XYZTEC

Measuring Hysteresis
CONDOR Software v3.32

DECEMBER 2007
Application note 100: Measuring Hysteresis

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1   Preface

This is an application note that describes the hysteresis measurement. This note explains the requirements, test setup and method setup. After performing a test a force graph can be generated. The data for this graph can be used in combination with a special Excel sheet to generate a hysteresis graph.

2   Requirements

- Any XYZTEC Condor tester with XYZAD firmware v1.28 or higher.
- Condor software version 3.32, build version 13467 or higher.
- Any XYZTEC measurement unit qualified for pull or shear testing.
- Optional: opto isolated trigger unit for external trigger event.

3   Test setup

The sample is placed in the work holder. If used, the external trigger must be connected in series with the opto isolated trigger unit and connected to the +5V power supply. Note that the +5V is connected to the pin 3 of the phone plug and the ground is connected to the pin 2 of the phone plug. When the switch is closed the 5V power supply will signal the opto coupler and LED1 will light. This signal is internally fed to the software to mark an event in the graph.
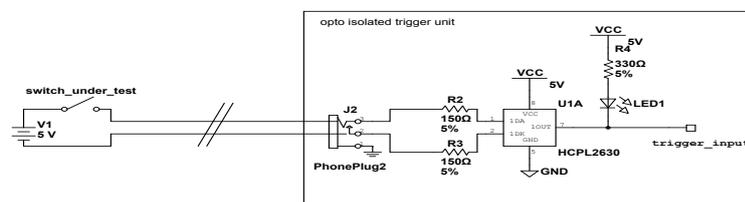
Figure 1: Schematic for test setup

The event marker can be switched on or off or can be changed in level by software settings.

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4   **Method setup**

Before performing the test it is important to create a method that can be used for this measurement. Depending on the sample that needs to be tested a pull/push test or a shear test can be used. Below are the settings for a push test.
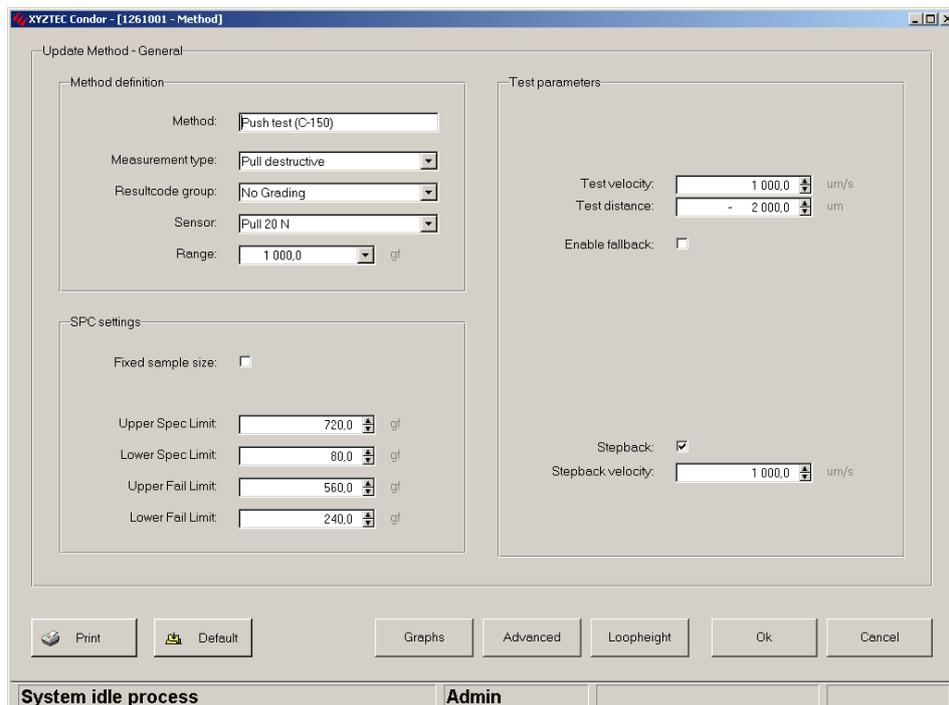
Figure 2: Method screen (standard)

Depending on the force required for the sample a measurement sensor and a force range are selected. Please check our administrator manual for more information about the method setup. For a push test it is important to choose a pull test and set a negative **test distance**. Important for the hysteresis measurement is that a **stepback** is used. In most cases **stepback velocity** and **test velocity** should be the same.

During the measurement the stage will move for the preset test distance with the preset test velocity. Since we have selected a destructive test the Z-stage will move the complete distance down. No fallback should be enabled. When a fallback is used the measurement might stop prematurely and hysteresis measurement will not be possible. After the test distance has been reached the stage will move back with the preset stepback velocity.

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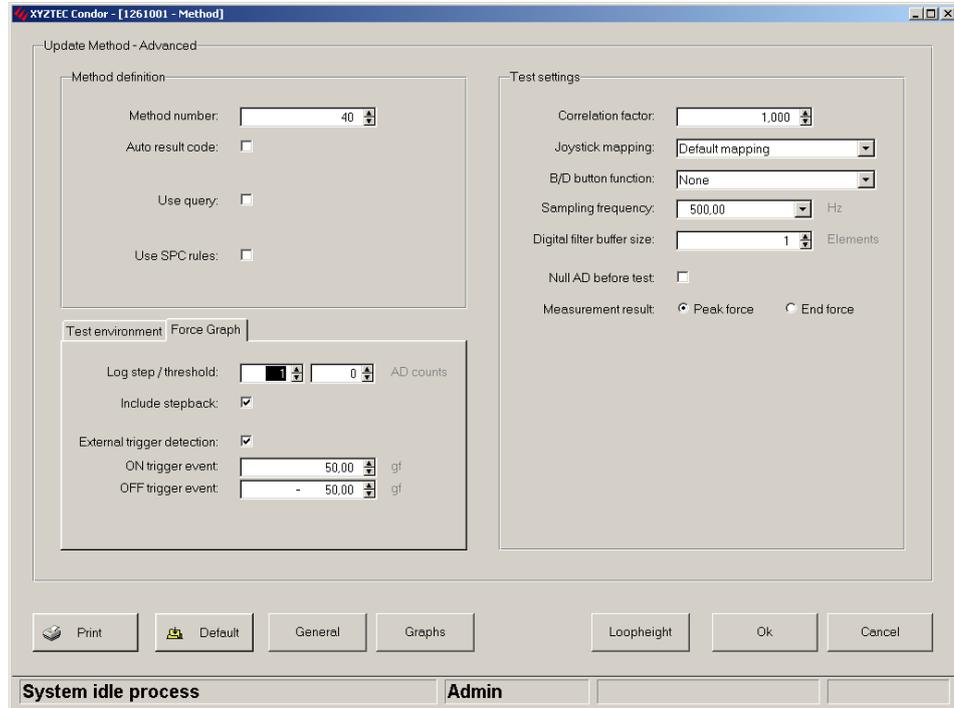
Figure 3: Method screen (advanced)

In the Advanced Method screen the settings for the force graph can be found. The **log step** should be set to the lowest value possible. In this example the log step is set to 1. All measurements made during the test will be stored. For a hysteresis test it is required to enable the **include stepback**. This way the measurement system will also graph the measurements during the stepback.

The markers below are stored in the graph:

0FF10h	65296	Test distance movement START
0FF11h	65297	Test distance movement STOP detected
0FF20h	65312	Stepback movement START
0FF21h	65313	Stepback movement STOP detected

If an external trigger is used you should enable the **external trigger detection**. This detection will store additional markers in the force graph data when an external trigger is detected. The following markers are used:

0FF00h	65280	External OFF event
0FF01h	65281	External ON event

Since the extra markers are only available when this option is enabled it is not possible to restore this information for measurements that where made before the option was turned on. Do not forget to enable the external trigger detection if!

The **ON trigger event** setting is used to set a force that is added to the measurement when the ON event occurs. This way the external trigger will become visible in the graph as a spike. Make sure to set a force that is high enough to be clearly visible in the graph. In the example above +50 gf is set. This causes a 50 gf spike in the graph. Leave this value at 0 gf if it is not required to see the trigger in the graph.

The **OFF trigger event** setting is used to set a force that is added to the measurement when the OFF event occurs. This way the external trigger will become visible in the graph as a spike. Make sure to set a force that is high enough to be clearly visible in the graph. In the example above -50 gf is set. This causes a 50 gf spike in the graph in downward direction. Leave this value at 0 gf if it is not required to see the trigger in the graph. Note that the trigger events are polled in software at the selected sample frequency. Trigger events are stored between two samples. No sample data will be lost! There is also no influence on the measurement result.

5   Performing the test

To perform the test go back to the Main Menu and click the Test button. The Test Setup screen is opened. Choose the correct method and set the correct user tables. Make sure to enable the Auto graph option. This way the software will automatically store a force graph for each measurement. Then click Next to enter the Test and Query screen.
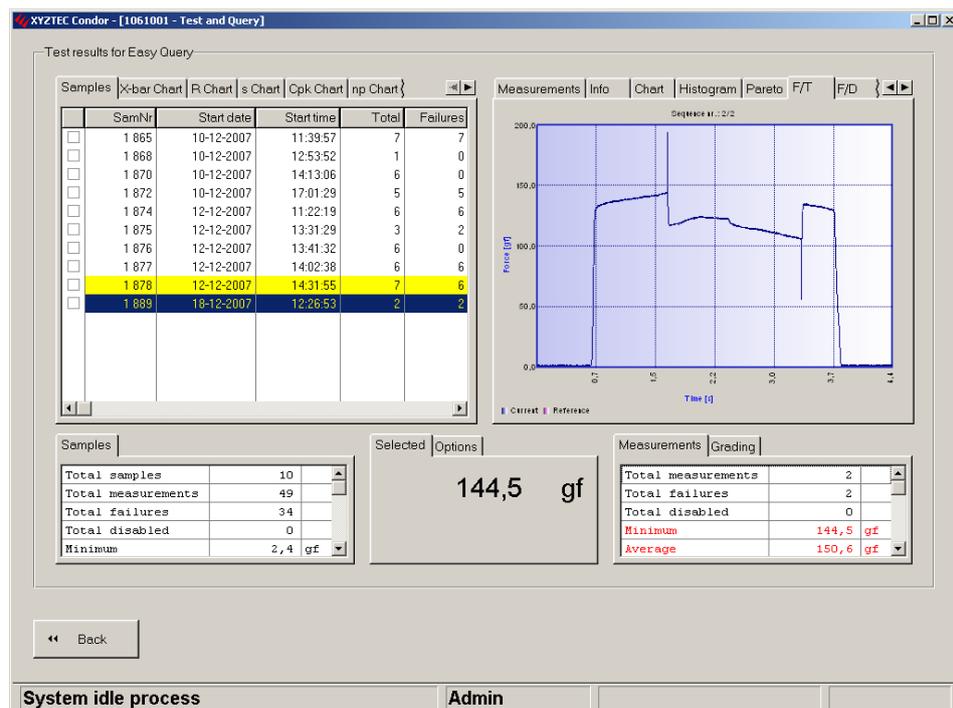
Figure 4: Test and query screen with force graph

In the Test and Query screen first move the stages to the correct position. Then click Start or press the A or C joystick buttons. The test is started. When the test is finished and auto graph was enabled the software will automatically store the graph. Click on the Graph button when auto graph is not enabled. Click on the F/T Graph (force/time) or the F/D Graph (force distance) tab to see the graph. Double click with the right mouse button to open a popup menu. Choose Copy to copy the graph to the clipboard. Choose Export to export the graph to an XML file.

When the force graph data is copied and pasted in an Excel sheet it is possible to generate a special hysteresis graph. The picture below shows an example of such a graph. The external trigger on and off events can easily be recognized.
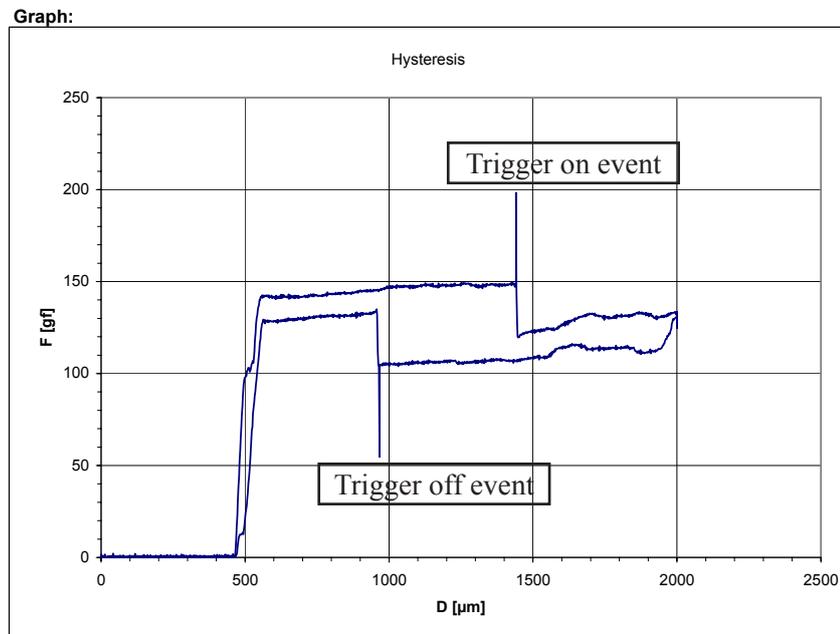
Figure 5: Hysteresis graph

Please check our administrator manual for more information about the test screen. An Excel template to automatically make the graph is available from XYZTEC.