

YJKP - Evaluation methods based on a reference curve

Description of how to record/load reference curves and how to configure evaluation methods.

YJKP

Title YJKP - Evaluation methods based on a reference curve
Version 1.20
Document no. 100266
Originalen
AuthorFesto

Last saved 14.08.2026

General information:

This document is intended for qualified, trained and instructed professionals. The data provided in this document are no guaranteed specifications, in particular with regard to functionality, condition or quality in the legal sense. The information in this document is intended only as simple indications for the implementation of a specific, hypothetical application, and in no way as a substitute for the operating instructions of the respective manufacturers or the design and testing of the respective application by the user. The respective operating instructions for Festo products can be found under www.festo.com. The user of this document must ensure that each function described herein works properly in his application. The user remains solely responsible for his or her own use of this document, even by studying this document and using the information mentioned therein. This also applies to any software (in source code and/or object code) that is made available to the user as an appendix to this document.

Rights of use of the software:

If software is made available to the user as an appendix to this document, the user is granted a simple and unlimited right of use hereto. This right also includes the processing and distribution of the software to third parties in edited or unedited form. The User is not permitted to use the name "Festo" to endorse or promote products derived from the Software without express prior written permission.

Software is provided to the user "as is". Festo does not assume any warranty or guarantee with regard to software. Festo's liability for damages of any kind arising from the use of the software is limited to intent and gross negligence.

Legal Notices:

©Festo SE & Co. KG, all rights reserved. A change in content and form is only permitted with the express written consent of Festo SE & Co. KG. Festo grants the user the right to reproduce this document in a form that remains unchanged in terms of content and form and to pass it on to third parties.

Table of contents

- 1 Components/Software used 5**
- 2 Application description..... 6**
- 3 Record/load reference curve(s)..... 7**
 - 3.1 Record reference curve(s) 7
 - 3.2 Load reference curve(s) 10
- 4 Configure monitoring..... 11**
 - 4.1 Windowing 12
 - 4.1.1 Description..... 12
 - 4.1.2 Example 16
 - 4.2 Threshold 18
 - 4.2.1 Description..... 18
 - 4.2.2 Example 23
 - 4.3 Envelope..... 25
 - 4.3.1 Description..... 25
 - 4.3.2 Example 28
 - 4.4 Singularity 30

1 Components/Software used

Type/Name	Version Software/Firmware
Servo press kit YJKP	EVO 4.1
Application software YJKP (GSAY-A4-F0-Z4-2.3.0)	V2.3.0
Firmware controller (CECC-X)	V3.8.14
Firmware motor controller (CMMT-AS)	V36.12.0

Table 1.1: Components/Software used

2 Application description

This application note explains how to use the evaluation methods of the servo-press kit system to assess the pressing process based on a recorded curve, supported by practical examples.

Topics covered:

- Record / loading reference curves
- Windowing
- Threshold
- Envelope
- Singularity

3 Record/load reference curve(s)

Many servo press applications require precise evaluation of the pressing process. This is achieved by analyzing the process curves of each press cycle using the following evaluation methods.

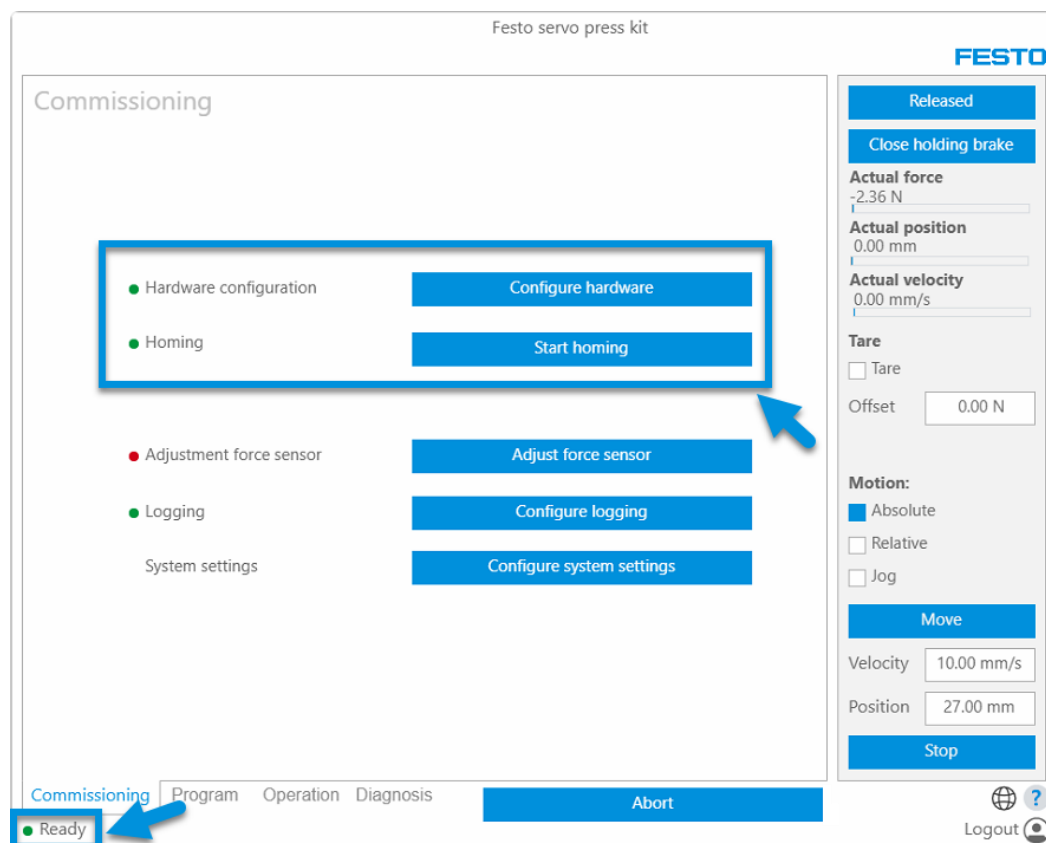
- Windowing
- Threshold
- Envelope
- Singularity

Before configuring these methods, a reference curve must be recorded or loaded.

3.1 Record reference curve(s)

When creating a new press program, the reference curves are recorded according to the following procedure:

1. Verify that the system is ready for operation by completing the hardware configuration and homing the system.



Record/load reference curve(s)

2. Create the sequencer program, activate the **recording option** for the evaluation functions. Release the **power stage** and click **Next** to continue.

Festo servo press kit

Edit program ● Ready for operation

Step 1/4: Configure sequencer

No.	Function	Name
1	PM	POSITION_MODE
2	FM	FORCE_MODE
3	PM	POSITION_MODE
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		

Function: **Force mode**

☒ Record

Position method: ☒ Absolute ☐ Relative

Target force: 200.00 N

Maximum position: 30.00 mm

Velocity: 1.00 mm/s

Buttons: Insert step, Delete step, Copy step, Insert copied step, Configure failure reaction, Cancel, Save, Next, Abort

Right panel (FESTO):

- Released (2)
- Close holding brake
- Actual force: -3.05 N
- Actual position: 0.00 mm
- Actual velocity: 0.00 mm/s
- Tare: ☐ Tare
- Offset: 0.00 N
- Motion: ☒ Absolute ☐ Relative ☐ Jog
- Move
- Velocity: 10.00 mm/s
- Position: 27.00 mm
- Stop
- Logout

Bottom status bar: Commissioning, Program, Operation, Diagnosis, Ready

3. Prepare the YJKP system with a sample workpiece to be used as the reference for all subsequent press operations in this program.
4. Start the process by pressing **Start record reference curve**.

Edit program ● Ready for operation

Step 2/4: Record / loading reference curve(s)

To create the monitoring reference curve(s) must be recorded or loaded.

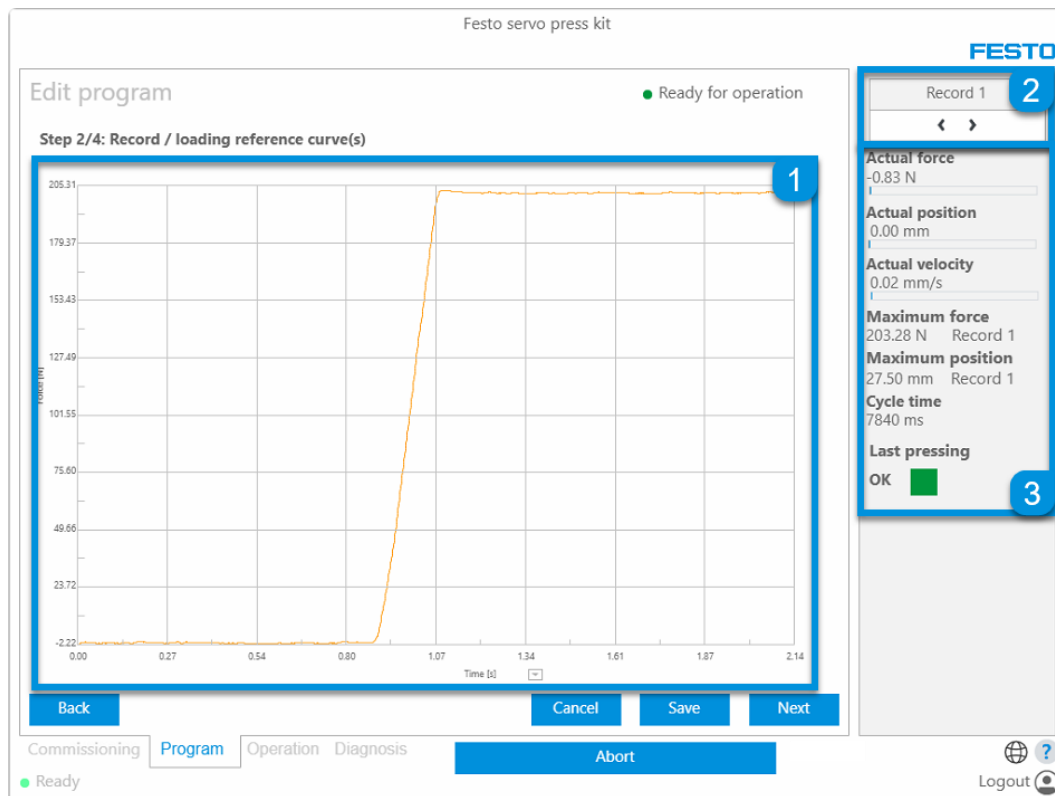
Record: Insert a standard part.
Afterwards start record reference curve(s) over button (Input X3.0 => Rising edge)
=> Modes of operation: Manual mode (Input X3.1 => True)
The reference curve(s) will be recorded automatically.

Loading: Push [Loading reference curve(s)] to load saved reference curve(s).

Start record reference curve ☐ Step mode

Buttons: Back, Cancel, Save, Next

5. When the process is finished , the reference curves will appear as shown in the following example.



[1] The reference curves.

[2] Navigate between the recorded curves.

[3] Actual sensor value and recorded value from the last process.



Note

Field [3] in **Error! Reference source not found.** displays the status of the press process. A successful process is indicated by **OK**. If an error occurs during execution or invalid sequencer settings are used, the status is set to **NOK** and no curve is generated.

3.2 Load reference curve(s)

If the selected program already contains recorded curves, an additional button is available to load them.

Edit program

● Ready for operation

Step 2/4: Record / loading reference curve(s)

To create the monitoring reference curve(s) must be recorded or loaded.

Record: Insert a standard part.
Afterwards start record reference curve(s) over button (Input X3.0 => Rising edge)
=> Modes of operation: Manual mode (Input X3.1 => True)
The reference curve(s) will be recorded automatically.

Loading: Push [Loading reference curve(s)] to load saved reference curve(s).

Loading reference curve(s)

Start record reference curve

☐ Step mode

Back

Cancel

Save

Next

By clicking Load Reference Curve(s), the previously recorded reference curves are displayed.

After recording or loading the reference curves, click **Next** to proceed to the next step, **Configure Monitoring**.

4 Configure monitoring

Many servo press applications require reliable process monitoring. In the YJKP system, selected process steps are monitored by evaluating recorded process curves using the following methods:

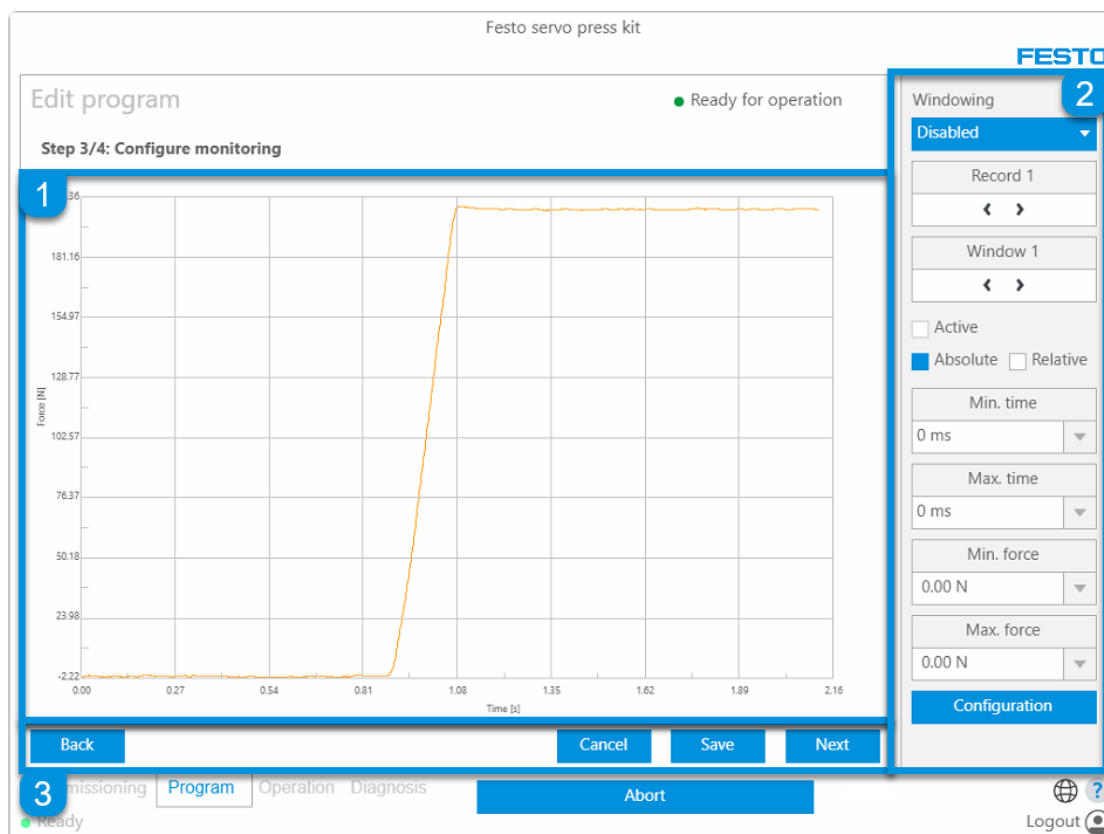
- Windowing
- Threshold
- Envelope
- Singularity



Note

- The methods can only evaluate recorded curves defined during sequencer configuration.
- Curve evaluation is performed after the press cycle has finished and does not provide real-time monitoring during operation.

The **Configure Monitoring** screen consists of the following sections:



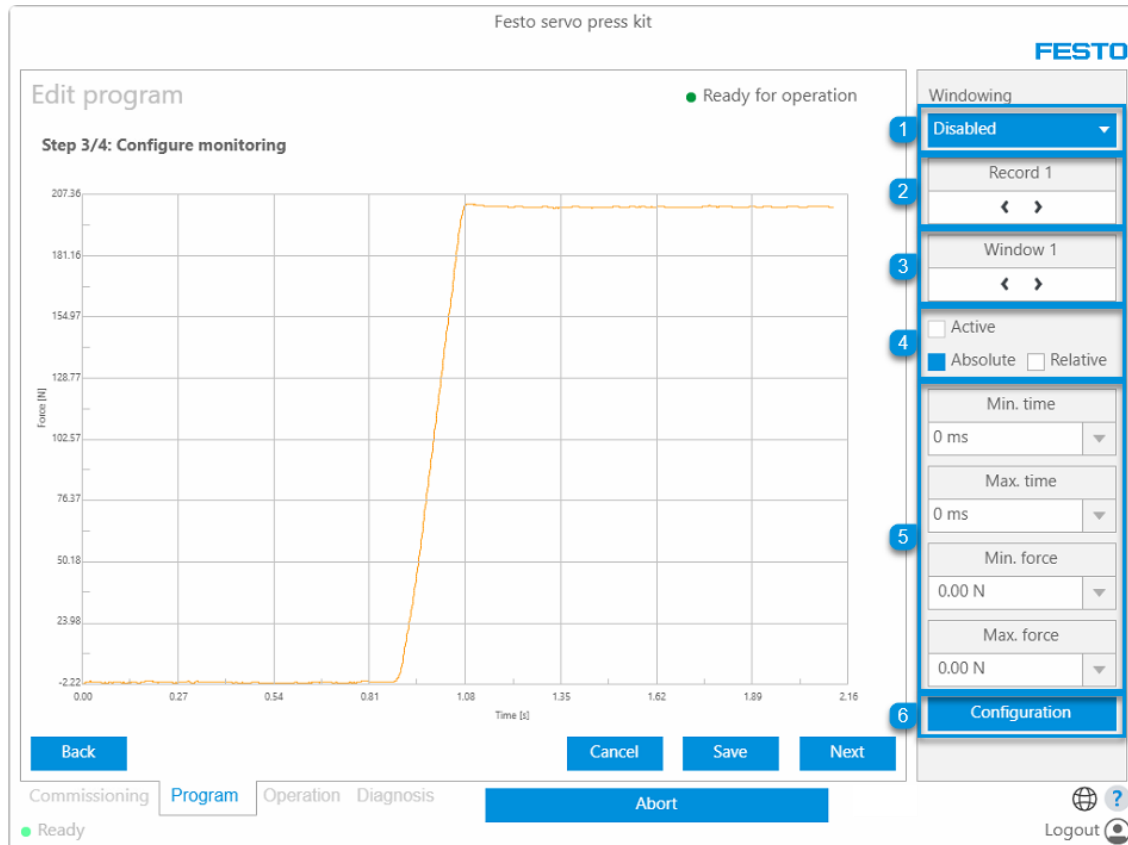
- [1] Display area showing the force-position or force-time reference curve recorded or loaded in the Record/Load Reference Curve step.
- [2] Configuration panel for the selected evaluation method.
- [3] Control buttons for navigating between Windowing, Threshold, Envelope and Singularity, and for saving or discarding the settings.

4.1 Windowing

4.1.1 Description

Windowing is an evaluation method based on defining windows on the recorded curve.

The configuration panel includes the following elements:



[1] Enable / disable (→)

[2] Currently displayed curve (→)

[3] Currently active window (→)

[4] Active / window's positioning method (→)

[5] Configure the window's position and size (→)

[6] Configuration of evaluation condition (→)

[1] Enable / disable

Activates or deactivates the Windowing evaluation method for all curves.

[2] Currently displayed curve

Select the curve to which the Windowing method will be applied.

[3] Currently active window

Up to **five** windows can be configured for each curve. Use this panel to select and switch between them.

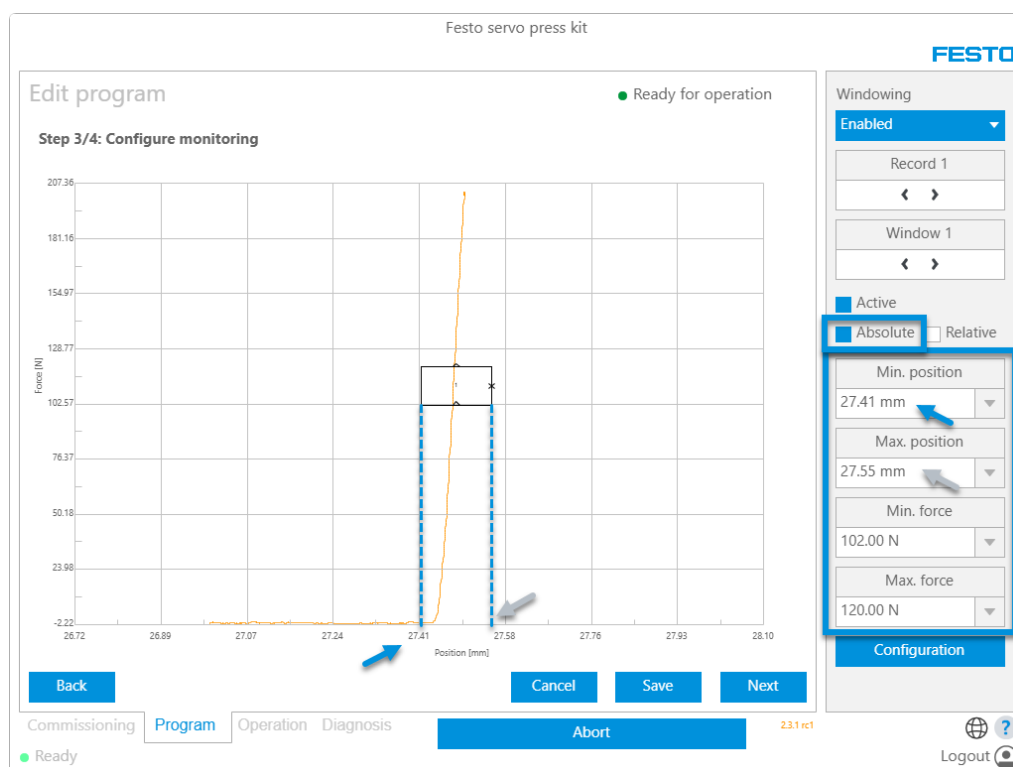
[4] Active / Window's positioning method

- **Activate:** Enable or disable the selected window.
- **Absolute / Relative:** Defines the reference of window's position axis.
 - **Absolute:** Uses the position recorded [mm] as min. / max. position.
The window position is defined relative to the cylinder's homing position and displayed accordingly on the curve.



Example

After recording a curve in a YJKP system, enable the Absolute option and set the window position values as shown below.



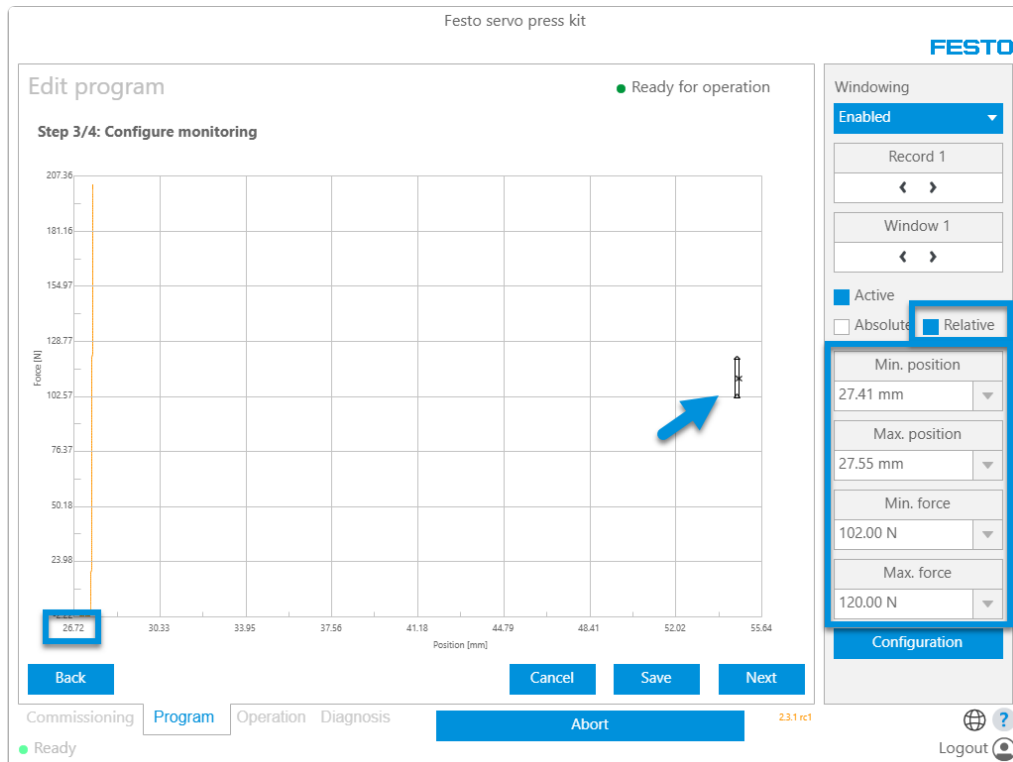
- **Relative:** Positions the window in mm relative to the start of the recorded curve.



Example

Using the previous example, enable the Relative option without changing the window position values. The window is then positioned relative to the start of the recorded curve (26.72 mm), resulting in the following window limits:

- Min. Position: 27.41 mm + 26.72 mm = 54.13 mm
- Max. Position: 26 mm + 9.90 mm = 54.27 mm



Note

The choice of positioning method depends on the process characteristics:

- Absolute positioning is suitable when the start position remains constant for every press cycle.
- Relative positioning should be used when the start position can vary, as the windows are automatically shifted relative to the curve start.

Consider a servo-press program consisting of the following functions:

1. Digital Signal Mode
2. Force Control
3. Position Mode

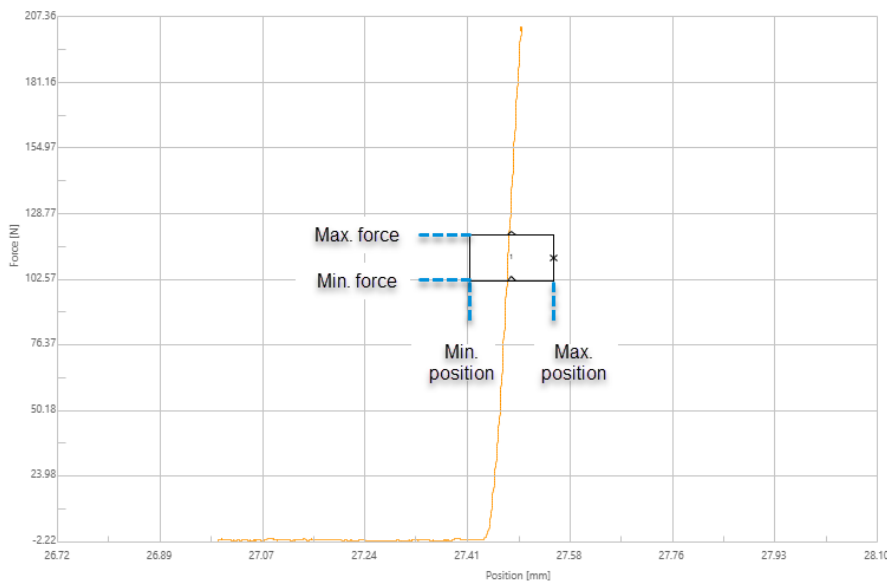
If the curve recorded during the Force Control function is evaluated using the Windowing method, Relative positioning should be used.

This is because the preceding Digital Signal Mode function makes it difficult to predict the exact position at which the Force Control function starts. By using Relative positioning, the window automatically follows the actual start of the recorded curve.

[5] Configure the window's position and size

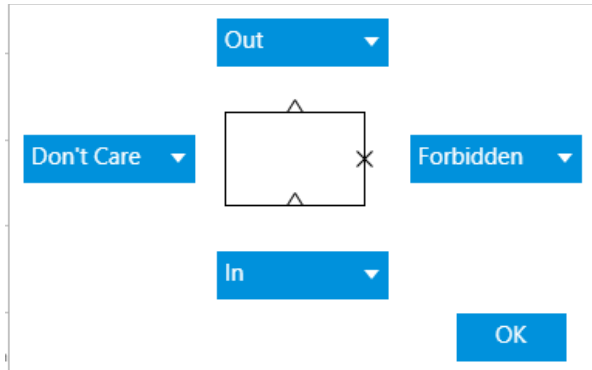
Min. Position and Max. Position define the window range on the position axis.

Min. Force and Max. Force define the window range on the force axis.



[6] Configuration of evaluation condition

Define the limits of the selected window. Clicking this button opens the following configuration dialog:



In the center, the selected window is displayed. For each window boundary, one of the following evaluation conditions can be defined:

- **In:** The curve must enter the window through this boundary. If it does not, the process is evaluated as NOK.
- **Out:** The curve must leave the window through this boundary. If it does not, the process is evaluated as NOK.
- **Forbidden:** The curve must not cross this boundary. If it does, the process is evaluated as NOK.
- **Don't Care:** This boundary is ignored during evaluation.

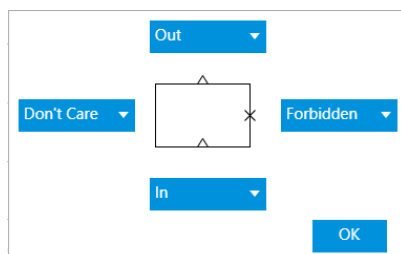
4.1.2 Example

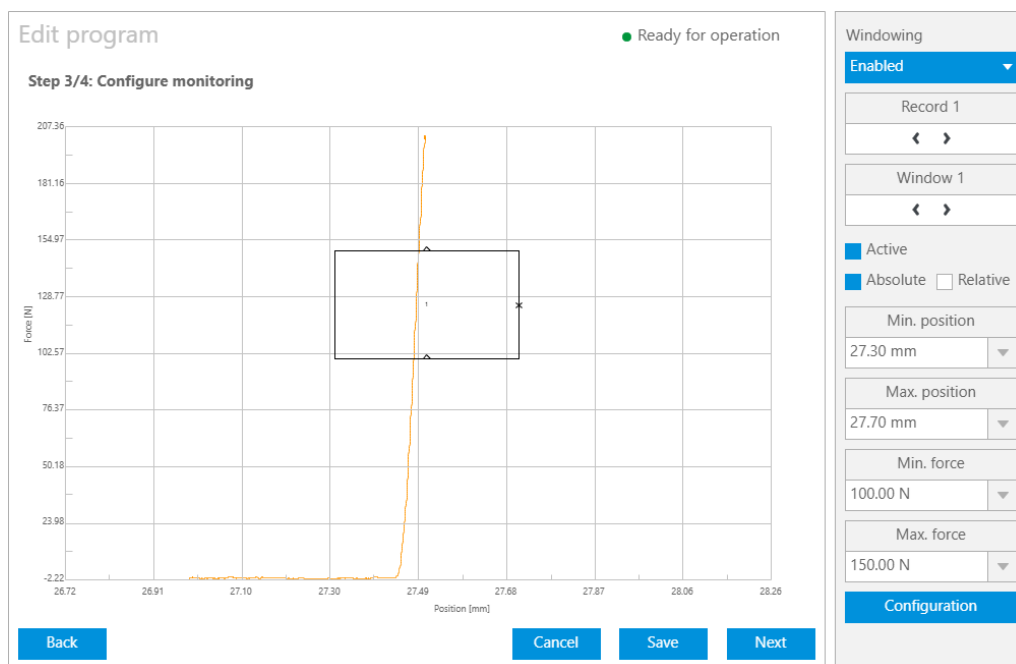
The following example shows a recorded curve and the corresponding window configuration used for process evaluation.



Steps:

1. Windowing : Enabled
2. Select record 1
3. Select window 1
4. Set:
 - Active
 - Absolute
5. Set these values:
 - Min. position = 27.30 mm
 - Max. position = 27.70 mm
 - Min. force= 100 N
 - Max. force = 150 N
6. Configuration :



Result:**Evaluation:**

During execution, the force-position curve must meet the following conditions:

- Enter the window through the bottom boundary.
- Exit the window through the top boundary.
- Not touch or cross the right boundary.
- The left boundary is not evaluated.

If all conditions are met, the process is evaluated as OK.

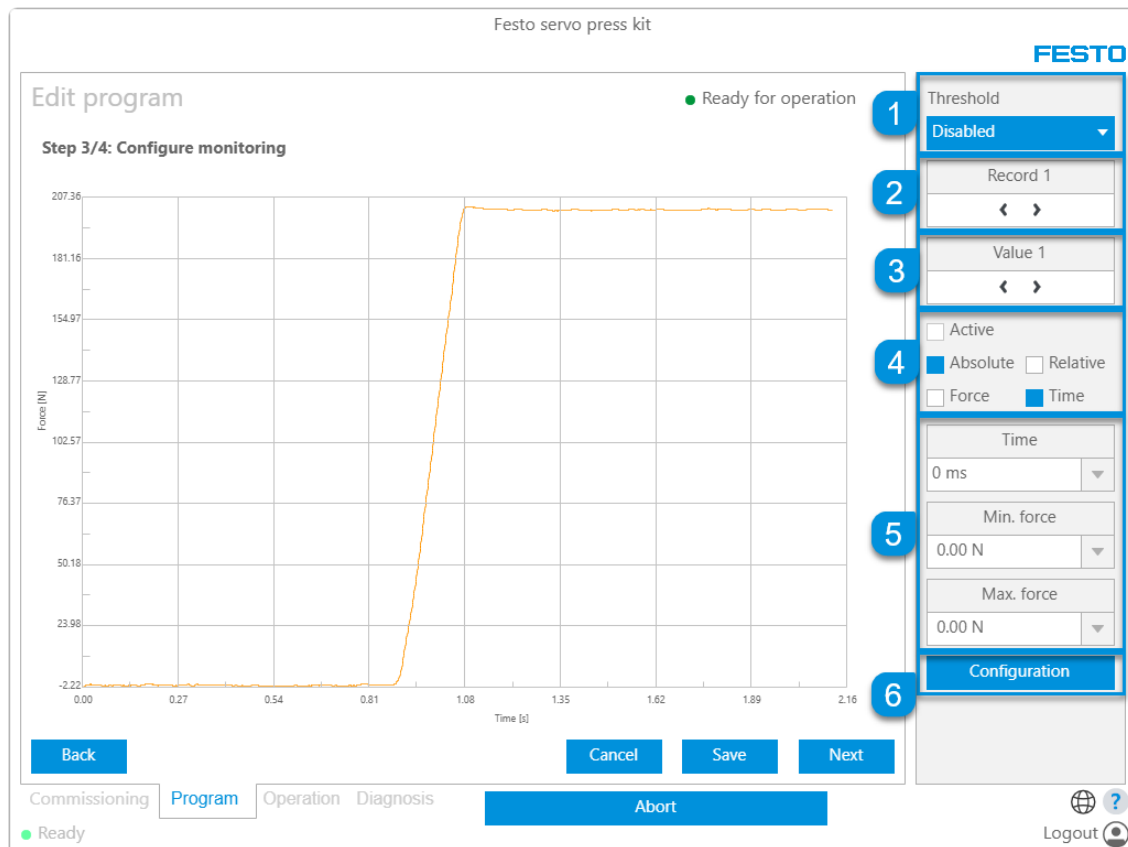
Violation of any defined condition results in a NOK evaluation.

4.2 Threshold

4.2.1 Description

Threshold evaluates the recorded curve against a defined threshold value.

To access the Threshold configuration, click Next from the Windowing screen. The configuration panel contains the following elements.



[1] Enable / disable (→)

[2] Currently displayed curve (→)

[3] Currently active threshold (→)

[4] Active / threshold's positioning method and orientation (→)

[5] Configure the threshold's position and length (→)

[6] Configuration of evaluation condition (→)

[1] Enable / disable

Enables or disables the Threshold method for all curves.

[2] Currently displayed curve

Select the curve to which the threshold evaluation will be applied.

[3] Currently active threshold

Up to five thresholds can be configured for each curve. Use this panel to switch between them.

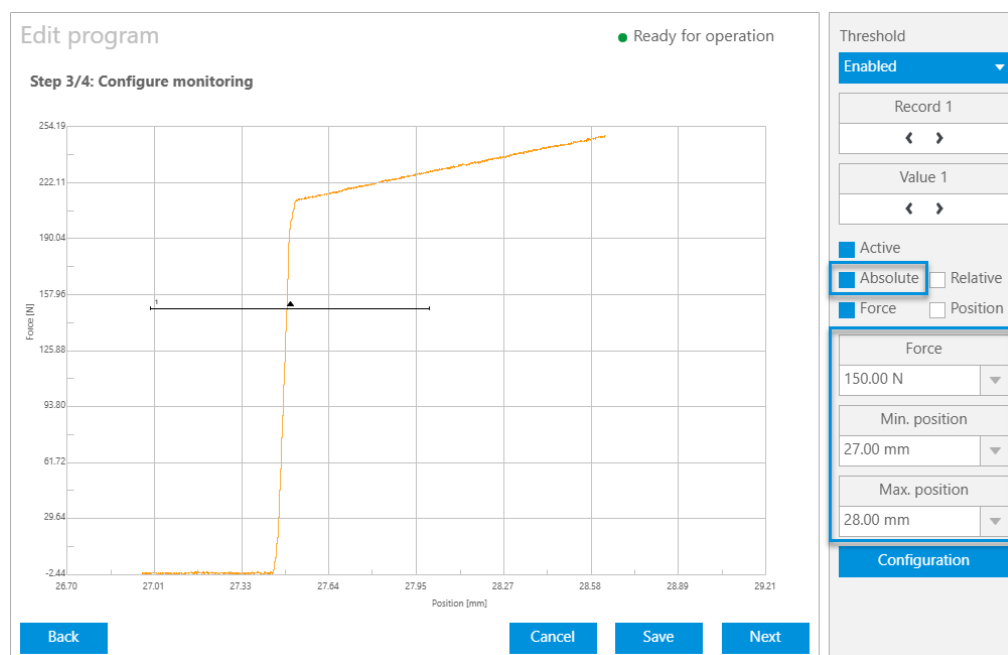
[4] Active / threshold's positioning method and orientation

- **Activate:** Enables or disables the selected threshold.
- **Absolute / Relative:** Defines the reference of threshold's position axis.
 - **Absolute:** Defines the threshold position in mm relative to the drive position.
The threshold position is defined relative to the cylinder's homing position and is displayed accordingly on the curve.



Example

After recording a curve in the YJKP system, enable the Absolute option and set the threshold position values as shown below.



- **Relative:** Defines the threshold position in mm relative to the start of the recorded curve.

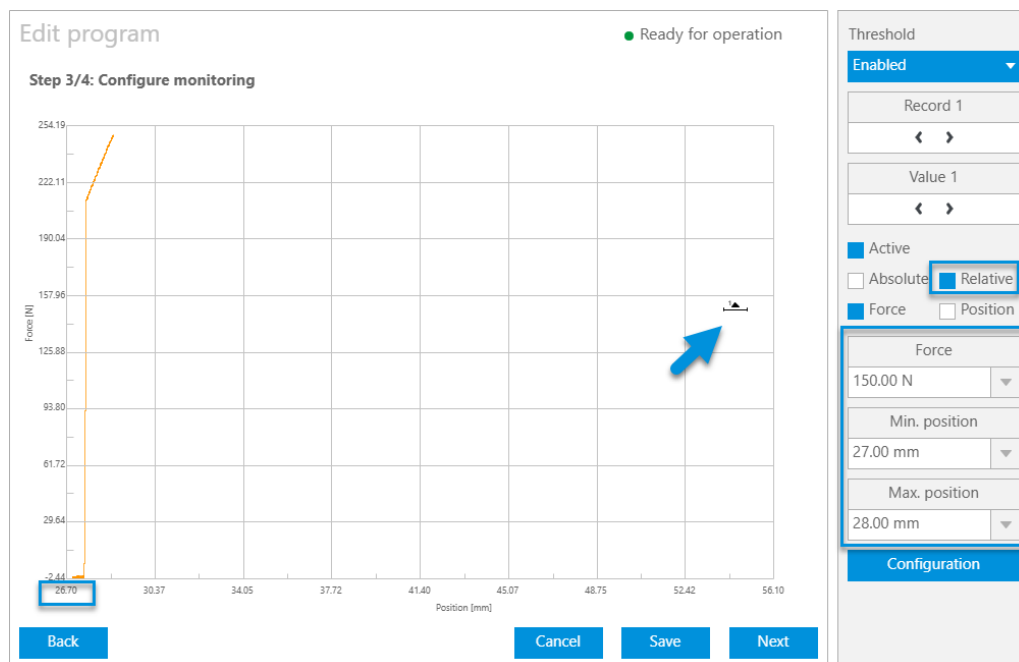


Example

Using the previous example, enable the Relative option without changing the threshold position values.

The threshold is then positioned relative to the start of the recorded curve (26.70 mm), resulting in the following limits:

- Min. Position: 27 mm + 26.70 mm = 53.70 mm
- Max. Position: 28 mm + 26.70 mm = 54.70 mm



Note

As with the Windowing method, choose Absolute positioning when the curve start position is constant and Relative positioning when it may vary between press cycles.

- **Force / Position:** The threshold can be defined either by a position value or a force value. The corresponding minimum and maximum limits define the acceptable range in the opposite axis and determine whether the curve passes the threshold successfully.
 - **Force:** Defines a force value that the curve must pass through.
When Force is selected, the following parameters are available:
 - Force : Force value used as the threshold.
 - Min. Position : Lower position limit at the threshold force.
 - Max. Position : Upper position limit at the threshold force.
 - **Position:** Defines a position value that the curve must pass through.
When Position is selected, the following parameters are available:
 - Position : Position value used as the threshold.
 - Min. Force : Lower force limit at the threshold position.
 - Max. Force : Upper force limit at the threshold position.

[5] Configure the threshold's position and length

Set the threshold's value and domain.

- **Force Threshold**

When Force is selected, the following parameters are available:

- Force: Force value used as the threshold.
- Min. Position: Lower position limit at the threshold force.
- Max. Position: Upper position limit at the threshold force.

- **Position Threshold**

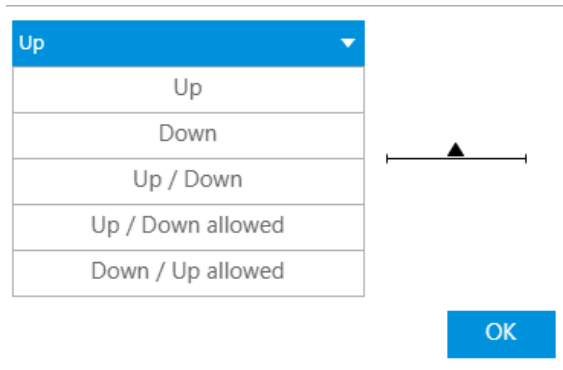
When Position is selected, the following parameters are available:

- Position: Position value used as the threshold.
- Min. Force: Lower force limit at the threshold position.
- Max. Force: Upper force limit at the threshold position.

[6] Configuration of evaluation condition

Specifies the required crossing direction of the curve at the threshold.

- **Force Threshold**

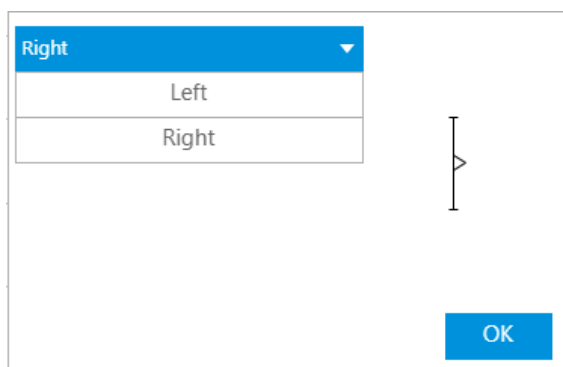


Up
Up
Down
Up / Down
Up / Down allowed
Down / Up allowed

OK

- Up: Positive crossing direction (bottom → top)
- Down: Negative crossing direction (top → bottom)
- Up / Down: Both crossing directions
- Up / Down allowed: First crossing must be positive crossing direction, after that both directions are allowed.
- Down / Up allowed: First crossing must be negative crossing direction, after that both directions are allowed.

- **Position Threshold**



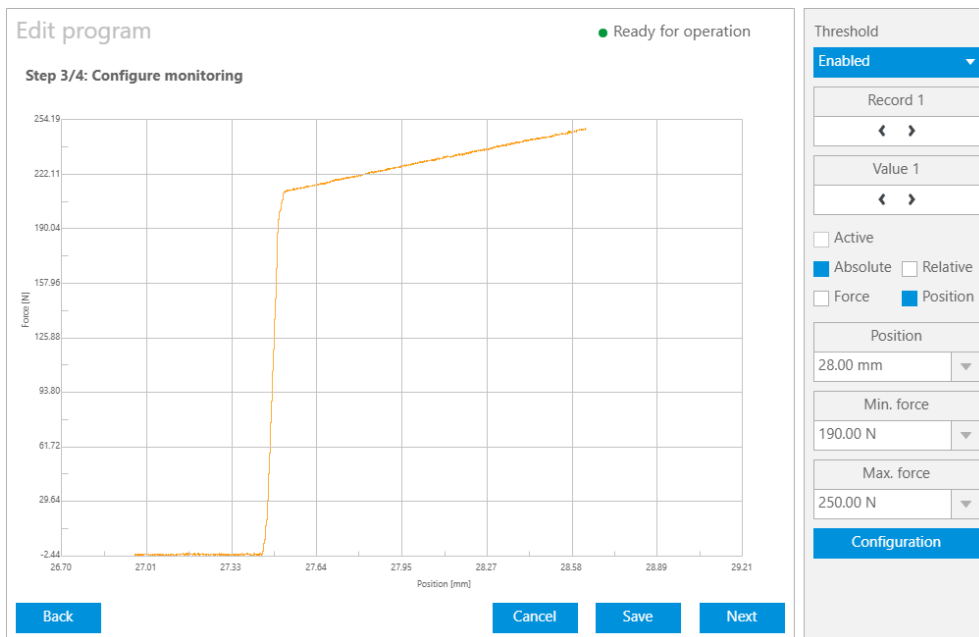
Right
Left
Right

OK

- Left: Crossing from left to right
- Right: Crossing from right to left

4.2.2 Example

Assume the recorded curve is shown below and two thresholds are to be configured, a Force Threshold and a Position Threshold.



Steps:

Configure the first threshold as force threshold.

1. Threshold: Enabled
2. Record: 1
3. Value: 1
4. Enable:
 - Active
 - Absolute
 - Force
5. Set:
 - Force: 150 N
 - Min. Position: 27 mm
 - Max. Position: 28 mm
 - Configuration: Up

Configure the second threshold as position threshold.

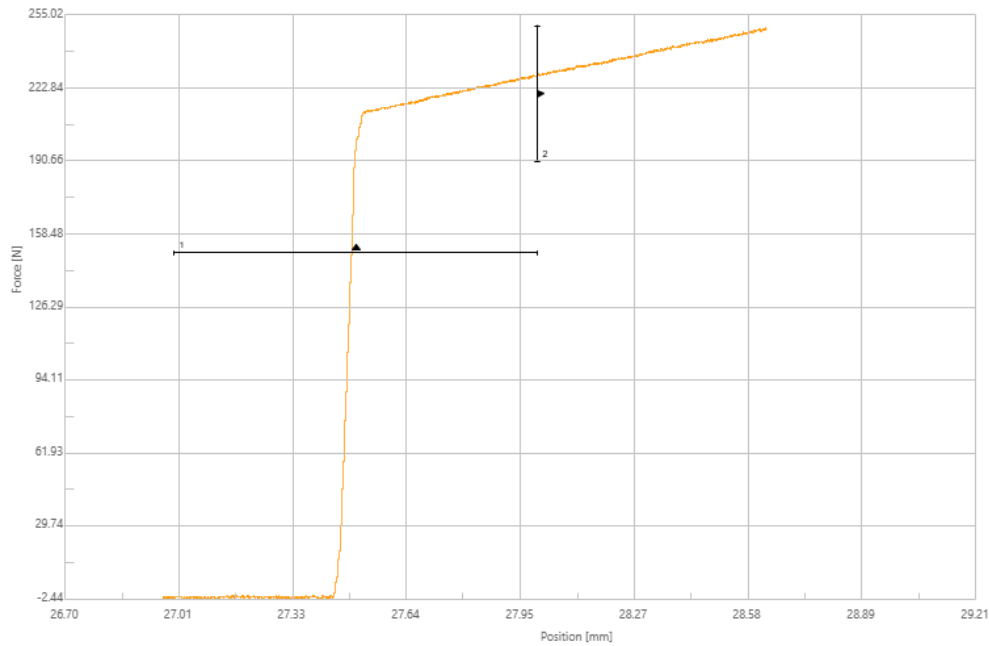
1. Threshold: Enabled
2. Record: 1
3. Value: 2
4. Enable:
 - Active
 - Absolute
 - Position

Configure monitoring

5. Set:

- Position: 28 mm
- Min. Force: 190 N
- Max. Force: 250 N
- Configuration: Right

Result:



Evaluation:

During execution, the force-position curve must:

- First cross the Force Threshold.
- Then cross the Position Threshold in the configured direction.

If both conditions are fulfilled, the process is evaluated as OK.

If either threshold is not crossed as configured, the process is evaluated as NOK.

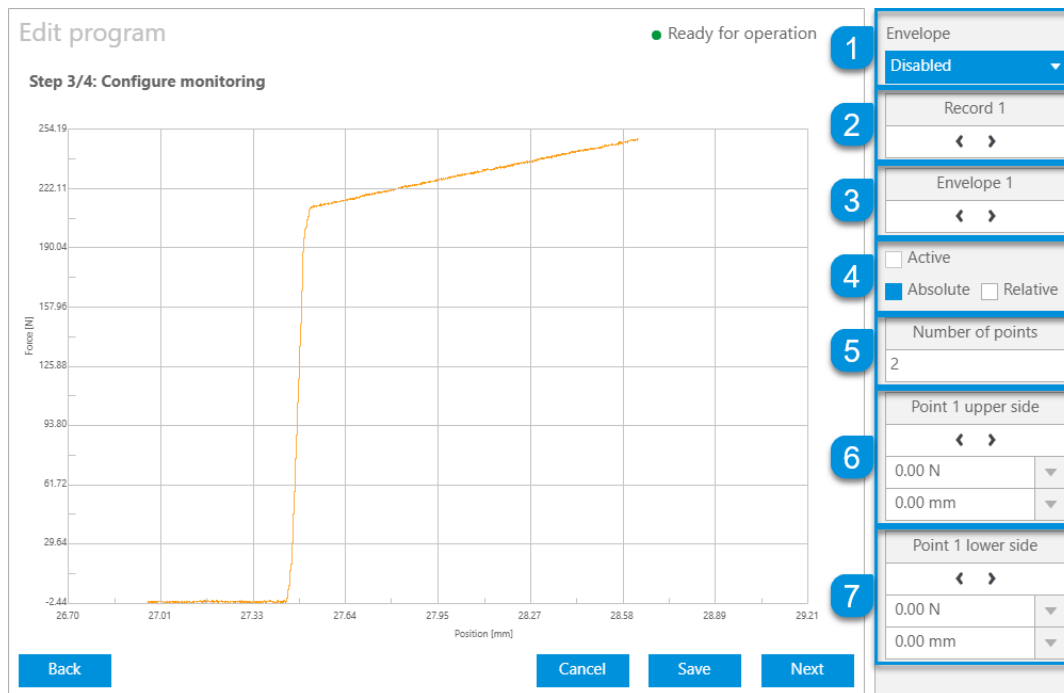
4.3 Envelope

4.3.1 Description

The Envelope method evaluates whether the recorded curve stays within a tolerance band defined by an upper and lower envelope. A curve is evaluated as OK only if it remains between both envelope boundaries throughout the monitored range.

To configure the method, navigate from the Threshold screen to the Envelope screen by clicking Next.

The configuration panel contains the following elements:



[1] Enable / disable (→)

[2] Currently displayed curve (→)

[3] Currently active envelope (→)

[4] Active / envelope's positioning method (→)

[5] Number of points (→)

[6] Define upper side value on graph (→)

[7] Define lower side value on graph (→)

[1] Enable / disable

Enables or disables the Envelope method for all curves.

[2] Currently displayed curve

Select the curve to which the envelope evaluation will be applied.

[3] Currently active envelope

Up to five envelopes can be configured for each curve. Use this panel to switch between them.

[4] Active / envelope's positioning method

This section contains the following options:

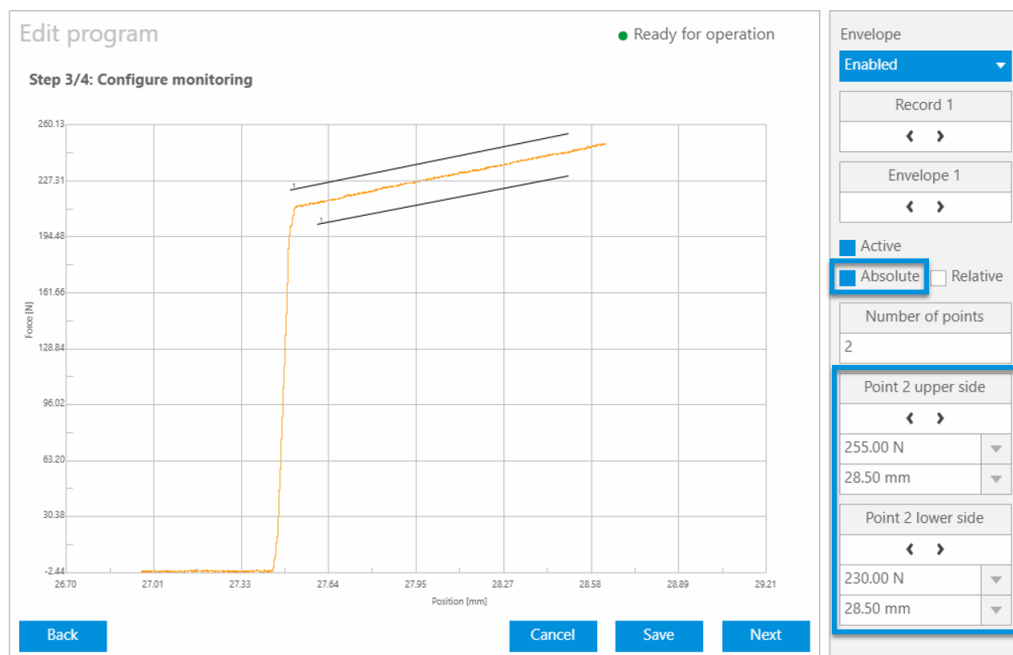
- **Activate:** Enables or disables the selected envelope.
- **Absolute / Relative:** Defines the reference of threshold's position axis.
 - **Absolute:** Defines the envelope position in mm relative to the drive position.
The envelope position is defined relative to the cylinder's homing position and is displayed accordingly on the curve.



Example

After recording a curve in the YJKP system, enable the Absolute option and configure the envelope using the following points:

1. Upper Envelope
 - Point 1 upper side: 222 N; 27.5 mm
 - Point 2 upper side: 255 N; 28.5 mm
2. Lower Envelope
 - Point 1 lower side: 202 N; 27.6 mm
 - Point 2 lower side: 230 N; 28.5 mm



- **Relative:** Defines the envelope position in mm relative to the start of the recorded curve.



Example

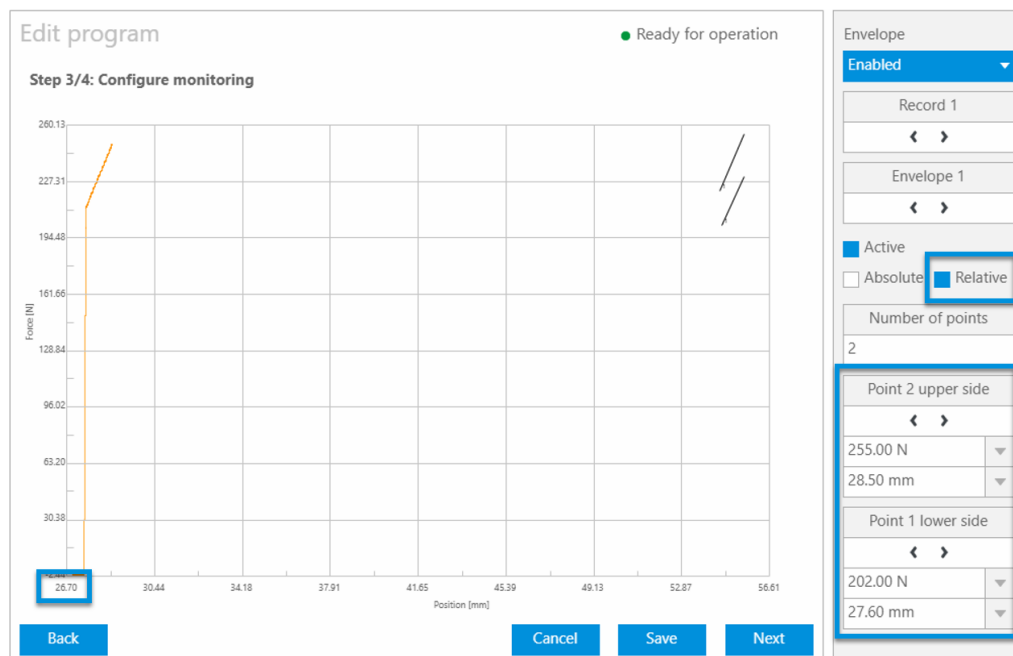
Using the previous example, enable the Relative option without changing the envelope coordinates. The envelope is then positioned relative to the start of the recorded curve (26.7 mm). The updated coordinates are:

1. Upper Envelope

- Point 1 upper side: 222 N; 54.2 mm (26.7 mm + 27.5 mm)
- Point 2 upper side: 255 N; 55.2 mm (26.7 mm + 28.5 mm)

2. Lower Envelope

- Point 1 lower side: 202 N; 54.3 mm (26.7 mm + 27.6 mm)
- Point 2 lower side: 230 N; 55.2 mm (26.7 mm + 28.5 mm)



Note

As with the Windowing and Threshold methods, use absolute positioning when the curve start position is fixed, and relative positioning when it may vary between press cycles.

[5] Number of points

Sets the number of points and bending corners defining the envelope.

[6] Define upper side value on graph

Define the coordinates for each point of the upper envelope.

- Force (N)
- Position (mm)

Use the arrow buttons to navigate between the upper envelope points.

Point 2 upper side	
◀ ▶	
255.00 N	▼
28.50 mm	▼

[7] Define lower side value on graph

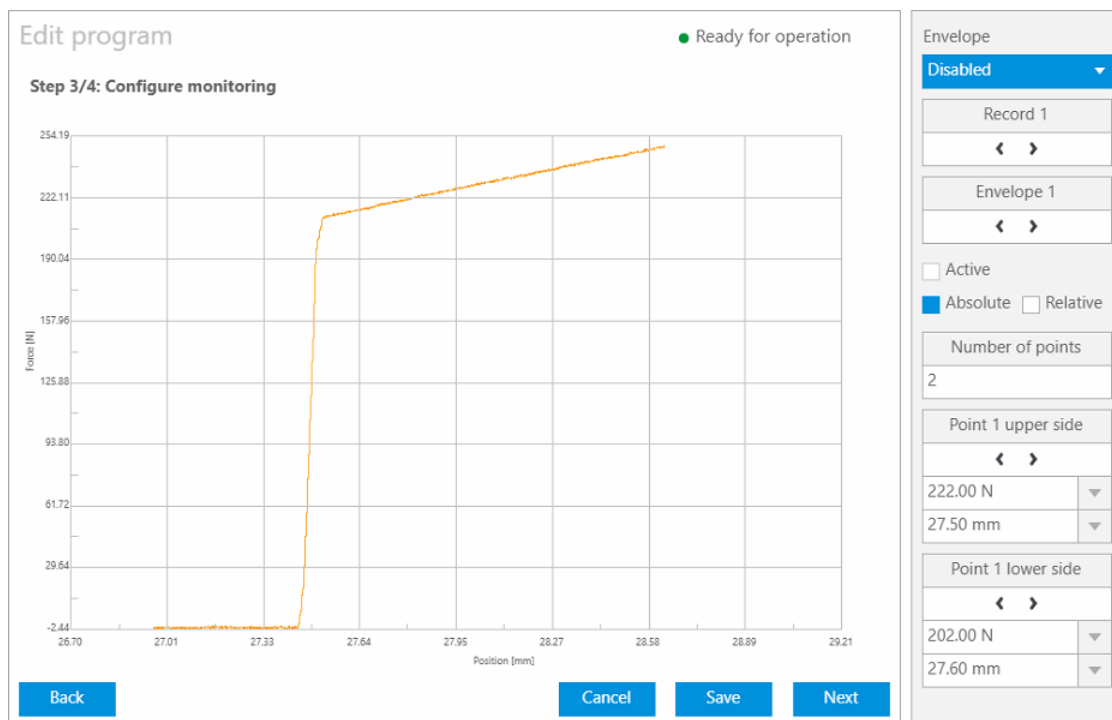
Define the coordinates for each point of the lower envelope.

- Force (N)
- Position (mm)

Same as upper envelope, use the arrow buttons to navigate between the lower envelope points.

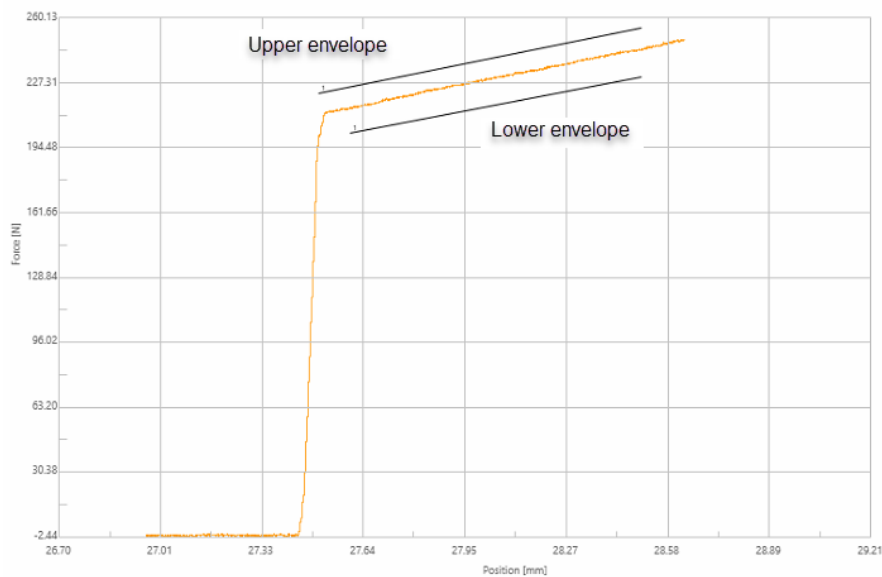
4.3.2 Example

The following example illustrates the configuration of an envelope based on a recorded reference curve.



Steps:

1. Envelope: Enabled
2. Record 1
3. Value 1
4. Set
 1. Active
 2. Absolute
5. Number of points: 2
6. Upper envelope
 1. Point 1 upper side: 220 N; 27.5 mm
 2. Point 2 upper side: 255 N; 28.5 mm
7. Lower envelope
 1. Point 1 lower side: 202 N; 27.6 mm
 2. Point 2 lower side: 230 N; 28.5 mm

Result:**Evaluation:**

For a successful evaluation, the recorded curve must stay within the tolerance band defined by the upper and lower envelope.

OK: The curve remains entirely within the envelope.

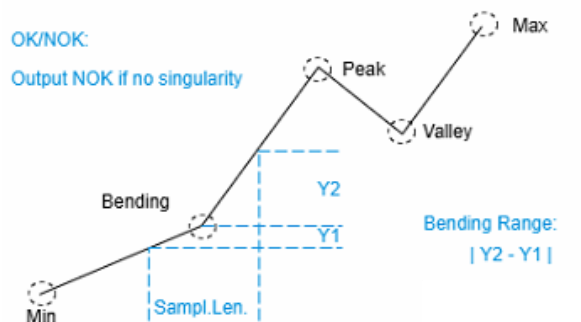
NOK: The curve exceeds the upper or lower envelope boundary.

4.4 Singularity

Singularity monitoring detects predefined characteristic points within a specified region of the recorded curve. Depending on the configuration, the detection result can be included in the overall process evaluation.

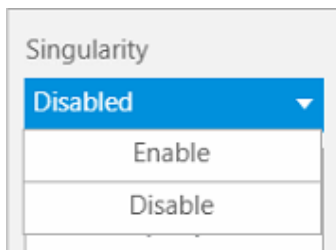
Supported singularity types:

- Minimum and maximum force
- Peaks and valleys
- Bending points

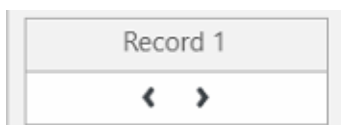


The **configuration panel** contains following elements:

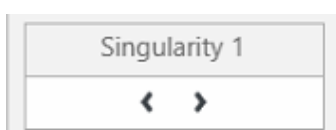
1. **Enable / Disable:** To enable and disable all singularity evaluation.



2. **Record:** Shows currently active curve. Switch between curves with arrows.



3. **Singularity:** Shows currently active singularity. Switch between singularities with arrows.



4. General configuration

☐ Active	☐ OK/NOK
☒ Absolute	☐ Relative

Contains following general configurations

1. **Active:** Activate or deactivate current singularity
2. **OK / NOK:**
 1. True: If the feature point is not detected or is out of range, judge NOK directly.
 2. False: If the feature point is not detected or is out of range, it does not affect the final judgement.
3. **Absolute / Relative:** Define how the detection windows will be configured in position axis. Same as in Windowing, Threshold and Envelope.

5. **Window range:** Define window range in terms of position/time and force.

Min. Position. Max	
0.00 mm	400.00 mm
Min. Force. Max	
0.00 N	500.00 N

6. **Singularity configuration:** Choose the type of singularity to be detected.

☐ MinForce	☐ MaxForce
Sample Len. 0.30 mm	
Sample Len. 0.30 mm	
☐ Peak	☐ Valley
☐ Bending	☒ ?

7. **Sample length:** Define sample length in mm.

Sampl.Len.	0.30 mm
------------	---------

8. **Slope limit:** Define min. and max. bending point threshold.

0.00 N	100.00 N
--------	----------