Titan[3]

Universal Strength Tester
Model 910

Covering Serial Numbers
910/09/1001
and upwards

James H. Heal & Co. Ltd.
Halifax, England

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Thank you for investing in **Titan^3**

by

James H Heal & Co Ltd.

Heal's would like to assure you that we are committed to providing you with first class Instruments, Quality Assured Consumables, excellent Customer Service and Support.
You are part of a growing community who considers Heal's products to of the highest quality whilst offering excellent value for money.

Titan's radically innovative engineering and software are designed exclusively around International Textile Testing Standards, providing unmatched ease of use, versatility and efficiency. When a Test Standard is selected, Titan sets all test parameters automatically, including analysis and reporting formats – even the jaw separation is set, with digital precision.

Developed in conjunction with expert users throughout the industry, Titan's outstanding modular software provides exceptional real-time graphic displays, archive retrieval facilities and a wide range of advanced features – while simplified operator menus boost the confidence and efficiency of inexperienced operators. Operator confidence is also enhanced by safety features, such as clamping jaws which act at very low pressure during specimen loading, automatically switching to full pressure when the test starts.

The innovative technology incorporated in the side entry T7 Jaw design permits testing of a wide range of fabrics and test types from high tensile to low demand capacity cyclic testing. Alternative dedicated jaw and fixture systems are available for specific applications such as Yarn testing (T5), Buttons (T4), Loop Bars (T3 and T3A), C-Clamps (T11), Compression Tooling (T10 series) and Attachments Kit for the testing of garment accessories. Bespoke fixtures are also available on request.

Model 910, Titan^3, supersedes Titan^2 which was launched in 2005 and the original Titan which was launched in 1999. Titan^3 has been launched with Version 9.0 software which includes many improvements and a complete Standards update.

Titan^3 is available in two options:

- Tension only (904-503)
- Tension and Compression (904-504)

This Operator's Guide covers the use of both options.

Introduction to Tooling

This section shows each Tooling assembly (also known as Grips or Fixtures) and their scope of application. The later section "Testing with Titan" will show them in use.

		Features and Use
T7	Pneumatic Fabric Grips 	• Jaws for general Fabric testing such as tensile, tear and seam slippage • Pneumatic operation • Zero Jaw Separation • Easy-to-fit Jaw Faces • Side entry of specimens • Supplied with 125x25mm and 25x25mm rubber faced Jaw Faces • Range of other Jaw Faces available including Line Contact Faces for Stretch & Recovery testing of strip specimens
T3	Narrow Loop Bars 	• Fixtures for Stretch & Recovery testing of loop specimens • Suitable for specimens up to 75mm wide • Supplied with 4mm and 8mm diameter bars
T3A	Wide Loop Bars 	• Fixtures for Stretch & Recovery testing of loop specimens • Suitable for specimens up to 125mm wide • Supplied with 6.5mm, 8mm, 10mm and 13mm diameter bars (shown here with only 10mm bars (fitted) and 8mm bars)

T11 C-Clamps

- Fixtures for Stretch & Recovery testing of loop specimens
- Suitable for specimens up to 125mm wide
- Supplied with 8mm and 10mm diameter bars

T8
T9 Needle Clamp

- Seam slippage of fabrics using needle clamp
- T8 Needle Clamp for Apparel fabrics
- T9 Needle Clamp for Upholstery fabrics (illustrated)
- Used for ISO 13936-3
- T9 also specified by IKEA
- Seam slippage without sewing a seam

T5 Pneumatic Yarn Grips

- Jaws for tensile testing of Yarn
- Pneumatic operation
- Supplied with Yarn Guide (not shown)

T4 Button Holder

- Strength of buttons and attachments to fabric/garment
- Integrated debris shield
- Used in conjunction with T7

T12 Attachments Kit

- Security of attachments to fabrics/garments
- Universal Hook Attachment
- Diamante Gripper
- Popper, Eye and Rivet Gripper
- Motif Lever Grip
- Pneumatic Lower Clamp

T13 Pile Loop Extraction Kit

- Loop extraction from Terry Towels
- Universal Hook Attachment
- Small Hook (Loop Hook)
- Used in conjunction with T7

T10A Ball Burst (Type A)

- Bursting Strength using ball probe
- Compression mode required
- Other types of Ball Burst and Compression fixtures such as crushing and puncture resistance are available on request (please specify standard)

Check Weight Set

- Used to verify Loadcell readings
- 5 x “10N” weights
- Specified by some Retailers
- Not used for Calibration

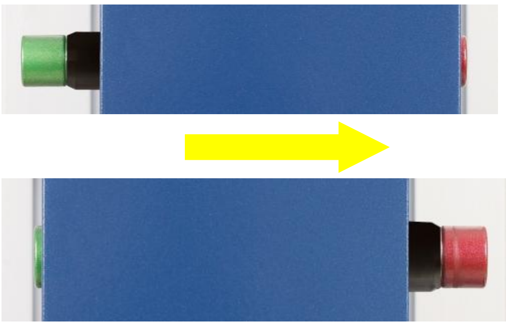
This section provides brief instructions to perform a new test, review the results, open a stored test, add more specimens and print results.

Navigation through the Titan software is best achieved using a combination of mouse and keyboard operations. Microsoft® Windows conventions apply for keyboard and mouse operations.

Note: More comprehensive descriptions of the test modules are given in the Operators Guide - Section 5 Testing with Titan.

If your Titan^3 instrument has the option for Tension and Compression (904-504) please follow the instructions below otherwise skip to the next page.

Switching from Tension to Compression



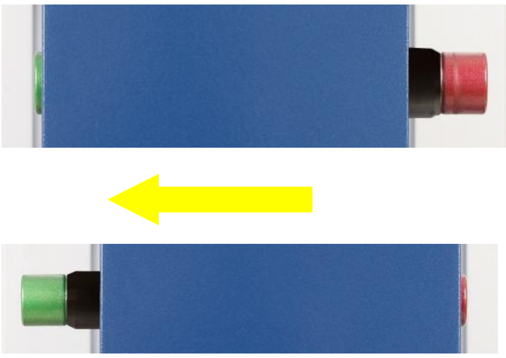
Mechanical setting:

Push the **GREEN** shuttle button to the right so that the **GREEN** button is in the casing and the **RED** shuttle button appears on the right.

Software setting:

When the **Compression Module** is selected you are prompted with the message to the left.

Switching from Compression to Tension

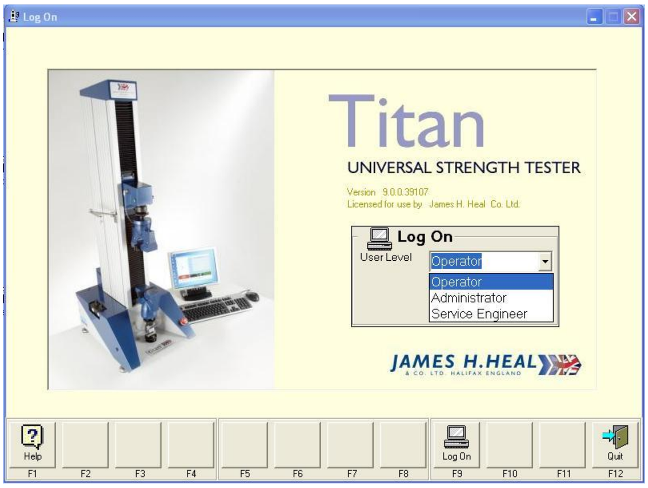


Mechanical setting:

Push the red shuttle button to the left so that the red button is in the casing and the green shuttle button appears on the left.

Software setting:

When any of the **Tension Modules** are selected you are prompted with the message to the left.



Log On

From the Windows Desktop, double click the Titan^3 icon. The Log On box is displayed.

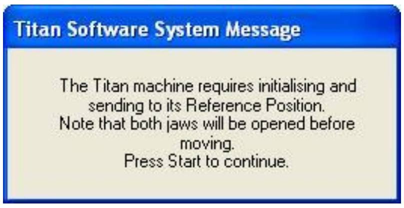
Choose the **User Level** required from the drop down list:

Operator
Administrator } Password
Service Engineer } required

Select **Log On** (F9).
When testing is completed, exit the Titan^3 software by selecting **Quit** (F12).

New Test

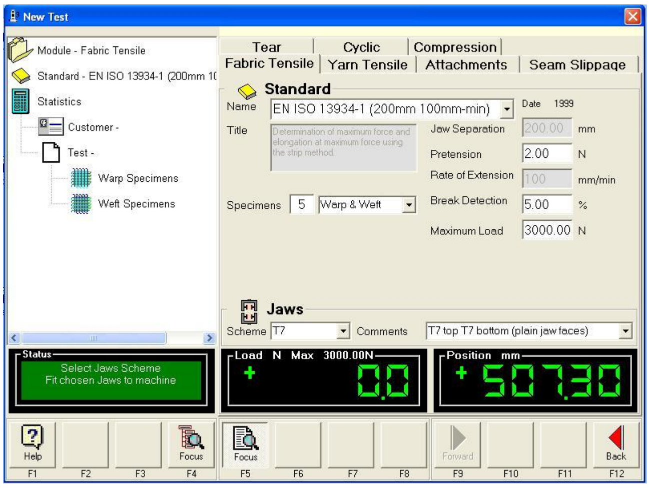
Press **New** (or press F3 on the keyboard) then select a Module Tab such as Fabric Tensile.



If at any time the Titan instrument has been switched off then these messages will be shown.

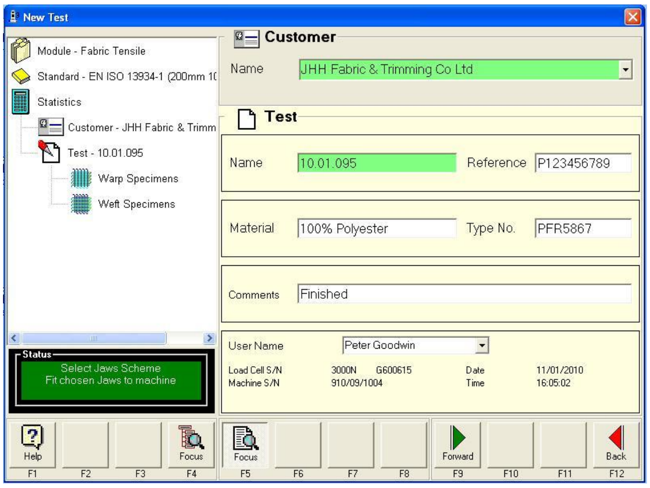
Press F9 **Start**.

The Upper Jaw will move to the Reference Position at the top of the carriage.



From the drop down list select the required **Standard** (test method).

Select the required **Jaws Scheme** and ensure this matches what is fitted to Titan.



At the left hand side of the display (known as the Navigator) select **Customer**. The screen changes.

On the right hand side enter a **Customer Name**. This becomes a directory (or folder) on the computer's hard disk. All tests done for this customer will be stored in this folder. Once this customer name has been entered, it can be selected from a list for later tests.

On the right hand side enter a unique **Test Name**. This becomes a file in the customer directory on the computer's hard disk.

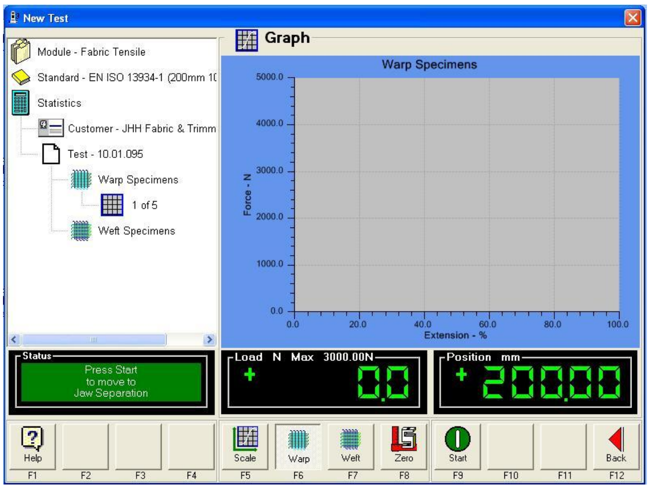
Note: Customer Name and Test Name are mandatory fields and must be completed in order to go Forward and proceed with testing. They are shaded green to highlight this point.

If required, enter any other information. For example, other information could be order numbers, fabric qualities, shade references.

Note: The headings used to name the Test fields can be changed. From the Main Menu select **Configuration** (F11) then select the Titles tab. For example, Name can be changed to Batch No.

Enter a **User Name**, then press **Forward** ► (F9).

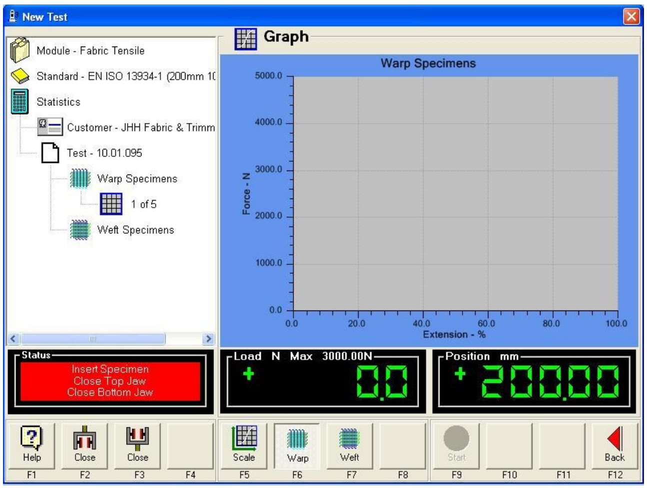
Note: User Names can be added from the Configuration menu.



Performing the test

Scale (F5) the graph if necessary, select **Warp** (F6) or **Weft** (F7). After the first specimen has been tested, the graph will rescale automatically to provide the best fit on screen.

Read the **Status** box at the bottom left hand side and follow the instructions. Titan will drive automatically to the required Jaw Separation.

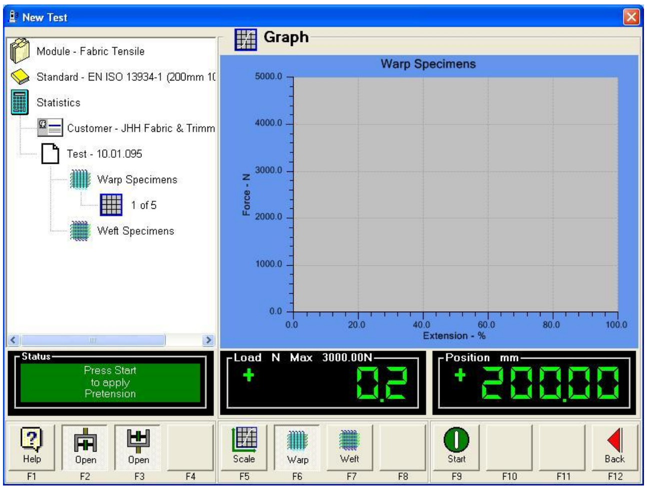


Insert the specimen and **Close** (F2) the top jaw using either the software or the foot pedal.

Close (F3) the bottom jaw in the same way.

Press **Start** (F9) to start testing the specimen.

Note: these instructions are shown in the red **Status** box.

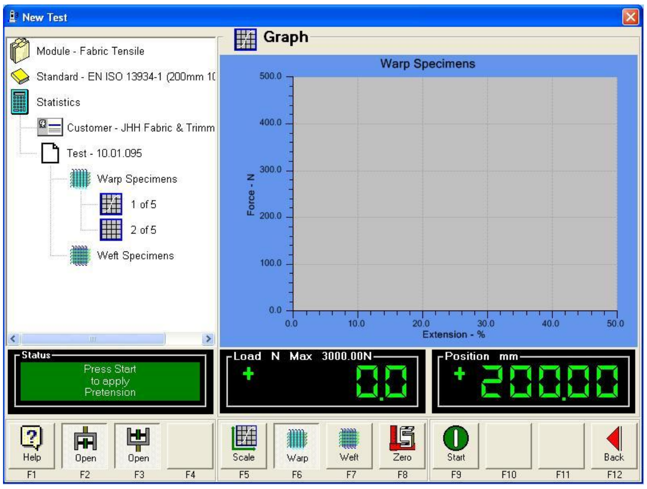


If required, the specified **Pretension** is applied.

Press **Start** (F9) to begin testing the first specimen.

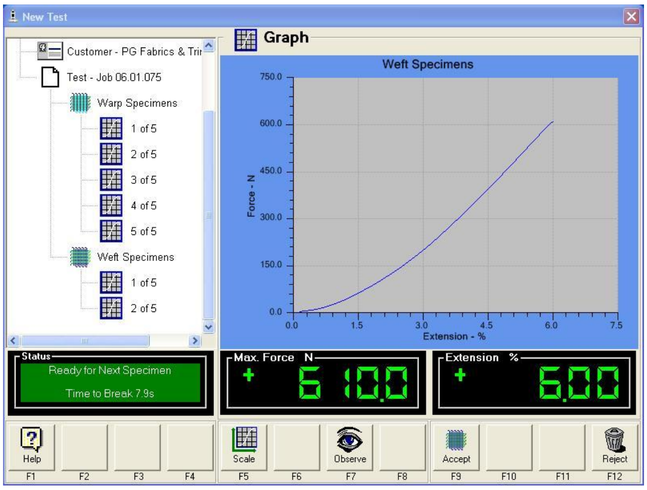
Note: **Pretension** is applied at a reduced rate of extension.

During the test it is possible to manually end the test by pressing **End** (F9). It is also possible to stop the traverse of the head by pressing **Stop** (F12).



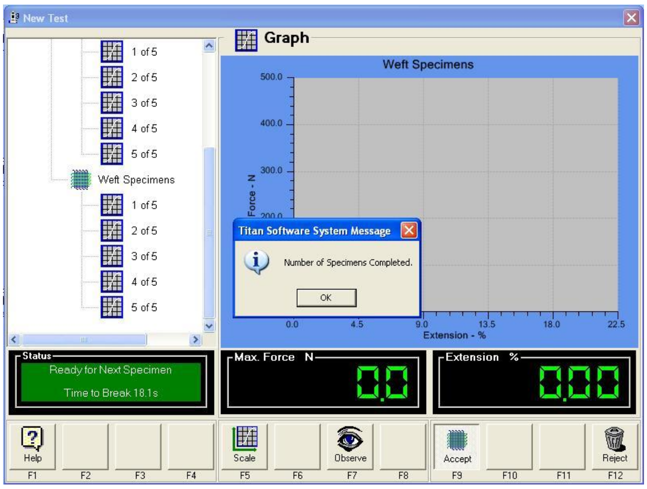
Based on the results obtained for the first specimen, the load and/or extension axes may be rescaled to for best fit on screen.

Compare the scales on this screenshot with the one above.

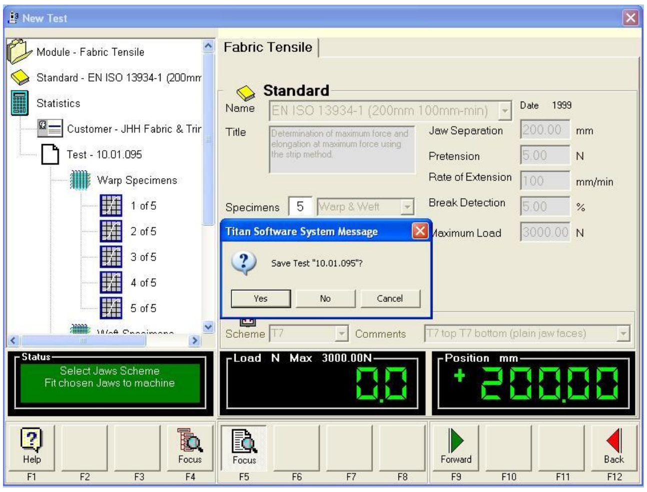


Accept (F9) or **Reject** (F12) each test in turn.

Accepting saves the results for the tested specimen, rejecting erases the last specimen test results.



When all the required specimens have been tested the message "Number of Specimens Completed". Press OK to continue.



Press **Yes** when prompted to save the test results. Yes is the default option.

Pressing No will close the test without saving and all the test results data will be lost !

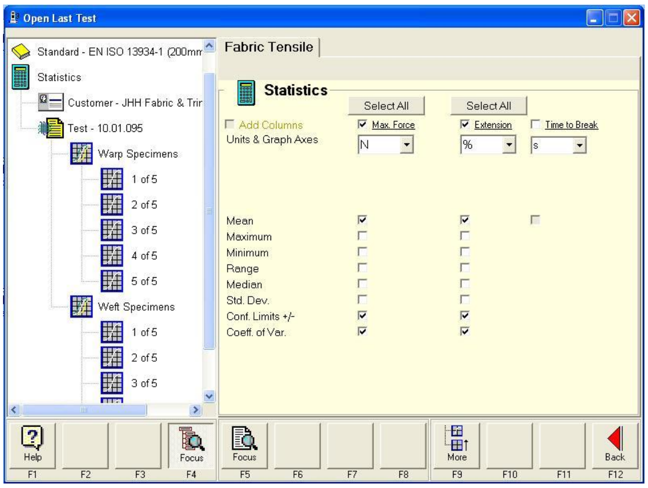
Note: To quit and save before testing all the required specimens are completed press **Back** ◄ (F12) three (3) times and press **Yes** when prompted to save the test results. Pressing No will close the test without saving and all the test results data will be lost !

Open a Test

The **Open Last** and **Open Stored** functions can be used to view or print test results, change the statistical display or add more specimens to the test data.

Open the Last Test

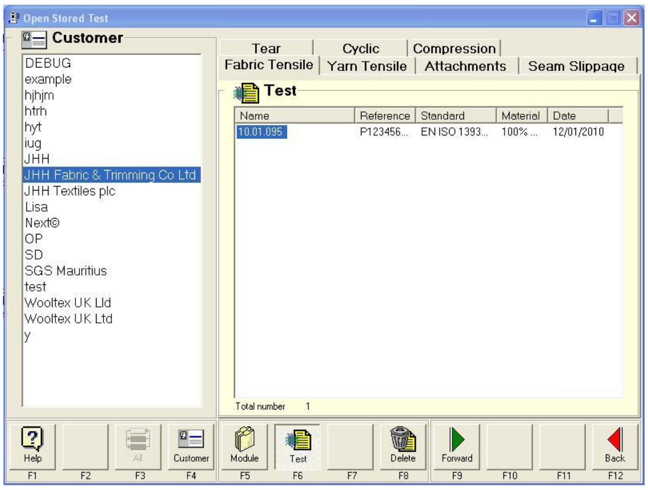
To view the results, select **Last** (F8) from the **Main Menu.**



Select Warp Specimens (or Weft Specimens) to see the graphical results of all warp (or weft) tests. Select **Results** to see the table of results.

To change the way the statistical analysis is reported, select **Statistics** from the Navigator to add or remove calculations. Check the box to calculate and show or uncheck not to show.

Then select Warp Specimens to see the graphical results of all warp tests. Select **Results** to see the table of results with the newly selected statistics displayed.



Open a Stored Test

From the Main Menu select **Stored** (F9).

Select the type of test you wish to retrieve, e.g., Fabric Tensile, by clicking the appropriate Module Tab.

Select the **Customer** from the Navigator.

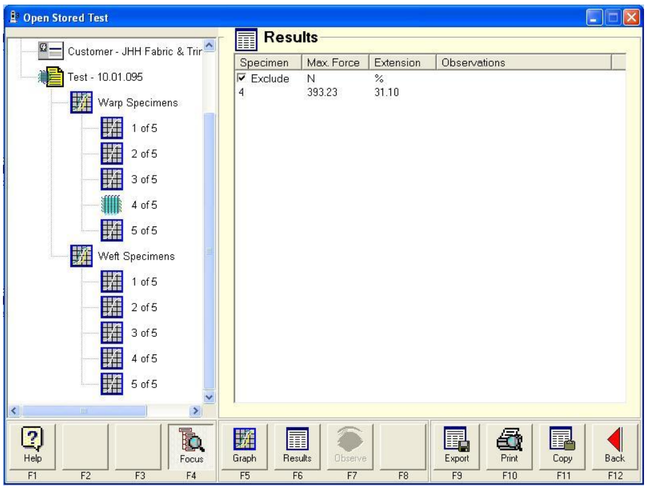
Select the **Test** from the list which appears (if list is not present then Customer has not been selected or no tests have been saved for the selected Customer).

Press **Forward** (F9).

The selected test results are loaded.

You can now view / print the results, add **More** (F9) tests, or change the way the results are reported.

Excluding Specimens

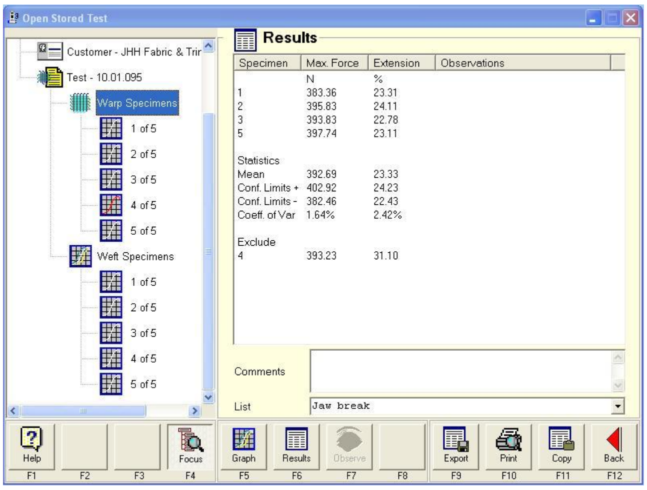


Open the required data file using **Last** or **Stored** from the **Main Menu**.

In the Navigator, select the test specimen required to be excluded.

Click **Results** (F6).

Check the **Exclude** box.

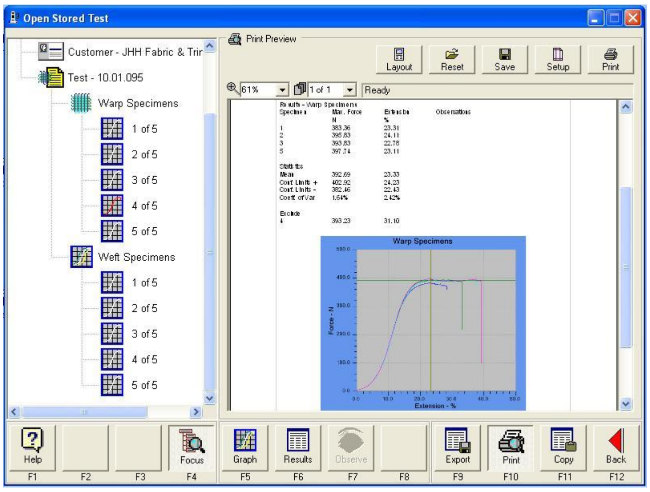


Excluded specimens are not deleted.

However, the results are not included in any statistical calculations. Also, they are not reported in the same list as the included results.

Excluded specimens are indicated by the specimen icon displaying a red graph.

Basic Print Routine



Open either **Last** (F8) or **Stored** (F9) from the **Main Menu**.

Press **Print** (F10) to display the **Print Preview** window.

By pressing the **Layout** button (at the top of screen) it is possible to customise the layout of your test reports.

Press the **Print** button (top of screen) on Print Preview window toolbar to print the test report to the default Windows printer.

Introduction to Strength Testing

This section introduces the user to the basic test principles for textile testing accommodated by Titan^3. Titan has always been described as a "Universal Strength Tester". Titan^3 takes this to another level with both Tension and Compression testing now available on selected models.

Tensile testing is a general term for testing on a machine that applies a force to a specimen and measures its force and extension. Tensile (tension) testing involves taking a small specimen of defined shape and size, and then pulling it in a controlled manner gradually increasing the force until the sample changes shape, breaks or fails.

In textile testing, Deformation is a change in shape that is the result of a force that influences the specimen. It can be a result of tensile (pulling) forces or compressive (pushing) forces. When a specimen is loaded in such a way that it extends it is said to be in tension. On the other hand if the specimen compresses and shortens it is said to be in compression.

Compressive strength is the ability of a material to withstand pushing forces. When the limit of compressive strength is reached, the specimen fails. The apparatus used is the same as that used in a tensile test. However, rather than applying a tensile (or pulling) load, a compressive load is applied.

In terms of Textile Testing, there are five (5) main types of test that are performed on a Universal Strength Tester: Tensile Strength, Seam Slippage, Tear, Cyclic (Stretch & Recovery) and Compression.

The number of textile standards and test methods is growing. The majority of textile standards can be put into one of the five sections. Later in this section each of these will be explained in greater detail.

Throughout this section, many technical terms specific to the testing of textiles and textiles generally will be used. To help understand these terms a Glossary of Terms is included at the end of this section.

Some Concepts Explained

Pretension

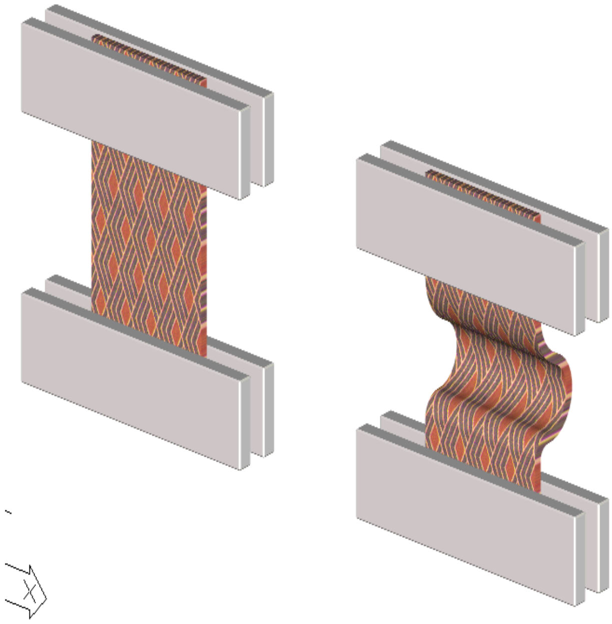


Figure 1: Pretension

Pretension is a small load that is used to pull a specimen taught before testing without causing significant extension.

If Pretension is not used then a slack mounted specimen appears to be more elastic by elongating more than the taught specimen.

The Position window shows the Jaw Separation (e.g., 200mm). When the test is started the specimen extends until the Pretension value is reached (typically 2N). The Position window shows this position (e.g., 208mm). Next the Position window becomes the Extension window and the reading becomes zero, that is zero Extension. The Extension increases as the specimen stretches.

The extension units are taken from the Statistics extension units.

The Jaw Separation at the Pretension value is used in the % Elongation calculation, not the original Jaw Separation. <u>This is very important</u>.

For example, a specimen has a 2N pretension and the Jaw Separation at this load is 208mm. The initial jaw separation is 200mm and the final extension is 92mm.

92 / 200 x 100% = 46%	✘	this is not the correct result !
92 / 208 x 100% = 44%	✓	this is the correct result

Rate of Extension

There are two (2) methods of applying the rate of extension: Constant Rate of Extension or Time to Break.

Constant Rate of Extension
Some Standards extend the specimen at a particular rate per unit time (e.g., 100 mm/min). Standards include DIN 53 858, M&S P11 and EN ISO 13934-1.

Time to Break
Other Standards state that the specimen must break in a specific time period (e.g., 20s ± 3s). To break in a time period the Operator uses at least one specimen and the default rate of extension. The test is rejected (F9 Reject) if the actual break time is outside the allowable limit. Titan then automatically calculates the new extension rate that will enable the next specimens to break within the correct time period. This feature cannot be used after the first specimen has been Accepted. However the Operator can reject several specimens at the beginning of the test.

For example, the time to break is 30 seconds. The first specimen used a rate of 100mm/min and failed at 45 seconds. This is rejected by the Operator and Titan calculates

New Rate	= Actual Time / Required Time x Rate
	= 45 / 30 x 100
	= 150 mm/min

Standards such as ASTM D5034, ISO 5081, ISO 5082 and BS 3424 Part 4 Method 6 use this feature.

Fabric Tensile Testing

Software Module S1 is required to carry out Fabric Tensile tests.

Typically a tensile test puts a force onto a specimen and pulls it until destruction. The force at failure is recorded and sometimes the amount of stretch (known as elongation) at this load.

There are two types of Fabric Tensile test, strip and grab. The Standard being used will clearly state the method of tensile test is to be used. There is no simple relationship between the results of the two types of test method.

Strip Test and Grab Test

Figure 2: Strip Tensile

Figure 3: Grab Tensile

For a Strip Test the Operator cuts specimens that are oversized on the width. The yarns from each of the long sides are carefully removed until it is to the specified size ± 0.5mm. This is a time and labour intensive job. Common specimen width is 50mm.

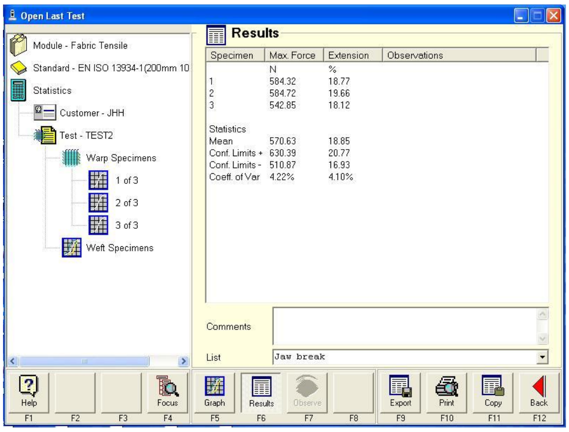
The full width of the specimen is gripped in the jaws. With Titan we usually select full (125 x 25mm) rubber faces for all Jaw Faces.

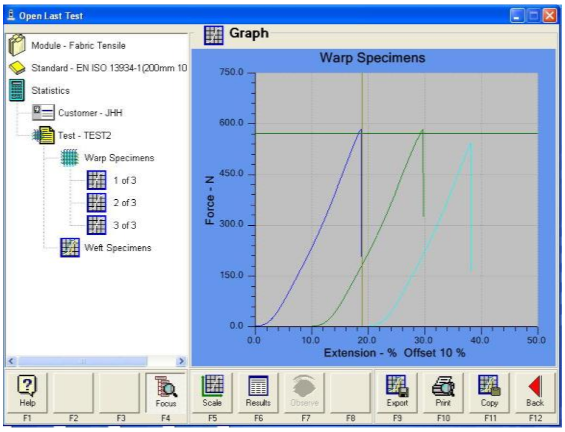
For a Grab Test the specimen is usually much wider than for the strip method. Common width is 100mm.

The main advantage of the Grab Test is that less preparation of the specimens is required. Specimens are cut carefully to size.

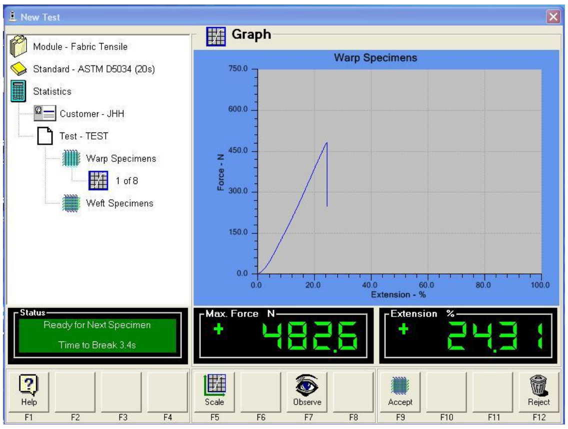
The centre of the specimen is gripped in the Jaws. With Titan we usually select rubber faces 125mm x 25mm for one face and 25mm x 25mm for the other.

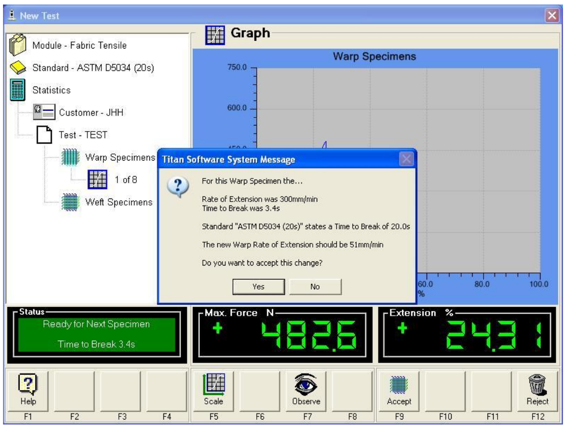
The following screenshots from Titan[3] Software while carrying out a Strip Test according to EN ISO 13934-1 using constant rate of extension of 100mm/min.

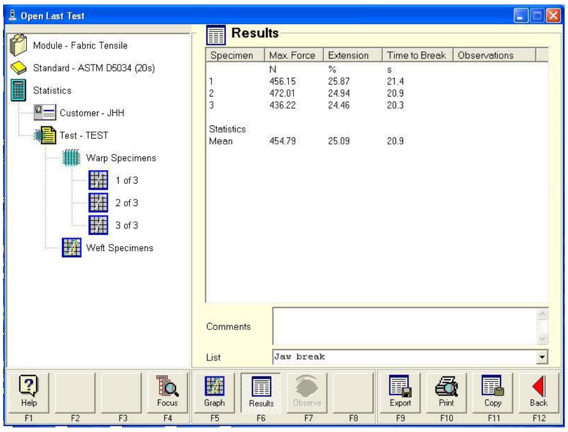


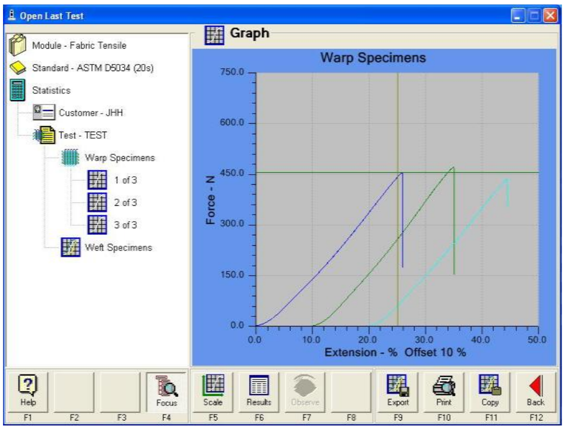


The following screenshots from Titan[3] Software while carrying out a Grab Test according to ASTM D 5034 using Time to Break of 20s. Note that the Time to Break of the first specimen was only 3.4s. Titan recalculated the new rate of extension to be 51mm/min in order to achieve the correct Time to Break of 20s. Note the actual Time to Break of each specimen in the Results below.









Seam Slippage

There are several techniques employed for the measurement of Seam Slippage (also known as Fabric Slippage by some Retailers). Some techniques rely on the Operator to make measurements of the specimen while held in the Jaws and others allow the software to calculate the results from the load/extension data.

Those techniques which rely on the Operator to measure and input results are found the Tensile Module, not the Seam Module. Those which allow the software to calculate results are found in the Seam Module.

Seam Slippage methods which rely on the Operator to measure and input results usually use a single specimen per test (a seamed specimen) whereas those which employ the software to calculate results have two (2) specimens per test, an unseamed specimen and an seamed specimen.

There are three (3) types of seam slippage test. These three (3) types are reflected in ISO 13936 Determination of the slippage resistance of yarns at a seam in woven fabrics, parts 1 to 3:

Standard	Description	Summary	Software Module
EN ISO 13936-1	Fixed seam opening method	Load-extension plotted using unseamed and seamed specimen and the distance between the two (2) curves is taken as the seam slippage	Seam
EN ISO 13936-2	Fixed load method	Seamed specimen is put under load and the seam gape is measured	Tensile
EN ISO 13936-3	Needle clamp method	No seamed specimen used and measures the force required to pull a set of pins (needles) through the specimen	Seam

To prepare a specimen for ISO 13936-1:

- Fold at one end.
- Stitch a seam to create a loop.
- Cut the loop with scissors to expose the stitched seam.
- Just before testing, cut the fabric to create two specimens and keep them together in pairs.

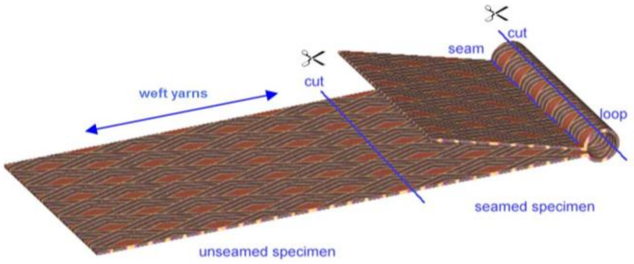


Figure 4: Seam Slippage Specimen

Common widths are 75mm and 100mm. Refer to the specific method for size and position of the seam as this differs according to Standard. The grab Jaws are used for seam slippage.

Terminology

The specimen pictured above is known as "Warp over Weft". That is, when the warp yarns slip over the weft yarns which are under tension. In this case the seam would be sewn along the warp direction. The opposite direction would be "Weft over Warp".

A simple way to remember this is that the *seam is warp ways over the weft yarns* (and vice versa).

If a combined seam slippage and tensile test was performed on the unseamed specimen it would be in the Weft direction, check this on the results page. This can be confusing, however, it is the terminology which has been adopted as the industry norm.

Seam Slippage Test Methods

The following is a summary of the important steps in each of the three (3) methods when using Titan Software. It shows what you should expect to see on screen when you carry out your tests. However, be aware that there are many Standards for Seam Slippage and these are a small selection.

Figure 5: Fixed Seam Opening

Figure 6: Fixed Load

Figure 7: Needle Clamp

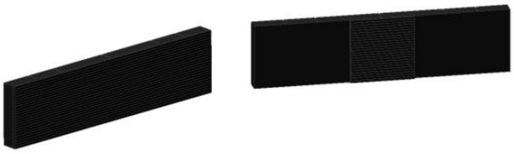


Figure 8: Grab Jaw faces

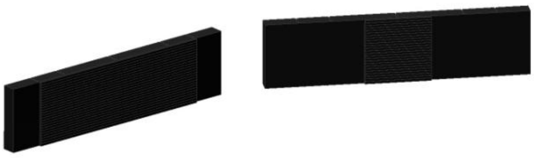
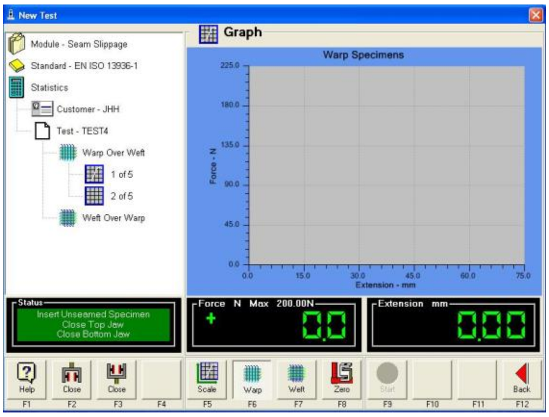


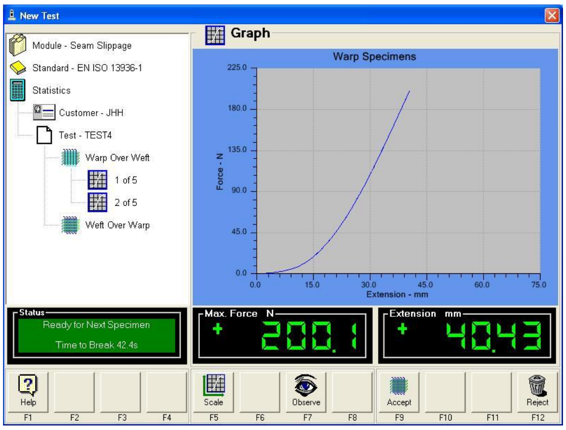
Figure 9: Grab Jaw Faces (Alternative)

Seam Slippage - Fixed Seam Opening Method

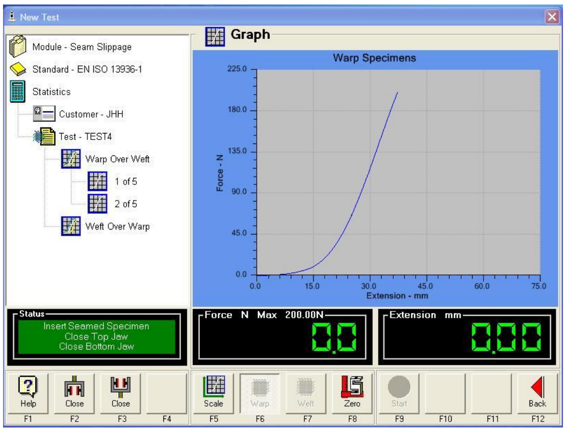
This method is widely used for testing seams in Apparel fabrics and has been adopted as the basis of many Test Methods published by Retailers.



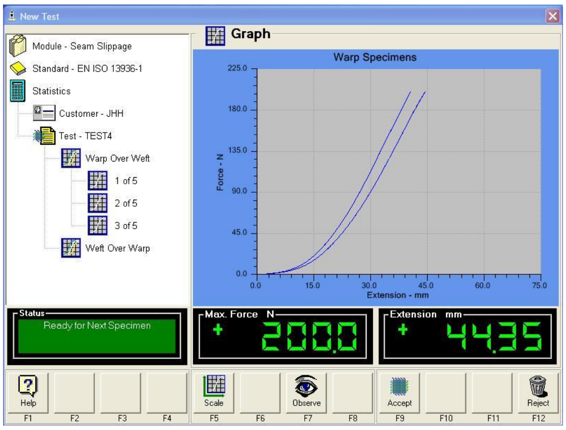
Insert the unseamed specimen in the T7 Jaws fitted with Grab Faces.



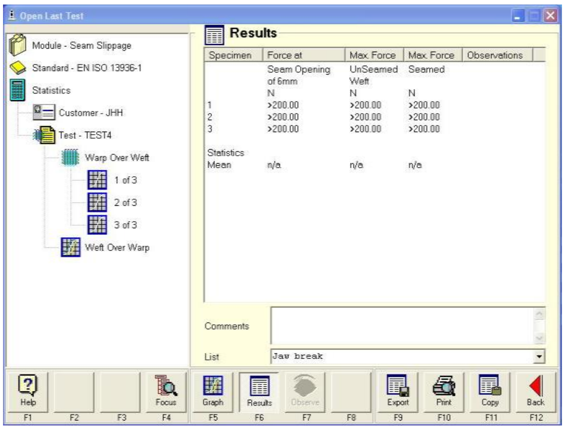
Pull the specimen to the defined load, in this case 200N.



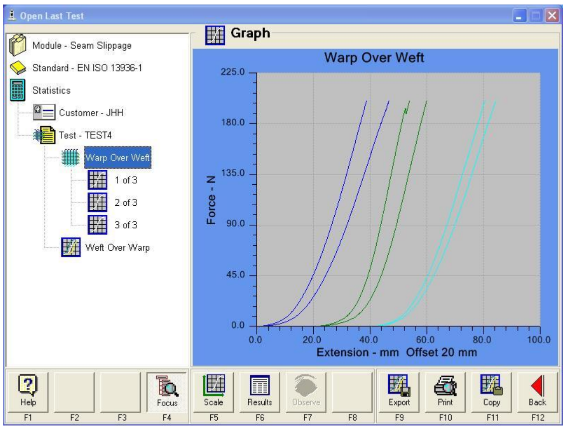
Insert the seamed specimen



Again pull to the defined load.
Notice the two (2) curves are overlaid.



Results. In this case the force required to produce a seam-opening of 6mm is >200N.
Notice the unseamed specimen results are referred to as just "weft".



Graphs on screen, displayed with offset.

The unseamed specimen is pulled to a pre-set maximum load or to destruction. Testing to destruction becomes a combined Tensile and Seam Slippage test. This has two benefits, the first is economy because it uses the same specimen. The second is that the operator can see the force at failure of both specimens, compare them and obtain the seam efficiency (as in ASTM D1683). See Figure 10, below.

In the initial few Newtons of pulling a seamed specimen there is some extension as the seam becomes taught. The difference in extension between the unseamed and seamed specimen is called Seam Straightening. The extension value at the Seam Straightening load (typically 5N) is recorded as "x". This is similar to pretension.

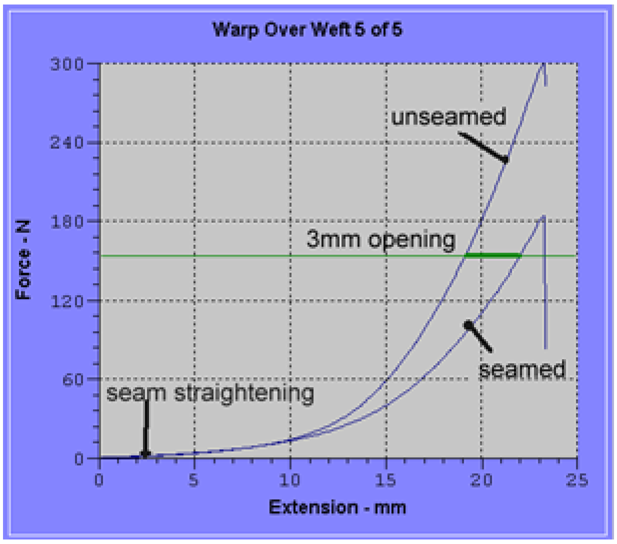


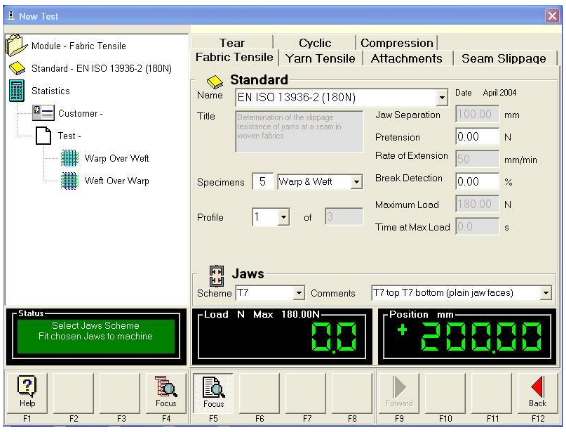
Figure 10: Seam Slippage Graph Explained

Titan Software analyses the unseamed and seamed specimens to find the Seam Opening. If the standard is using a 3mm seam opening then the software will look for a seam opening of 3mm + "x".

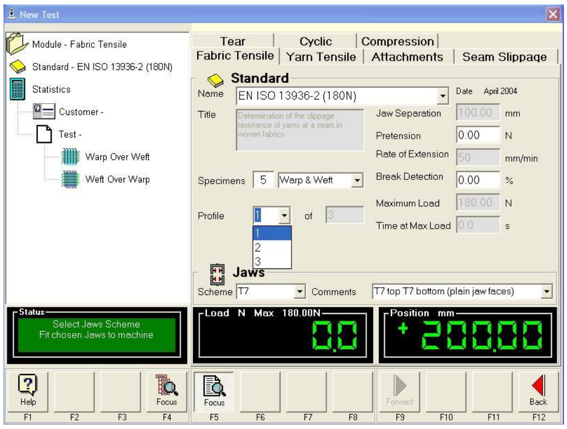
Some Standards give a maximum load that if a Seam Opening could not be found then end the test and state "greater than Max load". Typical maximum loads are 200N and 25kg.

Seam Slippage – Fixed Load Method

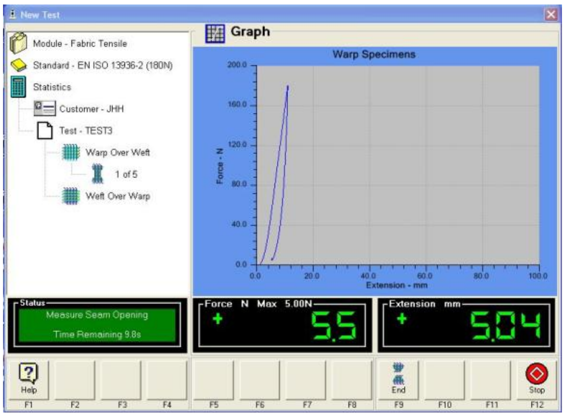
This method is widely used for testing seams in Upholstery fabrics.
The example described below changes the Rate of Extension part way through the test.
This type of test can be found in the Tensile Module.



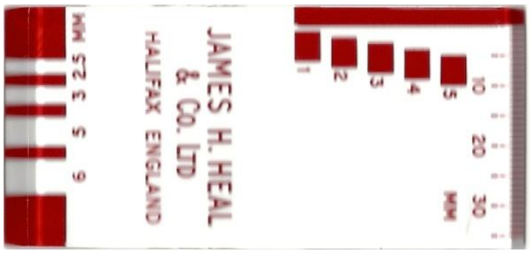
Select the Tensile Module.



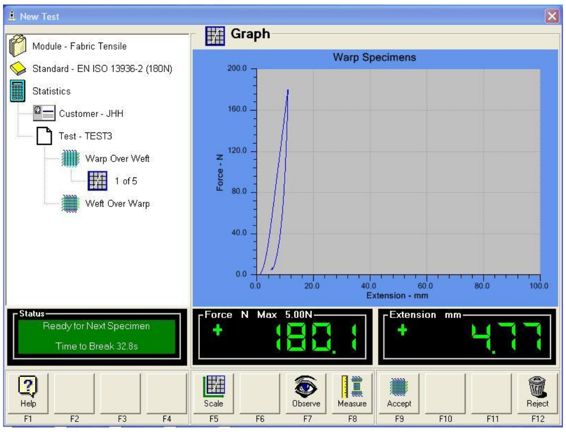
Note the use of a Profiled test to allow the Rate of Extension to be changed.



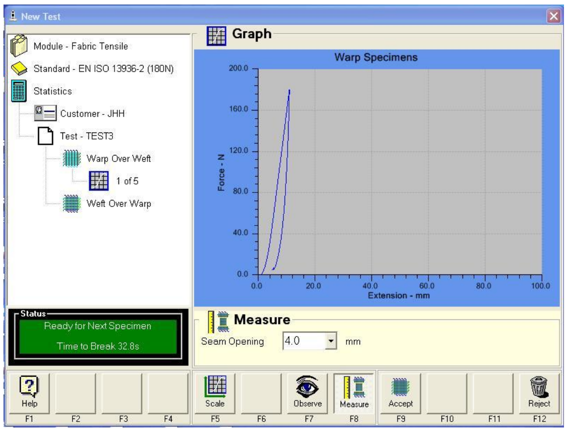
As soon as the maximum load is achieved, the load is reduced to 5N. There is then a timed delay to allow the Operator to manually measure the Seam Opening.



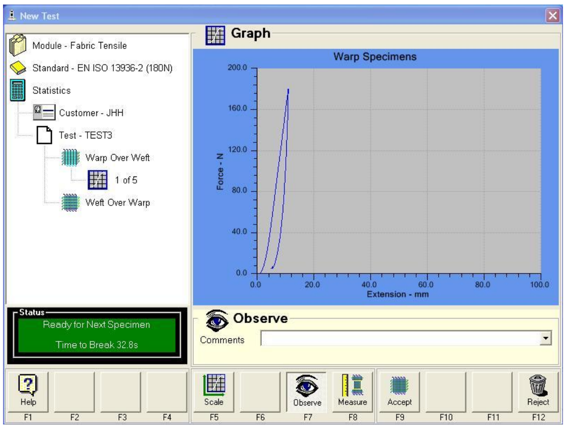
The seam opening can be measured with a Graduated Seam Opening Template (371-928) available from Heals, a calibrated rule or a pair of dividers.



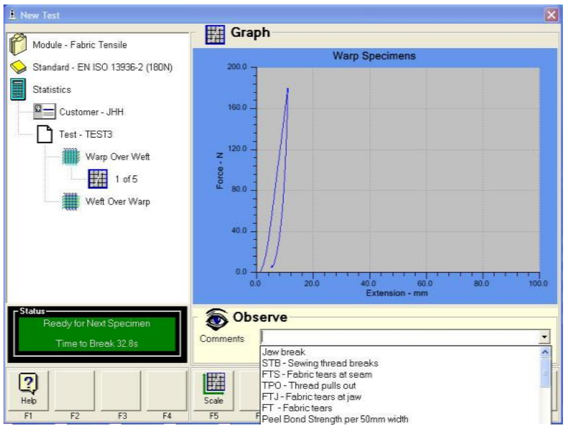
At the end of the timed delay period (typically 15s is allowed for the Operator to complete the measurement) press F8-Measure.



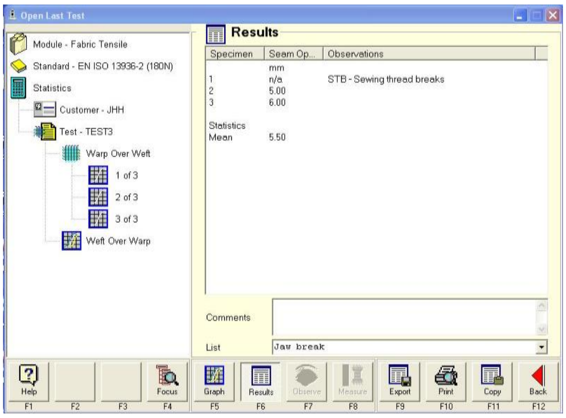
Enter the measured seam opening and then press F9-Accept.



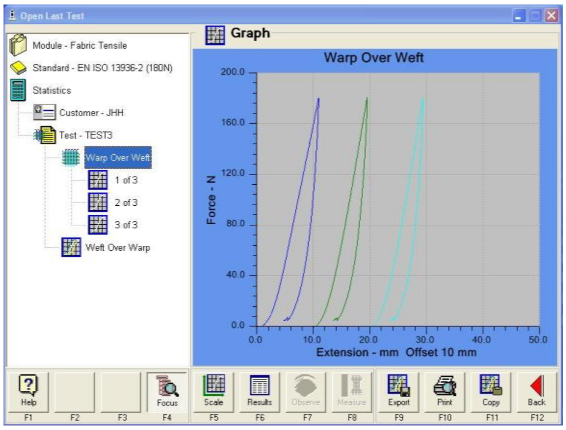
If the Operator has any Observations to record press F7-Observe.



Enter a pre-defined Observation from the drop-down list or type text.



Results. As specimen 1 was STB, the seam opening result would not normally be entered. The average seam opening value is calculated using the remaining valid specimens.



Graphs displayed on screen with offset.

Seam Slippage – Needle Clamp Method

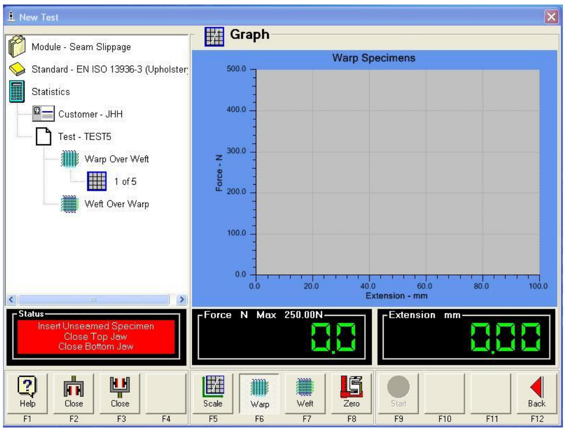
Even though this is the most recent addition to the ISO 13936 series, the concept has been around for over five decades. Specimens for this method are prepared in a similar manner to that of the strip tensile test, i.e., a revelled strip. See Figure 7: Needle Clamp.

Ensure the correct Needle Clamp has been selected:

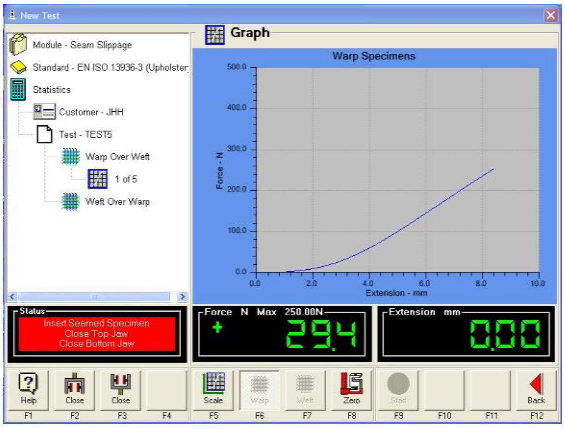
T8	Needle Clamp for Apparel fabrics
T9	Needle Clamp for Upholstery fabrics

This is important as the diameter of the needles and number of needles are very different.

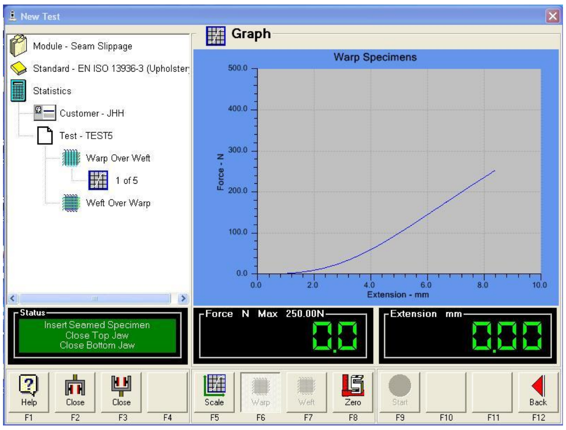
T8 and T9 Needle Clamps are use in conjunction with T7 Pneumatic Fabric Jaws.
The "unseamed" specimen is tested with T7 Jaws. The "seamed" specimen is tested with T7 at the top and T8 or T9 at the bottom. During this change-over the bottom T7 must remain connected to the compressed air supply. After each change-over the load value must be tared back to zero using F8-Zero.



T7 Jaw at top.
T7 Jaw at bottom.
Press F8-Zero to tare the load to zero.
Test the "unseamed" specimen.

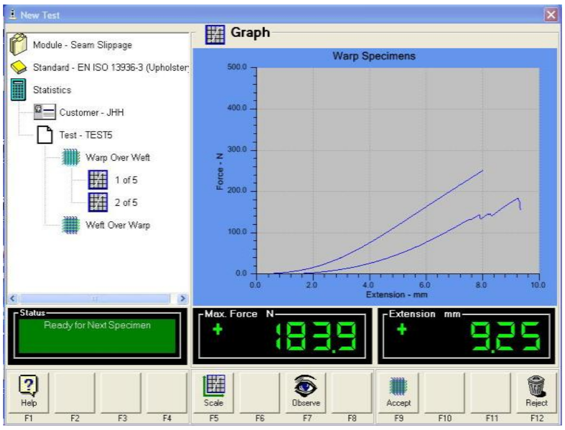


T7 Jaw at top.
T8 or T9 at bottom.
Notice the load now reads a large value after removal of the bottom T7 Jaw.



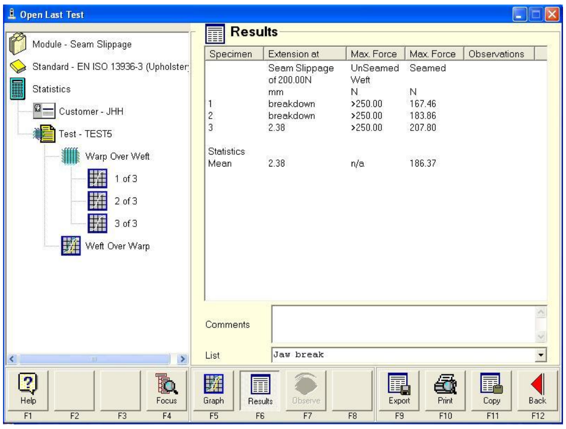
Press F8-Zero to tare the load to zero.
Failure to do this will result in incorrect or misleading results.

To load the "seamed" specimen turn the length of fabric around and mount in the Needle Clamp ensuring the narrow edge of the specimen butts against the stop.

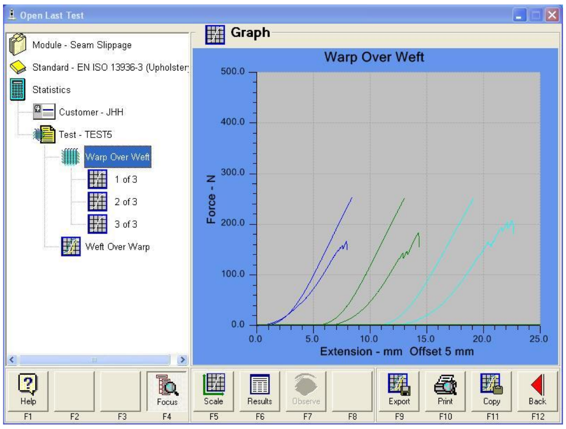


The two (2) load-extension curves are overlaid on screen.
Press F9-Accept.

Test any remaining specimens.



Results.



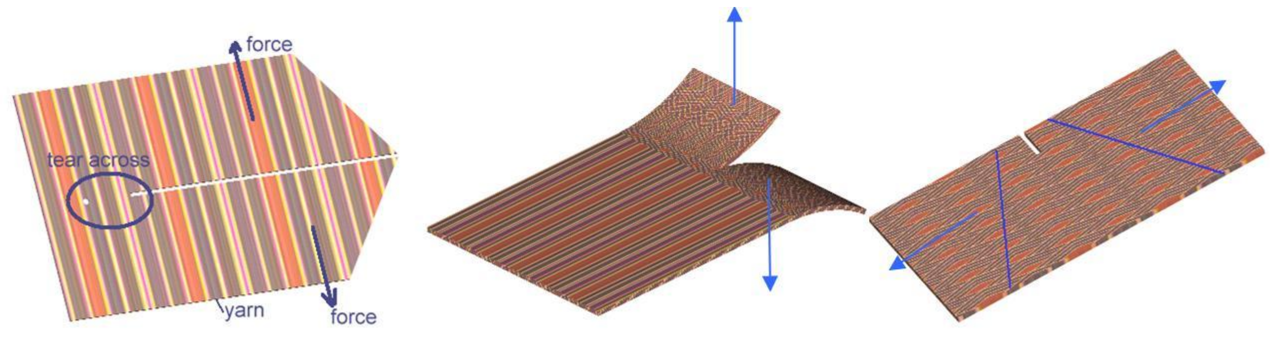
Graphs on screen offset for ease of viewing.

Tear Strength

Tear Strength is the force required to propagate an existing tear (not the force required to initiate a tear).

During a Tear Strength test the fabric is torn along a particular direction. As the fabric is torn each yarn breaks in turn. The peaks on the graph are the individual yarn breaks in the specimen.

There are many different types of tear specimen. Below are three popular shapes. The terminology relating to the names/shapes/ of the specimens varies by Standard Authority so care is required when comparing, e.g., a Tongue Tear in an ISO method is different to that in an ASTM method.



Wing-rip (single rip) Trouser tear (single rip) Trapezoidal tear (single rip)

Figure 11: Examples of tear strength specimens

The full width of the specimen is gripped in the T7 Jaws. With Titan we usually select full rubber faces for all tear strength tests. Two sizes are currently available: 125mm x 25mm and 200mm x 35mm. The larger size is typically only required for the double-rip tongue tear test such as ISO 13937-4.

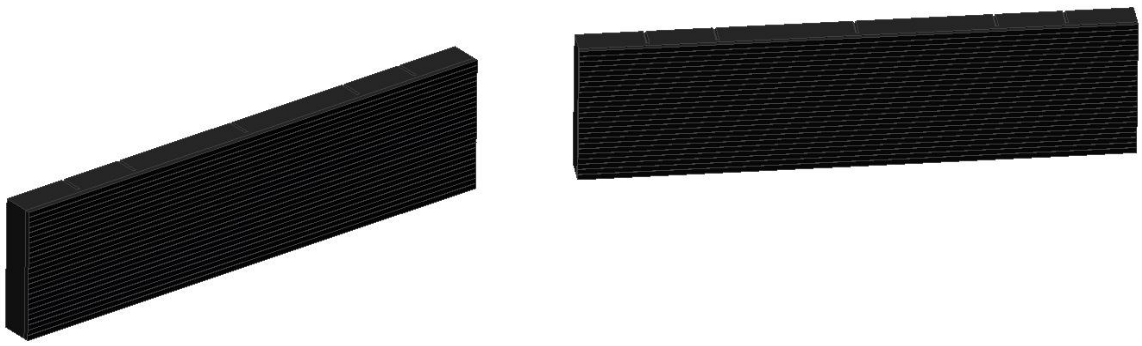


Figure 12: Full Rubber Faces (125mm x 25mm)

Similar to tear testing is Peel Bond. This test is also known as Delamination or Adhesion test where two (2) or more laminated surfaces are peeled apart. As the adhesion breaks it gives the same shape graph as tear testing, with peaks and troughs. Standards for these types of test can also be found in the S2 Tear Software Module.

Calculations of Tear Strength

This is complicated by the many different methods of finding the start and end point of peak analysis, these can be:

- Ignore up to and including the first peak. Analyse the remaining peaks. For example, BS 4303.
- Ignore up to and including the first peak. Ignore a further distance. Analyse the remaining peaks.
- Ignore up to and including the first peak. Ignore a further % distance of the overall distance. Analyse the remaining peaks.
- Ignore up to and including the first peak. Analyse the peaks in a further distance.
  For example, ISO 9073-3, ASTM D2261.
- Ignore up to and including the first peak.
  Analyse the peaks up to a % distance of the initial jaw separation.
- Ignore an initial distance. Analyse the remaining peaks.
  For example BS 3424 Part 5 Method 7A &7B.
- Ignore an initial distance. Analyse the peaks in a further distance.
  For example, BS 2782 Part 3 Method 360 B
- Ignore an initial % distance of the overall distance. Analyse the remaining peaks.
- Ignore an initial % distance of the overall distance. Analyse the peaks in a further % distance.

Once the peaks have been found there are different methods of obtaining the final result, these are:

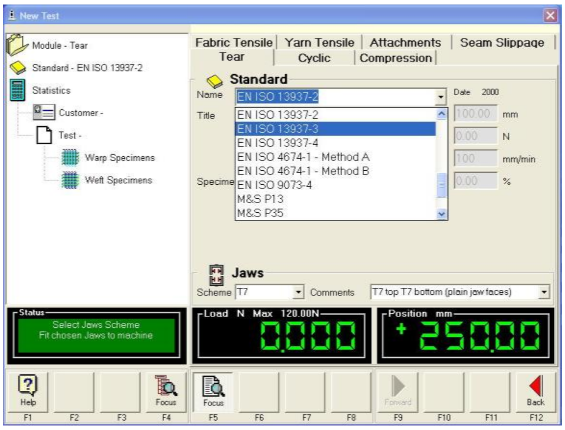
- Use all peaks
- Use n highest peaks (e.g. ten highest)
- Use nth highest and nth lowest peaks (e.g. fifth highest and fifth lowest)
- Use n highest % (e.g. top 20%)

Figure 13: Wing-rip tear test

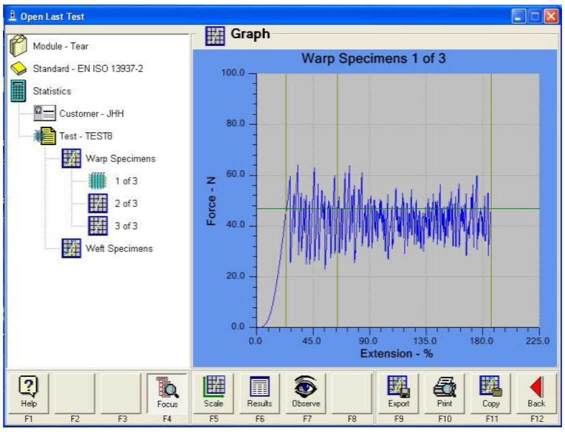
Figure 14: Trouser tear test

Figure 15: Peel Bond test

This example shows Titan screens as it progresses through the ISO 13937-2 trouser tear test.



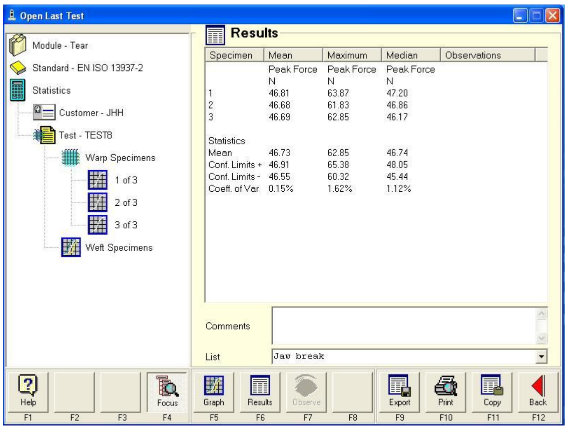
Select the Tear Module and required Standard from the Standard List.



As the test progresses, a series of peaks and troughs are displayed on screen.

Notice vertical lines indicating the areas of analysis. The horizontal line through the peaks is the mean of the peak forces.

It is not recommended to display more than one tear test at a time in graphical form. The large number of peaks and troughs become difficult to discern from each other.



Results are analysed and displayed are per the requirements of the selected Standard.

Yarn Strength

The tensile strength of yarn can be determined using Titan.

Yarn Strength – Single Strand Method

As in Fabric Strength testing, the rate of Extension can be fixed (e.g., always 500mm/min) or variable to achieve a specified Time to Break (e.g., 20 ± 3s). In addition, Standards often give a choice of Gauge Length (e.g., 500mm or 250mm). Before each test a pretension (typically 0.5cN/tex) is applied to the yarn in order to give a reproducible extension value. Yarn Strength results are usually expressed relative to their Linear Density, e.g., cN/tex. This is often referred to as Tenacity. If the Linear Density is not known the test can still be carried out but the results will be in absolute force, e.g., cN. However, should the Linear Density become known later, the value can be entered and the Tenacity calculated.

Cautionary Note:
Results from yarn strength tests carried out on Universal Strength Testers such as Titan and others, are not directly comparable with results obtained from high-speed testers such as the Uster® TENSORAPID range. Such high-speed testers can have a Rate of Extension of up to 5000mm/min. This tends to produce higher strength results when compared to the slower Universal Strength Testers. The very detailed statistical analysis provided by high-speed testers is not available Universal Strength Testers.

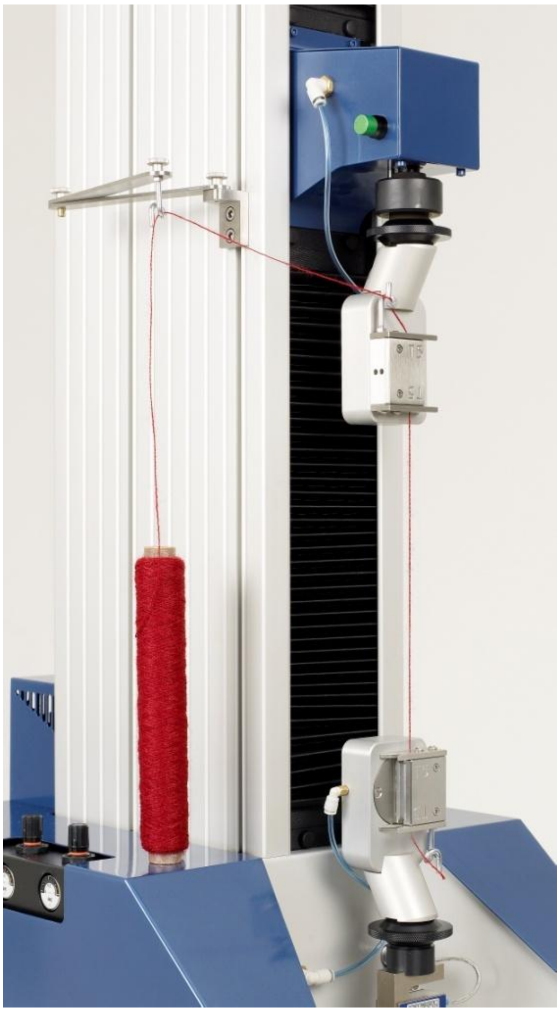
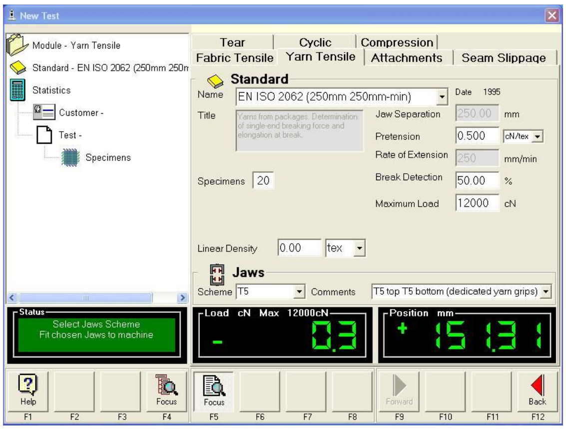


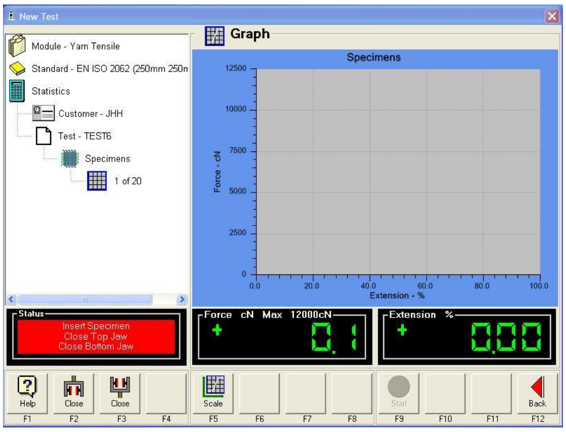
Figure 16: T5 Pneumatic Yarn Jaws in Use with Yarn Guide

Figure 17: Removing T5 Jaw Faces

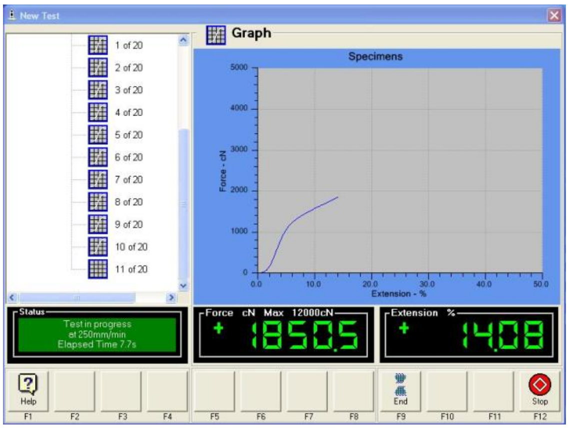
Here is an example of a Single Strand Yarn Strength test <u>without</u> using Linear Density.



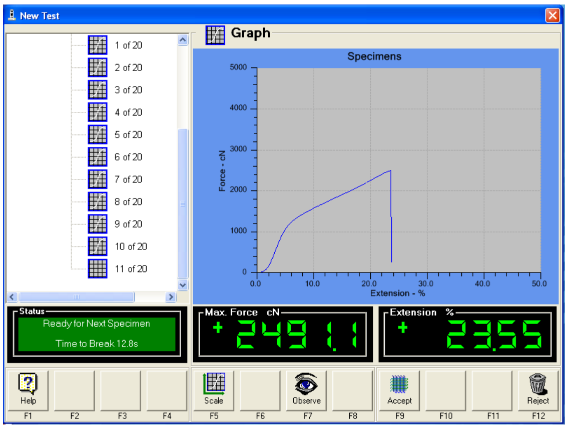
Select the Yarn Tensile Module and the required Standard from the Standard List.
Notice that no value is entered in the Linear Density field.



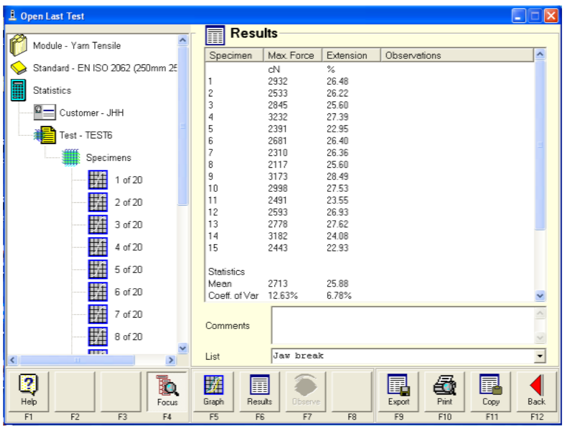
Thread the yarn from the package through the Yarn Guide on the side of Titan and on to the top T5 Jaw, through the pig-tail and into the T5 Jaws. Pull the yarn down to the bottom T5 Jaw and through the lower pig-tail guide. Avoid excessive tension in the yarn. Close the T5 Jaws using the Footswitch.



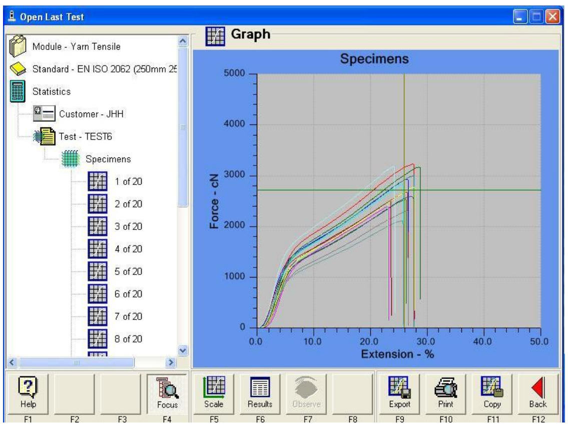
Test in progress before breakage.



Test after breakage.
Press F9-Accept to save the results.
If there was a problem with the test press F12-Reject and the results will be discarded (deleted).

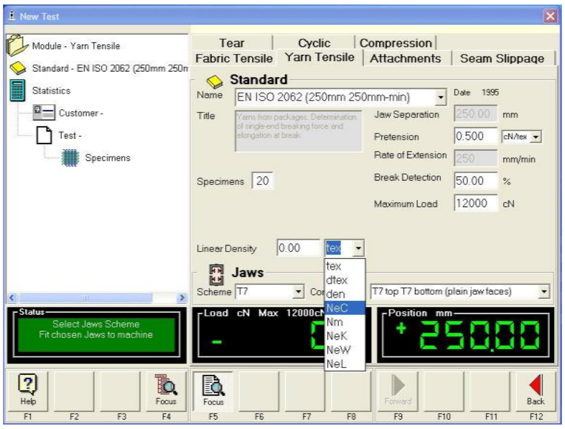


Results on screen.
Some of the results have been Excluded to show the Statistics.

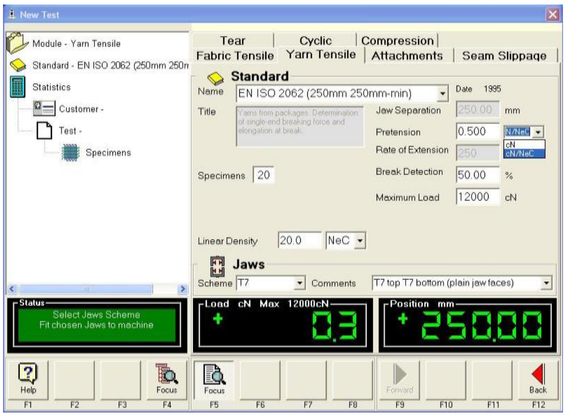


Graphs on screen.
Note the variation in test results.

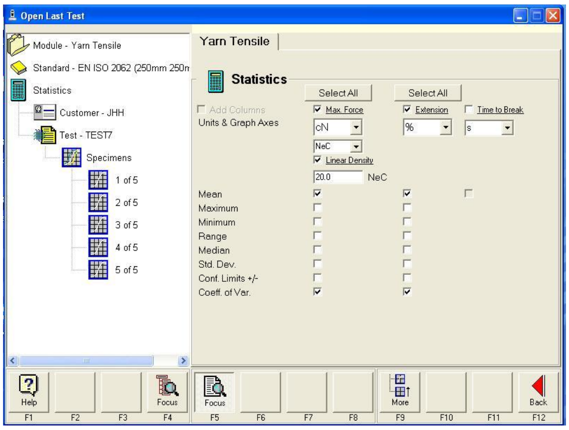
Here is a example of a Single Strand Yarn Strength test using Linear Density, expressing the yarn strength as Tenacity.



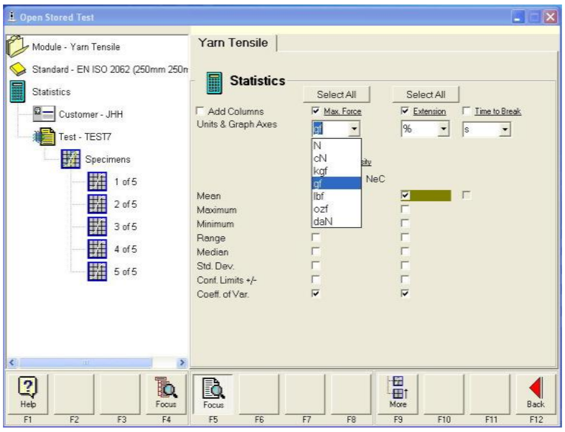
Select the required unit of Linear Density from the drop-down list. This example shows English Cotton Count being selected. Enter the Linear Density value.



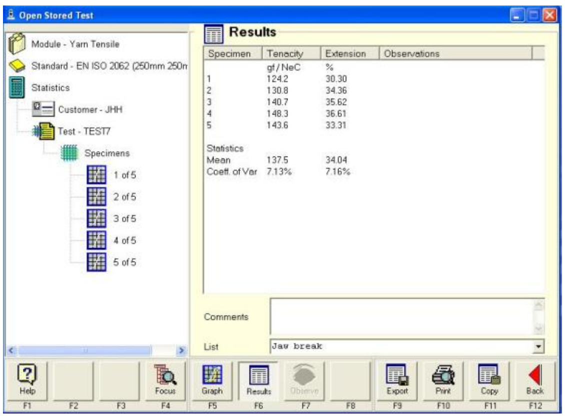
Choose how Pretension will be applied, i.e., as absolute force or relative to yarn linear density. We are selecting cN/NeC in this example so that pretension is relative to linear density.



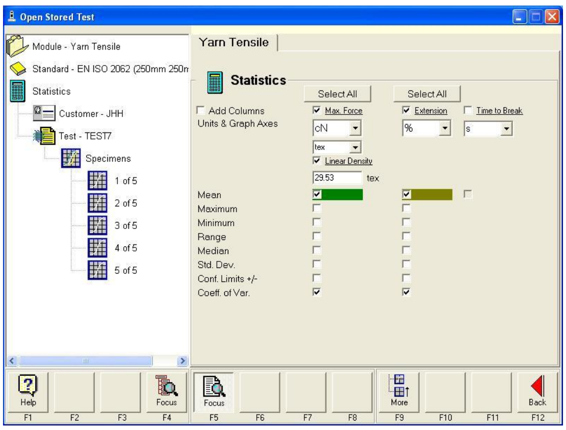
Carrying out the tests as previously described. Open the test and click on Statistics in the Titan Explorer.



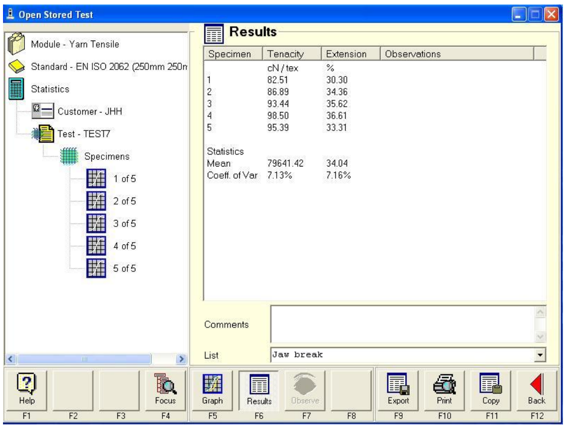
It is more common to express results for cotton yarn in gf/NeC. If required, change the Force units as shown above.



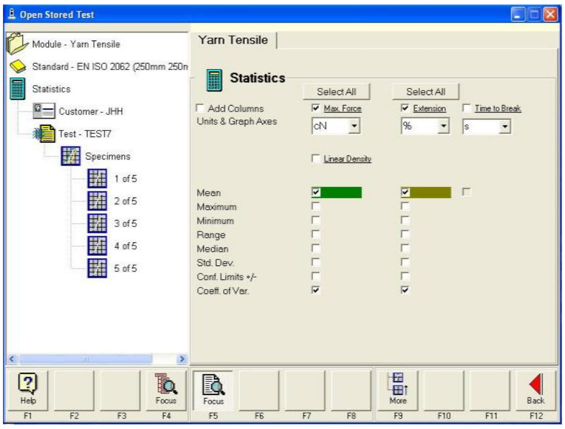
In Titan Explorer, click on Specimens, then F6-Results. Tenacity results are now displayed in gf/NeC.



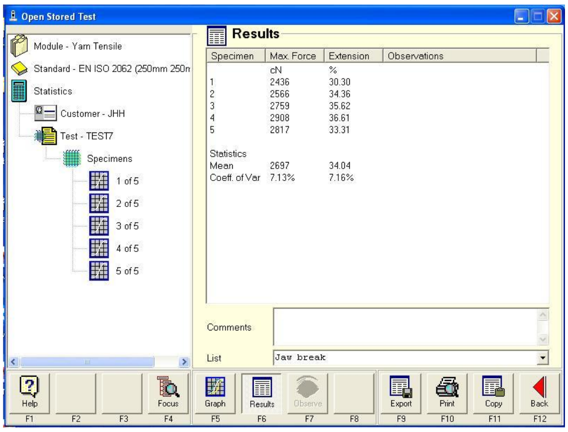
This example shows Force changed to cN and Linear Density changed to tex.



Tenacity results in cN/tex.



To view the absolute force results:
Click on Statistics and uncheck the Linear Density checkbox then press F6-Results.



Yarn strength results in absolute force (cN).

Unit	**Description**	**Comments**
tex	Tex	g/km
dtex	Decitex	g/10km
den	Denier	g/9km
NeC	English Cotton Count (also Spun Silk)	Number of 840 yd hanks/lb
Nm	Metric Number (Metric Count)	km/kg
NeK	Worsted Count	Number of 560 yd hanks/lb
NeW	Woollen Run	Number of 1600 yd hanks/lb
NeL	Linen (Lea) Count (also Woollen Cut)	Number of 300 yd hanks/lb

Table 1: Units of Linear Density Available

Notes:
1 yard (yd) = 0.9144m
1 pound (lb) = 0.4536kg
1km = 1000m

Cyclic Testing – Stretch & Recovery

Cyclic is a general term that refers to a specimen being repeatedly loaded and unloaded. This type of test does not rupture or cause the specimen to fail. The maximum load cycled up to are in the region of 10N to 100 N (1kg to 10kg) and is considered quite low. Typical extension is 100%. There are two main types of specimen, looped and strip.

Loop Bars (standard and wide)

Looped, used with a pair of T3 Loop Bars shown. This specimen is usually 75mm wide and is made to have a circumference of 200mm or 250mm. A wide version of Loop Bars, T3A, are available for specimens up to 125mm wide. T11 C-Clamps are an alternative to Loop Bars.

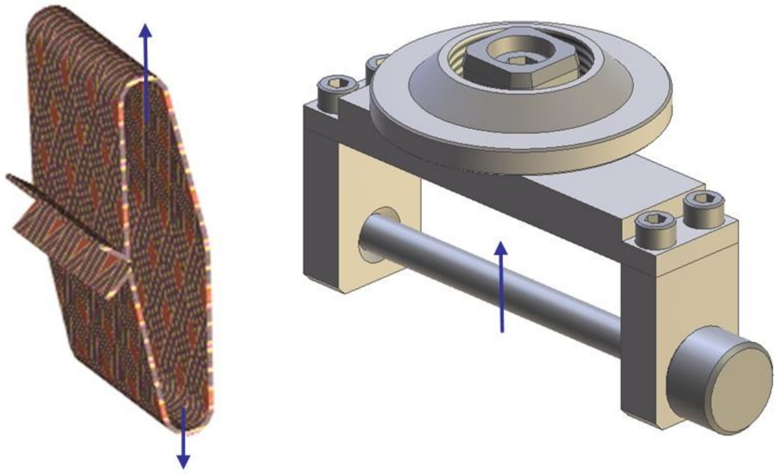


Figure 18: T3 Narrow Loop Bars and Specimen

Line Contact

Line contact jaws are used extensively in Marks & Spencer's Standards.
ISO 14707-1 Method A is also performed with these jaws.

Figure 19: Line Contact Jaw Faces and Specimen

Tooling Setup for Cyclic Testing

Figure 20: T3 Narrow Loop Bar with Specimen

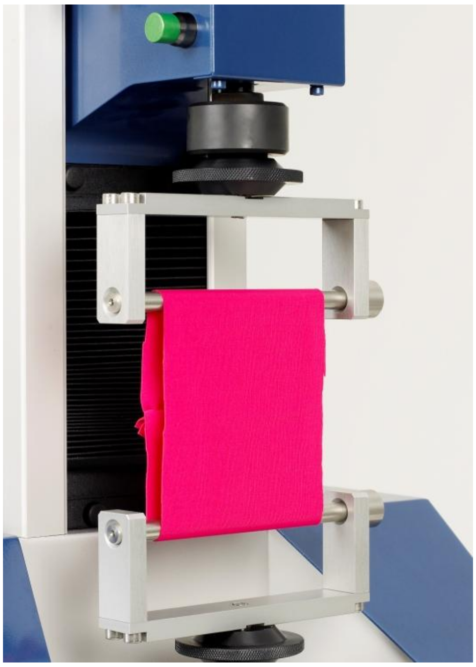


Figure 21: T3A Wide Loop Bars with Specimen

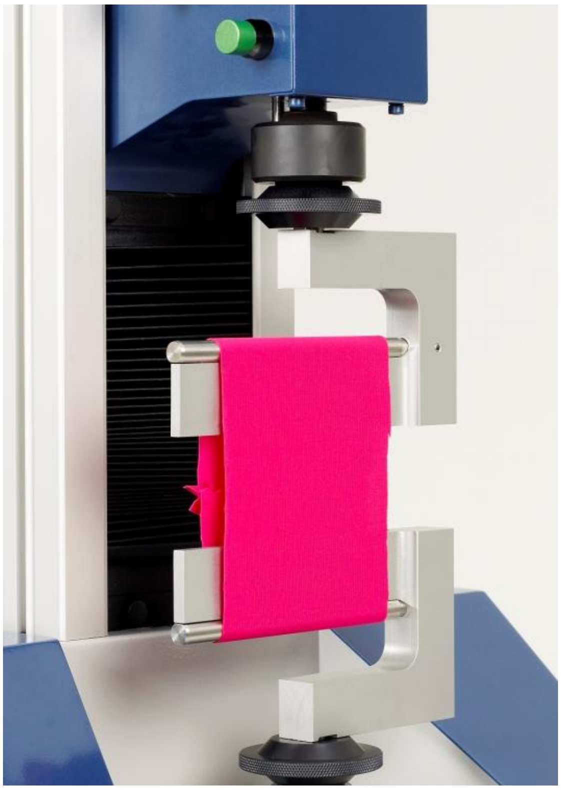
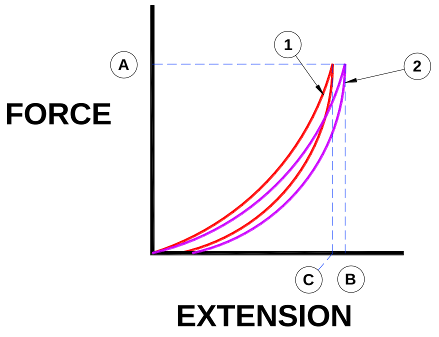


Figure 22: T11 C-Clamps with Specimen

Figure 23: T7 Line Contact Jaw Faces with Specimen and Gauge Marks

Cycle Analysis

Extension at Force

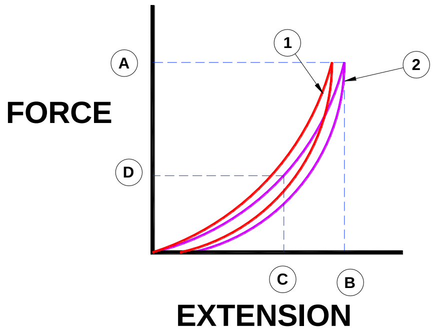


Select the appropriate force to cycle up to.
This is agreed between the operator and customer.

The force is marked **A** on the graph.
Cycle twice (for example) to this force.

The extension **B** and **C** is recorded from each cycle at the force **A**.

Determination of Modulus

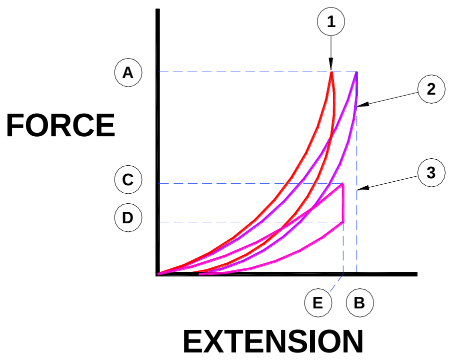


Select the appropriate force to cycle up to.
This is agreed between the operator and customer.

The force is marked **A** on the graph.
Cycle twice (for example) to this force.

At elongation intervals on the second cycle (as agreed, for example) find the corresponding forces **D** from either extension or retraction.

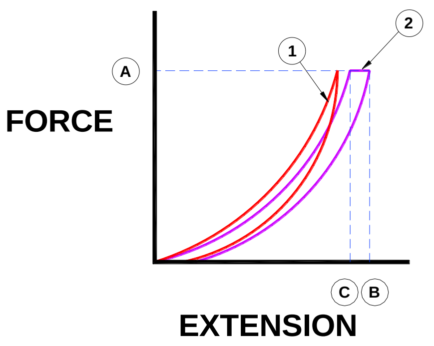
Determination of Tension Decay



Select the appropriate force to cycle up to.
The standard states 5N/cm or 10N/cm or as agreed between the operator and customer.

The force is marked **A** on the graph.
Cycle twice (for example) to this force **A** and return to the jaw separation.
Cycle to an agreed extension **E**, maintain this position for 5 minutes (for example) and return to the jaw separation.

Determination of Residual Extension

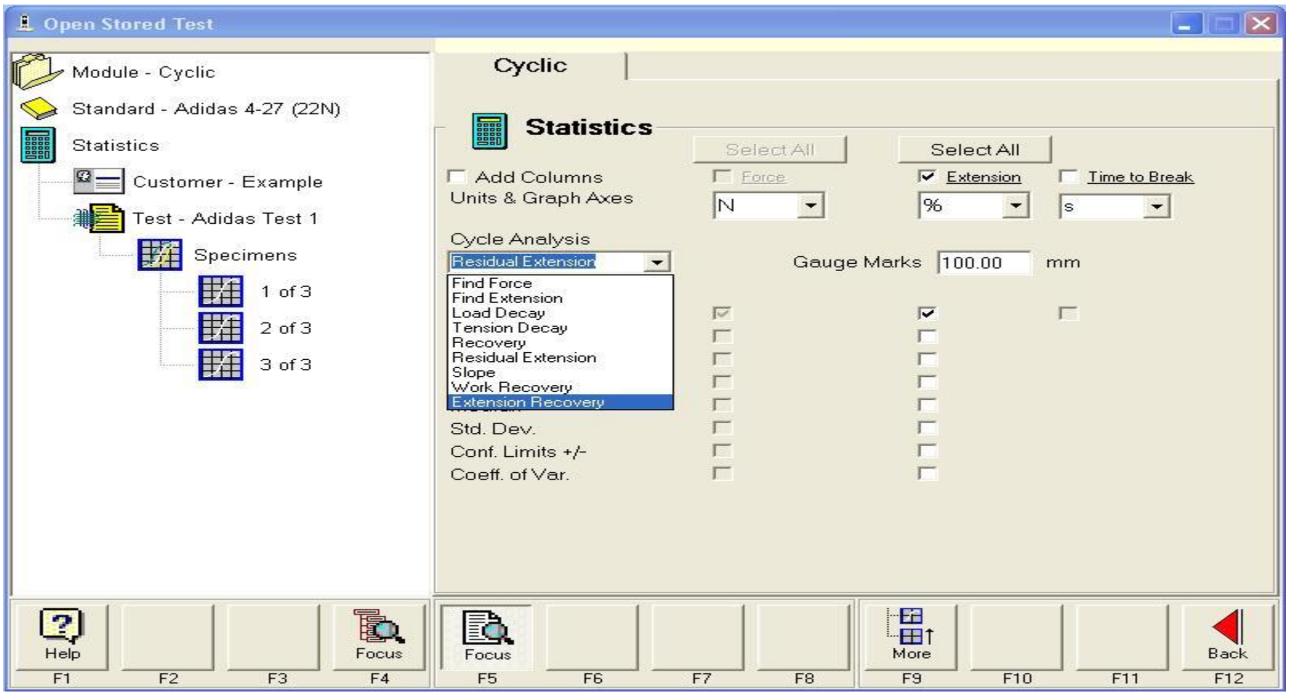


Physically mark two gauge points 100mm apart even though the jaw separation is 200mm.

Select the appropriate force to cycle up to. This is agreed between the operator and customer. The force is marked **A** on the graph.

On the second cycle at **A**, maintain the load, wait 10 seconds and return to the jaw separation.
Immediately remove from the machine, lay on a flat surface and after 1 minute measure the distance between the two marked gauge points, alternatively wait 30 minutes and measure the distance.

Cycle Analysis calculations can be accessed via the Statistics option.
The details displayed on the Statistics screen will vary dependent on which calculation has been selected.



Find Extension:
Enter two forces to find specific extensions.

Load Decay:
Difference in force between two force readings at the same extension on two different cycles

Tension Decay:
Difference in force between the start and end of extension-hold (e.g., what is the difference in force before and after 1 minute at a fixed elongation). Tension decay is the same as Stress Decay.
%Stress Decay = Load loss / Initial load x 100

Recovery:
Difference between the maximum extension and the extension at the first positive force reading (the slack is removed).

Residual Extension:
Difference between the initial length and the final length after cycling. (e.g., cycle twice, remove from machine, wait 1 minute, measure new length).
%Residual Extension = (Measured distance – Gauge Marks) / Gauge Marks x 100

Slope:
Ratio of one point on a cycle to another (e.g., load at 80% elongation on load curve divided by load at 30% elongation on unload curve).

Work Recovery:
%Work Recovery = Area under unload curve / Area under load curve x 100

Extension Recovery:
The immediate change in elongation displayed by a textile during a load cycle when, after being held at a defined elongation for a defined time, the applied tension is removed. Also known as Elastic Recovery.
%Extension Recovery = (Measured distance – Recovery Length) / (Measured distance – Gauge Marks) x 100

Performing a Stretch & Recovery Test using the Cyclic Software

Begin by selecting the correct tooling for the chosen Standard, if in doubt, consult the relevant standard or Retailer's Test Method. Essentially the choice is from Narrow Loop Bars, Wide Loop Bars, C-Clamps or Line Contact Faces. In some rare cases, standard flat jaw faces are used.

The most recent international standard is EN 14704 which is published in three (3) parts. This standard has replaced the long established BS 4952: 1992 which is now withdrawn.

EN 14704-1 Determination of the elasticity of fabrics. Strip tests
EN 14704-2 Determination of the elasticity of fabrics. Multiaxial tests
EN 14704-3 Determination of the elasticity of fabrics. Narrow fabrics

Part 1 is the most widely used.
Part 2 requires special Compression tooling.

EN 14704-1 describes two (2) methods:

Method A – which uses Line Contact faces for testing flat strip specimens
Method B – which utilises Loop Bars or C-Clamps for testing specimens sewn into a loop

The fabric from which the specimens are prepared is first conditioned for 20h, followed by a further 4h after preparation. The conditioning atmosphere is specified in ISO 139.

In Titan software, the options described in EN 14704-1 are made possible by selecting from the following standards:

Standard Name	Description
EN 14704-1 (K-A-X%)	Knitted fabric, method A, pull to extension
EN 14704-1 (K-A-XN)	Knitted fabric, method A, pull to load
EN 14704-1 (K-A-XN+FD)	Knitted fabric, method A, pull to load including Force Decay
EN 14704-1 (K-B-X%)	Knitted fabric, method B, pull to extension
EN 14704-1 (K-B-XN)	Knitted fabric, method B, pull to load
EN 14704-1 (K-B-XN+FD)	Knitted fabric, method B, pull to load including Force Decay
EN 14704-1 (W-A-30N)	Woven fabric, method A, pull to fixed load of 30N
EN 14704-1 (W-A-30N+FD)	Woven fabric, method A, pull to fixed load of 30N including Force Decay
EN 14704-1 (W-B-90N)	Woven fabric, method B, pull to fixed load of 90N
EN 14704-1 (W-B-90N+FD)	Woven fabric, method B, pull to fixed load of 90N including Force Decay

Illustrations of various tooling setups and specimens are shown on page 37.

Attachments

The T12 Attachments Kit is used for the assessment of security of components on garments and toys. Examples of the application of the T12 Attachments Kit are:

- Appliqué on garments
- Rivets
- Diamante
- Snap fasteners (aka: snap, popper, press stud)
- Toy Eyes
- General rigid attachments

EN 71-1 Safety of toys – Part 1: Mechanical and physical properties.
This standard applies to toys for children. Toys being any product or material designed or clearly intended for use in play by children of less than 14 years of age.

Within EN 71-1, the test methods applicable to Titan are the Tension Tests. The Tension Tests employ a tensile testing instrument with a means of applying forces up to 90N.

Test methods other than EN 71-1 may use forces greater than 90N.

After establishing that a component is grippable, a suitable clamp is affixed behind the component and a force applied and maintained for 10 seconds. The component is examined to determine if the component has become detached from the toy or garment.

Jaw faces (19mm diameter washer faces) for "Seam and materials" are not currently available for Titan.

The attachments offered in the EN 71 Attachments Kit are suitable for testing a large range of products. However, we cannot guarantee that every product can be accommodated.

Fitting the attachments

Many of the tests using Attachments may result in debris being ejected from the specimen at failure.

As a precaution, impact resistant safety glasses or goggles should be worn during testing.

The choice of attachment is dependent upon the component to be tested.
The T12 Attachments Kit contains the following fixtures:

- Pneumatic Lower Clamp
- Universal Hook Attachment
- Diamante Gripper
- Popper/Eyelet/Rivet Gripper
- Motif Lever Grip

The Pneumatic Lower Clamp is used for gripping a section of fabric with a prong-ring rivet or popper attached. The Pneumatic Lower Clamp is powered by compressed air and has two clamping faces; one fixed and one moving. Two removable clamping faces are supplied to accommodate a rivet or popper up to 13mm in diameter. Other sizes are available on request.

For operator safety the integrated pneumatic module operates the jaws at very low pressure during the loading of the specimen. Full clamping pressure is only applied when the test starts.

The testing pressure can be set to a maximum of 7 bar. 7 bar means that the lower clamp applies 220N gripping force onto the specimen to reduce the chance of slippage. Reduce the testing pressure to avoid damage to delicate fabric.

Refer to Figure 24 to Figure 27 for illustrations of the tolling setup.

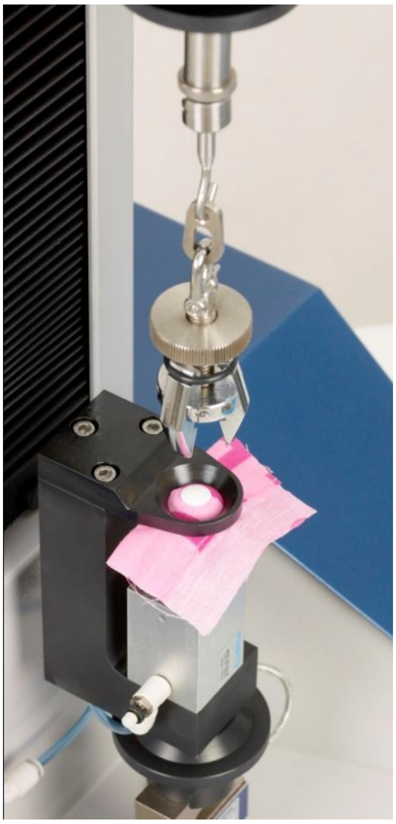


Figure 24: Pneumatic Lower Grip

Figure 25: Rivet Gripper

Notice how the Universal Hook is used to connect the different Attachments.

The Pneumatic Lower Clamp is connected to the Load Cell.

Figure 26: Diamante Gripper

Figure 27: Motif Lever Grip

The Jaw Separation of each of the Attachments is different.

This is accommodated in the software using the Variable Jaw Separation Feature described on Page 44.

Note: if the standard specifically defines the Jaw Separation then the variable jaw separation feature is not available.

Pile Loop Extraction

Figure 28: Pile Loop Extraction

The T13 Pile Loop Extraction Kit is used in conjunction with T7 Pneumatic Jaws. One T7 is used as the bottom jaw to grip the folded terry towel specimen.

The special small hook is carefully placed through a loop in the pile.

In the standard EN 15598, illustrated in Figure 28, the loop is withdrawn at 100mm/min.

An alternative test method to EN 15598 is the much older Swiss Standard, SIS 65 00 68.

Button Strength

There are many test methods describing how to test the strength of buttons.
The following example is based on the tension strength test in BS 4162.
The test establishes the resistance to strain of all types of buttons of 10mm diameter or greater.
The buttons are subjected to a tension in which the load is gradually increased until breakage occurs.

The following Apparatus are required:

- Titan Universal Testing Instrument set giving a constant rate of extension of 6.35 mm/min.
- T4 Button Holder.
- T7 Jaws for lower grips.
- 1.6 mm diameter welding rod.
- As a precaution, impact resistant safety glasses or goggles should be worn during testing.

Some other test methods based on BS 4162 use a textile thread in place of the welding rod.
For example, a braided cord with a minimum breaking strength of 350N or braided polyester cord of at least 25 kgf breaking strength. Other modifications to this method include changing the rate of extension to 100 mm/min. Some methods also specify the initial jaw separation at 50mm.

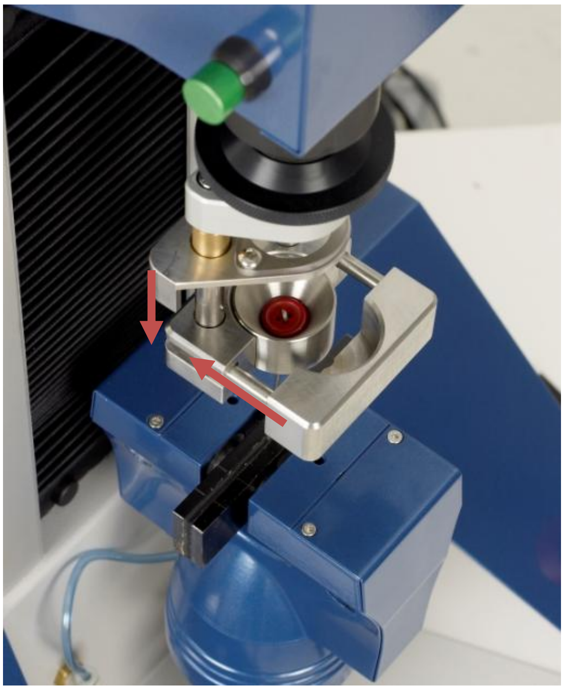


Figure 29: T4 Button Holder

Test a minimum of 10 buttons.

Pass the looped welding rod through two holes diagonally opposite each other or through the hole in the shank of the button.

Assemble the button and rod in T4 Button Holder mounted as the top clamp on Titan.

Apply a gradually increasing load until the button or shank breaks.

Record the breaking load in Newtons.
Repeat the procedure on the remaining test buttons.

Calculate the average and report the minimum and maximum breaking loads.

The minimum and maximum values are normally expected to deviate by up to 25% of the average strength.

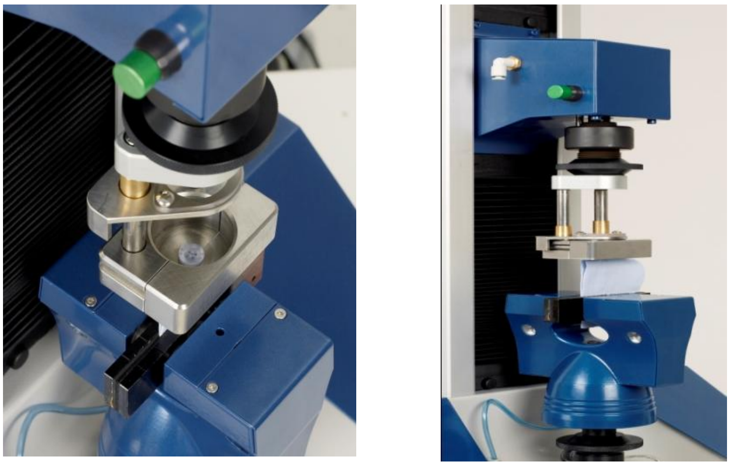
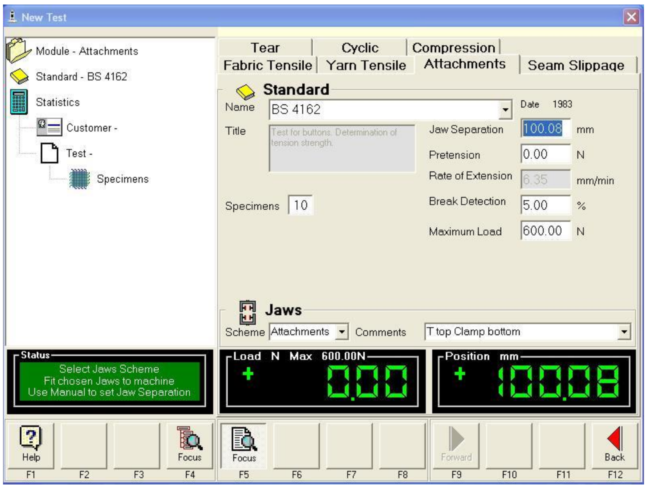


Figure 30: T4 Button Holder and Garments

T4 Button Holder can also be used to test the strength of buttons or the sewing thread used to attach them to garments as illustrated in Figure 30.

Variable Jaw Separation Feature

Many of the test methods employing Attachments requires the Jaw Separation to be variable.
The main reason for this is the variable size of the specimens.



Select New Test.

Select the Attachments tab.

Use the drop down arrow to select the appropriate standard, in this example, BS 4162.

Select the appropriate Jaws Scheme, for example, "Attachments".

Click the mouse inside the Jaw Separation field.

Set the Jaw Separation to *any convenient working distance*. You can do this in two ways:

1. Select the existing Jaw separation value (as shown highlighted in blue above) and overtype with the new value.

2. Use the Up ↑ and Down ↓ arrows on the PC keyboard to manually move to the desired Jaw Separation. The top jaw with move as soon as you press the up or down arrow key.

In either case, the new Jaw Separation value will be used for all subsequent specimens in the test.

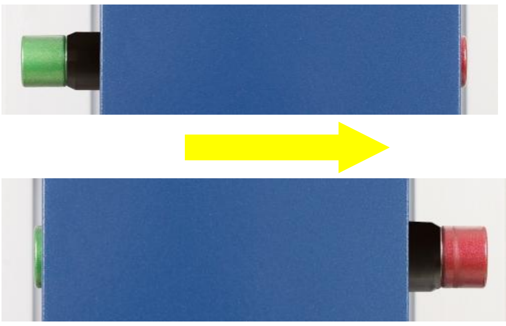
Compression

The Compression feature was added to Titan^3 in 2009.

Compression, as the word suggests is the opposite of Tension. In this mode of operation the direction of traverse is reversed, i.e., the crosshead moves downwards during the test. There are many applications in which compression forces are required to measure the desired properties. For example, Ball Burst, Puncture, Crushing and Flexing. Each of these applications requires its own unique compression fixtures (tooling). Compression testing of materials is an important application in many industries. In Textiles, an important application is Personal Protective Equipment (PPE).

> **Cautionary Note:**
> In Compression Mode, the top limit switch is disabled by moving the shuttle to the right.

Switching from Tension to Compression



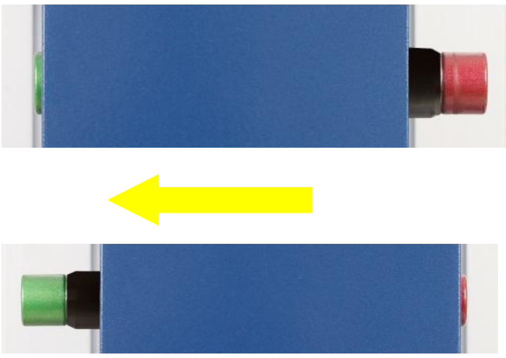
Mechanical setting:

Push the **GREEN** shuttle button to the right so that the **GREEN** button is in the casing and the **RED** shuttle button appears on the right.

Software setting:

When the Compression Module is selected you are prompted with the message to the left.

Switching from Compression to Tension



Mechanical setting:

Push the **RED** shuttle button to the left so that the **RED** button is in the casing and the **GREEN** shuttle button appears on the left.

Software setting:

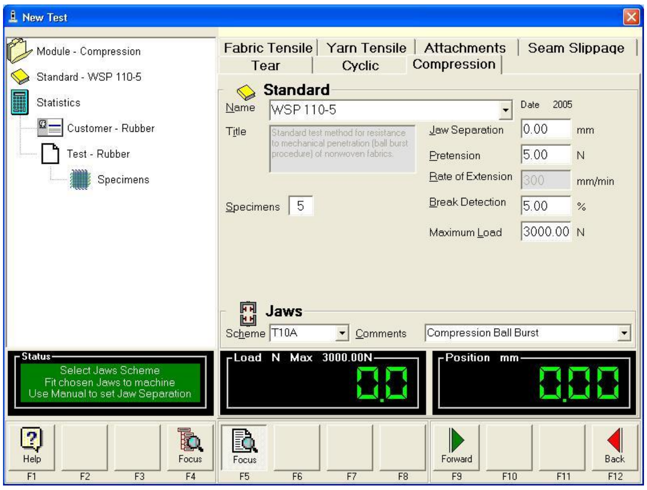
When any of the Tension Modules is selected you are prompted with the message to the left.

Ball Burst

The Ball Burst Strength test is an alternative to the more traditional diaphragm type burst strength test. However, the results between the two distinct methods are not comparable: Ball Burst produces results in force units whereas the diaphragm method produces results in pressure units.

Typically, in the test a 25mm diameter steel ball probe is pushed through the specimen and the force recorded. Hypothetically, there is no limit to the extension (or distension) the specimen can be subjected to as the is in the diaphragm method (bell or dome height).

There are a number of Ball Burst Fixture options – T10A is illustrated below. Ball Burst Strength is applicable to woven, knitted, coated and nonwoven fabrics. T10A can be used for Ball Burst Strength testing according to ASTM D751, D3787, D6797, and WSP 110.5. Fixtures for other standards are available on request.



Mechanically set Compression Mode.
Fit the appropriate tooling, e.g., T10A.
Selection the Compression Tab in the software.
Select the appropriate Standard for Ball Burst.

In this photograph, a sheet of rubber is being tested for improved illustrative effect.

Puncture

An example of this test method is described in section 6.4 of EN 388.

Crushing

An example of this test method is described in section 8.8 of EN 71-1.

Glossary of Terms

Adhesion Test; Delamination Test; Peel Bond Test	Test to measure the force required force per unit width to separate layers of coated or laminated fabrics.
Breaking Force; Tensile Strength at Break	Tensile force indicated at the moment the specimen breaks.
Breaking Strength; Tensile Strength	Maximum tensile force indicated when the specimen is extended to breaking point.
Cloth	Textile fabric.
Compression Test	A compression test determines behaviour of materials under crushing loads. The specimen is compressed and deformation at various loads is recorded. Compressive stress and strain are calculated and plotted as a stress-strain diagram which is used to determine various properties.
Conditioning	A process of allowing textile materials to reach hygroscopic equilibrium with the surrounding atmosphere. Materials are conditioned in a standard atmosphere (65%RH and 20°C) for testing purposes. See also Pre-conditioning.
CRE	Constant Rate of Extension. Machine setting in which the rate of increase in the length of the specimen is uniform with time. The rate of increase of force or elongation is dependent upon the extension characteristics of the specimen.
Cross Direction	The width direction, within the plane of the fabric, that is perpendicular to the direction in which the fabric is being produced by the machine. See also Machine Direction.
Cyclic Stress-Strain	Repeated loading and unloading of a yarn on a tensile testing machine and the determination of the physical properties of the yarn during these cycles.
Cyclic Test	Test in which a sequence of operations is repeated between defined limits.
Deformation	A change in the shape of a specimen, e.g., an increase in length produced as the result of the application of a tensile load or force. Deformation may be immediate or delayed, and the latter may be recoverable or non-recoverable.
Delayed Deformation	Deformation that is time-dependent and is exhibited by material subjected to a continuing load; creep. Delayed deformation may be recoverable following removal of the applied load.
Denier	Mass in grams of 9000 metres of product. See also Tex.
Dynamic Loading Test	Test in which the load is repeatedly applied to a textile fabric for a given number of cycles. See also Cyclic Test.
Elastic Fabric; Stretch Fabric; Power Stretch; Comfort Stretch	Fabric that incorporates rubber or other elastomeric yarns. Elastic fabrics typically have breaking elongations in excess of 100%.
Elasticity	The ability of a strained material to recover its original size and shape immediately after removal of the stress that causes deformation.
Elastic Recovery	The immediate change in elongation displayed by a textile during a load cycle when, after being held at a defined elongation for a defined time, the applied tension is removed.
Elastic Limit	In strength and stretch testing, the load below which the specimen shows elasticity and above which it shows permanent deformation. See also Yield Point.
Elastomer	A macromolecular material which returns rapidly to approximately its initial size and shape after substantial deformation by a weak stress and release of stress.
Elongation	The increase in length of a specimen during a tensile test, expressed in units of length.
Elongation %	Ratio of the extension of a specimen to its initial length, expressed as a percentage.
Extension & Modulus	Maximum extension at the specified maximum force.
Extension at Break; Breaking Extension	The Extension Percentage of a test specimen at breaking point.

Extension Percentage	The increase in length of the specimen during a tensile test, expressed as a percentage of the Gauge Length or the Nominal Gauge Length. See also Elongation.
Extensibility	The ability of a material to undergo elongation on the application of force. See also Elongation.
Face	The correct, used side or "better-looking" side of a fabric. As opposed to Back.
Gauge Length ; Jaw Separation	Distance between the bottom of the top jaw and the top of the bottom jaw before testing (e.g., starting distance). See also Nominal Gauge Length.
Gauge Marks; Datum Marks	Two points manually marked by the operator onto the specimen at a specific distance. Used for manual determination of elongation, e.g., comparison of initial distance apart to final distance apart after testing.
Grab Test	Tensile test in which the only the centre part of the specimen is gripped in the jaws of the testing machine.
Greige Fabric; Grey Fabric; Gray Fabric	An unfinished fabric from the loom or knitting machine.
Growth	The non-recoverable component of creep. Also known as Secondary Creep. See also Delayed Deformation.
Hank; Skein; Reel	Unsupported coil of a specified number of wraps or sliver wound on a reeling machine (Wrap Reel).
Hosiery	Knitted fabrics for the legs and feet. See also Knitwear.
Impact Resistance; Impact Strength	The resistance of a material to fracture by a blow, expressed in terms of the amount of energy absorbed before fracture. In yarn or cord, the ability to withstand instantaneous or rapid rate of loading.
Initial Length	Length of test specimen under specified pretension.
Initial Modulus	The slope of the initial straight portion of the stress-strain curve. The modulus is the ratio of the change in stress, expressed in newtons to the change in strain expressed as a fraction of the original length.
Jaws; Clamps	The parts of a testing machine that are used to hold a specimen while it is subjected to force.
Jaw Break	Any specimen that break within 5mm of the jaw face.
Knitwear	All knitwear outer garments except stockings and socks.
LASE	Acronym for load at specified elongation: the load required to produce a given elongation.
LCSP; CSP; Break Factor	Lea Count Strength Product: lea strength (lbf) x count (Nec) of cotton yarn. See also Specific Stress.
Linear Density	Linear density is the ratio of mass to length. The SI unit is tex, i.e., g/1000m. This is the direct system of "yarn numbering". The older indirect systems of yarn numbering are based on the ratio of length to mass. English Cotton Count (Nec) is an example of this system.
Load at Elongation	Force required to produced the specified elongation.
Load Decay	Difference in force between two force readings at the same extension on two different cycles.
Load-Deformation Curve	A graphical representation of the relationship between the change in dimension (in the direction of the applied force) of the specimen resulting from the application of an external force, and the magnitude of that force. In a tension test, a load-deformation curve becomes a load-elongation curve.
Load-Elongation Curve; Stress-Strain Curve	A graphical representation, showing the relationship between the change in dimension (in the direction of the applied stress) of the specimen from the application of an external stress, and the magnitude of that stress. In tension tests of textile materials, the stress can be expressed either in units of force per unit cross-sectional area, or in force per unit linear density of the original specimen, and the strain can be expressed either as a fraction or as a percentage of the original specimen length.
Machine Direction	The long direction in the fabric, i.e., the direction in which the fabric is being or was produced by the machine. See also Cross Machine.

Modulus	The tensile force in a test specimen required to produce a known extension. The ratio of change in stress to change in strain following the removal of crimp from the material being tested; i.e., the ratio of the stress expressed in either force per unit linear density or force per unit area of the original specimen, and the strain expressed as either a fraction of the original length or percentage elongation.
Necking	Reduction in width that may occur when the specimen is stretched.
Nominal Gauge Length	Length of the specimen under defined pre-tension, measured from nip to nip of the jaws in their starting position. See also Gauge Length.
Nonwoven Fabric	Fabrics made directly from fibres rather than yarns.
Permanent Deformation	The change in length of a sample after removal of an applied tensile stress. The permanent deformation is expressed as a percentage of the original sample length.
Permanent Growth; Secondary Creep	The non-recoverable component of creep. See also Delayed Deformation.
Pile Loop	Uncut loops in Terry Towelling fabrics.
Pre-conditioning	Bringing a sample or specimen of textile material to a relatively low moisture content (approximate equilibrium in an atmosphere between 5 and 25% relative humidity) prior to conditioning in a controlled atmosphere of higher humidity for testing. (While pre-conditioning is frequently translated as pre-drying, specimens should not be brought to the over-dry state). See also Conditioning.
Pretension	The relatively low (but controlled) tension (low force) applied to remove slack when mounting a specimen prior to making a test.
Primary Creep	The recoverable component of creep. See also Delayed deformation.
Ravelling	The process of undoing or separating the weave or knit of a fabric. The pulling out of threads to make the specimen the correct size for testing, as in ravelled strip.
Residual Extension	Percentage difference between the initial length and the final length after cycling. (e.g., cycle twice, remove from machine, wait 1 minute, measure new length).
Sample	Material from which the specimens are taken from.
SASE	Acronym for stress at specified elongation; the stress experienced at a given elongation.
Seam Slippage	A defect consisting of separated yarns occurring when sewn fabrics pull apart at the seams. Seam slippage is more prone to occur in smooth-yarn fabrics produced from manufactured filament yarns. Sliding or slipping of the filling threads over the warp ends (or vice versa), which leaves open spaces in the fabric. Slippage results from a loose weave or unevenly matched warp and weft.
Selvedge; Selvage	The narrow edge of woven fabric that runs parallel to the warp. It is made with stronger yarns in a tighter construction than the body of the fabric to prevent ravelling. A fast selvedge encloses all or part of the picks, and a selvedge is not fast when the filling threads are cut at the fabric edge after every pick.
Slack mounting	Starting a test without pre-tension. The specimen is clamped and is not made taught by pre-tension.
Slope	Ratio of one point on a graph to another (e.g., load at 80% elongation on load curve divided by load at 30% elongation on unload curve).
Specific Stress	Ratio of force to the linear density expressed as N/tex, or submultiples such as mN/tex. See also LCSP.
Specimen	Individual item to be tested. Textile specimens are usually directional.
Stress	The resistance to deformation developed within a specimen subjected to an external force. Typical examples are tensile stress, shear stress, or compressive stress. Stress usually reaches a maximum at the time of rupture. When a textile material is subjected to a stress below that causing rupture, the stress gradually decreases or decays with time.
Stress Decay; Tension Decay	Difference in force between the start and end of extension-hold (e.g., what is the difference in force before and after 1 minute at a fixed elongation).

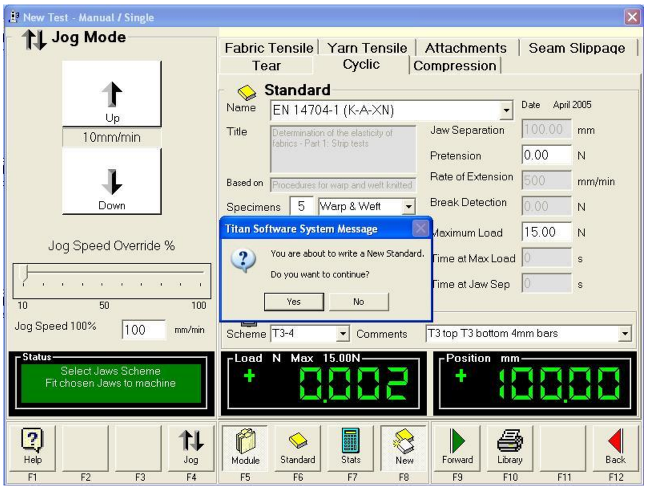
Stress Recovery Curve	
Strip test	Tensile test in which the full width of the specimen is gripped in the jaws of the testing machine
Tear Strength	The force required to begin or to continue a tear in a fabric under specified conditions.
Tenacity	Maximum Specific Stress in a Tensile Test taken to rupture.
Tensile Hysteresis Curve; Tensile Recovery Curve	A complex force-elongation, or stress-strain curve obtained when a specimen is successively subjected to the application of a load or stress less than that causing rupture and to the removal of the load or stress according to a predetermined procedure, or, when a specimen is stretched less than the breaking elongation and allowed to relax by removal of the strain according to a predetermined procedure.
Tensile Stress	The resistance to deformation developed within a specimen subjected to tension by external force. The tensile stress is commonly expressed in two ways, either as the tensile strength, i.e., the force per unit cross-sectional area of the unstrained specimen, or as tenacity, i.e., the force per unit linear density of the unstrained specimen. The latter is used in yarn testing.
Tensile Strength	In general, the strength shown by a specimen subjected to tension as distinct from torsion, compression, or shear. Specifically, the maximum tensile stress expressed in force per unit cross-sectional area of the unstrained specimen.
Tensile Test	A test in which the resistance of a yarn or fabric to a force tending to stretch the specimen in one direction.
Tex (tex)	Direct system for expressing linear density. Mass per unit length. Unit of measure is "tex", a recognised SI Unit, defined as the mass in grams of one kilometre of product (fibres, filaments, slivers, yarns). Submultiples and multiples are commonly used, e.g., decitex (dtex) and kilotex (ktex).
Time-to-Break	In tensile testing, the time interval during which a specimen is under prescribed conditions of tension and is absorbing the energy required to reach maximum load.
Titan Universal Tensile Tester	A high precision electronic test instrument designed for testing a variety of material under a broad range of test conditions. It is used to measure display and record the load-elongation properties of yarns, fabrics, webbings, plastics, films, rubber, leather, paper, etc. Titan may also be used to measure such properties as tear resistance, seam slippage and resistance to compression.
Warp; Chain	Threads lengthways in a woven fabric.
Weft; Woof; Shute; Filling	Threads widthways in a woven fabric.
Wet Strength	The measurement of the strength of a material when it is saturated with water, normally relative to the dry strength.
Work Recovery	Ratio of area under one curve to another (e.g., area under unload curve divided by area under load curve).
Yarn Guide	Device for controlling the path of a yarn during yarn tensile testing.
Yarn; Thread	Material of substantial length and relatively small cross-section consisting of fibres and/or filaments with or without twist.
Yield Point	Point on the stress-strain curve where the load and elongation stop being directly proportional. See also Elastic Limit.
Young's Modulus	A property of *perfectly* elastic materials, it is the ratio of change in stress to change in strain within the elastic limits of the material. The ratio is calculated from the stress expressed in force per unit cross sectional area, and the strain expressed as a fraction of the original length. Modulus so calculated is equivalent to the force required to strain the sample 100% of its original length, at the rate prevailing below the elastic limit.

Log On to the Titan software as an "Administrator", the factory default password is "titan".

Click **Manual** (F6).

Select the Module tab in which you want to create a user defined test method. In the following example we have selected the **Cyclic** tab.

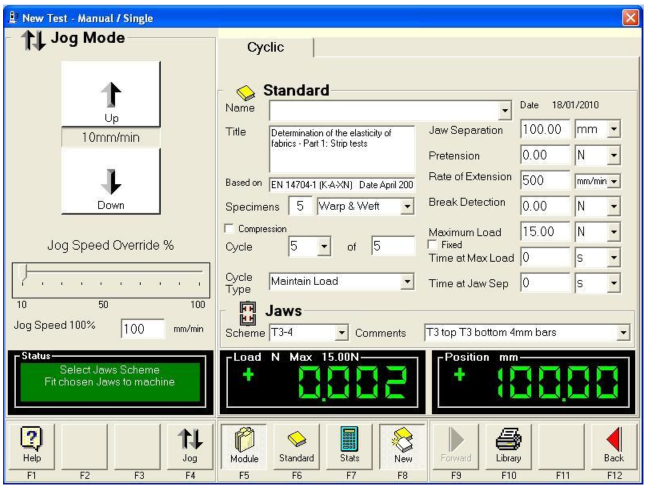
Then select the standard on which you want to base your new user defined test method. In the following example we have selected **EN 14704-1 (K-A-XN)**.



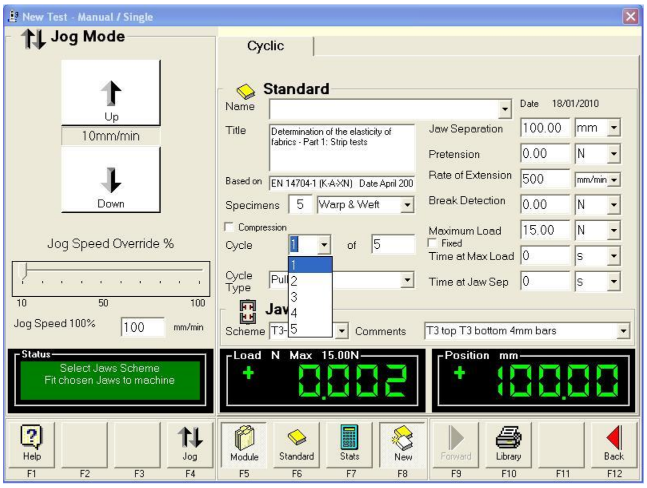
Click **New** (F8).

You will be prompted by a message box asking if you to confirm you want to create a New Standard.

Click **Yes** to confirm.

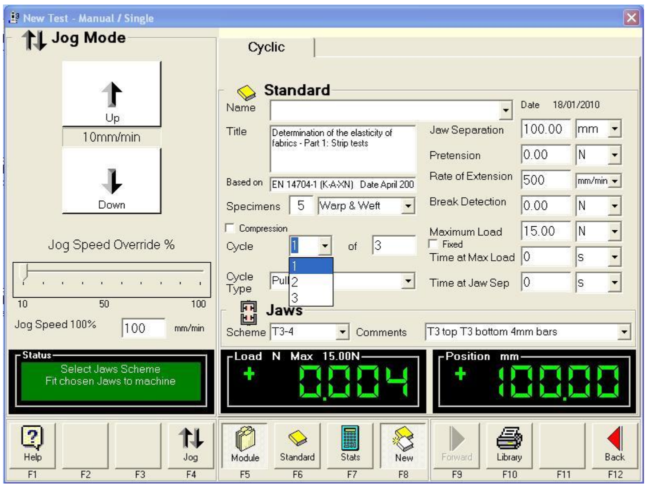


Notice the Standard Name field has been cleared and all the test parameters are now available for editing.

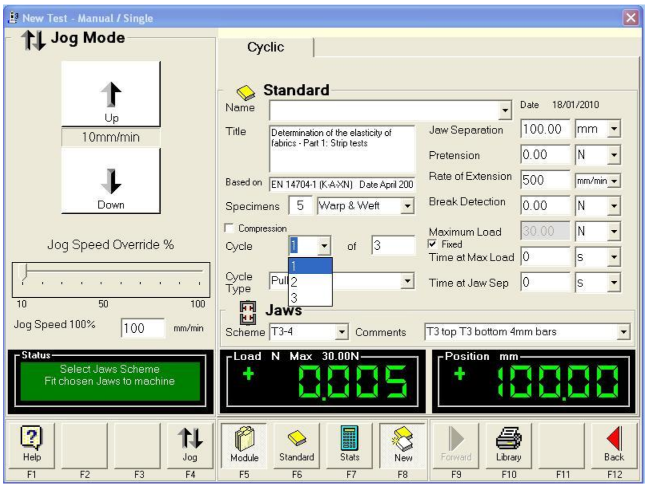


The following example will create a new standard and reduce the number of cycles from 5 to 3, set a *fixed* maximum load of 30N on all cycles and hold at maximum load for 60 seconds on the third (3rd) (last) cycle.

Notice the Cycle 1 of 5 fields.

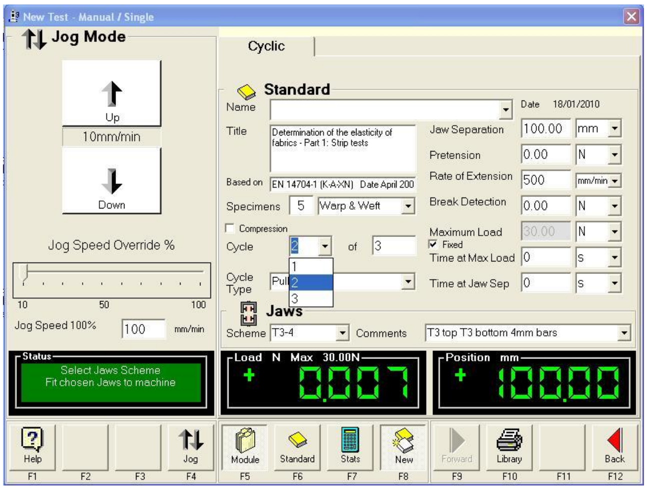


Click in the "of" field and replace the 5 with 3 and press enter. The new test now has only 3 cycles.

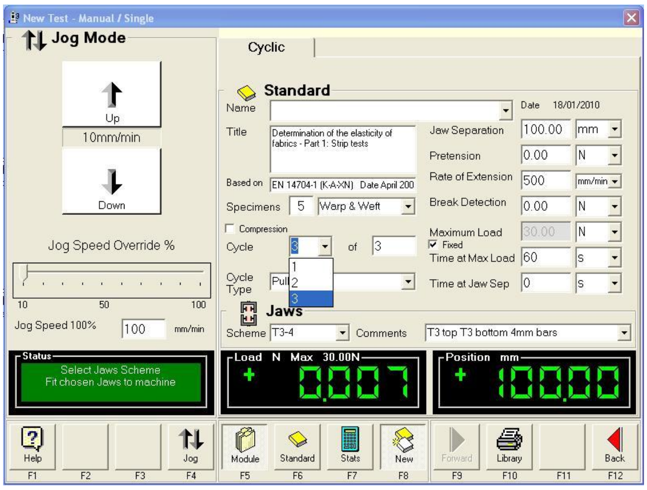


Each Cycle can be defined separately therefore when creating a new cyclic test each cycle must be redefined as required.

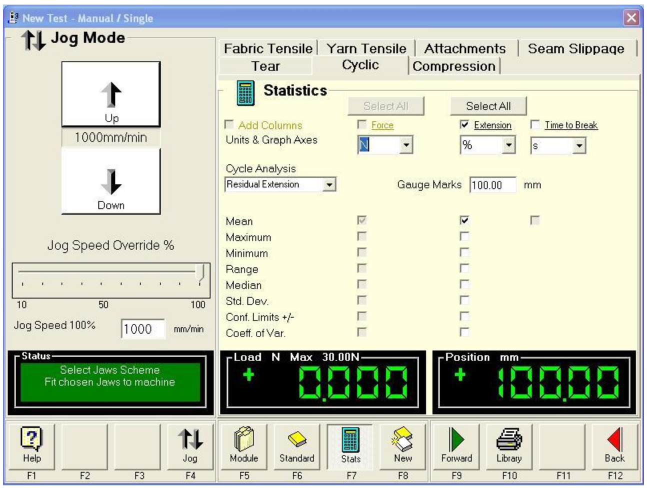
Select Cycle 1.
Type 30 in the Maximum Load field.
Check (tick) the Fixed box.



Repeat the above instructions for Cycle 2.



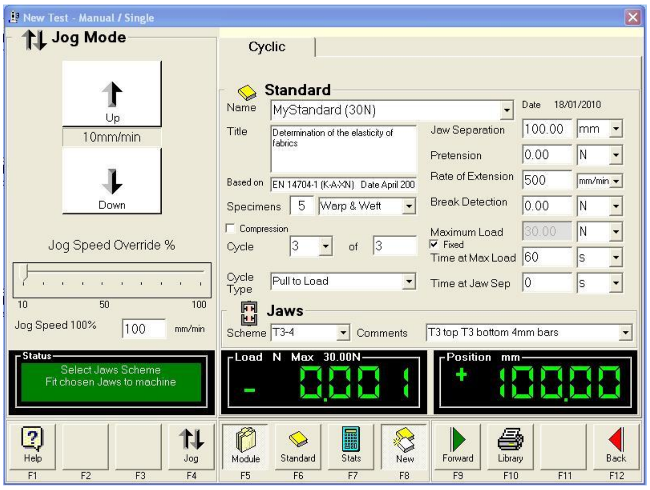
Repeat the above instructions for Cycle 3 and then type 60 in the Time at Max Load field.



To change which **Statistics** are presented in the Test Report, click **Stats** (F7).

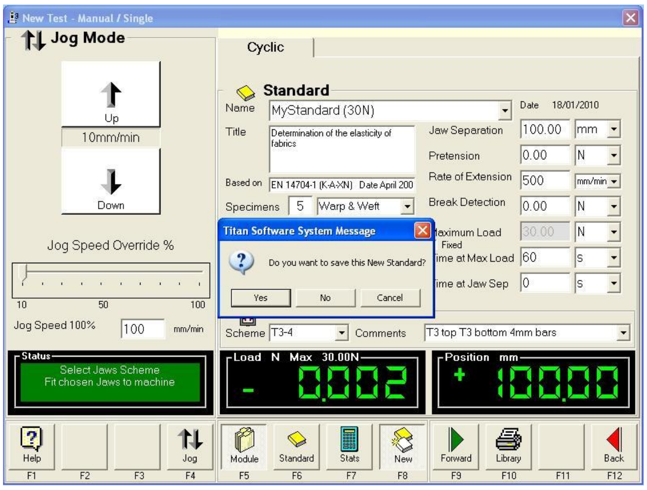
In the example we are following here, it is also possible to change the default calculation for **Cycle Analysis** and to change the **Gauge Marks** setting (initial value).

The appearance of the Statistics page will vary dependent upon which Module and Standard are selected.



Enter a **Name** for the new Standard, in this case we entered "MyStandard 30N".
This must be a unique name in the Module.

Enter or edit the **Title** for the new Standard.

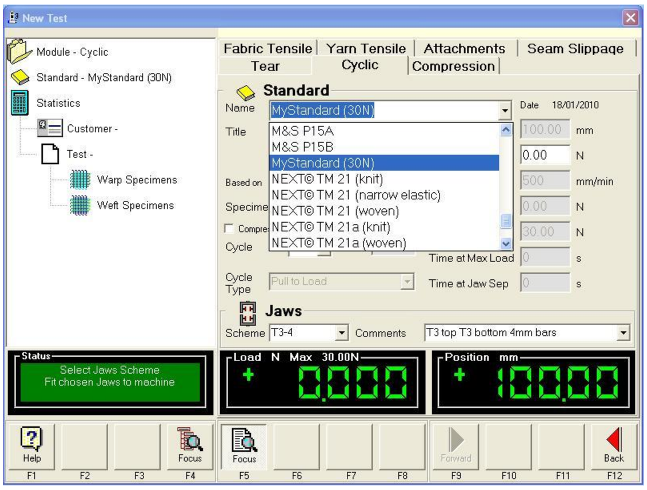


When all the parameters have been set as required for the new Standard click **Back** (F12).

You will then be prompted to save the new Standard.

If you wish to save click **Yes**.

To return to editing parameters click Cancel.
To abort the new Standard click No.



The new Standard is now available to all Users as illustrated in the New Test screen to the left.

Any Jaws which are purchased at the same as the Titan instrument will be configured ready for use. However, Jaws purchased subsequently need to be setup manually using the following instructions.

Each different piece of jaw tooling and faces must be set up as described below and have a separate entry in the Jaws Scheme drop down list.

1. Run the Titan software and Log On as an Administrator using the Password "Titan". From the Main Menu select F11-Config.

2. Select the Jaws tab. You should have at least one Jaws Scheme already in the list. This example below shows Jaws Scheme Name T7. Your Reference Position may be different. All Titans have slightly different values due to manufacturing tolerances. Do not change it.

3. Select "New Entry" to copy the parameters for T7 giving you an additional Name in the Jaws Schemes list. This example shows the addition of Jaws Scheme Name T11. However, the same procedure applies for all additional Jaws Schemes, only the parameters entered will be different. Edit the Selected Scheme parameters to be as listed in Table 1 at the end of this section except for the Reference Position. Do not change it.

4. Fit the new jaws to the instrument exactly as you will be using them, including jaw face inserts where used and select F8-Setup to zero the Load. The Position window will now show Absolute Position in mm of the top jaw from the Reference Switch at the top of the column to its current position.

5. Note that for Loop Bars T3-4, Wide Loop Bars T3A and T11 C-Clamps this step is not possible - see additional step 6 below.

   Use the Jog Mode to move the top jaw downwards until it just touches the bottom jaw. Use the Jog Speed Override % set to 10% when you are getting close. When the jaws are just touching this is zero (0.00mm) Jaw Separation. Check that the Load window is reading approximately zero and if so select F8-Record. If the Load window reads negative then the jaws have moved too far and are putting the load cell into compression. Move up slightly.

6. To set up T3 Loop Bars, T3A Wide Loop Bars and T11 C-Clamps follow these additional stages. For any other jaws continue from step 7 below.

   - Use the Jog Mode to move the top jaw downwards until it is at a distance of 100mm above the bottom jaw. Use a ruler to measure between the faces of the metal housings that the looped bars pass through.
   - Select F8-Record.
   - This measured "offset" of 100mm now needs to be manually added to the Reference Position and typed in. Press Enter to accept this value and the Position window will now display an increase of 100mm.

7. Upon selecting F8-Record, the value in the Position window will be copied to the Reference Position and the Position window will be set to 0.00mm. Note that the Top Jaw Face Offset and Bottom Jaw Face Offset values will also be taken into account to calculate the Reference Position.

8. You have successfully taught the Titan the new Reference Position for the new jaws. This value is the distance in mm from the Reference Switch at the top of the column to zero (0.00mm) Jaw Separation. On the Standard page whenever you select this Name from the Jaws Scheme drop down list this Reference Position is used to calculate the distance to move up or down for the correct Jaw Separation.

9. Finally decide if you want either the top and / or bottom jaws to automatically Open at Break. If "Yes" then tick the boxes as shown. Note that this option is usually ticked for pneumatic jaws to save the user having to manually select Open at the end of each specimen test. However if you are using either jaw to hold a jig or fixture for a particular test then do not tick these boxes otherwise at the end of each specimen test the jaws will open and the jig or fixture could fall out.

10. To save these changes select F12-Back and answer "Yes" to the question.

When you select New Test you must make sure that the Jaws Scheme drop down list on the Standard page is set to the same name as the physical jaws fitted to the machine. The software does not know which jaws you have fitted, you must tell it. If you do not select the correct jaws then the jaw separation will be wrong. For example if T7 jaws with plain jaw faces are fitted to the machine then select T7 as shown below.

Each different piece of jaw tooling and faces must be set up as described above and have a separate entry in the Jaws Scheme drop down list.

The Jaws Scheme Name and Comments that appear above are only for your reference. If you wish to use different text then select the Jaw Scheme from the list on the Jaws tab of the Configuration page and make any wording changes in the Selected Scheme boxes shown below.

Name	Comments	Top Jaw Face Offset mm	Pneumatic	Bottom Jaw Face Offset mm	Pneumatic	Minimum Jaw Separation mm
T3-4	T3 top T3 bottom 4mm bars	12	No	12	No	0
T3-8	T3 top T3 bottom 8mm bars	14	No	14	No	0
T3A-6.5	T3A top, T3A bottom 6.5mm bars		No		No	
T3A-8	T3A top, T3A bottom 8mm bars		No		No	
T3A-10	T3A top, T3A bottom 10mm bars		No		No	
T3A-13	T3A top, T3A bottom 13mm bars		No		No	
T4	Button T4 top T7 bottom	0	No	0	Yes	0
T5	T5 top T5 bottom		Yes		Yes	
T7	T7 top T7 bottom	0	Yes	0	Yes	0
T10A	Ball Probe top Clamp bottom		No		No	
T11-8	C-Clamps 8mm bars		No		No	
T11-10	C-Clamps 10mm bars		No		No	
T12	Universal Hook top, pneumatic clamp bottom	-	No	-	Yes	0
T13	Hook top T7 bottom	-	No	-	Yes	0

Loadcells purchased at the same time as the Titan instrument are already configured. However, if you have subsequently taken delivery of a new loadcell for use on your Titan instrument then you will need to enter the Calibration Values into the software configuration file so that Titan will indicate "true" force.

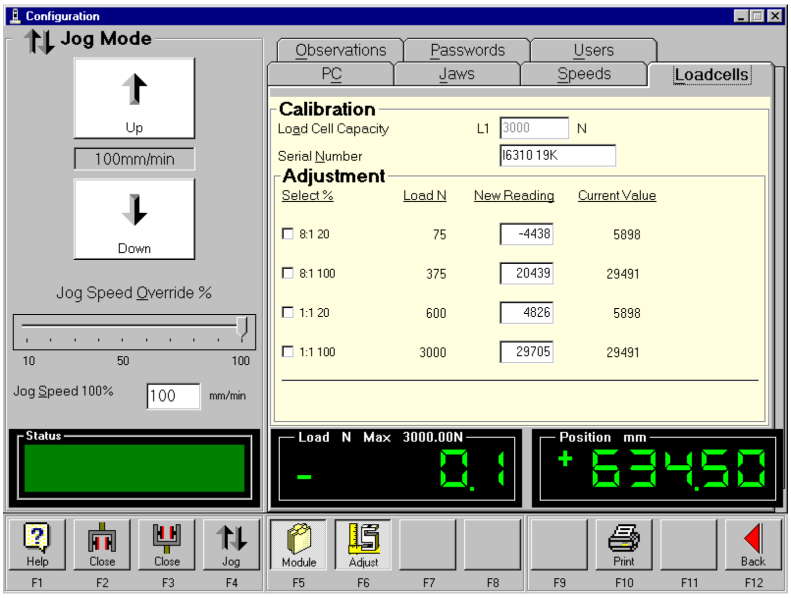
1. Power On the Titan instrument.
   Run the Titan software and Log On as an Administrator using the Password "Titan".
   From the Main Menu select F11-Config.
   Select the Loadcells tab.

2. Fit the new loadcell.
   Titan will automatically detect this loadcell and enter its maximum force (N) in the Load Cell Capacity field. Check this value is correct.

3. Type the new loadcell serial number into the Serial Number field.
   There will be a label on the loadcell similar to this:

Load Cell	**L1**
Capacity	**3000N**
Serial No.	**I6310 19K**
Cal8, 20	**-4438**
Cal8, 100	**20439**
Cal1, 20	**4826**
Cal1, 100	**29705**

4. Type the Calibration Values into the fields in the New Reading column.
   From the above example loadcell label the configuration page should look like this:



5. Select F12-Back and answer "Yes" to the following question to accept these new Calibration Values.
   You have successfully entered the new loadcell Calibration Values.

6. Next, answer "Yes" to the following question to save the changes to the software configuration file.

You can now verify that the new loadcell is reading true force correctly by using the Check Weight Set.

Check Weight Set

The optional Check Weight Set can be used periodically, between annual loadcell calibrations, to verify the load reading from the Titan Universal Strength Tester. Some Retailers specify weekly verification.

Instructions for use:

1. Power On the Titan instrument.
2. Run the Titan software and Log On as normal.
3. Allow the Titan instrument 20 – 30 minutes "warm up" time so that the loadcell and its associated electronics stabilises at ambient temperature. This is good practice in general whenever you are using Titan and is always done prior to calibration.
4. Remove both top and bottom jaws.

5. Fit the circular Check Weight Platen in place of the lower jaw.
   This allows the five circular weights to be centrally positioned on the loadcell.
   See Figure 31, below.

Figure 31: Check Weight Platen

Figure 32: Check Weight Set in Use

6. Select F6-Manual from the Main Menu.
   The load reading will automatically zero.

7. Ensure the reading is nominally zero before proceeding.
   If not nominally zero then press F9-Forward, the F8-Zero, then F12-Back.

8. Carefully place all five (5) circular Check Weights, one at a time, on to the platen, ensuring they are mounted centrally. See Figure 32, above.

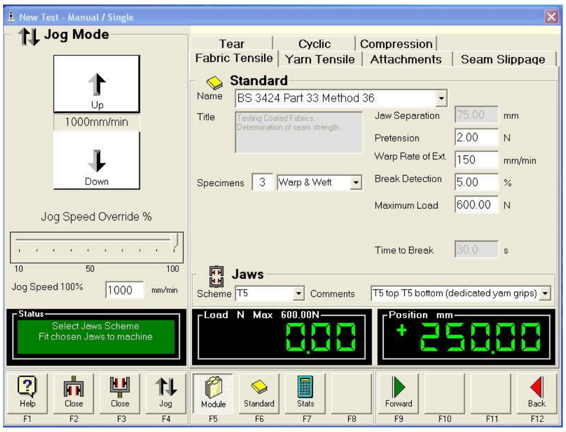


Figure 33: Manual Mode

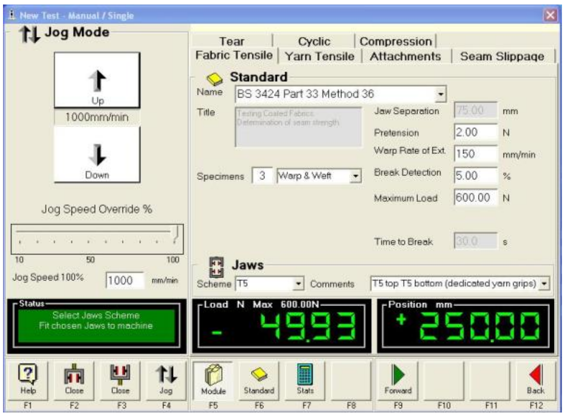


Figure 34: Check Weight Load Reading

9. Check the values obtained against Table 2, below, which indicates the theoretical expected values which are within tolerance based on the Loadcell capacity and the Calibration Class.

Check Weight		50				N
Loadcell		3000	600	120	60	N
Class 0.5	from	48.1	49.6	49.4	49.7	N
	to	51.9	50.4	50.6	50.3	N
Class 1.0	from	46.3	49.3	48.8	49.4	N
	to	53.8	50.8	51.2	50.6	N

Table 2: Expected Check Weight Values

Titan^3 software has up to 4 software modules:

S1	Tensile Module	Supplied as standard with Tension Only and Compression models
S2	Tear Module	Optional
S3	Cyclic Module	Optional
S4	Compression Module	Supplied as standard with Compression models

This is a list of pre-loaded Standards. Other similar Standards not mentioned in this list can be input manually (User Defined). Pre-loaded means that all parameters relevant to a Standard are automatically pre-set when the Standard is selected.

S1	Attachments	BS 4162	Test for buttons. Determination of tension strength
		M&S P115	Security of Attachments of Accessories to Garments
		M&S P115A	Security of Attachment of Poppers to Garments
		M&S P115B	Test to Failure Security of Attachment of Accessories to Garments
		M&S P115C	Test to Failure Security of Attachment of Poppers to Garments
		M&S P115H	Security of Attachment of Handles and Straps on Handbags and Laptop Bags
		M&S P122	Strength of Buttons
		M&S P124	Security of Attachments of Component Parts of Fabric Covered Buttons
		ASTM D4846	Resistance to Unsnapping of Snap Fasteners
		NEXT© TM37	Button Strength
		NEXT© TM42	Attachments strength of components and embellishments
		NEXT© TM45	Handle attachment strength
		NEXT© TM46	Strength of belt buckles
		EN 15598	Test method for the determination of the resistance to pile loop extraction
S1	Fabric Tensile	16 CFR 1500.53 Para (f)	Test method for simulating use and abuse of toys and other articles intended for use by children over 36 but not over 96 months of age - TENSION TEST
		AATCC-ASTM TS-010	Procedure for Determining Pocket Reinforcement
		AATCC-ASTM TS-015	Seam Stretchability of Knitted Garments
		ASTM D5034	Breaking Strength and Elongation of Textile Fabrics (Grab Test)
		ASTM D5035	Breaking Force and Elongation of Textile Fabrics (Strip Method)
		BHS 1	Tensile Strength
		BS 2543	Woven and knitted fabrics for upholstery. Annex A Method of test for seam slippage resistance
		BS 2576	Method for determination of maximum strength and elongation (strip method) of woven fabrics
		BS 3424 Part 4 Method 6	Testing Coated Fabrics. Method for determination of breaking strength and elongation at break
		BS 3424 Part 33 Method 36	Testing Coated Fabrics. Determination of seam strength
		DIN 53858	Determination of the breaking strength of textile fabrics (with the exception of non-woven textiles) Grab method

		EN ISO 1421 Method 1	Rubber or plastics-coated fabrics - Determination of tensile strength and elongation at break (strip test method)
		EN ISO 1421 Method 2	Rubber or plastics-coated fabrics - Determination of maximum strength (grab test method)
		EN ISO 13934-1	Determination of maximum force and elongation at maximum force using the strip method
		EN ISO 13934-2	Determination of maximum force using the grab method
		EN ISO 13935-1	Determination of maximum force to seam rupture using the strip method
		EN ISO 13935-2	Determination of maximum force to seam rupture using the grab method
		EN ISO 13936-2	Determination of the slippage resistance of yarns at a seam in woven fabrics
		ISO 5081	Textiles - Woven fabrics - Determination of breaking strength and elongation (Strip method)
		ISO 5082	Textiles - Woven fabrics. Determination of maximum strength. Grab method
		ISO 9073-3	Methods of test for nonwovens. Determination of tensile strength and elongation
		IWS TM 117	Seam Slippage (Woven Fabrics)
		M&S P11	Tensile strength
		M&S P12A	Fabric Slippage (including all stretch wovens) - Fixed Load Method
		M&S P12B	Garment Seam Slippage and Seam Strength - Fixed Load Method
		NEXT© TM 16a	Seam slippage of garment production seams
		NEXT© TM 27	Breaking Strength and Elongation of woven fabrics (Ravelled strip)
		NF G 35-107 Method B	Tissus d'ameublement. Détermination du glissement des files. Essai à la griffe
		RSG 1	Tensile strength using the grab method
		RSG 3	Seam slippage - seam method for fabrics containing elastanes

S1	Seam	ASTM D434	Resistance to Slippage of Yarns in Woven Fabrics Using a Standard Seam
		ASTM D1683	Standard Test Method for Failure in Sewn Seams of Woven Apparel Fabrics
		ASTM D4034	Resistance to yarn slippage at the sewn seam in woven upholstery fabrics
		BS 3320	Method for determination of slippage resistance of yarns in woven fabrics: seam method
		DIN 53868	Determination of the Resistance to Seam Shifting of Woven Fabrics
		EN ISO 13936-1	Determination of the slippage resistance of yarns at a seam in woven fabrics
		EN ISO 13936-3	Slippage Resistance of Yarns at a Seam in Woven Fabrics: Needle Clamp Method
		M&S P12	Fabric Slippage
		NEXT© TM 16	Grab strength and seam slippage of woven fabrics
		RSG 2	Determination of tensile strength, seam slippage and strength
S1	Yarn Tensile	ASTM D1578 (Option 2)	Breaking Strength of Yarn in Skein Form
		ASTM D2256	Tensile Properties of Yarns by the Single-Strand Method
		BS 1932 Part 2	Testing the strength of yarns and threads from packages. Methods for determination of knot strength and loop strength
		EN ISO 2062	Yarns from packages. Determination of single-end breaking force and elongation at break
		M&S P70	Strength Testing of Sewing Threads

S2	Tear	AS 2001-2.10	Determination of the Tear Resistance of Woven Textile Fabrics by the Wing-rip Method
		ASTM D2261	Tearing Strength of Fabrics by the Tongue (Single Rip) Procedure
		ASTM D2724	Standard Test Methods for Bonded, Fused, and Laminated Apparel Fabrics
		ASTM D5587	Tearing Strength of Fabrics by Trapezoid Procedure
		ASTM D5735	Tearing Strength of Nonwoven Fabrics by the Tongue (Single Rip) Procedure
		BHS 16	Peel Bond Strength of Fused Collars and Cuffs and Bonded / Laminated Textile Fabrics
		BS 3424 Part 5 Method 7A	Testing Coated Fabrics. Determination of tear strength
		BS 3424 Part 5 Method 7B	Testing Coated Fabrics. Determination of tear strength
		BS 3424 Part 5 Method 7C	Testing Coated Fabrics. Determination of tear strength
		BS 4303	Method for the determination of the resistance to tearing of woven fabrics by the wing-rip technique
		DBA RMQT-OI-020-050 Rev 02	Testing Procedure - Peel Strength of Laminated Fabric
		DIN 53859 Part 2	Tear growth testing of textile fabrics - Leg tear growth test
		DIN 53859 Part 5	Tear Growth Test on Textile Fabrics - Trapezoid Test
		DUPONT TTM 035	Tear Strength Shirtings
		EN ISO 4674-1 – Method A	Rubber- or plastics-coated fabrics. Determination of tear resistance. Constant rate of tear methods. Tongued (double-tear) test
		EN ISO 4674-1 – Method B	Rubber- or plastics-coated fabrics. Determination of tear resistance. Constant rate of tear methods. Trouser-shaped (single-tear) test
		EN ISO 9073-4	Test methods for nonwovens - Determination of tear resistance
		EN ISO 13937-2	Determination of tear force of trouser-shaped test specimens (single tear method)
		EN ISO 13937-3	Determination of tear force of wing-shaped test specimens (single tear method)
		EN ISO 13937-4	Determination of tear force of tongue-shaped test specimens (double tear test)
		M&S P13	Peel Bond Strength
		M&S P35	Baumann Tear Strength of Leather
		M&S P98	Tear Strength Wing Rip
		NEXT© TM 25	Tearing of woven fabrics by the Wing Rip technique
		SIS 25 12 31	Textiles. Determination of tearing strength (Withdrawn 2000)

S3	Cyclic	AATCC-ASTM TS-016	Procedure for the Stretch and Recovery of Knit Fabrics
		Adidas 4-27	Elongation and Recovery of Elastic Fabrics C-Clamp
		ASTM D4964	Tension and Elongation of Elastic Fabrics
		ASTM D6614	Standard Test Method for Stretch Properties of Textile Fabrics - CRE Method
		BHS 15J	Stretch and Recovery Properties
		BS 4952 (2.1 2.2) line contact	Methods of test for Elastic fabrics. Determination of extension at a specified force. Determination of modulus
		BS 4952 (2.1 2.2) loop bar	Methods of test for Elastic fabrics. Determination of extension at a specified force. Determination of modulus
		BS 4952 (2.3)	Methods of test for Elastic fabrics. Determination of tension decay
		BS 4952 (2.4)	Methods of test for Elastic fabrics. Determination of residual extension
		Calida Bodywear Test No. 21	Stress-strain behaviour of elastic bra straps
		Decathlon DS-275	Follow-up of the stretch properties of knitted textile and rubber foam based assemblies
		DUPONT TTM 076	Fabric Elongation
		EN 14704-1	Determination of the elasticity of fabrics - Part 1: Strip tests
		EN 14704-3 - Method A	Determination of the elasticity of fabrics - Part 3: Narrow Fabrics
		Limited Brands LTD03	Stretch Fabrics - Power and Recovery
		M&S P14	Extension and Modulus of Elastomeric Fabrics and Narrow Elastics
		M&S P14A	Extension and Modulus of Stretch Laces
		M&S P14B	Elastic Properties of Fabrics Labelled "Lycra Soft"
		M&S P15 Part 1	Extension, Modulus and Residual Extension of Stretch Woven Fabrics
		M&S P15A	Extension, Modulus and Residual Extension of Stretch Fabric
		M&S P15B	Prediction of Recoverability of Stretch Leggings (Knee Bagging)
		NEXT© TM 21 (knit)	Extension and modulus
		NEXT© TM 21 (narrow elastic)	Extension and Modulus for elastics less than 2 cm. width
		NEXT© TM 21 (woven)	Extension and Modulus
		NEXT© TM 21a (knit)	Extension and Recovery
		NEXT© TM 21a (woven)	Extension and Recovery
		RSG 4	Extension and modulus of knitted elastic fabrics
		RSG 5	Residual extension of knitted elastic fabrics
		RSG 6	Residual extension of woven fabrics containing elastanes
		SIS 65 00 68	Determination of the firmness of loops in terry cloths

S4	Compression	ASTM D751	Standard test methods for coated fabrics
		ASTM D3787	Standard test method for bursting strength of fabrics CRT ball burst test
		ASTM D4830	Standard test method for characterizing thermoplastic fabrics used in roofing and waterproofing
		ASTM D5748	Standard test method for protrusion puncture resistance of stretch wrap film
		ASTM D6797	Standard test method for bursting strength of fabrics CRE ball burst test
		EN 388	Protective gloves against mechanical risks
		EN 12332-1	Rubber- or plastics-coated fabrics - determination of bursting strength
		ISO 3303-A	Rubber- or plastics-coated fabrics - determination of bursting strength
		ISO 9073-5	Textiles - Test methods for nonwovens - Part 5: Determination of resistance to mechanical penetration (ball burst procedure)
		WSP 110-5	Standard test method for resistance to mechanical penetration (ball burst procedure) of nonwoven fabrics

General

Titan has been specifically designed with the Operator's health and safety in mind. This ensures the minimum Operator stress and fatigue. Titan is virtually silent in operation to suit the laboratory environment.

Please observe the following points at all times:

- Take extreme care when moving the machine. Never attempt to manoeuvre Titan without the appropriate lifting gear. Without jaws, Titan weighs approximately 85kg.
- Always remove both hands from the specimen area before starting a test.
- Take care when changing grips and load cell assemblies. Ensure they are always firmly and securely attached to the machine.
- Never place any obstruction in the path of the carriage.
- Always ensure the jaw faces are correctly seated.
- Always ensure pneumatic connections are secure when changing jaws.
- Some materials when tested to rupture can leave the test area either by a whipping action or as fragments. A risk assessment should be made for these types of uncommon materials.

Emergency Stop Button

Familiarise yourself with the location of the large red Emergency Stop Button at bottom right of the instrument. Use this button only in case of emergency to completely stop Titan.

Impact Protection

When the load on an obstruction, such as a hand, equals the weight of the jaw the drive will stop, this will prevent any serious injury. The Operator should, however, always be vigilant and never obstruct the motion of the jaw. If in doubt hit the Emergency Stop Button.

Soft Closing Jaws

Full jaw pressure is automatically applied when the Operator presses the Start button. When loading a sample, only a low pressure is applied, this will help prevent serious injury. The Operator should, however, always be vigilant and never place fingers between the jaw faces.
If in doubt hit the Emergency Stop Button.

Do not dispose of any packaging material until all standard and optional accessories are accounted for. If there are any discrepancies, please contact your supplier/agent immediately.

- Use a forklift truck or hydraulic pump up trolley to move the packing case on its pallet as near as possible to its final location. Carefully cut and remove the two metal straps.
- Remove the staples from the lid of the case and open.
- Carefully remove the packaging and contents from the upper part of the case.
- Note that any accessories ordered with the instrument are packed in this top section.
- Carefully remove the packing from around the instrument.
- Lift the outer cardboard sleeve to reveal the Titan on the wooden pallet.
- Using lifting gear, carefully lift the instrument and place it on a firm flat surface.
- Carefully adjust the four feet of the instrument until the instrument is level.

Identification of Parts

Standard Accessories

The following items accompany every Titan supplied:

- CD with Titan software module S1 and/or software module S4
- CD with customer specific configuration (Key CD)
- Power cables
- RS 232 Serial Cable (9 pin D type)
- 1m of 4mm O/D plastic pipe
- Titan Foot Pedal Assembly

Optional Accessories

The following items are supplied as optional accessories:

Stock Code	Description
201-928	ISO Certificate of Calibration for Titan (machine only) based on ISO 7500-1 Annex A and ASTM D76
794-714	'Tear' Software Module S2
794-715	'Cyclic' Software Module S3
794-716	Enablement of M & S Test Methods
794-717	Enablement of Next Test Methods
794-578	Load Cell L1 (3000N) 3000N - 30N (300kgf - 3kgf)
202-517	UKAS Certificate of Calibration for Titan 3000N Load Cell (6 point calibration in tension)
202-511	UKAS Certificate of Calibration for Titan 3000N Load Cell (9 point calibration in tension)
202-522	UKAS Certificate of Calibration for Titan 3000N Load Cell (9 point calibration compression)
794-579	Load Cell L2 (600N) 600N - 6N (60kgf - 0.6kgf)
202-518	UKAS Certificate of Calibration for Titan 600N Load Cell (6 point calibration in tension)
202-512	UKAS Certificate of Calibration for Titan 600N Load Cell (9 point calibration in tension)
202-523	UKAS Certificate of Calibration for Titan 600N Load Cell (9 point calibration compression)
794-807	Load Cell L4 (120N) 120N -1.2N (12000gf - 120gf)
202-519	UKAS Certificate of Calibration for Titan 120N Load Cell (6 point calibration in tension)
202-513	UKAS Certificate of Calibration for Titan 120N Load Cell (9 point calibration in tension)
202-524	UKAS Certificate of Calibration for Titan 120N Load Cell (9 point calibration compression)

Stock Code	Description
794-872	Pneumatic Fabric Jaws T7 (pair)
	4 rubber-lined jaw faces 100 x 25mm
	2 rubber-lined jaw faces 25 x 25mm (grab)
	Additional Jaw Faces for T7
794-873	4 plain steel jaw faces 100 x 25mm
794-874	4 rubber-lined jaw faces 75 x 25mm
794-875	2 rubber-lined jaw faces 25 x 25mm
794-877	2 line contact jaw faces 100 x 6mm diameter and 2 plain steel jaw faces 100 x 25mm
794-878	4 rubber-lined jaw faces 200 x 35mm (ISO 13937-4 - double tear test)
794-814	Looped Bars T3 (pair)
794-842	Looped Bars T3A (pair)
794-864	Button Holder T4 (used with T7)
794-806	Pneumatic Yarn Jaws T5 (pair) complete with Yarn Guide
794-686	Needle Clamp [Apparel Version] T8 (used with T7)
794-687	Needle Clamp [Upholstery Version] T9 (used with T7)
794-843	Ball Burst Compression Tooling T10A
794-838	C-Clamps T11 (pair)
794-866	Attachments Kit T12 (used with T7)
794-844	Pile Loop Extraction Kit T13
783-224	Air Compressor 230V 50Hz
783-232	Air Compressor 110V 60Hz
371-928	Graduated Seam Opening Template (ISO 13936 Part 2)
772-111	Wing Rip Specimen Preparation Template (BS 4303, M&S P98 and Next TM25)
772-142	Wing Rip Specimen Preparation Template (ISO 13937 Part 3)
772-140	Seam Slippage Sample Preparation Template (Next TM16/BS 3320)
789-575	Sewing Thread Epic/Polyfil 75
	(M&S P12; ISO 13936-1 for apparel; ISO 13936-2 for apparel)
785-516	Sewing Thread Polyester Oxlene 100%
	(ISO 13936-1 for furnishing fabric; ISO 13936-2 for furnishing fabric)
788-251	Sewing Machine Needles Metric Size 80 Normal Point (M&S P12)
706-680	Fabric Conditioner (M&S P12, P12A and P12B)
794-817	Check Weight Set
910-spares	2-year Spares Kit
541-960	100 x 25mm rubber lined
541-965	100 x 25mm plain steel
541-964	75 x 25mm rubber lined
541-963	25 x 25mm rubber lined
541-966	100 x 6mm diameter line contact jaw face
541-908	39.75 x 14mm aluminium jaw face

Installation Requirements

Instrument Dimensions

Width	395 mm
Depth	570 mm
Height	1310 mm
Desk depth	750 mm recommended, 600 mm absolute minimum.
Desk length	1500 mm to allow for Titan, PC (desktop style), monitor and printer.

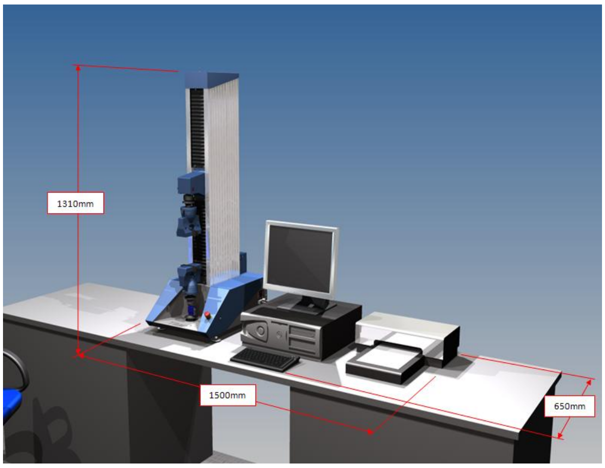


Figure 35: Typical Dimensions

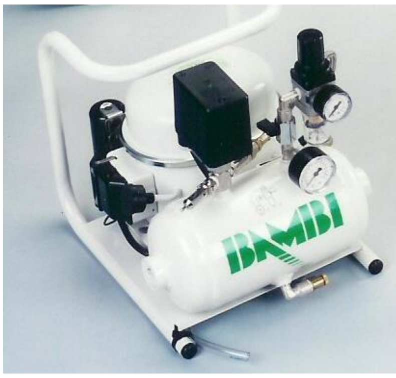
Electrical supply

Machine single phase 110 - 230Va.c. +/-10% at 10A maximum, 50/60Hz, 500W.
Provision must also be made for the PC, monitor and optional printer.

Environment:

As with all physical testing, tests should be carried out in a standard atmosphere for testing textiles, i.e., 20°C and 65% RH. However, the instrument will operate satisfactorily providing temperature and humidity levels are relatively stable. The humidity conditions must be non-condensing. The surrounding area should be electrically and magnetically stable.

Compressed Air supply

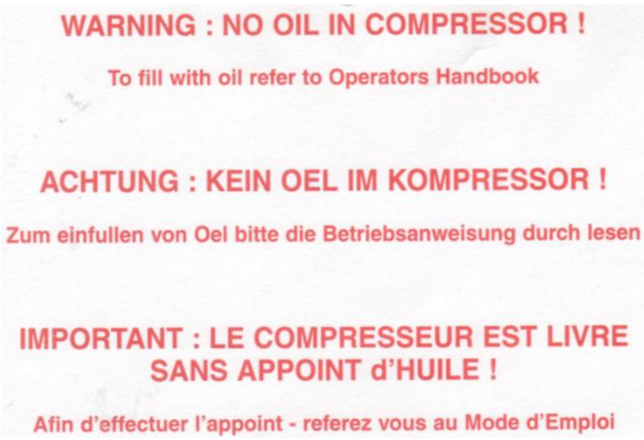


It is recommended the air supply has a minimum Free Air Delivery (FAD) of 11 litres per minute at 8 bar (116psi) and must be filtered to 5 microns (absolute) or better to remove excess particulates, oil and moisture. Minimum air supply 7 bar.

Note: Titan is fitted with onboard filtering. However, a contaminated air supply (not filtered) will result in early blockage of the onboard filter element.

For laboratories without a dedicated compressed air supply, we can offer the choice of a 110V (60Hz) or 230V (50Hz) silent laboratory compressor. See Figure 36 (Stock Codes 783-232 and 783-224 respectively).

Figure 36: Optional Compressor (silent laboratory type)



Setting up Titan

Whilst Titan is a sophisticated and reliable instrument, it is a sensitive high technology product and a few simple precautions are recommended to ensure satisfactory performance and long life.

- Check the operating voltage on the serial number plate is the same as your supply.
- The surface on which the instrument rests should be level, firm and free from vibration.

Identification of Major Parts

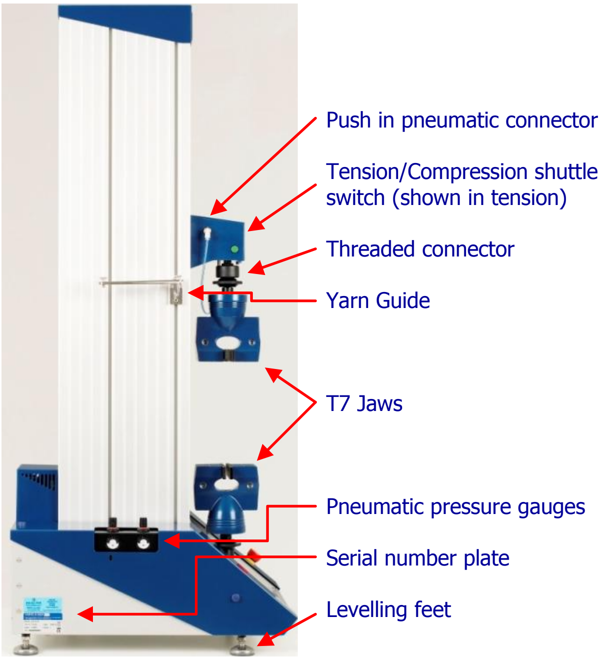


Figure 37: Left Side View

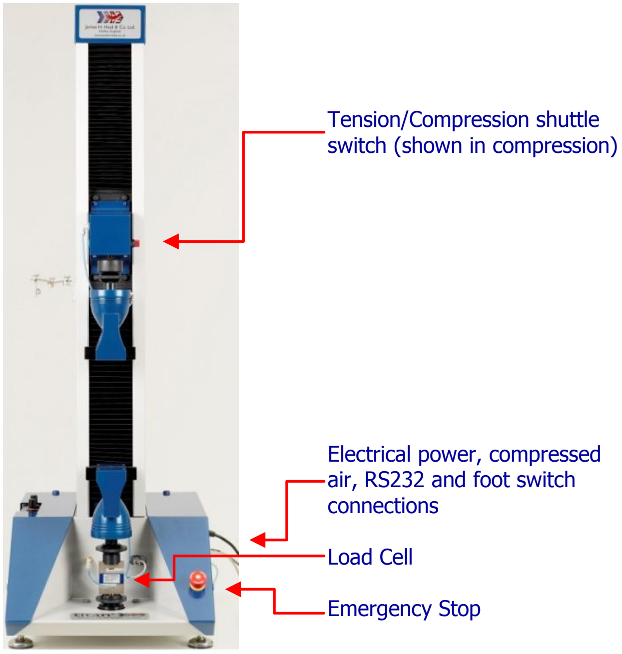
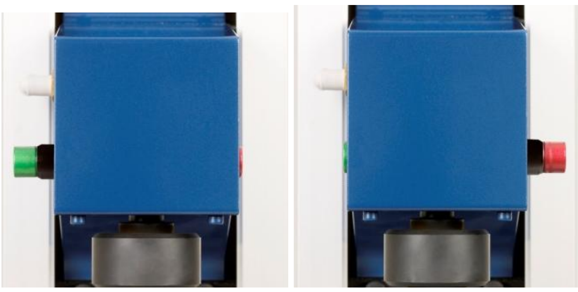


Figure 38: Front View



Tension/Compression shuttle switch

GREEN out for Tension testing

RED out for Compression testing

Figure 39: Setting Tension or Compression

Fitting the Jaws

Position the jaw so that the square locator fits into the square hole in the threaded connector.

Screw the threaded capstan onto the threaded connector until it is hand tight; do not use any tools.

Do not over tighten.

Figure 40: Connecting the Jaws

Connecting Pneumatics

The jaws are supplied with the requisite length of pneumatic pipe already connected, once the jaws are fitted simply push the pipe into the corresponding fitting.

To remove the pipe, push and hold the collar of the fitting and pull the pipe in the opposite direction.

Do not force the pipe from the fitting.

Figure 41: Connecting pneumatics to Jaws

Fitting Alternative Jaw Faces

The jaw faces simply snap into position. Each jaw face locates on two dowel pins and is held in position by powerful magnets. To remove a jaw, push the jaw face away from the mating face and then pull out. To insert a jaw face, position the jaw face so that the dowels fit into the holes in the jaw. Then simply allow the magnets to pull the jaw face into position. The dowels stop the specimens pulling the jaw faces out during testing and the magnets keep the faces in their position. Do not force the jaw faces into position.

Setting the Pneumatic Pressure

Pressure regulators are found on the left hand side of the instrument

Figure 42: Setting pneumatic pressures

To reduce operator hazards and increase productivity, the integrated pneumatic module operates the jaws at very low pressure during the loading of the specimen. Only when the operator actually starts the test does the pneumatic module apply full clamping pressure.

Loading pressure
To set the loading pressure pull knob upwards until it clicks. Rotate to increase or decrease pressure. The maximum pressure is 2 bar but should be ideally set to one third of a bar. Press down once adjusted.

Testing pressure
Adjust the pressure as above using knob. The testing pressure can be set to a maximum of 7 bar. It is necessary to reduce the testing pressure when the jaws damage delicate fabric or yarn.

Do not set the testing pressure higher than 7 bar.

Auxiliary Connections

Connect the appropriate electrical power lead.
Connect the RS232 serial cable to Titan and the PC.
Connect the foot switch if required (recommended).
Connect the compressed air.
Finally, switch the instrument on.

Figure 43: Auxiliary connections (before and after)

Changing a Load Cell

Figure 44: Fitting a Load Cell

Titan is supplied with a load cell fitted.
This cell will be the largest capacity unit ordered.
Changing the load cell is a simple procedure.

Firstly remove the bottom jaw and simply disconnect the loadcell plug by pulling the serrated sleeve back.

Finally unscrew the load cell threaded capstan and remove the loadcell.

Position the required loadcell so that the square locator fits into the square hole in the threaded connector.

Screw the threaded capstan onto the threaded connector until it is hand tight; do not use any tools.

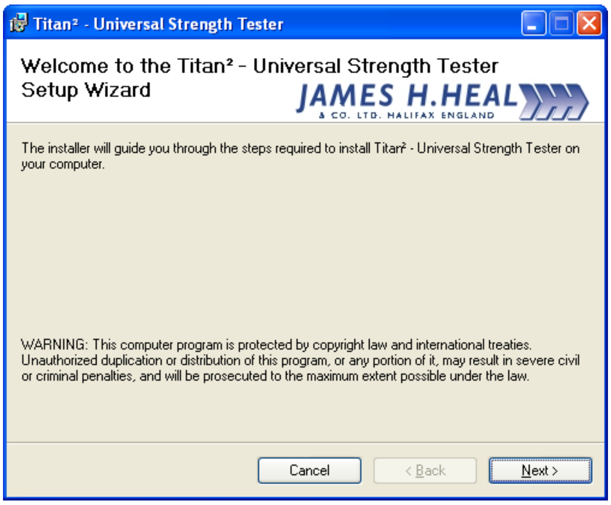
Push in the loadcell plug into the socket making sure that the red dot on the plug aligns with the red dot on the socket.

Minimum PC specification

Processor	2 GHz 32-bit processor or faster
RAM	1 GB of system memory
Operating System	Windows XP, Windows Vista, Windows 7
Graphics Card	512 MB of graphics memory
Monitor	17” LCD or CRT with minimum 800x600 pixels
Hard disk	80 GB (2 GB equates to about 1 year’s testing without archiving)
Optical Drive	DVD/CD-ROM drive compatible with CD-R media
Ports	RS232 serial port
Printer	Any Windows compatible printer

Please note:
James H Heal & Co Ltd have made every effort to ensure the Titan software is compatible with the above specification. The company cannot, however, accept responsibility for any additional or resident software which may compromise the operation of the PC and/or Titan software.

Software Installation Procedure

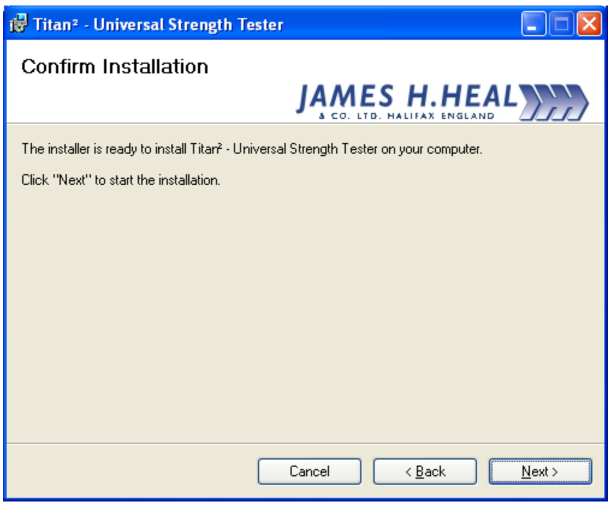


Stage 1

Insert the Titan Program CD.
After a few seconds the installation procedure should start automatically.

If it does not, then run setup.exe from the DVD/CD drive.

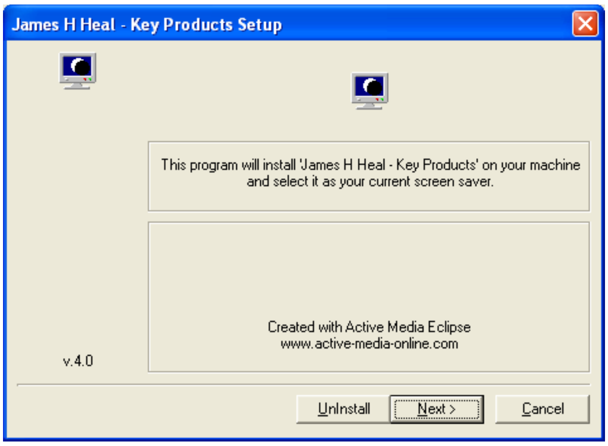
Click **Next** to continue.



Click **Next** to continue.

The Titan software begins to install.

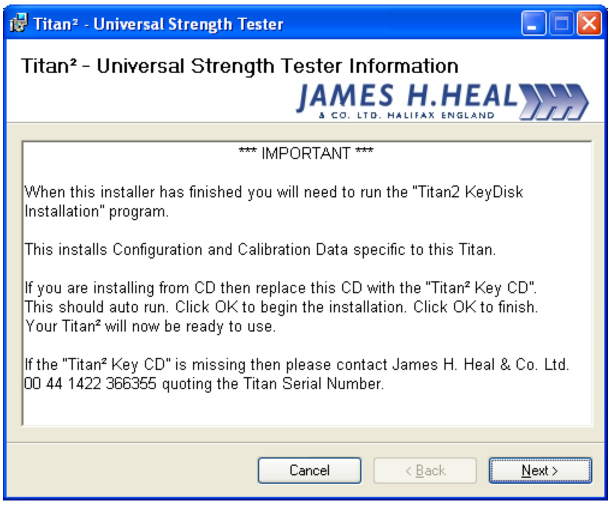
This will take several minutes.
Please wait.



Once complete the option of installing the "James H Heal – Key Products" screen saver can be made.

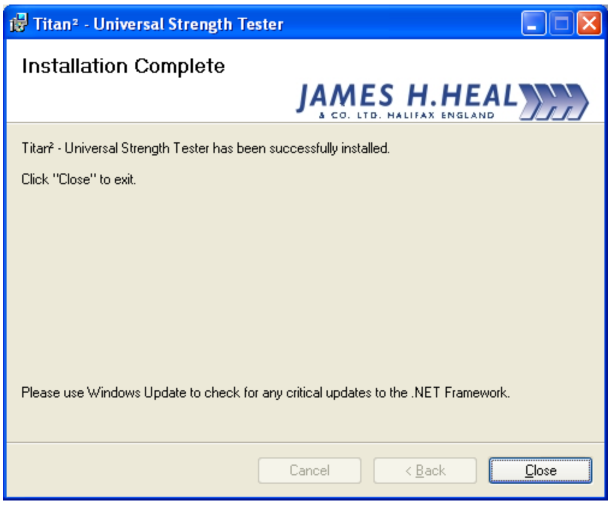
To skip and not install the screen saver, click Cancel.

Click Next to install screen saver.



This screen is advising you of the importance of the second stage of the software installation.

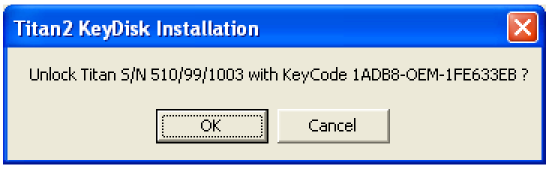
Click **Next** to continue.



Click **Close** to complete Stage 1.

Remove the Titan Software CD from the optical drive and store in a safe place.

Keep the .NET Framework up to date by using Windows Update.



Stage 2

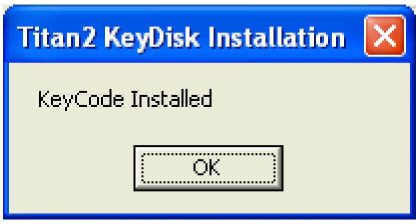
The KeyDisk determines Module permissions and is read every time the software is run. This is intended to ensure the user only has access to their permitted Modules. If this stage is skipped then a demo/trial version of Titan software is enabled.

Insert the Titan KeyDisk CD in to the optical drive.

After a few seconds the installation procedure should start automatically. If it does not, then run unlock.exe from the DVD/CD drive.

A message similar to that shown on the left should be displayed.

Press **OK** to continue.

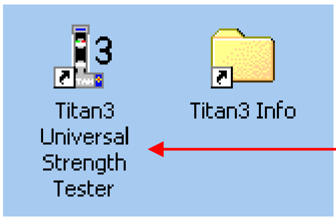


Click **OK** to complete Stage 2.

The Titan software is now ready for use.

Starting the Titan Software

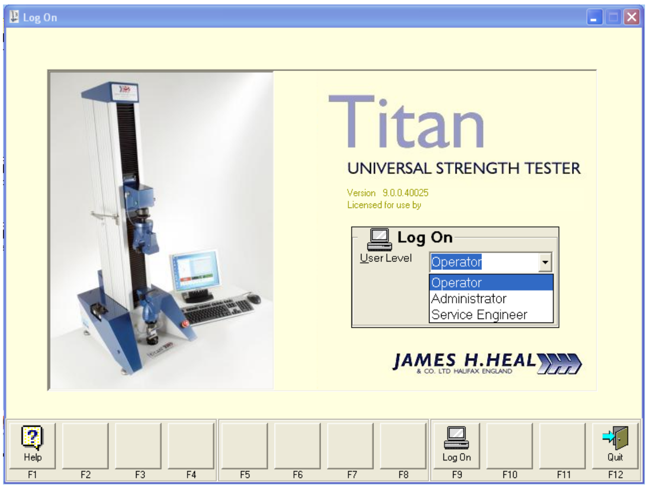
The installation program places two icons on the Windows Desktop of the Titan PC: the Titan Universal Strength Tester icon and the Titan Info folder. Both of these icons are Shortcuts.



Ensure the Titan instrument is set up correctly and switched on.

Double-click on the Titan Universal Strength Tester icon.

Please wait ... this may take a minute or two.



The Titan Log On screen is displayed.

The Log On User Level choices are:

1. Operator
2. Administrator
3. Service Engineer

Level 1 – User does not require a password, click Operator then click F9-Log On.

Levels 2 and require a password. The default password is "titan". Type the password and click F9-Log On.

You are now ready to start testing.

User Levels explained:

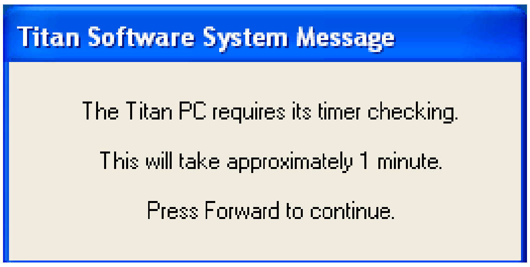
Operator – can carry out tests, save and print results.

Administrator – in addition to Operator functions can also modify settings and create or modify test routines.

Service Engineer – in addition to Administrator functions can also access the instrument function. This User Level should only be used by Healink Service Engineers.

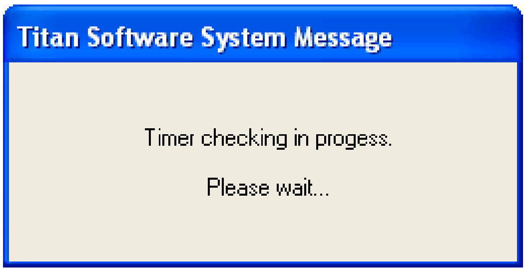
First Run

When the Titan Software is first run it needs to establish the speed of your PC hardware.



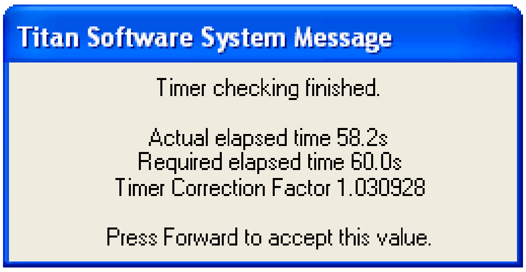
The first time you attempt to start a F3-New test this message will be displayed.

Click F9-Forward (or just press the F9 function key)



The Timer Check takes just over 1 minute.

Please wait ...



Click F9-Forward accept and save this value.

Dimensions	
Width	395 mm
Depth	570 mm
Height	1310 mm
Weight excluding fixtures	85 kg

Load	
Capacity	3000 N (Tension and Compression)
Accuracy	±0.5%
Range	1 - 100%
Available Loadcells	3000 / 600 / 120 N

Extension	
Maximum Speed	4000 mm/min
Testing/Return/Jog speed	2 - 4000 mm/min
Speed Accuracy	±0.005%
Maximum Stroke	600 mm
Total Vertical Space	840 mm
Positional Accuracy	±0.03 mm

Safety	
Gripping	Low pressure during specimen loading
Jaw Movement	Impact protection (Tension Only)
Loadcell	Force overload inhibit
Emergency Stop	Yes - located on front panel
Conformity	Complies with current CE Directives

Pneumatics	
Input Pressure	800 kPa (8 bar / 116 psi) - maximum
Test Pressure	800 kPa (8 bar / 116 psi) - maximum
Footswitch	Electronic footswitch control of pneumatic grips (software enable/disable)
Compressed Air Quality	Filtered to 5 microns (absolute) or better to remove excess particulates, oil and moisture

Control System	
Type	Constant Rate of Extension (CRE)
PC Control	Windows XP, Windows Vista or Windows 7 running dedicated Titan software
Drive Control	Digital precision closed loop AC servo system via RS232 serial port
Power Requirements	110-230V ± 10%, 50/60 Hz, 500W (mains electricity must be free from spikes and surges exceeding 10% of nominal voltage)

CE Compliance

Titan is CE marked.
It therefore complies with the following directives:

- Machinery Directive 2006/42/EC
- Low Voltage Directive 2006/95/EC
- Electromagnetic Compatibility Directive 2004/108/EC

Routine Maintenance

The Titan Universal Strength Tester is generally a maintenance free instrument as far as the user is concerned. The only customer maintenance required is to keep the instrument clean and free from debris and to apply a small amount of grease to the jaw mounting capstans if they start to bind or become difficult to remove and fit.

Servicing & Calibration are available world-wide – contact your local agent or HEALINK at James H Heal for further details. HEALINK is our totally comprehensive, world-wide support programme; it provides a range of services designed to maximise the potential of your testing resources. A brochure summarising the services is available on request.

Customer choosing a HEALINK Service & Calibration Contract are entitled to free Titan Software upgrades when they become available. The upgrade is normally carried out by the visiting HEALINK Engineer.

Contact: support@james-heal.co.uk

www.james-heal.co.uk

Remote Maintenance

New to Titan^3 Software is the ability to carry out Remote Maintenance via the internet. We use a software application known as Healink On-line Support. This application is located in the "Titan3 Info" folder which is installed to the user's desktop along with the "Titan3" shortcut.

In order to use this application the Titan PC must be connected to the internet with a broadband connection.

With the Healink On-line Support Application we can:

- Update Test Configuration Files
- Update Titan Software
- Interrogate the Titan PC remotely for problems.
- Provide online training and presentations (additional costs apply)

The Healink On-line Support Application is not troubled by firewalls, disabled ports and Network Address Translation (NAT) routers for local IP addresses and uses 256 bit AES encryption ensuring a secure connection. The key exchange also guarantees a full client-to-client data protection. This means that even the routing servers will not be able to read the data stream. The application will not run unless launched by the remote user, i.e., the customer. The customer can cancel the session at any time.

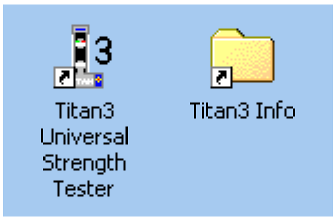
Before we can access your system, you supply us with a unique session id and password (by email or telephone), and once the session has ended we can no longer access your system. The Healink On-line Support Application is secured using VeriSign code signing technology. This allows you to verify the origin of any files you receive.

The Healink On-line Support Application also has Chat, VoIP and Video capabilities (subject to your hardware).

Launching the Healink On-line Support Application

Only launch the HealinkOS.exe program when requested by HEALINK or our Technical Team.
The HEALINK and Technical offices are only manned during UK office hours.

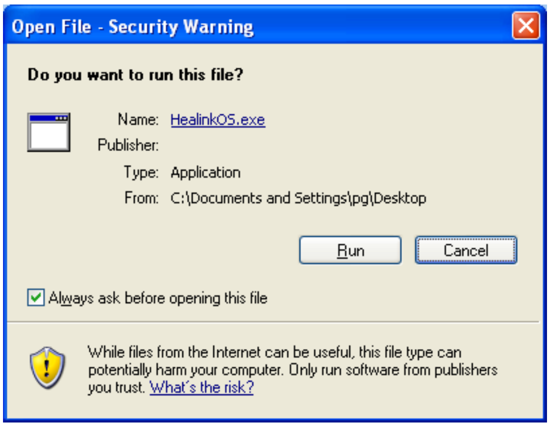
To launch the application from the Titan PC desktop:



For your privacy, please save your data and close any other running applications.

Open the **Titan3 Info** folder by double-clicking on it

Double-click on the HealinkOS icon



Dependent on your Windows Security Settings, you may be prompted with a message similar to this.

Uncheck (remove the tick from) the "Always ask before opening this file" and then click "Run".

The Healink On-line Support Application starts.

Follow the instructions in the window and wait for a member of Healink or the Technical Team to connect to your system.

At this point Healink will take control of your instrument and the Healink On-line Support Application will minimise to the Task Bar.

For your privacy, please close all other applications and refrain from using your keyboard and mouse.

Dependent on your PC hardware, we may send messages or instructions via the Chat Box or talk to you with the integrated VoIP system or by normal telephone. We may also use video during the session.

The Chat Box is part of the Healink On-line Support Application and is started by Healink.

See front cover for Publication number, e.g., 290-910-1$A.

Rev	Date	Originator	Details of revision
A	08-12-09	PG	Draft release
B	18-01-10	PG	First release
C	25-08-10	PG	Update to Installation – Compressed Air section