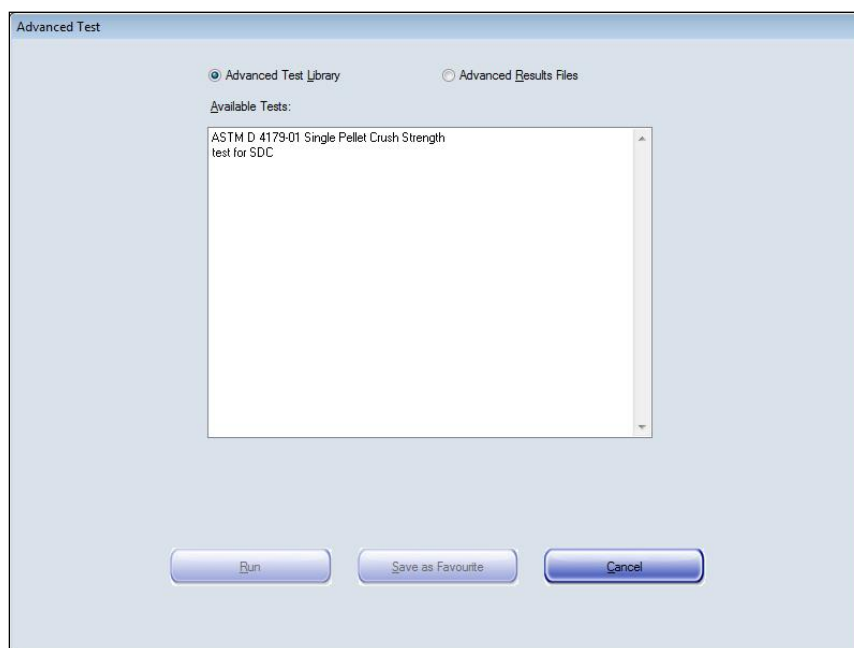
The Advanced Test screen: available programs and result files

The Advanced Test option is only available if you have the upgrade to the Advanced Program Builder option. If this is available, you will be able to select and run programs written in Mecmesin's powerful Emperor™ software. See Appendix D for instructions on how to install the Advanced Program Builder.

> **Note:** You cannot edit imported Emperor or Advanced Program Builder programs in -*xt* systems. Any changes must be made and saved in Emperor, and the modified file transferred into the -*xt* system (see below).

Advanced Test Library: This is a list of Advanced Tests, where no samples have yet been run. These are the equivalent of Emperor Library files. (Refer to the manual: *Emperor Programming for Mecmesin –i Test Stands*.)

Advanced Results Files: This is a list of Advanced Tests including sample results. These are the equivalent of Emperor results files.

These Advanced Tests may also be assigned to a Favourite button and so be directly accessible from the front screen. See Section 8, *Saving Tests as Favourites* for more details.

Select a Test and press Run to go to the Live Test Run screen.

Pressing Cancel will abandon any entries and take you to the front screen. An advanced test can be stored as one of your five favourites (see Section 8).

## 9.1 Importing Advanced Tests into the *-xt* system

In order to use Advanced Tests, you must have the Advanced Program Builder option installed. Advanced programs will be written on the PC or laptop computer that has the Emperor software installed. When the advanced program has been completed, save it as a library file. Emperor will save force library files as *Filename*.lif, and torque library files as *Filename*.lit.

Library files then need to be copied to the *-xt system*. First it is necessary to quit the *-xt system* and return to the Windows operating environment. If the library file uses a Report template or System Deflection Compensation (SDC) template, then these template files must also be copied to the relevant file folder in the *-xt* console.

If the *-xt system* and the PC/laptop with the Advanced Program Builder are connected by a network, then the library file can be copied and placed in the Library sub-folder of the *-xt system* console. If there is no connection between the *-xt system* and the computer hosting the Advanced Program Builder, then the library file should first be copied onto a USB memory stick for transfer to the *-xt system*.

To copy the library file to the *-xt system*:

- press the ⎢Logoff⎥ button on the front screen

- press the ⎢Shutdown⎥ button at the top of the splash screen

- in the Options dialog box, press ⎢Administrative tasks⎥ and enter a valid Master level username and password. This will return you to the Windows operating environment.

- Insert the USB memory stick that contains the library files into a spare USB port on the console. Choose 'Open folder to view files'—Windows explorer will open.

- Navigate to the location of the library file. To copy the file, first select it and continue to hold your finger (or stylus) on the file until the drop-down menu appears:
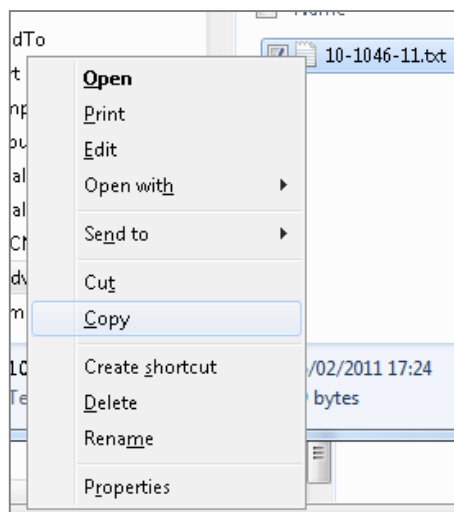
- Tap on 'Copy'

- On the console desktop you will see a shortcut called 'Emperor-*xt* Data Folder'. Tap on this shortcut to open a new Windows explorer window containing the *-xt system* folders sub-folder.

- Navigate to the 'Library' folder and press and hold on the touch screen until a drop-down menu appears. Remove your finger/stylus and a windows sub menu appears. Choose 'Paste' to copy the library file previously selected into the 'Library' sub-folder.

When all files have been copied, close the Windows explorer window and re-start *-xt* by tapping on the *-xt* shortcut on the desktop. When you enter the *-xt system* again, you will see the Advanced Program files are available in 'Advanced Test Library' of the Advanced Test screen.

Advanced Program files that already contain some results will be titled *Filename*.for for force programs and *Filename*.tor for torque programs. These can be copied into the 'Results' folder of the *-xt system* sub-folder. When the *-xt system* is re-started, these will appear in 'Advanced Results Files' on the Advanced Test screen.

10. Relative and Absolute Positions: Zero, Home and Start

Absolute Zero	Tare at Touch-on	Home position	Start position
Absolute Zero could be set where the attachment meets the anvil plate (or anywhere consistent you choose).	**Touch-on tare** defines a zero position as the top of a sample. It can be used to measure sample size with a FREE HEIGHT calculation, or just to set the test starting position as zero.	**Home** could be set as an end-of-test position relative to Absolute Zero or relative to Touch-on, for example, to provide clearance for changing samples. See *Setup > Preferences >* [General], Home Position.	A **Start** position could be set as a displacement to pre-compress a sample, relative to Touch-on, and this position also tared as a new zero point for starting measurements. Home as a position to return to, may be better set relative to Absolute Zero than to Tared positions.

10.1 Absolute Zero position

You can set an Absolute Zero position of the crosshead (force stands) or rotary drive (torque stands). This can be used as a reference point in any program, and any program that has reference to an Absolute Zero requires this to be set in order to run. This setting is held in the firmware of the test stand, so remains even when the system is switched off.

How to set the Absolute Zero position of the crosshead or rotary drive

Move the crosshead or drive to the required reference position.

- In the Live Test Run screen, press the [Zero] button. On the [Absolute Zero] tab, set Absolute zero, either as zero (0) for the current position, or as an offset away from the current position (shown in the example below as 15 mm *above* the current position), then press [Set Absolute Position] and [Exit]. **Note:** here is where you can also clear Absolute zero, reposition the crosshead or platen, and reassert a new Absolute zero.

> **Care!** If you position the crosshead, with or without fixtures, in contact with the anvil plate (MultiTest) *you must not use a positive offset*: this is always in a downwards direction irrespective of test direction!

10.2 Tare positions

Tare positions mean 'treat this as the reference point for the next measurement'. Tare position setting does not alter an Absolute Zero setting. These are the possible tare positions:

- a **temporary** tare position (e.g. for a Quick test)

    This is set in the Live Test Run screen with the [Zero] button, and is overwritten by tare positioning within a program:

- where the crosshead or platen actually is before a test starts, i.e. '**pre-test**' (this could be a useful 'Home' position to return to before the next test, and is the default 'Home' in Quick Test).

    Set 'Pre-test: Tare position' in the program set-up (i.e. 'wherever the crosshead or platen is now, call it zero').

- a set **start** position to which the crosshead or platen moves, itself relative to the last tare position or absolute zero.

If 'Start Position' is enabled in a program, set 'Start position: (+/–#) mm', 'From tared zero position / From absolute zero position', and then 'Post stage: Tare position' (i.e. 'go to this place to start, and then call it zero').

- the **touch-on** position, where a minimal load is first detected

  If 'Touch-on' is enabled, when a defined minimal load is detected by the loadcell or torque cell, this position can be tared (i.e. 'make contact with, or tension, the sample and call this point zero').

10.3 Home

Home is defined for each program as being either relative to Absolute zero, or relative to the latest tared zero. An instruction to 'Return to Home' may, for example, be used to provide clearance for the exchange of samples or grips.

In Quick Test, Home is the crosshead or platen position *when the test started*.

10.4 Taring load

When measuring the difference between loads, as when pre-tensioning a spring, or measuring consistency in mid-travel compression, or simply to eliminate the touch-on detection load, you will need to also tare a load in the same way as position.

> **Caution:** When manually taring the load while a large force is being applied to the sample, the Live screen will show the force to be zero, but the sample will still be under tension or compression. Use the Jog buttons to release the load before attempting to remove the sample.

11. Movement:
Direction of Speed, Force and Displacement

Everything increases in a test's direction of travel (i.e. compression, tension, clockwise, anticlockwise). Negative values are always away from the direction of travel. In *xt*-built programs, speed is always set as a positive value. In Advanced Programs built with Emperor, the RUN command defines speed in a direction, such that a positive value speed is in the direction of travel, and a negative value is against the direction of travel.

> **Speed direction** is an absolute function of the stand itself, not the test direction. For force stands, upwards is always positive; for torque, clockwise is always positive.

The following tables show how speed, displacement and force appeared in compression and tension tests. **Note:** you will only encounter speed instructions with a direction sign in the RUN command of Advanced Programs.

Force stands

	Compression test	
Crosshead direction	↓	↑
Displacement is shown as	increasing	decreasing
Load is shown as	increasing	decreasing
	Tension test	
Crosshead direction	↑	↓
Displacement is displayed as	increasing	decreasing
Load is displayed as	increasing	decreasing

Torque stands

In an *anticlockwise* test (e.g. to release a screw cap), the rotary drive will move *clockwise* so that the sample moves *anticlockwise* with respect to the torque cell.

Clockwise test	Anti-clockwise test
The drive moves anticlockwise and:	The drive moves clockwise and:
drive angle increases (goes to a positive angular displacement from zero)	drive angle decreases (goes to a negative angular displacement from zero)
Instruction to run to a positive angle will rotate the drive anticlockwise.	Instruction to run to a positive angle will rotate the drive clockwise.

12. Running Tests

12.1 Live Test Run screen

This view is common to all *-xt* machines: for torque, this screen shows torque units and anticlockwise/clockwise indicators on the jog buttons. Here, the Graph view is on:
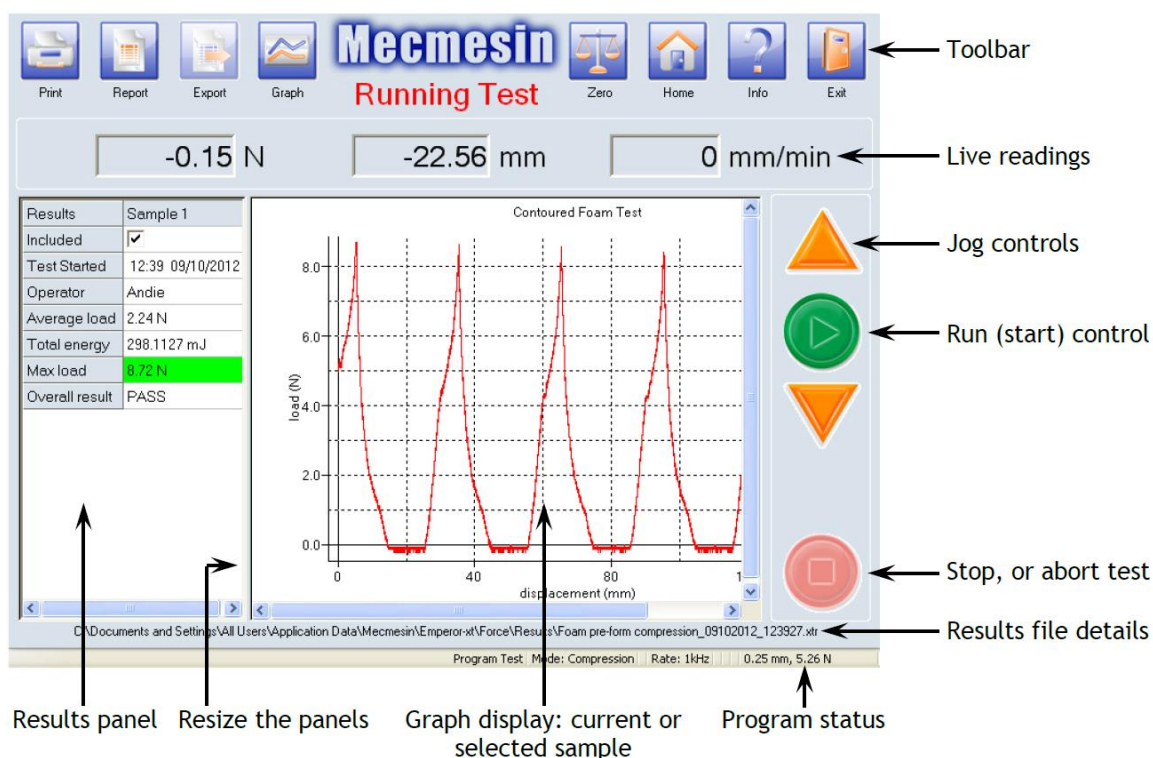
Start button: starts a test, or crosshead/platen movement

Stop button: aborts a test, or stops crosshead/platen movement

Jog buttons: move the crosshead up or down (force stands), or rotate the platen clockwise or anticlockwise (torque stands).

The Live Test Run toolbar

Print button: sends the report straight to a printer.

Report: views and prints the report as set up in: *Program Test Set-up > Report Set-up*. You can also save the report as a .pdf file.

Export button: exports results to file, as in *Program Test* > [Export Set-up] or using the default settings (CSV, TAB or XML format). This is also used to transmit raw data in ASCII to a COMM port. (See Section 14.4: *Exporting data*.)

Graph on/off: toggles between the Graph view (of current or selected sample) and just the Results grid.

Zero: use to tare the current load or position and set the absolute zero position. (See Section 10: *Relative and Absolute Positions: Zero, Home and Start*.)

Home: moves the crosshead (or rotary drive) to the Home position set in *Program Test Set-up* > *Test,* or the last position tare in a Quick Test. (See Section 10: *Relative and Absolute Positions: Zero, Home and Start*.)

Info: use to enter customer and sample information into the results file. Here you can also select samples to be deleted. The [Help] tab provides access to the Reconnect button to re-establish communications between the console and the stand. A Diagnostic report generator is provided. The [Help/About] tab carries system information and version details, and a Help button for the **online help** system based on this manual.

Exit: Leave the Live Test Run screen and return to the front screen.

12.2 Results and Graph views

Results for all samples can be viewed in the **Results grid** by switching Graph view off. Result lines show for calculations added in the *Program Set-up* **>** [Calculations] tab.

In a Quick Test, the results lines shown are those ticked under 'Calculations'.
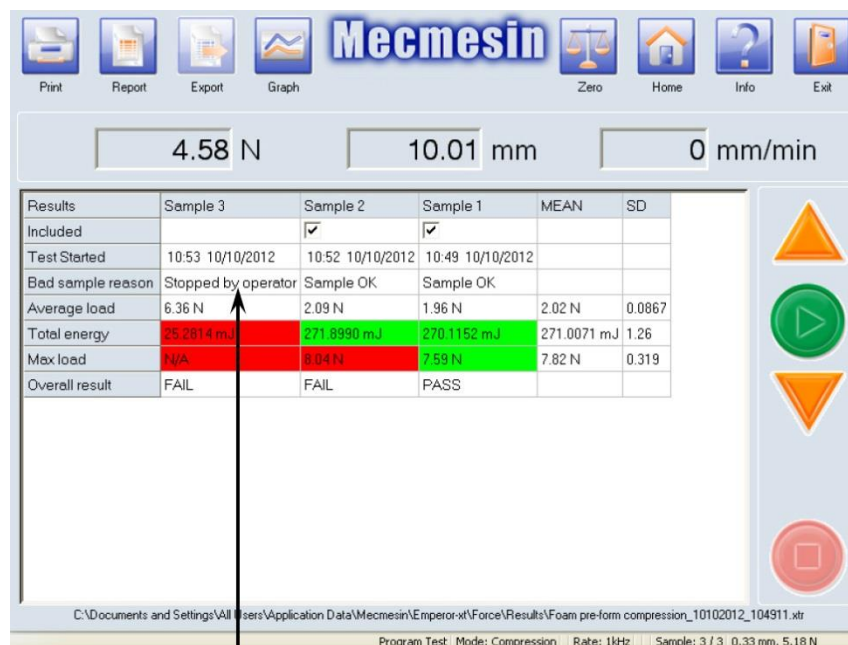
To view the graph of a particular sample: in Results view, click the title of the sample you want, and toggle the graph view back on.

Verified calculations: Ticking the check box to verify a calculation in the *Program Set-up* **>** [Calculations] tab enables you to set upper and lower limits for an acceptable result. Verified calculations are **colour coded** in the Results grid. If the calculated result lies within the limits, the result will appear with a green background in the Results grid, and in green text in a report. Results that are not within the limits will appear with a red background in the Results grid, and in red text in a report.

Overall result. If you have selected at least one calculation to be verified, then a final row is added to the list of calculations on the Results grid, called **Overall result**. Overall result is 'PASS' if all the verify results are met, i.e. all results are in green. If any of the verified results are not met, i.e. if any of the results show red, or it is a bad sample, then the Overall result is 'FAIL'.

12.3 Bad samples, including, and deleting samples

If a sample does not complete a test, it is called a 'bad sample'. Bad samples will appear in the results grid, but do not have an 'Include' tick-box, and are not included in a report, nor in the statistical functions (Mean and SD).

Test on this sample stopped by operator is automatically not included

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Reasons for failing to complete the test include:

- the stop button has been pressed
- the emergency stop button has been pressed
- a 'Limit' has been exceeded (Load, Displacement/Angle or time as set in the *System Settings* > [General Settings] tab.

If the result of a calculation cannot be evaluated, the calculation result will be displayed as 'N/A'. Possible examples for an 'N/A' result include: division by zero error; range of calculation outside range of data; non-occurrence (e.g. no peak) found within the requested range. It may be useful to introduce an INFORMATION line in the results (see Appendix A.6: *Information*.)

Include/exclude

If any individual sample result is 'N/A', then the statistical summary (Mean, SD) will also display 'N/A'. Results of calculations can be excluded from the statistical summary (Mean, SD etc.) by un-ticking the 'Include' check-box.

Similarly, to see the statistical results only for samples that pass, un-tick the failed samples so they are not included.

Delete

Samples can be deleted from results. Press the Info button:

Under the [Test Information] tab, tick the sample(s) to be deleted and press Delete .
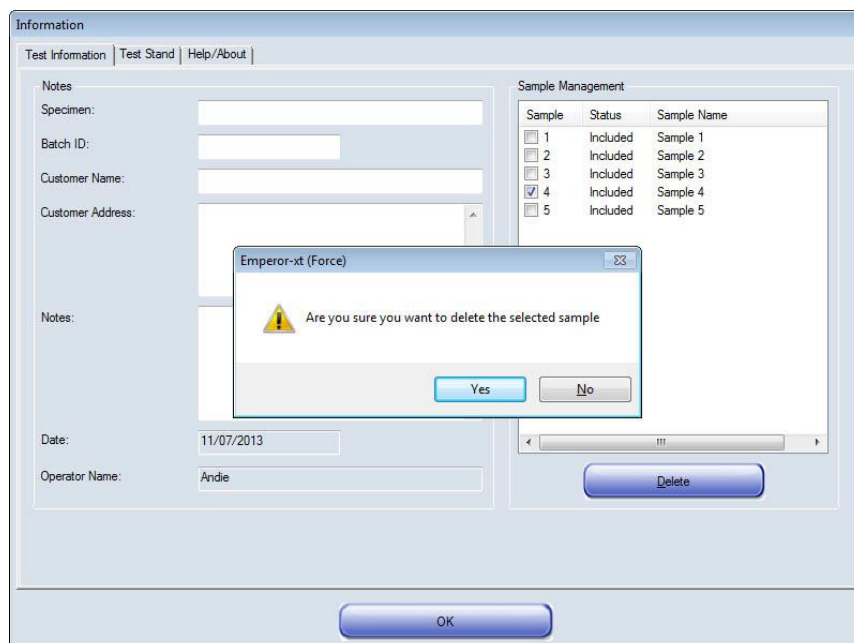
12.3.1 Adding test information to the results file

Complete the results file by adding descriptive information: what was being tested, is there a batch ID, who was it for and what was it about? These descriptions can be printed

in the header or footer of a report—see Section 14.3: *Report templates* for [Report Templates] under System Settings. The date is added automatically, and the operator name is taken from the user account currently logged in.

On the right, the sample status indicates if the sample is to be included in the report. Samples are not included in the report if:

- the 'Include' check-box in the Results grid is de-selected. Status is shown as 'Excluded'

- the run produced no valid results for the calculations specified. Status is shown as 'Excluded'

- the run was stopped for any reason and its status is shown as 'Bad'.

13. Handling Data Files

Familiarise yourself with the movement of data and its destination, so that you can establish a way of working that organises your files well.

Action with results	Destination of data
Run a test	Sample results accumulate in Console memory.
Save results of run 1	A default filename is presented comprising the test name and a current date-time stamp. You may choose an alternative file name. The file is saved to the Emperor-*xt* \Results folder.
Export results of run 1	Sample data are sent to file *as specified for the test*. You may not choose a new file name, and an existing file of this name will be overwritten. The file is saved to the Emperor-*xt* \Export folder.
Run a test again	Sample results accumulate in Console memory.
Save results of run 2	A default filename is presented comprising the test name and a current date-time stamp. You may choose an alternative file name. The file is saved to the Emperor-*xt* \Results folder.
Export results of run 2	Sample data are sent to file *as specified for the test*. You may not choose a new file name, and an existing file of this name will be overwritten. The file is saved to the Emperor-*xt* \Export folder.
Open results file	Select a file from the Results library and Edit or Run.
Run the test again	The test program is loaded with the previous results, and further samples tested will be *added to* the previous results.
Save results after run 3	The previous filename as opened is presented. Save to this file to overwrite the previous version, or choose a different filename. A new date-time stamp is not offered. The file is saved to the Emperor-*xt* \Results folder.
Export results after run 3	Sample data are sent to file *as specified for the test*. You may not choose a new file name, and an existing file of this name will be overwritten. The file is saved to the Emperor-*xt* \Export folder.

14. Setting System Defaults

For Master users only, from the front screen, the | Systems Settings | button takes you to the administrative area of the *-xt* system.

14.1 General settings

The parameters set in this screen will be the default settings used unless you set different values for individual tests.

System Settings: [General Settings] tab

Units

Set your preferred units for force: Displacement and Time (or torque: Angle and Time) as appropriate.

Limits

Maximum load and speed will automatically be detected and set to the maximum for the stand or loadcell fitted. You can set a lower limit if you wish.

Sampling rate

Set the sampling rate as required—higher rates record more data per second, and therefore create larger results files.

Available languages

Choose the language from the drop-down box.

> **Note:** you may want to change the language of the underlying Windows settings for when copying or moving files. See Appendix B: *Accessing Windows for Administrative Tasks'*, to access the Windows Control Panel, Regional and Language settings.

14.2 User accounts

Access privileges to various parts of the *-xt* system can be assigned using options in the [User Accounts] tab. There are two types of account: Operator and Master.

Master users: have full access to all parts of the system.

Operators: are given selective access to:

- Edit Program Tests
- Perform Quick Tests
- Set absolute zero
- Delete sample results

14.2.1 Passwords

When you first receive the *-xt* system, it will have the following factory-set user accounts as defaults. Master users can add new user accounts of both types.

Factory-set default users and passwords

Operator name*	Password*	Access privileges
supervisor	supervisor	**Type: Master** Full access to all system settings, programs and reports.
operator	operator	**Type: Operator** Can select and run previously-saved **favourite tests**, if any. Can select and run previously-saved **program tests**, if any. Can select and run any previously-saved **advanced tests**, if granted access to advanced programming mode capabilities. No access to System Settings.

* **Note:** operator names and passwords are case sensitive.

14.2.2 Adding and deleting user accounts

> **Caution:** the default accounts can be removed! Do not delete any Master account unless you have at least one valid Master account remaining.

To add a new user account, you must logon with a Master account. For the first time, the factory-set default 'supervisor' logon must be used. Press System Settings and select the [User Accounts] tab.

System Settings: [User Accounts] tab, showing user 'Andie' about to be added as an Operator with Automatic logon, and permission to delete samples from results

To add a new user, enter a new name in the **Operator name** text box. Then enter a password in the **Password** text box, and confirm by entering exactly the same text in the **Confirm password** text box.

Use the radio buttons to select the status as **Operator** or **Master**.

If **Operator** has been selected, tick the check boxes to allow editing of program tests, performance of quick tests and the ability to set absolute zero, and delete sample results.

When all the options have been entered, press Add to create the new user.

Press Save and Exit to confirm the entry and return to the front screen.

Pressing Cancel at any time will abandon any entries you have made, and take you back to the front screen.

To delete a user account, select the user name and press Remove .

Note: If you attempt to remove the user that you are currently logged on with, you will see the following message:
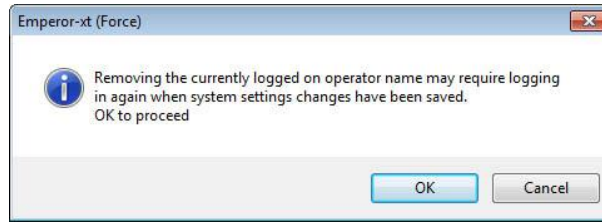
Press OK to remove the current user account. You will be taken back to the splash screen and will need to logon again using a valid username and password.

14.2.3 Changing an existing user account

To edit a user's settings, first select the user on the left. Make any changes required then press Change . You must press Save and Exit when you leave the systems settings screen, even if you visit another tab first.

Automatic logon

By selecting a valid user and ticking the 'Automatically Log On This User' check-box, the chosen user will be logged on without the need to enter the user name and password at the splash screen when *-xt* is started. Press Change to confirm the choice, then Save and Exit .

If the user to be logged on automatically is a Master level user, then all *-xt* functions and features and are available when the Emperor software starts.

If the user to be logged on automatically is an Operator level user, then *-xt* will open with the access privileges or restrictions that are available to that operator.

Logging off will return the system to the splash screen, where a valid user and password will be required to log on again.

Changing the automatic logon user

If the automatically logged on user is Master level, you have access to system settings.

If the automatically logged on user is operator level, first press Logoff to return to the splash screen, and then logon with a Master account and press System Settings .

Select the user who is currently set as the automatic log on, and untick the check-box and press Change . You can now choose a different user to be the automatic log on, press Change again and Save and Exit , or just press Save and Exit if an automatic logon is no longer required.

Automatically run a favourite program

To start a Favourite program for this user, choose a Favourite program from the drop-down box. If you do not want to start a Favourite program on start-up, choose 'None'. Favourite programs can be run without an automatically logged-on user.

Note: the Favourite titles/names do not appear in this list.

14.3 Report templates

Reports can be viewed on screen, sent to a printer connected to the console, or saved as a .pdf file. The *-xt* system has a template for reports that you can customise and save for future use. You can include graphics (e.g. company logos), user names, batch numbers and notes (entered under *Info* > [Test Information] in the live test screen). You can choose to include graphs of the results and display some statistical information, including sample means and standard deviations. Once you have defined a report template, you can re-name it and associate it with any program test.

Structure of the report template

The built-in template 'Mecmesin' can be modified by adding different logos, headers, sample information, ordering the results, and choosing to include graphs, or you can start with a new template.

To start a new template, choose New Template from the drop-down box. You will be prompted to enter a name for the template. Press OK then Update . Then choose the various options from the five design buttons, remembering to press Update each time to save the template as it is revised.

Always press Save and Exit when you have finished.

14.3.1 Logos
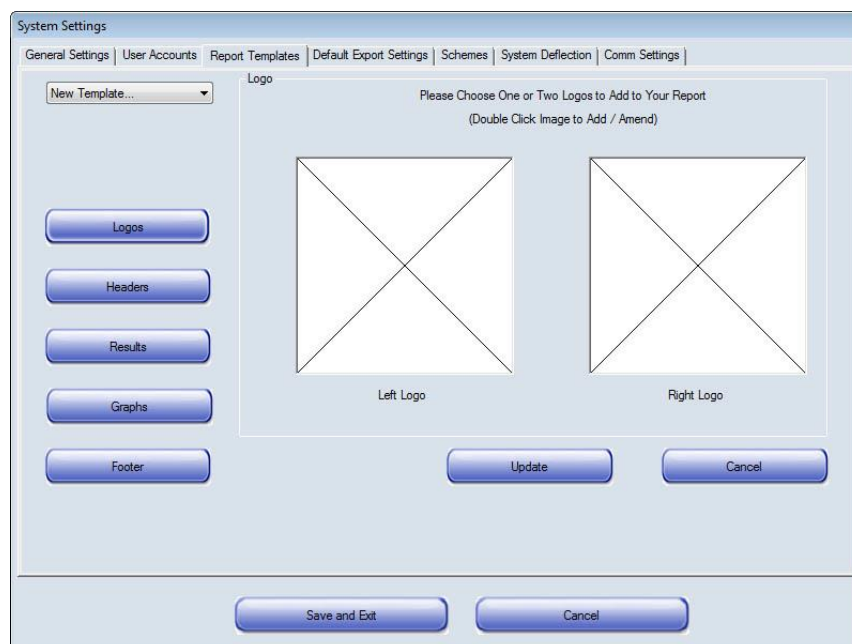
Report Templates: adding logos

Logos for use in report templates must be first placed in the *-xt* logos file folder. To do this, press Logoff then Shutdown, Administrative Tasks, enter a Master level username and password, and you arrive at the underlying Windows desktop. There you will find a shortcut to Emperor-*xt* (Force)/(Torque) Data folder, with its subfolder \Logos.

Two logos can be displayed on a Report. You can import graphical bitmap (.bmp) files for the left logo or right logo or both. To import an image, double-click on a logo preview area. This will open a list of images that are already in the \Logos folder. When you have added and previewed the chosen logos, press Update.

14.3.2 Headers and Footers

Press Headers to go to the header set-up. Header information can be added to both the left hand and right hand side at the top of the page.

Headers and Footers both work in the same way. Available elements are listed in the box at the top, and the two boxes below represent left and right print areas. The actual content for each of these items is added before a test is run and the results saved in the Live Test Run screen under Info.
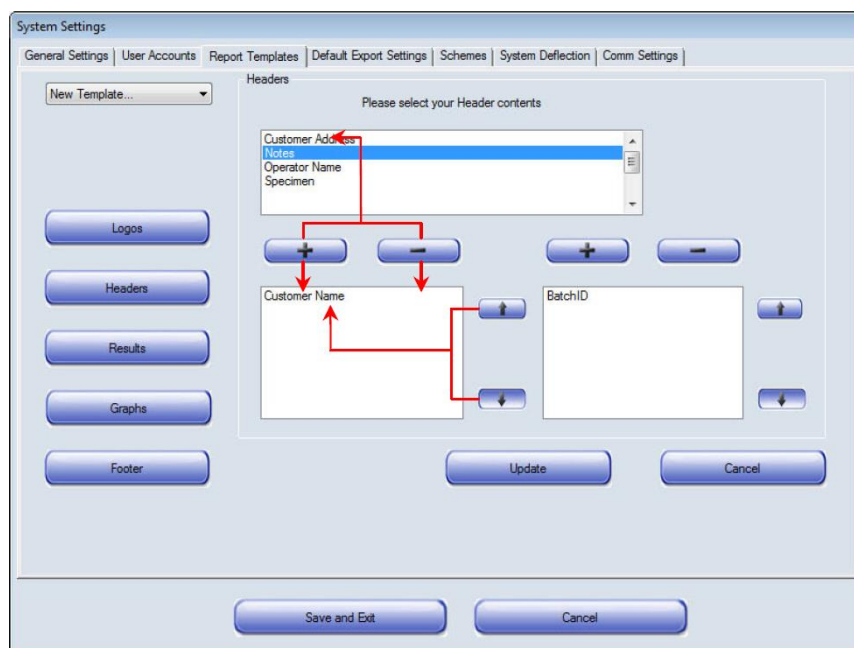
Report Templates: adding and re-ordering headers
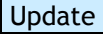
Select each item you want to include and press the + button above the respective box to add it. To move an item out of the used list, back into the available list, select the item and press the − arrow.

To change the order of header or footer contents, left or right, select the item and use the ↑ and ↓ arrows to the right of the box.
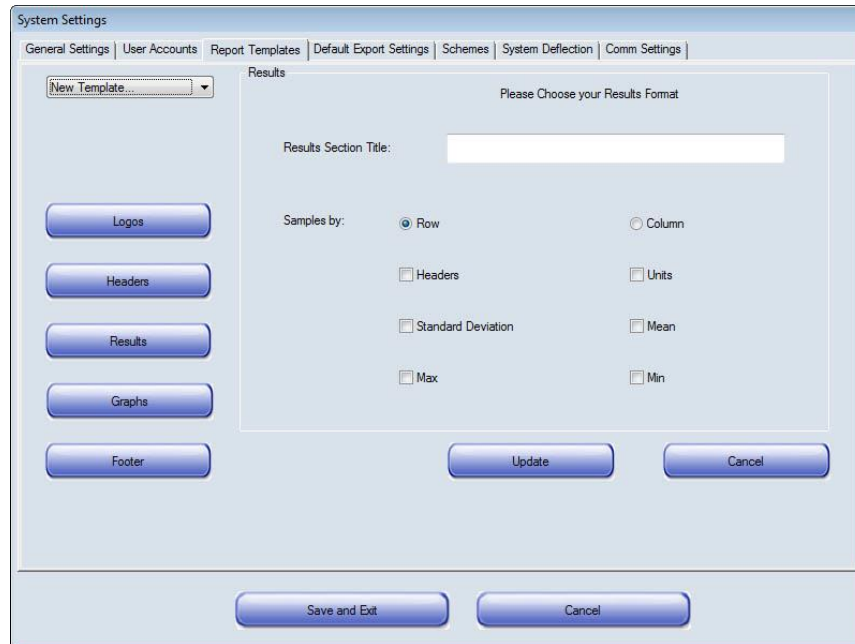
Remember to Save and Exit.

Use the $\boxed{+}$ and $\boxed{-}$ buttons to add and remove headers from the top list to the left and right hand header areas. Use the buttons at the side of the selected Header contents list to change the order in which the headers appear on the page.

Press $\boxed{\text{Update}}$ to save any modification to the template.

14.3.3 Results

Report Templates: adding the results detail

Results Section Title: enter a name for the results section. The default is 'Results'.

Samples by: Row or Column. Use the radio buttons to present the results in rows (sample numbers down the side) or in columns (sample numbers across the top).

Headers: tick the check box to include the sample and result header and footer information.

Units: tick the check box to include the units of the results.

Standard deviation: tick the check box to include the standard deviation of the included results. The formula used for this is the Sample Standard Deviation:

$$s_N = \sqrt{\frac{1}{N}\sum_{i=1}^{N}\left(x_i - \bar{x}\right)^2}$$

Mean: tick the check box to include the arithmetic mean of the included results.

Max: tick the check box to display the highest value of the included results.

Min: tick the check box to display the lowest value of the included results.

Press $\boxed{\text{Update}}$ to save the changes to the template.

14.3.4 Graphs
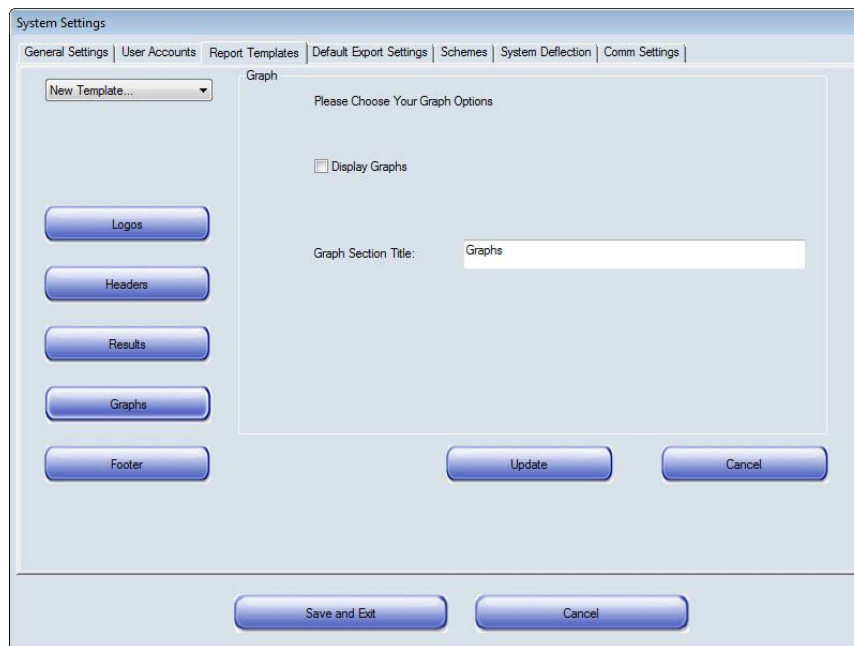
Report Templates: adding Graphs

Display Graphs: tick the check box to display graphs in the report. The graphs of up to 8 samples will be overlaid with a legend of the samples.

Graph Section Title: if required, add a title to precede the graph section of the report (the default is 'Graphs').

Press Update to save the changes to the template.

14.3.5 Footer

Footers can be printed on the left hand side and right hand side at the bottom of each page, in a similar way to Headers at the top of the page. Use the buttons to add, remove and re-arrange the footers available from the list in the same way.

Press Update to save the changes to the template.

When you have made all your report template settings, press Save and Exit to return to the front screen. You have now saved a new report template that will be available to be used with Program Tests. For details of how to add Reports to Program Tests, see under *Program Test Set-up* > [Report Set-up] tab.

14.4 Exporting data (system defaults)

Important: see also Section 13: *Handling Data Files*.

Action	Method	Requires	Options
Export results Export raw data	As a file	Export scheme	File type File location All samples/last sample Manual/auto export
	ASCII to Comm port	Export scheme	Comm port Baud rate Manual/auto export

The data from tests are stored in the console, but can be exported to an external device connected to the *-xt* system. Information can be sent in one of two ways: **Results Export** sends just the results of all valid tests, or alternatively **Raw Data Export** sends all the data points collected. In either case, the information can be saved as a file, or transmitted in ASCII format to a Comm port.

- The default file format and destination are determined under **Export Settings**

- the content and sequence of the data are set under **Schemes**

- each test program has its own Export set-up, which takes precedence.

In a **Results Export**, the results for all valid samples can be exported. These will be the results of all the Selected Calculations in the *Program Test Set-up* > [Calculations] tab. Only the results are sent, so the file size is small.

In a **Raw Data Export**, all the data points recorded are sent. The sampling rate is set in *Program Test Set-up* > [Data Handling] tab and *-xt* systems can sample at up to 1 kHz. This means that 1,000 readings are recorded per second, and can include the time, the position and the force. It may be appreciated that large amounts of data can be accumulated quite rapidly, resulting in very large file sizes. For example, a six-hour load hold test recorded at 100 Hz produces a .csv file of 60 Mb with more than 2,000,000 data points. Time taken exporting this may make the system appear to have become unresponsive.

To export data, the procedure is to select a file destination and a data export scheme (the equivalent of a report template). These can be created or customised by:

- modifying one of the built-in data export schemes and saving it with a new name under *Systems Settings* > [Schemes] tab

- configuring the default destination, file type and content in *System Settings* > [Default Export Settings] tab

- configuring the exporting of data from a regular test program in *Program Test Set-up* > [Export Set-up] tab.

Default Export Settings with Results Export selected

Select Results Export or Raw Data Export .

Export to: select a radio button to choose:

- CSV (comma-separated values)
- TAB (tab separated value)
- XML (extensible markup language)

Export File: use the Browse button to select an existing, or establish a new, filename.

Export Format Scheme: use the drop-down box to select an export scheme previously saved in the Export [Schemes] tab. (See Schemes below.)

Write options: use the radio buttons to choose between:

- All samples
- Last Sample

Action at end of test: use the drop-down box to choose if the file is to be sent automatically at the end of the test, or if the operator is to press the Export button on the Live Test Run screen in order to save the file.

Transmit Results to Comm port: if you need to connect directly with another PC or device to transmit data (rather than export to a file on the console), tick the box to send the results to a console Comm port. To make the connection you require, contact your internal IT support for the correct cable, software and settings.

Export Format Scheme: use the drop-down box to select an export scheme previously saved in the Export [Schemes] tab.

Action at end of test: use the drop-down box to choose if the file is to be sent automatically at the end of the test, or if the operator is to press the Export button on the live test run screen in order to save the file.

14.5 Schemes

A Scheme is a template for exporting data, in either results-only or raw data format, to file or to a Comm port. This tab is used to create and modify export schemes, which can be attached to test set-ups in the same way that report templates are.

Press Results Scheme or Raw Data Scheme to present the appropriate scheme profile.

Results Export Scheme screen

To create a scheme, click in the drop-down scheme name box and Select 'New Scheme …' and give the new scheme a name. Make your preferences and press Update .

To modify an existing scheme, select the scheme name from the drop-down list, make your changes and press Update .

For the Raw Data Scheme only, you can also choose both the data to include and the sequence of data columns (Force, Distance/Angle, Time and Event).

You can also choose to export the data as:

- Displayed: readings are adjusted if System Deflection Compensation is turned on
- Original: with no compensation applied

When all changes have been updated, press Save and Exit .

14.6 System Deflection Compensation (SDC)

Applied mainly to MultiTest force stands under compression, System Deflection Compensation (SDC) allows you to compensate for the small amount of movement inherent in the combination of test stand, loadcell and grips. It is possible to correct for this when performing measurements on certain samples where more accurate readings are required, or where the sample deflection is similar in magnitude to the system deflection for the load applied. With the *-xt* system you can store the compensation data from different attachment accessories (called 'Groups') for different loadcells, and apply it to the set-up in use.

SDC groups are limited to plates, probes, grips or holders where the SDC test can be run without introduction of a sample.

14.6.1 SDC Groups and Systems

A **Group** is a fixing accessory, which might be as simple as a compression plate and the anvil plate, or could be a combination of different gripping accessories, one fixed to the loadcell and a different one fitted to the anvil plate. The **Group** could be used on a stand or several stand/loadcell combinations.

A **System** is the combination of the test stand and loadcell. In practice you might have one stand with perhaps two or three loadcells. Each combination of test stand and loadcell is a different **System**.

Example:

Groups	Systems
50 mm compression plate	MT 1-*xt* Stand – serial no. 10-1013-01 ILC 500N – serial no. 10-2056-10
	MT 1-*xt* Stand – serial no. 10-1013-01 ILC 1000N – serial no. 10-1080-20
Small single-action vice plus multi-jaw grip	MT 1-*xt* Stand - serial no. 10-1013-01 ILC 200N – serial no. 10-1945-10
	MT 2.5-*xt* Stand – serial no. 10-1022-01 ILC 500N – serial no. 10-2056-10

SDC Compensation data are stored for each combination of Group and System, in order to be available to any program test.
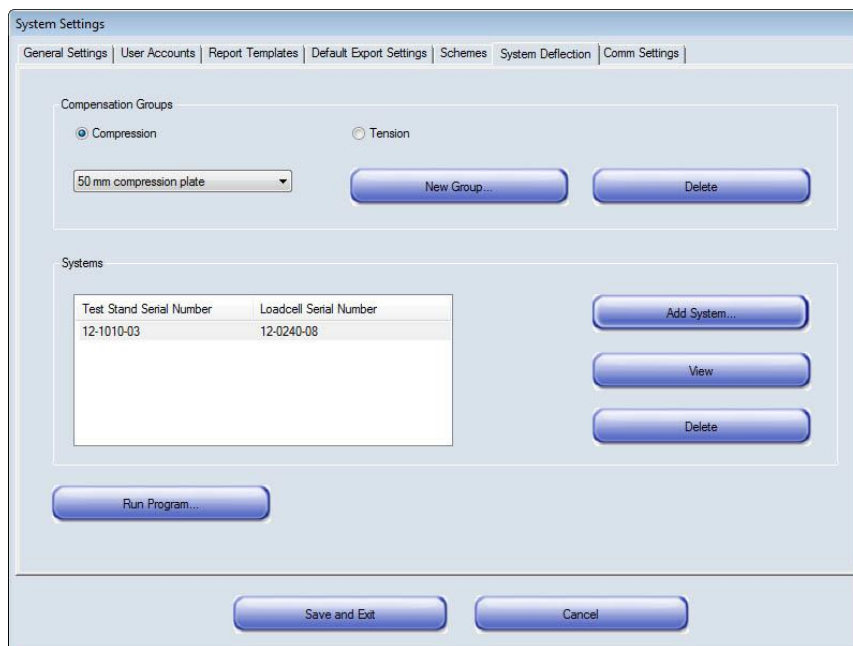
System Settings: System Deflection Compensation

Sequence overview for creating each SDC System/Group data combination

1. Attach the accessories without a sample. For MultiTest compensation corrections in the compression direction, place (jog) the compression plate very close to the anvil plate. Hooks may be closely engaged for the tension direction.

2. Run the special built-in SDC program (Run Program) to measure the deflection and calculate the compensation data. The results are automatically exported.

3. Name and create a new compensation **Group** (e.g. '50 mm compression plate').

4. Add the **System**.

5. To use the compensation data in a Program Test, on the *Program Test Set-up* > [General] tab tick the 'System Deflection Compensation' check-box. The Available Groups for the current system will be seen in the drop-down box—choose the required group.

> **Note:** MultiTest-*xt* always knows which test stand and loadcell (System) are in use, but cannot automatically identify which fixing accessories (Group) are attached. It is important to check that the SDC Group selected is correct for the accessories actually fitted.

14.6.2 Run the built-in System Deflection Compensation (SDC program)

Press Run Program and select the direction. You will be taken to the Live Test Run screen.

Press the round green 'Start' button.

When prompted, enter the maximum load to which you wish to calibrate. Enter a value, up to the maximum for the loadcell and test stand, and press OK .

MultiTest-*xt* will now load and run a special program that will locate the point of contact between the gripping/compression accessories, then very slowly increase the load to the maximum that you have set. During this test you will see various messages informing you of the progress of the SDC calibration.
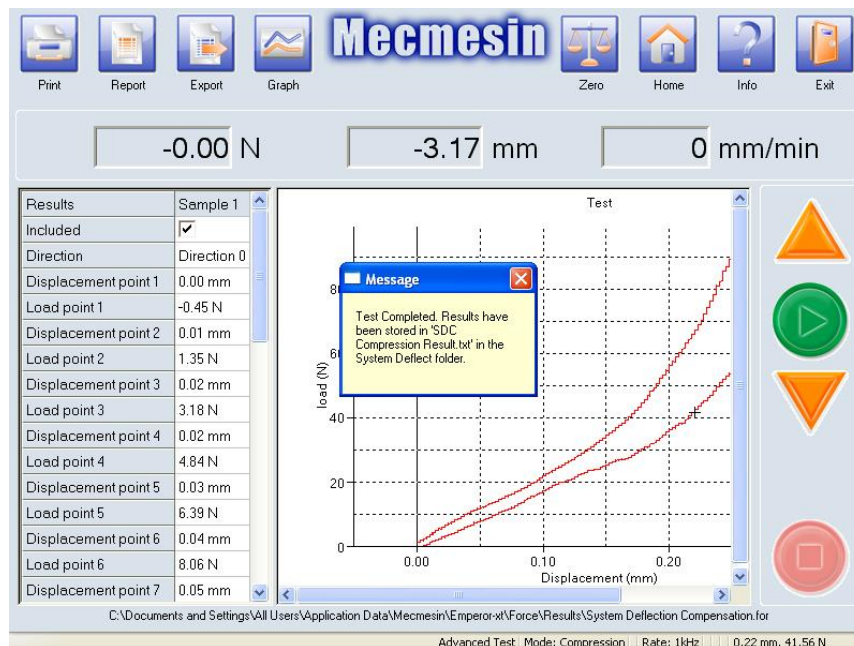
After the program has run, you will see the message that the test is complete and the results have been stored in a file 'SDC [direction] Results.txt' in the System Deflect folder.

The relevant calculated results have been automatically saved as a .txt file, which will be used later for adding the System.

Press Exit and when prompted, discard the regular results file, which is not needed. Confirm this decision and return to the front screen.

Now press System Settings again and return to [System Deflection] to create a new Group for this System.

14.6.3 Create a new System Deflection group

Select the direction for the compensation group, press New Group and name it precisely and clearly. This will be the name seen in the drop-down box on the *Program Test Set-up* > [General] tab. Press OK to save.

Press the Add System button and when the Add System window appears with details of the current stand and loadcell serial numbers, press Get File . The browser will take you to the System Deflect folder that contains the SDC compensation results.txt file previously created. There may be two files in here, one for compression and one for tension. Select the appropriate file (you will be alerted if you choose the wrong one). These files only contain temporary data from the last instance of the SDC program run.

Select 'SDC Compression (or Tension as appropriate) Results.txt' file and press on Open.
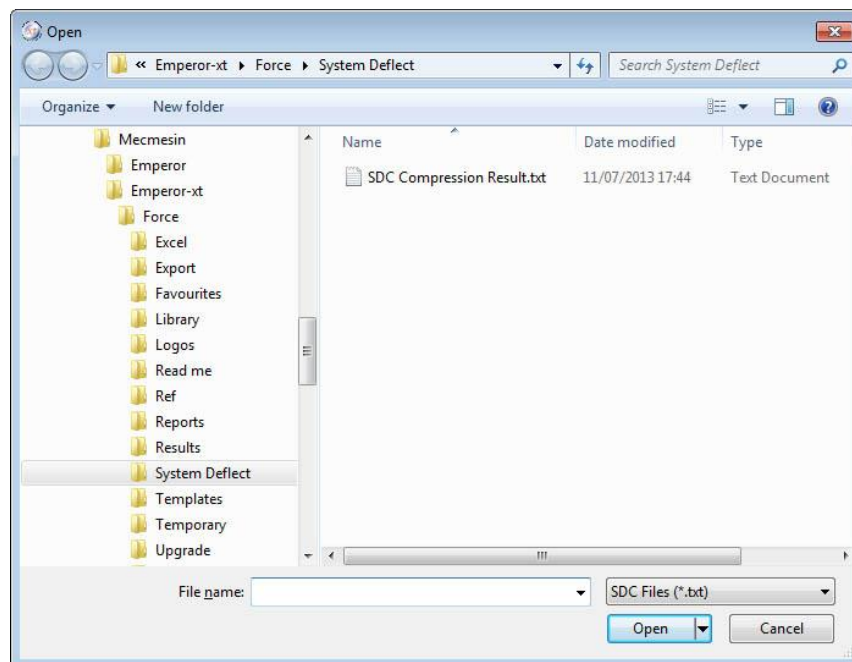
This returns you to the Add System screen. Press Add and the test stand and load cell serial numbers will appear in the Systems box.
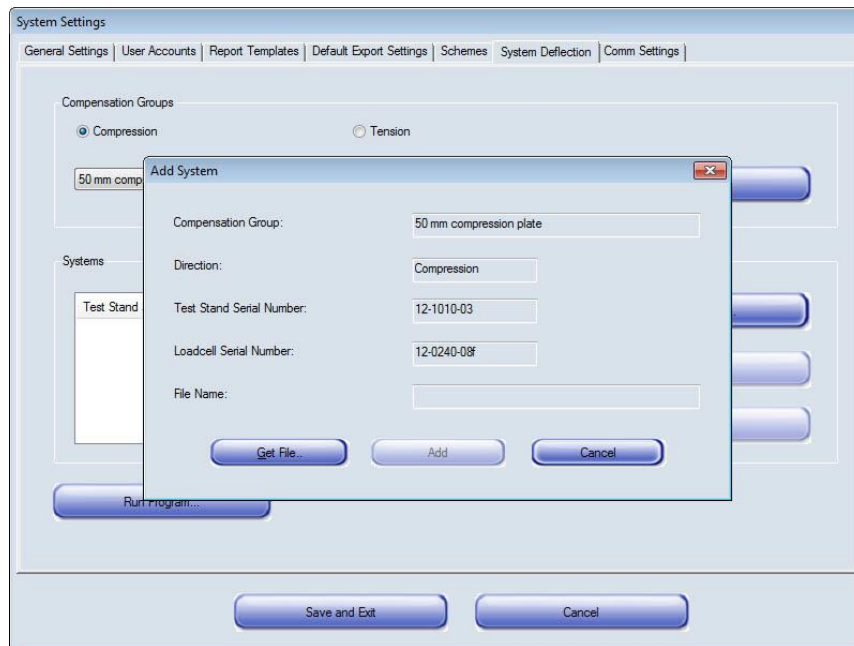
System Deflection: Add System. Check the loadcell serial number.

The System Deflection Compensation for the combination of stand, loadcell and holding accessories has now been loaded. Press Save and Exit .

14.6.4 Applying System Deflection Compensation

To include System Deflection Compensation in a test program, tick the check-box 'System Deflection Compensation' on the *Program Test Set-up* > [Test] tab General settings, and choose the group from the drop-down box. Only those that apply to the current system will be shown; you must choose the group of accessories being used.
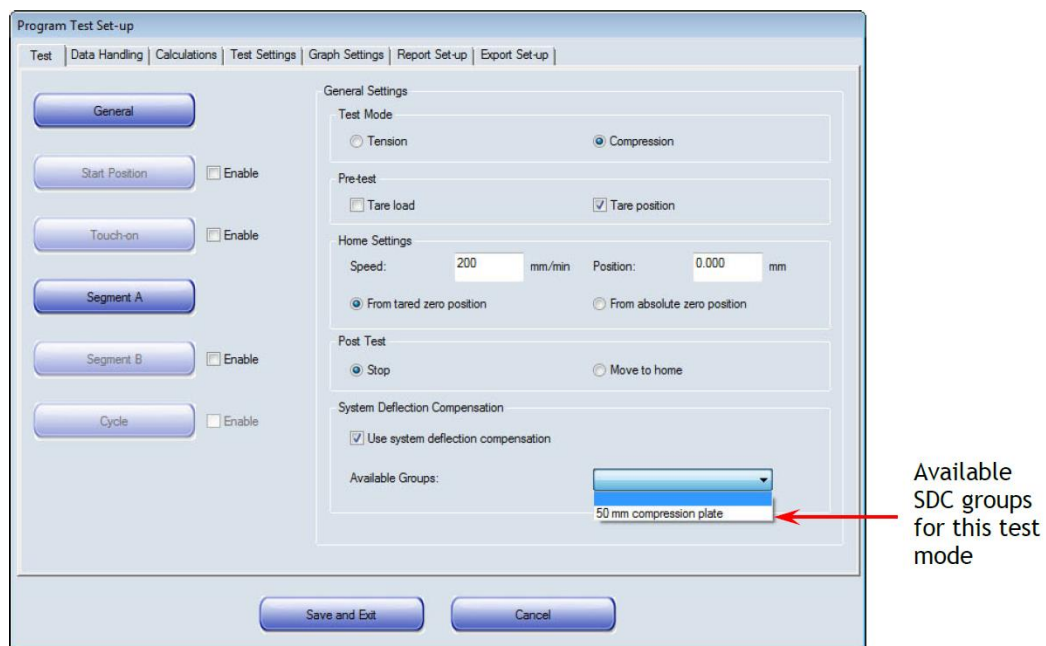
To verify if the sample was run with SDC applied, add an **Information** calculation and choose 'SDC Status' from the drop-down box:
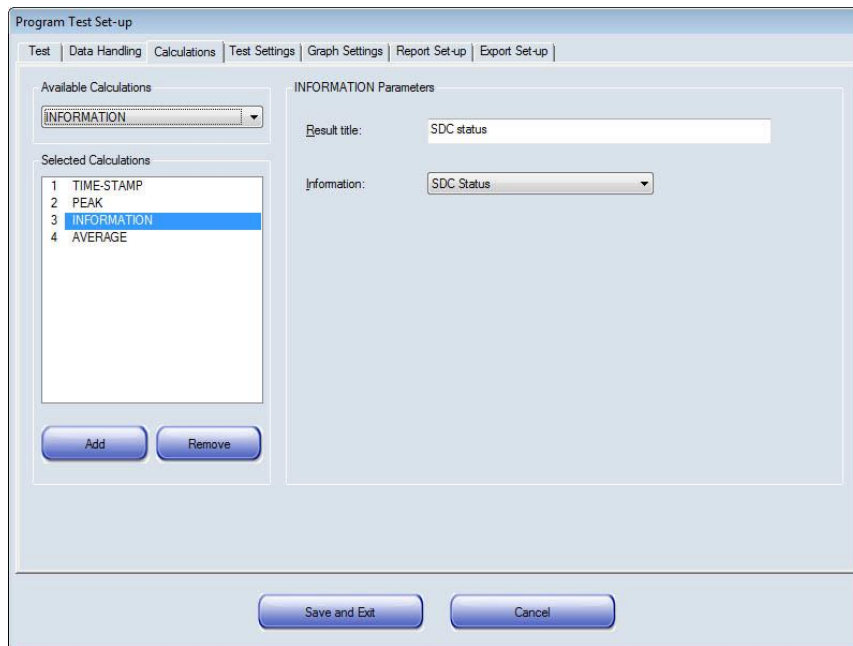
14.7 Comm settings

This tab is used to select the Comm port for transmitting data to another device. It also has some buttons for configuring and updating the system, and for a Diagnostics report (see below under *Troubleshooting*).

The Test Stand Input Port drop-down box will contain the Comm port than connects the Console to the test stand, and will not normally need to be altered.

System Settings: [Comm Settings] tab

Use the Data Transmission Comm Port drop-down box to choose the port that will be used to connect to the external device. Use the Baud rate drop-down box to set the transmission speed.

Press ⌈Save and Exit⌉ to save the entries.

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15. Troubleshooting

15.1 Test stand

The *Live Test Run* > *Info* > [Test Stand] tab has two buttons: one to reconnect the console to the stand, and a facility for diagnosing problems.

Reconnect

Should the stand lose communication with the console, pressing the Reconnect button will re-establish communication.

Diagnostics
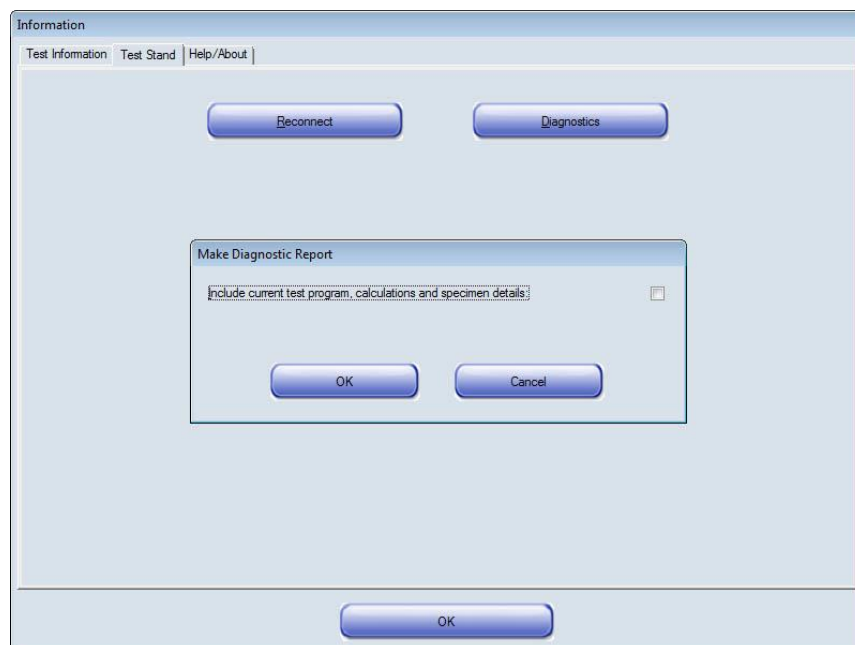
In the unlikely event of any difficulties arising with the system, your local Mecmesin distributor will almost certainly be able to resolve these quickly and effectively. It may, however, occasionally be appropriate to use the system's remote report-making facility. If your Distributor does recommend this, you will need to use this Diagnostic button.

> For guaranteed completeness of information, please run this report with stand and loadcell connected and switched on.

If a program is running or results are present, you will be prompted to include the current test program, calculations and specimen details. Pressing OK will display a dialog box showing any previously-saved reports, with the option to change the current diagnostic report name. Press OK to save the diagnostic report. A message will be displayed giving the file location. With Master access you can retrieve this file and email it to your authorised Mecmesin distributor.

15.2 Help/About

This tab records details of the software version of the Emperor-*xt* system software, together with the contact address for Mecmesin in the UK and has a [Help] button. The help system is arranged in chapters by topic and can be searched by keyword.

Appendix A
Calculations

A.1 Multi-valued functions

Consider the general equation:

y = f(x)

In a simple situation, when given the value of 'x' and asked to calculate 'y' there may be only one result—in this case the function is called 'monotonic'. For example:

y = ax + b

has only one solution, because for any value of 'x' there is only one possible value of 'y'.

Most functions, however, are either inherently multi-valued, or else noise on a signal can make an inherently single-valued dataset multi-valued. Consider a peel adhesion curve:
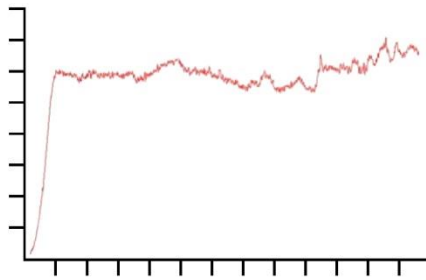
Load is on the 'y' axis and displacement is on the 'x' axis. If you need to know the displacement {x} at a certain load {y}, there may be more than one solution.

Similarly, consider the case of a cyclic test:
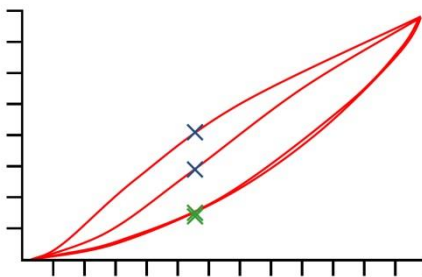
This graph shows load/displacement data obtained by applying two compression cycles to a block of polyurethane foam. For each value of load, there are four corresponding displacement values, and for each value of displacement there are four corresponding load values (illustrated). This is most obvious for the compression stroke (i.e. the top two curves) where, for a given displacement, the load on the first cycle was significantly greater than the load on the second, as illustrated by the blue crosses. It is not so obvious

on the return cycle, as illustrated by the lower green crosses. The difference is due to the plastic deformation of the foam.

A.2 Area

The Area calculation returns the area under the curve for defined 'start and 'finish' values of {X}.

Result title This is a free-form text entry field that allows you to re-name the test result. This title will appear as the row header in the results grid.

Y	Use the drop-down box to select the parameter plotted on the Y-axis, choose from 'Load', 'Displacement/Angle' or 'Time'.
X	Use the drop-down box to select the parameter plotted on the X-axis. This cannot be the same as used for the Y-axis.
Start	Enter the start value of {X}. If you leave this blank, the value from the start of the test will be used.
Finish	Enter the end value of {X}. If you leave this blank the final value from the test will be used.
Verify result	Minimum and Maximum. Tick the check box and enter minimum and maximum values.

A.3 Average

The **Average** calculation returns the average value of {Y} for chosen 'start' and 'finish' values of {X}. You can display the result as the 'Average', i.e. the arithmetic mean, or as the 'RMSE' value (see next below).

average value y

x range

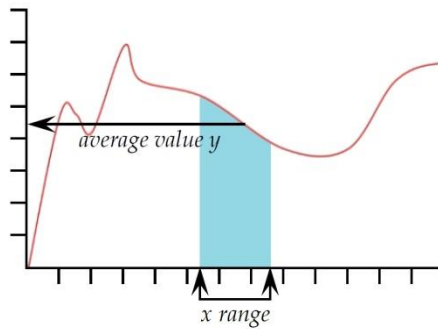|	
Result title	This is a free-form text entry field that allows you to re-name the test result. This title will appear as the row header in the results grid.
Y	Use the drop-down box to select the parameter plotted on the Y-axis, choose from 'Load', 'Displacement/Angle' or 'Time'.
X	Use the drop-down box to select the parameter plotted on the X-axis. This cannot be the same as used for the Y-axis.
Start	Enter the start value of {X}. If you leave this blank, the value from the start of the test will be used.
Finish	Enter the end value of {X}. If you leave this blank the final value from the test will be used.
Verify result	Minimum, Maximum. Tick the check box and enter minimum and maximum values.
Result is	Choose between Average and RMSE
	RMSE: The root mean square error (RMSE) is a frequently-used measure of the differences between values predicted by a model or an estimator and the values actually observed. RMSE is a good measure of accuracy. These individual differences are also called residuals, and the RMSE serves to aggregate them into a single measure of predictive power.

A.4 Break

Break returns the value (load or displacement or time) when a sample break has been detected. The break can be defined in one of two ways, as a 'sharp' break, or as a 'percentage' break. A sharp break is typically chosen when the sample suffers a sudden fracture or the break occurs instantaneously. A percentage break is more suitable when the sample stretches slowly, and the break occurs over an extended period. See below for an explanation.

Calculations after a break are made by comparing consecutive data points according to the criteria given below. This may not necessarily be at the same point as where the break detector has operated.

Result title	This is a free-form text entry field that allows you to re-name the test result. This title will appear as the row header in the results grid.
Result is	Choose 'Load' or 'Displacement/Angle' or 'Time'.
Start	Enter the start value of {X}. If you leave this blank, the value from the start of the test will be used.
Finish	Enter the end value of {X}. If you leave this blank the final value from the test will be used.
Type	Choose 'Sharp' or 'Percentage'. 'Threshold' is the % of loadcell capacity below which break will not be detected, in order to avoid misinterpretation of system noise.

Sharp:
Change factor - default value is 5
Threshold % - default value is 3

Percentage:
% Drop - default value is 40
Elongation - default value is 1.25 |
| **Verify result** | Minimum, Maximum. Tick the check box and enter minimum and maximum values. |

Sharp break
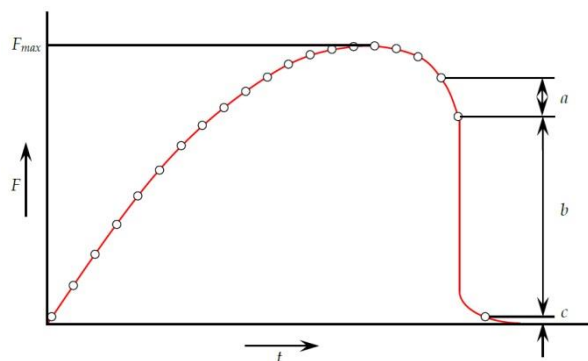
Sharp break is detected when analysing a set of three data points a, b, c, and the following criteria are met:

$b > 2 \times a$

$c < \{100\text{-}Break\ \%\} \times F_{max}$

Where

a = the change in load between the first set of data points

b = the change in load between the second set of data points

c = the load value above zero of the last data point

F_{max} = maximum load

Percentage break
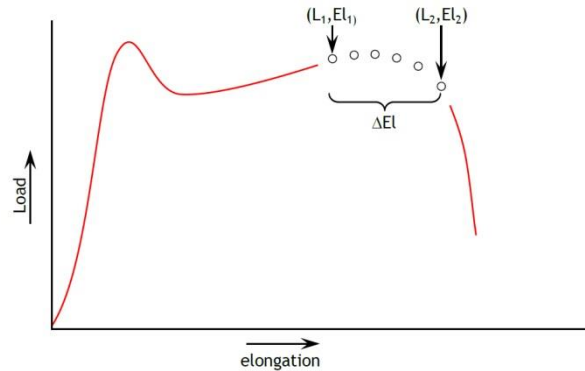
Percentage break is detected when analysing a set of data points and the following criteria are met:

$$El_2 \geq El_1 + \Delta El$$

$$L_2 \leq L_1 \times (1 - \%drop/100)$$

Where

L_1 = first load point

L_2 = second load point

El_1 = Elongation at L_1

El_2 = Elongation at L_2

ΔEl = required change in elongation = {elongation}

%drop = percentage drop in load required between L_1 and L_2. = {%drop}

A.5 Free Height (MultiTest-*xt* only)

The Free Height calculation returns the distance between Absolute zero and the Touch-on position. For example, it can be used to find the length of a spring before it is compressed to measure the spring rate. First, the Absolute zero position is set with the compression plate just touching the anvil plate. Then a Program Test is run including taring the position when a small Touch-on load has located the top of the spring. Finally, the spring is compressed to determine the spring rate. Adding a Free Height calculation will give the uncompressed length of the spring.

Result title   This is a free-form text entry field that allows you to re-name the test result. This title will appear as the row header in the results grid.

A.6 Information

**Result title**   This is a free-form text entry field that allows you to re-name the test result. This title will appear as the row header in the results grid.

Information   Use the drop-down box to select:

Bad sample reason: This will give the reason why a test run was not completed satisfactorily, e.g. 'Emergency Stop button pressed'.

Operator's name: This is taken from the User name logged on when the sample was run. It links the sample result to the operator.

SDC Status: Whether a system deflection calculation was included in the results.

A.7 Peak
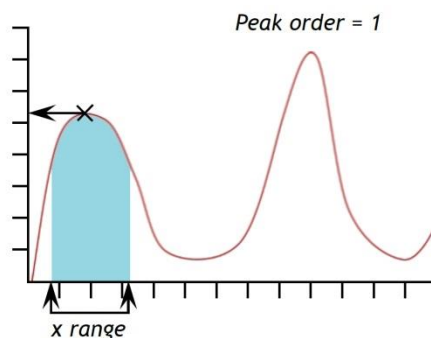
The **Peak** Calculation returns the maximum {Y} value of the chosen parameter of 'Load' or 'Displacement' or 'Time' for a defined range of {X} values. You can choose to report the highest of all the {Y} values, or select the peak of interest by setting 'Start' and 'Finish' values, and by making entries in the 'Order' and '%' boxes.

Result title   This is a free-form text entry field that allows you to re-name the test result. This title will appear as the row header in the results grid.

Y   Use the drop-down box to select the parameter plotted on the Y-axis, choose from 'Load', 'Displacement/Angle' or 'Time'.

X   Use the drop-down box to select the parameter plotted on the X-axis, choose from 'Load', 'Displacement/Angle' or 'Time'. This cannot be the same as used for the Y-axis.

Start   Enter the start value of {X}. If you leave this blank, the value from the start of the test will be used.

| Finish	Enter the end value of {X}. If you leave this blank the final value from the test will be used.
Order	To return the highest value of {Y} within the range of {X} defined by 'Start' and 'Finish'. Order 0 = max. value. Order 1 = highest peak value. Order 2 = second highest peak value, and so on.
%	The per cent field allows the PEAK calculation to distinguish between small spikes that are a genuine signal, and background noise. If after the peak the y-value does not fall by at least the selected percentage of the total range of y-values, then that spike is not a genuine peak. If however there are two peaks that are very close together, it may be necessary to experiment with different values in the '%:' box.

A.8 Print When

The **Print When** calculation applies a test to the value of the result from a line number in the Selected Calculations list and returns text that depends on the result of a conditional test. **Note:** the **Print When** calculation must be lower down the list of Selected Calculations than the calculation to be tested.

Result title	This is a free-form text entry field that allows you to re-name the test result. This title will appear as the row header in the results grid.
Calculation no.	This is the line number of the calculation to be tested as they appear in the 'Selected Calculations' list.
Condition	Choose the Boolean test to be applied from the drop-down list:
	<, <=, <>, =, >, >=
Test value	Enter the test value
True text	Enter the text to be displayed if the test condition is met.
False text	Enter the text to be displayed if the test condition is not met.

A.9 Slope

The **Slope** calculation returns either:

- The **gradient of Y** within a defined range of {X}. The value is determined by linear interpolation between the 'Start' and 'Finish' points.

- The **Y Intercept** as a function of {X} within a defined range of X values, determined by linear interpolation between the 'Start' and 'Finish' points.

y intercept

x range
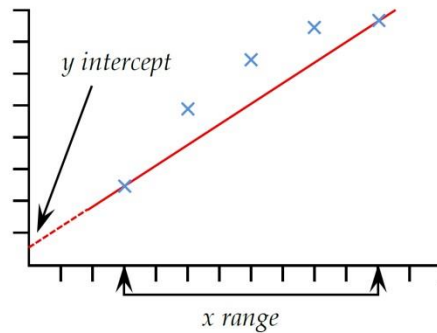
The **RMSE** of the data set compared to the slope of {Y} as a function of {X}. See Appendix A.3: **RMSE** above, for the definition.

Note: the Slope calculation performs a linear interpolation between the two point defined by the 'Start' and 'Finish' values. Points in between are not included in the calculation.

Result title	This is a free-form text entry field that allows you to re-name the test result. This title will appear as the row header in the results grid.
Y	Use the drop-down box to select the parameter plotted on the Y-axis, choose from 'Load', 'Displacement/Angle' or 'Time'.
X	Use the drop-down box to select the parameter plotted on the X-axis, choose from 'Load', 'Displacement/Angle' or 'Time'. This cannot be the same as used for the Y-axis.
Start	Enter the start value of {X}. If you leave this blank, the value from the start of the test will be used.
Finish	Enter the end value of {X}. If you leave this blank the final value from the test will be used.
Result is	Choose 'Gradient' or 'Y intercept' or 'RMSE'.

A.10 Time-Stamp

Used to add the date and time the test started and finished. Use the Radio button to select the time—Start time is taken when the green 'Start' button is pressed. The End time is recorded when the test has finished, or if terminated by pressing the red 'Stop' button. You can display both start and end times by adding two Time-Stamp calculations.

A.11 Trough

The **Trough** calculation returns the minimum value of {Y} of the chosen parameter of 'Load' or 'Displacement' or 'Time' within a defined 'Start' and 'Finish' value of {X}. You

can choose to report the lowest of all the {Y} values, or select the trough of interest by setting the 'Start' and 'Finish' values and by making entries in the 'Order' and '%' boxes.

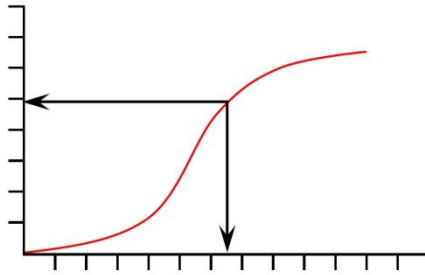|	
Result title	This is a free-form text entry field that allows you to re-name the test result. This title will appear as the row header in the results grid.
Y	Use the drop-down box to select the parameter plotted on the Y-axis, choose from 'Load', 'Displacement/Angle' or 'Time'.
X	Use the drop-down box to select the parameter plotted on the X-axis, choose from 'Load', 'Displacement/Angle' or 'Time'. This cannot be the same as used for the Y-axis.
Start	Enter the start value of {X}. If you leave this blank, the value from the start of the test will be used.
Finish	Enter the end value of {X}. If you leave this blank the final value from the test will be used.
Order	To return the lowest value of {Y} within the range of {X} defined by 'Start' and 'Finish'. Order 0 = min. value. Order 1 = lowest trough value. Order 2 = second lowest trough value, and so on.
%	The per cent field allows the **Trough** command to distinguish between small dips, which are a genuine signal, and background noise. If after the trough the signal does not climb by at least the selected percentage of the total range of y-values, then that dip is not a genuine trough.

A.12 Value

The value calculation returns the value of {Y} for a specified value of {X}. {Y} can be 'Load', Displacement/Angle' or 'Time'. {X} can be 'Load', Displacement/Angle', 'Time' or an 'Event'. See the discussion at the beginning of this appendix on Multi-valued functions.

Result title	This is a free-form text entry field that allows you to re-name the test result. This title will appear as the row header in the results grid.
Y	Use the drop-down box to select the parameter plotted on the Y-axis, choose from 'Load', 'Displacement/Angle' or 'Time'.
X	Use the drop-down box to select the parameter plotted on the X-axis. This cannot be the same as used for the Y-axis. Choose from 'Load', 'Displacement/Angle', 'Time' or 'Event'.
Value	Enter the desired value of {X}. If 'Event has been chosen for the {X} parameter, then the options for value are on 'open' or on 'close'
Start time	Enter the start value of {X}. If you leave this blank, the value from the start of the test will be used.
Finish time	Enter the end value of {X}. If you leave this blank the final value from the test will be used.
Occurrence	Enter a number to return the value of {Y} corresponding to the occurrence of the {Y} value of interest. E.g. suppose that you want to find the load {Y}, at its third occurrence at a displacement of {X}, and then enter 3 in the occurrence entry box.

Appendix B
# Accessing Windows for Administrative Tasks

The system is designed to run the Emperor software full screen by default. To access the Windows operating system on the touch screen console, you must quit the *-xt* system.

Return to the front screen and press `Logoff`. Press `Administrative Tasks` and then login with a valid Master level username and password. Press `OK` to leave the *-xt* system and resume at the normal Windows desktop for file maintenance and other system administrative tasks.

B.1 File folder structure

Use the shortcut on the console desktop to navigate to the *-xt* data file folder.

Note: the folder-naming structure is \Force for MultiTest-*xt* and \Torque for Vortex-*xt* and Helixa-*xt*.
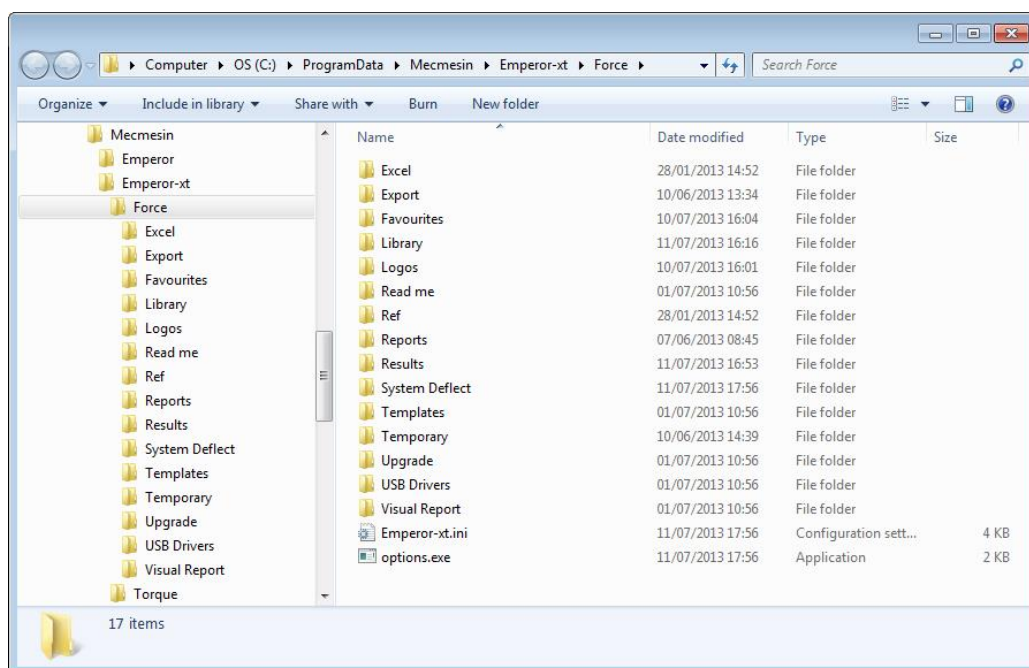
> **Useful key in Windows:** the icon key next to Fn is a key accessing Right-click menus.

B.2 *-xt* system file folder structure

Use the Windows explorer to copy library files, results files, and bitmap images to the relevant sub-directories. The sub-directories have the following uses:

Folder	Contents	File extensions
Export	Location for storing exported data.	*Typical file extensions*: xml .csv .txt (TAB format)
Favourites	Location for graphical images used with Favourite buttons	*Required file extension*: .bmp
Library	Location for storing Program tests without results. These will appear as a list on the *Program Test screen* when Test Library is selected, or as a list in the Advanced Test Library on the *Advanced Test screen*.	*Default file extensions*: .xtl (Program test library file) .lif (Advanced force test library file) .lit (Advanced torque test library file)
Logos	Location for graphical images that can be used in the two Logo positions in *System Settings > Report Template* tab.	*Required file extension*: .bmp
Read me	Location for a copy of the MultiTest-*xt* Reference Manual and Start-up manual in Adobe .pdf file format.	*Typical file extension*: .pdf
Ref	Location for some Emperor administrative files	
Reports	Location for storing Diagnostic reports and Results reports saved in .pdf format	*Required file extension*: .rep (diagnostic reports) .pdf (saved results reports)
Results	Location for the storing of results files	*Required file extensions*: .xtr (Program test results file) .for (Advanced force results file) .tor (Advanced torque results file)
System deflect	Location for System deflection programs and saved compensation results files	*Required file extensions*: .lif (System deflection program file) .tab (Compensation results file)
Templates	Location for default templates for reports and export schemas	*Required file extensions*: .xml .res .des
Temporary	Storage area for temporary files	
Upgrade	Location for files used to upgrade the firmware in the test stand	*Required file extension*: .bin (Firmware upgrade) .txt (Installable options) .cde (system files)
USB drivers	A back-up copy of the system USB drivers	
Visual report	Location for various report administrative files	

For setting alternative file locations, see Appendix E.

B.3 Backing up

We strongly recommend that you back up the *xt*-System files on a regular basis to an external device. Use the shortcut installed on the Console desktop to navigate to the *xt*-System data file folder and back up from this point:

C:\ProgramData\Mecmesin\Emperor-*xt*\Force (or Torque)

This will ensure that all tests, results, reports, templates and any images are copied for safe keeping.

B.4 Importing into Emperor-*xt*

Tests written in the full version of Emperor can be imported into the console as Advanced Test Programs by using a USB memory stick. Save the files to the stick and insert into one of the spare USB sockets on the underside of the touch screen console. Use the file explorer to copy the files to the library or results sub-folders. They will then appear in in the *-xt* system under the lists of Test files or Results files as appropriate.

Similarly, you can import graphics for logos into the \Logo sub-folder, and bitmap images for the favourite buttons into the \Favourites folder.

Appendix C
Checking and Updating the *-xt* System Software

Mecmesin may periodically issue updates to the *-xt* system operating software. Contact your local authorised Mecmesin distributor about the possibility of updating to the latest version.

C.1 Check the *-xt* System software version installed

The software version is found on the bottom right of the splash screen, which appears when the *-xt* System is switched on, and to which you return when you logoff. Note this down.

C.2 Verify the software version

New versions of the *-xt* System software can be supplied on a Mecmesin USB memory stick. First check that the software on the Mecmesin USB memory stick is more recent than the version currently installed on your test stand. A higher number is more recent than a lower.

C.3 Update the *-xt* system software

Exit to the console's Windows desktop:

- on the splash screen, press Shutdown
- press Administrative Tasks under the Shutdown Options
- enter a Master level username and password and press OK

This will close the *-xt* system and leave you on the Windows desktop of the console.

Insert the Mecmesin USB memory stick with the new software into a spare USB socket on the console and a Windows AutoPlay dialog box headed 'Removable Disk' will appear. Press on 'Open folder to view files'.

Confirm that the version of Emperor-*xt*, as shown in the USB memory stick folder name (e.g.: *Emperor-xt 1.18-408*) is higher than the version installed on your console, as previously noted. If it is higher, use the following procedure to update your *-xt* system.

Uninstall Emperor-*xt*

> **Note:** The uninstall process will only remove the Emperor-*xt* system files. *It will not remove any results, library files, templates, or bitmap images that you have previously created.*

Open the Windows Start menu and **from the All programs list**, run the 'Uninstall Emperor-*xt*'.
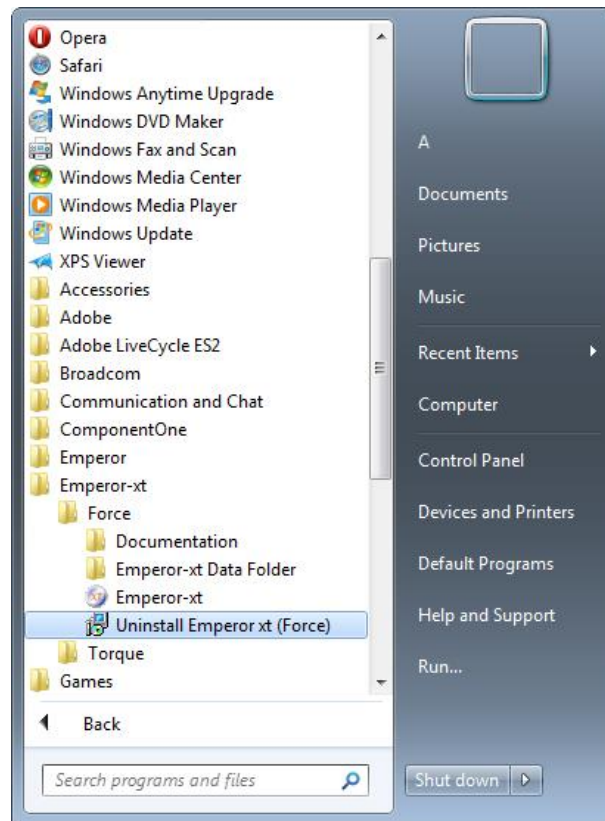
Reinstall Emperor-*xt*

If you have closed the USB file folder, reopen File Explorer (from the desktop, My Computer, then Removable Disk) and double-tap on 'Set-up' on the USB to begin the installation process.

Follow the on-screen instructions to complete the installation.

When the installation is complete, press on the 'Finish' button, and *xt* will re-start.

Note: if *xt* does not automatically re-start, then open the Windows Start menu and run Emperor-*xt* from the program list.

At the splash screen, enter a valid user name and password.

Note: if the firmware (stored programs, information and settings) in the stand itself also needs to be updated, you will see 'Incorrect version of Test Stand software. Allowing limited functionality'.

Press OK and then go to System Settings on the front screen and press the [Comm Settings] tab.

Press on the Upgrade button and acknowledge the software license agreement.

A selection window listing upgrade files will be shown.
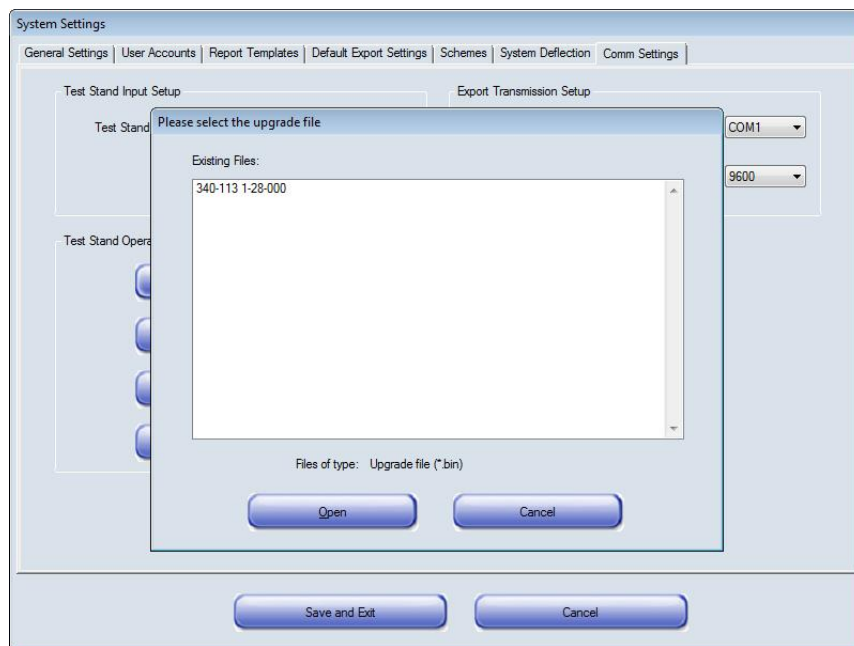
Select the upgrade file shown for your system, and press Open .

The latest test stand firmware will then be installed.

Appendix D
Installing the Advanced Program Builder

**Emperor software CD, Advanced Program Builder upgrade on USB memory stick and cable
for running the *-xt* stand directly from the host PC**

The Advanced Program Builder is an upgrade option for use with Mecmesin-*xt* test stands. It allows the creation of complex testing programs using Mecmesin's powerful Emperor™ Force and Torque testing software. When saved as library files, these programs can be transferred to the Emperor-*xt* console, where they can be used by staff who require only minimal training.

To use the Advanced Program Builder:

1. Install the Emperor Force or Emperor Torque program onto your PC or laptop computer.
2. Upgrade the *-xt* console to activate the Advanced Program Builder option.
3. Write Advanced Programs on the PC or laptop computer. Save them as Library files.
4. Transfer the library files from the host PC or laptop to the *-xt* system console.

> **Note:** advanced Library files or Results files cannot be edited in the *-xt* system. If changes need to be made to a library file, it is necessary to make the changes in Emperor on the host PC or laptop and re-save the file. The modified file must then be transferred back to the *-xt* system console.

D.1 Installing Emperor on another computer

Minimum system requirements

1.3 GHz processor, 1 GB RAM, 80 GB hard drive, running Windows XP Pro with SP3 or above, a CDRW drive, and one available USB port.

Note: Emperor software cannot run on hardware running Unix or on the Apple Mac.

Access to data folders

Emperor will need access to certain folders listed below. Before installing the program, please make sure that read and write access is granted for these folders. In particular if the computer is part of a centrally controlled Windows Domain system, it may be necessary to consult with your IT department to allow correct access to these locations.

Windows XP User Data location	
Emperor Force	C:\Documents and Settings\All Users\Application Data\Mecmesin\Emperor\Force
Emperor Torque	C:\Documents and Settings\All Users\Application Data\Mecmesin\Emperor\Torque
Windows Vista or Windows 7 User Data location	
Emperor Force	C:\ProgramData\Mecmesin\Emperor\Force
Emperor Torque	C:\ProgramData\Mecmesin\Emperor\Torque
All Windows versions Program files location	
Emperor Force	C:\Program Files\Emperor\Force
Emperor Torque	C:\Program Files\Emperor\Torque
Emperor-*xt* Force	C:\Program Files\Emperor-*xt*\Force
Emperor-*xt* Torque	C:\Program Files\Emperor-*xt*\Torque

Install the program

Insert the Emperor CD; Emperor should start automatically and ask if you wish to proceed with the installation of the software.

If the installation program does not start automatically or if you have other problems:

- On your computer desktop click the shortcut to 'My Computer'
- Click on the CD drive that contains the Emperor software CD
- Navigate to the Emperor folder
- Right click on the Set-up.exe file, and Run as Administrator

Emperor will begin the process of installing the program onto your hard-drive. Follow the instructions, and accept the license agreement. You can choose which languages are installed: English only, all languages, or custom, so you can select languages you need.

D.2 Upgrade the *-xt* system to run advanced programs

> **Note:** the Advanced Builder option files are supplied for a specified stand serial number, and can only be installed on that stand.

Quit the *-xt* system and return to the Windows operating system (see Appendix B).

Insert the USB memory stick containing the Advanced Program Builder software into a spare USB port on the console and select 'Open folder to view files'. Now open the Advanced Program Builder Option folder.

Check that the file name is identical to the serial number of your stand. The serial number can be found on the rear of the stand (or on the right-hand side of twin-column MultiTest-*xt* stands). Contact your authorised Mecmesin distributor if the serial number in the file name is different.

Press and hold the filename with the same name as your stand serial number until the pop-up menu appears. Select Copy.

Now open the Emperor-*xt* Data Folder using the desktop icon.

Open the Upgrade folder by pressing and holding the name. Use the pop-up menu to Paste the file into the Upgrade folder. The copied filename with your test stand serial number will then appear.

Open the Windows Start menu and from the program list, run 'Emperor-*xt*' to re-start the *-xt* System. The splash screen will appear for you to log in.

Navigate to the *System Settings* > [Comm Settings] tab, and press Update Options . You will be prompted to Get File . Do this and you will see your stand serial number listed:
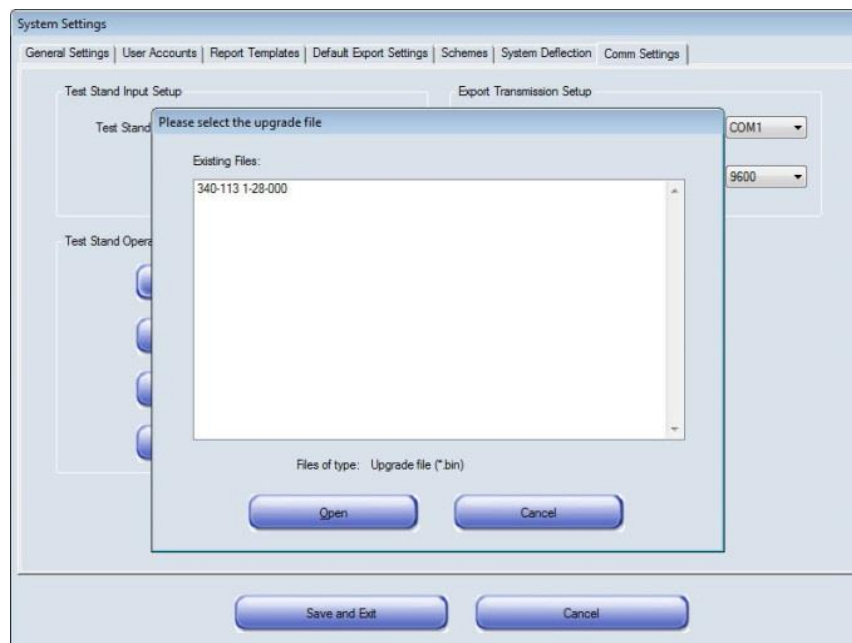
Select this and press Open :

Then press Update Options to install the Advanced Builder option onto your system. A successful update will be confirmed. Press OK then Exit the Update Stand options window.

If you see the error message 'Filename does not match serial number of test stand – possibly incorrect file', save a diagnostic report and then email this to your authorised Mecmesin distributor with your error message.

Press Save and Exit on the System Settings screen to return to the front screen where the Advanced Test button is now available.

D.3 Start Emperor on your remote computer

Start the program by using the Emperor icon that was installed on your computer desktop—the splash screen is displayed. Logon with a Master level username and password. If this is the first time you have started the program, you can use:

Default Username: supervisor

Default Password: supervisor

Note: both the username and password are case-sensitive.

On the Operating Mode selection screen click on Programmed Testing .

This will take you to the Emperor front screen where you can create Advanced programs. For details of the program commands and calculations, see the manual: *Emperor Programming for Mecmesin Test Systems*.
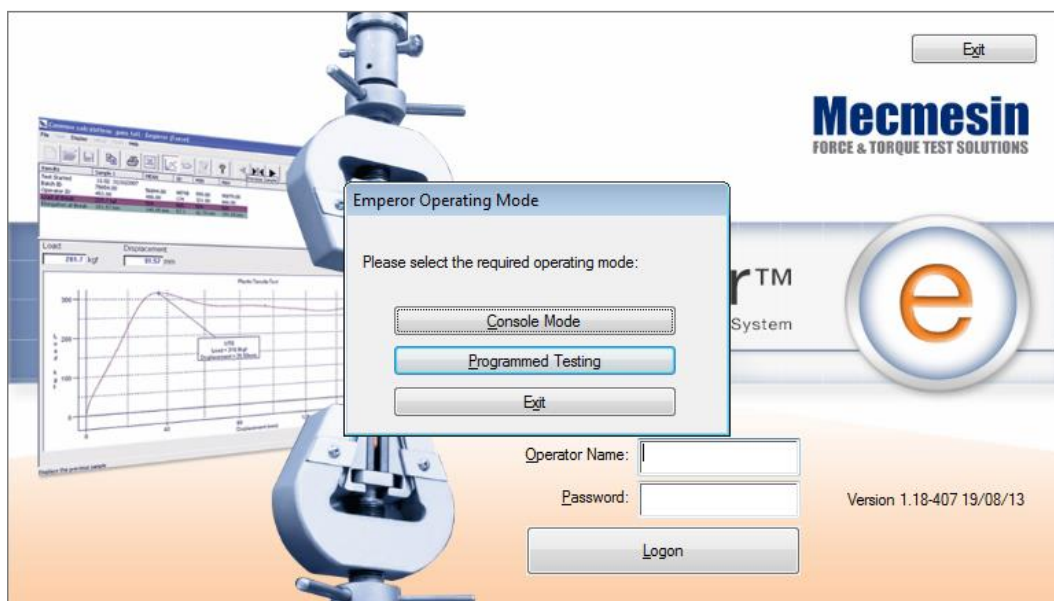
Note the differences on this splash screen: In place of Shutdown , Exit simply closes the Emperor window, and the Operating Mode permits operation or testing in Console (*-xt*) Mode.

D.4 Write advanced programs on your remote computer

A copy of the *Emperor Force and Torque Testing Software: Operator Manual* (PDF file) is included in the Documents folder that was installed along with the Emperor program

files. This gives full details of the Emperor program. Navigate to the folder from *Windows Start > All programs > Emperor > Force/Torque > Documentation.*

The manual can be viewed on-screen using Adobe Reader. It can also be printed in part or in full if you have a printer connected to your computer.

D.5 Save advanced programs on your remote computer

When you have finished writing an Advanced Program, save the file as a library file in *File > Save library Program.* Emperor will automatically add the file extension (filename).*lif* for force programs and (filename).*lit* for torque programs.

D.6 Transfer advanced program library files to the *-xt* system

Locating library programs for transfer to Emperor-*xt*

When Emperor was installed on your computer, a desktop shortcut was created: 'Emperor (Force) Data Folder', or 'Emperor (Torque) Data Folder'. This will open the Emperor data folders.

If the test stand console is connected to a network either by a cable or wirelessly, then it is possible to copy library files directly to the *-xt* system data folders. If there is no connection, then the Library or Results files should be copied to a USB memory stick for transfer.

Copying library files into the *-xt* system

To copy library files back into the *-xt* System console, you need to be at the console Windows desktop (see Appendix B: *Accessing Windows for Administrative Tasks*). Insert the USB memory stick and choose 'Open folder to view files'. Navigate to the saved library files.

Press and hold the required filename until a drop-down menu appears, release and choose 'Copy' from the popup menu. Using the desktop shortcut to 'Emperor-*xt* Data Folder', open this location. Press and hold the Library folder, and select the 'Paste' option on the popup menu to add your copied library files. When the *-xt* system is restarted, these will appear in the 'Advanced Test Library' on the Advanced Test screen.

Copying results files into the *-xt* system

Advanced Program files that already contain some **results** will be titled *Filename*.for for force programs and *Filename*.tor for torque programs. These can be copied in the same way into the 'Results' folder of the *-xt* System. When the *-xt* system is restarted, these will appear in 'Advanced Results Files' on the Advanced Test screen.

Report templates

If your library file or results file uses a **report template** or **SDC template** then you must also copy these template files to the relevant template folder in the *-xt* System.

Exporting data to Excel

If your Advanced Program exports data to Excel, then you need to take into consideration the **file path for the destination** of the exported information. You also need to consider if Excel needs to be installed on the *-xt* System console.

When all files have been copied, close the Windows explorer window and re-start *-xt* by tapping on the *-xt* shortcut on the desktop. When you enter the *-xt* system again, the Advanced Test button is now active, and you can tap on this to access the 'Advanced Test Library' and 'Advanced Test Results', where your library and results files will be listed.

D.7 Using your remote computer to control the *-xt* system stand

When developing a program, it may be more convenient to control the test stand directly from the computer that hosts the Emperor software. This will enable you to edit and modify the programs to check the function without having to save the programs to a USB memory stick and transfer them to the *-xt* System Console.

To control the *-xt* system directly from the host PC or laptop:

If the console is switched on, switch it off by returning to the splash screen and pressing `Shutdown`. Choose `Shutdown` again from the options. This will close down the console.

- Turn off the power to the stand.

- Remove the cable from the 9-way connector from the 'PC' socket on the rear of the stand (or the right-hand side of twin-column stands).

- Using cable part No. 428-126 to connect the host PC to the *-xt* stand. Plug the 9-way connector into the 'PC' socket just vacated and the other end into a spare USB socket on your separate computer.

- Switch on the *-xt* stand.

- Start Emperor on the computer, and login at the Emperor splash screen with a valid username and password as usual.

- You can start Emperor in Program mode or Console mode, which emulates the *-xt* system console.

You can now use either mode to control your stand, write, modify and save programs. When you are happy that the program is finished, the saved file can be transferred to the *-xt* console as described previously.

Appendix E
Setting Alternative File Locations

By default, Emperor-*xt* saves all the user files into folders in the Emperor-*xt* data folder on the console computer C:\ (local) drive. If required or preferred, you *can* redirect the folders to a different location, but it needs to be done by editing the Emperor-xt.ini file in the Program Data folder:

\Mecmesin\Emperor-xt\Force(Torque)\Emperor-xt.ini

In this file, find the section called [Default Preferences].

A standard installation of Emperor-*xt* uses the default locations and so there are no paths listed for the folders. They are automatically directed to the data folder.

Check your own destination folders exist, then redirect Emperor-*xt*.

To redirect any folder, add a line to the Emperor-xt.ini file Default Preference section:

```
[Default Preferences]
OutputFileType=0
Library Folder=Z:\Save-Here
```

Example (inserted lines shown indented, use your preferred locations):

```
[Instrument]
Primary Input=COM2
[Default Preferences]
OutputFileType=0
    Export Folder=C:\ProgramData\Mecmesin\Emperor\Force\Export
    Report Folder=C:\ProgramData\Mecmesin\Emperor\Force\Reports
    Library Folder=C:\ProgramData\Mecmesin\Emperor\Force\Library
    Results Folder=C:\ProgramData\Mecmesin\Emperor\Force\Results
    Upgrade Folder=C:\ProgramData\Mecmesin\Emperor\Force\Upgrade
    Reference Folder=C:\ProgramData\Mecmesin\Emperor\Force\Ref
    Excel Folder=C:\ProgramData\Mecmesin\Emperor\Force\Excel
    Temporary Folder=C:\ProgramData\Mecmesin\Emperor\Force\Temporary
    Visual Report Folder=C:\ProgramData\Mecmesin\Emperor\Force\Visual
    Report Templates Folder=C:\ProgramData\Mecmesin\Emperor\Force\Templates
    System Deflect Folder=C:\ProgramData\Mecmesin\Emperor\Force\System Deflect
    Logos Folder=C:\ProgramData\Mecmesin\Emperor\Force\Logos
    Favourites Folder=C:\ProgramData\Mecmesin\Emperor\Force\Favourites
AcquisitionRate=1
AcquisitionFlags=0
…
```

You cannot redirect the temporary files in the root of the data folder—these are always saved in the \Emperor-xt data folder.

Appendix F
Digital Inputs and Outputs

MultiTest-*xt* has the facility for six digital inputs and six digital outputs that can be used to integrate the test stand with programmable logic controllers (PLCs) or other equipment.

Setting up the inputs and outputs is done in the [Test Settings] tab of the Program Test Set-up screen. To allocate a function to the input or output, first select a Digital Input or Digital Output. Then choose a function from the drop-down box to the right of the selected input or output. The alternative functions are:

F.1 Available commands for digital inputs

OFF
START TEST (Idle mode event)
STOP TEST (Testing mode event)
START START POSITION (Testing mode event)
START TOUCH (Testing mode event)
START SEGMENT A – FIRST CYCLE (Testing mode event)
START SEGMENT A – EVERY CYCLE (Testing mode event)
START SEGMENT B – FIRST CYCLE (Testing mode event)
START SEGMENT B – EVERY CYCLE (Testing mode event)
START HOME (Testing mode event)
START ACQUISITION Testing mode event)
STOP ACQUISITION (Testing mode event)
TARE LOAD (Idle mode event)
TARE POSITION (Idle mode event)
TARE BOTH (Idle mode event)
GO HOME (Idle mode event)

F.2 Available notifications for digital outputs

OFF
TEST STARTED (Testing mode event)
TEST STOPPED - COMPLETED OK (Testing mode event)
TEST STOPPED – EMERGENCY STOP (Testing mode event)
TEST STOPPED – USER (Testing mode event)
TEST STOPPED – ALL (Testing mode event)
TEST STARTED START POSITION STAGE (Testing mode event)
TEST ENDED START POSITION STAGE (Testing mode event)
TEST STARTED TOUCH ON STAGE (Testing mode event)
TEST ENDED TOUCH ON STAGE (Testing mode event)
TEST STARTED SEGMENT A STAGE (Testing mode event)
TEST ENDED SEGMENT A STAGE (Testing mode event)
TEST STARTED SEGMENT B STAGE (Testing mode event)
TEST ENDED SEGMENT B STAGE (Testing mode event)
TEST STARTED MOVE HOME STAGE (Testing mode event)
AT HOME POSITION (Testing mode event)
TEST RESULTS – PASS (Idle mode event)
TESTRESULTS – FAIL (Idle mode event)

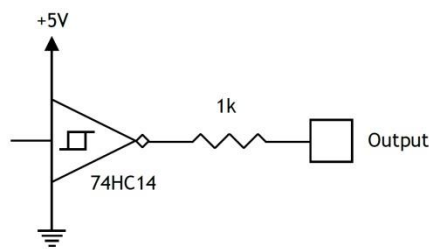# Appendix G
Pin-out Connections for Digital Inputs and Outputs

G.1 Digital inputs

- Input voltage range is 0 to +5V

- The input pins are normally high (+5V) and should be pulled low (0V) for a minimum of 100ms to trigger an operation

G.2 Digital outputs

- Normally low (0V)

- When set the appropriate output pin is pulsed high (+5V) for 500ms

Digital Output circuit

25-Way D-type pin	Function	25-Way D-type pin	Function
1	Not connected	14	Digital output 1
2	Auxiliary receive	15	Digital output 2
3	Auxiliary transmit	16	Digital output 3
4	Not connected	17	Digital output 4
5	Not connected	18	Digital output 5
6	Not connected	19	Digital output 6
7	Ground	20	Not connected
8	Not connected	21	VCC (+5V)
9	Digital input 1	22	Not connected
10	Digital input 2	23	Event input
11	Digital input 3	24	Digital input 6
12	Digital input 4	25	Ground
13	Digital input 5		

Appendix H
RS232 protocol

H.1 Comm port settings:

Data bits: 8

Parity: None

Stop bits: 1

Flow control: None

Appendix I
Bad Sample Messages and Error Codes

If a test does not complete, it will be marked as 'Bad' in the sample status in the sample management section on the Info/Help screen. Bad results are not included in 'Mean' and 'SD' calculations in the Results grid, and are not printed in a report. You can get more information on the cause of the problem by adding an 'Information' calculation in a program test. This will then show the Reason code in the 'Bad sample reason' line displayed in the Results grid.

I.1   Error messages

Error message	Cause
'Stopped by operator'	The run has been stopped by pressing the red 'Stop' button on the Live Test Run screen
'Aborted by test system [0x0000000N]'	The system has stopped the run. By adding an 'Information' calculation line to a Program Test, a Reason code will be displayed in the Results grid. See below for a list of the Reason codes.
'Stopped by external input'	Test stopped due to a digital input
'No data acquired'	No data has been acquired
'Program not completed'	Program not finished, typically this will happen when a communication error occurs and aborts program execution

I.2   Reason codes

These codes indicate the reason for the test not finishing successfully. The codes displayed can be for a single reason, or if more than one failure has occurred the codes will be added together. For example, in the case of a single fault, the code [0x00000001] means 'Motor current limit Encountered'.

In the case of a multiple fault, a code of [0x00000003] would be displayed if both [0x00000001] 'Motor current limit Encountered' and [0x00000002] 'Motor drive has been disabled' had occurred at the same time.

Fault code	Reason
0x00000001	Motor Current Limit Encountered
0x00000002	Motor Drive Has Been disabled
0x00000004	Test stand has recovered from reaching the upper limit of travel
0x00000008	Test stand has recovered from reaching the lower limit of travel
0x00000020	Emergency Stop Button Pressed
0x00000040	Overtravel Switch Encountered
0x00000080	Overload detected, automatic recovery
0x00000100	Intelligent Load Cell not present, Switch test stand off and check the link. Allowing limited access.
0x00000200	Test Stand Data Buffer Overflow
0x00000800	Tachometer Failure
0x00001000	PID Overflow Too Many Times
0x00002000	PC Comms watchdog has timed out. Allowing limited access.
0x00004000	Failed holding the motor
0x00008000	Motor deceleration failure
0x00010000	Intelligent Load Cell receive load error
0x00020000	Test Stand transmit buffer is full
0x00040000	Invalid parameter in Test Stand PIC
0x00080000	Real Time Controller PIC failure, Switch test stand off, contact your Agent/Distributor. Allowing limited access to stand
0x00100000	Overload detected.
0x00200000	Test Stand has not been calibrated. Allowing limited access.
0x00400000	Extensometer jump detected
0x00800000	Invalid parameter sent to Test Stand

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