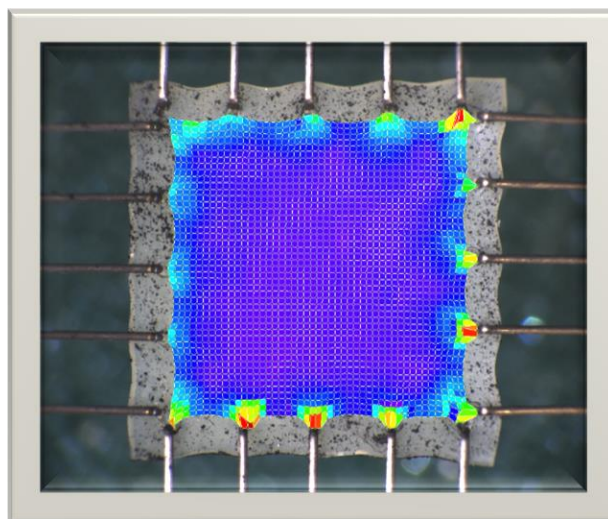




# Data Analysis

## Software

*User Manual*  
*version 1.2*



## *Mechanical measurement and analysis of materials*

CellScale provides scientific and medical researchers with turn-key systems for measuring the mechanical properties of materials. We provide user-friendly software, an easy-to-use patented attachment system, and effective data analysis tools.

Our foundation was laid at one of the world's leading research institutions – the University of Waterloo. We understand research and aim to provide effective solutions at a reasonable price.

Explore our web site [www.cellscale.com](http://www.cellscale.com) or contact us to learn more about our measurement systems.

© 2024 CellScale. All rights reserved. This material may not be reproduced, displayed, modified, or distributed without the express prior written permission of the copyright holder. For permission, contact CellScale Biomaterials Testing at [info@cellscale.com](mailto:info@cellscale.com).



Sales and Support  
CellScale Biomaterials Testing  
5–564 Weber St. N.  
Waterloo, Ontario, Canada N2L 5C6  
Phone: 519.342.6870

# Table of Contents

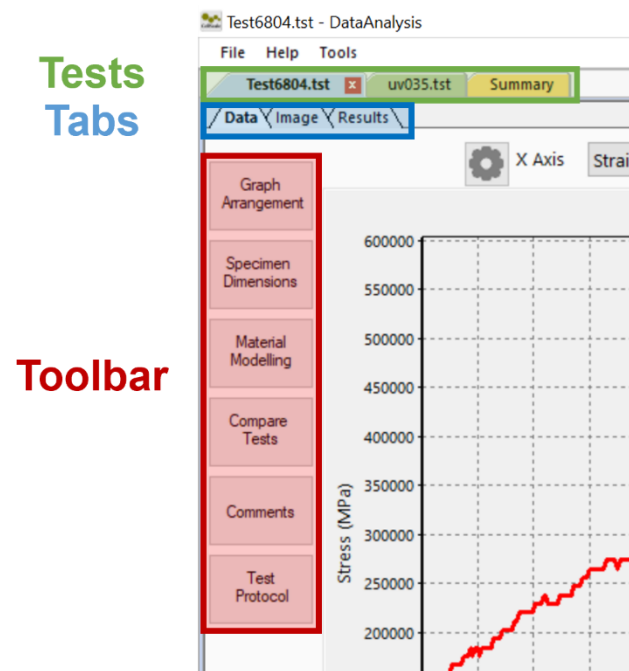
Overview .....	1
Analysis Templates .....	1
Data Tab.....	2
Overview .....	2
Graph and Axes .....	2
Current Point.....	3
Chart Filters .....	4
Curve Fitting.....	4
Graph Arrangement.....	6
Specimen Dimensions.....	6
Image Tab .....	7
Overview .....	7
Selecting Images.....	8
Image Playback Options .....	8
Feature Tracking: Overview .....	9
Feature Tracking: Display Options .....	12
Points (Grids).....	12
Displacements .....	13
Strains .....	14
Edge Tracking: Overview .....	15
Exporting Edge Tracking Data.....	15
Measurement Tools.....	16
Grid.....	16
Ruler.....	16
Scale Bar.....	17
Image Scale .....	17
Test Control Points.....	17
Image Arrangement.....	18
Data and Graph.....	19
Exporting Movies.....	19
Results Tab .....	20
Overview .....	20
Exporting Results .....	20
Toolbar Actions.....	21
Overview .....	21
Material Modeling .....	21
Compare Tests.....	22
Comments.....	23

Test Protocol.....	23
Tools.....	24
Test Renamer .....	24

# Overview

The Data Analysis software allows users to review, analyze, process, interpret and compare data and images collected by CellScale equipment. This includes graphing, curve fitting, material modeling and image processing to determine detailed strain maps.

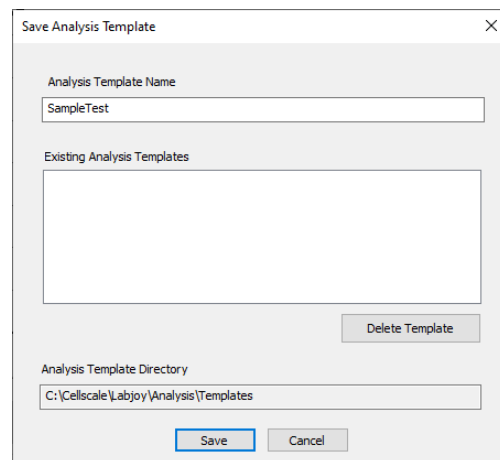
From the file menu select open and select a .tst file. This will open the test data and associated images (if collected) which will be shown in the following tabs: Data tab, Image tab, and Results tab. Multiple tests can be opened in the same session. A toolbar is shown on the left of every tab.



## Analysis Templates

All generated graphs, curve fits, material models, and display settings will be automatically saved with each test.

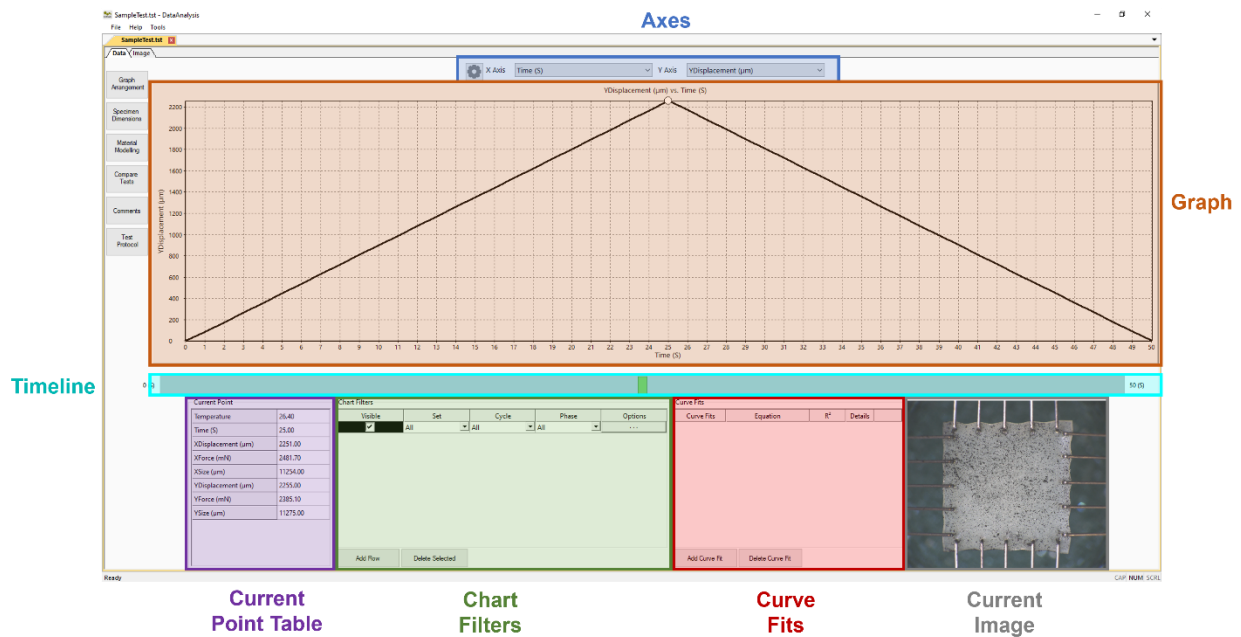
This information can also be saved as an analysis template by selecting *Save Analysis Template* from the File menu. Analysis templates can be applied to other tests with similar data by selecting *Load Analysis template* from the File menu.



# Data Tab

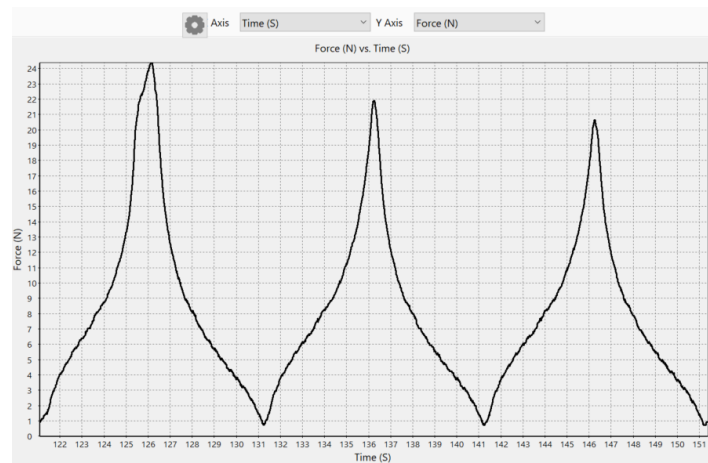
## Overview


The data tab is used to view and graph test data. The upper half contains the graph plot, graph axes selection, and timeline slider bar. The lower half of the tab contains the current point details table, chart filters and settings, curve fit creation and settings, and corresponding image (if applicable).



## Graph and Axes

The graph plot of the data set that can be used to visualize various data fields. To change what data is plotted on the graph, click on the X axis or Y axis drop down menu and select the desired field. The fields available to graph are the ones exported to the test .csv file during the data collection. Exported fields can be configured in the main data collection software during test setup and collection (i.e. select *Data Output* from the *Settings* menu of the data collection software).



Graph axes scaling and gridline ticks can be modified by selecting the gear icon  to the left of the axis drop down menus.

Graph Scaling

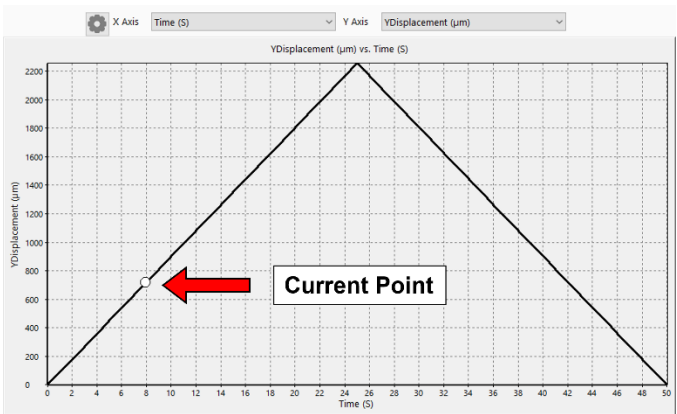
	Minimum	Maximum	Autoscale	Tick Intervals	Autoticks
X Axis	<input type="text" value="0.00"/>	<input type="text" value="50.02"/>	<input checked="" type="checkbox"/>	<input type="text" value="1.00"/>	<input checked="" type="checkbox"/>
Y Axis	<input type="text" value="0.00"/>	<input type="text" value="2255.00"/>	<input checked="" type="checkbox"/>	<input type="text" value="200.00"/>	<input checked="" type="checkbox"/>

OK

Cancel

Current Point

The white circular marker denotes the current position of the graph at the specified time. To change the current point, click and drag the green rectangular marker on the timeline slider located below the graph. Additionally, clicking on a new position on the plot will select a new current point. The details of the current data point are shown in the bottom left table. The corresponding image for the current point will also be shown in the bottom right (if images were collected during the test).



Current Point	
Temperature	26.40
Time (S)	8.00
XDisplacement (µm)	720.00
XForce (mN)	1001.00
XSize (µm)	9723.00
YDisplacement (µm)	718.00
YForce (mN)	957.50
YSize (µm)	9738.00

## Chart Filters

Chart filter can be applied to display specific portions of the data such as Set, Cycle, Phase, and Repeat. These settings are located in the lower centre portion of the window. To filter for a specific portion of data, select the desired section from the corresponding dropdown menu in the Set, Cycle, Phase, or Repeat column. Please note that changing the Set field will revert all other fields back to All.

To add an additional filter, click the *Add Row* button. Each filter can also be shown and hidden by toggling the visibility checkbox. To remove a filter, select the filter row and click the *Delete Selected* button or the delete key on your keyboard. The chart filter line colour, width, and style can also be modified for each line by clicking the options button located in the last column of each filter row.

Visible	Set	Cycle	Phase	Repeat	Options
<input checked="" type="checkbox"/>	A100	1	Compress	2	...
<input checked="" type="checkbox"/>	C25	2	All	2	...
<input checked="" type="checkbox"/>	B50	2	Recover	1	...
<input checked="" type="checkbox"/>	E1	3	All	2	...
<input checked="" type="checkbox"/>	D10	5	Recover	All	...
<input checked="" type="checkbox"/>	All	All	All	All	...

Add Row      Delete Selected

## Curve Fitting

The graph also supports five types of curve fits that can be applied to the graph lines: *Linear*, *2<sup>nd</sup> Order Polynomial*, *3<sup>rd</sup> Order Polynomial*, *Exponential*, and *Logarithmic*.

To apply a curve fit:

1. Click on *Add Curve Fit* in the curve fit table located in the lower right of the window. This will open a new dialog window.
2. From this window, select the curve fit type that best fits your data set from the dropdown menu.
3. Specify both the starting X point and the end X point by either typing the value of the desired point or clicking the crosshair button located beside the input box to select a point on the graph. The x value of the selected point will be defined as the start or end point of the curve fit.
4. Enter a name for the curve fit in the textbox.
5. Click the OK button to plot the curve fit. It will appear as a dotted line overlayed on the graph and as a new row in the curve fits table.

Add Curve Fit

Type: Linear

Start Point: 6.000000

End Point: 18.000000

Curve Fit Name: Linear Fit

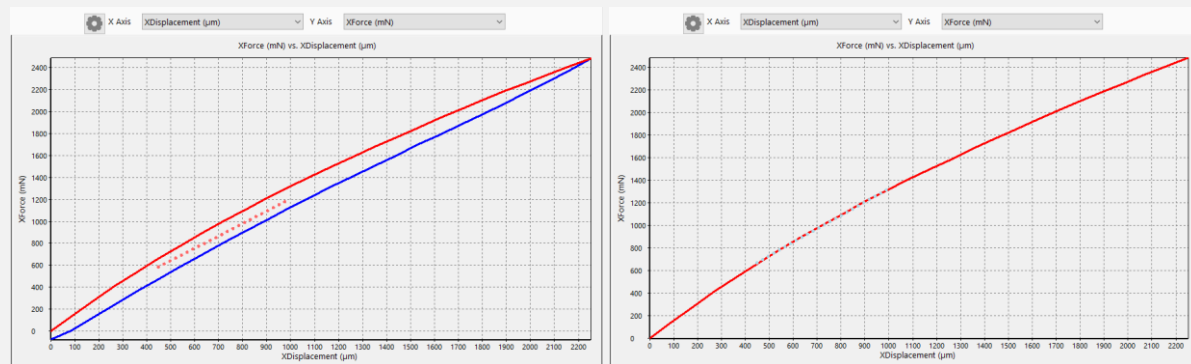
OK      Cancel



**Data Analysis Tip: Graph Axes and Chart Filters for Curve Fits**

Note all data visible between the start and end X point will be used for the curve fit calculation. Be sure to use the chart filters to only display the desired data prior to creating a curve fit. This is especially true for a graph that may double back on itself, such as force-displacement graphs for elastic materials.

For example, the graph below on the left displays a linear curve fit for the entire data set (stretch and recover phases). Whereas the graph on the right has a linear curve fit for only the stretch phase.



The current graph axes and chart filters will be applied to the curve fit details. These same settings must be visible and applied to view the curve fit.

Selecting the *Show* button will automatically change the graph axes and chart filters to display the desired curve fit.

The curve fit table shows details of the curve fit including: the name, the equation, and the  $R^2$  value. The (...) button in the Details column will open all the details of the curve fit including: the type, the equation and its coefficients, the start and end points, and the applicable chart filters. Curve fits also dynamically hide and show themselves based on currently displayed graph axes and chart filters. The *Show* button will automatically change the graph axes and chart filters to match that curve fit and display it on the main window.

Curve Fits				
Curve Fits	Equation	$R^2$	Details	
Linear	$y = 1.44x + 0.21$	0.994529	...	Show
2nd order poly	$y = 0.88x^2 + 0.93x + 0.28$	0.996736	...	Show
3rd order poly	$y = -1.11x^3 + 1.85x^2 + 0.66x...$	0.996520	...	Show
Exponential	$y = 0.31(\exp^{2.34x})$	0.994837	...	Show
Logarithmic	$y = 1.11 + 0.38 \ln x$	0.964977	...	Show

Add Curve Fit    Delete Curve Fit

Curve Fit

Type

Linear

Equation

$y = 0.05x + -170.74$

Slope

0.05

Y-Intercept

-170.74

Line Points

Starting Point

End Point

Time(ms)

8940.98

14139.81

Base Displacement(um)

262.13

513.83

Chart

Set

Cycle

Phase

All

All

All

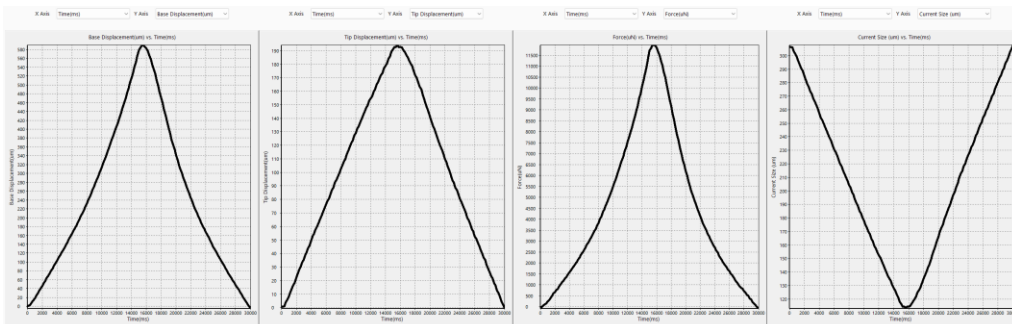
OK

## Graph Arrangement

The data tab also has multiple graph layouts to display up to 4 different graphs. To change the graph arrangement, click the *Change Arrangement* button in the Toolbar on the left side of the screen and select the desired layout.

With multiple graphs visible, the X and Y axis of each graphs can be changed to visualize and compare different forms of data. Manipulating the timeline slider below the graphs or clicking on a point on one graph will change the current point for all graphs. The current point table will only show the data for the current point of the graph last clicked on.

Multi-graph layouts also change how curve fits are applied. A curve fit will only apply to the graph most recently clicked on. The curve fit can also be applied to any additional graphs with the same axes and chart filters applied. When creating a curve fit, the start and end point must be from the same graph. This is especially important when using the crosshair button to manually select points on a graph.



## Specimen Dimensions

Stress and strain values can be calculated for the data set by specify the specimen dimensions. Click on the *Specimen Dimensions* toolbar button on the left side of the screen. In the dialog, specify the Specimen Type, the dimensions, and the gauge length. The specimen types available are rectangular, circular, irregular, and planar biaxial (for BioTester systems only). The other input fields will correspond to the specimen type selected. The gauge length and dimensions of the specimen can be entered in either micrometers or millimeters.

Once complete, stress and strain will appear in the X and Y axis dropdowns for the graphs as well as in the current point table. Stress is displayed in kilopascals (kPa) and strain is unitless. Specimen dimensions can be modified at any time by selecting the *Specimen Dimensions* button again.

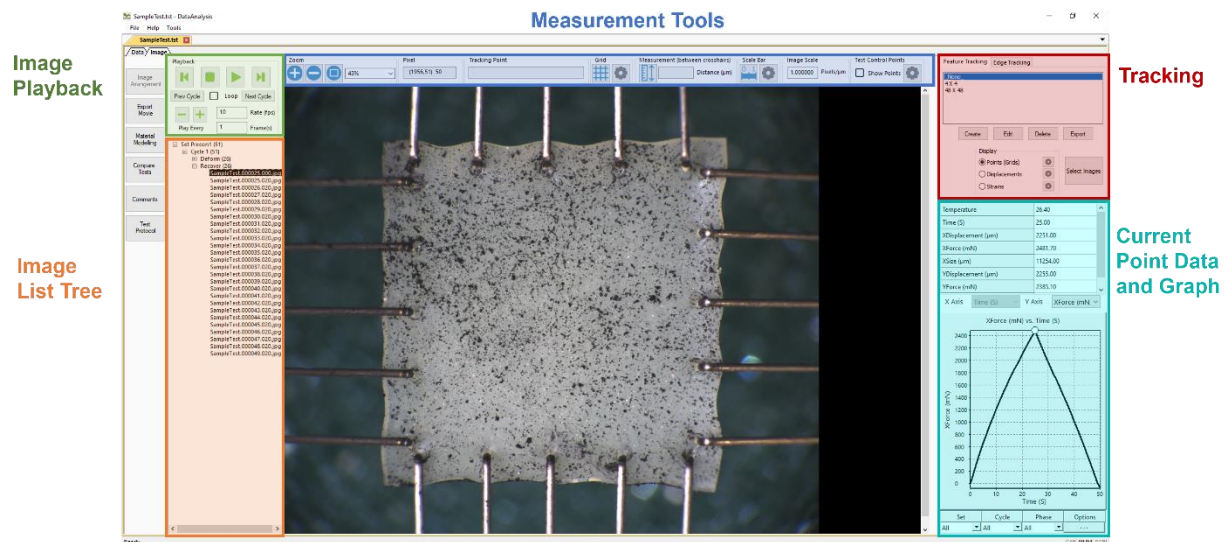
### **Data Analysis Tip: Stress and Strain Calculations**

The Data Analysis software utilizes Engineering Stress and Engineering Strain principles as well as the entered specimen dimensions to calculate stress and strain values.

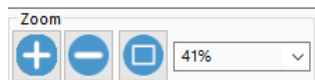
# Image Tab

## Overview

The image tab is used to view test images and create detailed strain maps. The image tab contains a list of all images associated with a test, playback tools, measurement tools, tracking tools, and a current point details table that corresponds to the displayed image. Movies can also be created from test images.



The zoom level at which images are display can be controlled with the zoom control:



The current mouse cursor position on the image (shown in brackets) and the pixel intensity at that location are displayed in the pixel information section next to the zoom control. Pixel values range from 0 (black) to 255 (white). Color images will show as an equivalent grayscale intensity.

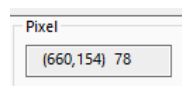


Image tracking is only available with images captured using a scientific camera. Currently supported devices include BioTester, MicroTester, and UniVert (with upgraded imaging package).

The base model UniVert includes a Logitech HD 1080p webcam intended to be used for recording images for image playback and review only. Image tracking is not supported for this camera.

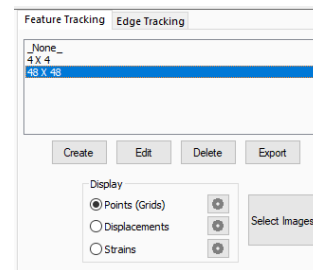
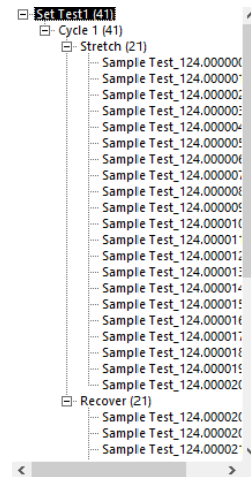
## Selecting Images

The images are shown in a tree structure on the top left panel. The tree structure organizes the images by:

- **Set:** a row within the test parameter window
- **Cycle:** an iteration of a given Set.
- **Phase:** a portion of a cycle which includes Preload, Stretch, Hold, Recovery, or Rest.
- **Image:** individual image(s) collected in each Phase

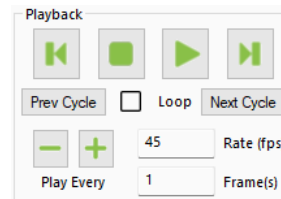
You can select which images to include in a playback set in one of several ways:

- Hold down the shift key and click on individual images
- Select entire sets, cycles, or phases (will playback all contained images)
- Select images associated with a particular tracking set (click the desired tracking set followed by the *Select Images* button next to the display options)



## Image Playback Options

Playback buttons allow the user to step through and review the images captured during a test.



Next/Prev	Display next or previous image (as dictated by "Play Every" parameter).
Play/Stop	Start and stop the playback.
Prev/Next Cycle	Jumps to a corresponding image and phase in the next or previous cycle. Useful when reviewing sets that have multiple cycles.
Loop	Sequences can be played continuously in a loop or only once.
Playback Rate	+/- changes the speed of the playback. A playback rate can also be manually entered in the display box.
Play Every	Allows the user to skip some frames to expedite playback.

## Feature Tracking: Overview

Feature tracking is a function that can be used to quantify the motions of image features (specimen texture and fiducial markers). This can be useful for studying localized specimen deformations, verifying strain magnitudes, and comparing the results of one test to another.

The image tracking engine is based on a template matching algorithm. This algorithm starts by defining a “patch” of pixels (called a template) surrounding the selected source point on the source image. It then determines the optimal location for this template on a target image within a specified search region.

The algorithm defines the location of the tracked point on the target image as the center of the optimally located template.

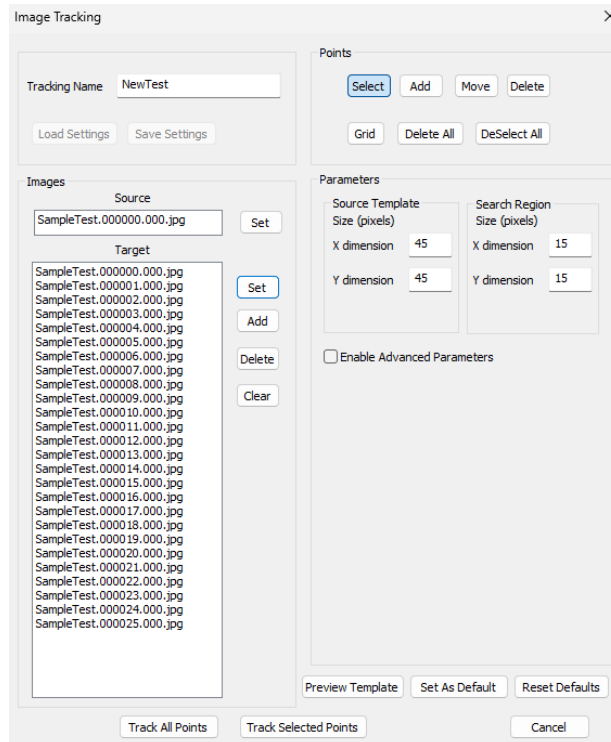
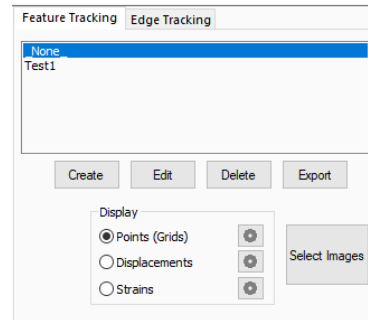
To track an image, follow these steps:

1. Select the Feature Tracking tab and click the *Create* (shown above). This will open the Tracking Editor dialog box.
2. Enter a Tracking Name.
3. Select *Source Image* in the test image list tree and click *Set* to the right of the Source box.
4. Select the *Target Images* in the test image list tree and click *Set* to the right of the Target box. The target image list will automatically be sorted to remove duplicates and be put in sequential order.
5. Generate source points on the source image by performing the following steps:
  - a. Manually click source point locations on the source image with the *Add* button depressed.

OR

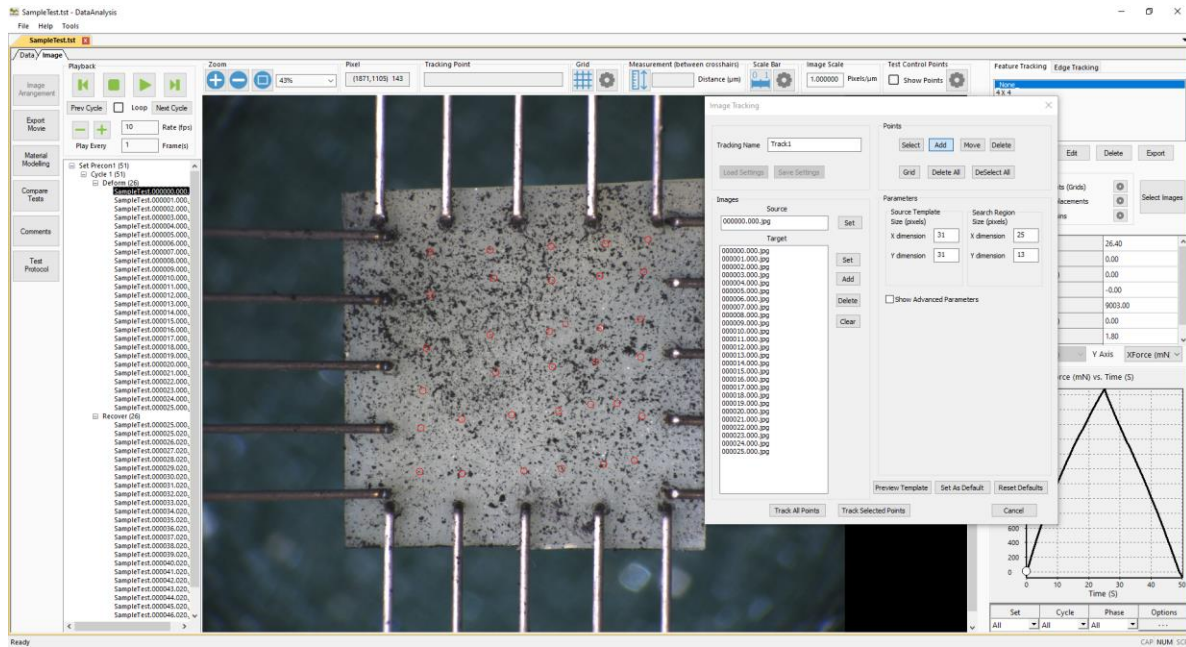
- b. Draw a box on the source image with the *Select* button depressed, then click the *Grid* button and define a grid of points.

The displayed image will automatically change to the source image when either the *Add* or *Grid* buttons are depressed.

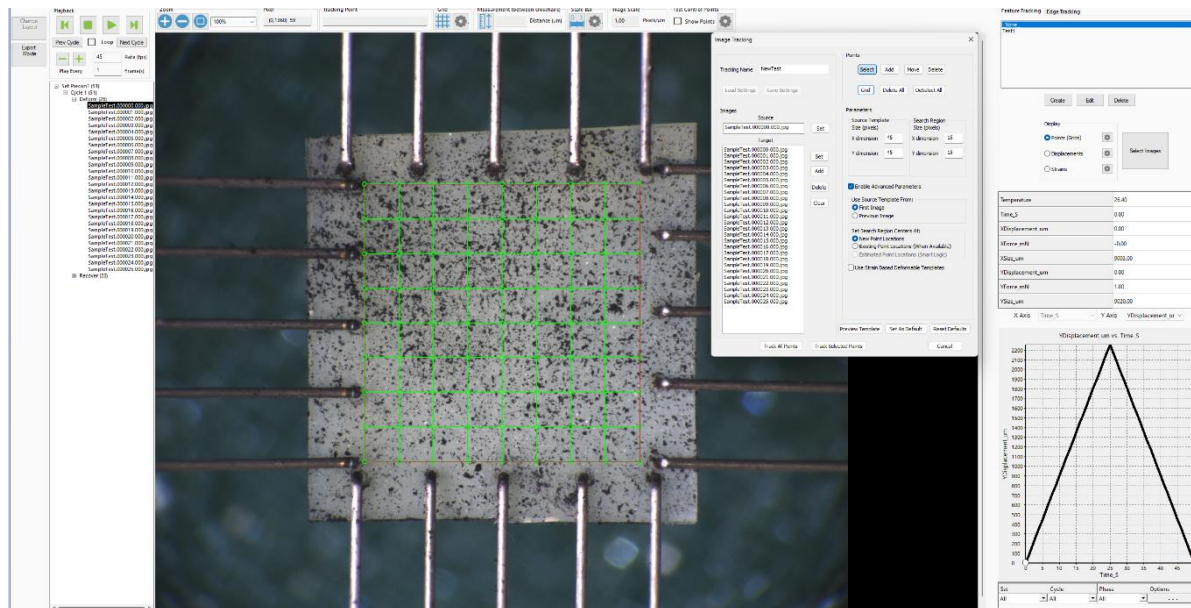




Manually selecting source points (shown as red circles) using the *Add* button (Step 5a):



Creating a grid of source points using the *Select* button (Step 5b):

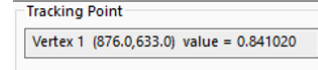


6. Modify search parameters as needed. To show Advanced Parameters, click the checkbox.

<b>Source Template</b>	The optimal source template is difficult to predict, but in general it is advantageous for the template to be large enough that it contains at least one feature, but not so large that it contains multiple features. Typical values for this parameter are between 15 and 55, with 35 being a good starting point for most users. Noticeable light/dark (grayscale) contrast is critical for the source template.
<b>Search Region</b>	The search region needs to be large enough that the optimal location for the template is found. In general, no part of the specimen moves more than the grips or platens, so the motion of these is a good guideline for how large the template needs to be. For example, if they move 50 pixels over the 10 frames you are interested in, it is unlikely that any part of the specimen is moving more than 5 pixels/frame and so a good value for the search region parameter would be 11 (5 pixels each way, plus the center pixel).
<b>Use Source Template From</b>	<p><b>First Image</b> tracks all images against the first in the series (1→2, 1→3, 1→4...).</p> <p><b>Previous Image</b> tracks each subsequent image against the image before it (1→2, 2→3, 3→4...).</p> <p>First Image Tracking tends to have poorer correlation than Previous Image Tracking because the current image is usually closer in content to the previous image than it is to the first image in the sequence. Previous Image Tracking tends to have good correlation for each individual step but is prone to error accumulation since each step is independent. The best method for a given data set will depend on the number of images and the content of the images. Sometimes it is best to use Previous Image Tracking but use every other image or every <math>n^{\text{th}}</math> image rather than all the images available. Sometimes it is best to use First Image Tracking and use every image but set the source image in the middle of the image series rather than at the beginning.</p>
<b>Set Search Region Centre</b>	<p><b>New Point Locations:</b> The location of the center of the search region is set to the same location of that point in the previous image (even when the source template is from the first image).</p> <p><b>Existing Point Locations:</b> The search region center location is set to the previously tracked location of that point. When no previously tracked point exists, the location is chosen in the same way as New Point Locations.</p>
<b>Use Strain Based Deformable Templates</b>	When this option is checked, the source template will be scaled according to strains calculated from the Size parameters from the test data. In other words, the source template will be deformed according to the displacement of the grips or platens at that point in the test. Best tracking results are often obtained when using this option. However, this option may not be the best for simple uniaxial tests or tests where the specimen deformation is non-uniform.

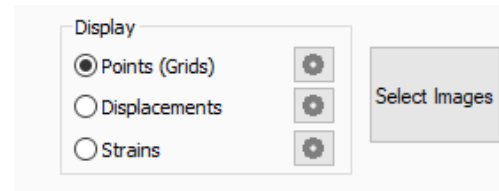
7. Perform tracking with either *Track All Points* or *Track Selected Points*.

Details of tracked points including pixel location and tracking correlation value can be displayed by hovering the mouse cursor over them. Tracking Point Information is located next to the measurement tools on the top of the image view.




## Feature Tracking: Display Options

The tracked features can be displayed in three ways: *points (grids)*, *displacements*, or *strains*. Select the desired Display by click on the radio button located on the right side of screen. See the following sections for more details about each one and the corresponding settings.



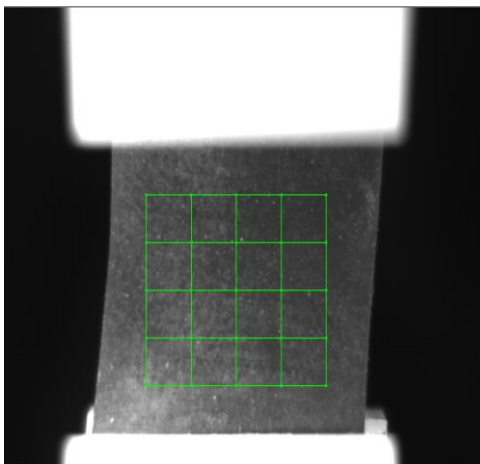
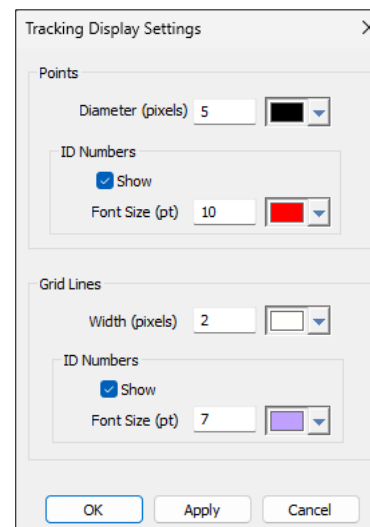
### Points (Grids)

The *Points* option displays the points in their current location (i.e. their location on the currently displayed image) with or without gridline connecting points that were generated using the grid function.

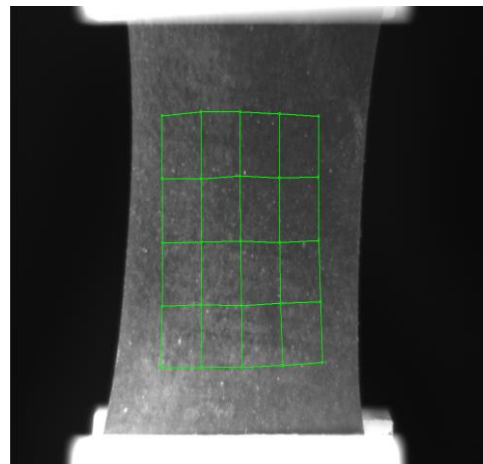
Clicking the gear icon  brings up the window shown to the right. Options include changing the point diameter or color, showing ID numbers, and showing gridlines with or without ID numbers.

Gridline ID numbers are associated with each grid square (cell), while Point ID numbers are associated with the points themselves.

Tracking display settings default to the last used settings.



*Initial tracking grid displayed as points.*




*Tracking to 33% strain displayed as points.*



## Displacements

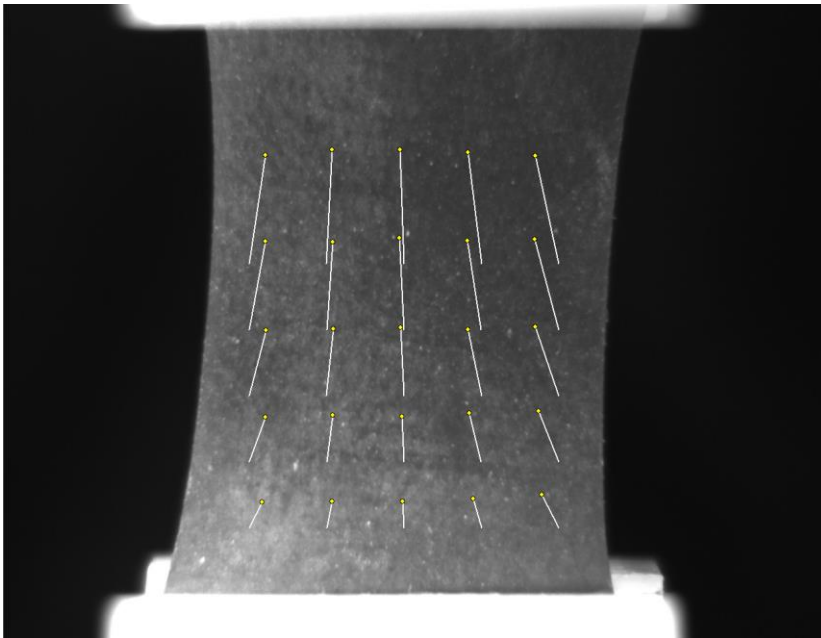
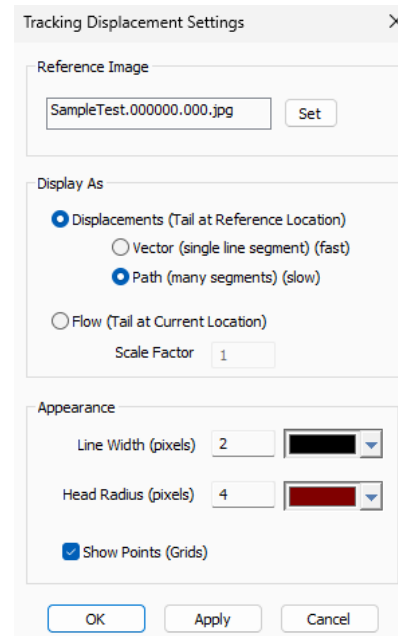
The *Displacements* option displays the points in their current location as well as graphically representing their motion through time.

Clicking the gear icon  brings up the window shown to the right. This dialog allows the user to change the reference image, change the type of connecting line, and change the line appearance.

Displacement connecting lines directly connect the reference and current points via a vector or a path. The path option provides more information but can result in slow playback speeds for sets with many points and/or many images.

The *Flow* option generates a direction vector based at the current location and oriented in the direction of motion relative to the reference image. This can be useful because the length of this vector can be scaled to better visualize small displacements.

Tracking displacement settings default to the last used settings.




*Tracking to 33% strain displayed as displacement.*

## Strains

The *Strains* Option can only be used in conjunction with a grid of points (as opposed to individually placed points).

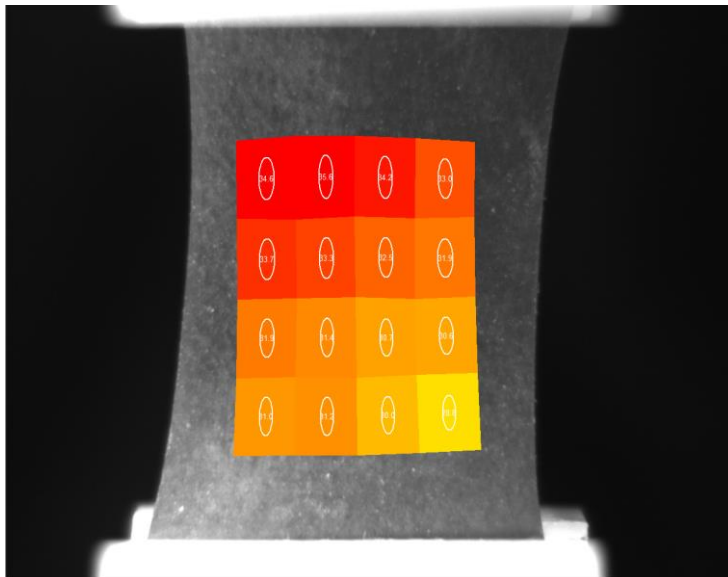
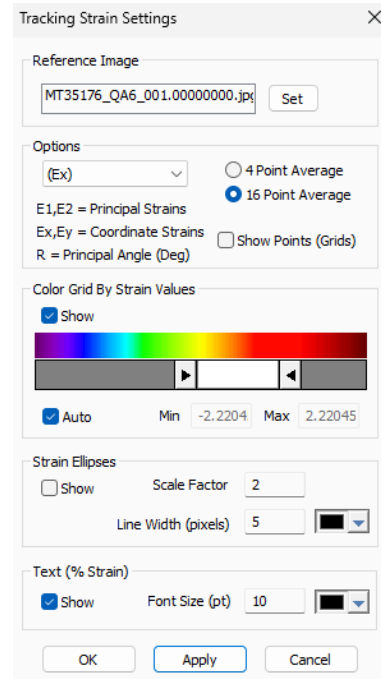
This option calculates the regional strains inside every grid box and displays this data as an ellipse. One can imagine this is what would happen to a grid of circles drawn on the surface of the specimen at the beginning of the test.

Clicking the gear icon  brings up the window shown to the right. This dialog allows the user to change the reference image as well as the appearance of the circles and text.

Showing text for E1, E2 will result in the text showing the principal strains along the major and minor axis of the ellipse. Showing text for Ex, Ey will result in text showing the strains along the X and Y directions regardless of the ellipse orientation.

A 4-point or 16-point average can be used to calculate the strain inside each grid box (each individual grid box or each box plus additional surrounding grid points).

Tracking strain settings default to the last used settings.



*Tracking to 33% strain displayed as strain ellipses with text showing x% strain.*

## Edge Tracking: Overview

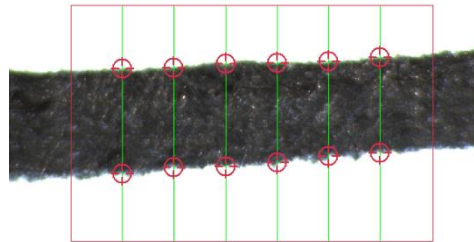
Edge tracking is an image processing function that can be used to find specimen edges in an image. Edge tracking can be useful for measuring the dilation of arteries or other vessels during inflation or stretching. Measurements are made in pixels and converted to  $\mu\text{m}$  using the current image scale.

To edge track an image, follow these steps:

1. Select the *Edge Tracking* tab and click the *enable* button in the tracking window (shown in the image on the top right).
2. Create a selection area by clicking and dragging on the image.
3. The selection area should then be filled in by a grid with crosshairs (shown in the image on the bottom right). The edge tracking tab should also now show the average dilation and a table containing the dilation for each line.
4. One can also change the number of dilation lines by entering a number in the *Number Of Lines* field.

Line Number	Dilation ( $\mu\text{m}$ )
Line 1	314.00
Line 2	300.00
Line 3	309.00
Line 4	299.00
Line 5	284.00
Line 6	286.00

298.67 Average Dilation Export Data



## Exporting Edge Tracking Data

Edge tracking data for a series of images, can be exported to a .csv file by selecting *Export Data* from the bottom right of the *Edge Tracking Tab*. The dialog shown on the right will be displayed. The image list is automatically set to the currently selected images in the test image list tree. This image list can be changed by selecting new images in the test image list tree and pressing the Add button.

Export Data

Image List

- Test011.000000.000.jpg
- Test011.000001.000.jpg
- Test011.000002.000.jpg
- Test011.000003.000.jpg
- Test011.000004.000.jpg
- Test011.000005.000.jpg
- Test011.000006.000.jpg
- Test011.000007.000.jpg
- Test011.000008.000.jpg
- Test011.000009.000.jpg
- Test011.000010.000.jpg

Export Directory: C:\CellScale\TestDataForDemo\EdgeTracking\Dilations8.csv

Export Cancel

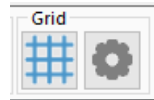
**Note:** Edge tracking must be enabled and a selection box must be drawn in order to properly export data.

## Measurement Tools

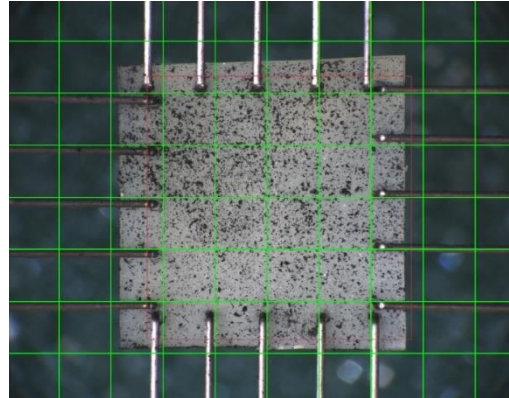
Data Analysis includes a variety of different measuring tools within the Image tab that allow you to easily measure any feature of your image. The measurement tools include a grid, a ruler, and a scale bar. Each one can be toggled on and off by clicking on their respective icons.

### Grid

The grid tool overlays a grid onto the image at a user defined space in micrometers. The default spacing is 100 micrometers.

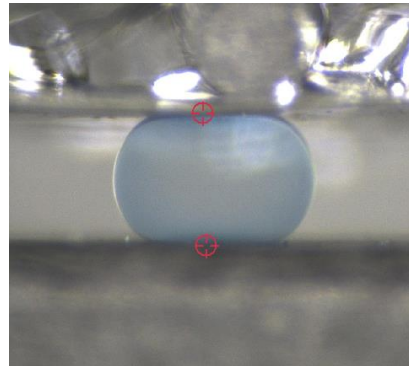
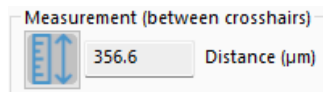


The spacing, line colour, and line width can be changed by clicking the gear icon. The current image scale is used to convert  $\mu\text{m}$  into pixels. The default image scale is 1 pixel/ $\mu\text{m}$  if no image scale is defined with the test data.



### Ruler

The ruler tool allows you to measure the distance between any points on the picture. To use the ruler, click the ruler icon to activate the tool.



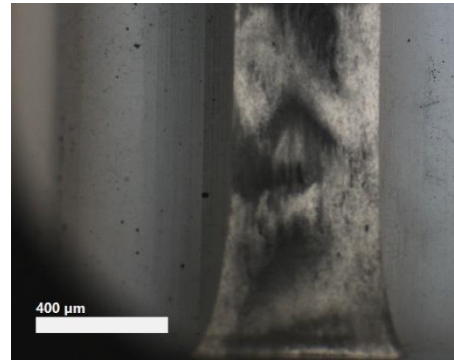
Once the tool is activated two crosshairs will appear on the screen. You can then drag the crosshairs around and place them on different points of the image to get measurements. The distance between the crosshairs is then displayed automatically in the text box beside the ruler icon. The current image scale is used to convert pixels into  $\mu\text{m}$ . The default image scale is 1 pixel/ $\mu\text{m}$  if no image scale is defined with the test data.

## Scale Bar

The scale bar tool provides a simple visualization tool for reference on the image. By default, the scale bar will appear in the bottom left corner of the image with a length of 100 micrometers.

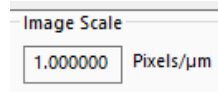


The scale bar length, colour, width, and the text colour can be changed by clicking the gear icon next to the scale bar icon. The current image scale is used to convert  $\mu\text{m}$  into pixels. The default image scale is 1 pixel/ $\mu\text{m}$  if no image scale is defined with the test data.



## Image Scale

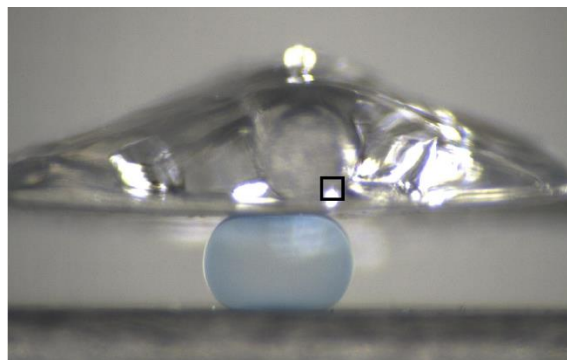
Image scale is used to convert pixels to  $\mu\text{m}$  and vice versa. If the image scale value was set during test collection, it will be imported here (e.g. MicroTester devices have image scales programmed as part of calibration processes). It can be modified by typing a new value into the textbox. Calculating the image scale typically involves imaging a ruler or target of known dimensions in the frame during test collection.



## Test Control Points

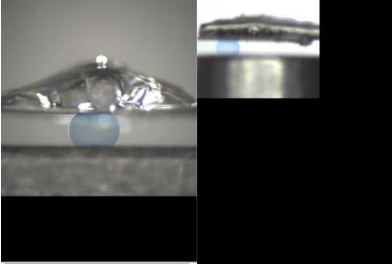
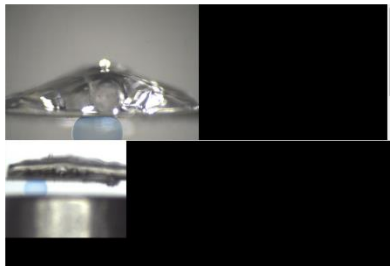
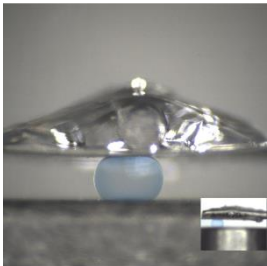
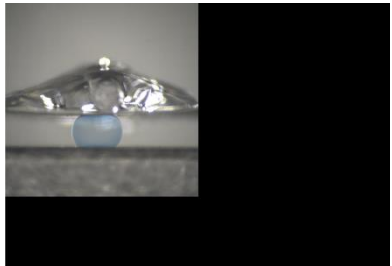

Some tests use control points to track parts of the image during test collection. For example, tests collected with the MicroTester G2 or LT use control points to track specimen deformations. To view where these control points are located, Click the *Show Points* toggle to see where the points are located. To modify the appearance of the test control points, click the gear icon next to the Show Points toggle. The shape of the control point, colour, radius, and line width.

**Note:** Not all images will have test control points.



**Image Arrangement**

Some CellScale devices allow for two cameras to capture images from multiple angles. To change the image arrangement, click the *Image Arrangement* button in the Toolbar on the left side of the screen and select the desired layout. The image arrangement layout options are:

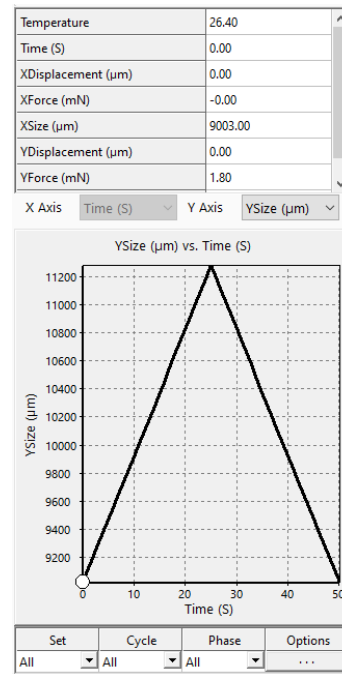
Side By Side	Display the primary image to the left of the auxiliary image.	
Above And Below	Display the primary image above the auxiliary image.	
Picture In Picture	Display the auxiliary image within the primary image. The auxiliary image can be moved within the primary image by clicking and dragging it.	
Primary Only	Display only the primary image.	
Auxiliary Only	Display only the auxiliary image.	

## Data and Graph

Data associated with each image is displayed below the tracking controls on the right side of the main window.

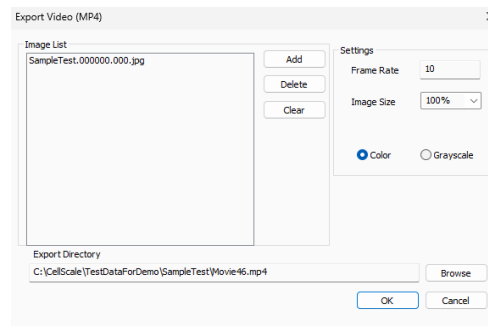
All the data associated with the image is shown in the data table. The graph below the data table shows a visual representation of how a data field changes over time. The specific data field used can be changed by clicking on the Y Axis dropdown and selecting a new field. There is also a marker on the graph which shows the position of the current image data with respect to the graph. The marker will continue to move along the graph as the images change.

Additionally, portions of the data set can be hidden or shown by manipulating the chart filters below the graph (see more information about how the chart filters in the Data tab section). When changing the chart filters, all images associated in the image list will automatically be selected.

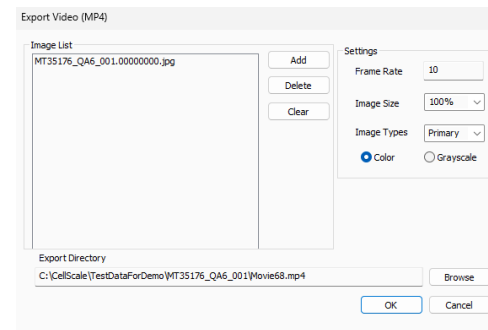


## Exporting Movies

A series of image views, including all displayed tracking grids, tracking data and overlaid data can be exported as a .mp4 file. To do so, select the *Export Movie* button from the toolbar on the left side of the screen. The image list is automatically set to the current image selection in the test image list tree. This image list can be changed by selecting new images in the test image list tree and clicking the *Add* button. Options are available for setting the frame rate or image size (resolution), adding filenames, and choosing color or grayscale output.



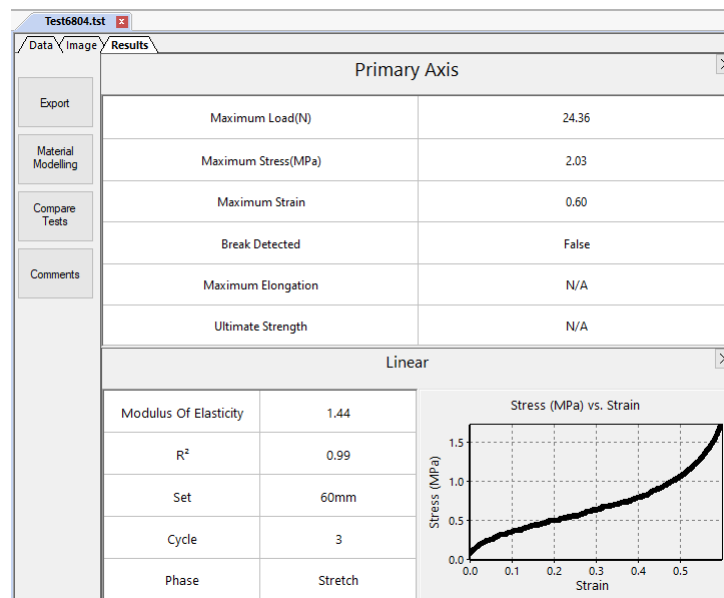
If the current test includes auxiliary images, another option will be displayed called *Image Types*. The additional dropdown menu will allow for primary images, auxiliary images, or both to be displayed in the exported movie.



# Results Tab

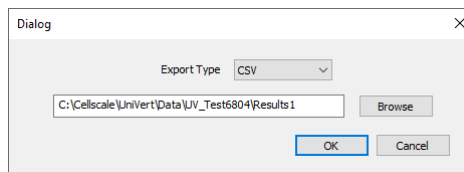
## Overview

The Results tab shows calculated material properties including a summary of maximum loads, stress and strain values, and a description of the calculated material properties (e.g. Modulus of Elasticity). Multiple calculations of material properties are possible using various portions of a data set. All available values will be displayed in the results tab. The results tab automatically appears after completing the *Material Modeling* section from the toolbar. Results can be removed by clicking the X in the upper right corner of each section.



## Exporting Results

The data generated in the Results tab can be exported as a .csv file by selecting *Export* from the toolbar on the left side of the screen.





# Toolbar Actions

## Overview

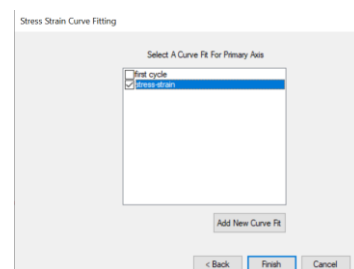
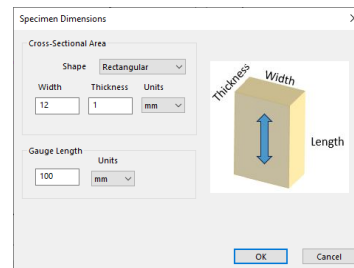
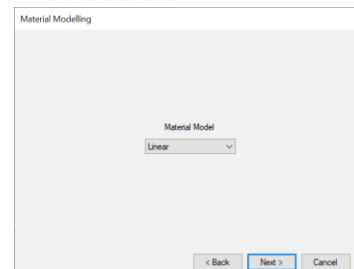
Each tab contains a toolbar on the left side of the screen. Some of the toolbar actions apply to specific tabs and are described in those sections of this manual. Toolbar actions that apply to the entire data set are:

<b>Material Modeling</b>	Guided process for determining material properties such as elastic (Young's) modulus
<b>Compare Tests</b>	Reporting of summary results and statistics across multiple tests
<b>Comments</b>	A section to review or add any notes taken during data collection
<b>Test Protocol</b>	Review the protocol executed during data collection

## Material Modeling

Material properties can be calculated by clicking on the *Material Modeling* toolbar button. A series of dialogs will appear that guide the process as follows:

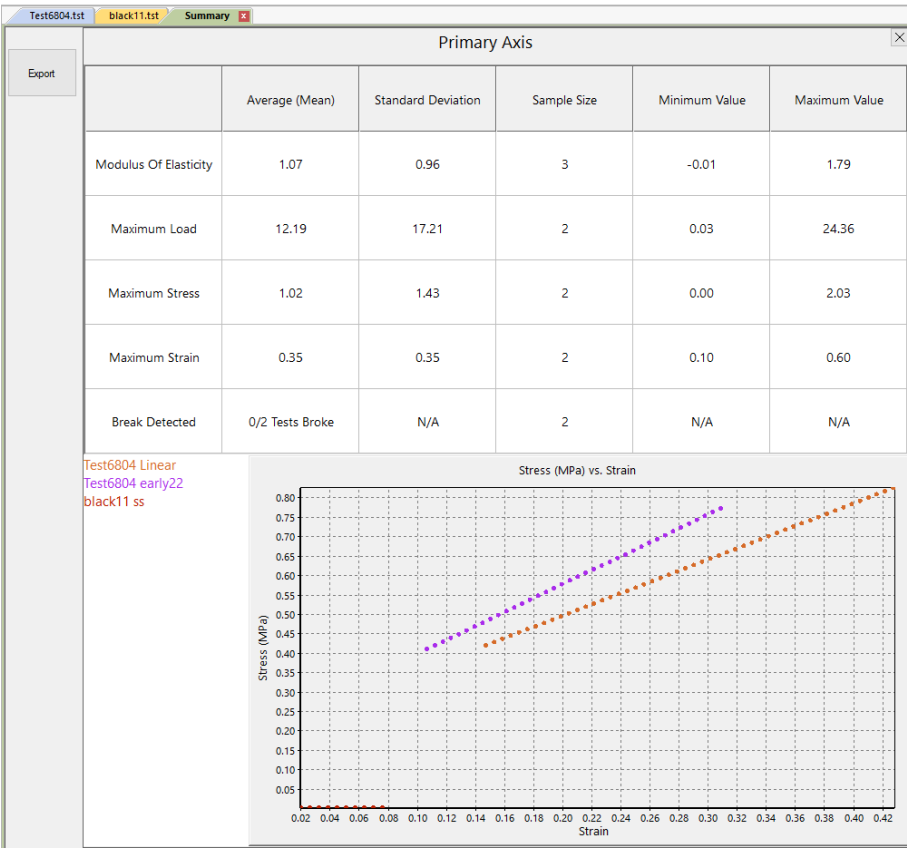
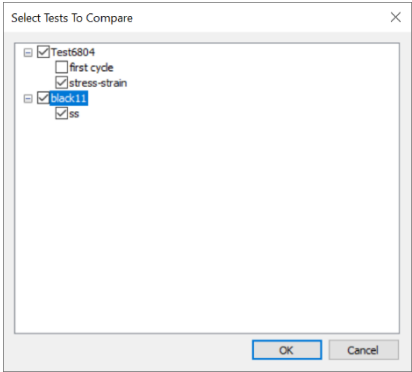
1. Choose the type of material model.  
Currently, only Linear models are supported.
2. Review or enter specimen dimensions.  
See *Specimen Dimensions* in the Data tab section.
3. Select a stress-strain curve fit to use for calculating material properties. A new stress-strain curve can also be created at this time by pressing the *Add New Curve Fit* button.



After clicking the *Finish* button, the results will be computed and displayed in the Results tab. See *Results Tab* section for more details.

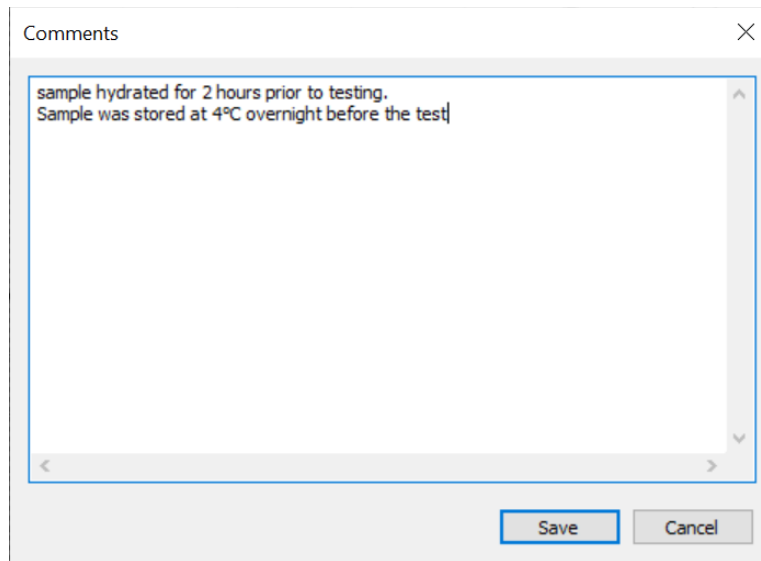
## Compare Tests

Results from different curve fits and from different tests can be compared and averaged by clicking on the *Compare Tests* toolbar button on the left side of the screen. Select all the desired curve fits to compare in the dialog. Comparison results are placed in a new *Summary* Tab.



## Comments

Comments created during the test collection can be reviewed and added to by clicking on the *Comments* toolbar button on the left side of the screen.

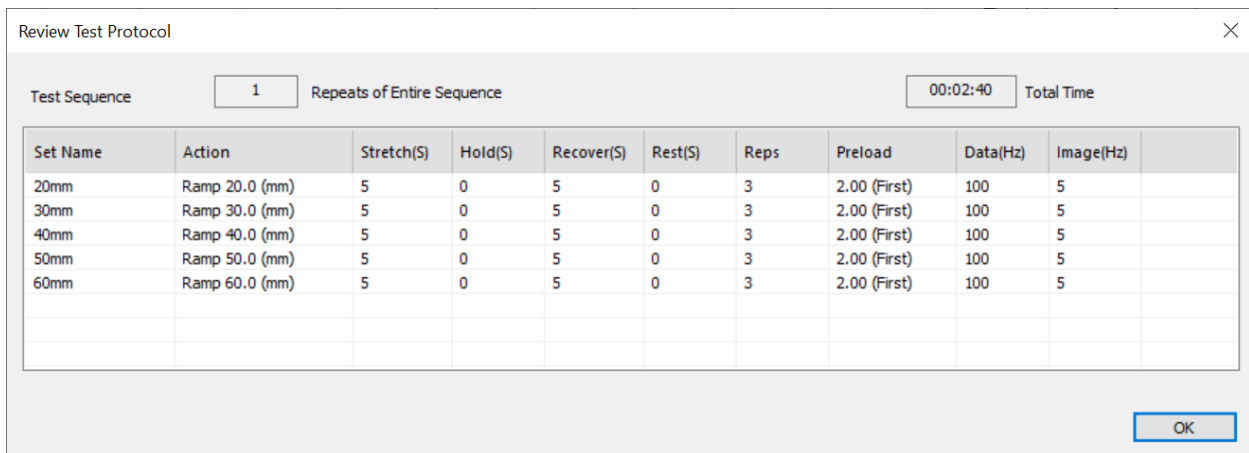


A dialog box titled "Comments" with a close button (X) in the top right corner. It contains a text area with the following text: "sample hydrated for 2 hours prior to testing. Sample was stored at 4°C overnight before the test". Below the text area are two buttons: "Save" and "Cancel".

Typical comments can include notes about sample preparation, test conditions, observations, or recommendations.

## Test Protocol

The test protocol can be reviewed at any time by clicking on the *Test Protocol* toolbar button on the left side of the screen.



A dialog box titled "Review Test Protocol" with a close button (X) in the top right corner. It contains a table with the following data:

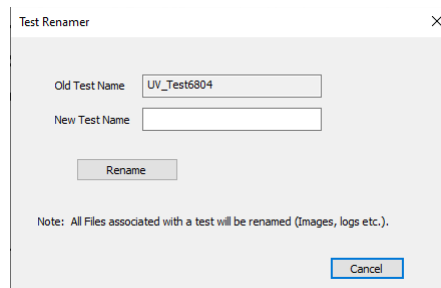
Set Name	Action	Stretch(S)	Hold(S)	Recover(S)	Rest(S)	Reps	Preload	Data(Hz)	Image(Hz)
20mm	Ramp 20.0 (mm)	5	0	5	0	3	2.00 (First)	100	5
30mm	Ramp 30.0 (mm)	5	0	5	0	3	2.00 (First)	100	5
40mm	Ramp 40.0 (mm)	5	0	5	0	3	2.00 (First)	100	5
50mm	Ramp 50.0 (mm)	5	0	5	0	3	2.00 (First)	100	5
60mm	Ramp 60.0 (mm)	5	0	5	0	3	2.00 (First)	100	5

Below the table is an "OK" button. Above the table, there are fields for "Test Sequence" (1) and "Repeats of Entire Sequence" (00:02:40) with a "Total Time" label.

# Tools

## ***Test Renamer***

The Test Renamer tool will modify all associated files for a test to a new name. Select Test Renamer from the Tools menu, enter a new name for the current test file, and click the *Rename* button. This tool will safely rename all associated images, data files, log files, and folders associated with a test. It is crucial for all test files to have the same prefix filename for proper function within the Data Analysis software.



The screenshot shows a dialog box titled "Test Renamer" with a close button (X) in the top right corner. Inside the dialog, there are two text input fields. The first field is labeled "Old Test Name" and contains the text "UV\_Test6804". The second field is labeled "New Test Name" and is currently empty. Below these fields is a button labeled "Rename". At the bottom of the dialog, there is a note that reads "Note: All Files associated with a test will be renamed (Images, logs etc.)." and a "Cancel" button.