Instron
Bluehill
Calculation Reference

Reference Manual - Software

Manual Number   Help Version 1.1

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Calculation Reference

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Version

Bluehill Help Version

V1.1

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Calculations

There are six calculation libraries and different combinations are loaded by default when you open a particular test type.

The software is set up to make available only those calculations that are applicable to the current test type. If you prefer, you can configure the system to always include all the calculations from all the test types that you have purchased. You can choose this option in the **Admin** tab by selecting **Configuration - Options**. and checking the **Show all available calculations in all test types** box.

The first section in this document contains two tables. The first one shows the contents of each calculation library and the second shows the default libraries loaded for each test type.

Each calculation is then described in a separate section. The calculations are listed in alphabetical order of the calculation title.

The last two sections provide:

- a table of the channels that can be used as inputs for calculations for the different test types

- a comprehensive channel reference

Calculation Libraries and Test Types

There are six calculation libraries and different combinations are loaded by default when you open a particular test type.

The following table shows the contents of each library:

Base	General	Creep/ Relaxation	Metals	Peel, Tear, Friction	User Calculations
Break	Slack correction	Creep/ Relaxation	Yield point extension	First peak	User calculation
Break location	Modulus	Hold preset point	Tensile strength	Average value	
Absolute peak	Yield		Non-proportional elongation	Coefficient of friction	
Local peak	Area Reduction		n-value		
Percent of break	Poisson's ratio		r-value		
Preset point	Compliance correction				

Notes:
Compliance correction is not a true calculation, and is not available in the Peel, Tear, and Friction test type.

Slack correction also includes gauge length correction, but not in Peel, Tear, and Friction or Flexure test types

The following table shows the default libraries loaded for each test type:

Test Type	Libraries loaded (by default)					
Tension	Base	General				User calculation
Tension, Creep, Relaxation	Base	General	Creep/ Relaxation			User calculation
Compression	Base	General				User calculation
Compression, Creep, Relaxation	Base	General	Creep/ Relaxation			User calculation

Flexure	Base	General				User calculation
Flexure, Creep, Relaxation	Base	General	Creep/ Relaxation			User calculation
Peel, Tear, Friction	Base	General		Peel, Tear, Friction		User calculation
Metals	Base	General			Metals	User calculation
Tension Profile	Base	General	Creep/ Relaxation	Peel, Tear, Friction		User calculation
Compression Profile	Base	General	Creep/ Relaxation	Peel, Tear, Friction		User calculation

Note: Coefficient of friction is only available in the Peel, Tear, and Friction test type.

% of Break

This calculation is a special kind of preset point calculation, where the preset point is defined as a percentage of the value of a channel at break.

Parameters

You must specify:

- a channel.

- a value for the percentage of break between 0 and 100.

The system includes the percentage of break value with the calculation description when you add it to the **Calculation list**. For example, if you choose Tensile Extension at 50% of break, the description appears as:

50% of Break (Tensile extension)

You have the option to:

- edit the calculation description by clicking in the **Description** field and typing new or additional details. Any changes to the description appear in the **Calculation list** and results table.

- indicate the break point on the graph by clicking in the **Indicate on graph** check box.

Algorithm

The system:

- uses a break point determined by a previous calculation as a starting point.

- determines the value at the break point of the channel that you specified.

- determines the value of the same channel that corresponds to the percentage of break that you specified.

Results

All channels in the system are available.

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Example

In this example, the percent of break is set for 50% extension. The result required is **Load**. After performing the break calculation, the system determines the value of extension at break. If this value is 100mm, then the value of extension at 50% of break is 50mm. The result is therefore the value of load when extension is 50mm.
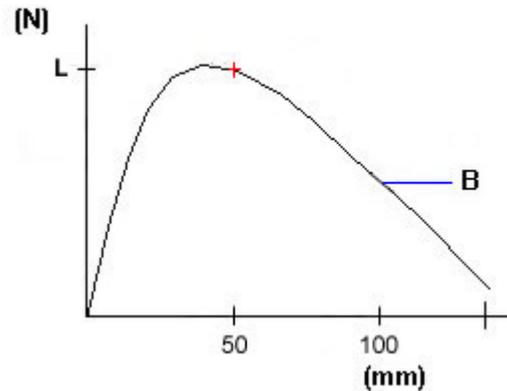
B = break point

+ = 50% of break marker

L = load at 50% of break

Fails to Calculate

The algorithm will not calculate a result if:

- the break calculation that it depends on is not calculated.

Channels used as inputs for the calculation

The channel designated for Stress, Load, Strain and Extension varies according to the test type. Refer to Channels for Calculations.

Absolute Peak Calculation

Library - Base

This calculation detects the maximum peak value on the channel you specify.

Absolute Peak Parameters

You must specify:

- a channel

- a peak type, either maximum or minimum
  Selecting a minimum peak will detect the lowest value. Conversely, a maximum peak detects the highest value

When you select an absolute peak calculation, the peak type and channel labels appear in the **Description** field. For example, if you select the compressive strain channel with a maximum peak type, the calculation description appears as:

Maximum Compressive Strain

You have the option to:

- edit the calculation description by clicking in the **Description** field and typing new or additional details. Any changes to the description appear in the **Calculation list** and results table.

- place an absolute peak point marker on the graph by clicking in the **Indicate on graph** check box.

Absolute Peak Algorithm

The system:

- searches all the data on the channel you specified.

- (if you specified maximum) sequentially compares each point with the highest point found so far to determine the absolute maximum.

- (if you specified minimum) sequentially compares each point with the lowest point found so far to determine the absolute minimum.

- assigns that point as the peak.

Peak Results

All channels in the system are available.

Note: For metals testing only, absolute peak should not be used to detect the upper yield point or tensile strength point since it cannot distinguish between them.

Absolute Peak Example

In this example, the parameters are set to a minimum peak type on the **Load** channel. The system detects a peak at 30kN because this point is the lowest data point in all the data. The **Time** channel result at the minimum peak is 5.0 seconds. For a maximum peak, the system detects a 50N peak at 10.0 seconds.

+ = Peak Marker

A = Minimum Peak

B = Maximum Peak
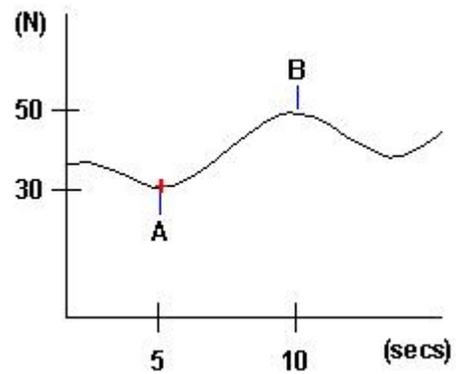
Area Reduction Calculation

Library - General

This calculation meets the requirements for the EN10002 and ASTM E8 standards. It determines the difference between the initial specimen area and the final specimen area, expressed as a percentage of the initial specimen area. You enter the initial dimensions before a test and the final dimensions after a test. You can enter the dimensions manually or with a measuring device.

Area Reduction Fails to Calculate

The algorithm will not calculate a result if you do not enter the parameters required to determine the final area.

Area Reduction Results

Reduction of Area

Initial Area

Final Area

Automatic Modulus

This calculation determines the slope of the stress/strain curve by using fixed parameters.

Note: For metals testing, automatic modulus should not be used because the range determination is not current for metals. Other modulus types can only be used if a suitable range is entered.

Parameters

You must specify the **Automatic** type of modulus.

When you add the calculation to the **Calculation list**, the description appears as:

Modulus (Automatic)

You have the option to:

- edit the calculation description by clicking in the **Description** field and typing new or additional details. Any changes to the description appear in the **Calculation list** and results table.

- place a modulus line on the graph by clicking in the **Indicate on graph** check box.

Algorithm

The system:

- searches the data from the first data point to the maximum load value.

- uses the first data point and maximum load point as the start and end values respectively.

- divides the data between the start and end values into 6 equal regions with 0% overlap.

- applies a least square fit algorithm to all of the points in each region to determine the slope of each region.

- determines the pair of consecutive regions that has the highest slope sum.

- from this pair, determines which region has the highest slope and assigns the modulus to that region.

Example

In this example, the first data point, 0 kN, is the start value and 5 kN is the end value. The third region within the start and end values has the greatest slope, therefore the system constructs a modulus line along the slope of that region.
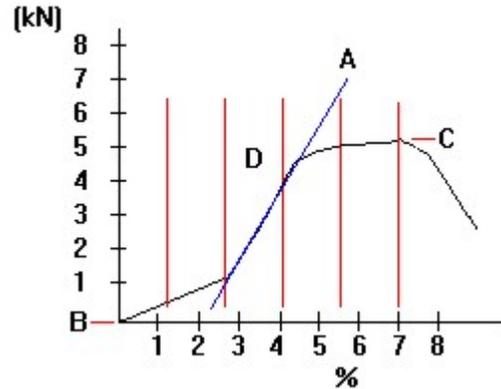
A = Modulus Marker

B = Start Value

C = End Value

D = Greatest Slope

Fails to Calculate

The algorithm will not calculate a result if there are fewer that two data points between 2% of maximum load and maximum load.

Results

X-Intercept
Y- Intercept
Modulus

Channels used as inputs for the calculation

The channel designated for Stress, Load, Strain and Extension varies according to the test type. Refer to Channels for Calculations.

Average Value (All Peaks)

This calculation accumulates all peaks in the user-specified range of data to determine an average value.

Parameters

You must specify:

- **All Peaks** type of average value calculation.

- start value or channel. This can be a channel or a particular data point such as the first peak.

- start value in the units of the start value channel unless the start value is first peak.

- end value channel.

- end value in the units of the end value channel.

- sensitivity as a percentage of the maximum load.

The system includes the type of average value calculation in the calculation description when you add the calculation to the **Calculation list**. For example, if you select an **All Peaks** type of calculation, the description appears as:

<div align="center">

Average Value (All Peaks)

</div>

You have the option to:

- edit the calculation description by clicking in the **Description** field and typing new or additional details. Any changes to the description appear in the **Calculation list** and results table.

- place an average value marker on the graph by clicking in the **Indicate on graph** check box.

Note: If the Average Value region start channel is First Peak or % Peel Length, the system retrieves the index of the First Peak from the parent First Peak calculation.

Algorithm

The system:

- searches all the data between the start and end values you specified.

- using the sensitivity you specified, determines the value of all the peaks.

- accumulates all the peaks in the Average Value region.

- calculates the average value result by dividing the value of the accumulated peaks by the number of peaks accumulated.

Example

In this example, **Start** is set for the **Time** channel with a **Start value** of 2.0 seconds and an **End value** of 8.0 seconds. **Sensitivity** is set to 25 % which detects a 2 kN rise and fall in load. The system detects three peaks which have an average value of 7.7 kN.

A = Start Value

B = End Value

C = Average Value
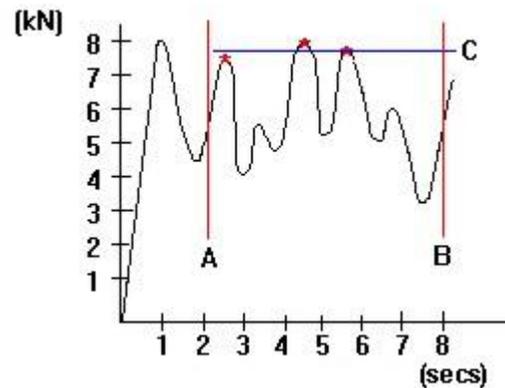
Fails to Calculate

The algorithm will not calculate a result if:

- no peaks were found in the data,

-or-

- the parent First Peak calculation failed,

-or-

- the start and/or end point was not found.

Results

Average Load
Average Load/Width
Start Energy
Delta Energy
Delta Peel Extension
Number of Peaks
Number of Troughs
Median Peak
Peak Range

Channels used as inputs for the calculation

The channel designated for Stress, Load, Strain and Extension varies according to the test type. Refer to Channels for Calculations.

Average Value (Automatic Peaks)

Library - PTF

This calculation examines the number of peaks found in the data to determine which evaluation method to use.

Parameters

You must specify:

- **Automatic Peaks** type of average value calculation.

- start value or channel. This can be a channel or a particular data point such as the first peak.

- start value in the units of the start value channel unless the start value is first peak.

- end value channel.

- end value in the units of the end value channel.

- sensitivity as a percentage of the maximum load.

- Method A limit as a number of peaks.

- Method B limit as a number of peaks.

- Method C as a number of regions.

The system includes the type of average value calculation in the calculation description when you add the calculation to the **Calculation list**. For example, if you select a **Automatic Peaks** type of calculation, the description appears as:

Average Value (Automatic Peaks)

You have the option to:

- edit the calculation description by clicking in the **Description** field and typing new or additional details. Any changes to the description appear in the **Calculation list** and results table.

- place an average value marker on the graph by clicking in the **Indicate on graph** check box.

Algorithm

The system:

- searches all the data between the start and end values you specified.

- using the sensitivity you specified, determines the value of all the peaks.

- if the number of peaks found is less than or equal to the value you specified for Method A limit, accumulates all the peaks in the data.

- if the number of peaks found is greater than the value you specified for Method A limit or less than or equal to the value you specified for Method B limit, finds the first peak in the data, based on increasing elongation. The system discards the data before the first peak. Of the remaining data, uses the middle 80% (based on elongation) to accumulate peaks.

- if the number of peaks found is greater than the value you specified for Method B limit, finds the indices of the first peak of the Average Value region of the data based on the value you specified for the start and end values. The system divides the data in the Average Value region by the value you specified for Method C number of equal regions based on elongation. It accumulates the peak closest (in terms of elongation) to the end of each region except the last.

- calculates the average value result by dividing the value of the accumulated peaks by the number of peaks accumulated.

Note: If the Average Value region start channel is First Peak or % Peel Length, the system retrieves the index of the First Peak from the parent First Peak calculation.

Example

In this example, **Sensitivity** is set to 25 % which detects a 2 kN rise and fall in load. The **Method A limit** is set to 5. The system detects three peaks which have an average value of 7.7 kN.

A = Average Value
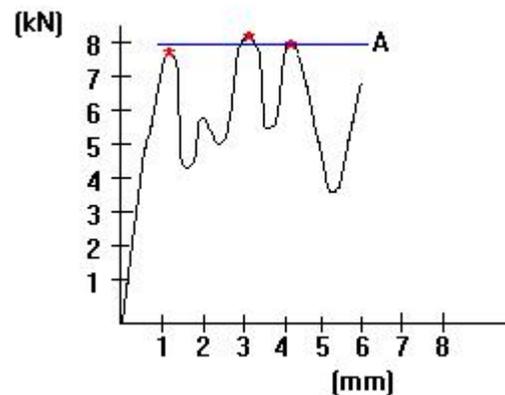
Fails to Calculate

The algorithm will not calculate a result if:

- no peaks were found in the data,

  -or-

- the parent First Peak calculation failed,

  -or-

- the start and/or end point was not found.

Results

Average Load
Average Load/Width
Start Energy
Delta Energy
Delta Peel Extension
Number of Peaks
Number of Troughs
Median Peak
Peak Range

Channels used as inputs for the calculation

The channel designated for Stress, Load, Strain and Extension varies according to the test type. Refer to Channels for Calculations.

Average Value (High and Low Peaks)

This calculation averages the value of the specified number of highest and lowest peaks detected between values that you specify. If you specify first peak as the start value, average peaks becomes a dependent calculation that requires the result from the first peak calculation.

Parameters

You must specify:

- **High and Low Peaks** type of average calculation.

- start value or channel. This can be a channel or a particular data point such as the first peak.

- start value in the units of the start value channel unless the start value is first peak.

- end value channel.

- end value in the units of the end value channel.

- sensitivity as a percentage of the maximum load.

- number of high and low peaks to average. If the data does not contain more than twice the number of peaks that you specify, all peaks are used.

The system includes the type of average value calculation and the number of high and low peaks to average in the calculation description when you add the calculation to the **Calculation list**. For example, if you select a **High and Low Peaks** type of calculation with the number of high and low peaks to average to 3, the description appears as:

<div align="center">

Average Value (3 High and Low Peaks)

</div>

You have the option to:

- edit the calculation description by clicking in the **Description** field and typing new or additional details. Any changes to the description appear in the **Calculation list** and results table.

- place an average value marker on the graph by clicking in the **Indicate on graph** check box.

Algorithm

The system:

- searches all the data between the start and end values you specified.

- using the sensitivity you specified, determines the value of all the peaks.

- sums the values of the specified number of highest and lowest peaks.

- divides the sum of the peaks by the number of peaks.

Example

In this example, **Start** is set for the **Extension** channel with a **Start value** of 85 mm and an **End value** of 250mm. The number of peaks to average is 2.

The system detects the two highest and the two lowest peaks and calculates the average value.
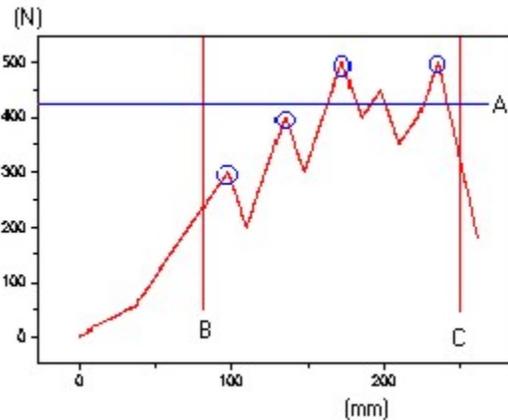
A = Average Value Marker

B = Start Value

C = End Value

If you specify more high and low peaks than the system detects in the specified range, all the peaks that it detects are included in the calculation. In this example, if you had specified the number of peaks to average as 3, the system would not be able to find 3 high and 3 low peaks. In this case, it would average all five peaks in the range.

Fails to Calculate

The algorithm will not calculate a result if:

- the data does not contain the start or end value you specified,

-or-

- the data does not contain any peaks that meet the criteria you specified.

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Results

Average Load
Average Load/Width
Start Energy
Delta Energy
Delta Peel Extension
Number of Peaks
Number of Troughs
Median Peak
Peak Range

Channels used as inputs for the calculation

The channel designated for Stress, Load, Strain and Extension varies according to the test type. Refer to Channels for Calculations.

Average Value (Integral)

This calculation uses energy divided by the change in extension to determine the average value of the load data between points that you specify.

Parameters

You must specify:

- a start value or channel. This can be a channel or a particular data point such as the percent of peak load drop.

- a starting value in the units of the start value channel.

- an end value or channel. This can be a channel or a particular data point such as the first peak.

- an end value in the units of the end value channel.

The system includes the type of average value calculation in the calculation description when you add the calculation to the **Calculation list**. For example, if you select an **Integral** type of calculation, the description appears as:

<div align="center">

Average Value (Integral)

</div>

You have the option to:

- edit the calculation description by clicking in the **Description** field and typing new or additional details. Any changes to the description appear in the **Calculation list** and results table.

- place a horizontal line on the graph that indicates the average value by clicking in the **Indicate on graph** check box.

Algorithm

The system:

- searches all the data for the start and end values you specified.

- determines the change in extension between the points.

- determines the energy by calculating the area between the points.

- uses the following equation to determine the average value:
  Average load = {energy/change in extension}

Example

In this example, the start value is set for 3 kN on the **Load** channel. The end value is set for 6 mm on the **Extension** channel. Between the points, the energy is 16 joule and the extension changes by 4 mm. By dividing the energy by the change in extension, the system calculates an average load value of 4 kN.
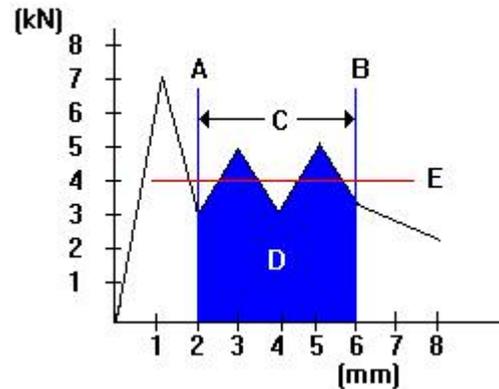
A = Start Value

B = End Value

C = Change in Extension

D = Energy

E = Average Value Marker

Fails to Calculate

The algorithm will not calculate a result if:

- the data does not contain the start or end value you specified.

    -or-

- you have specified the same value for the start and end values.

Results

Average Load
Average Load/Width
Start Energy
Delta Energy
Delta Peel Extension
Number of Peaks
Number of Troughs
Median Peak
Peak Range

Channels used as inputs for the calculation

The channel designated for Stress, Load, Strain and Extension varies according to the test type. Refer to Channels for Calculations.

Average Value (Peaks and Troughs)

Library - PTF

This calculation averages the value of a specified number of highest peaks and lowest troughs detected between points that you specify. If you specify first peak as the start value, average peaks and troughs becomes a dependent calculation that requires the result from the first peak calculation.

Parameters

You must specify:

- the **Peaks and Troughs** type of average calculation.

- a start value or channel. This can be a channel or a particular data point such as the first peak.

- a starting value in the units of the start value channel.

- an end value or channel. This can be a channel or a particular data point such as the first peak.

- an end value in the units of the end value channel.

- a sensitivity as a percentage of the full-scale channel value.

- number of peaks and troughs to average. If the data does not contain at least the number of peaks and troughs you specified, the system will not calculate the average.

The system includes the type of average value calculation and the number of peaks and troughs to average in the calculation description when you add the calculation to the **Calculation list**. For example, if you select a **Peaks and Troughs** type of calculation with the number of troughs to average to 8, the description appears as:

Average Value (8 Peaks and Troughs)

You have the option to:

- edit the calculation description by clicking in the **Description** field and typing new or additional details. Any changes to the description appear in the **Calculation list** and results table.

- place a horizontal line on the graph that indicates the average value by clicking in the **Indicate on graph** check box.

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Algorithm

The system:

- searches all the data between the start and end values you specified.

- using the sensitivity you specified, determines the value of all the peaks and troughs.

- sums the values of the specified number of highest peaks and lowest troughs.

- divides the sum of the peaks and troughs by the specified number of peaks and troughs. The result is an average value.

Example

In this example, the **Start value** is 8 kN on the **Load** channel, the **End value** is 8 seconds on the **Time** channel. Sensitivity is set to 30%, the number of peaks is set to 2. The system detects 2 peaks with an average value of 7.7 kN and 2 troughs with an average value of 4 kN. The average value of the peaks and troughs is 5.85 kN.
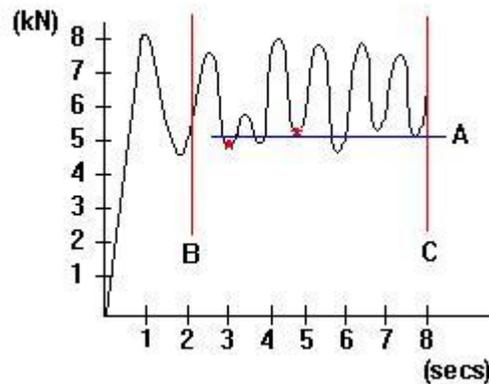
+ = Peak

A = Average Value Marker

B = Start Value

C = End Value

Fails to Calculate

The algorithm will not calculate a result if:

- the data does not contain the start or end value you specified,

  -or-

- the data does not contain any peaks or troughs that meet the criteria you specified.

Results

Average Load
Average Load/Width
Start Energy
Delta Energy
Delta Peel Extension
Number of Peaks
Number of Troughs
Median Peak
Peak Range

Channels used as inputs for the calculation

The channel designated for Stress, Load, Strain and Extension varies according to the test type.
Refer to Channels for Calculations.

Average Value (Peaks)

This calculation averages the value of the specified number of highest peaks detected between values that you specify. If you specify first peak as the start value, average peaks becomes a dependent calculation that requires the result from the first peak calculation.

Parameters

You must specify:

- the **Peaks** type of average calculation.

- a start value or channel. This can be a channel or a particular data point such as the first peak.

- a starting value in the units of the start value channel unless the start value is first peak.

- an end value channel.

- an end value in the units of the end value channel.

- a sensitivity as a percentage of the maximum channel value.

- the number of peaks to average. If the data does not contain at least the number of peaks you specified, the system will not calculate the average.

The system includes the type of average value calculation and the number of peaks to average in the calculation description when you add the calculation to the **Calculation list**. For example, if you select a **Peaks** type of calculation with the number of peaks to average to 8, the description appears as:

Average Value (8 Peaks)

You have the option to:

- edit the calculation description by clicking in the **Description** field and typing new or additional details. Any changes to the description appear in the **Calculation list** and results table.

- place an average value marker on the graph by clicking in the **Indicate on graph** check box.

Algorithm

The system:

- searches all the data between the start and end values you specified.

- using the sensitivity you specified, determines the value of all the peaks.

- sums the values of the specified number of highest peaks.

- divides the sum of the peaks by the number of peaks.

Example

In this example, **Start** is set for the **Time** channel with a **Start value** of 2.0 seconds and an **End value** of 8.0 seconds. The number of peaks to average is 3. Sensitivity is set to 25 % which detects a 2 kN rise and fall in load.

The system detects the three highest peaks which have an average value of 7.7 kN.

+ = Peak

A = Average Value Marker

B = Start Value

C = End Value

Fails to Calculate

The algorithm will not calculate a result if:

- the data does not contain the start or end value you specified,

  -or-

- the data does not contain any peaks that meet the criteria you specified.

Results

Average Load
Average Load/Width
Start Energy
Delta Energy
Delta Peel Extension
Number of Peaks
Number of Troughs
Median Peak
Peak Range

Channels used as inputs for the calculation

The channel designated for Stress, Load, Strain and Extension varies according to the test type. Refer to Channels for Calculations.

Average Value (Regions)

This calculation averages the value of the highest peak detected within each region that you specify. If you specify first peak as the start value, average value becomes a dependent calculation that requires the result from the first peak calculation.

Parameters

You must specify:

- the **Region** type of average value calculation.

- a start value or channel. This can be a channel or a particular data point such as the percent of peak load drop.

- a start value in the units of the start value channel.

- an end value or channel. This can be a channel or a particular data point such as the first peak.

- an end value in the units of the end value channel.

- a sensitivity as a percentage of the highest channel value.

- number of regions.

The system includes the type of average value calculation and the number of regions to average in the calculation description when you add the calculation to the **Calculation list**. For example, if you select a **Regions** type of calculation with 8 regions to average, the description appears as:

<div align="center">

Average Value (8 Region)

</div>

You have the option to:

- edit the calculation description by clicking in the **Description** field and typing new or additional details. Any changes to the description appear in the **Calculation list** and results table.

- place a horizontal line on the graph that indicates the average value by clicking in the **Indicate on graph** check box.

Algorithm

The system:

- divides the data into the number of regions you specified.

- using the sensitivity you specified, determines the value of all the peaks in each region.

- sorts the peak value list to the get the highest peak in each region.

- averages the highest peak in all of the regions.

Example

In this example, the **start value** is set for the first peak on the **Load** channel with a sensitivity of 30%. The **end value** is set for 7 seconds on the **Time** channel. The number of regions is set for 2. The system calculates an average value of 5.3 kN for the first region and 5.7 kN for the second region. The average value for all the regions is 5.5 kN.
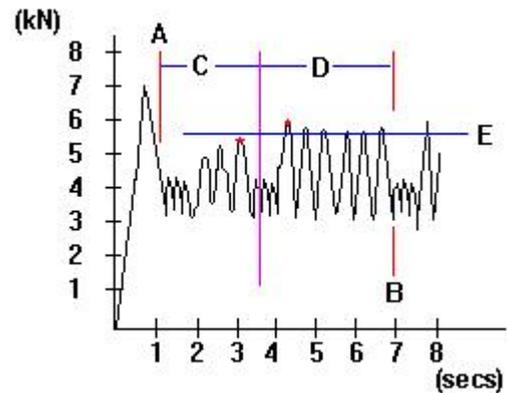
A = Start Value

B = End Value

C = First Region

D = Second Region

E = Average Value Marker

Fails to Calculate

The algorithm will not calculate a result if:

- the data does not contain the start or end value you specified,

    -or-

- the data does not contain any peaks that meet the criteria you specified.

Results

Average Load
Average Load/Width
Start Energy
Delta Energy
Delta Peel Extension
Number of Peaks
Number of Troughs
Median Peak
Peak Range

Channels used as inputs for the calculation

The channel designated for Stress, Load, Strain and Extension varies according to the test type. Refer to Channels for Calculations.

Average Value (Troughs)

This calculation averages the value of the troughs detected between points that you specify. If you specify first peak as the start value, average peaks and troughs becomes a dependent calculation that requires the result from the first peak calculation.

Parameters

You must specify:

- the **Troughs** type of average value calculation.

- a start value or channel. This can be a channel or a particular data point such as the first peak.

- a starting value in the units of the start value channel unless the start value is first peak.

- an end value or channel. This can be a channel or a particular data point such as the first trough.

- an end value in the units of the end value channel.

- a sensitivity as a percentage of the maximum channel value.

- the number of troughs to average. If the data does not contain at least the number of troughs you specified, the system will not calculate the average.

The system includes the type of average value calculation and the number of troughs to average in the calculation description when you add the calculation to the **Calculation list**. For example, if you select a **Troughs** type of calculation with the number of troughs to average to 8, the description appears as:

Average Value (8 Troughs)

You have the option to:

- edit the calculation description by clicking in the **Description** field and typing new or additional details. Any changes to the description appear in the **Calculation list** and results table.

- place an average value marker on the graph by clicking in the **Indicate on graph** check box.

Algorithm

The system:

- searches all the data between the start and end values you specified.

- using the sensitivity you specified, determines the value of all the troughs.

- sums the values of the specified number of lowest troughs.

- divides the sum of the troughs by the number of troughs.

Example

In this example, **Start** is set for the **Time** channel with a **Start value** of 2 seconds and an **End value** of 8 seconds. The number of troughs to average is 4. Sensitivity is set to a 25 % which detects a 2 kN rise and fall in load.

The average value of the troughs between the start and end values is 4.6 kN.
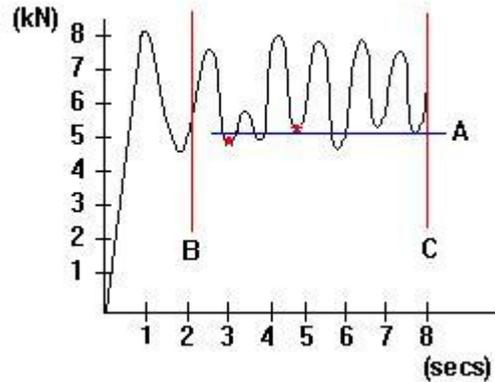
+ = Peak

A = Average Value

B = Start Value

C = End Value

Fails to Calculate

The algorithm will not calculate a result if:

- the data does not contain any troughs that meet the criteria you specified,

  -or-

- the data does not contain the number of peaks you specified.

Results

Average Load
Average Load/Width
Start Energy
Delta Energy
Delta Peel Extension
Number of Peaks
Number of Troughs
Median Peak
Peak Range

Channels used as inputs for the calculation

The channel designated for Stress, Load, Strain and Extension varies according to the test type. Refer to Channels for Calculations.

Break (Cursor)

This calculation assigns the specimen break to a point that you select on the curve after the specimen has been tested.

Parameters

You must specify:

- the **Cursor** type of Break

When you add the calculation to the **Calculation list**, the calculation description appears as:

Break (Cursor)

You have the option to:

- edit the calculation description by clicking in the **Description** field and typing new or additional details. Any changes to the description appear in the **Calculation list** and results table.

- place a break marker on the graph by clicking in the **Indicate on graph** check box.

Algorithm

The system assigns the specified cursor point as the break.

Results

All channels in the system are available.

Break (Load)

This calculation detects the specimen break as a load value that you specify.

Parameters

You must specify a break point value less than the data's maximum load point.

The system includes the break value with the calculation description when you add it to the **Calculation list**.

You have the option to:

- edit the calculation description by clicking in the **Description** field and typing new or additional details. Any changes to the description appear in the **Calculation list** and results table.

- place a break point marker on the graph by clicking in the **Indicate on graph** check box.

Algorithm

The system:

- searches all the test data on the load channel for the maximum load point.

- searches the data beyond the maximum load point for the first point where the load is less than or equal to the load value you specified.

- assigns that point as the break.

Results

All channels in the system are available.

Example

In this example, the load at break value is set for 75 N. The system detects the maximum load, which is 100 N, and then searches the remaining data for the first data point equal to or less than 75 N.
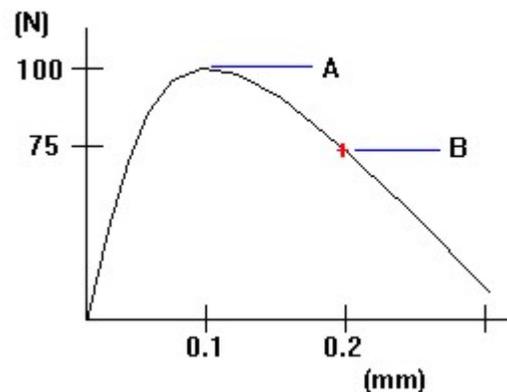
+ = Break Marker

A = Maximum Load

B= Specified Break

Fails to Calculate

The algorithm will not calculate a result if:

- the load does not drop to the value you specified,

-or-

- the maximum load is the last data point.

Channels used as inputs for the calculation

The channel designated for Stress, Load, Strain and Extension varies according to the test type. Refer to Channels for Calculations.

Break (Load/Extension Rate)

This calculation detects the specimen break as a drop in load at a rate you specify. The rate of the drop is derived from the change in load divided by a change in extension.

Parameters

You must specify a rate value.

The system includes the rate value in the calculation description when you add the calculation to the **Calculation list**. For example, if you selected a rate of 20 N/mm, the calculation description appears as:

Break (Load/Extension Rate 20 N/mm)

You have the option to:

- edit the calculation description by clicking in the **Description** field and typing new or additional details. Any changes to the description appear in the **Calculation list** and results table.

- display a break point marker on the graph by clicking in the **Indicate on graph** check box.

Algorithm

The system:

- searches all the data on the **Load** channel for the maximum load point.

- searches the load and extension data beyond the maximum load point for the first point where the slope of the curve is equal to or less than the negative of the rate you specified.

- assigns that point as break.

Results

All channels in the system are available.

Example

In this example, the rate is set to 20 N/mm. The system first finds the maximum load point, which is 60 N, and searches from that point to the end of the data for the first occurrence of the load dropping at the rate of 20 N/mm.

When the load drops from 50 N to 40 N, between extension points 2.5 mm and 3 mm, the system assigns the break. The system determined that the change in load divided by the change in extension (10N/0.5 mm) is equivalent to the specified rate of 20 N/1 mm.
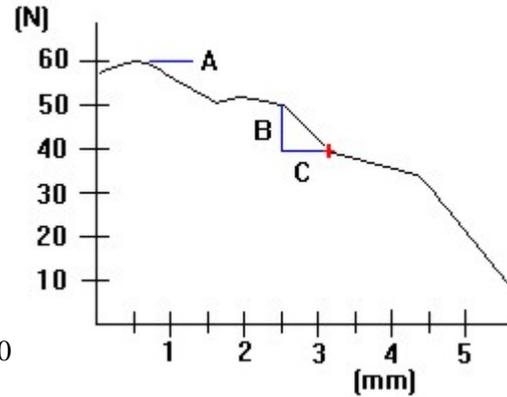
+ = Break Marker

A = Maximum Load

B = Load Change

C = Extension Change

Fails to Calculate

The algorithm will not calculate a result if:

- the data does not contain a slope that is equal to or less than the rate you specified,

-or-

- the maximum load is the last data point.

Channels used as inputs for the calculation

The channel designated for Stress, Load, Strain and Extension varies according to the test type. Refer to Channels for Calculations.

Break (Load/Strain Rate)

This calculation detects the specimen break as a drop in load at a rate you specify. The rate of the drop is derived from the change in load divided by a change in strain.

Parameters

You must specify a rate of change in load/strain.

The system includes the rate value in the calculation description when you add the calculation to the **Calculation list**. For example, if you selected a rate of 20 N/mm/mm, the calculation description appears as:

Break (Load/Strain Rate 20 N/mm/mm)

You have the option to:

- edit the calculation description by clicking in the **Description** field and typing new or additional details. Any changes to the description appear in the **Calculation list** and results table.

- place a preset point marker on the graph by clicking in the **Indicate on graph** check box.

Algorithm

The system:

- searches all the data on the Load channel for the maximum load point.

- searches the data beyond the maximum load point for the occurrence when the slope of the curve is equal to or less than the rate you specified.

- assigns that point as break.

Results

All channels in the system are available.

Example

In this example, the rate is set to 20 N/mm/mm. The system first finds the maximum load point, which is 35 N, and searches from that point to the end of the data for the first occurrence of the load dropping at the rate of 20 N/mm/mm.

When the load drops from 30 N to 20 N, between strain points 2.5 mm/mm and 3 mm/mm, the system assigns the break. The system determines the break point by calculating that the rate of 10N/0.5 mm/mm is equivalent to the specified rate of 20 N/1 mm/mm.
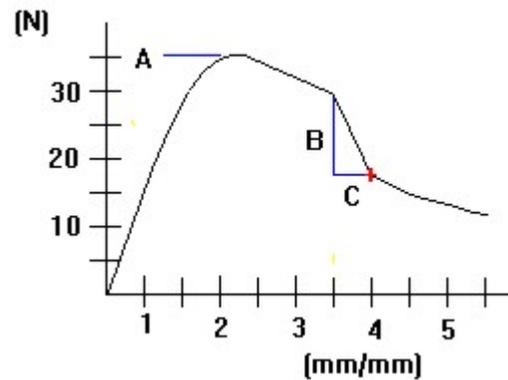
+ = Break Marker

A = Maximum Load

B = Load Change

C = Strain Change

Fails to Calculate

The algorithm will not calculate a result if:

- the data does not contain a slope that is equal to or less than the rate you specified,

-or-

- the maximum load is the last data point.

Channels used as inputs for the calculation

The channel designated for Stress, Load, Strain and Extension varies according to the test type. Refer to Channels for Calculations.

Break (Percent of Maximum Load)

This calculation detects the specimen break as a drop to a load value by a percentage, that you specify, of the maximum load attained.

Parameters

You must specify a percentage of maximum load between 0 and 100. For example, if the maximum load is 100 N and you specify a value of 60%, the system detects a break at 60 N.

The system includes the break value with the calculation description when you add it to the **Calculation list**.

You have the option to:

- edit the calculation description by clicking in the **Description** field and typing new or additional details. Any changes to the description appear in the **Calculation list** and results table.

- indicate the break point on the graph by clicking in the **Indicate on graph** check box.

Algorithm

The system:

- searches all the data on the load channel for the maximum load point.

- searches the data beyond the maximum load point for the first point where the load is less than or equal to the percentage of the load you specified. If the value falls between two points, the system interpolates the value.

- assigns that point as the break.

Results

All channels in the system are available.

Example

In this example, the percent value is set for 25% of maximum load. The system detects a maximum load of 100 N and then searches the remaining data for the load data point of 25 N. Therefore the break at percent of maximum load is 25 N.
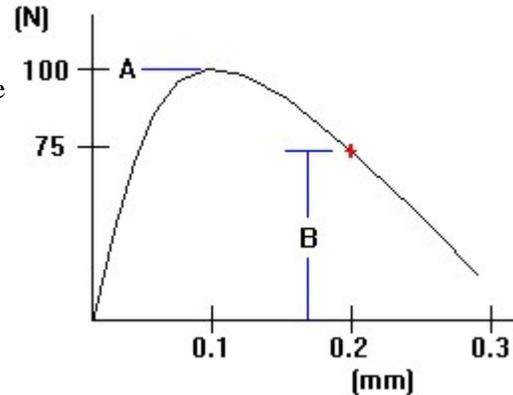
+ = Break Marker

A = Maximum Load

B = % of Maximum Load

Fails to Calculate

The algorithm will not calculate a result if:

- the load does not drop below the percent of maximum load you specified after the maximum load point,

-or-

- if the maximum load is the last data point.

Channels used as inputs for the calculation

The channel designated for Stress, Load, Strain and Extension varies according to the test type. Refer to Channels for Calculations.

Break (Standard)

This calculation detects the specimen break as the highest load in the last 100 ms of data.

Parameters

There are no parameters that you must specify.

You have the option to:

- edit the calculation description by clicking in the **Description** field and typing new or additional details. Any changes to the description appear in the **Calculation list** and results table.

- place a break marker on the graph by clicking in the **Indicate on graph** check box.

Algorithm

The system:

- searches the last 100 ms of the load channel data.

- sequentially compares each point with the next to determine the maximum value.

- assigns the maximum point as the break.

Results

All channels in the system are available.

Example

In this example, the total time of the data is 450 ms. The system searches the data from 450 to 350 ms for the maximum load. The system determines the break as a 50 N load at 400 ms.

+ = Break Marker

A = 100 ms

B = Total Time
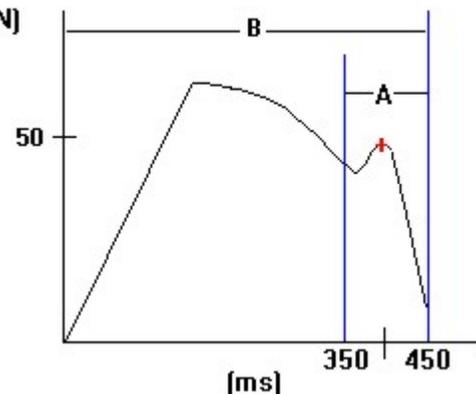
Fails to Calculate

The Break (Standard) algorithm will not calculate a result if there is less than 100 ms of data.

Channels used as inputs for the calculation

The channel designated for Stress, Load, Strain and Extension varies according to the test type. Refer to Channels for Calculations.

Break Location Calculation

This calculation determines if the specimen breaks inside the gauge length, outside the gauge length or reports an indecisive result (could be outside the gauge length or inside the gauge length). It is a dependent calculation that requires a result from a break calculation.

Parameters

When you add the calculation to the Calculation list, the description appears as:

Break Location

You have the option to:

- edit the calculation description by clicking in the **Description** field and typing new or additional details. Any changes to the description appear in the **Calculation list** and results table.

- edit the **Inside GL** (gauge length) description by clicking in the **Inside Break** field and typing new or additional details. Any changes to the description appear in the Result table.

- edit the **Unsure** description by clicking in the **Unsure Break** field and typing new or additional details. Any changes to the description appear in the Result table.

- edit the **Outside GL** description by clicking in the **Outside Break** field and typing new or additional details. Any changes to the description appear in the Result Table.

- edit the location factor value by clicking in the **Location Factor** field and typing a new value. The default value is 0.0.

Algorithm

The system:

- finds the total elongation at maximum force.

- finds the break according to the calculation you chose.

- determines the extensometer and crosshead extensions at the maximum force and break points.

- calculates the effective parallel length of the specimen by comparing the extensometer and crosshead extensions over the region between any yield phenomena and the maximum force point.

- determines the point where the specimen starts to neck based on the start of non-uniform elongation and hence the portion of local deformation that occurs after the maximum force point.

- compares the extension difference between the extensometer reading and the crosshead/actuator for the region between the maximum force and specimen break point to determine the location of the break. The break location can occur inside the gauge length, outside the gauge length or can be indecisive.

Note: Any total elongation result is not valid if the specimen breaks outside of the gauge length or the break location is indecisive. The break location factor ranges from 0.0 to 1.0. It represents the fraction of the specimen elongation that occurs after the uniform elongation, which is attributable to local deformation in the specimen neck region. A value of 1.0 means that all the deformation that occurs after the uniform elongation occurs in the specimen neck whereas a value close to 0.0 means that the specimen elongates uniformly to break. A location factor of 0.0 indicates that the system will automatically determine a value from the measured data. If the automatic value is unsuitable for a particular material type, a manual location factor may be entered.

Example

Specimen 1 illustrates a break inside the gauge length. The determined strain at break is correct.
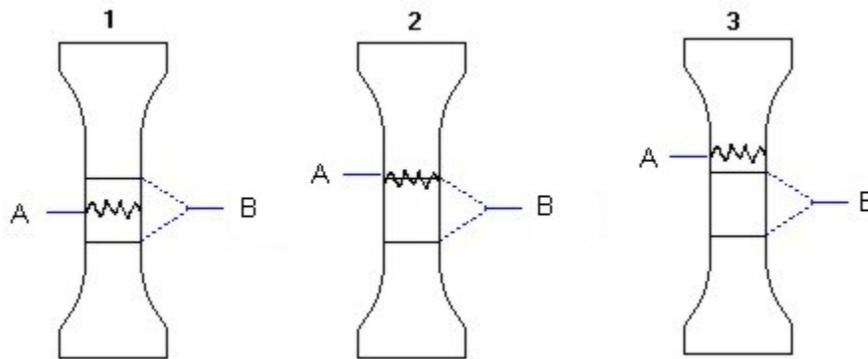
Specimen 2 illustrates a break inside or outside the gauge length - it cannot be determined where the break occurs. The determined strain at break is probably not valid but may be corrected by using the crosshead extension.

Specimen 3 illustrates a break outside the gauge length. The determined strain at break is not valid and is difficult to correct accurately.

Fails to Calculate

The algorithm will not report a break location correctly if:

- the extensometer is removed before the specimen breaks,

-or-

- the extensometer channel is not selected as the strain source,

-or-

- the extensometer gauge length is not correct or the specimen parallel length is wildly in error,

-or-

- the extensometer is not set to zero at the beginning of a test.

Channels used as inputs for the calculation

The channel designated for Stress, Load, Strain and Extension varies according to the test type. Refer to Channels for Calculations.

Chord Modulus

This calculation determines the slope of the stress/strain curve between any two points on the curve. It constructs a straight line between the lower and upper bounds that you specify.

Parameters

You must specify:

- a **Chord** type modulus.

- a channel.

- an end value. in the units of the channel you specified. This value must be higher than the start value .

- a start value in the units of the channel you specified. This value must be lower than the end value.

The system includes the modulus type and the start and end values in the calculation description when you add the calculation to the **Calculation list**. For example, if you select a **Chord** modulus on the **Tensile extension** channel with a start value of 5 mm and an end value of 7 mm, the description appears as:

Modulus (Chord 5 mm - 7 mm)

You have the option to:

- edit the calculation description by clicking in the **Description** field and typing new or additional details. Any changes to the description appear in the **Calculation list** and results table.

- place a modulus marker on the graph by clicking in the **Indicate on graph** check box.

Algorithm

The system:

- searches the channel between the start and end values you specified.

- calculates the modulus between the start and end values as follows:

  modulus = {stress at upper value - stress at lower value} / {strain at upper value - strain at lower value}

Example

In this example, the **Strain** channel is set with a start value of 1 mm/mm and an end value of 5 mm/mm. The system calculates the modulus by dividing the change in stress by the change in strain between the start and end values.

A = Modulus Marker

B = Start Value

C = End Value

Fails to Calculate

The algorithm will not calculate a result if the data does not contain either the start and end values you specified.

Results

X-Intercept

Y- Intercept

Modulus

Channels used as inputs for the calculation

The channel designated for Stress, Load, Strain and Extension varies according to the test type. Refer to Channels for Calculations.

Coefficient of Friction Calculation

This calculation determines the static (motionless) and dynamic (moving) coefficient of friction. Typically, this calculation analyzes data collected from a test that used a friction table and sled.

Parameters

You must specify:

- a sensitivity value as a percentage of the channel's maximum value. A lower sensitivity detects a smaller percent change in the data while a higher sensitivity detects a larger change.

- a start value or channel. This can be a channel or a particular data point such as the first peak.

- a starting value in the units of the start value channel.

- an end value or channel. This can be a channel or a particular data point such as the first peak.

- an end value in the units of the end value channel.

When you add the calculation to the calculation list, the description appears as:

Coefficient of Friction

You have the option to:

- edit the calculation description by clicking in the **Description** field and typing new or additional details. Any changes to the description appear in the **Calculation list** and results table.

- place a marker on the graph by clicking in the **Indicate on graph** check box.

Algorithm

The system:

- searches the data from the start value to the end value on the channel you specified for the maximum value.

- determines the first data point that rises and falls by the percentage of the maximum value and assigns this point as the first peak.

- uses the following equation to determine the coefficient of static friction:

  static friction = first peak/sled weight

- uses the following equation to calculate the average load of the area from the first peak to the end value:

  average load = energy/change in extension

- uses the following equation to determine the coefficient of dynamic friction:

  dynamic friction = average load/sled weight

Example

In this example, the **Time** channel is set for a start value of 1 second and an end value of 7 seconds. The sensitivity is 40% of 5 kN which is 2 kN. Static friction is the maximum load point. Dynamic friction is the average load (based on energy and the change in extension) of the data from 1 to 7 seconds.
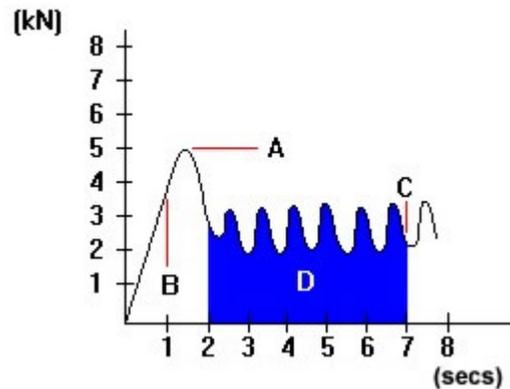
A = Maximum Value

B = Start Value

C = End Value

D = Energy

Fails to Calculate

The algorithm will not calculate a result if:

- the data does not contain a first peak,

-or-

- the system did not detect a first peak based on the parameters you specified,

-or-

- the data does not contain either the start or end value you specified.

Results

Coefficient of static friction

Coefficient of dynamic friction

Channels used as inputs for the calculation

The channel designated for Stress, Load, Strain and Extension varies according to the test type. Refer to Channels for Calculations.

Compliance Correction

Note: This calculation is not suitable for use with the Microtester. Compliance correction does work on the Extension channel (actuator data from the motor encoder). It does not work on the Strain channel (actuator data from the Heidenhein gauge).

This calculation provides a way to correct values of extension used in calculations to allow for the compliance, or elastic "give", of your testing system. First, you run a test using a dummy specimen that will deform very little at the maximum test load. The dummy specimen should be as many times stiffer than the real specimen as possible. During this test the system creates a compliance file containing values of load and extension. When you test the real specimens, the system uses the compliance file to correct values of strain and extension collected during the test.

It is important to understand that compliance is a property of the entire testing system, not only the load frame. When you run the test to create the compliance file you must use exactly the same components in the testing system as you will use in the real tests, including the load cell, grips and couplings.

Parameters

The only parameter that is required for this calculation is the name of the compliance correction file. The software assigns a default name of the following form:

- Ccompsav.cmt for tension tests

- Ccompsav.cmc for compression tests

Results

There are no results for the compliance correction calculation.

How to:

Step 1 - Create the Compliance File

1. In the **Calculations Setup** dialog box, highlight **Compliance Correction** in the **Calculation List**. [If you have not used the **Compliance Correction** calculation before, you need to highlight **Compliance Correction** in the **Library** list and click on the **Add** button to add the calculation to the list of **Available Calculations**.]

2. In the **Parameters** area of the dialog box, choose **Create** in the **Type** list box. Choose **Browse…**, type a filename into the **File Name** edit box, and click **OK**.

3. Set up a test in tension or compression using a very stiff dummy specimen. Set the load to a value higher than the maximum test load or to the maximum capacity of the system. This must be done using the same load string that you will use in tests on real specimens. Set the **Control Mode** to **Extension**. Set up the test to apply a small preload, or make sure there is no slack in the specimen. Set up data logging so that one data point is

collected approximately every 1-2% of the testing load range. Install the stiff specimen and run the test.

4. During the test a file with extension and load values is created with the name and location specified in the calculation setup. The load values are in newtons, extension values are in millimeters, and the file can be viewed in any text editor such as Notepad.

Step 2 - Apply the Compliance File

1. In the **Calculations Setup** dialog box, highlight **Compliance Correction** in the **Calculation List**.

2. In the **Parameters** area of the dialog box, choose **Apply** in the **Type** list box and use the **Browse…** button to find the file created during the test on the stiff specimen.

3. (Optional) Check the Compliance Correction. Repeat the test using the dummy specimen. The load versus extension graph should plot as a vertical line. This indicates zero extension over the range of applied load and indicates that the compliance correction is valid.

4. Setup the test for the real specimens. As tests are run and results are calculated, the software applies a correction to values of Extension and other channels whose values are derived from Extension.

For more detailed information about the Compliance Correction calculation and how it works, especially which channels are affected by the correction, refer to the Compliance Correction Reference.

Compliance Correction Reference

Machine compliance is the elastic deflection or "give" of the testing machine when reacting the load supported by the specimen. It is measured in mm/kN or equivalent units. The compliance is determined by running a test using a dummy specimen that will deform very little at the maximum test load. As load is applied to the dummy specimen, load and extension data are collected. The Extension data represents the amount of machine compliance corresponding to the respective load readings. The collected data is written to the Compliance file, which is then used for correction while testing real specimens.

Compliance correction can be applied when the Extension channel is selected as the source for Axial Strain. If an extensometer is removed part way through a test, the Extension channel is automatically selected as the source for Axial Strain after the extensometer has been removed. In both cases, the Tensile Strain and Tensile Extension channels are corrected. These channels can be observed during a test on the live displays. Any results based on Tensile Strain or Tensile Extension will also be corrected.

In the area of test control, channels affected by compliance correction (Tensile Strain and Tensile Extension) no longer have a linear relationship to Extension. This has implications when choosing the criteria by which the system changes from Ramp 1 to Ramp 2. Ramp changeover occurs when an event on the Extension transducer channel in the machine controller is reached, not by setting a trip point on the composite channel in the software. The full list of criteria that use machine controller events rather than software trip points on the composite channels is:

- Precycling - minimum and maximum limits

- Changeover from Ramp 1 to Ramp 2

- Test Profiler Ramp End Points

If you select Tensile Strain or Tensile Extension as the criterion by which the system changes from Ramp 1 to Ramp 2 and compliance correction is applied, the actual ramp changeover may occur at a different value from the one expected.

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Delta Creep

This calculation determines the change in a channel value, from the minimum derived extension point in a hold segment to a point that you specify.

Parameters

You must specify:

- the **Delta Creep** type of creep/relaxation.

- a channel.

- a channel value. This value is the amount of change from the minimum extension point.

The system includes the type of relaxation and the channel value in the calculation description when you add the calculation to the **Calculation list**. For example, if you select a **Delta Creep** calculation on the **Compressive load** channel with a channel value of 6 N, the description appears as:

Delta Creep (6 N)

You have the option to:

- edit the calculation description by clicking in the **Description** field and typing new or additional details. Any changes to the description appear in the **Calculation list** and results table.

- place a marker on the graph by clicking in the **Indicate on graph** check box.

Algorithm

The system:

- searches the derived extension channel for the minimum value in the hold segment of the data.

- establishes a search value by adding the channel value you specified to the channel value at minimum extension.

- searches the specified delta channel for the search value.

- determines the difference between the minimum extension point and the search value point.

Example

In this example, the **Extension** channel is set for a user specified value of 2 mm. The minimum data point within the hold segment is 4 mm. By calculating the difference between these points, the system determines the delta creep as 2 mm.

A = Hold Segment Markers

B = Hold Segment

C = Channel Value
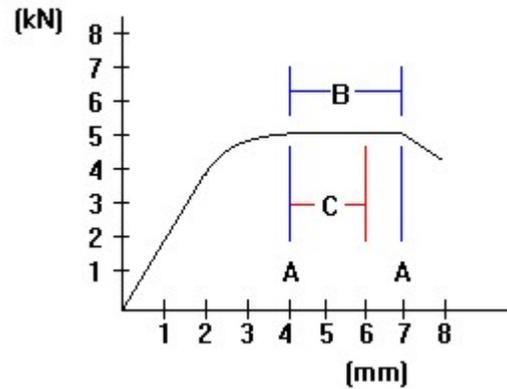
Fails to Calculate

The algorithm will not calculate a result if:

- there is no hold data,

-or-

- the value you specified is not within the data.

Results

All channels in the system are available.

Channels used as inputs for the calculation

The channel designated for Stress, Load, Strain and Extension varies according to the test type. Refer to Channels for Calculations.

Delta Relaxation

This calculation determines the change in a channel value, from the maximum derived load point in a hold segment to a point that you specify.

Parameters

You must specify:

- the **Delta Relaxation** type of creep/relaxation.

- a channel.

- a channel delta value.

The system includes the type of relaxation and the channel value in the calculation description when you add the calculation to the **Calculation list**. For example, if you select a **Delta Relaxation** calculation on the **Compressive strain** channel with a channel value of 10 mm/mm, the description appears as:

Delta Relaxation (10 mm/mm)

You have the option to:

- edit the calculation description by clicking in the **Description** field and typing new or additional details. Any changes to the description appear in the **Calculation list** and results table.

- place a marker on the graph by clicking in the **Indicate on graph** check box.

Algorithm

The system:

- searches the derived extension channel for the data collected during the hold segment for the maximum value.

- establishes a search value by adding the channel value you specified to the channel value at maximum load.

- searches the specified delta channel for the search value.

- determines the difference between the maximum load point and the search value point.

Example

In this example, the **Load** channel is selected with a delta value of 2 kN. During the hold segment of the data, the maximum channel value is 5 kN. By calculating the difference between these points, the system determines the delta relaxation as 2 kN.
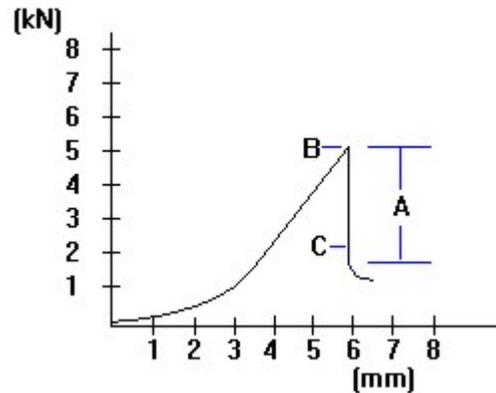
A = Hold Segment

B = Maximum Value.

C = Channel Value

Fails to Calculate

The algorithm will not calculate a result if:

- there is no hold data,

-or-

- the value you specified is not within the data.

Results

All channels in the system are available.

Channels used as inputs for the calculation

The channel designated for Stress, Load, Strain and Extension varies according to the test type. Refer to Channels for Calculations.

E-Modulus

This calculation is performed in accordance with the EN10002 and ASTM E8 standards. It determines the elastic modulus of the material by using a standard linear regression technique. The portion of the curve to be used for the calculation is chosen automatically and excludes the initial and final portions of the elastic deformation where the stress-strain curve is non-linear.

Parameters

You must specify the **E-modulus** type of modulus.

When you add the calculation to the **Calculation list**, the description appears as:

Modulus (E-modulus)

You have the option to:

- edit the calculation description by clicking in the **Description** field and typing new or additional details. Any changes to the description appear in the **Calculation list** and results table.

- place a marker on the graph by clicking in the **Indicate on graph** check box.

Algorithm

The system:

- automatically scans the curve from the first recorded stress signal, which is greater than K_{mp3}. This avoids any noise due to the specimen straightening.

- finds a sample of data points with stress values between K_{mp1} and K_{mp2} of the current last data point.

- performs a linear regression on the stress-strain curve to calculate the modulus line.

- constructs a line, offset by 0.2%, parallel to the modulus line. A check is made if the offset line crosses the test curve in the yield region. If so, the point of intersection defines the offset yield point and the modulus line is determined. If not, the offset yield point is not yet reached and a new data point is added to the set and the steps are repeated.

Example

In this example, the algorithm has automatically chosen the start and end points as 30 and 120 MPa, defining the linear portion of the curve. A least squares fit algorithm is applied to the region between the start and end values to determine the stress-strain curve slope, the material modulus.
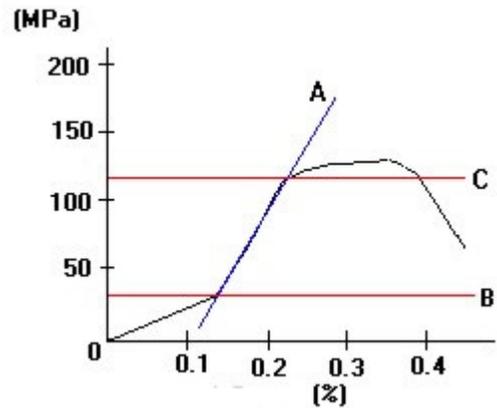
A = Modulus marker

B = Start value (automatically determined)

C = End value (automatically determined)

Fails to Calculate

The algorithm will not calculate a result if:

- total elongation is less than 0.2%.

-or-

- there are fewer than two data points.

Results

X-Intercept

Y- Intercept

Modulus

Channels used as inputs for the calculation

The channel designated for Stress, Load, Strain and Extension varies according to the test type. Refer to Channels for Calculations.

First Peak Calculation

This calculation determines the first peak in the test data.

Parameters

You must specify:

- a channel.

- a sensitivity value as a percentage of the channel's maximum value. For example, if the highest value of the **Load** channel is 100 N and you want to detect a rise and fall of 30 N, you would select a peak sensitivity of 30%.

The system includes the channel and the percentage change in the calculation description when you add the calculation to the **Calculation list**. For example, if you select a first peak on the **Load** channel with a sensitivity of 10%, the description appears as:

First Peak (Load 10% Change)

You have the option to:

- edit the calculation description by clicking in the **Description** field and typing new or additional details. Any changes to the description appear in the **Calculation list** and results table.

- place a marker on the graph by clicking in the **Indicate on graph** check box.

Algorithm

The system:

- searches all the data on the channel you specified for the maximum value.

- finds the first maximum value.

- if the data before and after a maximum value rises and falls by the sensitivity value you specified, the system defines the point as the first peak. If the data does not meet this criteria, the system continues searching the data for the next maximum value.

Example

In this example, the channel is set to **Load** with a sensitivity of 50%. The channel's highest value load is 8 kN. The system detects the first peak when the load rises and falls by at least 50% of the maximum load (4 kN).

+ = Marker

A = Sensitivity
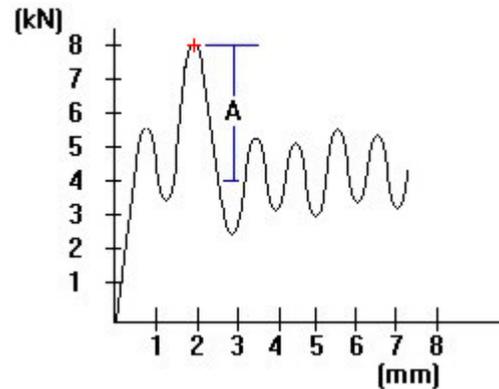
Fails to Calculate

The algorithm will not calculate a result if the data does not increase and then decrease by the sensitivity you specified.

Results

All channels in the system are available.

Channels used as inputs for the calculation

The channel designated for Stress, Load, Strain and Extension varies according to the test type. Refer to Channels for Calculations.

Hold Preset Point Calculation

This calculation is based upon an assigned channel and value within the hold segment of the test curve. For example, you can set a preset point of 20 kN of load, 30 seconds of time, 0.005 mm of strain, pip marks, and so on.

Parameters

You must specify:

- a channel.

- a preset point value. This value must be within the hold segment of the data. If it is not, the system will not calculate the result.

The system includes the channel and preset hold value in the calculation description when you add the calculation to the **Calculation list**. For example, if you select a preset point of 3 mm on the **Compressive extension** channel, the calculation description appears as:

Hold Preset Point (Compressive Extension 3 mm)

You have the option to:

- edit the calculation description by clicking in the **Description** field and typing new or additional details. Any changes to the description appear in the **Calculation list** and results table.

- place a preset point marker on the graph by clicking in the **Indicate on graph** check box.

Algorithm

The system:

- searches the hold segment of the test data on the channel you specified.

- determines the first occurrence of the preset value you specified.

- uses linear interpolation to determine the point if the specified value falls between two data points.

Example

In this example, the preset point is set for 6 seconds on the **Time** channel.

+ = Preset Point Marker

A = Hold Segment
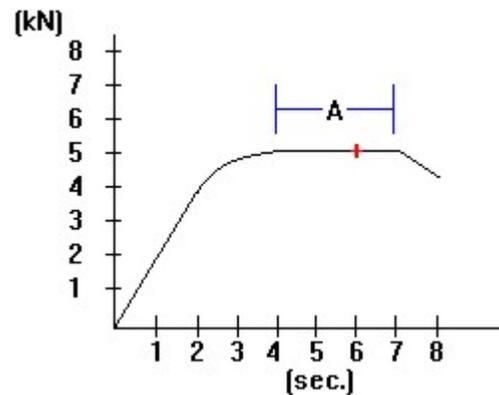
Fails to Calculate

The algorithm will not calculate a result if:

- the preset point value you specified does not occur within the data,

-or-

- you have specified a cursor selected point and pressed the **Cancel** button in the **Graph** window,

-or-

- you have specified a pip point and there are not enough pip marks in the data. For example, if there are 4 pip marks on the curve and you specify the fifth, the calculation fails.

Results

All channels in the system are available.

Channels used as inputs for the calculation

The channel designated for Stress, Load, Strain and Extension varies according to the test type. Refer to Channels for Calculations.

Hysteresis Modulus

This calculation is in accordance with the EN10002 standard. It determines the material modulus from a hysteresis loop generated by a loading and reloading section.

Parameters

You must specify the **Hysteresis** type of modulus.

When you add the calculation to the **Calculation list**, the description appears as:

Modulus (Hysteresis)

You have the option to:

- edit the calculation description by clicking in the **Description** field and typing new or additional details. Any changes to the description appear in the **Calculation list** and results table.

- place a marker on the graph by clicking in the **Indicate on graph** check box.

Algorithm

The system:

- records the stress and strain data during an unloading section.

- records the stress and strain data in the following reloading section.

- uses a least squares fit method to determine the slope of the line through the hysteresis loop, using data points in both the unloading and reloading sections (uses data recorded in the central 15-80% of the hysteresis loop to improve the accuracy of the calculation).

Note: The position of the hysteresis loop is determined by the reversal point value entered in the hysteresis group box in Test Control.

Example

In this example, the system starts to unload at the user specified reversal point, which is the start of the hysteresis loop. Then the system reloads at the second reversal point, which is 10% of the stress value at the start of the hysteresis loop. The system calculates the modulus from the line drawn through the hysteresis loop.
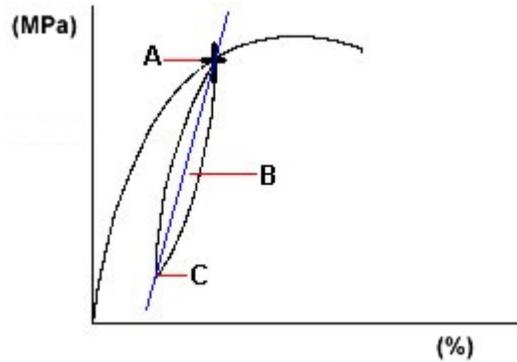
A = User Specified Reversal Point

B = Least Squares Fit Line (through Hysteresis Loop)

C = Second Reversal Point

Fails to Calculate

The algorithm will not calculate a result if:

- the unloading or reloading sections of the stress-strain curve are not found.

-or-

- less than three data points are found in the hysteresis loop.

-or-

- the stress at the turnaround point is not less than the start of the unloading section.

Results

X-Intercept

Y- Intercept

Modulus

Channels used as inputs for the calculation

The channel designated for Stress, Load, Strain and Extension varies according to the test type. Refer to Channels for Calculations.

Local Peak Calculation

This calculation detects a peak value on a particular channel where the change in value exceeds a preset sensitivity value. You can detect either a maximum peak, which occurs where the channel values decrease from a previous high value, or a minimum peak, where the channel values increase from a previous low value.

Parameters

You must specify:

- a channel.

- a peak type, either maximum or minimum. Selecting a minimum peak will detect the lowest value. Conversely, a maximum peak detects the highest value.

- a sensitivity as a percentage of the channel's maximum value. For example, if the highest value of the **Load** channel is 100 N and you want to detect a local peak defined as a drop of 30 N, you would select a peak sensitivity of 30%.

The system includes the channel, the peak type and the sensitivity in the calculation description when you add the calculation to the **Calculation list**. For example, if you select a maximum local peak on the **Tensile Extension** channel with a sensitivity of 1%, the description appears as:

Local Peak Maximum (Tensile Extension 1% Change)

You have the option to:

- edit the calculation description by clicking in the **Description** field and typing new or additional details. Any changes to the description appear in the **Calculation list** and results table.

- place a marker on the graph by clicking in the **Indicate on graph** check box.

Algorithm

The system:

- (for the initial calculation) searches all the data on the channel you specified for the maximum value.

- finds the first maximum value.

- if the data before and after a maximum value rises and falls by the sensitivity value you specified, the system defines the point as the first peak. If the data does not meet this criteria, the system continues searching the data for the next maximum value.

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- (for subsequent calculations) searches from the data point after the first local peak providing you selected another local peak calculation with the same channel and peak type settings.

If you select another local peak calculation with different channel or peak type settings, the system begins the search from the first data point.

Example

In this example, the parameters are set to a maximum peak on the **Load** channel with a 20 N sensitivity. The system detects local peak A because the data following this point drops more that 20 N.

If you select another local peak calculation with the same parameters, the system detects local peak C.

If you change the peak type to minimum, the system detects only peak B because the data after this point rises more than 20 N.
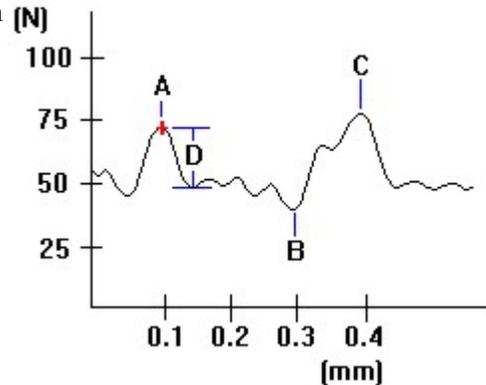
+ = Peak Marker

A= First Maximum Peak

B= Minimum Peak

C = Second Maximum Peak

D = Specified Sensitivity

Fails to Calculate

The algorithm will not calculate a result if it does not find a point where the data decreases by the sensitivity you specified.

Results

All channels in the system are available.

Channels used as inputs for the calculation

The channel designated for Stress, Load, Strain and Extension varies according to the test type. Refer to Channels for Calculations.

Lower Yield

This calculation determines the point on the stress/strain curve at which the slope increases to zero after a zero slope yield point.

Note:
　　For metals testing, lower yield should not be used. Use the Yield (EN/ISO Lower) calculation, which is a more reliable version relevant to metals tests.

Parameters

You must specify:

- the **Lower** type of yield.
- a number of regions. You can specify 1 to 100 regions. The more regions you specify, the higher the accuracy and processing time.

- percentage of overlap between 0 and 99.
- a yield slope criteria. This is the number of consecutive regions with a zero or positive slope the system must detect to establish the yield point. You can specify 1 to 99.

The system includes the type of yield in the calculation description when you add the calculation to the **Calculation list** .If you select a **Lower** yield, the calculation description appears as:

Yield (Lower)

You have the option to:

- edit the calculation description by clicking in the **Description** field and typing new or additional details. Any changes to the description appear in the **Calculation list** and results table.

- place a marker on the graph by clicking in the **Indicate on graph** check box.

Algorithm

The system:

- searches all the data for the initial zero slope yield.

- uses the initial yield as the starting point.

- divides the data into the number of regions with the percent overlap you specified.

- finds the number of consecutive regions that have a slope greater than or equal to zero.
- assigns the point of the minimum load, from the initial yield to the end of the regions that have a slope equal to or greater than zero, as the lower yield.

Example

In this example, the system finds the upper yield point at 6 MPa. From that point, the system divides the remaining data into 8 regions and begins calculating the slope for each region. The third region is the first to have a zero slope, the point where there is an increase in strain and no increase in stress. The system assigns the lower yield point at 5 MPa.
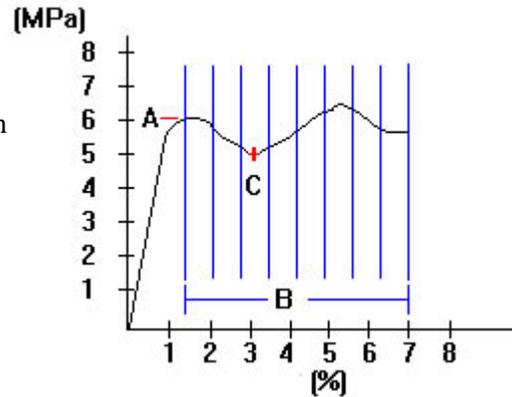
+ = Yield Point Marker

A = Upper Yield Point

B = Regions

C = Lower Yield Point

Fails to Calculate

The algorithm will not calculate a result if:

- the data contains the same number or fewer points than the number of regions you specified,

-or-

- the data does not contain a zero or negative slope,
-

-or-

- the data beyond the zero slope point does not contain a positive slope.

Results

All channels in the system are available.

Channels used as inputs for the calculation

The channel designated for Stress, Load, Strain and Extension varies according to the test type. Refer to Channels for Calculations.

Lower Yield (EN/ISO)

This calculation is performed in accordance with the EN10002 and ASTM E8 standards. It determines the point on the stress/strain curve at which the slope increases to zero after an upper yield point. Optionally, the transient (first low peak) can be included.

Parameters

You must specify:

- the **EN/ISO Lower** type of yield.
- a number of regions. You can specify 1 to 100 regions. The more regions you specify, the higher the accuracy and processing time.

- percentage of overlap between 0 and 99.
- a yield slope criteria. This is the number of consecutive regions with a zero or positive slope the system must detect to establish the yield point. You can specify 1 to 99.

The system includes the type of yield in the calculation description when you add the calculation to the **Calculation list** .If you select an **EN/ISO Lower** yield, the calculation description appears as:

<p align="center">Yield (EN/ISO Lower)</p>

You have the option to:

- edit the calculation description by clicking in the **Description** field and typing new or additional details. Any changes to the description appear in the **Calculation list** and results table.

- place a marker on the graph by clicking in the **Indicate on graph** check box.
- include transient by clicking the **Include transient** check box.

Algorithm

The system:

- finds the upper yield point.

- uses the upper yield point as the starting point.

- determines the EN\ISO lower yield by finding the lowest point on the stress-strain curve between the upper yield point and the end of the yield point elongation that has a slope increasing to zero. Optionally it can include the transient lower yield point if it is the lowest value.

Example

In this example, the system finds the upper yield point. If **Include transient** is checked, the system finds the lowest point on the stress-strain curve and assigns it as the EN/ISO lower yield (as shown in the first example). If **Include transient** is not checked, the system finds the lowest point on the stress-strain curve, excluding the transient, and assigns it as the EN/ISO lower yield (as shown in the second example).
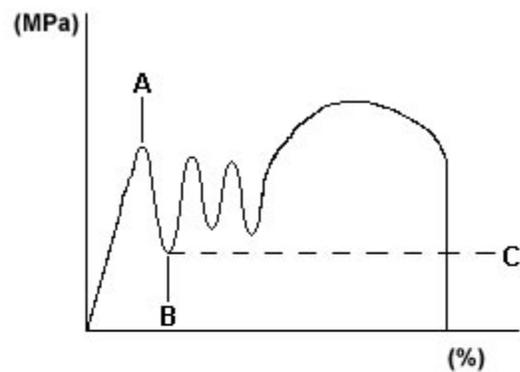
A = Upper Yield Point

B = Lower Yield Point

C = Transient
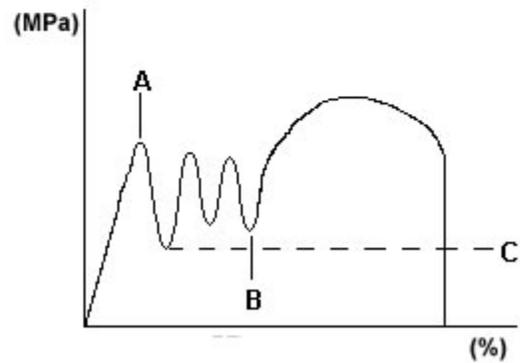
Fails to Calculate

The algorithm will not calculate a result if:

- no upper yield point is detected,

-or-

- the curve does not have a yield point elongation..

Results

All channels in the system are available.

Channels used as inputs for the calculation

The channel designated for Stress, Load, Strain and Extension varies according to the test type. Refer to Channels for Calculations.

Metal Matrix Modulus

This calculation is performed in accordance with the normative section A.4.9 of the EN10002 standard. It determines the elastic modulus of the material using a technique described in the normative section M bibliography. The portion of the curve to be used for the calculation is chosen automatically and the method is applicable to other metallic material in addition to metal matrix composites.

Parameters

You must specify the **Metal Matrix** type of modulus.

When you add the calculation to the **Calculation list**, the description appears as:

Modulus (Metal Matrix)

You have the option to:

- edit the calculation description by clicking in the **Description** field and typing new or additional details. Any changes to the description appear in the **Calculation list** and results table.

- place a marker on the graph by clicking in the **Indicate on graph** check box.

Algorithm

The system:

- fits an initial E-modulus to the stress-strain curve and from this determines the 0.1% offset stress point to define the curve region to be analyzed.

- if an E-modulus calculation cannot be performed, selects all data points up to 0.3% strain or selects the whole curve if the total elongation is less than 0.3%.

- checks that there is no hysteresis loop within the selected region.

- checks that there are sufficient readings for the calculation.

- follows the method of Roebuck et al., and calculates the tangent modulus at each point in the selected region.

- chooses the tangent slope with the least variation about the mean value and estimates the true origin of the stress-strain curve.

- with the new origin defined, calculates a secant modulus at each point in the selected region.

- chooses the secant slope with the least variation about the mean value to determine the material modulus and re-estimates the true origin of the stress-strain curve.

Example

In this example, the algorithm has automatically chosen the
start and end points as 30 and 120 MPa, defining the linear
portion of the curve. The region BC contains the most colinear
data points in the initial part of the stress-strain curve and this
determines the stress-strain curve slope, hence the material
modulus.
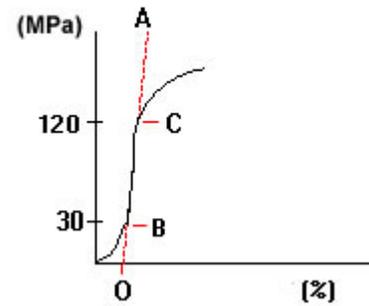
A = Modulus marker

B = Start value (implicitly determined)

C = End value (automatically determined)

O = True origin of stress-strain curve

Fails to Calculate

The algorithm will not calculate a result if:

- there are less than approximately 35 data points in the linear portion of the curve.

-or-

- a hysteresis loop is detected in the linear portion of the curve.

Results

X-Intercept

Y- Intercept

Modulus

Channels used as inputs for the calculation

The channel designated for Stress, Load, Strain and Extension varies according to the test type.
Refer to Channels for Calculations.

n-Value (Automatic)

This calculation determines the strain hardening exponent, n, as the slope of the true stress versus true strain curve in the plastic region specified.

Parameters

You must specify the **Automatic** type of n-value.

When you add the calculation to the **Calculation list**, the description appears as:

n-Value (Automatic)

You have the option to:

- edit the calculation description by clicking in the **Description** field and typing new or additional details. Any changes to the description appear in the **Calculation list** and results table.

- place a marker on the graph by clicking in the **Indicate range on graph** check box.

Algorithm

The system:

- finds the fixed start point (0.2% offset yield point or end of YPE\ A_e if it exists) and end point (point of maximum load).

- takes the desired portion of the curve between the start and end points.

- calculates the logarithm of the true stress and true strain for each point in the desired portion of the curve.

- uses a least-squares fit method to calculate the slope and offset of the true stress versus true strain curve based on the selected curve portion, which determines the n-value and strength coefficient.

Note:
If a ramp transition occurs between the start and end points, the start point will be moved to the beginning of the ramp where the maximum load occurs. The end point always remains the same at maximum load.

Example

The system finds the start and end points and uses a least-squares fit method to determine the n-value.
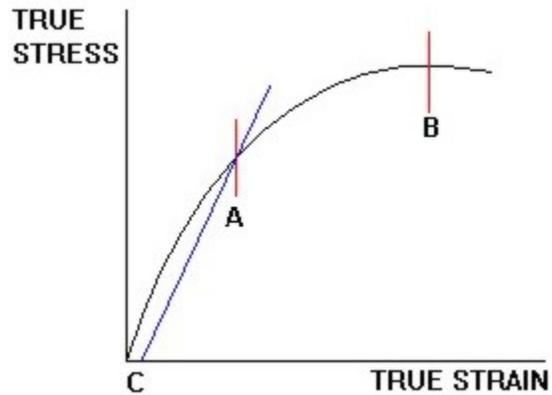
A = Start Point

B = End Point

C = 0.2% Offset

True stress = $\sigma(1+\varepsilon)$

True strain = $\ln(1+\varepsilon)$

Fails to Calculate

The algorithm will not calculate a result if there is a hysteresis loop or change in speed within the specified region.

Results

Starting Strain

Starting Stress

Ending Strain

Ending Stress

Strain Hardening Exponent

Strength Coefficient

Channels used as inputs for the calculation

The channel designated for Stress, Load, Strain and Extension varies according to the test type. Refer to Channels for Calculations.

n-Value (Manual)

This calculation determines the strain hardening exponent, n, as the slope of the true stress versus true strain curve in the plastic region specified. If you require analysis over a particular region of the stress-strain curve, this calculation lets you manually enter the start point and the end point.

Parameters

You must specify:

- the **Manual** type of n-value.

- the Start type.

- the Start value.

- the End type.

- the End value.

When you add the calculation to the **Calculation list**, the system includes the start type, start value, end type and end value in the description. For example, if you select extension as a start type, 5.0mm as a start value, extension as an end type and 12.5mm as an end value, the description appears as:

n-Value (Exten 5.0mm, Exten 12.5mm)

You have the option to:

- edit the calculation description by clicking in the **Description** field and typing new or additional details. Any changes to the description appear in the **Calculation list** and results table.

- place a marker on the graph by clicking in the **Indicate range on graph** check box.

Algorithm

The system:

- finds the user specified start and end points.

- takes the desired portion of the curve between the start and end points.

- calculates the logarithm of the true stress and true strain for each point in the desired portion of the curve.

- uses a least-squares fit method to calculate the slope and offset of the true stress versus true strain curve based on the selected curve portion, which determines the n-value and strength coefficient.

Example

The system finds the user specified start and end points and applies a least-squares fit method to the log of the true stress and true strain data.
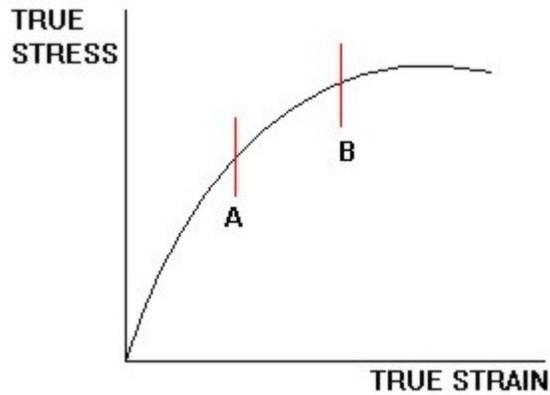
A = Start Point

B = End Point

True stress = $\sigma(1+\varepsilon)$

True strain = $\ln(1+\varepsilon)$

Fails to Calculate

The algorithm will not calculate a result if:

- there is a hysteresis loop or change in speed between the start and end points.

-or-

- the end point is beyond the point of maximum load.

-or-

- the start point is before the upper yield point or if yield point elongation is present.

Results

Starting Strain

Starting Stress

Ending Strain

Ending Stress

Strain Hardening Exponent

Strength Coefficient

Channels used as inputs for the calculation

The channel designated for Stress, Load, Strain and Extension varies according to the test type. Refer to Channels for Calculations.

Non-Proportional Elongation (% Maximum Load)

Library - Metals

This calculation determines the plastic portion of elongation using a break point defined as a percentage of the maximum load.

Parameters

You must specify:

- the **% Maximum load** type of non-proportional elongation.

- the value. Typically the value is a percentage of maximum load between 0 and 100.

When you add the calculation to the **Calculation list**, the system includes the value in the description. For example, if the maximum load is 100 N and you specify a value of 60% the system detects a break when the load falls to 60 N after the maximum load. The description appears as:

Non-Proportional Elongation (% Maximum load 60 %)

You have the option to:

- edit the calculation description by clicking in the **Description** field and typing new or additional details. Any changes to the description appear in the **Calculation list** and results table.

- place a marker on the graph by clicking in the **Indicate on graph** check box.

Algorithm

The system:

- searches all the data on the load channel for the maximum load point.

- searches the data beyond the maximum load point for the first point where the load is less than or equal to the percentage of the load you specified. If the value falls between two points, the system interpolates the value.

- assigns that point as the break.

- from the break point, draws a line parallel to the modulus line then calculates the distance between the intercepts of the line and modulus line on the strain axis.

Example

In this example, the system finds the user-specified percentage of maximum load and assigns that point as the break. From that point, it draws a line parallel to the modulus line to calculate the non-proportional elongation.

A = Maximum Load

B = % of Maximum Load

C = User-Specified Break Point

D = Line Drawn Parallel to Modulus Line

E = Non-proportional (plastic) Elongation

F = Modulus Line

Fails to Calculate

The algorithm will not calculate a result if:

- the load does not drop below the percent of maximum load you specified after the maximum load point,

-or-

- if the maximum load is the last data point.

Results

Percentage Elongation at Break

Elongation at Break

Percentage Elongation at Tensile Strength

Elongation at Tensile Strength

Channels used as inputs for the calculation

The channel designated for Stress, Load, Strain and Extension varies according to the test type. Refer to Channels for Calculations.

Non-Proportional Elongation (EN Standard)

This calculation determines the plastic portion of elongation by using a break point defined as a drop in load between two data points which is greater than five times the drop of the previous two points. The load must also be lower than 3% of the maximum load.

Parameters

You must specify the **EN standard** type of Non-proportional elongation.

When you add the calculation to the **Calculation list**, the description appears as:

Non-proportional elongation (EN standard)

You have the option to:

- edit the calculation description by clicking in the **Description** field and typing new or additional details. Any changes to the description appear in the **Calculation list** and results table.

- place a marker on the graph by clicking in the **Indicate on graph** check box.

Algorithm

The system:

- searches all the data on the stress channel for three consecutive data points such that the stress drop between the last two points is more than five times the stress drop of the first two points. Assigns the middle point as a potential break point.

- discards the potential break point if the stress increases beyond the recorded break stress.

- if a potential break point has been found, searches the rest of the data on the stress channel for a value less than 3% of the maximum-recorded stress.

- assigns that point as the break.

- from the break point, draws a line parallel to the modulus line then calculates the distance between the intercepts of the line and modulus line on the strain axis.

Example

In this example, the system finds the required stress point and assigns that point as the break. From that point, it draws a line parallel to the modulus line to calculate the non-proportional elongation.

A = Maximum Stress

B = Potential Break Point where b>5a

C = Calculated Break Point at or <3% of A

D = Line Drawn Parallel to Modulus Line

E = Plastic Portion of Elongation
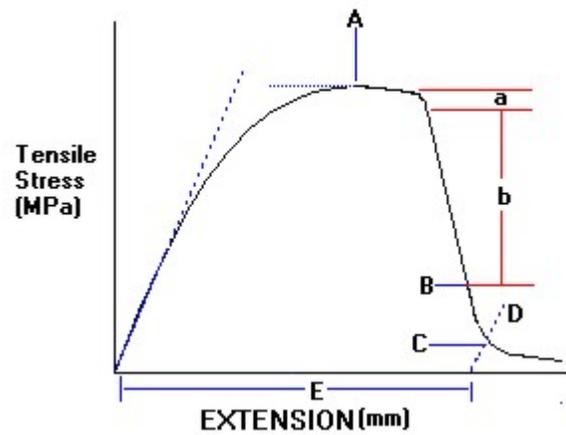
Fails to Calculate

The algorithm will not calculate a result if:

- no three consecutive data points can be found such that the stress drop between the last two points is more than five times the stress drop of the first two points,

-or-

- the recorded stress never falls to less than 3% of the maximum stress.

Results

Percentage Elongation at Break

Elongation at Break

Percentage Elongation at Tensile Strength

Elongation at Tensile Strength

Channels used as inputs for the calculation

The channel designated for Stress, Load, Strain and Extension varies according to the test type. Refer to Channels for Calculations.

Non-Proportional Elongation (Load)

This calculation determines the plastic portion of elongation using a break point defined as a load value that you specify.

Parameters

You must specify:

- the **Load** type of Non-proportional elongation.

- the value. The value must be less than the maximum load point.

When you add the calculation to the **Calculation list**, the system includes the value in the description. For example, if the value is 10 N then the description appears as:

Non-Proportional Elongation (Load 10 N)

You have the option to:

- edit the calculation description by clicking in the **Description** field and typing new or additional details. Any changes to the description appear in the **Calculation list** and results table.

- place a marker on the graph by clicking in the **Indicate on graph** check box.

Algorithm

The system:

- searches all the test data on the load channel for the maximum load point.

- searches the data beyond the maximum load point for the first point where the load is less than or equal to the load value you specified.

- assigns that point as the break.

- from the break point, draws a line parallel to the modulus line then calculates the distance between the intercepts of the line and modulus line on the strain axis.

Example

In this example, the system finds first point, beyond maximum load, where the load is less than or equal to the user-specified load value and assigns that point as the break. From that point, it draws a line parallel to the modulus line to calculate the non-proportional elongation.

A = Maximum Load

B = User-Specified Break Point

C = Line Drawn Parallel to Modulus Line

D = Non-proportional (plastic) Elongation

E = Modulus Line

Fails to Calculate

The algorithm will not calculate a result if:

- the load does not drop to the value you specified,

-or-
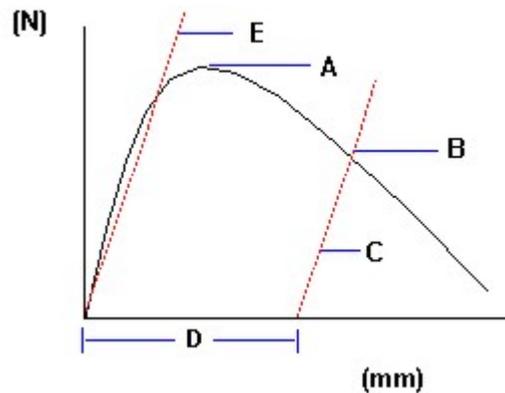
- the maximum load is the last data point.

-or-

- the maximum load is less than the value you specified.

Results

Percentage Elongation at Break

Elongation at Break

Percentage Elongation at Tensile Strength

Elongation at Tensile Strength

Channels used as inputs for the calculation

The channel designated for Stress, Load, Strain and Extension varies according to the test type. Refer to Channels for Calculations.

Non-Proportional Elongation (Load/Tensile Extension Rate)

Library - Metals

This calculation determines the plastic portion of elongation using a break point defined as a drop in load at a rate you specify. The rate of the drop is derived from the change in load divided by a change in extension.

Parameters

You must specify:

- the **Load/tensile extension rate** type of Non-proportional elongation.

- the value.

When you add the calculation to the **Calculation list**, the system includes the value in the description. For example, you select 20 N/mm as a value, the description appears as:

Non-proportional elongation (Load/tensile extension rate 20 N/mm)

You have the option to:

- edit the calculation description by clicking in the **Description** field and typing new or additional details. Any changes to the description appear in the **Calculation list** and results table.

- place a marker on the graph by clicking in the **Indicate on graph** check box.

Algorithm

The system:

- searches all the data on the **Load** channel for the maximum load point.

- searches the load and extension data beyond the maximum load point for the first point where the slope of the load/tensile extension curve is equal to or greater than the rate you specified.

- assigns that point as break.

- from the break point, draws a line parallel to the modulus line then calculates the distance between the intercepts of the line and modulus line on the strain axis.

Example

In this example, the system finds the maximum load and searches from that point to the end of the data for the first occurrence of the load dropping at the user-specified rate. The rate of the drop is derived from the change in load divided by a change in extension. The system assigns that point as the break. From that point, it draws a line parallel to the modulus line to calculate the non-proportional elongation.
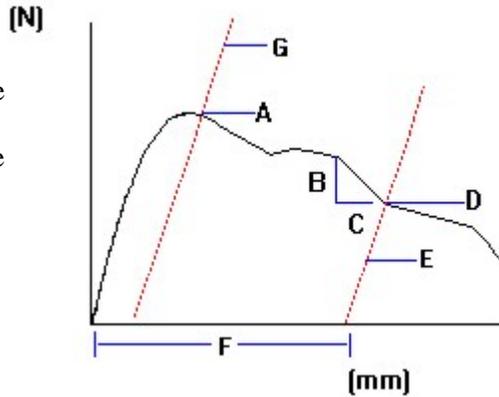
A = Maximum Load

B = Load Change

C = Extension Change

D = User-Specified Break Point

E = Line Drawn Parallel to Modulus Line

F = Plastic Portion of Elongation

G = Modulus Line

Fails to Calculate

The algorithm will not calculate a result if:

- the data does not contain a slope that is equal to or less than the rate you specified,

-or-

- the maximum load is the last data point.

Results

Percentage Elongation at Break

Elongation at Break

Percentage Elongation at Tensile Strength

Elongation at Tensile Strength

Channels used as inputs for the calculation

The channel designated for Stress, Load, Strain and Extension varies according to the test type.
Refer to Channels for Calculations.

Non-Proportional Elongation (Load/Tensile Strain Rate)

Library - Metals

This calculation determines the plastic portion of elongation by using a break point defined as a drop in load at a rate you specify. The rate of the drop is derived from the change in load divided by a change in strain.

Parameters

You must specify:

- the **Load/tensile strain rate** type of Non-proportional elongation.

- the value.

When you add the calculation to the **Calculation list**, the system includes the value in the description. For example, you select 20 N/mm/mm as a value, the description appears as:

Non-Proportional Elongation (Load/Tensile Strain Rate 20 N/mm/mm)

You have the option to:

- edit the calculation description by clicking in the **Description** field and typing new or additional details. Any changes to the description appear in the **Calculation list** and results table.

- place a marker on the graph by clicking in the **Indicate on graph** check box.

Algorithm

The system:

- searches all the data on the **Load** channel for the maximum load point.

- searches the data beyond the maximum load point for the occurrence when the slope of the curve is equal to or greater than the rate you specified.

- assigns that point as break.

- from the break point, draws a line parallel to the modulus line then calculates the distance between the intercepts of the line and modulus line on the strain axis.

Example

In this example, the system finds the maximum load [N] and searches from that point to the end of the data for the first occurrence of the load dropping at the user-specified rate. The rate of the drop is derived from the change in load divided by a change in strain. The system assigns that point as the break. From that point, it draws a line parallel to the modulus line to calculate the non-proportional elongation.
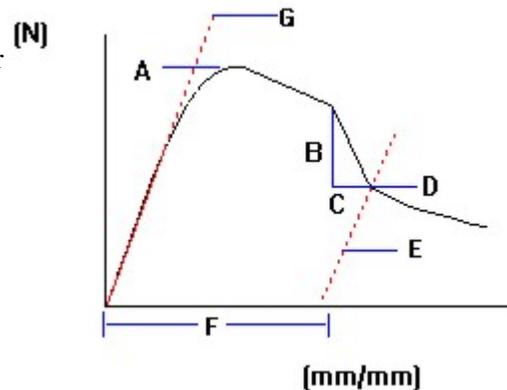
A = Maximum Load

B = Load Change

C = Strain Change

D = User-Specified Break Point

E = Line Drawn Parallel to Modulus Line

F = Plastic Portion of Elongation

G = Modulus Line

Fails to Calculate

The algorithm will not calculate a result if:

- the data does not contain a slope that is equal to or less than the rate you specified,

-or-

- the maximum load is the last data point.

Results

Percentage Elongation at Break

Elongation at Break

Percentage Elongation at Tensile Strength

Elongation at Tensile Strength

Channels used as inputs for the calculation

The channel designated for Stress, Load, Strain and Extension varies according to the test type. Refer to Channels for Calculations.

Non-Proportional Elongation (Standard)

This calculation determines the plastic portion of elongation by using a break point defined as the highest load in the last 100 ms of data.

Parameters

You must specify the **Standard** type of non-proportional elongation.

When you add the calculation to the **Calculation list**, the description appears as:

Non-Proportional Elongation (Standard)

You have the option to:

- edit the calculation description by clicking in the **Description** field and typing new or additional details. Any changes to the description appear in the **Calculation list** and results table.

- place a marker on the graph by clicking in the **Indicate on graph** check box.

Algorithm

The system:

- searches the last 100 ms of the load channel data.

- sequentially compares each point with the next to determine the maximum value.

- assigns the maximum point as the break.

- from the break point, draws a line parallel to the modulus line then calculates the distance between the intercepts of the line and modulus line on the strain axis.

Example

In this example, the system searches the last 100 ms for the maximum load and assigns that point as the break. From that point, it draws a line parallel to the modulus line to calculate the non-proportional elongation.

A = 100 ms

B = Break Point

C = Line Drawn Parallel to Modulus Line

D = Non-proportional (plastic) Elongation

E = Modulus Line
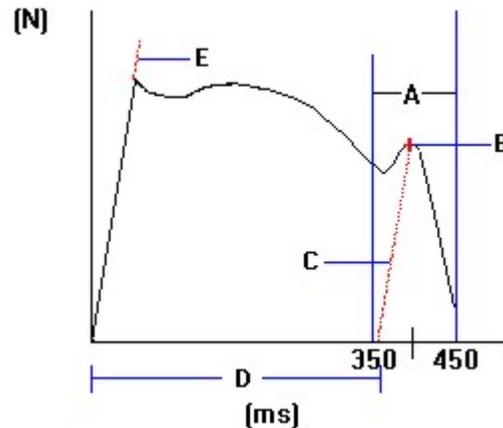
Fails to Calculate

The algorithm will not calculate a result if there is less than 100 ms of data.

Results

Percentage Elongation at Break

Elongation at Break

Percentage Elongation at Tensile Strength

Elongation at Tensile Strength

Channels used as inputs for the calculation

The channel designated for Stress, Load, Strain and Extension varies according to the test type. Refer to Channels for Calculations.

Offset Yield

This calculation determines the point on the stress/stain curve at which yield is assumed to have taken place. Offset yield is a dependent calculation that requires a result from a modulus calculation. The offset yield calculation constructs a line parallel to the modulus and offset from it by an amount that you specify. The offset yield point is where the offset line intersects the curve.

Parameters

You must specify:

- the **Offset Yield** type of yield.

- either the derived extension or strain channel.

The system includes the type of yield and the offset value in the calculation description when you add the calculation to the **Calculation list**. If you select an **Offset Yield** with a 30% offset on the **Tensile Strain** channel, the calculation description appears as:

Yield (Offset 30%)

You have the option to:

- edit the calculation description by clicking in the **Description** field and typing new or additional details. Any changes to the description appear in the **Calculation list** and results table.

- place a marker on the graph by clicking in the **Indicate on graph** check box.

Algorithm

The system:

- uses a modulus line determined by a previous calculation as a starting point.

- searches the channel, either strain or extension, you specified for the point of intersection of a line parallel to the modulus but offset by a channel value you specified.

- assigns an interpolated point of intersection as the yield point.

Example

In this example, the **Tensile strain** channel is set to an offset yield value of 2%. The system draws a line parallel (but offset by the value you specified) to the line created by a previous modulus calculation. The yield point is where this line intersects the data, in this case a stress point of 4 MPa.
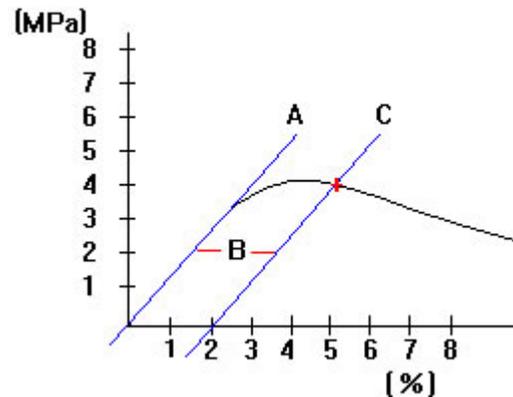
+ = Yield Point Marker

A = Initial Modulus

B = Offset Value

C = Offset Line

Fails to Calculate

The algorithm will not calculate a result if:

- the data never intersects the offset line,

-or-

- there is no modulus line.

Results

All channels in the system are available.

Channels used as inputs for the calculation

The channel designated for Stress, Load, Strain and Extension varies according to the test type. Refer to Channels for Calculations.

Poisson's Ratio (Chord)

Library - General

Poisson's Ratio is the absolute value of the ratio of transverse strain to the corresponding axial strain resulting from uniformly distributed axial stress below the proportional limit of the material. Transverse strain is measured in a direction perpendicular to the applied load and axial strain is measured in a direction of the applied load. The ratio is a material constant for stresses in the region below the proportional limit; that is in the region where stress and strain are proportional.

The axial strain always comes from the axial strain source, and the transverse strain always comes from the transverse strain source 1.

This calculation determines the slope of the transverse strain/tensile strain curve between any two points on the curve. It constructs a straight line between the lower and upper bounds that you specify.

Parameters

You must specify:

- the **Chord** type of Poisson's Ratio

- a channel.

- an **End Value** in the units channel you specified. This value must be higher than the start value. The system does not include data after the end value in the calculation.

- a **Start Value** in the units channel you specified. This value must be lower than the end value. The system does not include data before the start value in the calculation.

When you add the calculation to the **Calculation list**, the system includes the **Poisson's Ratio** type in the description. For example, if you select a **Chord** type of Poisson's Ratio on the Strain 1 channel with a start value of 0.3 mm/mm and an end value of 0.5 mm/mm, the description appears as:

Poisson's Ratio (Chord 0.3 mm/mm - 0.5 mm/mm)

You have the option to edit the calculation description by clicking in the **Description** field and typing new or additional details. Any changes to the description appear in the **Calculation list** and results table.

Algorithm

The system:

- Searches the channel between the start and end values you specified.

- calculates the modulus between the start and end values as follows:

Poisson's ratio = {transverse strain at upper value - transverse strain at lower value} / {tensile strain at upper value - tensile strain at lower value}

- Finds the first point in the test data where the start value falls between two points. Interpolate the primary normalized load and normalized extension at the start value.

- Finds the first point in the test data after the start value where the end value falls between two points. Interpolate the primary normalized load and normalized extension at the end value.

- Calculate the straight line between the two interpolated points of the primary normalized load and normalized extension data.

Example

In a tensile test, for example, transverse strain decreases as axial strain increases. The value of Poisson's Ratio is therefore the negative value of the ratio of the two strains in order to produce a positive number. You define limits between which the system constructs a straight line. Poisson's Ratio is the slope of that line.

In this example, the **Strain** channel is set with a start value of 1 mm/mm and an end value of 5 mm/mm. The system calculates Poisson's Ratio by dividing the change in stress by the change in strain between the start and end values.
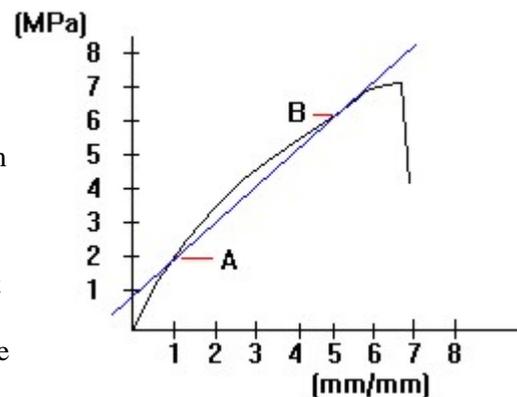
A = Start Value

B = End Value

Fails to Calculate

The algorithm will not calculate a result if:

- the data does not contain either the upper or lower bound you specified.

or-

- no yield calculation is selected for Fraction of Yield Load.

Results

Poisson's Ratio

X-Intercept

Y-Intercept

Channels used as inputs for the calculation

The channel designated for Stress, Load, Strain and Extension varies according to the test type. Refer to Channels for Calculations.

Poisson's Ratio (Least Squares Fit)

Library - General

Poisson's Ratio is the absolute value of the ratio of transverse strain to the corresponding axial strain resulting from uniformly distributed axial stress below the proportional limit of the material. Transverse strain is measured in a direction perpendicular to the applied load and axial strain is measured in a direction of the applied load. The ratio is a material constant for stresses in the region below the proportional limit; that is in the region where stress and strain are proportional.

The axial strain always comes from the axial strain source, and the transverse strain always comes from the transverse strain source 1.

This calculation determines the slope of the transverse strain/tensile strain curve between the specified limits using least squares fit on test data.

Parameters

You must specify:

- the **Least Squares Fit** type of Poisson's Ratio

- a channel.

- an **End Value** in the units channel you specified. This value must be higher than the start value. The system does not include data after the end value in the calculation.

- a **Start Value** in the units channel you specified. This value must be lower than the end value. The system does not include data before the start value in the calculation.

When you add the calculation to the **Calculation list**, the system includes the **Poisson's Ratio** type in the description. For example, if you select a **Least Squares Fit** type of Poisson's Ratio on the **Strain 1** channel with a start value of 0.3 mm/mm and an end value of 0.5 mm/mm, the description appears as:

Poisson's Ratio (Least Squares Fit 0.3 mm/mm - 0.5 mm/mm)

You have the option to edit the calculation description by clicking in the **Description** field and typing new or additional details. Any changes to the description appear in the **Calculation list** and results table.

Algorithm

The system:

- Defaults to a single data region with no overlap.

- Finds the first point in the test data where the start value falls between two points. Then it selects that point or the preceding point, whichever is closer to the specified value.

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- Finds the end value in the same way. Start the search with the start n point.

- Using this data, calculates a least squares fit for transverse strain vs. tensile strain. Does not interpolate. Reports this as Poisson's Ratio.

Example

In a tensile test, for example, transverse strain decreases as axial strain increases. The value of Poisson's ratio is therefore the negative value of the ratio of the two strains in order to produce a positive number. You define limits between which the system constructs a straight line. Poisson's ratio is the slope of that line.

Fails to Calculate

The algorithm will not calculate a result if:

- the data does not contain either the upper or lower bound you specified.

-or-
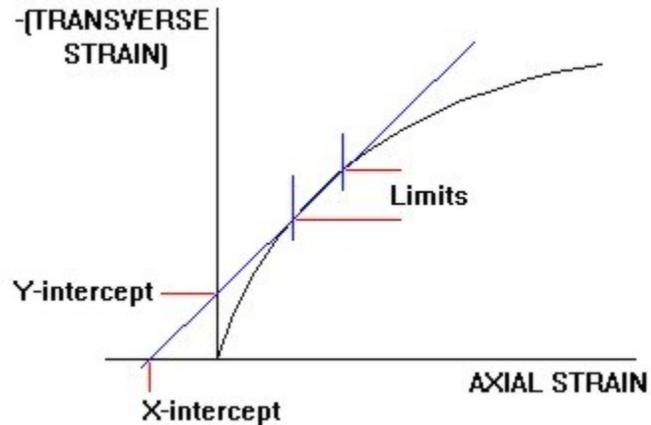
- no yield calculation is selected when the channel is % of Yield Load.

Results

Poisson's Ratio

X-Intercept

Y-Intercept

Channels used as inputs for the calculation

The channel designated for Stress, Load, Strain and Extension varies according to the test type. Refer to Channels for Calculations.

Preset Point Calculation

This calculation is based upon an assigned channel and value. For example, you can set a preset point of 20 kN of load, 30 seconds of time, 0.005 mm of strain, cursor selected points, pip marks, and so on.

Parameters

You must specify:

- either a channel, a cursor-selected point, or a pip point.

- a preset point value if you selected a channel, or a pip number if you selected a pip point.

When you add the calculation to the **Calculation list**, the system includes the channel and preset point value in the description. For example, if you select a preset point of 3mm on the Compressive extension channel, the description appears as:

Preset Point(Compressive extension 3mm)

You have the option to:

- edit the calculation description by clicking in the **Description** field and typing new or additional details. Any changes to the description appear in the **Calculation list** and results table.

- place a marker on the graph by clicking in the **Indicate on graph** check box.

Algorithm

The system:

- searches all the test data on the channel you specified.

- determines the first occurrence of the preset value you specified.

- uses linear interpolation to determine the value if the point falls between two data points.

Example

In this example, the preset point is set for 50 N on the **Load** channel. The **Time** result at the first occurrence of the preset point is 0.4 seconds.
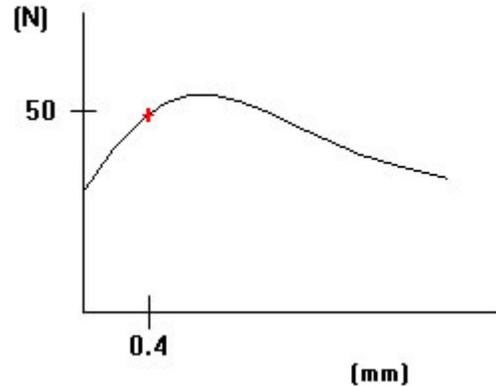
+ = Preset Point Marker

Fails to Calculate

The algorithm will not calculate a result if:

- you have specified a cursor-selected point for the calculation but have not selected the point in the **Edit Cursor-Selected Points** dialog,

-or-

- the preset point value you specified does not occur within the data,

-or-

- you have specified a pip point and there are not enough pip marks in the data. For example, if there are 4 pip marks on the curve and you specify the fifth, the calculation fails.

Results

All channels in the system are available.

Channels used as inputs for the calculation

The channel designated for Stress, Load, Strain and Extension varies according to the test type. Refer to Channels for Calculations.

r-value (Automatic)

This calculation determines the plastic strain ratio, r, as the ratio of the true width strain to the true thickness strain.

Parameters

You must specify:

- the **Automatic** type of r-value.

When you add the calculation to the **Calculation list**, the description appears as:

r-Value (Automatic)

You have the option to:

- edit the calculation description by clicking in the **Description** field and typing new or additional details. Any changes to the description appear in the **Calculation list** and results table.

- remove the elastic components of the measured strains by clicking in the **Remove elastic strains** check box.

- specify **Modulus**. Modulus of elasticity is greater than zero.

- specify **Poisson's Ratio**. Poisson's Ratio value ranges from 0.1 to 0.9.

- place a marker on the graph by clicking in the **Indicate on graph** check box.

Algorithm

The calculation to determine r-value is as follows:

r = ln{b(initial)/b(final)} / ln[{L(final) * b(final)}/{L(initial) * b{initial)}].

where:

b = specimen width

L = specimen gauge length

The system finds the start point (0.2% offset yield point) and the end point (point of maximum load) and uses a least-squares fit method to determine the r-value.

The system:

- finds the fixed start point (0.2% offset yield point) and end point (point of maximum load).

- selects a region on the stress-strain curve between the start and end points.

- uses a least-squares fit method to calculate the ratio of the width and length strains over the selected region, which determines the r-value.

Notes:
Changes in thickness are very difficult to measure with sufficient precision. The system uses an equivalent relationship based on length and width strain measurements to calculate the r-value.

If a ramp transition occurs between the start and end points, the start point will be moved to the beginning of the ramp where the maximum load occurs. The end point always remains the same at maximum load.

Example

In this example, the system finds the start point (0.2% offset yield point) and the end point (point of maximum load) and uses a least-squares fit method to determine the r-value.

A = Start point

B = End point

C = Load versus Extension curve

D = Width versus Extension curve

E = Change in width
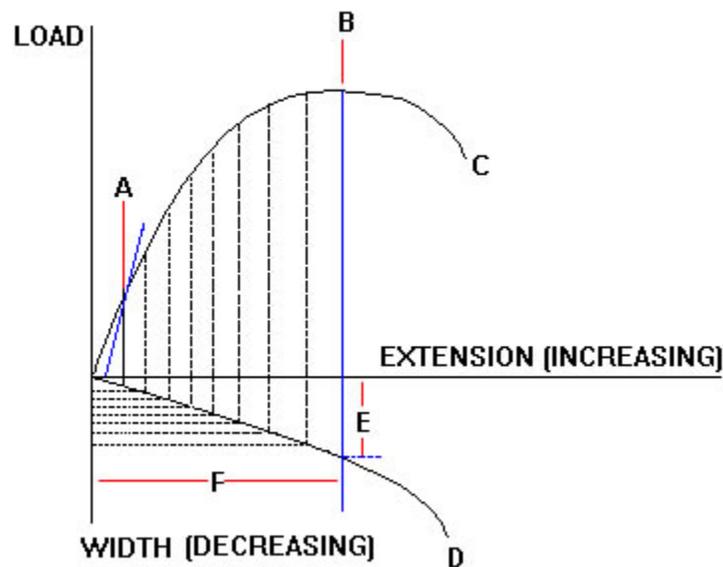
F = Change in length

Fails to Calculate

The algorithm will not calculate a result if:

- you do not use two extensometers: one measuring axial strain and one measuring transverse strain.

-or-

- there is a hysteresis loop or change in speed.

Results

Axial Length

Transverse Length

Starting Strain

Ending Strain

Plastic Strain Ratio

Channels used as inputs for the calculation

The channel designated for Stress, Load, Strain and Extension varies according to the test type. Refer to Channels for Calculations.

r-value (Manual)

This calculation determines the plastic strain ratio, r, as the ratio of the true width strain to the true thickness strain. If you require analysis over a particular region, use this calculation to manually enter the start point and the end point.

Parameters

You must specify:

- the **Manual** type of r-value.

- the **Start** type.

- the **Start value**. Typically the Start value is 12-15%.

- the **End** type.

- the **End value**. Typically the End value is 12-15%.

The system includes the start type, start value, end type and end value in the calculation description when you add the calculation to the **Calculation list**. If you select tensile strain as a start type, 12% as a start value, tensile strain as an end type and 15% as an end value, the description appears as:

r-Value (Strain 12% Strain 15%)

You have the option to:

- edit the calculation description by clicking in the **Description** field and typing new or additional details. Any changes to the description appear in the **Calculation list** and results table.

- remove the elastic components of the measured strains by clicking in the **Remove elastic strains** check box.

- specify **Modulus**. Modulus of elasticity is greater than zero.

- specify **Poisson's Ratio**. Poisson's Ratio value ranges from 0.1 to 0.9.

- place a marker on the graph by clicking in the **Indicate on graph** check box.

Algorithm

The calculation to determine r-value is as follows:

$r = \ln\{b(initial)/b(final)\} / \ln[\{L(final) * b(final)\}/\{L(initial) * b\{initial)\}]$

where:

b = specimen width

L = specimen gauge length

Multiple Points

The system finds the user specified start and end points and uses a least-squares fit method to calculate the r-value.

The system:

- finds the user specified start and end points.

- takes the selected region of the curve between the start and end points.

- uses a least-squares fit method to calculate the ratio of the width and length strains over the selected region, which determines the r-value.

Note:
Changes in thickness are very difficult to measure with sufficient precision. The system uses an equivalent relationship based on length and width strain measurements to calculate the r-value.

Single Point

The system finds the user specified point, for example 15%, and uses the data at that point to calculate the r-value.

The system:

- finds the user specified point.

- as specified in the standards, uses the data at that point to calculate the ratio of the width and length strains, which determines the r-value.

Note:
Changes in thickness are very difficult to measure with sufficient precision. The system uses an equivalent relationship based on length and width strain measurements to calculate the r-value.

Examples

Multiple Points

In this example, the system finds the user specified start and end points and uses a least-squares fit method to calculate the r-value.

A = User-specified start point

B = User-specified end point

C = Load versus Extension curve

D = Width versus Extension curve

E = Change in width

F = Change in length
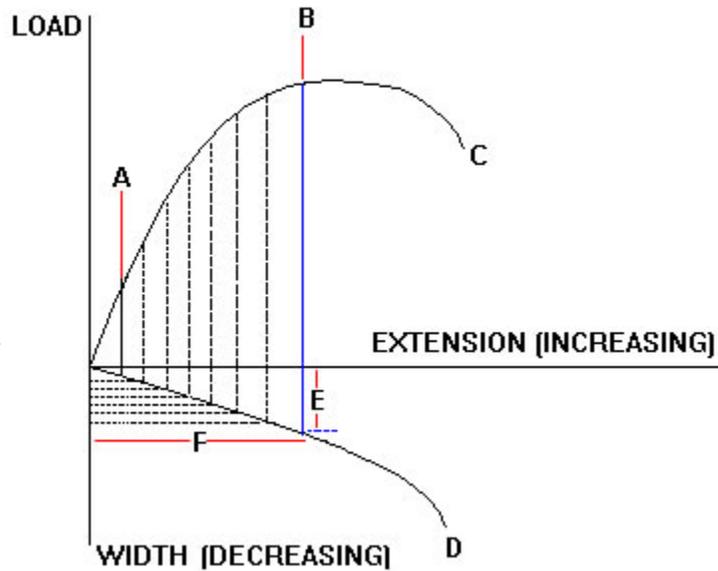
Single Point

In this example, the system finds the user specified point, for example 15%, and uses the data at that point to calculate the r-value.

A = User-specified point

B = Load versus Extension curve

C = Width versus Extension curve

D = Change in width

E = Change in length
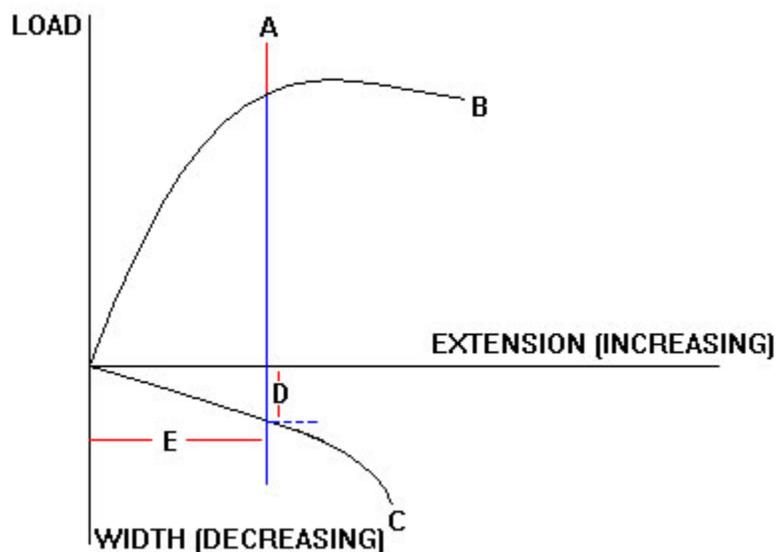
Fails to Calculate

The algorithm will not calculate a result if:

- the start point is before the upper yield point or before the end YPE/Ae is present.

-or-

- you do not use two extensometers: one measuring axial strain and one measuring transverse strain.

-or-

- the end point is beyond the point of maximum load,

-or-

- there is a hysteresis loop or change in speed between the start and end points.

Results

Axial Length

Transverse Length

Starting Strain

Ending Strain

Plastic Strain Ratio

Channels used as inputs for the calculation

The channel designated for Stress, Load, Strain and Extension varies according to the test type. Refer to Channels for Calculations.

Secant Modulus

This calculation determines the slope of a line constructed between zero and any point on the curve. It constructs a straight line between zero and a start value that you specify.

Parameters

You must specify:

- the **Secant** type of modulus.

- a channel.

- an end value in the units of the channel you specified. The system does not include data after the end value in the calculation.

The system includes the modulus type and the start value in the calculation description when you add the calculation to the **Calculation list**. For example, if you select a **Secant** modulus on the **Time** channel with a start value of 1 second, the description appears as:

Modulus (Secant 1 sec)

You have the option to:

- edit the calculation description by clicking in the **Description** field and typing new or additional details. Any changes to the description appear in the **Calculation list** and results table.

- place a modulus line on the graph by clicking in the **Indicate on graph** check box. This is available only if the graph is plotting a combination of normalized Y (stress) and normalized X (strain) channels or their source.

Algorithm

The system:

- uses the zero stress/strain point as the start value.

- searches the data on the channel for the end value you specified.

- calculates the modulus between the start and end values as follows:

  modulus = {stress at upper value - stress at lower value} / {strain at upper value - strain at lower value}

Example

In this example, the **Stress** channel is set for a start value of 4 MPa. The start value is fixed at Strain point 0.0 %. The system calculates the modulus by dividing the change in stress by the change in strain between the start and end values.

A = Modulus Marker

B = Start Value
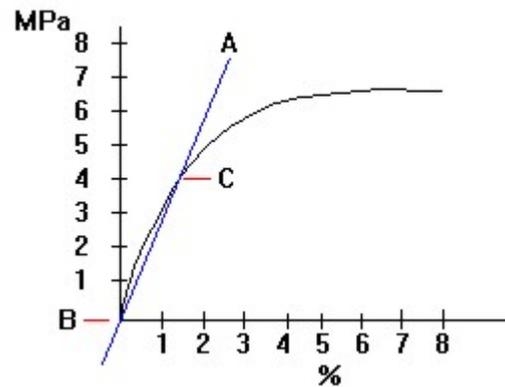
C = End Value

Fails to Calculate

The algorithm will not calculate a result if the end value you specified is not within the data.

Results

X-Intercept

Y- Intercept

Modulus

Channels used as inputs for the calculation

The channel designated for Stress, Load, Strain and Extension varies according to the test type. Refer to Channels for Calculations.

Segment Modulus

This calculation determines the slope of the stress/strain curve between bounds you specify. The system interpolates the start and end values if the values do not match actual data points. The system uses a least squares fit routine to construct the modulus line.

Parameters

You must specify:

- the **Segment** type modulus.

- a channel.

- a end value in the units of the channel you specified. This value must be higher than the start value . The system does not include data after the end value in the calculation

- a start value in the units of the channel you specified. This value must be lower than the end value. The system does not include data before the start value in the calculation.

The system includes the modulus type and the start and end values in the calculation description when you add the calculation to the **Calculation list**. For example, if you select a **Segment** modulus on the **Strain 1** channel with a start value of 0.1 % and an end value of 0.5 %, the description appears as:

Modulus (Segment 0.1% - 0.5%)

You have the option to:

- edit the calculation description by clicking in the **Description** field and typing new or additional details. Any changes to the description appear in the **Calculation list** and results table.

- place a marker on the graph by clicking in the **Indicate on graph** check box.

Algorithm

The system:

- searches the data on the channel for the start and end values you specified.

- if necessary, uses linear interpolation to define the start and end values.

- calculates the least squares fit on all the points between the start and end values. The modulus line will not necessarily pass through the start and end values or any point in between.

Example

In this example, the **Stress** channel is set with a start value of 2 MPa and an end value of 6 MPa. Because no data point is equal 6 MPa, the system uses linear interpolation to define an end value. The system defines the modulus by constructing a straight line using a least squares fit equation.
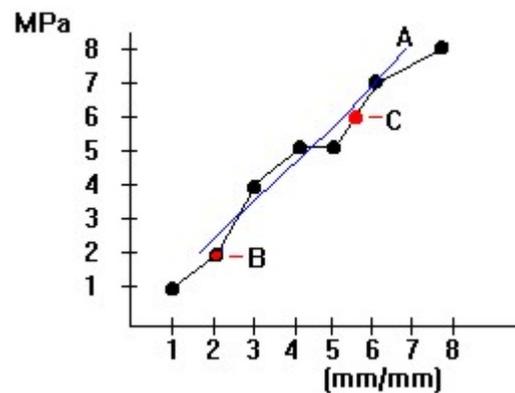
A = Modulus Marker

B = Start Value

C = End Value(Interpolated)

Note: The modulus line does not intersect the start and end values.

Fails to Calculate

The algorithm will not calculate a result if:

-   the data does not contain either the start or end value you specified.

-or-

-   there are fewer than two data points between the start and end values you specified.

Results

X-Intercept

Y- Intercept

Modulus

Channels used as inputs for the calculation

The channel designated for Stress, Load, Strain and Extension varies according to the test type. Refer to Channels for Calculations.

Slack Correction (Automatic)

<div align="right">Library - General</div>

This calculation applies a correction to the specimen to compensate for any slack in the specimen. Slack correction is always the first calculation and subsequent calculations use the corrected gauge length.

Parameters

You must specify the **Automatic** type of slack correction.

When you add the calculation to the **Calculation list**, the system includes the slack correction type in the description, which appears as:

<div align="center">**Slack Correction (Automatic)**</div>

You have the option to:

- edit the calculation description by clicking in the **Description** field and typing new or additional details. Any changes to the description appear in the **Calculation list** and results table.

- correct the gauge length by clicking in the **Correct Gauge Length** check box.

Algorithm

The system:

- searches the data from the first point to the maximum load point.
- determines the start value by finding the first data point equal to or greater than 2% of the maximum load. .

- defines the end value as the maximum load point.

- divides the data between the start and end values into 6 equal regions with no overlap.

- applies a least squares fit algorithm on all the data points in the regions.

- calculates the sum of the slopes of each pair of adjacent data regions.

- determines which pair of regions that has the highest slope sum.

- from this pair, determines which region has the highest slope and assigns the modulus to that region.

- determines the slack correction at the point where the modulus line intersects the zero-stress strain axis.

- applies the correction to the derived strain and extension channels.

Example

In this example, the system constructs a modulus line along the initial linear portion of the data. The modulus line intersects the Strain channel at 3 % strain. This point is the calculated slack that the system uses to correct the gauge length. Applying the calculation to the same data on the Tensile strain channel produces the graph below. Notice that there is no slack.
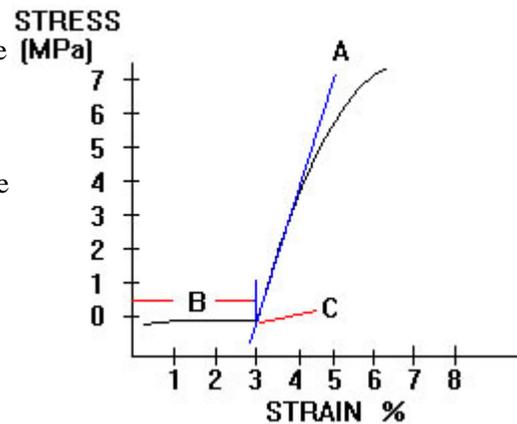
A = Modulus Marker

B = Slack

C = Modulus/Strain intersect
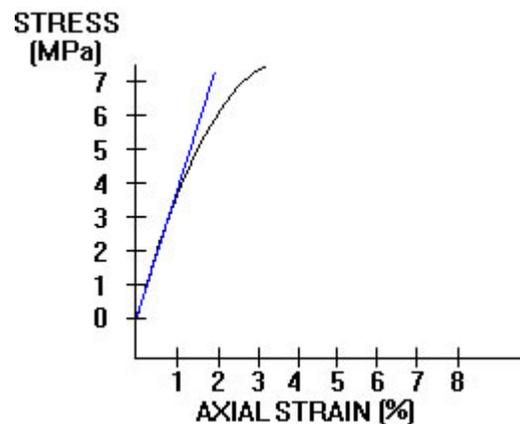
Fails to Calculate

The algorithm will not calculate a result if there are fewer that two data points between 2% of maximum load and maximum load.

Results

Extension Offset
Strain Offset
Corrected Gauge Length

Channels used as inputs for the calculation

The channel designated for Stress, Load, Strain and Extension varies according to the test type. Refer to Channels for Calculations.

Slack Correction (Channel Value)

This calculation determines the point on the stress/strain curve at which any slack is removed from the specimen. You specify a minimum load or stress value that the system must reach. You have the option of correcting the gauge length at the specified point. This action corrects the derived strain and extension.

Parameters

You must specify:

- the **Channel Value** type of slack correction.
- the channel to determine the slack correction point.

- a value in the units of the channel you specified.

When you add the calculation to the **Calculation list**, the system includes the slack correction type and the channel value in the description. For example, if you select a **Channel Value** type of slack correction on the **Compressive strain** channel with a value of 2mm/mm, the description appears as:

<div align="center">

Slack Correction (Channel Value 2mm/mm)

</div>

You have the option to:

- edit the calculation description by clicking in the **Description** field and typing new or additional details. Any changes to the description appear in the **Calculation list** and results table.

- correct the gauge length by clicking in the **Correct Gauge Length** check box.

Algorithm

The system:

- searches the data on the channel you specified.
- finds the first point that is equal to or greater than the channel value you specified. If the value does not fall on a data point, the system interpolates between the points on either side of the value.

- determines the slack correction as the strain value corresponding to the channel value.

Example

In this example, the Extension channel is set with a channel value of 5 mm. Applying the calculation to the same data on the Tensile extension channel produces the graph below. Notice that there is no slack.

+ = Channel Value Marker

A =Slack
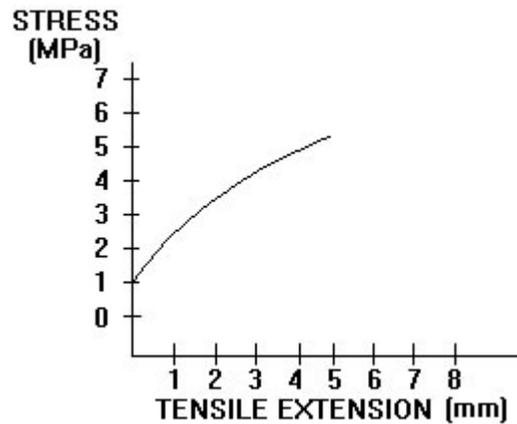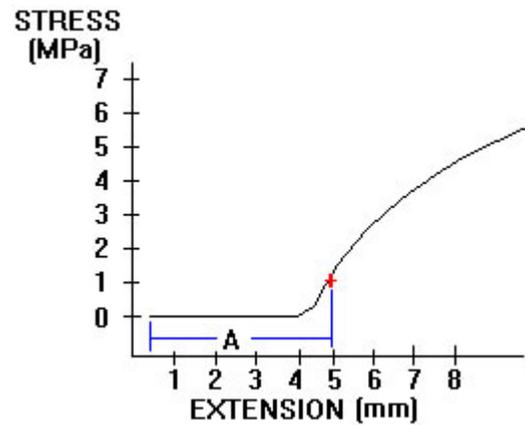
Fails to Calculate

The algorithm will not calculate a result if the data does not contain the channel value you specified.

Results

Extension Offset
Strain Offset
Corrected Gauge Length

Channels used as inputs for the calculation

The channel designated for Stress, Load, Strain and Extension varies according to the test type. Refer to Channels for Calculations.

Slack Correction (Young's)

This calculation determines the point on the stress/strain curve at which load is fully applied to the specimen.

Parameters

You must specify:

- the **Young's** type of slack correction.
- a channel.

- a start value in the units of the channel you specified. This value must be lower than the end value. The system does not include data before the start value in the calculation.

- an end value in the units of the channel you specified. This value must be higher than the start value. The system does not include data beyond the end value in the calculation.
- number of regions. You can specify 1 to 100 regions. The more regions you specify, the higher the accuracy and processing time.
- Overlap as a percent value from 0 to 99%. The greater the number, the more overlap between regions.

When you add the calculation to the **Calculation list**, the system includes the slack correction type and start and end values in the description. For example, if you select a Young's type of slack correction on the **Compression extension** channel with a start value of 0 mm and a end value of 10 mm, the description appears as:

Slack Correction (Young's 0mm - 10mm)

You have the option to:

- edit the calculation description by clicking in the **Description** field and typing new or additional details. Any changes to the description appear in the **Calculation list** and results table.

- correct the gauge length by clicking in the **Correct Gauge Length** check box.

Algorithm

The system:

- searches the data for the lower and upper bounds you specified.
- divides the data between the start and end values into the number of equally spaced regions with the percentage of overlap you specified.

- assigns the start of each region to the closest data point.

- assigns the end of each region to the closest data point.

- applies a least squares fit algorithm to all the data points in each region.

- calculates the sum of the slopes of each pair of adjacent regions.

- determines which pair of regions that has the highest slope sum.

- from this pair, determines which region has the highest slope and assigns the modulus to that region.

- determines the slack correction from the point where the modulus line intersects the strain axis.

- applies the correction to the derived strain and extension channels.

Example

In this example, the system constructs a modulus line along the initial linear portion of the data. The modulus line intersects the Strain channel at 2% strain. The system uses this point to correct the gauge length. Applying the calculation to the same data on the Tensile strain channel produces the graph below. Notice that there is no slack.

A = Modulus Marker

B = Slack

C = Modulus/Strain intersect

Fails to Calculate

The algorithm will not calculate a result if the data contains the same number or fewer points than the number of regions you specified.

Results

Extension Offset
Strain Offset
Corrected Gauge Length

Channels used as inputs for the calculation

The channel designated for Stress, Load, Strain and Extension varies according to the test type. Refer to Channels for Calculations.

Slope Threshold Yield

This calculation determines the point on the stress/stain curve at which yield is assumed to have taken place. Slope threshold yield is a dependent calculation that requires a result from a modulus calculation. The slope threshold yield calculation searches for the point at which the slope of the stress/strain curve has decreased to a specified percentage of the modulus slope.

Parameters

You must specify:

- the **Slope Threshold** type of yield.
- a percentage of the initial modulus slope.
- a number of regions. You can specify 1 to 100 regions. The more regions you specify, the higher the accuracy and processing time.

- a percentage of overlap between 0 and 99.

The system includes the type of yield in the calculation description when you add the calculation to the **Calculation list**.If you select a **Slope Threshold** yield with a 50% value, the calculation description appears as:

Yield (Slope Threshold 50%)

You have the option to:

- edit the calculation description by clicking in the **Description** field and typing new or additional details. Any changes to the description appear in the **Calculation list** and results table.

- place a marker on the graph by clicking in the **Indicate on graph** check box.

Algorithm

The system:

- divides the curve into the number of regions with any percent overlap you specified.

- calculates the slope of each region.

- finds the first region with a slope that is less than or equal to the percentage of the modulus' slope you specified.

- assigns the center point of this region as the yield point.

Example

In this example, the specified threshold slope is set for 10% of the modulus slope. The first region contains the initial slope. The data in the fourth region is the first point where the slope drops to 10% of the initial slope.
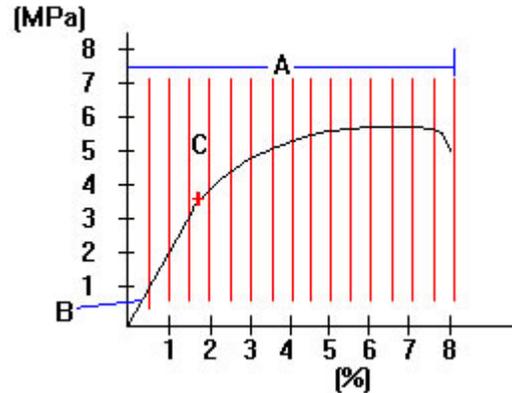
+ = Yield Point Marker

A = Regions

B = Initial slope

C = Region of percent change

Fails to Calculate

The algorithm will not calculate a result if:

- there is no data with a zero or negative slope,

-or-

- the system did not detect a zero slope based on the parameters you specified,
-

-or-

- the data contains the same number or fewer points than the number of regions you specified.

Results

All channels in the system are available.

Channels used as inputs for the calculation

The channel designated for Stress, Load, Strain and Extension varies according to the test type. Refer to Channels for Calculations.

Tangent Modulus

This calculation finds the slope of the stress/strain curve at a point on the curve. It constructs a modulus line at a tangent to the point that you specify.

Parameters

You must specify:

- a **Tangent** type of modulus.

- a channel.

- a channel value (tangent point).

The system includes the modulus type and the channel value in the calculation description when you add the calculation to the **Calculation list**. For example, if you select a **Tangent** modulus on the compressive stress channel with a channel value of 11 kPa, the description appears as:

Modulus (Tangent 11 kPa)

You have the option to:

- edit the calculation description by clicking in the **Description** field and typing new or additional details. Any changes to the description appear in the **Calculation list** and results table.

- place a modulus marker on the graph by clicking in the **Indicate on graph** check box.

Algorithm

The system:

- searches all the data on the channel you specify for the first point equal to or greater than the channel value (tangent point).

- uses this data point as the end value.

- uses the first data point before the tangent point as the start value.

- calculates the modulus between the start and end values as follows:

  modulus = {stress at upper value - stress at lower value} / {strain at upper value - strain at lower value}

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Example

In this example, the **Stress** channel is selected with a channel value of 4 MPa. No data point is equal to this point so the system uses 5 MPa as the end value. The start value is 3 MPa, the first point less than the channel value. The system constructs a modulus line through these points.
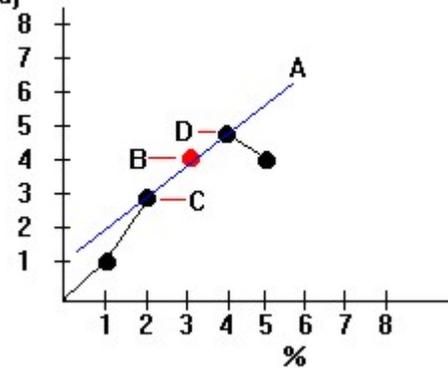
A = Modulus Marker

B = Channel Value

C = Start Value

D = End Value

Fails to Calculate

The algorithm will not calculate a result if the data does not contain the tangent value you specified.

Results

X-Intercept

Y- Intercept

Modulus

Channels used as inputs for the calculation

The channel designated for Stress, Load, Strain and Extension varies according to the test type. Refer to Channels for Calculations.

Tensile Strength Calculation

This calculation meets the requirements of the EN10002 and ASTM E8 standards. It determines the percentage of total elongation at the maximum force and the value of all data channels at that point, which includes the tensile strength of the material.

Parameters

When you add the calculation to the **Calculation list**, the calculation description appears as:

Tensile Strength

You have the option to:

- edit the calculation description by clicking in the **Description** field and typing new or additional details. Any changes to the description appear in the **Calculation list** and results table.

- place a marker on the graph by clicking in the **Indicate on graph** check box.

Algorithm

The system:

- smoothes the raw stress data after the upper yield point (if any) by using a moving average of the recorded stress readings and records the highest value seen as an approximate position of the total elongation at maximum force.

- after all the data has been analyzed, selects an interval around the approximate total elongation at maximum force and smoothes the raw stress data by using a smoothing cubic spline.

- selects the data point where the slope of the smoothed data changes from positive to negative.

- assigns that point as the total elongation at maximum force.

- returns the value of all data channels at this point, including the tensile strength.

Example

In this example, the system detects an ultimate tensile
stress point at A because this point is the highest
(smoothed) stress value after the yield point.

A = Ultimate Tensile Stress (UTS) point
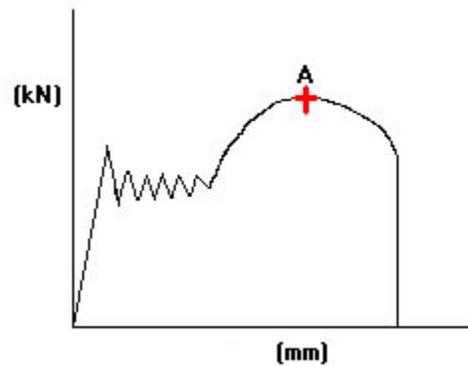
Fails to Calculate

The algorithm will not calculate a result if:

- there are less than 50 data points collected.

Note:
    The approximate value of the total elongation at maximum force will be used if the
    total elongation of the material is less than about 4%

Results

All channels in the system are available.

Channels used as inputs for the calculation

The channel designated for Stress, Load, Strain and Extension varies according to the test type.
Refer to Channels for Calculations.

Total Creep

This calculation determines the difference between the channel values at the minimum and maximum derived extension points during the hold segment.

Parameters

You must specify the **Total Creep** type of creep/relaxation.

The calculation description appears in the **Calculation list** as:

Total Creep

You have the option to:

- edit the calculation description by clicking in the **Description** field and typing new or additional details. Any changes to the description appear in the **Calculation list** and results table.

- place hold segment markers on the graph by clicking in the **Indicate on graph** check box.

Algorithm

The system:

- searches the derived extension channel for the minimum point in the hold segment of the data.

- searches the derived extension channel for the maximum point in the hold segment of the data.

- determines the difference between the channel values of a selected results channel at the derived extension maximum and minimum points.

Example

In this example, the maximum value on the **Extension** channel is 6 mm. The minimum value is 3 mm. By calculating the difference between these points, the system determines the total creep as 3 mm.

A = Hold Segment Markers
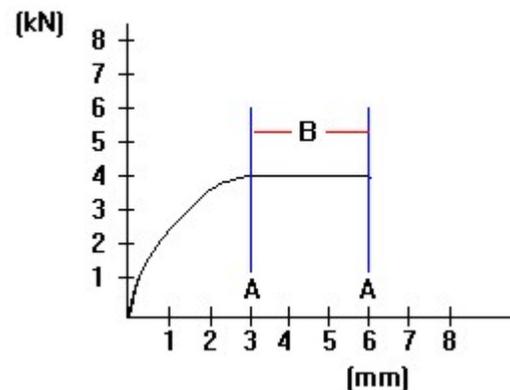
B = Hold Segment

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Fails to Calculate

The algorithm will not calculate a result if there is no hold data.

Results

All channels in the system are available.

Channels used as inputs for the calculation

The channel designated for Stress, Load, Strain and Extension varies according to the test type. Refer to Channels for Calculations.

Total Relaxation

This calculation determines the difference between the channel value at the minimum and maximum derived load points during the hold segment.

Parameters

You must specify the **Total Relaxation** type of creep/relaxation.

The calculation description appears in the **Calculation list** as:

Total Relaxation

You have the option to:

- edit the calculation description by clicking in the **Description** field and typing new or additional details. Any changes to the description appear in the **Calculation list** and results table.

- place hold segment markers on the graph by clicking in the **Indicate on graph** check box.

Algorithm

The system:

- searches the derived load channel for the minimum and maximum points in the hold segment of the data.

- determines the difference between a selected results channel value and the derived load maximum and minimum values.

Example

In this example, the maximum value on the **Load** channel is 5 kN. The minimum value is 2 kN. By calculating the difference between these points, the system determines the total relaxation as 3 kN.

A = Hold Segment

B = Maximum Value.

C = Minimum Value
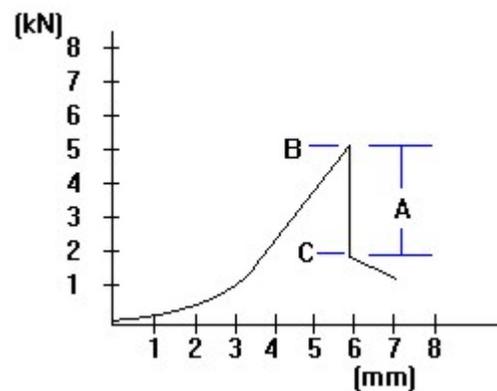
Fails to Calculate

The algorithm will not calculate a result if there is no hold data.

Results

All channels in the system are available.

Channels used as inputs for the calculation

The channel designated for Stress, Load, Strain and Extension varies according to the test type. Refer to Channels for Calculations.

User Calculations

What are User Calculations?

User calculations are equations that you build to perform computations on the test data. The equations are built from variables, functions and numbers. Each user calculation produces a single result. You can display the result in a column of the results table.

User calculations use variables as the base for their computation. Variables are similar to results in that they return the result of a calculation. Calculations used as a base for a variable may be either a standard installed calculation such as maximum load, a test parameter such as rate or specimen width, or a previously built user calculation.. Thus a variable used in one user calculation may be dependent upon the result of another user calculation.

Dependencies within User Calculations

Variables

If a variable is used in a user calculation, you cannot remove that variable from the Variable List.

Standard Calculations

If a standard calculation is used as a variable in a user calculation, you cannot delete that standard calculation from the available calculations list in the Calculations Setup dialog box.

User Calculations

If user calculation A is used as a variable in another user calculation B, you cannot delete user calculation A from the available calculations list in the Calculations Setup dialog box.

Creating User Calculations

The process falls into three parts, as follows:

Defining variables

Building equations

Validating equations

Defining Variables for User Calculations

User calculations use variables as the base for their computation. Variables are similar to results in that they return the result of a calculation. Calculations used as a base for a variable may be either a standard installed calculation such as maximum load, a test parameter such as rate or specimen width, or a previously built user calculation.

Note: You can only use alphanumeric characters and the underscore character in the variable name. The name must begin with an alphabetic character and can be up to 32 characters long.

Defining Variables

Before you can use a variable in a user calculation, you must define it.

You must first add a user calculation to the Selected Calculations list in the Calculations Setup dialog box. When you highlight the User Calculation in the list, you see the Parameters for that calculation.

To open up the dialog where you define variables and build equations, click the Setup... button in the Parameters area to open the User Calculation Setup dialog.

Click on the Variable Definition tab.

There are two lists beneath the Variable Definition field which you use to define a variable from its two component parts.

1. Scroll the list on the left-hand side to see the different calculations and parameter categories and click on one of the items to select it. The calculations in this list are only those that you have previously added to the Selected Calculation List. Your selection appears immediately in the Variable Definition field above the lists.
   When you select an item from this list, a default selection is made in the list on the right-hand side. The next step in the procedure allows you to change this.

2. Scroll the list on the right-hand side to see the different parameters and click on one of the items to select it. Your selection is added immediately to the Variable Definition field above the lists to complete the definition of the variable. If you have selected a previously-defined user calculation in the list on the left-hand side, the variable must always be the result of that calculation.

3. Type a name for your variable into the Variable Name field.

4. Click the Add button to add the variable to the list.

Example

As a basis for establishing a safe working load on a cable, you wish to find the load that corresponds to 2/3 of the load reached at the 0.2% offset yield point. Thus load at 0.2% offset yield is the variable that your user calculation will use. This example assumes that you have already established a standard 0.2% Offset Yield calculation in the Selected Calculation List.

To define the variable:

1. Select your Yield (Offset 0.2%) calculation from the left-hand list.

2. Select Load from the corresponding channel list on the right.

3. Type the name Yield_Load in the Variable Name edit field.

4. Click the Add button to add the variable to the Variable List.

Modifying Variables

You can modify any variable in the Variable List. When you select an existing variable, the Modify button becomes available. If you change the Variable name, the Add button also becomes available to let you add the new variable. If you change the Variable name and click the Modify button, you will overwrite the original variable name and definition.

Removing Variables

You can remove a variable in the Variable List, provided that the variable is not being used by any user calculation. When you select an existing variable, the Remove button becomes available. If the variable is being used by another user calculation, the Remove button grays out when you select that variable.

Building Equations for User Calculations

To build an equation, you use the Insert variable button and the calculator to assemble the equation components. The calculator provides numbers, functions, and numeric operators. The Variables List contains variables that you have previously defined.

As you build the equation, it appears in the Equation field above the calculator.

You can type directly into this field except for variable names, which you must add from the list using the Insert button, and the Pi constant, trigonometric and logarithmic functions which you must add using the calculator. You can highlight and delete characters using the cursor as well as using the Delete and Backspace keys to remove individual characters. You can also use the Clear button on the Calculator to remove the whole equation string.

Example

As a basis for establishing a safe working load on a cable, you wish to find the load that corresponds to 2/3 of the load reached at the 0.2% offset yield point. You have established your Yield_Load variable already.

To build the equation:

1. Highlight the Yield_Load variable in the Variables list and click the Insert button. The variable appears in the Equation field.

2. Select in turn from the calculator buttons the characters (2 / 3) or type them directly from the keyboard.

3. Click the OK button

4. In the Calculations Setup dialog, type a calculation description such as Safe Working Load and set the units.

5. Click the Add button to add the new user calculation to the Calculation List.

List of Functions and Operators

The calculator provides the following:

Calculator key	Shortcut key	Result
Ln	n	Natural log()
Log	l	Log to base 10()
Sqrt	q	Square root()
Sin	s	Sine()
Cos	c	Cosine()
Tan	t	Tangent()
Pi	p	Pi
Sin^{-1}	Shift + s	Inverse Sine() or Arcsin()
Cos^{-1}	Shift + c	Inverse Cosine() or Arccos()
Tan^{-1}	Shift + t	Inverse Tangent() or Arctan()
e^x	e	inverse of natural log()
EXP	x	Exponential

( )	Precedence operators
x(y)	Function calls
^	Power function
* , /	Multiply, divide
+ , -	Add, subtract

For example, the equation 3+4*5 resolves to 23, but the equation (3+4)*5 resolves to 35.

Modifying Equations

You can modify a user calculation as required.

You should be aware that if user calculation A is used as a variable in another user calculation B, then modifying user calculation A may change the operation of user calculation B. Furthermore, you cannot change the name of user calculation A.

Validating Equations for User Calculations

When you select the OK button in the User Calculation Setup dialog box, the program checks the syntax of the equation.

The syntax checker ensures the following:

- All variables referenced in the equation are defined.

- Functions have an opening parenthesis.

- Functions have a number or a variable as a parameter.

- Opening and closing parentheses match.

- Function numeric values are legal. A variable parameter is accepted as a deferred evaluation. For example, Sqrt(-9) is rejected but Sqrt(Load) is deferred for calculation after the test.

If the equation is incorrect, the program displays an error message and places the cursor as close as possible to the position that the error was detected.

If a deferred calculation cannot produce a result, the relevant column in the Results Table will show dashes in the cells in the place of values.

If you select the Cancel button, the program discards all changes to equations and variables made since the dialog was opened.

Yield Point Extension (Automatic)

The Automatic Yield Point Extension/Elongation (YPE/Ae) calculation measures the extension from the upper yield point to the end of discontinuous yielding.

Parameters

You must specify:

- the **Automatic** type of YPE/Ae.
- the **Offset Yield** for a type 2 curve and a type 3 curve. The default value is 0.2%.

When you add the calculation to the **Calculation list**, the calculation description appears as:

YPE/Ae (Automatic)

You have the option to:

- edit the calculation description by clicking in the **Description** field and typing new or additional details. Any changes to the description appear in the **Calculation list** and results table.

- enable **End point slope intersection correction**, which calculates the YPE/Ae for ASTM E8 and EN10002:2003 standards. If you do not enable this option, the YPE/Ae is calculated according to versions of EN10002 prior to EN10002:2003.

- place a marker on the graph by clicking in the **Indicate on graph** check box.

Algorithm

EN10002 (versions prior to EN10002:2003)

If you do not enable the **End point slope intersection correction**, the system performs the calculation according to versions of EN10002 prior to EN10002:2003.

The system:

- finds the upper yield point.

- uses the upper yield point as the start point.

- finds the last point of inflection on the curve.

- calculates the extension between the upper yield point and the last point of inflection to determine the YPE/Ae.

ASTM E8 and EN10002:2003

If you enable the **End point slope intersection correction**, the system performs the calculation according to ASTM E8 and EN10002:2003.

The system:

- finds the upper yield point.

- uses the upper yield point as the start point.

- finds the last point of inflection on the curve.

- draws a tangent at the last point of inflection.

- draws a horizontal line at the last lower yield point. The intersection of the two lines is the end point slope intersection correction.

- calculates the extension between the upper yield point and the intersection of the lines constructed above to determine the YPE/Ae.

Examples

EN10002 (versions prior to EN10002:2003)

In this example, the system finds the upper yield point and the last point of inflection on the curve. The system calculates the extension between the upper yield point and the last point of inflection.

A = Upper yield point
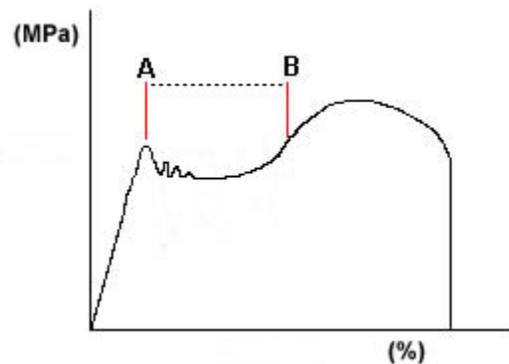
B = Last point of inflection

ASTM E8 and EN10002:2003

In this example, the system finds the upper yield point and the last point of inflection on the curve. The system determines the end point slope intersection correction. The system calculates the extension between the upper yield point and the end point slope intersection correction.
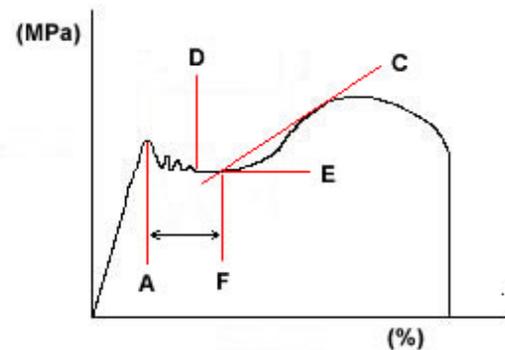
A = Upper yield point

B = Last point of inflection

C = Tangent at Inflection Point

D = Last Lower Yield Point

E = Horizontal Line at Lower Yield Point

F = End Point Slope Intersection Correction

Fails to Calculate

The algorithm will not calculate a result if:

- no upper yield point is found,

-or-

- the stress-strain curve contains no points of inflection,

-or-

- the difference between the measured upper yield point and lower yield strength is less than 2.5 MPa (i.e. the upper yield point is insignificant),

-or-

- the YPE/Ae is beyond the point of maximum load,

-or-

- there is a hysteresis loop or change in speed.

Results

YPE\ Ae

Starting Strain

Ending Strain

Ending Stress

Ending Extension

Ending Load

Curve Types:

      Curve Type 1

      Curve Type 2

      Curve Type 3

UYS or Proof Strength

UYS

Channels used as inputs for the calculation

The channel designated for Stress, Load, Strain and Extension varies according to the test type. Refer to Channels for Calculations.

Yield Point Extension (Cursor)

The Cursor Yield Point Extension/Elongation (YPE/Ae) calculation measures the extension from the upper yield point to the specified cursor point. This calculation is useful if you get an unusual stress-strain curve. You specify the end of the region on the graph of the stress-strain curve.

Parameters

You must specify:

- the **Cursor** type of YPE/Ae.
- the **Offset Yield** for a type 2 curve and a type 3 curve. The default value is 0.2%.

When you add the calculation to the **Calculation list**, the calculation description appears as:

YPE/Ae (Cursor)

You have the option to:

- edit the calculation description by clicking in the **Description** field and typing new or additional details. Any changes to the description appear in the **Calculation list** and results table.

- enable **End point slope intersection correction**, which calculates the YPE/Ae for ASTM E8 and EN10002:2003 standards. If you do not enable this option, the YPE/Ae is calculated according to versions of EN10002 prior to EN10002:2003.

- place a marker on the graph by clicking in the **Indicate on graph** check box.

Algorithm

EN10002 (versions prior to EN10002:2003)

If you do not enable the **End point slope intersection correction**, the system performs the calculation according to versions of EN10002 prior to EN10002:2003.

The system:

- finds the upper yield point.

- uses the upper yield point as the start point.

- finds the specified cursor point.

- calculates the extension between the upper yield point and the specified cursor point to determine the YPE/Ae.

ASTM E8 and EN10002:2003

If you enable the **End point slope intersection correction**, the system performs the calculation according to ASTM E8 and EN10002:2003.

The system:

- finds the upper yield point.

- uses the upper yield point as the start point.

- finds the specified cursor point.

- draws a tangent at the specified cursor point.

- draws a horizontal line at the last lower yield point. The intersection of the two lines is the end point slope intersection correction.

- calculates the extension between the upper yield point and the intersection of the lines constructed above to determine the YPE/Ae.

Examples

EN10002 (versions prior to EN10002:2003)

In this example, the system finds the upper yield point and the user specified cursor point. The system calculates the extension between the upper yield point and the user specified cursor point.

A = Upper yield point
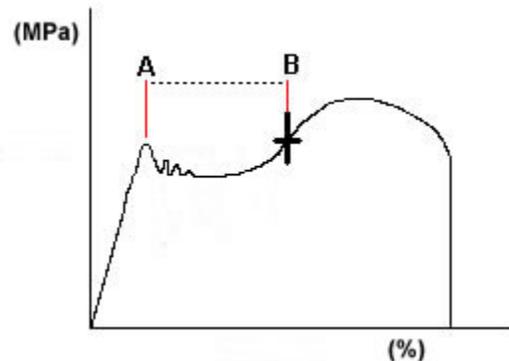
B = User-specified cursor point

ASTM E8 and EN10002:2003

In this example, the system finds the upper
yield point and the user specified cursor point.
The system determines the end point slope
intersection correction. The system calculates
the extension between the upper yield point
and the end point slope intersection correction.
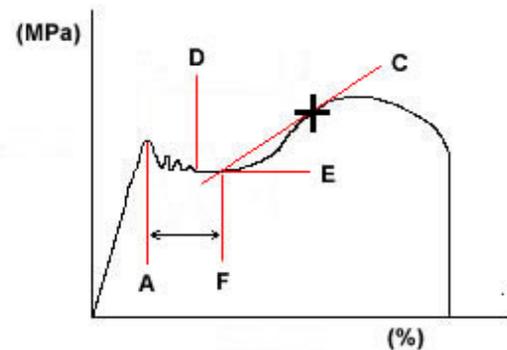
A = Upper yield point

B = User-specified cursor point

C = Tangent at Inflection Point

D = Last Lower Yield Point

E = Horizontal Line at Lower Yield Point

F = End Point Slope Intersection Correction

Fails to Calculate

The algorithm will not calculate a result if:

- no upper yield point is found,

-or-

- the difference between the measured upper yield point and lower yield strength is less
  than 2.5 MPa (i.e. the upper yield point is insignificant),

-or-

- there is a hysteresis loop or change in speed.

Results

YPE\ Ae

Starting Strain

Ending Strain

Ending Stress

Ending Extension

Ending Load

Curve Types:

> Curve Type 1

> Curve Type 2

> Curve Type 3

UYS or Proof Strength

UYS

Channels used as inputs for the calculation

The channel designated for Stress, Load, Strain and Extension varies according to the test type. Refer to Channels for Calculations.

Young's Modulus

This calculation determines the slope of the stress/strain curve in the initial linear portion of the curve. It calculates the slopes using least-squares fit on test data for a number of regions that you specify between lower and upper bounds that you also specify, and reports the steepest slope as the modulus.

Parameters

You must specify:

- the **Young's** type of modulus.

- a channel.

- an end value. in the units of the channel you specified. This value must be higher than the start value . The system does not include data after the end value in the calculation.

- a start value. in the units of the channel you specified. This value must be lower than the end value. The system does not include data before the start value in the calculation.

- the number of regions. You can specify between 1 and 100 regions.

- a percentage of overlap between 0 and 99.

The system includes the modulus type and the upper and lower bound values in the calculation description when you add the calculation to the **Calculation list**. For example, if you select a **Young's** type of modulus on the **Strain 1** channel with a start value of 0.3 mm/mm and an end value of 0.5 mm/mm, the description appears as:

Modulus (Young's 0.3 mm/mm - 0.5 mm/mm)

You have the option to:

- edit the calculation description by clicking in the **Description** field and typing new or additional details. Any changes to the description appear in the **Calculation list** and results table.

- place a modulus line on the graph by clicking in the **Indicate on graph** check box.

Algorithm

The system:

- divides the data between the start and end values into the number of equally spaced regions with the percentage overlap you specified.

- assigns the start of each region to the closest data point.

- assigns the end of each region to the closest data point.

- applies a least squares fit algorithm on all the data points in each region.

- calculates the sum of the slopes of each pair of adjacent data regions.

- determines which pair of regions that has the highest slope and assigns the modulus to that region.

- determines the modulus by using the highest slope of the adjacent region that had the highest sum.

Example

In this example, the **Strain** channel is selected with a start value of 2% and an end value of 6%. The number of regions is set to 8. The system applies the least square fit algorithm to each region between the start and end values and constructs a modulus to the region with the highest slope and the adjacent region.
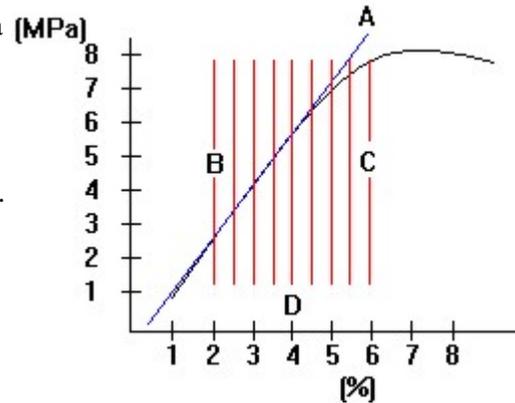
A = Modulus Marker

B = Start Value

C = End Value

D = Regions

Fails to Calculate

The algorithm will not calculate a result if:

- the data does not contain either the upper or lower bound you specified.

-or-

- the data contains the same number or fewer points than the number of regions you specified.

Results

X-Intercept

Y- Intercept

Modulus

Channels used as inputs for the calculation

The channel designated for Stress, Load, Strain and Extension varies according to the test type. Refer to Channels for Calculations.

Zero Slope Yield

This calculation finds the first point on the stress/strain curve at which the slope decreases to zero.

Note:
For metals testing, zero slope yield should not be used. Use Yield Point Extension/Elongation (YPE\Ae) using UYS results, which is a more reliable version relevant to metals tests.

Parameters

You must specify:

- the **Zero Slope** type of yield.
- a number of regions. You can specify 1 to 100 regions. The more regions you specify, the higher the accuracy and processing time.

- percentage of overlap between 0 and 99.
- the upper limit. This is the maximum value that can be determined for the upper yield.
- a yield slope criteria. This is the number of consecutive regions with a negative slope the system must detect to establish the yield point. You can specify 1 to 99.

The system includes the type of yield in the calculation description when you add the calculation to the **Calculation list**. If you select a **Zero Slope** yield, the calculation description appears as:

Yield (Zero Slope)

You have the option to:

- edit the calculation description by clicking in the **Description** field and typing new or additional details. Any changes to the description appear in the **Calculation list** and results table.

- place a marker on the graph by clicking in the **Indicate on graph** check box.

Algorithm

The system:

- divides the data, based on extension and any percent overlap, into the number of regions you specified.

- using the least squares fit method, calculates the slope of each region.

- finds the number of consecutive regions that have a slope equal to or less than zero.

- assigns the point of the highest load within the regions as the yield point.

Example

In this example, the data is divided in 10 regions. The [MPa] slope is less than zero in the third region, the stress does not increase while the strain does.

+ = Yield Point Marker

A = Regions

B = First region with zero slope
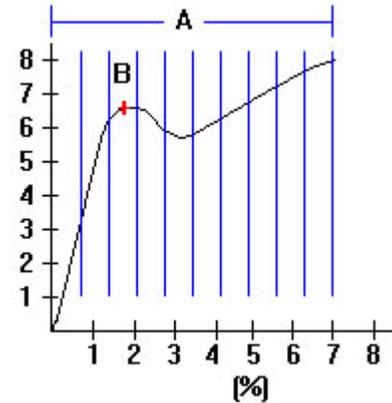
Fails to Calculate

The algorithm will not calculate a result if:

- there is no data with a zero or negative slope,

-or-

- the system did not detect a zero slope based on the parameters you specified,
-

-or-

- the data contains the same number or fewer points than the number of regions you specified.

Results

All channels in the system are available.

Channels used as inputs for the calculation

The channel designated for Stress, Load, Strain and Extension varies according to the test type. Refer to Channels for Calculations.

Channels used as inputs for calculations

The channel designated for Stress, Load, Strain and Extension varies according to the test type as follows:

Test Type	Stress Channel	Load Channel	Strain Channel	Extension Channel
Tension, Tension Creep Relaxation, Tension Profile, Asphalt	Tensile Stress (or Tenacity for fiber specimens)	Load	Tensile Strain	Tensile Extension
Compression, Compression Creep Relaxation, Compression Profile	Compressive Stress	Compressive Load	Compressive Strain	Compressive Extension
Flexure, Flexure Relaxation	Flexure Stress	Flexure Load	Flexure Strain	Flexure Extension
Peel, Tear and Friction	Load/Width (or Load for Friction tests)	Load	Peel Extension (or Extension for Friction tests)	Peel Extension (or Extension for Friction tests)

Channel Reference

A channel can be one of three types, real, derived or composite, as described in the following sections.

Real Channels

Definition

A real channel is a test data channel measured directly from the transducers that monitor the specimen. For example, load from the load cell, strain from the extensometer.

A real channel can be a source of data for a derived channel. For example, Stress is derived from Load divided by the specimen cross-sectional area.

List

Extension The location of the crosshead/actuator relative to the point where the gauge length is reset. Extension is a real channel on an electromechanical system. Extension is derived from position on servohydraulic systems.
Load The force the testing system exerts on the specimen. Load is a real channel. The testing system uses a load cell to measure force.
Position Records the absolute position of the actuator. Position is a real channel. This channel is available in servohydraulic systems only.
Strain The change in specimen length divided by the original length. Strain is a real channel. You normally use an extensometer to measure strain, where the extensometer has a specific gauge length.

Derived Channels

Definition

A derived channel is a test data channel calculated using data from the transducers that monitor the specimen. For example, stress is derived using load data from the load cell, average strain is derived by dividing the sum of two strain channels.

Some derived channels are specific to the test type. For example, flexure stress is derived from load divided by an outer fiber stress factor.

List

Average Strain
Average strain is a derived channel. Calculated as the average value of the output from two extensometers.   (Strain 1 + Strain 2)/2

Compressive Load
Compressive load is a derived channel calculated as the standard load with the sign inverted.   Compressive load is reported using positive values for increasing compression.   The compressive load channel is available in the following test types: • Compression   • Compression Creep Relaxation   • Compression Test Profile   Load with sign inverted

Compressive Stress
Compressive stress is a derived channel calculated as compressive load divided by the cross-sectional area of the specimen.   Compressive stress increases as the compressive load on the specimen increases.   The compressive stress channel is available in the following test types: • Compression   • Compression Creep Relaxation   • Compression Test Profile   Compressive load/cross-sectional area

Cycle Count
A count of all triangles run during the current block. Each time a new triangle block is executed in profiler, the cycle count is reset to zero. Cycle count counts the number of precycles too.

Differential Strain
Differential strain is a derived channel calculated as the difference between the output of two extensometers.   Strain 1 - Strain 2.

Flexure Load
Flexure load is a derived channel calculated as the standard load with the sign inverted.   Flexure load is reported using positive values for increasing compression.   Flexure load channel is available in the following test types: • Flexure   • Flexure Creep Relaxation   Load with sign inverted

Flexure Stress

Flexure stress is a derived channel calculated as flexure load divided by an outer fiber stress factor.

Flexure load is reported using positive values for increasing compression.

Flexure stress channel is available in the following test types:

- Flexure
- Flexure Creep Relaxation

For rectangular specimens in a 4-point bend test:

Flexure stress = Flexure load * 1.5 *(1 - load span/support span) * (support span)/(width * thickness^2)

For rectangular specimens in a 3-point bend test:

Flexure stress = Flexure load * 1.5 *(support span)/(width * thickness^2)

For cylindrical specimens in a 4-point bend test:

Flexure stress = Flexure load * 8 *(1 - load span/support span) * (support span)/(π * diameter^3)

For cylindrical specimens in a 3-point bend test:

Flexure stress = Flexure load * 8 *(support span)/(π * diameter^3)

Load/Width (Peel, Tear and Friction test type only)

Load/Width is a derived channel calculated by dividing the readings of the load channel by the width of the specimen.

Peel Extension (Peel, Tear and Friction test type only)

Peel extension is a derived channel calculated as extension divided by a peel factor.

The value of the peel factor varies according to specimen geometry. For 90° peel specimens and friction specimens, the peel factor is 1. For 180° peel specimens, T-peel specimens and tear specimens, the peel factor is 2.

Repetitions Count

Counts the repetitions of the profile.

Tenacity

Load divided by linear density.

Tenacity is a derived channel. The testing system calculates tenacity using the measured load and the value of linear density that you enter into the test application.

Tenacity is a measure used in the testing of fibers and is therefore only available in those test types where fibers can be tested.

Tenacity channel is available in the following test types:

- Asphalt

- Tension
- Tension Creep Relaxation
- Tension Test Profile

Tensile Stress

Tensile stress is a derived channel. calculated as load divided by the cross-sectional area of the specimen.

Tensile stress increases as the load increases on the specimen.

The tensile stress channel is available in the following test types:

- Asphalt
- Tension
- Tension Creep Relaxation
- Tension Test Profile
- Metals

Total Cycle Count

A running count of all triangles run during the current test. Total cycle count is set to zero when a new test is started and does not include precycle cycles.

Transverse Strain

Transverse strain is a derived channel. It is measured in a direction perpendicular to the applied load.

Transverse Strain = Transverse Strain Source * Source Gauge Length/Transverse Gauge Width Value.

For example, if Strain 1 is the source channel for Transverse Strain then:

Transverse Strain = Strain 1 * Strain 1 Gauge Length/Transverse Gauge Width Value.

The transverse gauge width value can be set to a specimen dimension (e.g.. width, thickness) or a manually entered value.

The transverse strain channel is available in the following test types:

- Asphalt
- Compression
- Compression Creep Relaxation
- Compression Test Profile
- Metals
- Tension
- Tension Creep Relaxation
- Tension Test Profile

Transverse Extension

Transverse extension is a derived channel. The extension is calculated from the transverse strain sensor by multiplying the transverse strain by transverse gauge width value.

The transverse extension channel is available in the following test types:

- Asphalt
- Compression
- Compression Creep Relaxation
- Compression Test Profile
- Metals
- Tension
- Tension Creep Relaxation
- Tension Test Profile

True Strain

True strain is a derived channel that is available with the Enhanced Test Control Module. The system derives true strain from composite channels in different test types as follows:

- Tension test types (including Asphalt) and the Metals test type use Tensile Strain
- Compression test types use Compressive Strain

It is assumed that composite strain is equivalent to engineering strain.

The system calculates the true strain channel value by applying the appropriate composite strain channel in the following formulas:

Tension and Metals Test Types (including Asphalt)

True Strain = ln (1 + composite strain)

Compression Test Types

True Strain = -ln (1 - composite strain)

You can specify the true strain channel as a control mode in the Metals, Asphalt, Tension, Tension Creep Relaxation, Compression and Compression Creep Relaxation test types.

True Stress

True stress is a derived channel that is available with the Enhanced Test Control Module. The system derives true stress from the load cell and a composite strain channel in different test types as follows:

- Tension test types (including Asphalt) and the Metals test type use Tensile Strain
- Compression test types use Compressive Strain

It is assumed that composite strain is equivalent to engineering strain.

The system calculates the true stress channel value by applying the appropriate composite strain channel in the following formulas:

Tension and Metals Test Types (including Asphalt)

True Stress = (load * (1 + composite strain)/(initial specimen cross-sectional area)

Compression Test Types

True Stress = (load * (1 - composite strain)/(initial specimen cross-sectional area)

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Composite Channels

Definition

A composite channel is a test data channel that can change its information source during a test. For example, the composite channel Tensile Strain lets you measure strain directly from an extensometer during the first part of a test, then calculate strain from the extension of the crosshead for the remainder of the test. Thus the total strain measurement is a composite of the real strain channel and the derived strain from extension channel.

List

Compressive extension
Compressive extension is a composite channel calculated from compressive strain multiplied by the anvil height.
Compressive extension is reported using positive values for increasing compression.
The compressive extension channel is available in the following test types:
- Compression   - Compression Creep Relaxation   - Compression Test Profile

Compressive strain
Compressive strain is a composite channel. You can choose any strain channel as a source channel for compressive strain. If your source channel is an extensometer, you can choose to remove the extensometer during a test; from this point compressive strain measurement continues using the extension channel as the source. The extension readings are corrected and normalized using the Extensometer Removal Correction Algorithm.
Compressive strain increases as the specimen compresses.
The compressive strain channel is available in the following test types:
- Compression   - Compression Creep Relaxation   - Compression Test Profile

Flexure extension
Flexure extension is a composite channel calculated from flexure strain multiplied by an outer fiber strain factor.
Flexure extension is reported using positive values for increasing compression.
The flexure extension channel is available in the following test types:
- Flexure   - Flexure Creep Relaxation

Flexure strain

Flexure strain is a composite channel. You can choose any strain channel as a source channel for flexure strain. If your source channel is an extensometer, you can choose to remove the extensometer during a test; from this point flexure strain measurement continues using the extension channel as the source. The extension readings are corrected and normalized using the Extensometer Removal Correction Algorithm.

Flexure strain is reported using positive values for increasing compression.

The flexure strain channel is available in the following test types:

- Flexure
- Flexure Creep Relaxation

Note:	When using a 4-point bend fixture for flexural testing, you should use a deflectometer to measure the specimen deflection directly at the mid-span point on the specimen. You must set up the method to use output from the deflectometer as the Axial Strain Source. If you don't use a deflectometer, the software uses the crosshead extension at the point of contact of the fixture, which may be significantly different from the specimen deflection at mid-span.

For rectangular specimens in a 4-point bend test:

Flexure strain = Deflection * thickness * $12/(\text{support span}^2*(3 - (1 - \text{load span/support span})^2))$

For rectangular specimens in a 3-point bend test:

Flexure strain = Deflection * thickness * $6/\text{support span}^2$

For cylindrical specimens in a 4-point bend test:

Flexure strain = Deflection * diameter * $12/(\text{support span}^2*(3 - (1 - \text{load span/support span})^2))$

For cylindrical specimens in a 3-point bend test:

Flexure strain = Deflection * diameter * $6/\text{support span}^2$

Tensile extension

Tensile extension is a composite channel calculated from tensile strain multiplied by the specimen gauge length.

The tensile extension channel is available in the following test types:

- Asphalt
- Tension
- Tension Creep Relaxation
- Tension Test Profile
- Metals

Tensile Strain

Tensile strain is a composite channel. You can choose any strain channel as a source channel for tensile strain. If your source channel is an extensometer, you can choose to remove the extensometer during a test; from this point tensile strain measurement continues using the extension channel as the source. The extension readings are corrected and normalized using the Extensometer Removal Correction Algorithm.

Tensile strain increases as the specimen stretches.

The tensile strain channel is available in the following test types:

- Asphalt
- Tension
- Tension Creep Relaxation
- Tension Test Profile
- Metals

Glossary

A

absolute peak: Typically, the highest value reached by the assigned channel during a test. For example, if load is assigned to the absolute peak calculation, then the highest value of load reached during a test is the absolute peak load. You can monitor for either a maximum peak, which occurs where the channel values decrease from a previous high value, or a minimum peak, where the channel values increase from a previous low value.

actuator: A rod, mounted on the load frame that is driven up or down using servohydraulic force. The force required to drive the actuator is transferred to the specimen through the grips. Actuator applies to servohydraulic systems only. Note that the crosshead is fixed during a test on a servohydraulic system.

analog meters: Show an analog representation of their associated parameters on the live display area of console. You can set the scale of each analog meter to increase the resolution of the parameter level.

anvil height: The distance between the upper and lower components of a compression fixture.

ASCII raw data: A file, saved at the end of the sample, of the measured data points relevant to each specimen. The data is in the standard ASCII text format, which means that you can open the file into a text editor or spreadsheet and read, print, or further analyze the details of the data.The ASCII raw data file name is of the form filename.raw.

ASCII results data: A file, saved at the end of the sample, of the results data calculated for each specimen using the calculations that you have currently set up in the Results Table. The data is in the standard ASCII text format, which means that you can open the file into a text editor or spreadsheet and read, print, or further analyze the details of the result data. The ASCII results data file name is of the form filename.rlt.

average value: Group of calculations that test properties such as adhesion, fabric and paper tear resistance, and surface friction. Calculations available are average peaks, average troughs, average peaks and troughs, first peak, and interval peaks.

axial strain: Strain measured in a direction parallel to the applied load.

B

balance: Balance resets the current transducer value of load or strain to zero by removing offsets due to minor electrical or mechanical changes. For example, the change in weight of a new upper grip can cause slight changes in the load signal. The load balance procedure resets the load signal to zero.

binary raw data: A file, saved at the end of the sample, of the basic data relevant to each specimen. The data is in binary format, which means that you cannot open the file into a text editor or spreadsheet and read or print the details of the data.

bounds: The term "bounds" is used to describe limits that you set for a particular parameter. These bounds must lie within system limits set by the software. For example, you know that the width of all the specimens in a particular sample should be between 10 and 15mm. If you set bounds for width of 10 and 15 and an operator accidentally enters 100mm, an error message is generated. If bounds were not set, no error would result because 100mm is a valid value for the testing system.

C

calculation: A computation carried out on the test data. Calculations are used to find points in the test data from which you can take results. For example, you can perform a peak calculation to find the maximum load during a test. You can then obtain various results from that point, such as load, strain, or time.

calibration: Calibration ensures that the transducer is sending the correct output voltage signals throughout its range of measurement. For example, a calibrated 100 kN load cell has an output signal of 10 V at a load of 100 kN, - 10 V at a load of - 100 kN, and 0 V at a load of 0 kN.

channel: A source of test data. Typical channels of information are measurements of physical properties such as load, strain, and temperature. Channels may be real, derived, or composite.

compliance: The ability of an object to yield elastically when a force is applied.

composite channel: A composite channel is a test data channel that can change its information source during a test. For example, the composite channel Tensile Strain lets you measure strain directly from an extensometer during the first part of a test, then calculate strain from the extension of the crosshead for the remainder of the test. Thus the total strain measurement is a composite of the real strain channel and the derived strain from extension channel.

console: The top region of the Bluehill software display that lets you setup and monitor a test. The console comprises the hardware icons and the live displays.

context menu: Also known as the right-click menu. Right-click on the screen to show the context menu for that screen component, if there is one available.

control loop: The testing machine operates on a closed-loop control system. In extension control, the Master Controller board generates a command signal which dictates a required position for the crosshead. An encoder in the load frame has an associated feedback signal that details the current position of the crosshead. If the required position and the actual position are not equal, the system generates an error signal that drives the motor in the direction necessary to reduce the error signal to zero.

control mode: The transducer feedback signal that controls the system. The normal mode of control is extension. Under extension control, the system requests a specific extension of the crosshead. If the current extension is different to that requested, the system generates an error signal to drive the crosshead in the direction necessary to achieve the requested extension. With the optional Enhanced Test Control module, you can specify other modes of control such as load, strain or true strain.

control panel: On some load frames, the control panel contains dedicated keys to control the most repeated test actions and those actions that take place close to the test area. The keys let you (1) start and stop a test, (2) manually move the crosshead between tests at a

selectable speed using jog keys, (3) use preassigned soft-keys on the control panel to carry out actions between or during tests, (4) select the Specimen Protect function, (5) reset the gauge length.

controller: The controller is the piece of hardware that controls the testing frame and any ancilliary equipment in your testing system. Different controllers have different testing capabilities. Examples are the 3300, 4400, 5500, 5800 and 8800 controllers.

creep: Deformation that occurs over time when a material is subjected to constant stress at a constant temperature.

crosshead: A stiff beam, mounted on the load frame, that is driven up or down using electromechanical force. The force required to drive the crosshead is transferred to the specimen through the grips. Crosshead applies to electromechanical systems only.

D

default specimen: Values of parameters for the default specimen are the values that are saved in a test method file. Take width and thickness as examples. When you start testing real specimens in a sample, they are assigned the default values of width and thickness. In the Test Inputs area on the test workspace, you can then enter different values of width and thickness for each specimen.

delete a specimen: When you delete a specimen, the specimen is permanently destroyed. All the data from that specimen is removed from the sample data file. This is very different from excluding a specimen, where the specimen data is retained but is not included in statistics calculations. The ability to delete specimens can be permitted or denied to an operator using security settings.

demonstration mode: Demonstration mode is distinguished from standalone mode by the ability to run tests. Standalone mode lets you do everything except run tests on specimens. Demonstration mode uses test data to simulate running tests on specimens. It is primarily a tool for sales personnel.

dependent calculation: A calculation carried out on the test data that is dependent upon the completion of a previous calculation. For example, an offset yield calculation may be dependent upon results obtained from a prior modulus calculation.

derived channel: A derived channel is a test data channel calculated using data from the transducers that monitor the specimen. For example, stress is derived using load data from the load cell, average strain is derived by dividing the sum of two strain channels. Some derived channels are specific to the test type. For example, flexure stress is derived from load divided by an outer fiber stress factor.

double shear round: When this geometry is selected, specimen diameter is required. The specimen cross section is calculated as the area of two circles. This affects all computations based on area, including stress (and stress control rates if entered prior to test start).

E

elongation: Increase in the original gauge length at the end of the test.

energy: A measurement of the work done on a specimen during a test. The energy expended between any two points in a test is measured as the area under the stress/strain curve between those points.

engineering strain: The change in specimen length divided by the original length. Refer to the definition for strain.

engineering stress: Load applied to a specimen in a tension or compression test divided by the cross-sectional area of the specimen. The change in cross-sectional area that occurs with increases and decreases in applied load, is disregarded in computing engineering stress. Refer to the definition for stress.

enhanced test control module: Allows you to specify various system channels, such as Load or Strain to control the crosshead/actuator's movement. During a test, the system uses a real channel transducer to control the crosshead's movement.

exclude a specimen: When you exclude a specimen, the data from that specimen is excluded from statistics calculations. The data is not destroyed and the specimen can be included again at any time, even after the sample is finished.

extension: The location of the crosshead/actuator relative to the point where the gauge length is reset. Extension is a real channel on an electromechanical system. Extension is derived from position on servohydraulic systems.

extensometer: A transducer that converts a value of displacement into a proportional electrical signal. There are two main types of extensometer; contacting, such as the strain gauge and automatic extensometers, and non-contacting, such as the video extensometer.

F

freeform test: If a test method is not set up to run as a prompted test, it runs as a freeform test. There are no prompts for the operator to enter values and the entire test workspace is visible to the operator at all times during testing, allowing entry of values at any time and in any sequence.

full-scale: The maximum capacity of a load cell or extension of an extensometer.

G

gauge length: The distance along the specimen upon which extension calculations are made. The gauge length is sometimes taken as the distance between the grips.

gauge width: The separation of the transverse extensometer knife edges at the start of a test.

H

hold: A test segment that holds the crosshead at the current value of the selected channel. Thus, when the Start of Hold criteria are met with load as the hold channel, the crosshead maintains the specimen at the current load value.

hysteresis loop: The closed curve representing the successive stress-strain status of the material during a cyclic deformation.

I

include a specimen: This is the reverse of exclude a specimen.

J

jog controls: Buttons and a thumbwheel on the control panel that move the crosshead up or down manually. You use the jog keys and thumbwheel to manually position the crosshead; for example, when you install a specimen.

L

limits: The selected boundaries to which the system can drive the crosshead. You can set physical limit stops on the load frame to limit crosshead travel, and you can set electrical limits in the software for each transducer. Limits are set as safety measures to prevent overtravel or overloading.

linear interpolation: Method of estimating a value that falls between two data points by extending a straight line between those points.

live displays: The numeric displays in the console show current values for the selected channel in the selected units.

load: The force the testing system exerts on the specimen. Load is a real channel. The testing system uses a load cell to measure force.

load cell: A transducer which converts a value of force into a proportional electrical signal.

load frame: A high stiffness support structure against which the test forces can react. The load frame comprises a base beam, two columns, and a moving crosshead.

load string: The complete test setup between the moving crosshead and the load frame table (or fixed crosshead). The load string normally comprises a load cell, grip adapters, grips, and the specimen.

loop shaping: Loop-shaping is the process of tuning the control loop such that the movement of the crosshead closely follows the requirements of the command signal without any significant lag or overshoot.

M

method: The set of values of all the parameters in the system that are saved to define a test setup.

modulus: Rate of change of stress as a function of strain. Usually the slope of the straight-line portion of a stress/strain curve.

N

nominal modulus: A Nominal modulus value is required only when you select Stressing Rate as a control mode in a Metals test. The nominal modulus is your estimate of the modulus value of the material that you are testing. It is used in conjunction with the specified stressing rate to calculate the speed at which the test runs.

O

offset yield: Calculation of the point on the stress/strain curve at which yield is assumed to have taken place. Offset yield is a dependent calculation that requires the result from a modulus calculation. The offset yield calculation constructs a line parallel to the modulus and separated from it by an amount that you specify. The offset yield point is where the new line intersects the curve.

P

parallel length: Parallel portion of the reduced section of the test piece or specimen.

parent calculation: A calculation upon which a dependent calculation depends. For example, an offset yield calculation may be dependent upon results obtained from a prior modulus calculation, which is the parent.

peel extension: Peel extension is a derived channel calculated as extension divided by a peel factor. The value of the peel factor varies according to specimen geometry. For 90 degree peel specimens and friction specimens, the peel factor is 1. For 180 degree peel specimens, T-peel specimens and tear specimens, the peel factor is 2.

peel factor: The value of the peel factor varies according to specimen geometry. For 90 degree peel specimens and friction specimens, the peel factor is 1. For 180 degree peel specimens, T-peel specimens and tear specimens, the peel factor is 2. This factor is used to calculation peel extension and peel length.

peel length: Peel length is the value of peel extension relative to the first peak. The first peak detector searches for a 10% drop in load from peak. The load must first attain a value of at least 1% of the full-scale of the load cell.

pip: On some load frames, you can connect an external marking device to the rear of the electrical compartment to the 1/4 in. phone jack marked PIP. When you select PIP as the source channel for a preset point result, you can display a result item in the Results column whenever you press the button on the pip marker. For example, if you set up a result of Extension at Preset Point PIP 1, the specimen extension is displayed in the Results table the first time that you press the button during a test. You can set up to 99 pip results, and capture data from all available channels on each one.

poisson's ratio: The ratio of the lateral contraction to the axial elongation.

position: Records the absolute position of the actuator. Position is a real channel. This channel is available in servohydraulic systems only.

precycling: A test segment where the crosshead moves to cycle the specimen between specified bounds before a test starts. Data is captured during the precycle segment, but is not used for subsequent analysis.

preload: A test segment where the crosshead moves to load the specimen to a specified value before a test starts. Data is not captured during the preload segment.

prompt workspace: The version of the screen within the Test tab that displays during a prompted test.

prompted test: To simplify testing, test methods can be set up to direct you through setting up and running a test. If a method is set up to run as a prompted test, the procedure constructed by the method designer automatically runs, displaying the steps and prompting you for the required inputs.

proof strength: The stress at the point of offset yield.

R

ramp: A test segment where the crosshead moves at a constant speed in a constant direction. Some test types such as tension relaxation have a single ramp segment while others such as tension have two ramp segments with a changeover point during the test.

rationalized transducer: A rationalized transducer contains code resistors which are recognized by the testing system. When you connect a rationalized transducer to the testing system, the type and the full-scale value of the transducer is registered into the system.

real channel: A real channel is a test data channel measured directly from the transducers that monitor the specimen. For example, load from the load cell, strain from the extensometer. A real channel can be a source of data for a derived channel. For example, Stress is derived from Load divided by the specimen cross-sectional area.

relaxation: The rate of reduction of stress in a material due to creep.

result: A measured value at a point in the test data found using a calculation. For example, you can perform a peak calculation to find the maximum load during a test. You can then obtain various results from that point, such as load, strain or time.

reverse polarity: When the reverse polarity checkbox is enabled, the transverse strain channel applies a factor of -1 to the source signal received.

S

sample: A group of material specimens. whose properties are studied and compared to gain statistical or quality assurance information. For example, you could take a specimen from different parts of a single manufacturing run of a material to form a sample of the material. The sample is then representative of the complete run and you can test it to ensure that the material quality has remained stable over the complete run. You perform the same test on each specimen in a sample.

sample file: File that contains the set of test parameters that were used to test the specimens AND all of the test data for each of the specimens. Test parameters that are the same for all specimens are stored as global parameters, test parameters that may be different for each specimen (specimen width, for example) are stored for each individual specimen.

self-identification: A self-identifying transducer contains code resistors which are recognized by the testing system. When you connect a self-identifying transducer to the testing system, the type and the full-scale value of the transducer is registered into the system.

slack: Typically, the distance the crosshead must travel before load is fully applied to the specimen.

soft-keys: Buttons on the control panel to which you can assign certain test functions from the software.

specimen: A single piece of a material for testing.

standalone mode: When you start the software, it detects any frame that is connected to the computer. If no frame is connected, the software runs in "standalone" mode. This lets you do everything except run tests on specimens.

strain: The change in specimen length divided by the original length. Strain is a real channel. You normally use an extensometer to measure strain, where the extensometer has a specific gauge length. The testing system uses the deflection of the extensometer divided by the gauge length to calculate the strain.

strain hardening exponent: The slope of the log(true stress) versus log(true strain) curve in the region specified.

strength coefficient: Stress-strain power curve coefficient, K, numerically equal to the extrapolated value of true stress at a true strain of 1.00.

stress: Load divided by the specimen cross-sectional area. Stress is a derived channel. The testing system calculates stress using the measured load and the specimen dimension values that you enter.

T

test data: Data points read from the testing system as each specimen is tested.

test director: Refer to the definition for a prompted test. The Prompted Test is the new version of the Test Director that existed within Merlin software.

test method: A file containing all the parameters needed by the testing system to run a test, analyze the test data and produce calculated results. It may be linked to other files; a report template to format a printed report from the testing and a test profile file, if test profiler software is being used.

test parameter: A test parameter is any value, numerical or alphabetic, that the testing software uses to run a test on a specimen and produce some kind of output. Examples are test speed, specimen geometry, and the list of results that are to be calculated. A group of test parameters can be saved as a test method.

test profile: A file containing a sequence of waveforms and ramps. You apply the test sequence to a specimen by using the optional Tension or Compression Test Profile test types.

test profiler: An optional software program for creating, editing and saving a Test Profile.

test segment: A single portion of a test, such as preload, precycle, ramp, and hold. You link individual test segments to create a complete materials test. If the system is equipped with the optional Test Profiler, you can specify the system to graph or apply calculations to segments of test data.

test type: Bluehill software consists of a number of test types, allowing you to run different types of materials tests within the software. Examples of test types include Tension, Compression and Peel, Tear and Friction.

test workspace: The area of the screen comprising one or more runtime graphs, a result table, and an area for specimen parameters. It is the dynamic content of the screen during testing of a sample.

transducer: A device which converts a physical property such as force, motion, temperature, and so on, into a proportional electrical signal which is used to measure the property. A load transducer, or load cell, converts load into an electrical signal, and an extensometer converts specimen extension into an electrical signal.

transverse strain: Transverse strain is a derived channel. It is measured in a direction perpendicular to the applied load.

true strain: Instantaneous % of change in length of a specimen in mechanical test. It is equal to the natural logarithm of the ratio of length at any instant to original length.

true stress: Applied load divided by actual area of the cross section through which load operates. It takes into account the change in cross section that occurs with changing load.

U

undo test: Undo Test is available when running a prompted test. It is not the same as Delete Specimen. Delete Specimen removes all theinformation about a specimen, including any parameters such as dimensions and specimennotes that you may have entered. Undo Test only deletes test data and calculatedresults, it does not delete any parameters that you may have entered in earlier promptedtest screens, such as specimen dimensions.

Y

yield point extension (YPE): In materials that have a yield point, the yield point extension is the difference between the extension (elongation) at the completion and at the start of discontinuous yielding.

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