Application Note

FESTO

YJKP - Evaluation methods based on a reference curve

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

YJKP

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1 Components/Software used

Type/Name	Version Software/Firmware	Date of manufacture
Servo press kit YJKP	general	--
Application software YJKP (GSAY-A4-F0-Z4-1.3.5)	V1.3.5	--
Firmware controller (CECC-X)	V3.4.6	--
Firmware motor controller (CMMP-AS)	V4.0.1501.2.4	--

Table 1.1: Components/Software used

2 Application description

In this application note you will find a guide about using the evaluation methods in the servo-press kit system and setting them to evaluate the pressing process, backed up by practical examples.
It's all based on a recorded curve.

The following descriptions are parts of the application note:

- Record or load a reference curve
- Windowing
- Threshold
- Envelope

3 Record/load reference curve(s)

Many servo press applications require a high-precision methods to evaluate the performance of the pressing process.

The evaluation process is based on evaluating the curves of each press process by applying the following evaluation methods:

- Windowing
- Threshold
- Envelope

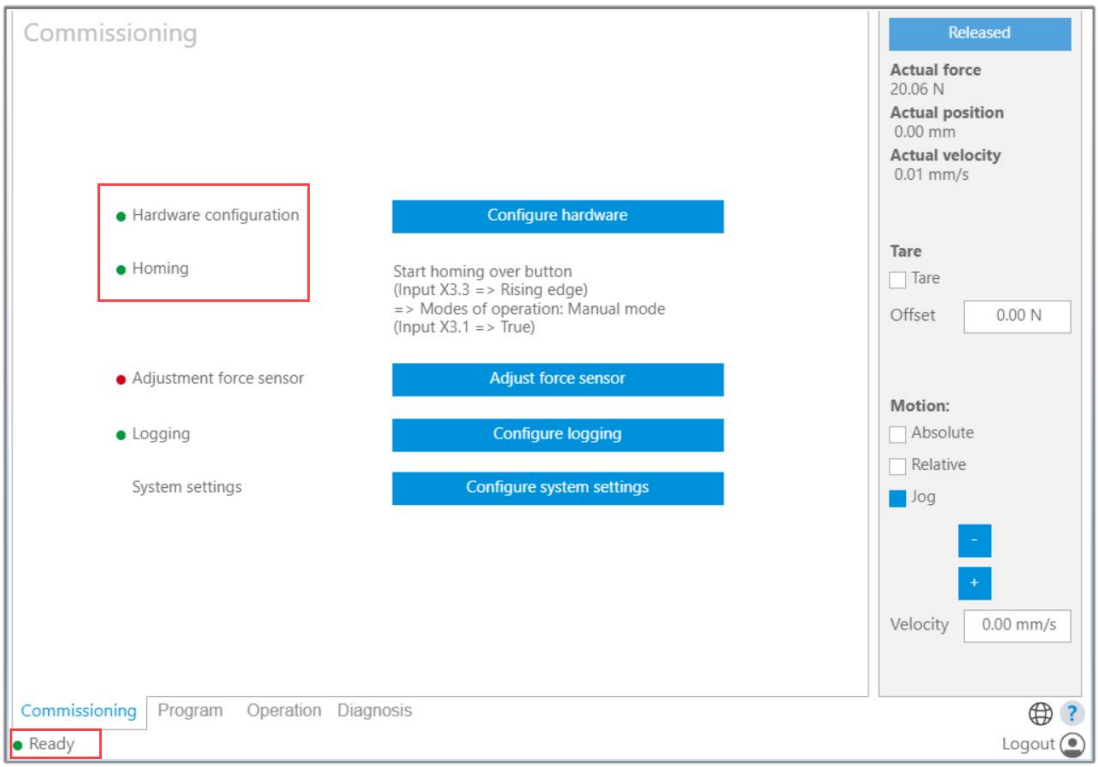
In the step **“record /loading reference curve(s)”** , a sample curve is recorded or loaded in order to configure the evaluation methods.

We can define two ways to get a reference curve.

3.1 Record reference curve(s)

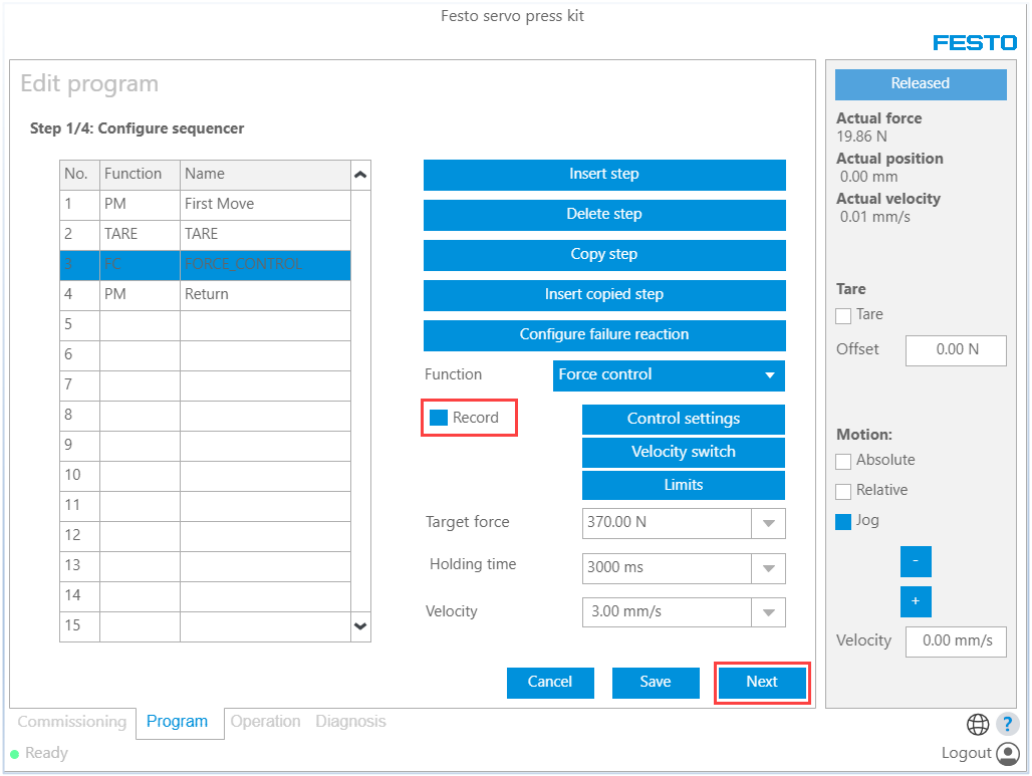
When creating a new press program, reference curves are recorded according to the following steps and in order:

1. Make sure that the system is ready for movement by setting the hardware configuration and Homing the system.
   (further information about system configuration and homing , please read application note Servo Press Kit YJKP- Hardware configuration , application note Servo Press Kit YJKP- Homing).

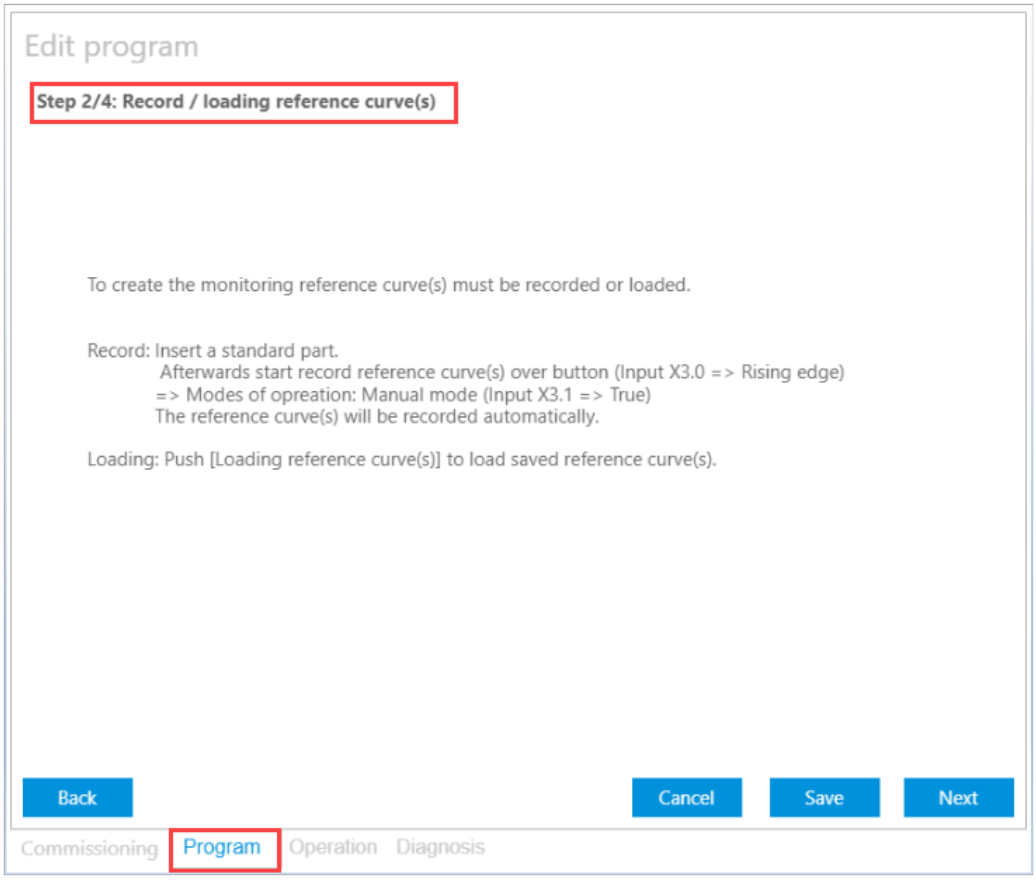


2. Create your sequencer program and activate the record option in the functions ,which should be evaluated, then click on next to navigate to this step.

As you see in the following screen:

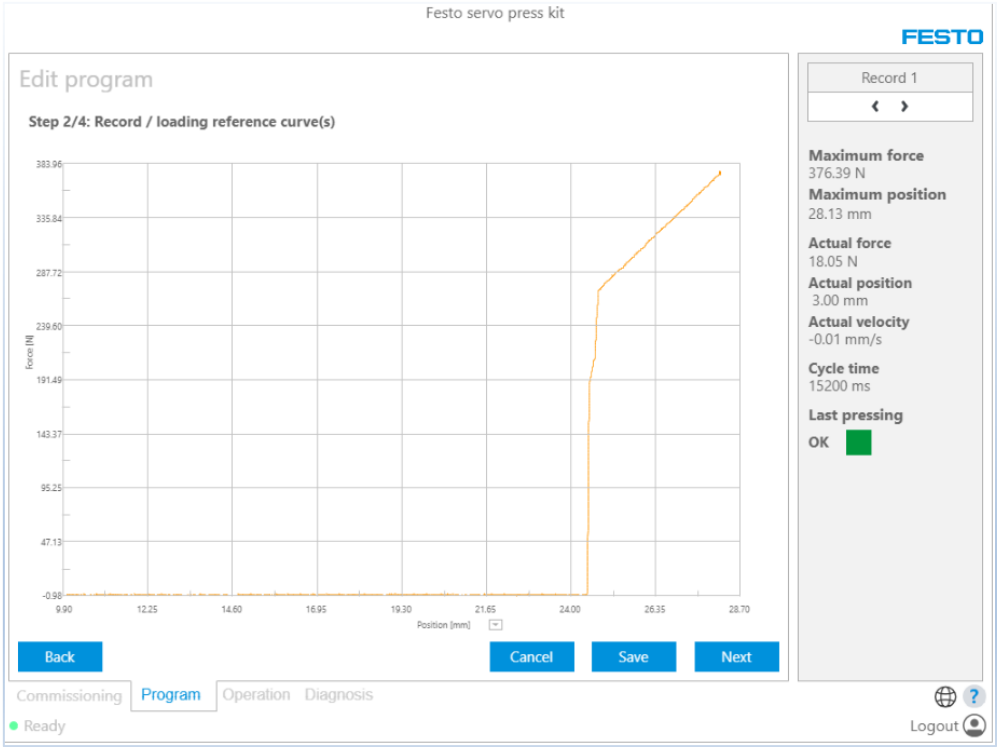


The record/loading reference curve (s) screen:

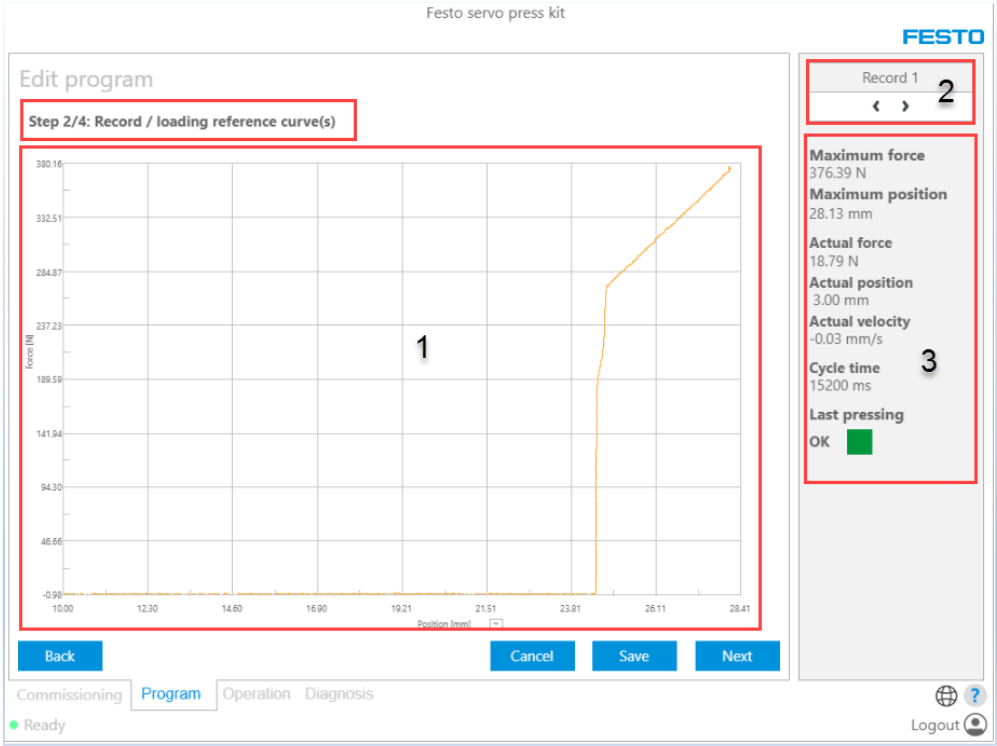


3. Prepare the YJKP system with a sample to be pressed. It will be used as reference for all other press operations for this program.
4. Activate the manual mode (Input X3.1 high, input X3.2 low (automatic mode)).
5. Start process (rising edge on the input X3.0).

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



This screen consists of the following parts :



1. The reference curves.
2. Navigate between the recorded curves.
3. This part contains some information about the press process that was performed on the sample.

Note

The status of the press process is displayed in this field. As shown in the example , the last process status was ok (successful).
If there is an error during the press process or incorrect values are set in the sequencer program ,the status will be NOK and no curve will be displayed.

Note

If you use a host controller to control the press process, the following function blocks are required:

I. FB_Connect

Required inputs:

- xEnable := true;
- enTargetComMode := 1;

Required outputs:

- xActive := true;
- enActualComMode := 1;
- xConnected := true;

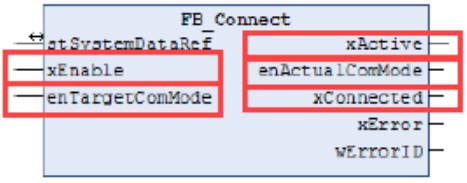


Figure 3-7: FB_Connect

II. FB_PressControl

Required inputs:

- xEnable := true;
- xEnableSystem := True;
- xStartRecordReferenceCurve :=True;
- xAbort :=True;

Required outputs:

- xActive := true;
- xSystemEnabled := True;
- xSystemIsHomed :=True;
- xInoperation:= False;
- xSystemError:=False;
- xError:=0;

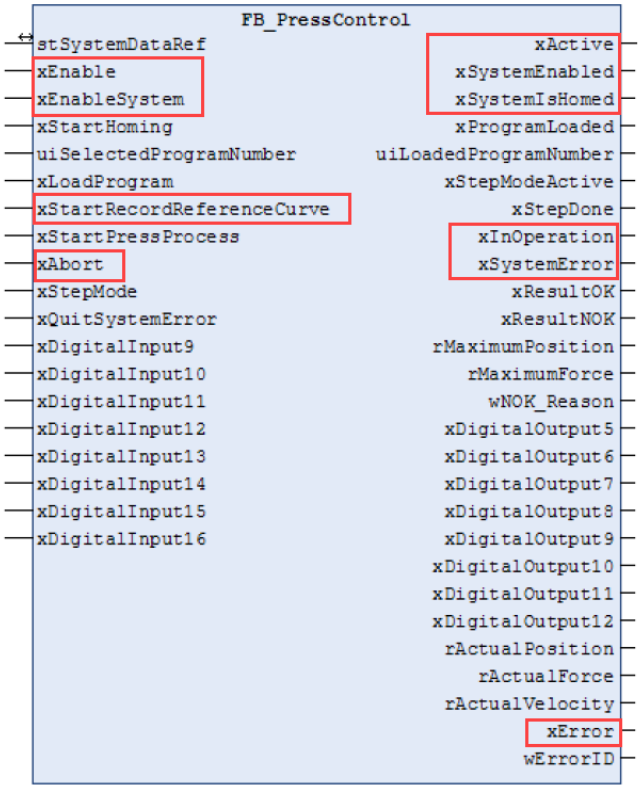
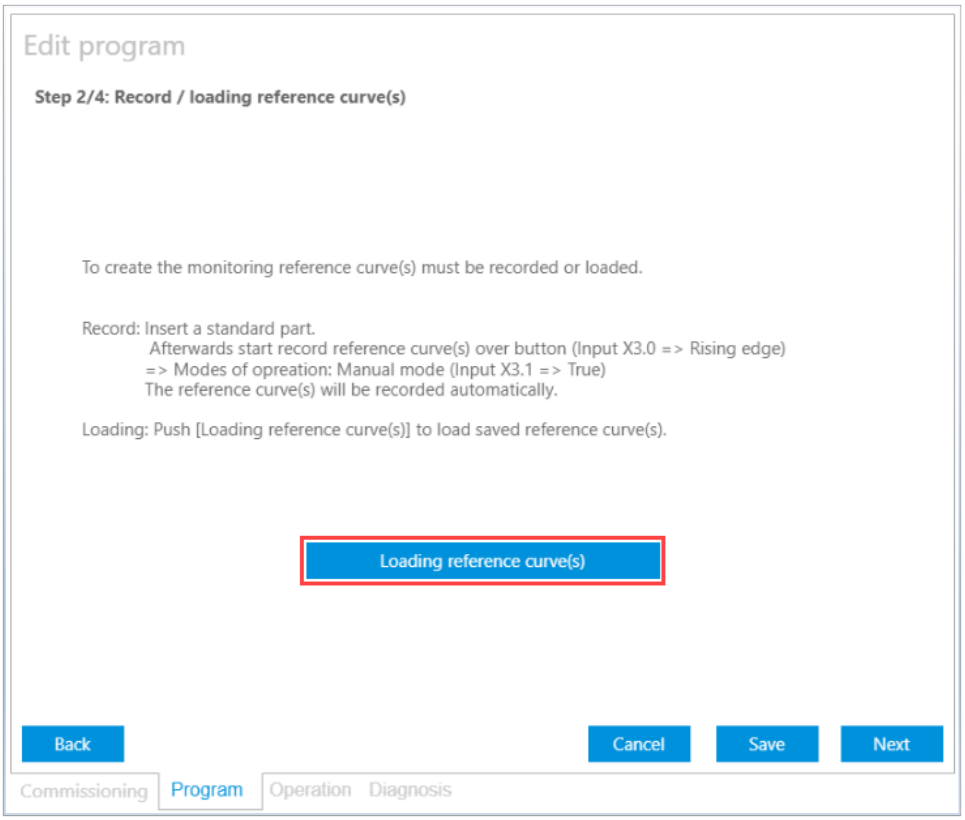


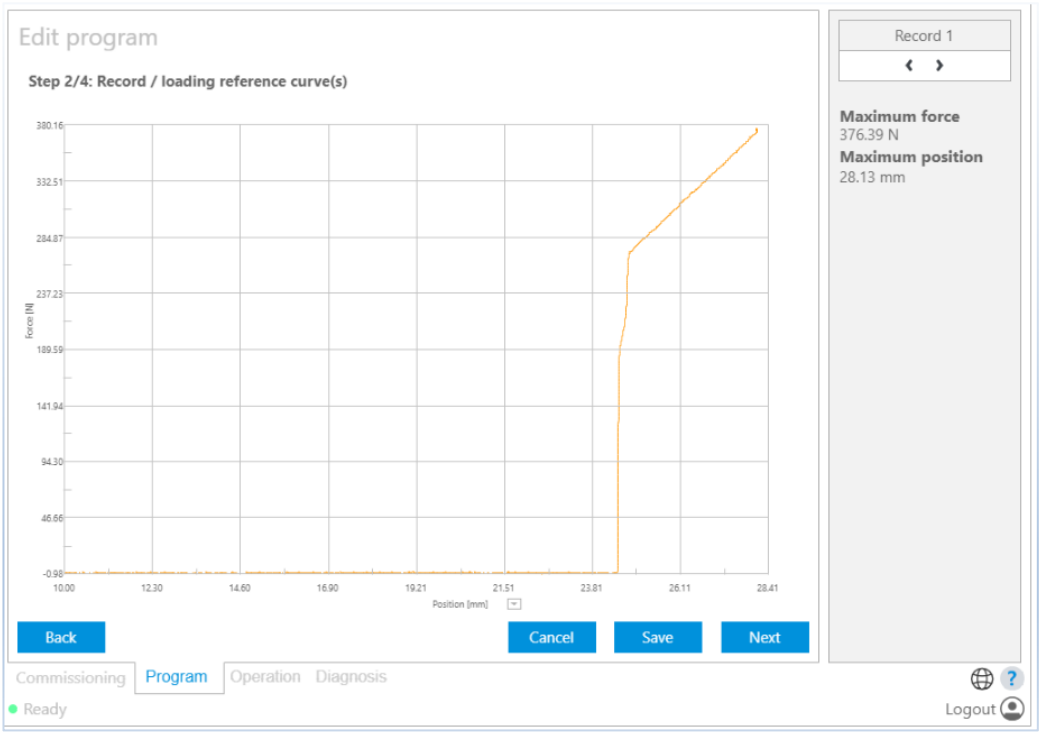
Figure 3-10: FB_PressControl

3.2 Load reference curve(s)

If you use a program, which has already recorded curves, a new button will appear to load these curves.



By clicking on Loading reference curve(s) ,the previous references curves will appear



When you finish recording/ loading the reference curves , click on Next to navigate to the next step (configure monitoring).
(Further information about monitoring tools ,please read AppNote Servo Press Kit YJKP – Configure monitoring).

4 Configure monitoring

A lot of servo-press applications need to be monitored. The YJKP system can monitor each with the recorded graphs of selected steps.

The monitoring process is done by one or more of the following:

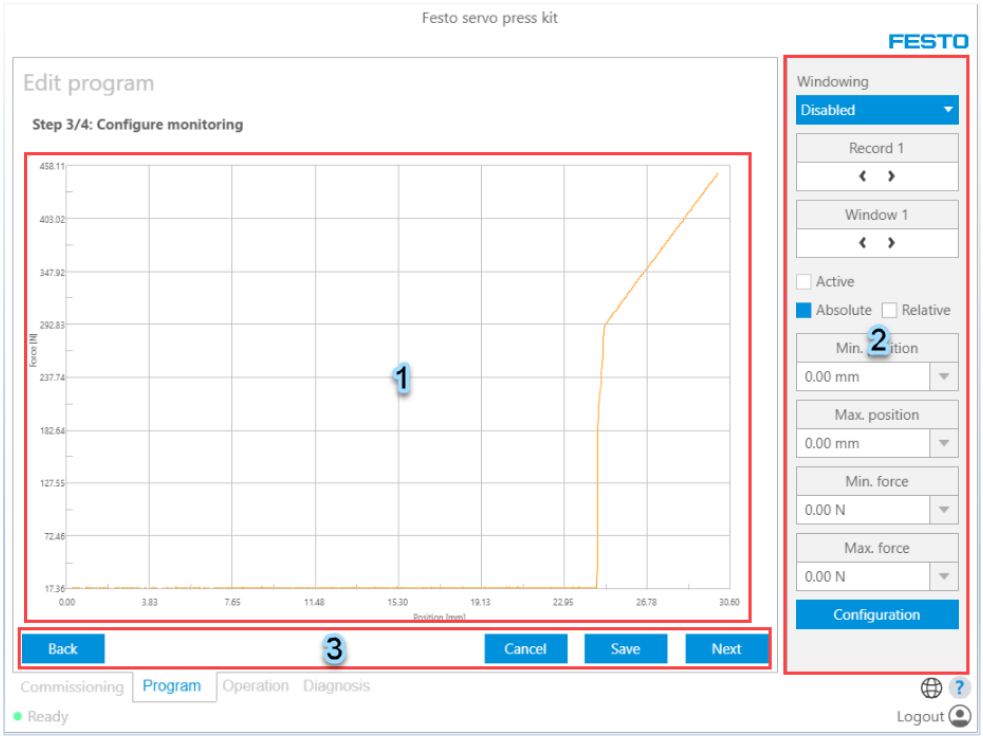
- Windowing
- Threshold
- Envelope

Note

When using the evaluation methods , please pay attention to these points:

- The evaluation methods work only on the recorded curves, which are already determined when configuring the sequencer program.
- These methods evaluate the press process after the operation is completed and not during operation.

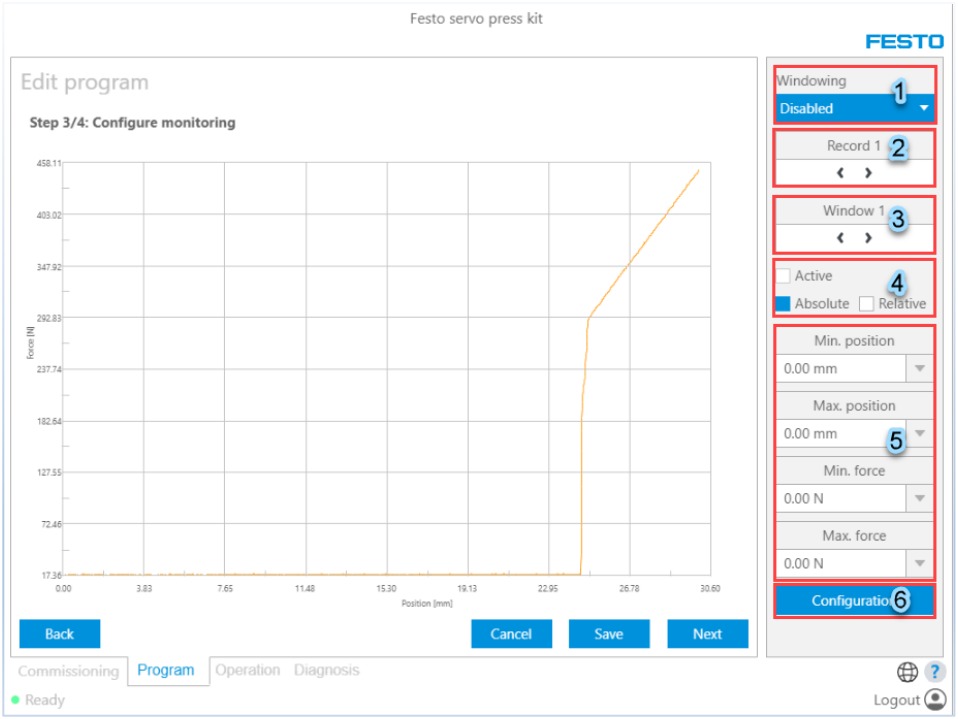
The configure monitoring screen consists of the following parts :



1. A screen to display the force/position or force/time curve, that had been recorded/loaded in the step 2/4 (Record/loading reference)
2. Setting panel for the evaluation method .
3. Buttons to navigate between the methods (windowing / threshold / envelope) and save/cancel the setting.

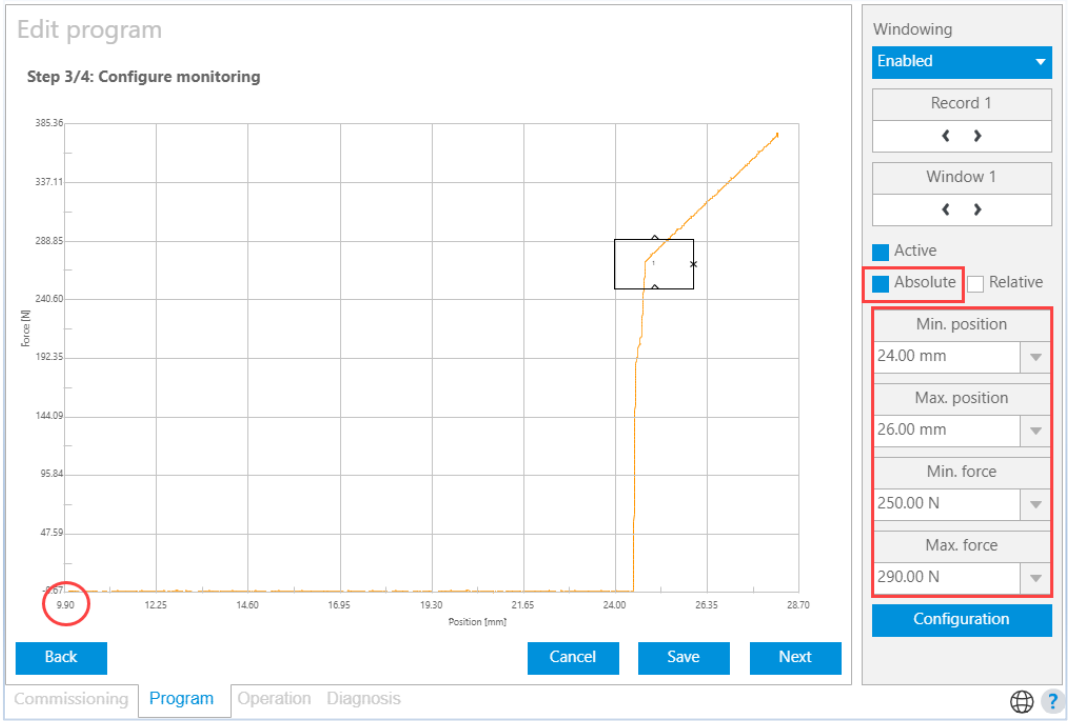
4.1 Windowing

It is an evaluation method that depends on adding windows on the curve that had been recorded.
The control panel of this method consists of the following parts :



1. Activate/deactivate the windowing method for all curves .
2. Choose the curve that you want to apply the windowing on .
3. You can set up 5 different windows for each curve. With this panel you can switch between them.
4. This part consists of :
    - *Activate :* to activate/deactivate the current window (window 1)
    - *Absolute :* to locate the window in (mm) according to the position of the drive.

    e.g. in a YJKP system, if you have finished recording a curve, check an absolute option and set the location values of the window as shown.



The window will be located on the curve, based on the homing position of the cylinder.

- *Relative:* to locate the window in (mm) according to the beginning of the recorded curve.

  e.g. In the previous example, check the relative option without changing the location values of the window.

  The window will be located on the curve, considering that the start position is the beginning of the curve (9.90 mm).

  The new window's location will be :

  - Min Position of the window = 24 mm (Min.position)+ 9.90 = 33,9 mm
  - Max Position of the window =26 mm(Max.position)+ 9.90 = 35,9 mm
  - Min Force of the window = 250 N (Min.force)
  - Max Force of the window = 290 N (Max.force)

Note

The position method is chosen depending on the application . That's mean:

- If the application ensures that the starting positions of the curves are always the same ,you can use the absolute method.
- If the starting positions of the curves could change at each process , the relative method should be used to let the windows follow the curves.

e.g. A servo press program consists of 3 function :

1. Digital signal mode
2. Force control
3. Position mode

The curve of the force control function is recorded to be evaluated by using the windowing method. In this case, the relative method should be used.

The reason for this is that by using the digital signal mode , it is difficult to predict exactly when the system will start to execute the force control function.

Note

Further information about the sequencer functions , please read application note Servo Press Kit YJKP- Configure sequencer.

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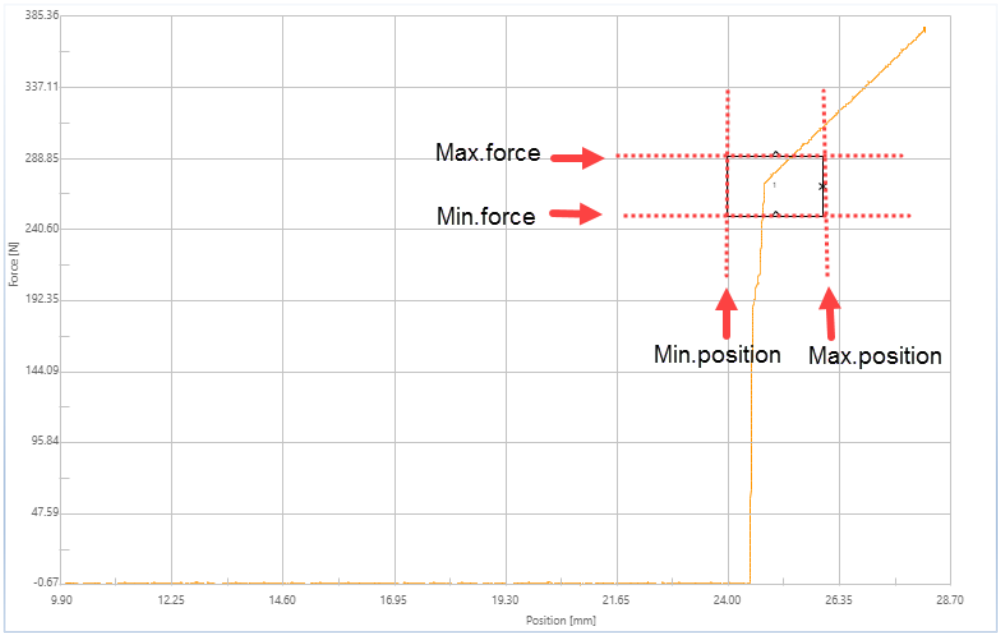
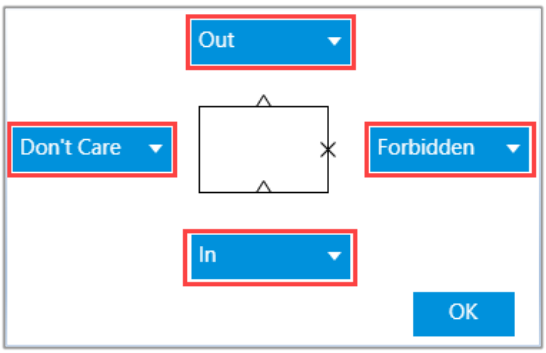
5. Set the borders of the window that you want to apply on the curve :
   - *Min.position :* The window minimum limit on the position axis .
   - *Max.position :* The window maximum limit on the position axis .
   - *Min.force :* the window minimum limit on the force axis .
   - *Max.force :* the window maximum limit on the force axis .



6. Configuration : configure each boarder of a window. By clicking on this button the following window will be displayed :

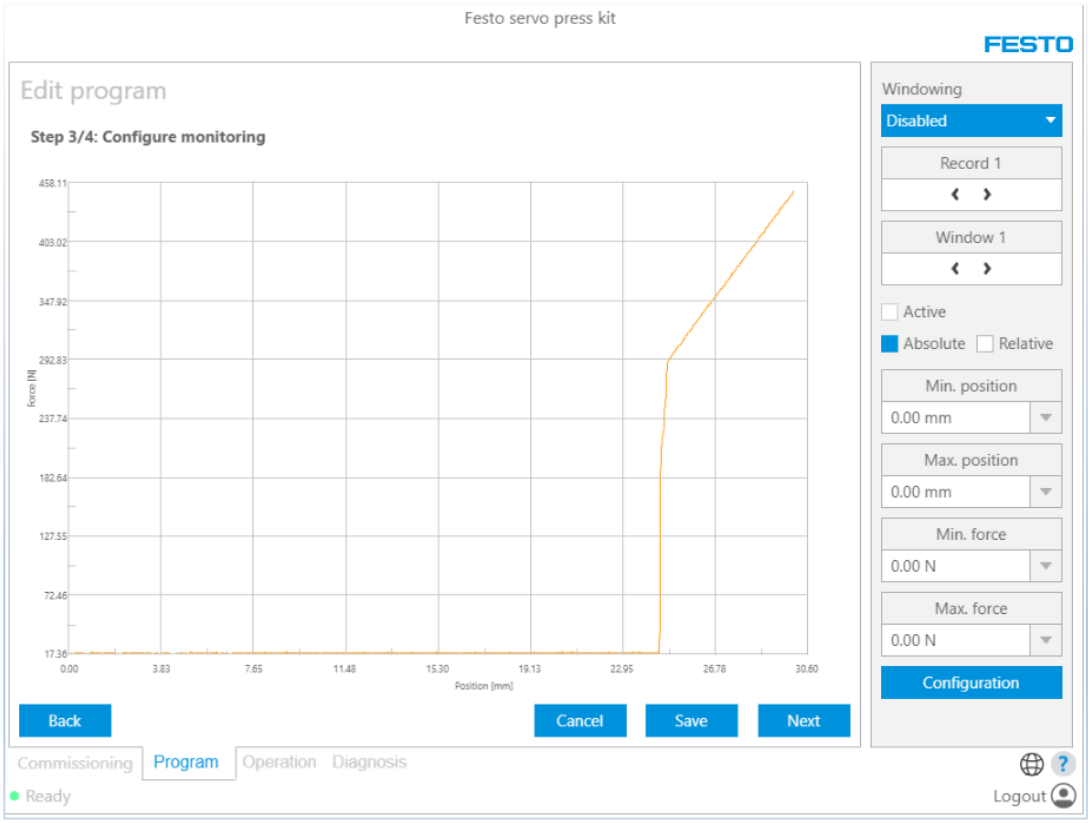


In the center you can see the window that will be applied on the curve. On each side of it you can see the condition that needs to be achieved .

- In : If you set one of the window sides with In , the system will anticipate that the curve will enter the window from this side , and in case it did not the process will be evaluated as NOK.
- Out : To set one of the window sides as an exit for the curve , and in case it did not ,the process will be aborted the process will be evaluated as NOK.
- Forbidden : The curve is not allowed to touch this side of the window. If the force curve exceeds this side the process will be evaluated as NOK..
- Don't care : This side isn't evaluated.

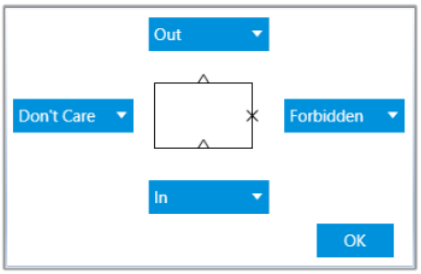
Example:

Let's suppose the recorded curve was as follows and we want to add a window to evaluate the process :

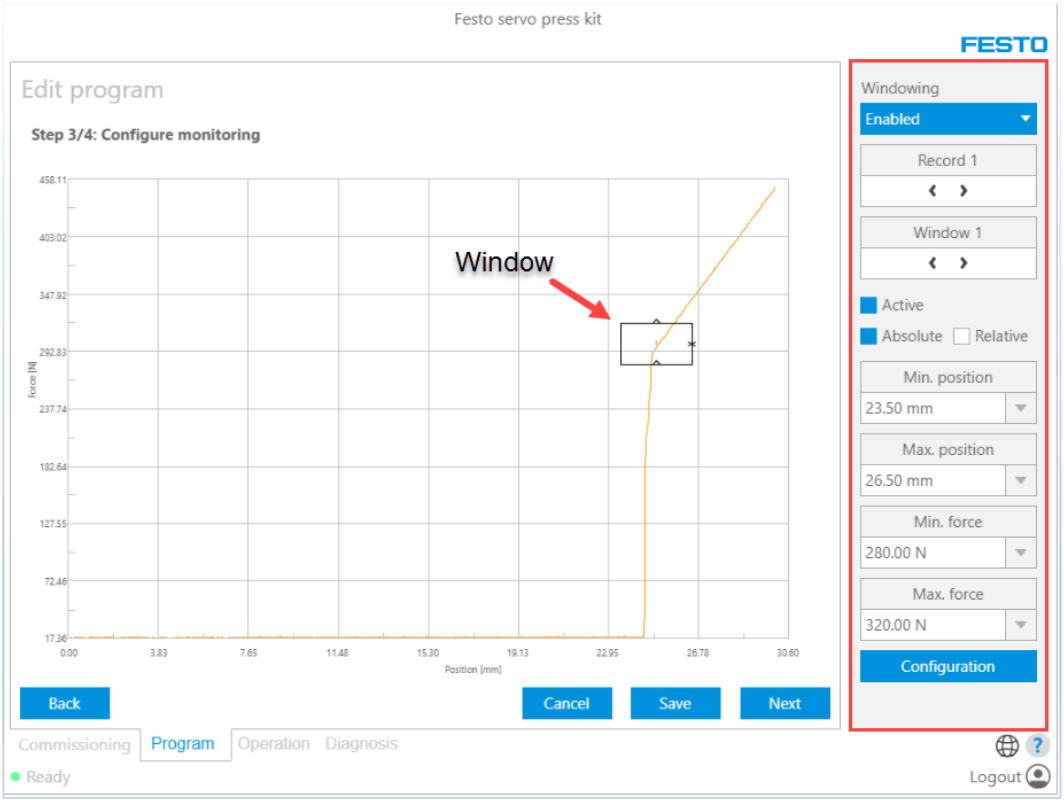


Set the window:

1. Windowing : Enabled
2. Record 1
3. Window 1
4. Check the following :
   - Active
   - absolute
5. Set these values:
   - Min.position = 23.50 mm
   - Max. position = 26.50 mm
   - Min.Force= 280 N
   - Max. Force = 320 N
6. Configuration :



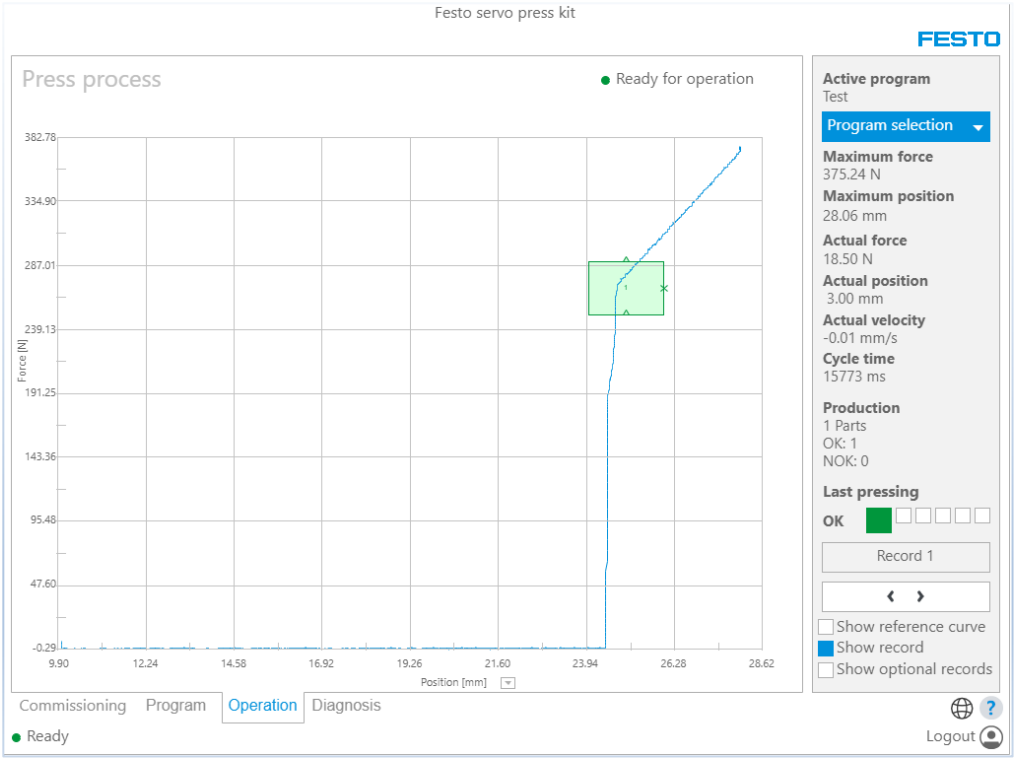
When you finish setting the values , the following window will appear on the curve :



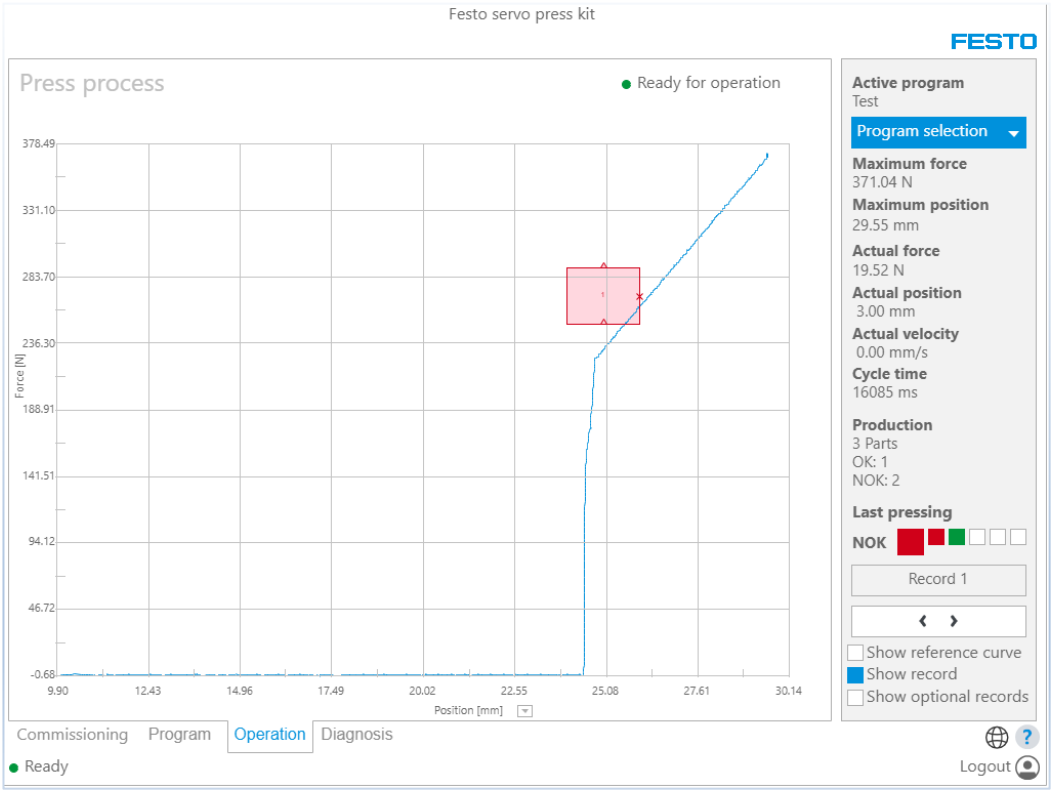
When executing:

- The force/position curve should enter from the bottom side of the window and exit from the top.
- It shouldn't touch the right side of the window.
- The left side has no influence.

- If the all previous conditions are fulfilled , the process will be evaluated as **OK**.



- If any of these conditions are surpassed, thy process will be evaluated as **NOK.**

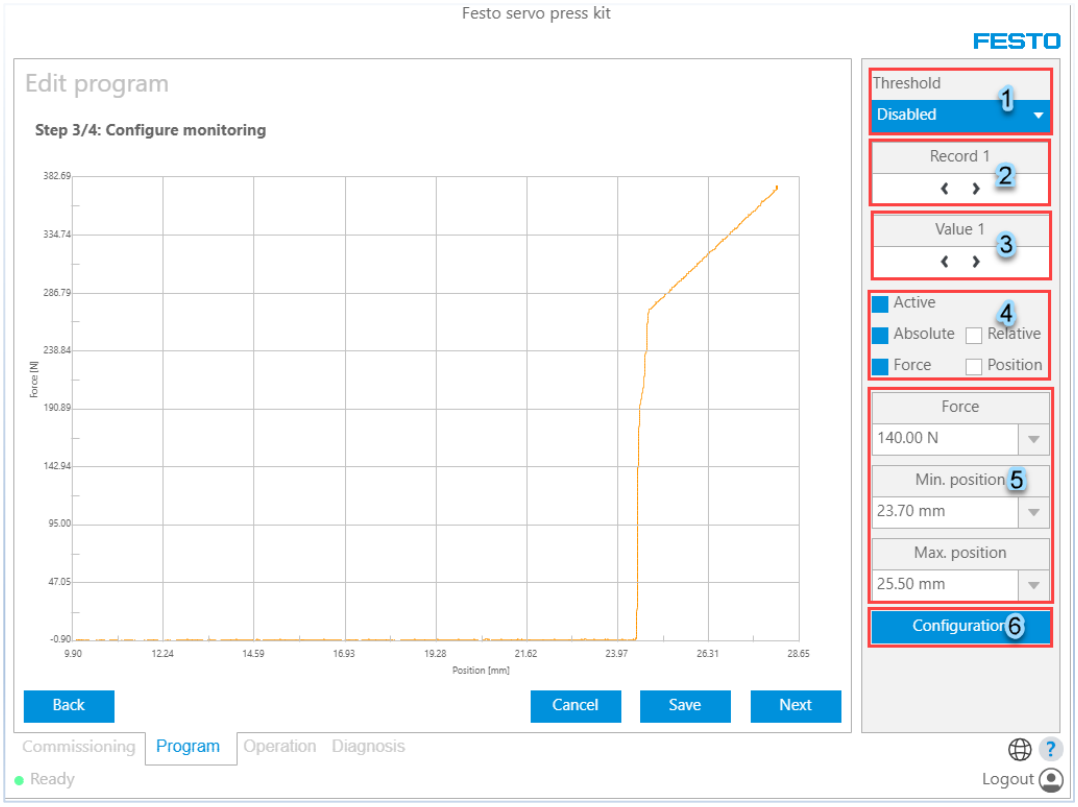


The curve exited from the right side (forbidden).

4.2 Threshold

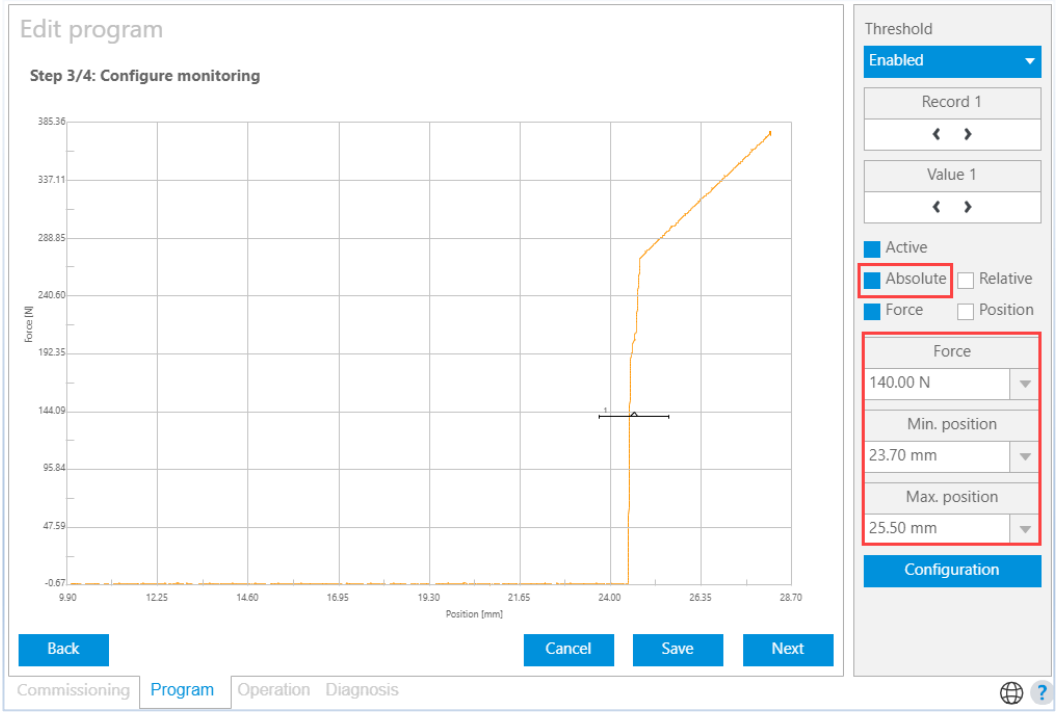
It is a an evaluation method that depends on adding a threshold on the curve that had been recorded.

If you still in windowing screen, please click on next to navigate to threshold screen. The control panel of this method consists of the following parts:



- Activate/deactivate the threshold method for all curves .
- Choose the curve that you want to apply the threshold on .
- You can set up 5 different thresholds for each curve. With this panel you can switch between them.
- This section contains :
  - Activate : to activate/deactivate the current threshold (threshold 1)
  - Absolute : to locate the position of the threshold in (mm) according to the position of the drive .

    e.g. in a YJKP system if you have finished recording a curve , check an absolute option , and set the position values as shown

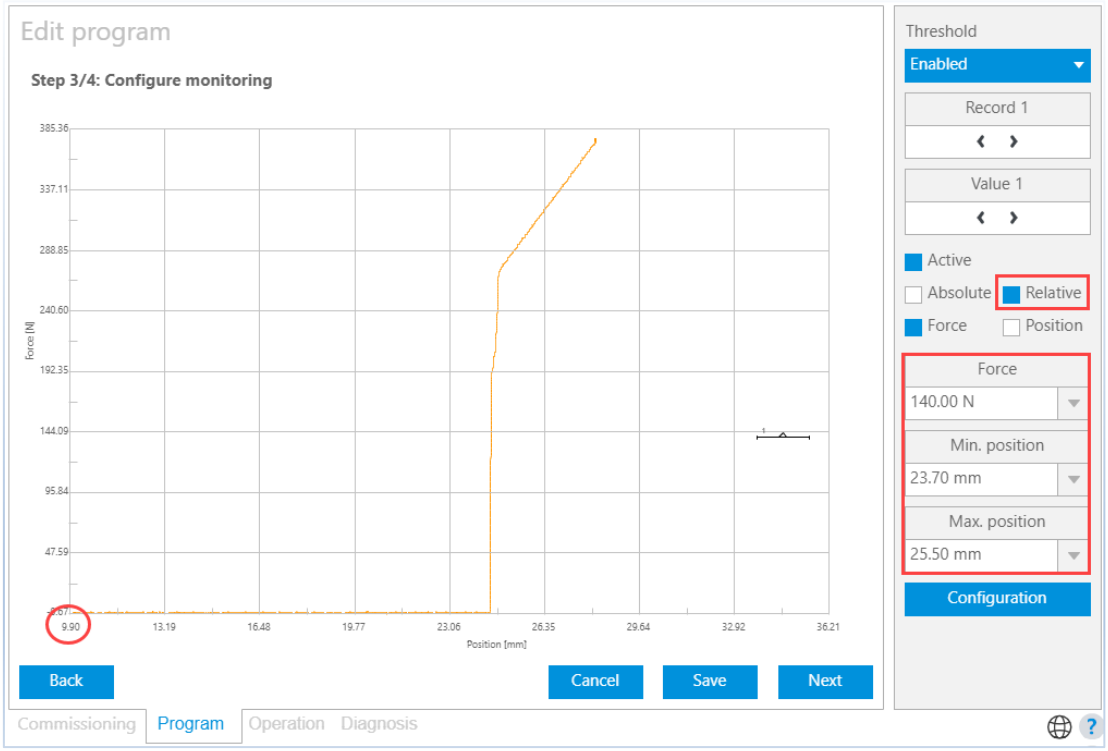


The threshold will be located on the curve, based on the homing position of the cylinder.

- Relative : To locate the position of the threshold in (mm) according to the beginning of the recorded curve.

  e.g. In the previous example, check the relative option without changing the location values of the threshold.
  The threshold will be located on the curve, considering that the start position is the beginning of the curve (9.90 mm).

  The new threshold position will be :
  - Min Position of the threshold = 23.70 mm (Min.position)+ 9.90 = 33,6 mm
  - Max Position of the threshold=25.50 mm(Max.position)+ 9.90 = 35,4 mm



Note

The position method is chosen depending on the application . That's mean:

- If the application ensures that the starting positions of the curves are always the same ,you can use the absolute method.
- If the starting positions of the curves could change at each process , the relative method should be used, to let the thresholds follow the curves.

e.g. A servo press program consists of 3 function :

4. Digital signal mode
5. Force control
6. Position mode

The curve of the force control function is recorded to be evaluated by using the threshold method. In this case, the relative method should be used.

The reason for this is that by using the digital signal mode , it is difficult to predict exactly when the system will start to execute the force control function.

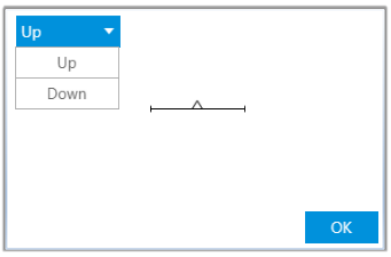
Note

Further information about the sequencer functions , please read application note Servo Press Kit YJKP- Configure sequencer.

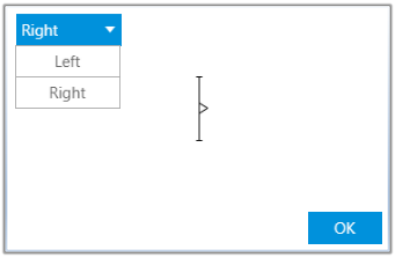
- Force : to set a force value and use it as a threshold for the curve to pass through .
- Position : to set a position value and use it as a threshold for the curve to pass through .

- Set the threshold value and domain :
  - If you choose "position" in section 4 , the following options will be displayed :
    - Position : the position value that will be used as a threshold for the passing of the curve
    - Min.Force : the minimum threshold value on the force axis .
    - Max.Force : the maximum threshold value on the force axis .
  - If you choose "force" in section 4 , the following options will be displayed :
    - Force : the force value that will be used as a threshold for the passing of the curve .
    - Min.Position: the minimum threshold value on the position axis .
    - Max.Position: the maximum threshold value on the position axis.

6. Configuration : choose the passing direction of the force/position curve through the threshold.
   By clicking on this button one of these windows will be displayed :
   - In case you are using a force value as a threshold, the following figure will be displayed with the determining :
     - UP : If the curves is passing from the bottom to the top .
     - Down : If the curve is passing from the top to the bottom .

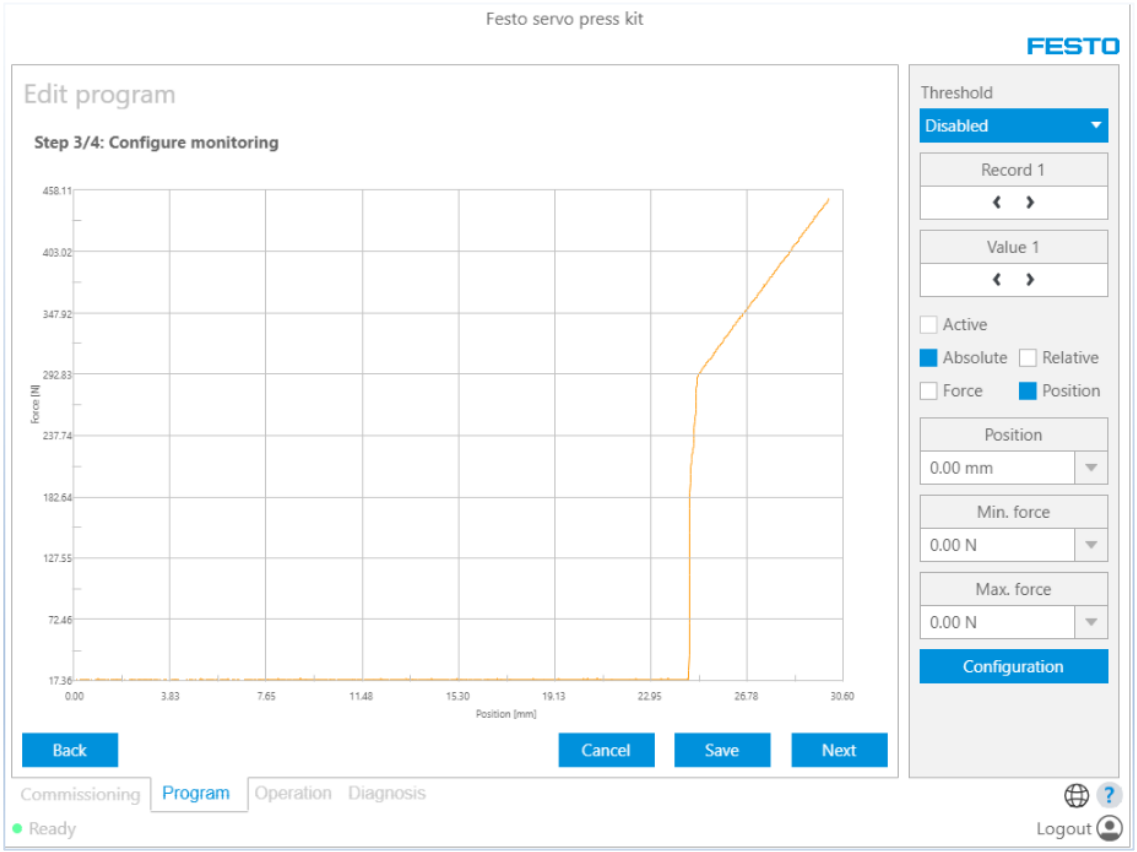


   - In case you are using position value as a threshold , the following figure will be displayed with determining :
     - Left : If the curve is passing from the left to the right .
     - Right : If the curve is passing from the right to the left .



Example:

Let's suppose the recorded curve was as follows and we want to add two thresholds on it (force threshold & position threshold).

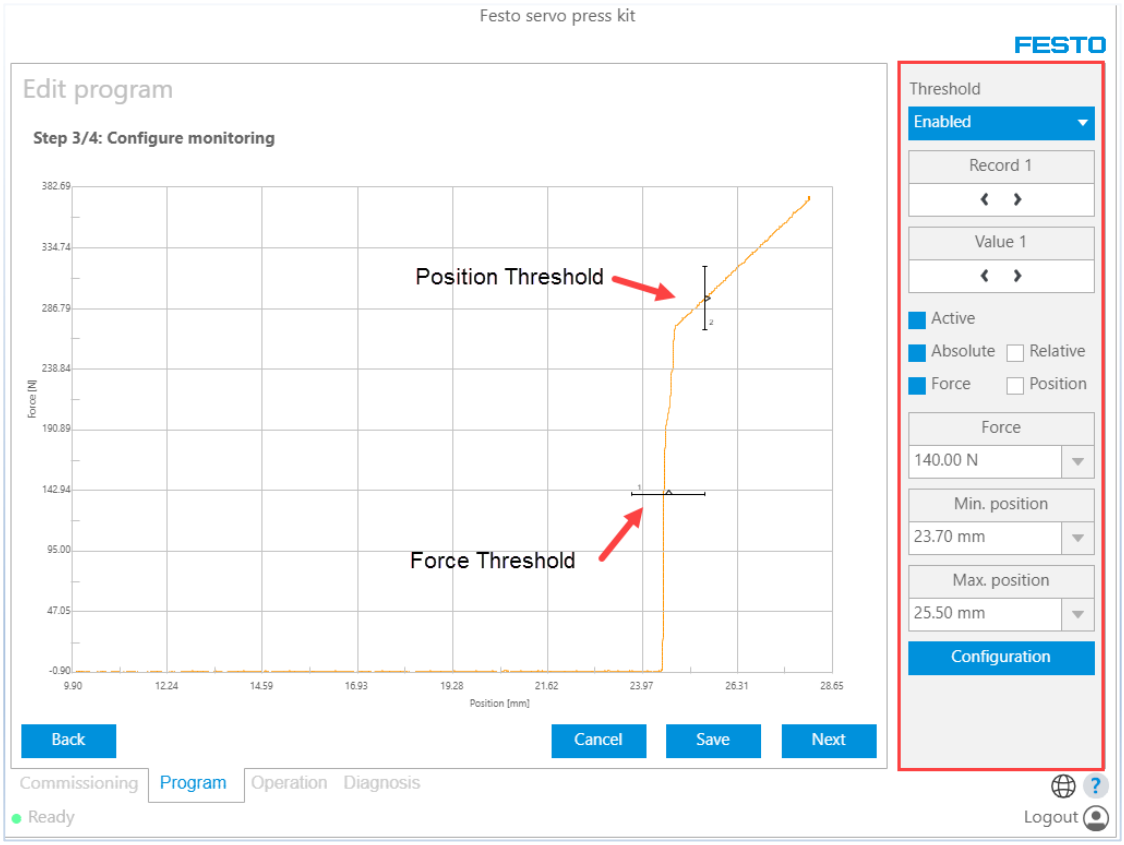


Set the thresholds values :

- For the first threshold (force threshold) :
  1. Threshold: Enabled
  2. Record 1
  3. Value 1
  4. Check the following :
     - Active
     - Absolute
     - Force
  5. Set these values:
     - Force:1 40 N
     - Min.position: 23.70 mm
     - Max.position: 25.50 mm
  6. Configuration: Up

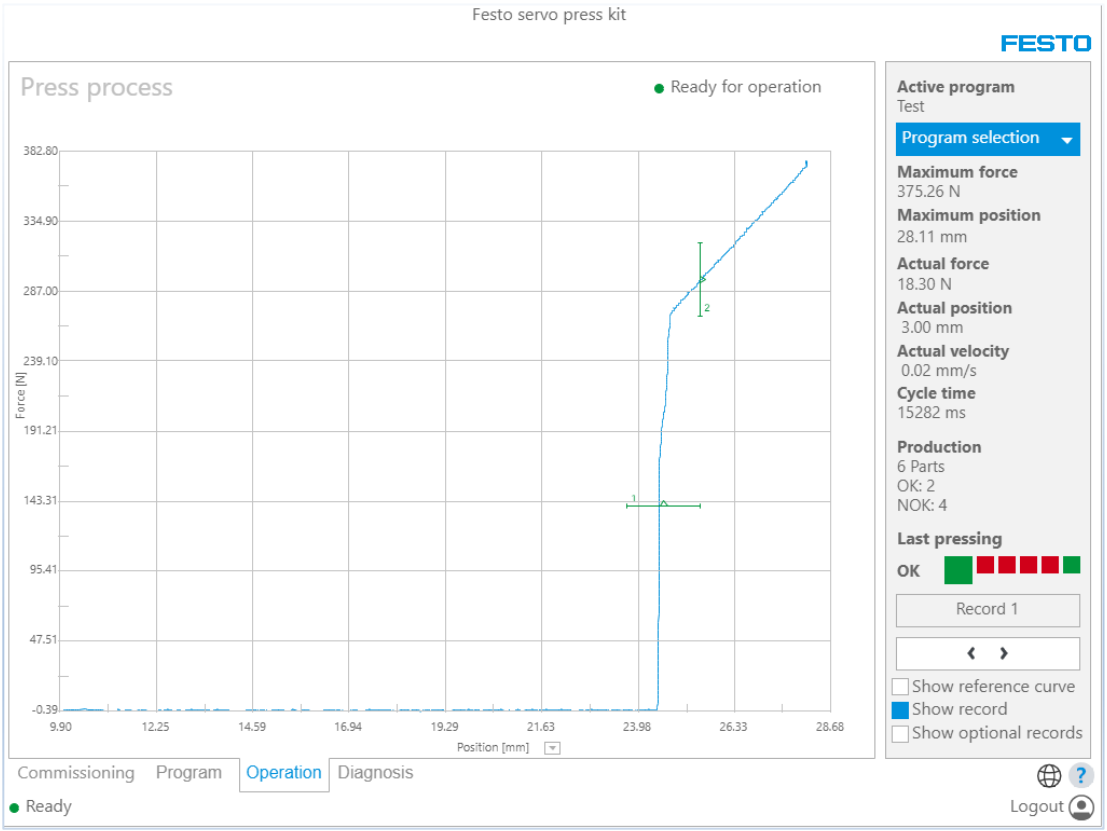
- For the second threshold (position threshold)
  1. Threshold: Enabled
  2. Record 1
  3. Value 2
  4. Check the following :
     - Active
     - Absolute
     - Position
  5. Set these values :
     - Position:25.50 mm
     - Min.force:370 N
     - Max.force:320 N
  6. Configuration: Right

When you finish setting the previous values , the following two thresholds will be displayed :

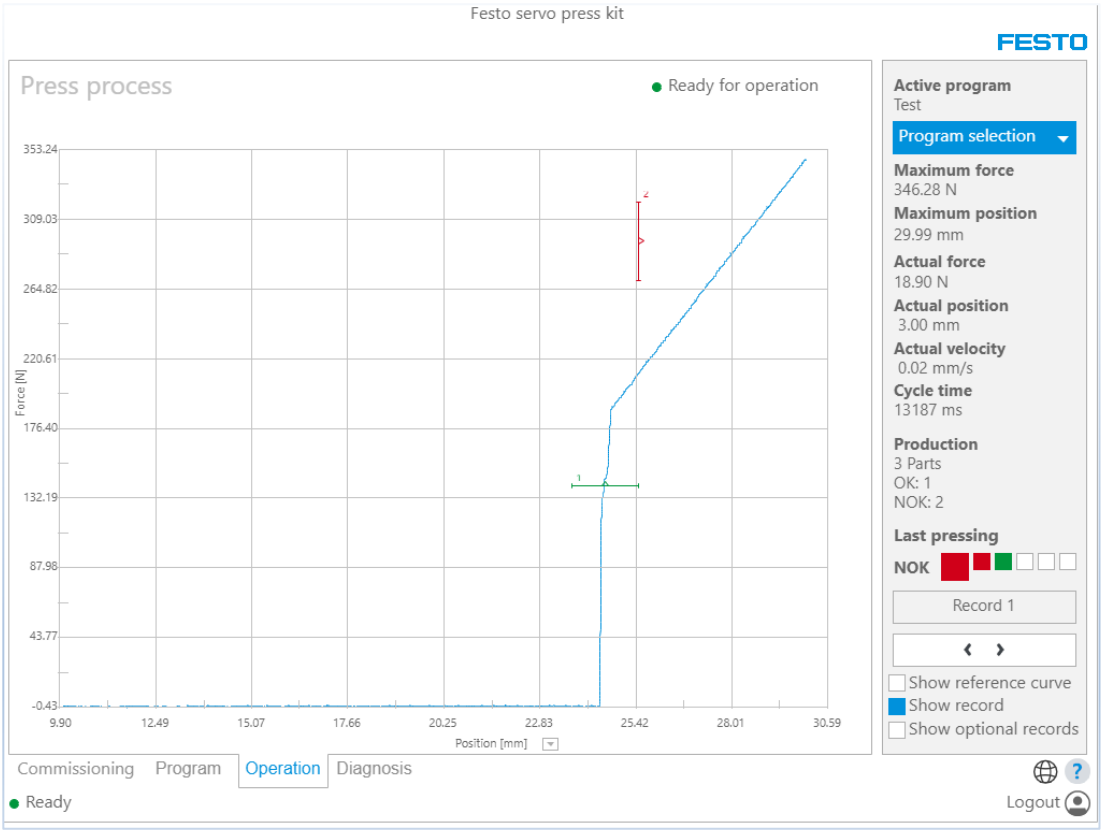


When executing:

- The force/position curve must firstly go through the first threshold (force threshold) ,then through the second threshold (position threshold).
- If the all previous conditions are fulfilled , the process will be evaluated as **OK**.



- If any of these conditions are surpassed, thy process will be evaluated as **NOK.**



The curve didn't pass through the second threshold (position threshold).

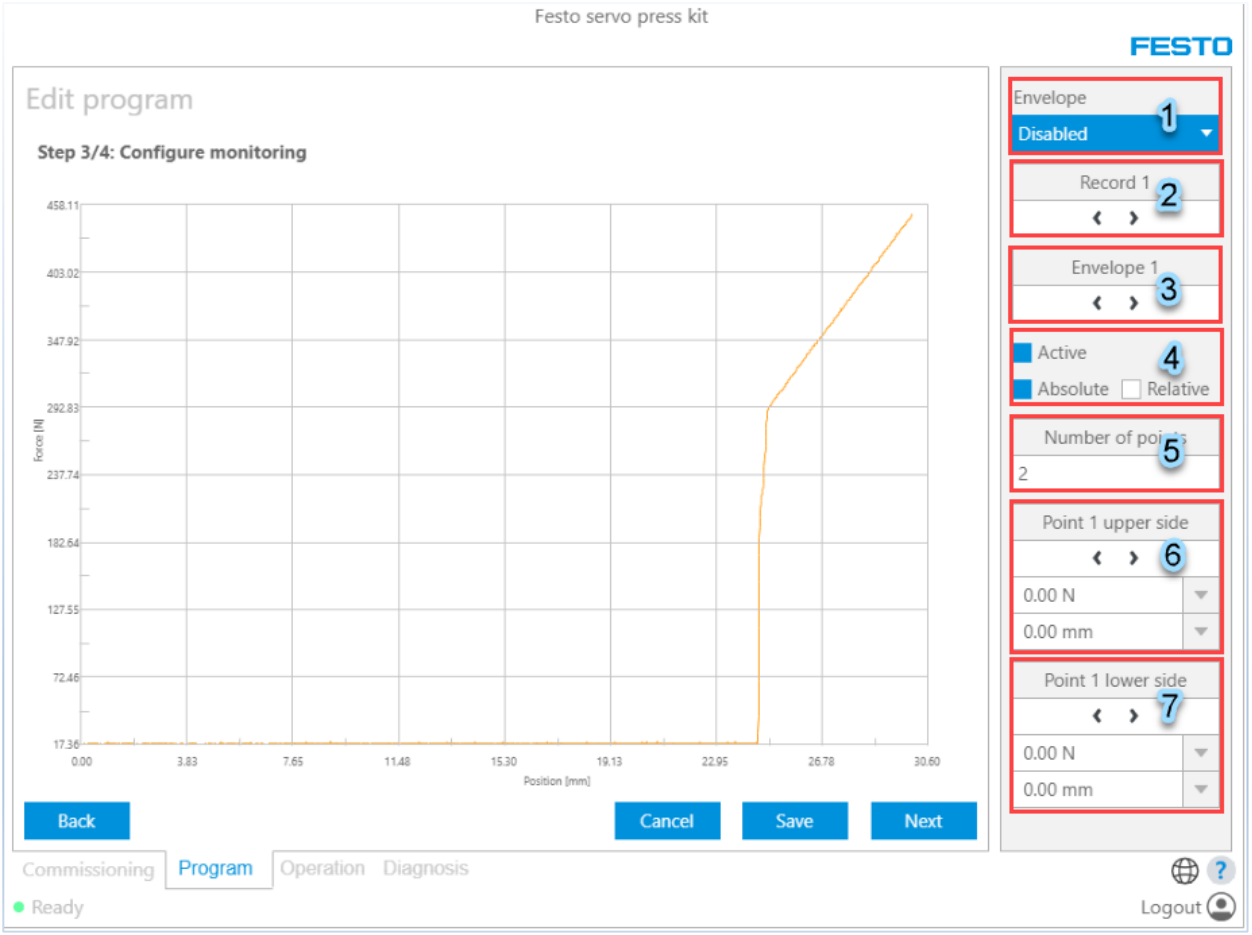
4.3 Envelope

It is a an evaluation method depends on adding envelops on the curve that had been recorded.

An Envelope consists of two groups of values. The first group will be represented by arrows called „upper side“ , the second one is represented by arrows called „lower side“ .

A recorded curve must pass between these two groups , to evaluate the process as Ok.

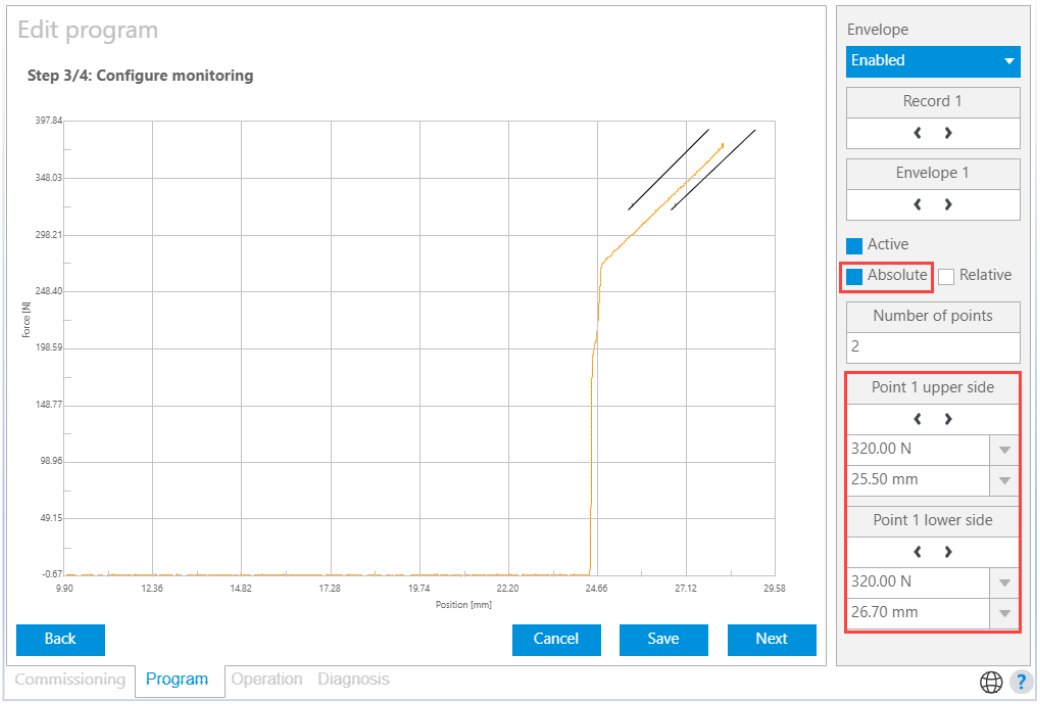
If you still in the threshold screen , please click on next to navigate to the envelope screen. The control panel of this method consists of the following parts:



1. Activate/deactivate the envelope method for all curves .
2. Choose the curve that the envelope will be applied on .
3. You can set up 5 different envelops for each curve. With this panel you can switch between them.
4. This section contains :
   - Activate : to activate/deactivate the current envelope (envelope 1).
   - Absolute : to locate the position of the envelope in (mm) according to the position of the drive .

     e.g. in a YJKP system if you have finished recording a curve , check an absolute option , and set the position values as follows:

     1. Point 1 upper side : 320 N
        25,50 mm
        Point 2 upper side : 393 N
        27,7 mm
     2. Point 1 lower side : 320 N
        26,70 mm
        Point 2 lower side : 395 N
        28,5 mm



The threshold will be located on the curve, based on the homing position of the cylinder.

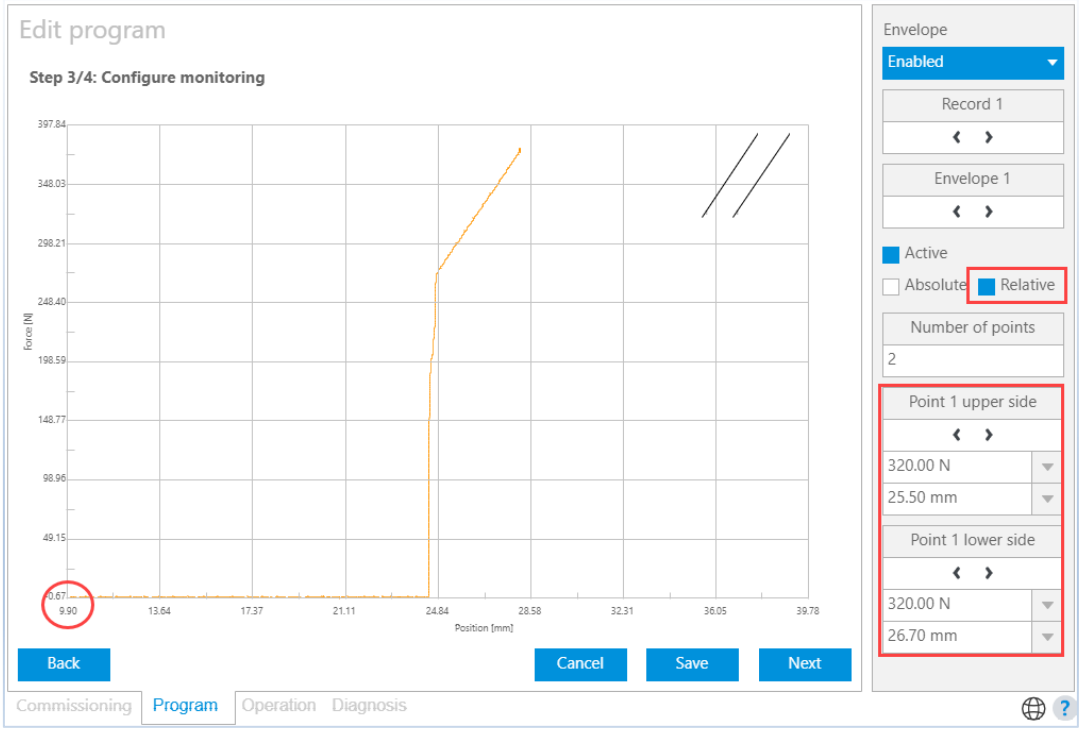
- Relative : To locate the position of the envelope in (mm) according to the beginning of the recorded curve.

In the previous example ,check the relative option without changing the location values of the envelope.

The envelope will be located on the curve, considering that the start position is the beginning of the curve (9.90 mm).

The new envelope's position will be :

1. Point 1 upper side : 320 N
   25,50 mm (Min.position)+ 9.90 = 35,4 mm
   Point 2 upper side : 393 N
   27,7 mm (Min.position)+ 9.90 = 37,6 mm
2. Point 1 lower side : 320 N
   26,70 mm (Min.position)+ 9.90 = 36,6 mm
   Point 2 lower side : 395 N
   28,5 mm (Min.position)+ 9.90 = 38,4 mm



Note

The position method is chosen depending on the application . That's mean:

- If the application ensures that the starting positions of the curves are always the same ,you can use the absolute method.
- If the starting positions of the curves could change at each process , the relative method should be used, to let the envelopes follow the curves.

e.g. A servo press program consists of 3 function :

7. Digital signal mode
8. Force control
9. Position mode

The curve of the force control function is recorded to be evaluated by using the envelope method. In this case, the relative method should be used.

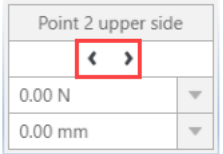
The reason for this is that by using the digital signal mode , it is difficult to predict exactly when the system will start to execute the force control function.

Note

Further information about the sequencer functions , please read application note Servo Press Kit YJKP- Configure sequencer.

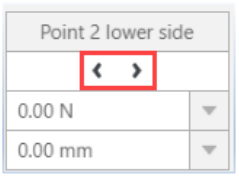
5. Number of points : Set the number of points ,that form the upper and lower side .
6. Set the upper side values for each point :
   - In the first field, set the force value in (N) .
   - In the second field, set the position value in (mm)

To navigate between the points that form the upper side, please click on the arrow as shown:



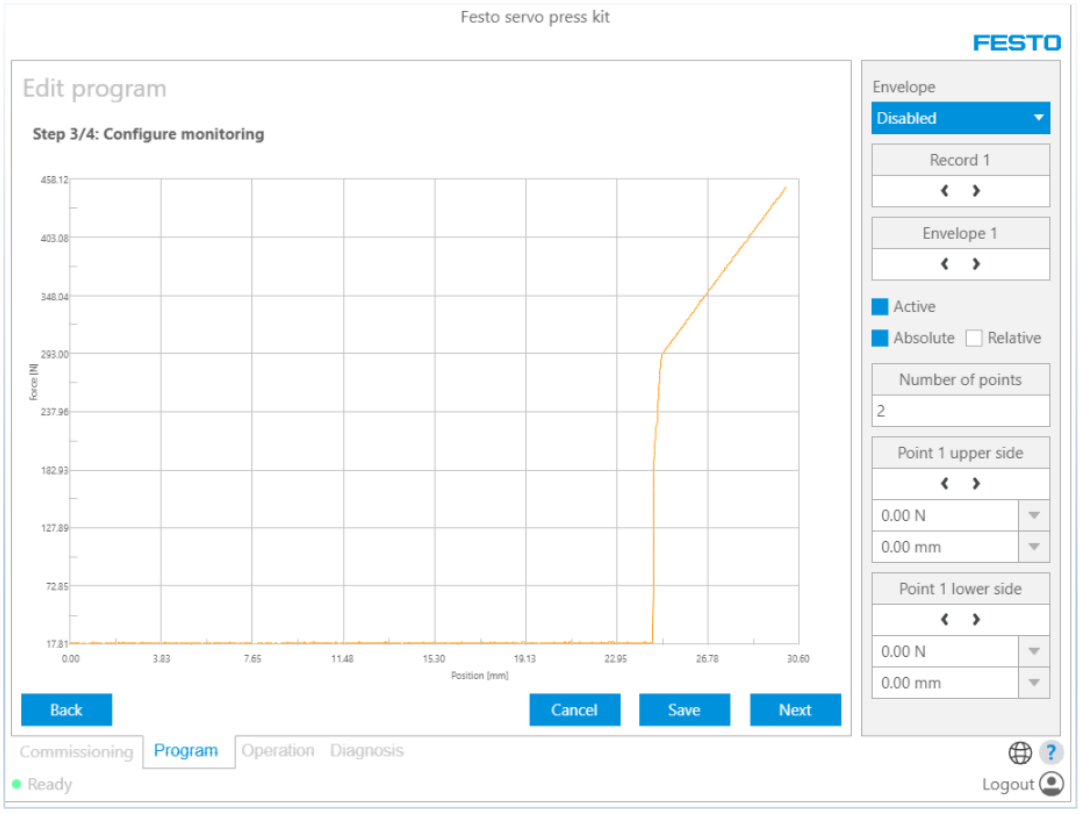
7. Set the lower side values ,which consists of two fields :
    - In the first field, set the force value in (N) .
    - In the second field, set the position value in (mm)

To navigate between the points that form the lower side, please click on the arrow as shown:



Example:

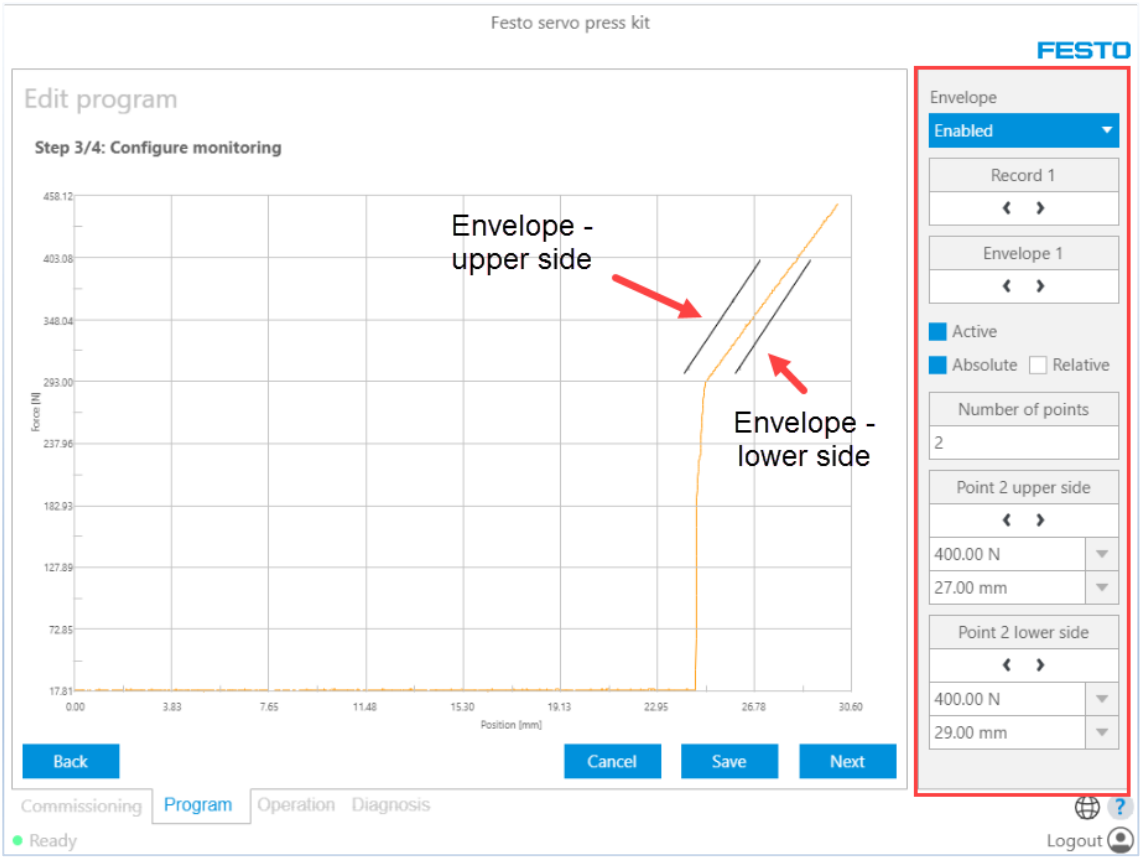
Let's suppose the recorded curve was as follows and we want to add the envelope method on it.



Set the envelope values :

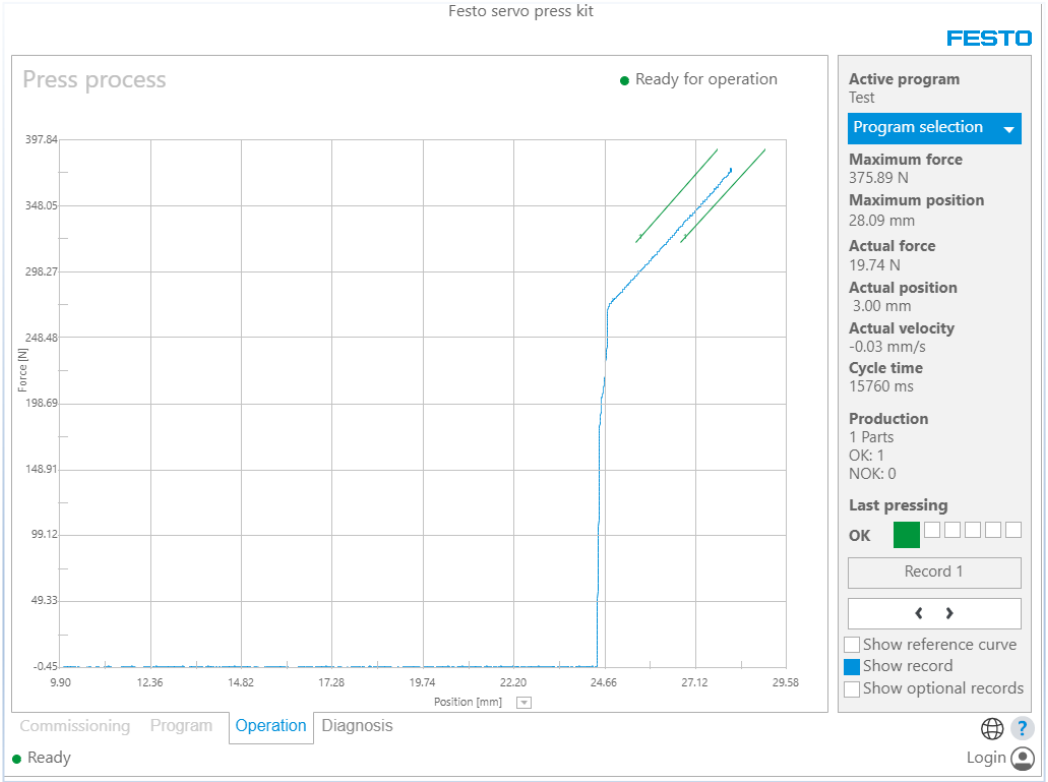
3. Envelope: Enabled
4. Record 1
5. Value 1
6. Active
7. Number of points: 2
8. Point 1 upper side : 300 N
   24 mm
   Point 2 upper side : 400 N
   27 mm
9. Point 1 lower side : 300 N
   26 mm
   Point 2 lower side : 400 N
   29 mm

When you finish setting the previous values, the upper and lower side will be displayed as follows :

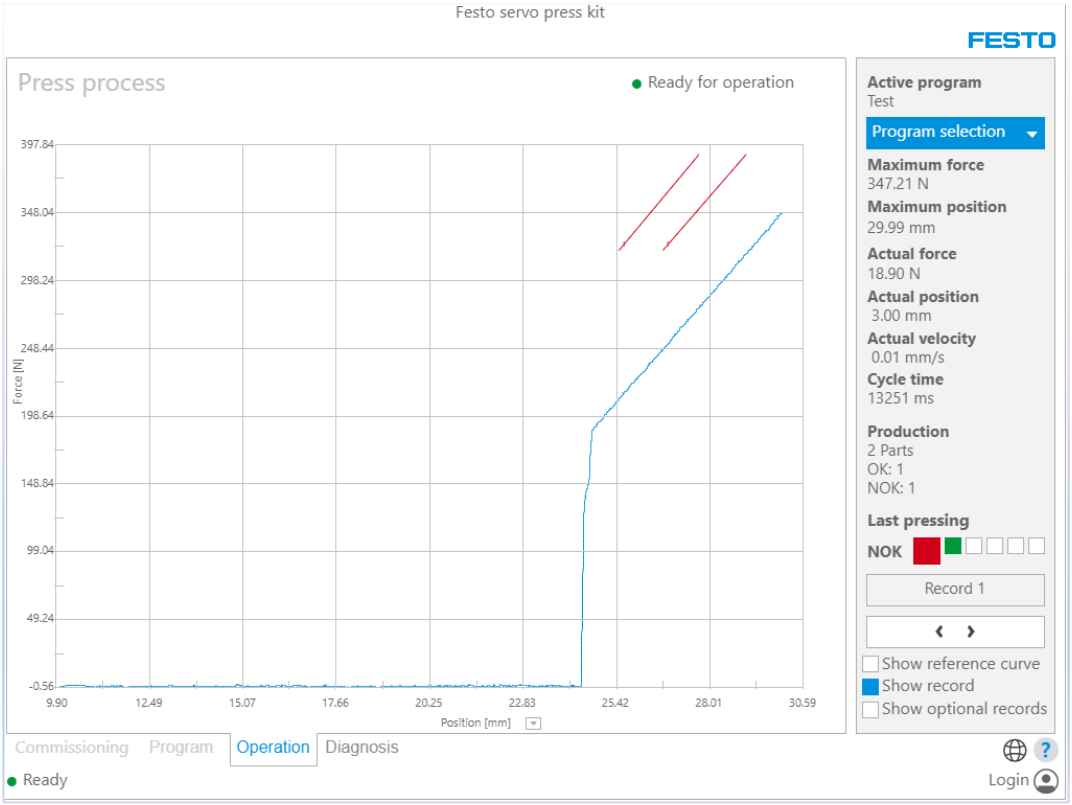


When executing :

- The curve must pass between the upper and lower side.
- If the previous condition is fulfilled , the process will be evaluated as **OK**.



- If the condition isn't fulfilled, thy process will be evaluated as **NOK.**



The curve passed below the lower side.