Application Note

FESTO

YJKP - Creating program and descriptions of sequencer functions

Description of how to create and edit a servo press program
with details explanation of available sequencer functions

YJKP

Title ....YJKP - Creating program and description of sequencer functions

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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: 1 Components/Software used

1.1 Application description

This application note illustrate how to create a servo press program and start editing it using WebVisu control , as well as the requirements that must be verified before starting the program.

Furthermore it explains the available functions in detail with examples.

2 Prerequisites

1. Open a browser and start the WebVisu of the YJKP.

   In Browser: ‹IP of the CECC-X›:8080/servo_press_kit.htm

   The visualization of the servo-press kit is opened with 4 tabs :
   - Commissioning / Program : Not active
   - Operation / Diagnosis: Active

2. Click on **Login** to active the commissioning and program tabs. A new pop-up window will be appeared , and a password must be entered to login and start a new program (as shown in the figures below).

   Default password: User name: Admin

   　　　　　　　　　　Password: ServoPressKit
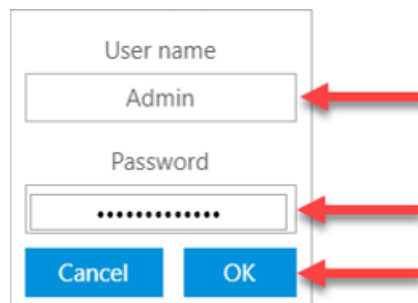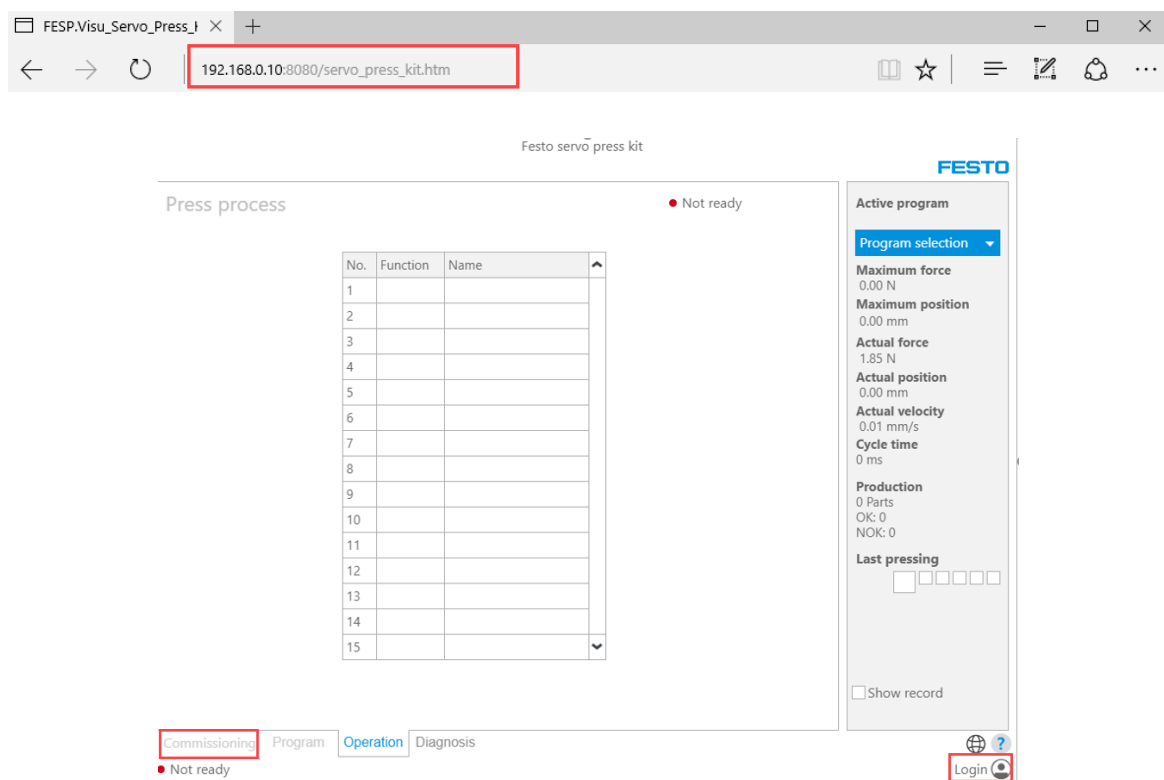
3. Go to **commissioning** -› **System settings tab.**
   Set the control highness according to your system. In this example it is **WebVisu**.
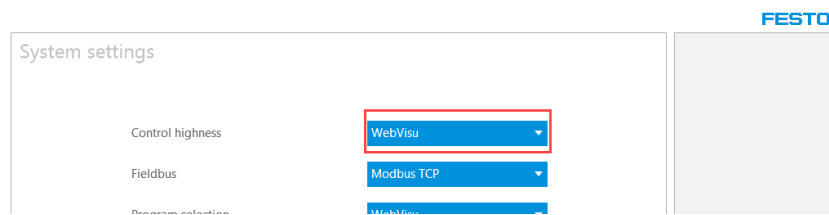

4. In the commissioning tab, check if the hardware is configured successfully and the status indicates that it is valid (Green).
   (further information about hardware configuration, read **AppNote Servo Press Kit YJKP -Hardware Configuration**).
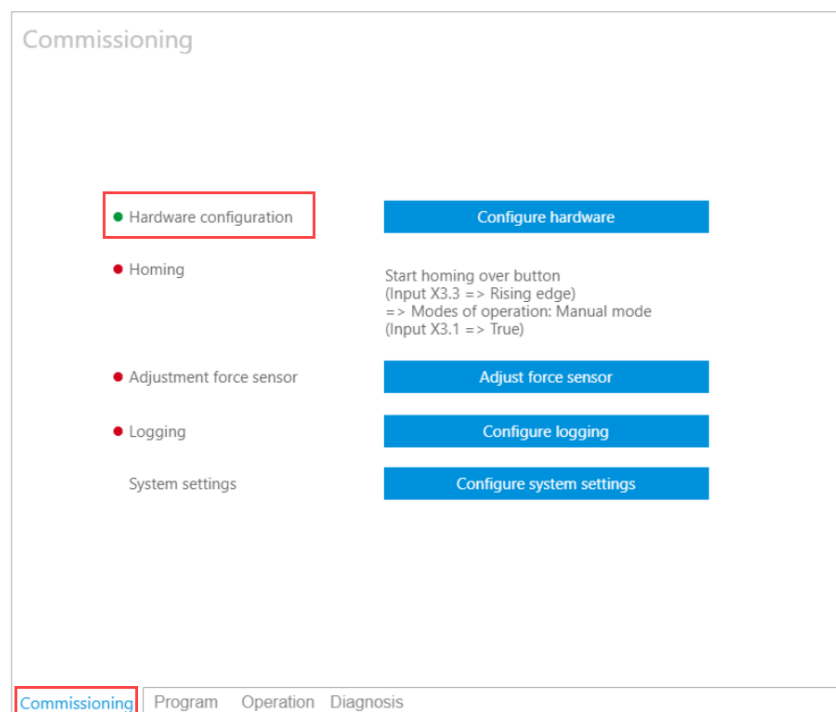
5. Check ,if your system is already homed .Otherwise start homing over the button **Input X3.3**.
   If it's done, the homing status indicates that it is valid (Green) and the status of the servo press turns to "Ready".
   The system is ready now for operation.

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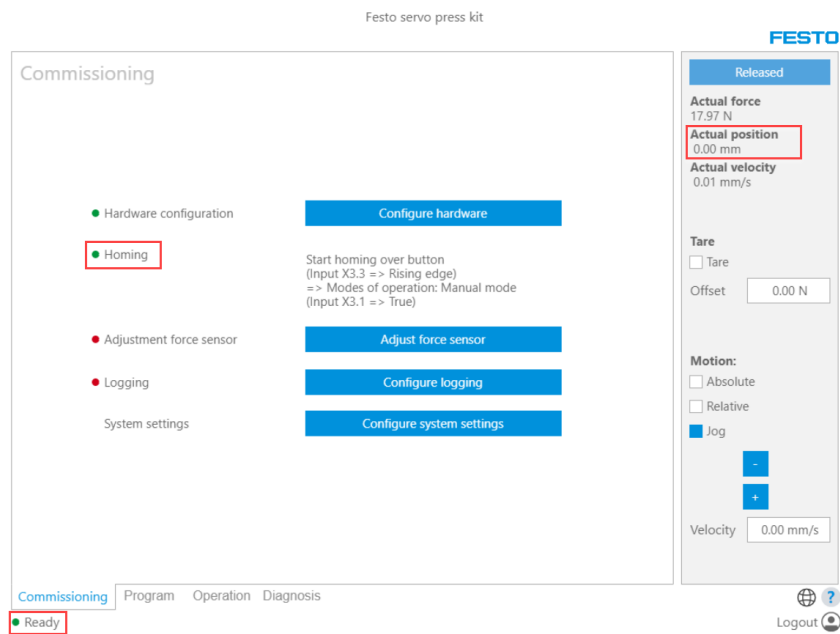
4. Program

Click on **Program** to navigate to program tab , you will see this screen which consists of these parts:
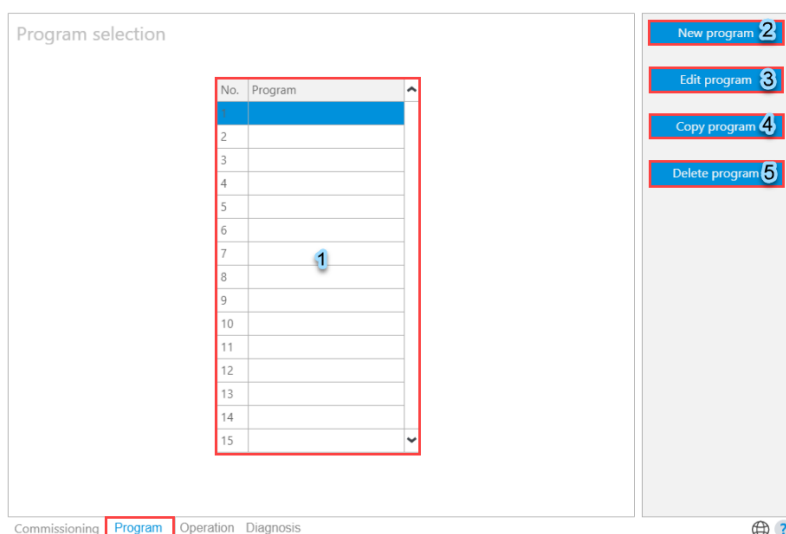
1. **LIST of programs:** this list shows you the all program created in the controller.

➔ **Note:**
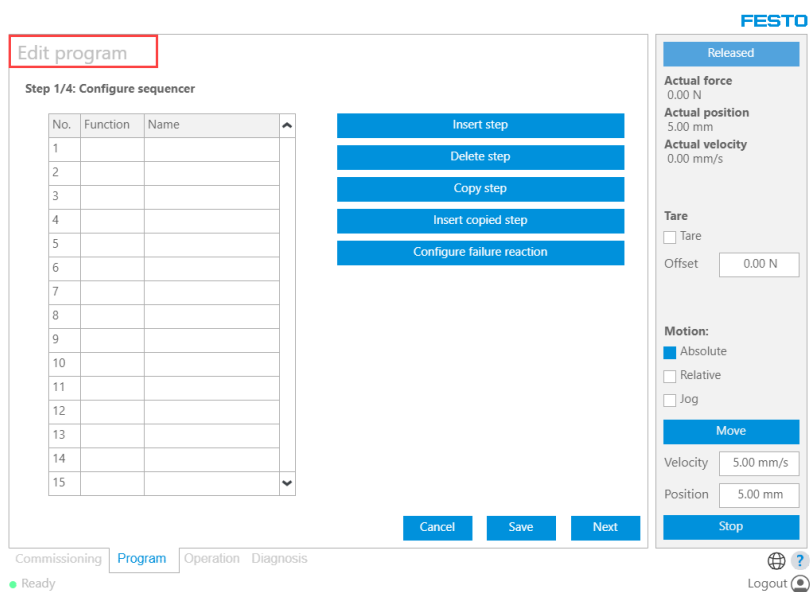   - The maximum number of programs is limited to 20.

2. **New program:** to create a new program.
   - Select a blank field in the list and click on **New Program**
   - A Popup window will show up, type your program name and click **ok** .
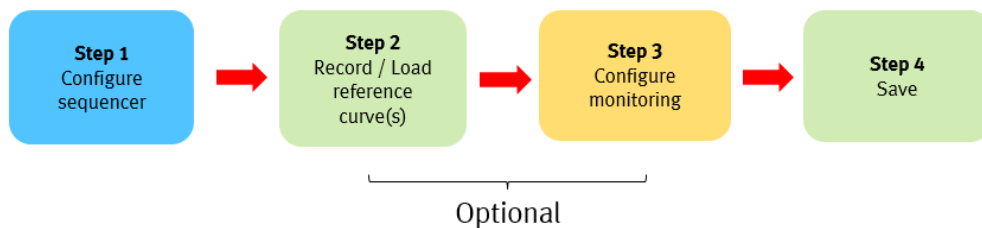

➔ **Note:**
   - After clicking on **Ok** , the WebVisu will navigate automatically to the edit program screen, where you can start editing your press program.

3. **Edit Program:** to edit the selected program.

Select a program in the program's list and click on **Edit Program.** This screen will be appeared:

Edit program screen consists of 4 main steps to complete a servo press program. These steps must be configured in order to be ready for operation:

- **Step1: configure sequencer**

Create a sequencer program by using several functions available in the servo press kit.

(Further information about creating a sequencer program ,please read AppNote Servo Press Kit YJKP– Configure sequencer)

- **Step2 (optional): Record/ loading reference curves**

The sequencer program created in step 1 will be executed step by step, pressing a sample and recording the reference curves, which will be used later to configure the evaluation methods.

(Further information about recording/ loading reference curves, please read AppNote Servo Press Kit YJKP- Record_Load reference curve).

- **Step3 (optional): Configure monitoring**

Add and configure evaluation methods, which will be used to evaluate the curves of each press process.

(Further information about configuring evaluation methods , please read AppNote Servo Press Kit YJKP– Configure monitoring)

- **Step4: Save program**

4. **Copy program:** to copy the selected program.

5. **Delete program:** to delete the selected program.

2. Configure sequencer

A Sequencer program consists of several steps in order to complete the required pressing process , and each of these steps is a function that enables you to configure the whole press steps, adjust force limits , set cylinder speed limits and many other features.

In the program tab select the program you want to be edited, then click on "Edit program " to navigate to the first step of the program configuration.

In this screen we can define 4 parts:

1. Name/Number of the **step**.
2. List of the sequencer functions .This list can contain max 100 functions ,and at startup the system will execute the steps from top to bottom.
3. Edit sequencer functions
     - **Insert step:** add a new function .
     - **Delete step:** delete the selected function.
     - **Copy step:** copy the selected function.
     - **Insert copied step:** paste the copied function.
       Configure failure reaction: add a specific movement to the cylinder if an error occurs during the operation.
       Note: It is always recommended to use failure reaction in the press applications if possible.
4.
     - **Next:** to navigate between the 4 steps (configure sequencer /record -load reference curve / configure monitoring / save)
     - **Save :** to save the sequencer program.
     - **Cancel :** to cancel the current screen and return to the program tab.

1 Create a sequencer program

1. Select a blank field in the list and click on **Insert Step** , a new **Position mode** function will be created in the list as you see in the following screen.

2. Click on the function name on the right side of the screen to open a list of all the functions available in the servo press kit .

3. Select the required function from the list and then complete the first step in the press program by setting the values of this function.

➡ Note :
- All functions will be explained later with examples of how to use them.

4. Repeat the previous steps to add an another step until you finish creating all the steps of pressing.

5. Add a failure reaction to your application if possible.

    Click on configure failure reaction button , and then activate the error reaction to display the target position and velocity fields.
    Set the target position and velocity of the movement and the cylinder will move to this position at this speed when an error occurs.

    when you have finished creating the sequencer steps, you can either save the program and start pressing after selecting the program in the operation tab (Further information about operation ,please check AppNote Servo Press YJKP – Operation) ,or use the evaluation methods by clicking on next to start recording refence curves.(further information about record/load reference curves, see AppNote Servo Press Kit YJKP- Record_Load reference curve)

2   Sequencer Functions

2.1   Position mode (PM)

This function is used to move the cylinder to a certain position , considering the max force limit.

How to configure this function:

- *Record:* is an option to record a force/position curve, which results from the movement of the cylinder when executing this function.

➔   **Note :**
- Further information about using the curve to analyze the function performance , please see „AppNote Servo Press Kit YJKP - Configure_monitoring".

- *Position method:* The cylinder movement methods :
    - *Absolute:*   it is a method to move the cylinder to a target position based on the homing position of the cylinder.
    - *Relative:*   it is a method to move the cylinder a certain distance based on the current position of the cylinder.

- *Target position/Target distance:* The target position(mm) that you want the cylinder to reach.

    You can enter this value in one of three ways :
    - *Value:*   Input the value directly from the keyboard . It's a fixed value in the sequencer, which only can be changed by editing the program.
    - *Variable:*   The value has to be set either in the sequencer or via the host-PLC. It can be adjusted before each cycle without editing the program itself. (to see how to add variables, you may go to „variable" in page 58).
    - *Teach:*   the system will use the „actual position" value as a „target position/target distance".

- **Maximum force:** if this value is exceeded before reaching the target position, either the selected "failure reaction" is executed or the process is interrupted.

    You may enter this value in one of three ways :
    - *Value:*   Input the value directly from the keyboard . It's a fixed value in the sequencer, which only can be changed by editing the program.
    - *Variable:*   The value has to be set either in the sequencer or via the host-PLC. It can be adjusted before each cycle without editing the program itself. (to see how to add variables, you may go to „variable" in page 58).
    - *Teach:*   the system will use the „actual position" value as a „target position/target distance".

- **Velocity:** cylinder speed when moving to the target position .

    You may enter this value in two ways :
    - *Value:*   Input the value directly from the keyboard . It's a fixed value in the sequencer, which only can be changed by editing the program.
    - *Variable:*   The value has to be set either in the sequencer or via the host-PLC. It can be adjusted before each cycle without editing the program itself. (to see how to add variables, you may go to „variable" in page 58).

Examples

In this examples the „position mode" will be used to move the cylinder 20 mm .

1. _By using an absolute method:_
   Add the position mode to the sequencer list , then adjust it as the following :

   - _Position method :_   Check Absolute
   - _Target position:_   20 [mm]
   - _Maximum force :_   700[N]
   - _Velocity :_   5[mm/s]

In the following figures , you will see how the cylinder will behave in this mode , considering that the actual position = 7 .

Before executing the function:

After executing the function: Cylinder moved from absolute position 7mm to absolute position 20mm (distance of 13mm).New **Actual position** = 20 mm.

2. *By using a relative method:*
    Add the position mode to the sequencer list **,** then adjust it as the following**:**

- *Position method :*   Check Relative
- *Target position:*   20 [mm]
- *Maximum force :*   700[N]
- *Velocity :*   5[mm/s]

In the following figures you will see how the cylinder will behave in this mode **,** considering that the actual position = 7 mm **.**

Before executing the function:

After executing the function: The cylinder moved a distance of 20mm (from absolute position 7mm to absolute position 27mm).New **Actual position** = 27 mm**.**

3. *Exceed the limits:*

In this example you will see how the cylinder will behave if the maximum force is exceeded before reaching the desired position.
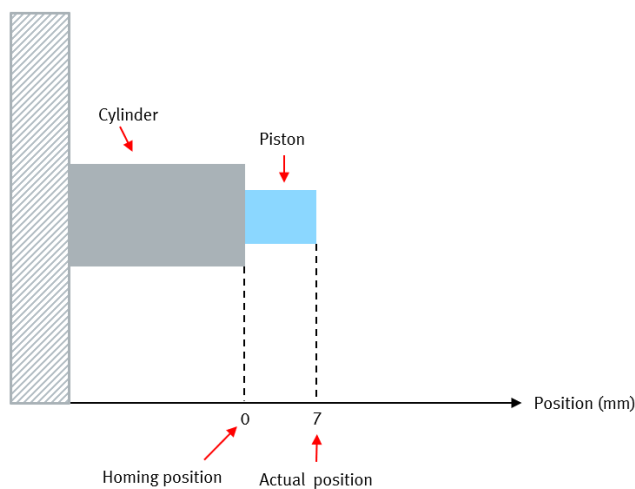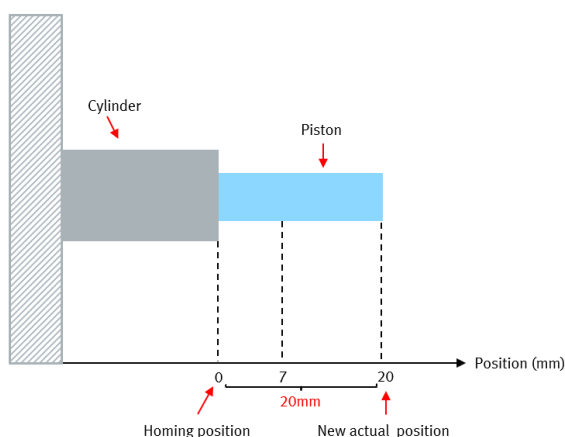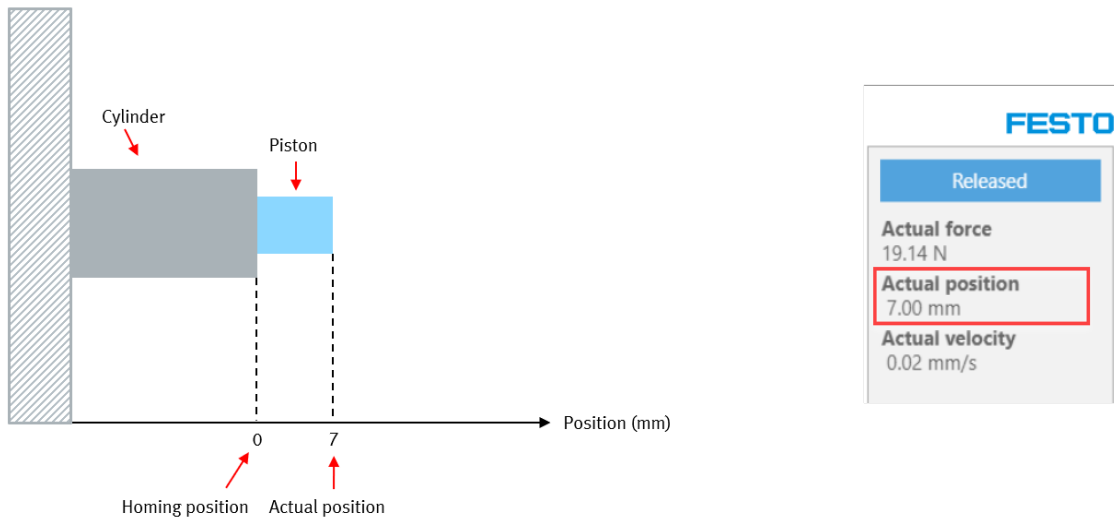
Add the position mode to the sequencer list , then adjust it as the following :

- • *Position method :*   Check Absolute
- • *Target position:*   26 [mm]
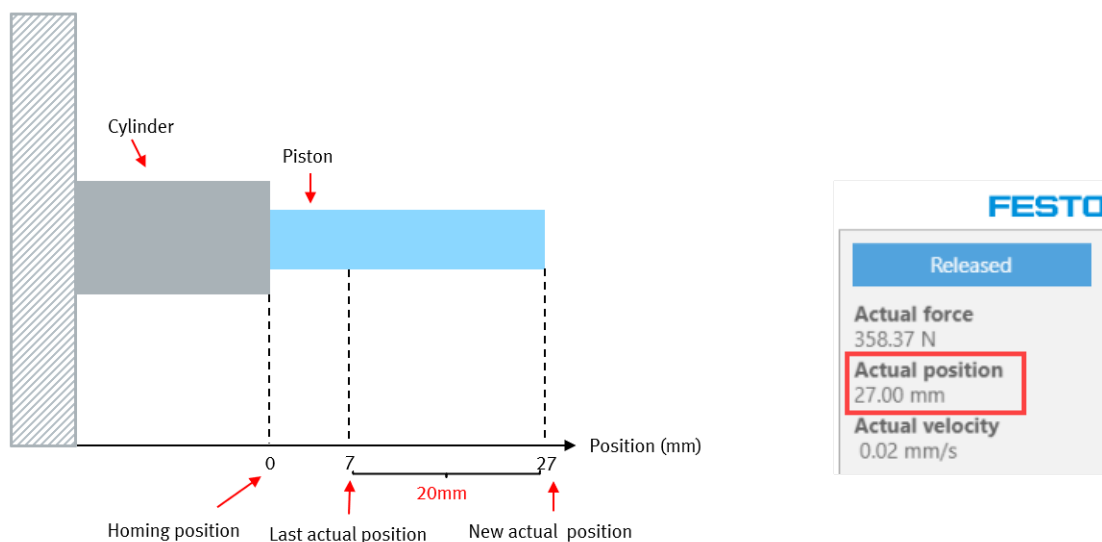- • *Maximum force :*   200[N]
- • *Velocity :*   5[mm/s]

Function	Position mode ▼
☐ Record	
Position method	
■ Absolute	☐ Relative
Target position	26.00 mm ▼
Maximum force	200.00 N ▼
Velocity	5.00 mm/s ▼

Before executing the function: considering that the actual position = 7 .

Released
Actual force
0.68 N
Actual position
7.00 mm
Actual velocity
0.02 mm/s
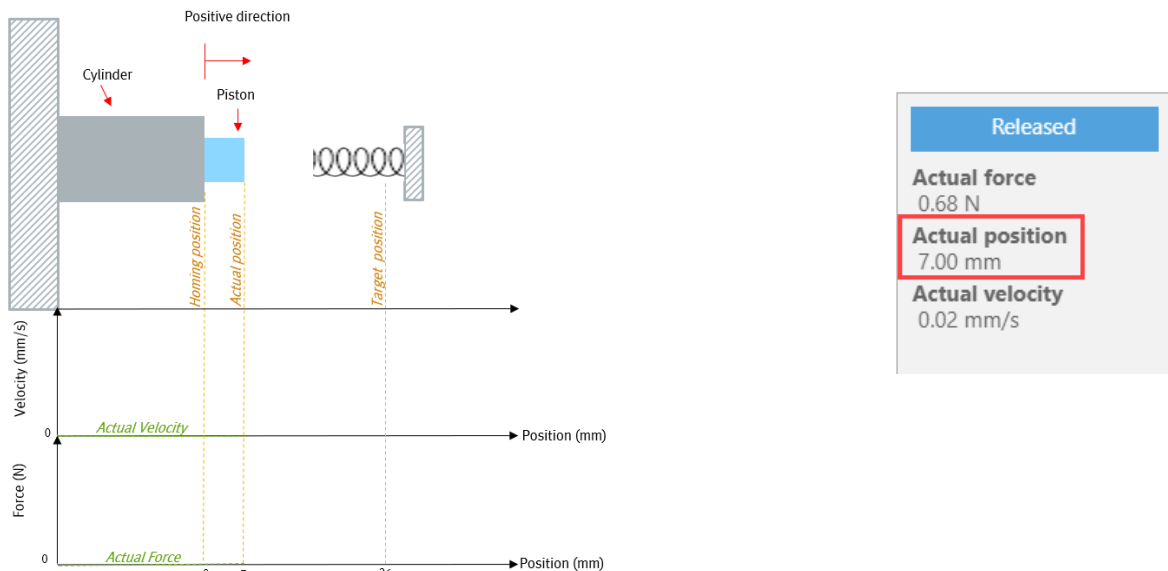
After executing the function : the cylinder moved from the actual position (7 mm) to the target position (26mm), and when the force reached a value greeter than the maximum (200 N) , the process is terminated before reaching the target position (terminated at 24.60 mm).
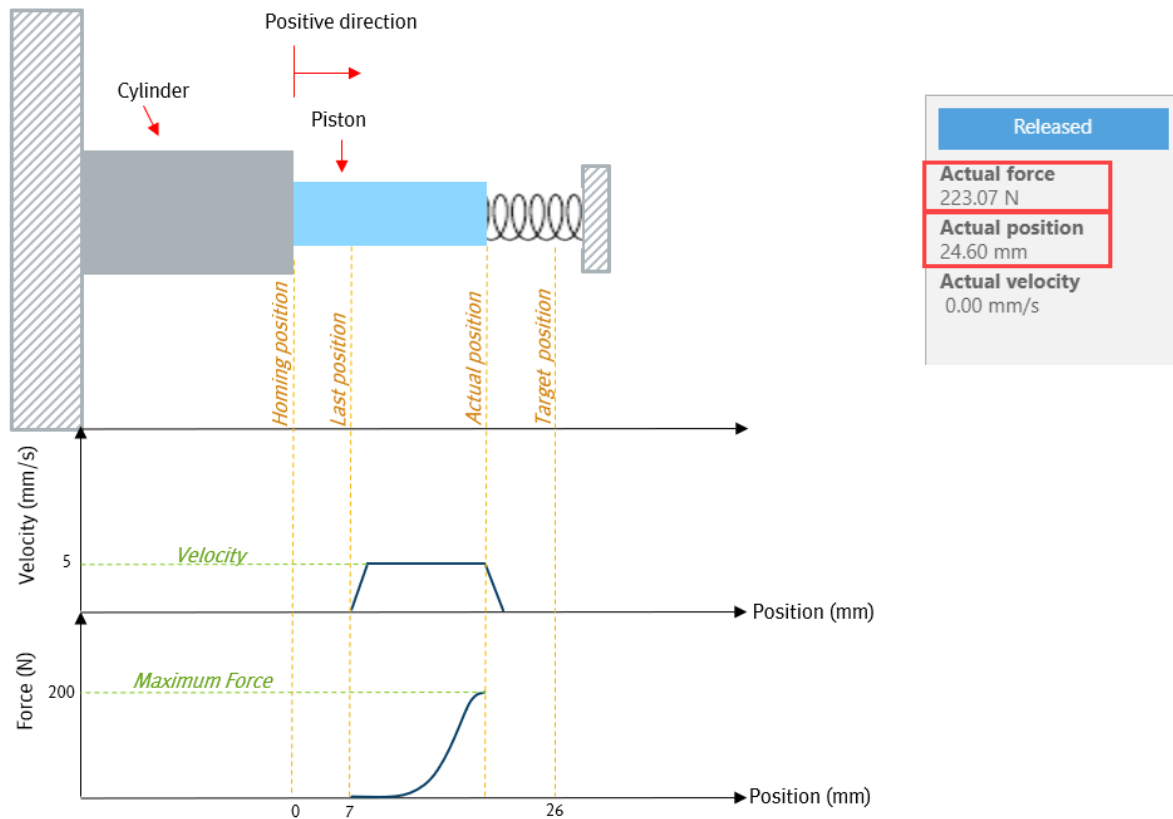
2.2 Force modes

2.2.1 Force mode (FM)

It is a function, to move the cylinder to a certain force , taking into account the max position limit.

How to configure this function:

- *Record:* is an option to record a force/position curve, which results from the movement of the cylinder when executing this function.

➔ **Note :**
- Further information about using the curve to analyze the function performance , please see „AppNote Servo Press Kit YJKP - Configure_monitoring".

- **Position method:** You may choose between two ways to move the cylinder :
  - _Absolute:_ it is a method to move the cylinder to a target position based on the homing position of the cylinder.
  - _Relative:_ it is a method to move the cylinder a certain distance based on the current position of the cylinder.

- **Target force:** The desired press force to be applied

  You may enter this value in one of three ways :
  - _Value:_ Input the value directly from the keyboard . It's a fixed value in the sequencer, which only can be changed by editing the program.
  - _Variable:_ The value has to be set either in the sequencer or via the host-PLC. It can be adjusted before each cycle without editing the program itself. (to see how to add variables, you may go to „variable" in page 58).
  - _Teach:_ the system will use the „actual position" value as a „target position/target distance".

- **Maximum position/Maximum distance:** if this value is exceeded before reaching the target force, either the selected "failure reaction" is executed or the process is interrupted.

  You may enter this value in one of three ways :
  - _Value:_ Input the value directly from the keyboard . It's a fixed value in the sequencer, which only can be changed by editing the program.
  - _Variable:_ The value has to be set either in the sequencer or via the host-PLC. It can be adjusted before each cycle without editing the program itself. (to see how to add variables, you may go to „variable" in page 58).
  - _Teach:_ the system will use the „actual position" value as a „target position/target distance".

- **_Velocity:_** the speed of the cylinder when moving to the desired force .

    You may enter this value in one of two ways :
    - _Value:_   Input the value directly from the keyboard . It's a fixed value in the sequencer, which only can be changed by editing the program.
    - _Variable:_   The value has to be set either in the sequencer or via the host-PLC. It can be adjusted before each cycle without editing the program itself. (to see how to add variables, you may go to „variable" in page 58).

Examples of how the force mode works:

In YJKP system , if you want to use force mode to apply a 200N pressing force :

1. _By using an absolute position method:_

    First you need to add force mode to the sequencer list , then adjust it as the following :

    - _Position method :_   Check Absolute
    - _Target force:_   200 [N]
    - _Maximum position :_   27 [mm]
    - _Velocity :_   5 [mm/s]

In the following figures you will see how the cylinder will behave in this mode , considering that the actual position = 7 mm , and the actual force = 0 N .

Before executing the function:

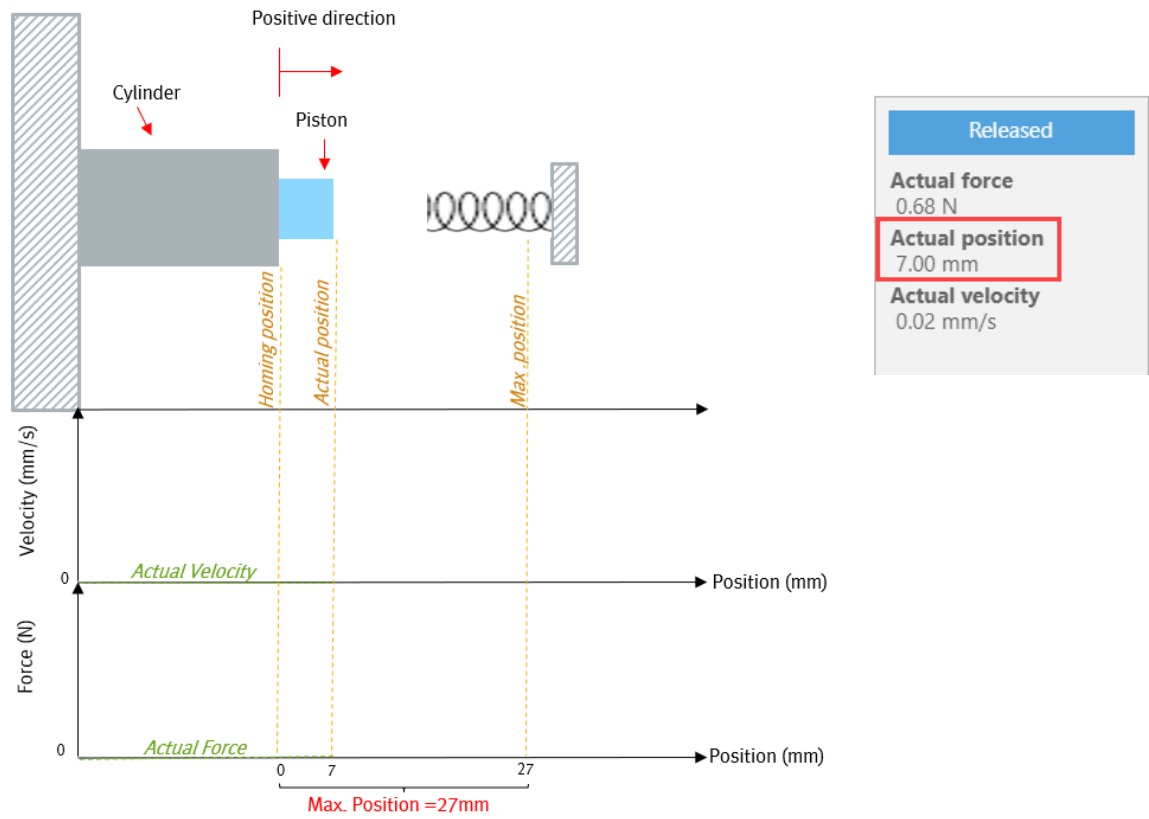After executing the function: New Actual position = 24.56 mm , Actual force=202 N.

2. *By using a relative method:*

First you need to add force mode to the sequencer list , then adjust it as the following :

- *Position method :*   Check Relative
- *Target force:*   200 [N]
- *Target distance :*   20 [mm]
- *Velocity :*   5 [mm/s]

Function	Force mode ▼
☐ Record	
Position method	
☐ Absolute	■ Relative
Target force	200.00 N ▼
Maximum distance	20.00 mm ▼
Velocity	5.00 mm/s ▼

In the following figures you will see how the cylinder will behave in this mode , considering that the actual position = 7 mm , and the actual force = 0 N .

Before executing the function:

Released
Actual force 0.68 N
Actual position 7.00 mm
Actual velocity 0.02 mm/s

After executing the function: New Actual position = 24.56 mm , Actual force=202 N.

3. *Exceed the limits:*

In this example you will see the cylinder reaction if the maximum position is exceeded before reaching the desired force.

Add the force mode to the sequencer list , then adjust it as the following :

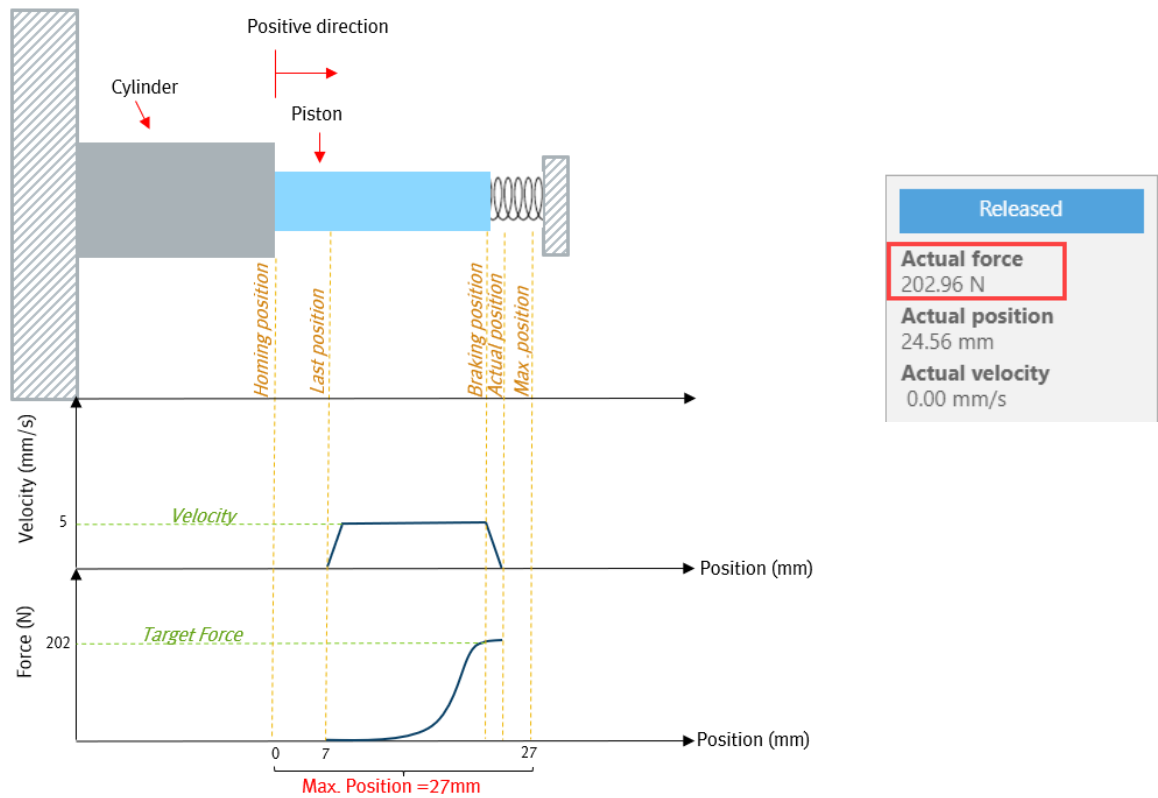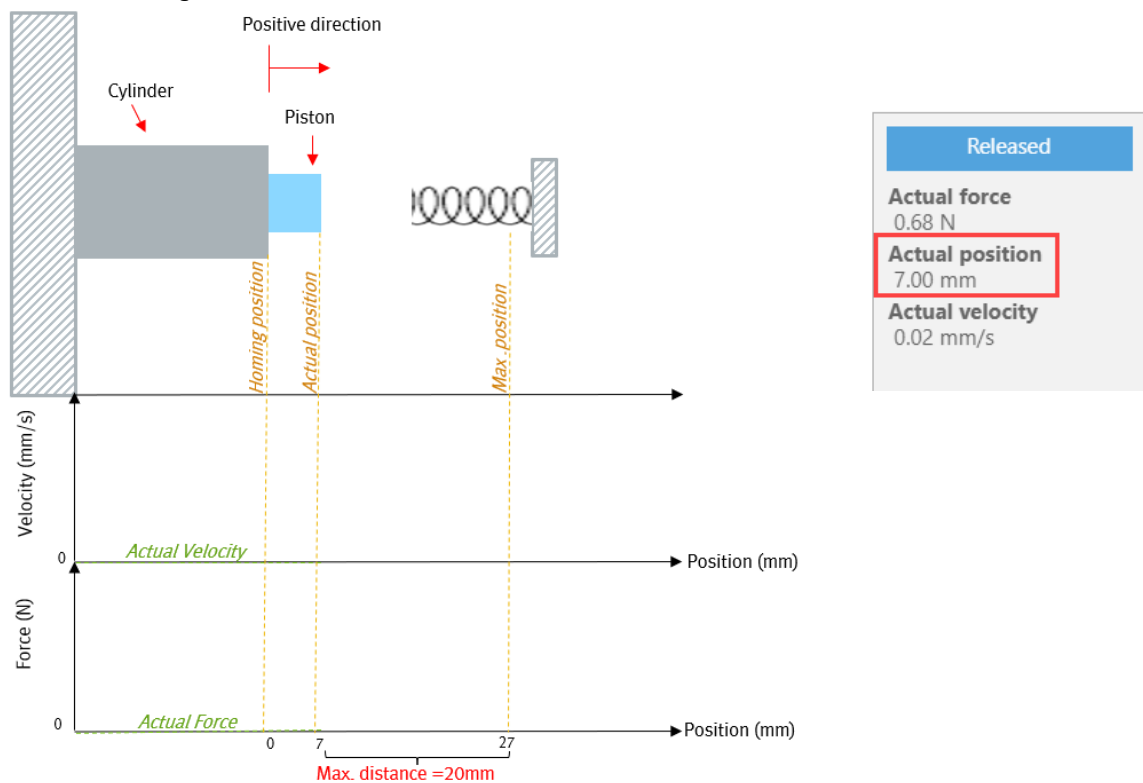- *Position method :*   Check Absolute
- *Target force:*   200 [N]
- *Maximum position :*   24.5 [mm]
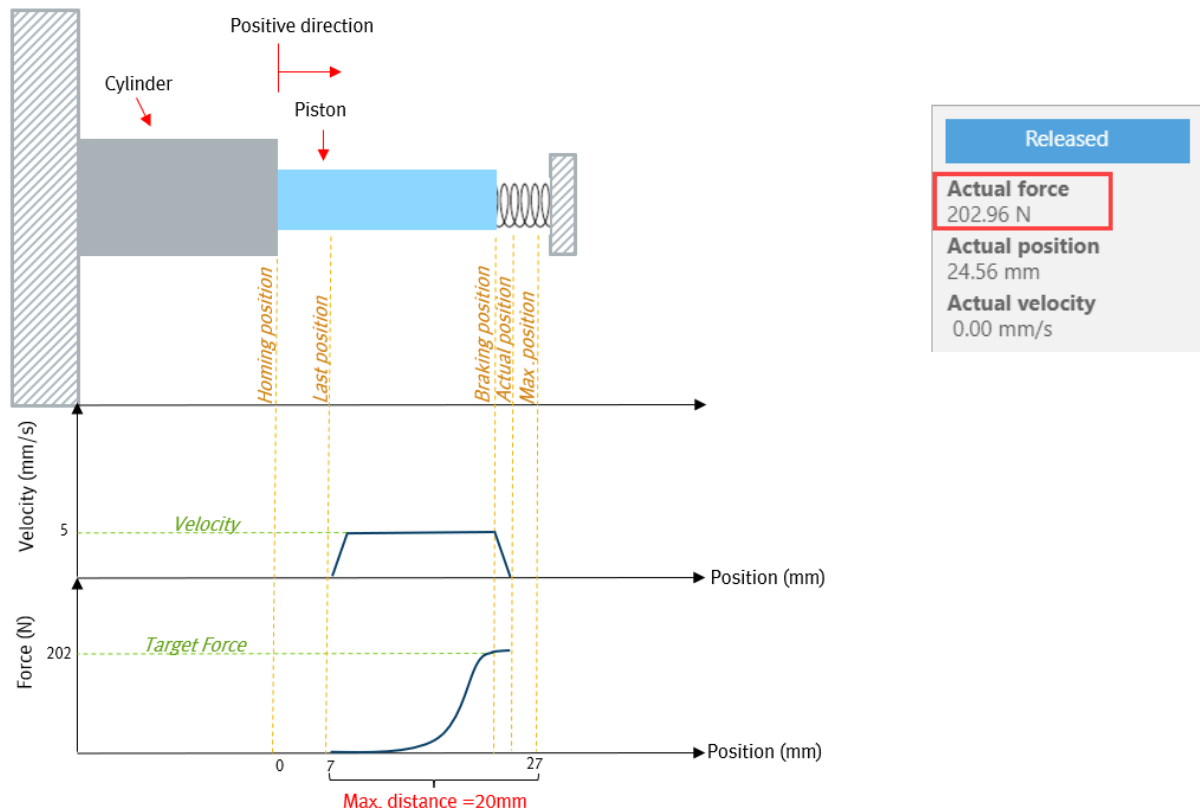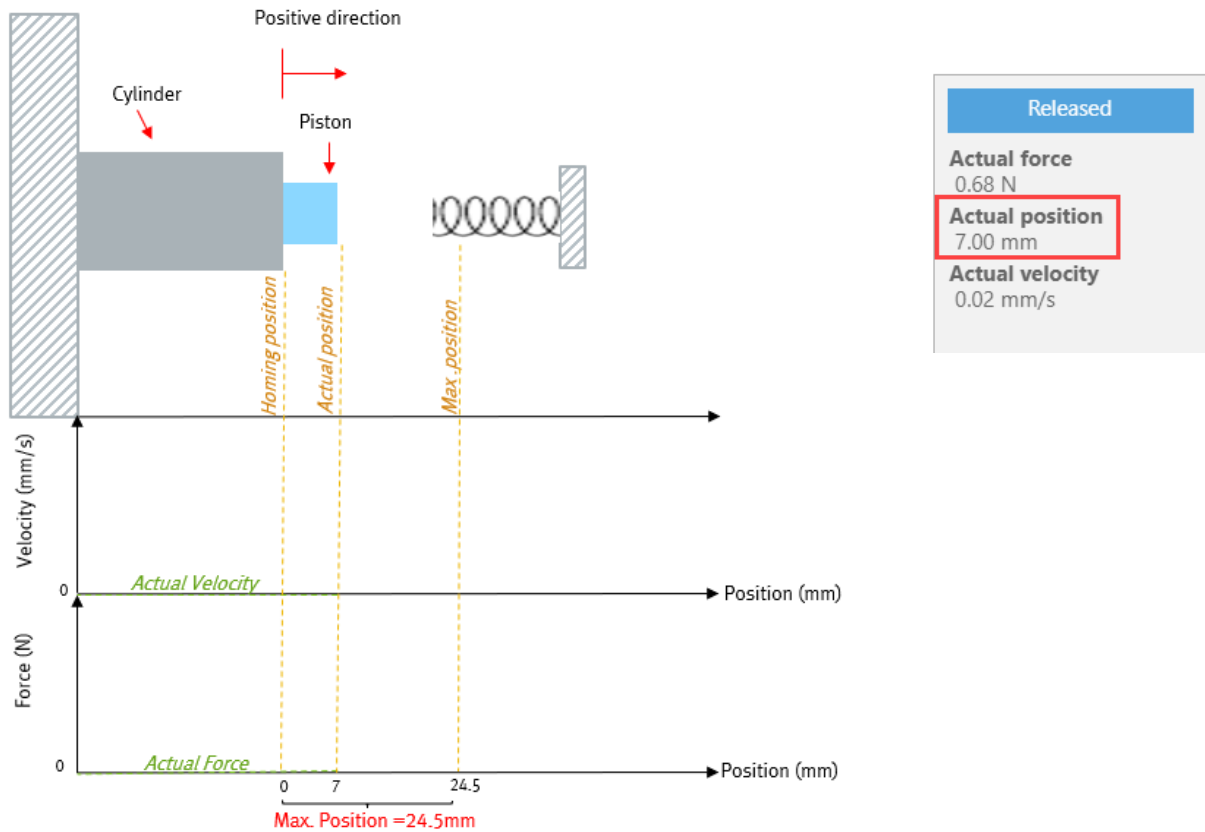- *Velocity :*   5 [mm/s]

Before executing the function: considering that the actual position = 7 mm , and the actual force = 0 N .

Released

Actual force
0.68 N

Actual position
7.00 mm

Actual velocity
0.02 mm/s

Max. Position =24.5mm

After executing the function : the cylinder started moving from the actual position (7 mm) in the positive direction, but when it reached the maximum position (24.5 mm) , the process was terminated (terminated at 171N)even though the pressing force didn't reach the desired force .

Released

Actual force
171.15 N

Actual position
24.53 mm

Actual velocity
0.01 mm/s

Max. Position =24.5mm
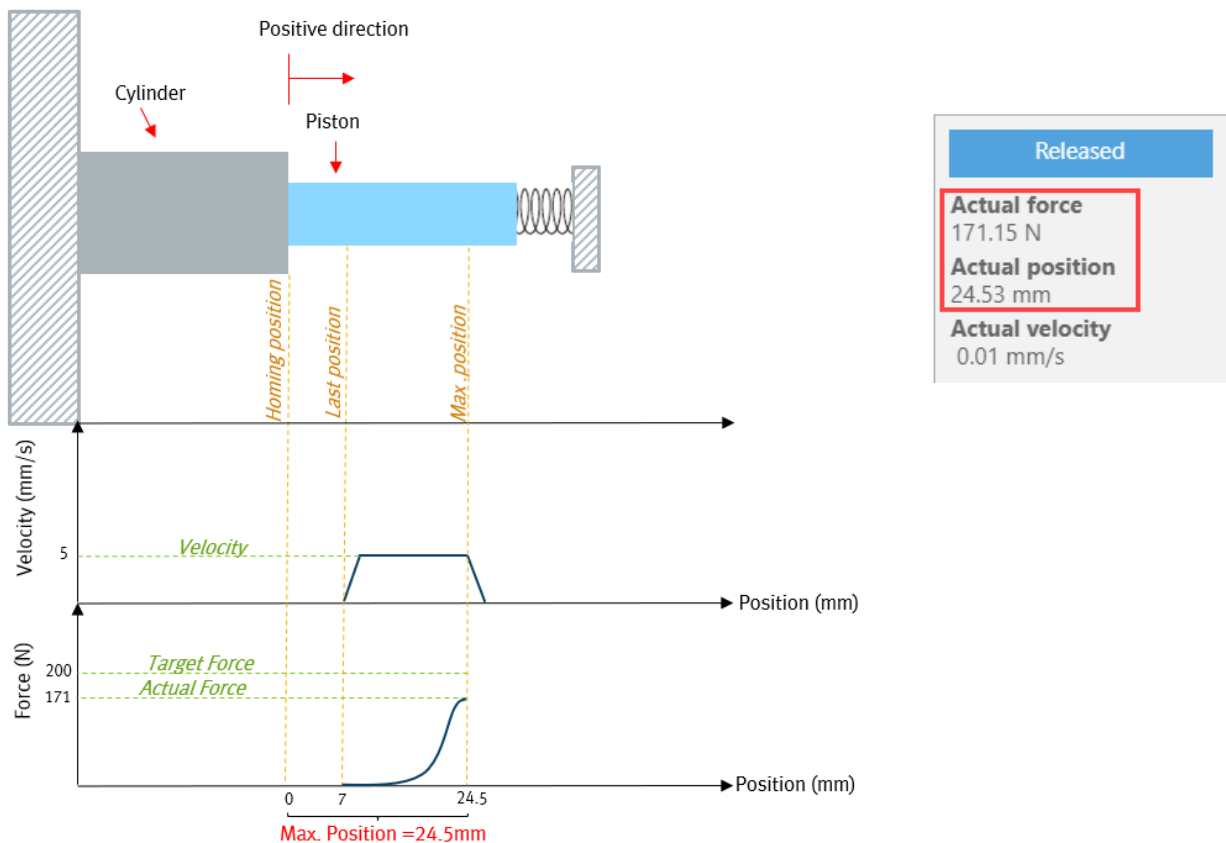
Issues:

1. **Force regular:**

   "Force mode" is **not** a force regular function , which means that the cylinder accepts a range of force values and not just one .

   This range starts from the target force to max system-force.

   If the actual force is greater than the target force , the cylinder will **not** move in the negative direction to the desired force.

   e.g. In a YJKP system if the actual position= 28 mm , actual force= 300 N, and the target force is **250 N**.

   As you see in the figure below this function accepts a range of force values (**from** 250 N **to** Max system-force) , since the actual force (F=300 N) is greater than the target force, the cylinder will **not** move in the negative direction to the desired force and rather the step will be fulfilled as successful.

   Depending on your application it might be, that you **can't** use this function directly.
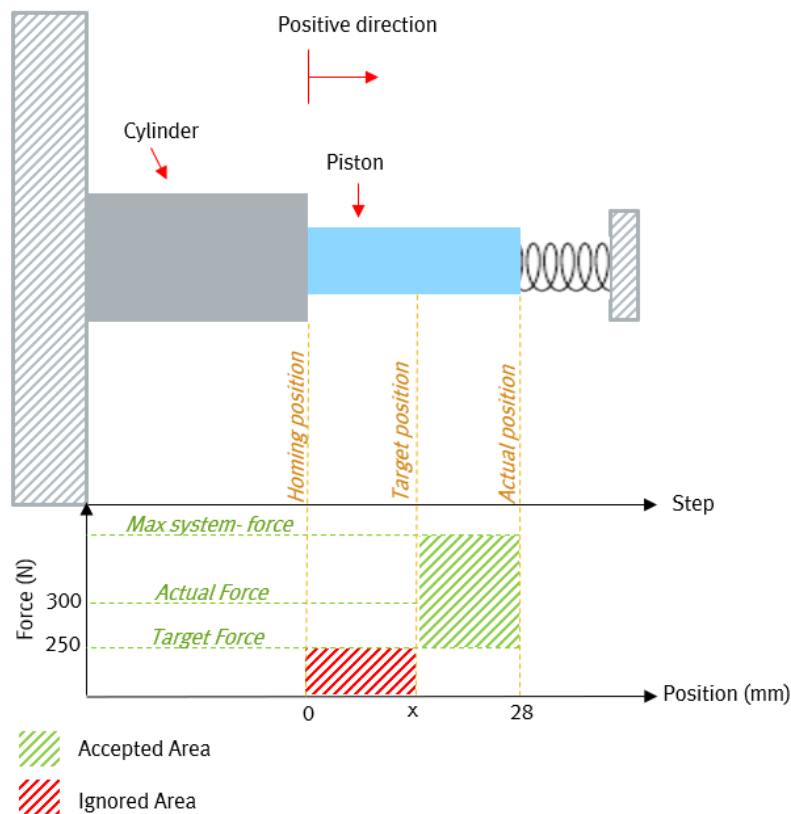
   You can solve this issue in 2 ways:

   - Before using this function , use a position mode function to move the cylinder back to the ignored area , then use force mode function in order to move the cylinder in the positive direction till it reaches the target force.
   - Use a force regular function (Force mode Advanced).

2. **Overshooting**

   This function always has a system-dependent overshooting of the target force. The system starts braking **only** when the required value is reached. The higher the speed of the cylinder the greater the overshooting.

   As you see in this diagram, the system starts braking at the target force . Braking delays result a reached force, which is higher than the target force.
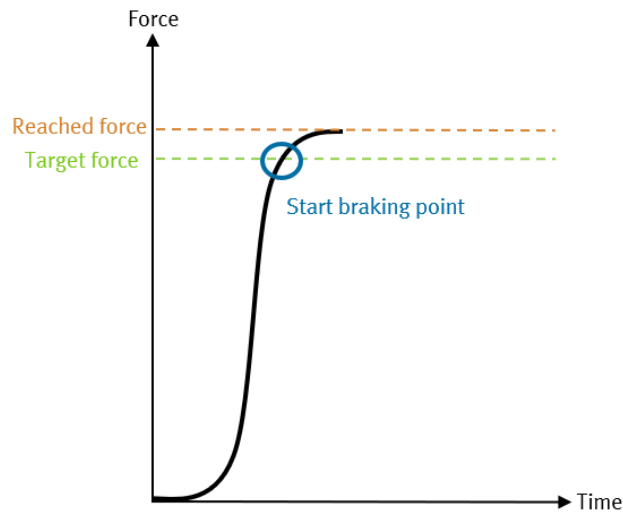
To solve overshooting:

- Reduce the cylinder speed to the smallest possible value when using this function.

  Use the advanced force mode function.

2.2.2 Advanced Force Mode (AFM)

The purpose of the advanced force mode function is to achieve a certain target force. As soon as this force has been reached without violating a limit value, the step will be fulfilled as successful.

In contrast with force mode, a parameterizable braking ramp is used. This reduces the pressing velocity (v_max) from 100% to 1% at target force. As a result, the target force is achieved more precisely and faster.

Advanced force mode is a force regular function ,meaning that the cylinder can move in the both positive/negative directions in order to reach a desired force.

➔ **Note :**
- Further information about advanced force mode , please see „ AppNote Servo Press Kit YJKP- Advanced   Force Mode_V1 ".

How to configure this function:

- **Record:** is an option to record a force/position curve, which results from the movement of the cylinder when executing this function.

➔ **Note :**
- Further information about using the curve to analyze the function performance , please see „AppNote Servo Press Kit YJKP - Configure_monitoring"..

- **Velocity switch:** it is an option to move the cylinder with 2 different velocities : v_max and v_max_2.

- *V_max_2 (Approach velocity):*　　Velocity from the start of force control up to the middle position.
- *V_max (velocity):*　　　　　　Velocity from the middle position to the position where the force is equal to the braking value.

Click on velocity switch to set the middle position and approach velocity (v_max_2).

- • *Activate:*　　　　　　Activation of velocity switch
- • *Middle position [mm]:*　At this position, the velocity starts to be reduced from v_max_2 to v_max.
- • *Approach velocity [mm/s]:* Velocity from the start of force control up to the middle position (v_max_2)

- • **Limits:** If one of the limits is exceeded, either the selected "failure reaction" is executed or the process is interrupted.

- • *Max. position* [mm]:　　If the maximum position (absolute) is exceeded, the function is aborted.
- • *Max. force* [N]:　　　If the force is exceeded, the function is aborted.

- • **Target force** [N]: The desired press force to be applied .

You may enter this value in one of three ways :

- - *Value:*　　Input the value directly from the keyboard . It's a fixed value in the sequencer, which only can be changed by editing the program.
- - *Variable:*　　The value has to be set either in the sequencer or via the host-PLC. It can be adjusted before each cycle without editing the program itself. (to see how to add variables, you may go to „variable" in page 58).
- - *Teach:*　　the system will use the „actual position" value as a „target position/target distance".

- **Force start braking [N]:** The force from which the reduction in velocity begins.

  You may enter this value in one of three ways :
  - _Value:_   Input the value directly from the keyboard . It's a fixed value in the sequencer, which only can be changed by editing the program.
  - _Variable:_   The value has to be set either in the sequencer or via the host-PLC. It can be adjusted before each cycle without editing the program itself. (to see how to add variables, you may go to „variable" in page 58).
  - _Teach:_   the system will use the „actual position" value as a „target position/target distance".

- **Velocity [mm/s]:** The maximum possible velocity during the pressing procedure (v_max).

  You may enter this value in one of two ways :
  - _Value:_   Input the value directly from the keyboard . It's a fixed value in the sequencer, which only can be changed by editing the program.
  - _Variable:_   The value has to be set either in the sequencer or via the host-PLC. It can be adjusted before each cycle without editing the program itself. (to see how to add variables, you may go to „variable" in page 58).

Examples of how this function works:

1. *Using this function without velocity switch option:*
    1. Click on velocity switch and set these values:
        - *Uncheck activate*

    2. Click on limits and set these values:
        - *Max.position :*   30 mm
        - *Max.Force :*   300 N

    3. Set these values:
        - *Target force :*   200N
        - *Force start braking :*   150 N
        - *Velocity:*   3 mm/s
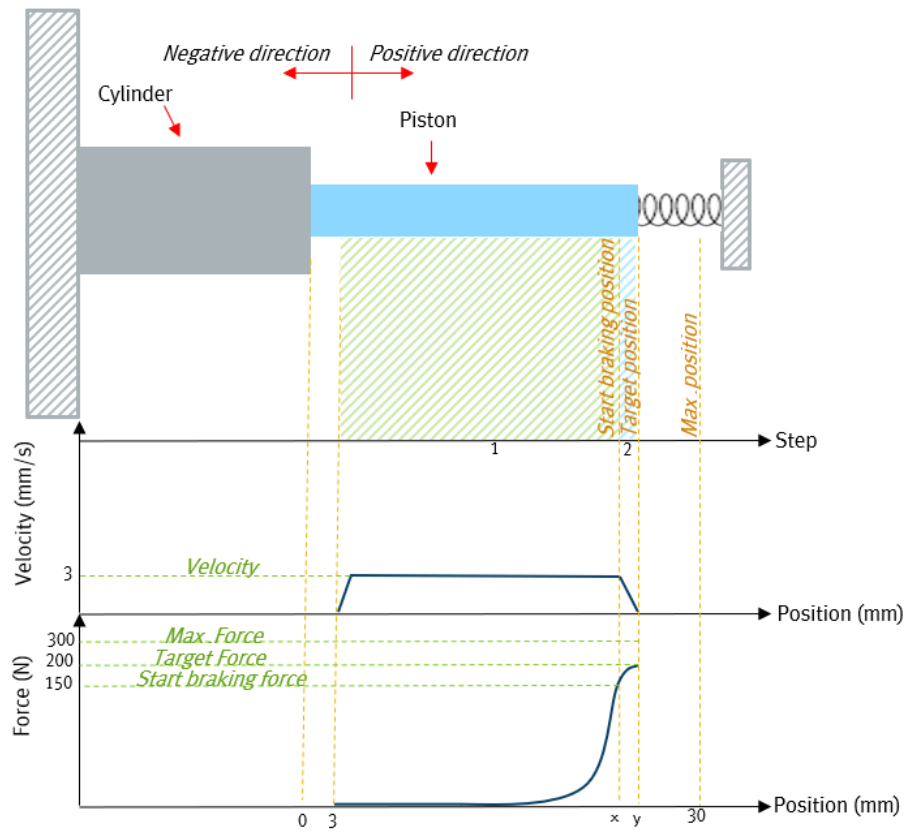
Before executing the function:

After executing this function ,the cylinder will react as shown in the figure below.

In this figure we can only 2 steps resulting from the movement of the cylinder:

Step 1:

- *Position:*   this step starts at the position *3 [mm] (actual position)* and ends at position *x [mm] (a position where the actual force is equal to start braking force)* .
- *Velocity:*   the speed of the cylinder increases from *0 [mm/s]* (actual velocity) to *3 [mm/s] (velocity of advanced force mode function)*.
- *Force:*   the force value increases after touching the spring from *0 [N]* to *150 [N] (start braking force)*.

Step 2:

- *Position:*   this step starts at the position *x [mm] (a position where the actual force is equal to start braking force)* and ends at *y [mm] (a position where the actual force is equal to target force)*.
- *Velocity:*   the speed of the cylinder decreases from *3 [mm/s] (velocity of advanced force mode function)* to *0 [mm/s] (stop point)*.
- *Force:*   the force value increases from *150 [N] (start braking force)* to *200 [N] (target force)*.

2. Using this function with velocity switch option:
   1. Click on velocity switch and set these values:
      - *Check activate*
      - *Middle position :*   15 mm
      - *Approach velocity :*   10 mm/s

   2. Click on limits and set these values:
      - *Max.position :*   30 mm
      - *Max.Force :*   300 N

   3. Set these values:
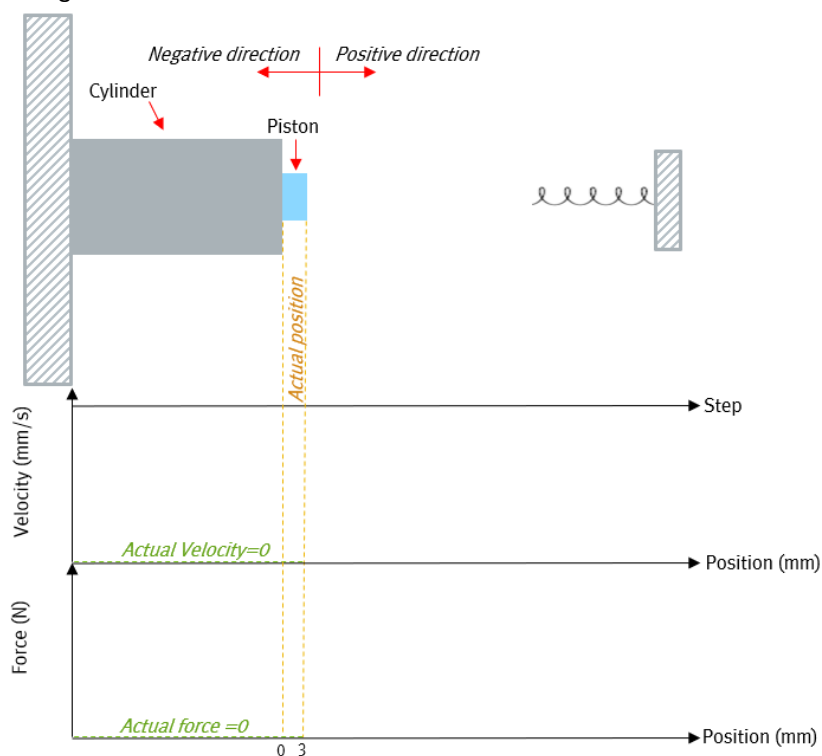   - *Target force :*   200N
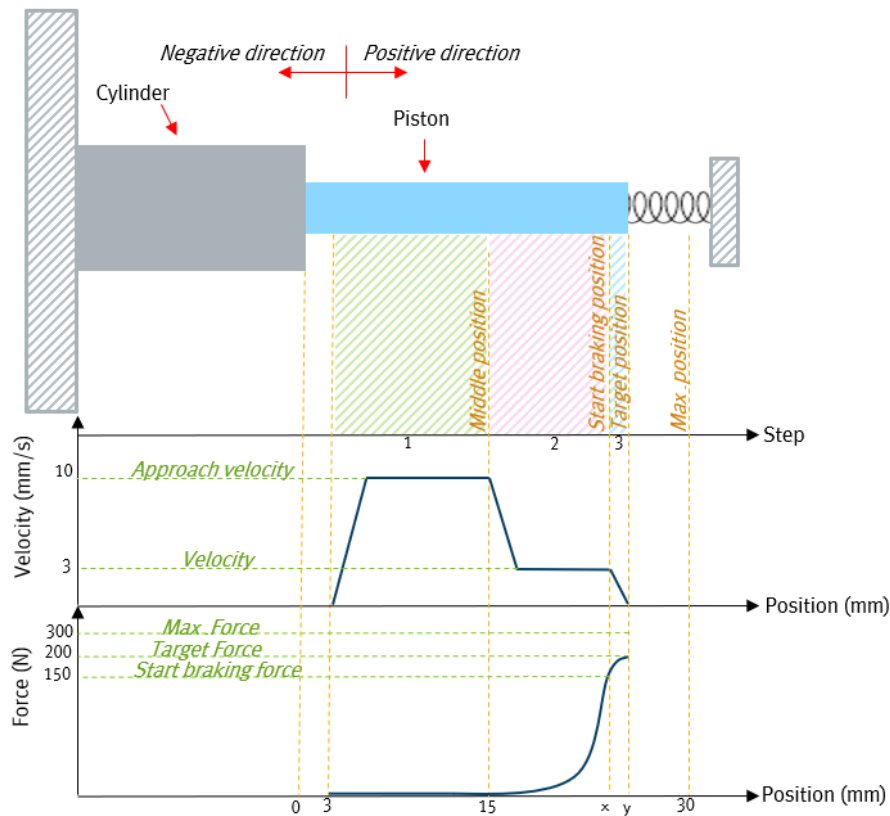   - *Force start braking :*   150 N
      - *Velocity:*   3 mm/s

Before executing the function:

After executing this function, the cylinder will react as shown in the figure below.

In this figure we can identify 3 steps resulting from the movement of the cylinder:

▨ Step 1:

- *Position:*   this step starts at the position 3 [mm] (actual position) and ends at 15 [mm] (middle position).
- *Velocity:*   the speed of the cylinder increases in this step from 0 [mm/s] (actual velocity) to 10 [mm/s] (approach velocity).
- *Force:*   the value of press force value remains at 0 [N] .

▨ Step 2:

- *Position:*   this step starts at the position 15 [mm] (middle position) and ends at x [mm] (a position where the actual force is equal to brake force value).
- *Velocity:*   the speed of the cylinder decreases from 10 [mm/s] (approach velocity) to 3 [mm/s] (velocity of advanced force mode function).
- *Force:*   the force value increases immediately after touching the spring from 0 [N] to 150 [N] (start braking force).

▨ Step 3:

- *Position:*   this step starts at the position x [mm] (a position where the actual force is equal to start braking force) and ends at y [mm] (a position where the actual force is equal to target force).
- *Velocity:*   the speed of the cylinder decreases from 3 [mm/s] (velocity of advanced force mode function) to 0 [mm/s] (stop point).
- *Force:*   the force value increases from 150 [N] (start braking force) to 200 [N] (target   force).

3. Exceed the limits:
   In this example you will see the cylinder reaction if the maximum position is exceeded before reaching the desired force.

   Add an advanced force mode to the sequencer list , then adjust it as the following :

   1. Click on velocity switch and set these values:

Uncheck activate

2. Click on limits and set these values:
   • *Max.position :*   20 mm
   • *Max.Force :*   300 N

3. Set these values:
   • *Target force :*   200N
   • *Force start braking :*   150 N
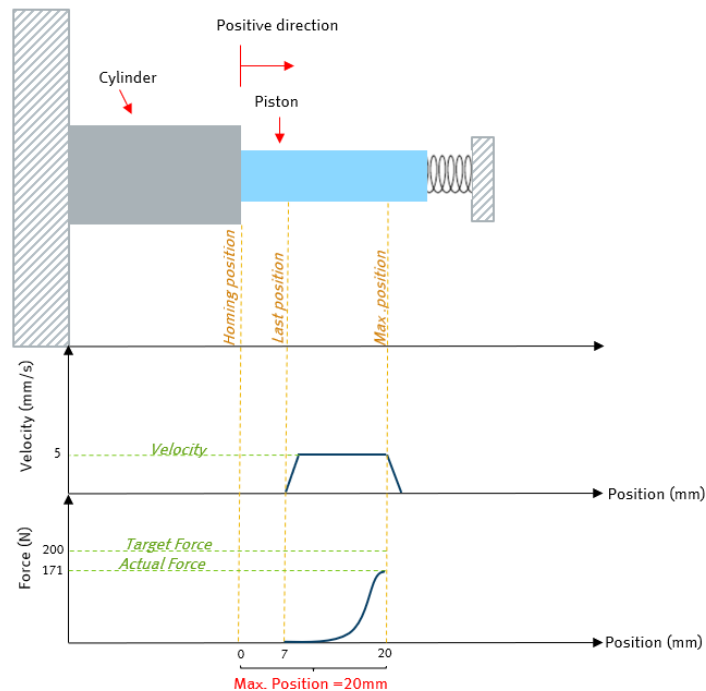   • *Velocity:*   3 mm/s

Before executing the function:
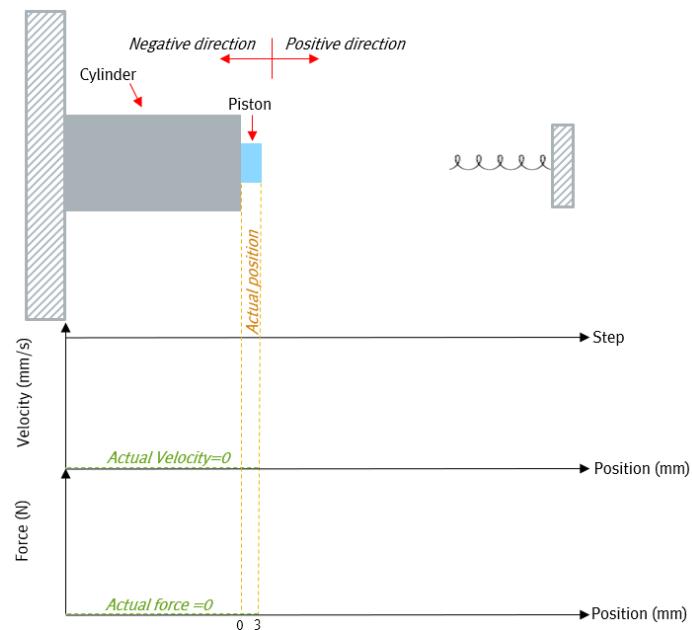
After executing this function , the cylinder started moving from the actual position (7 mm) in the positive direction, but when it reached the maximum position (20 mm) , the process was terminated (terminated at 171N) even though the pressing force didn't reach the desired force.

Conclusion „velocity switch" :

- The main advantage of the velocity switch is to set the cylinder speed high at first and then reduce the speed at a certain point to achieve the complete process more quickly.
- If you don't use the velocity switch option , then you have only one velocity value to be set. If this value is too high, that will increase the probability of overshooting issue to appear. If it is too low it will increase the cycle time of the process.   .

2.2.3   Force Control (FC)

The force control function is to achieve a certain target force and maintain this value over a defined period of time. This Function is a force regular ,meaning that the cylinder can move in the both positive/negative directions in order to reach a target force.

How to configure this function:

- **_Record:_** is an option to record a force/position curve, which results from the movement of the cylinder when executing this function.

➔ **Note :**
- Further information about using the curve to analyze the function performance , please see „AppNote Servo Press Kit YJKP - Configure_monitoring".

- *Control settings:* Force control is based on a precontrol with a PI controller. Only the I controller can be deactivated. Further information on parameters configuration is included in the *AppNote Servo Press Kit JYKP- Force control_V1.*

  - *Kv*:   Precontrol gain
  - *Kp*:   Proportional gain
  - *Ki*:   Integrator gain
  - *Act_I*:   Activation of the integrator
  - *Default parameters:*   Standard control parameters apply to each servo press size.

  These are only intended as benchmarks.

- *Velocity switch:* it is an option to move the cylinder with 2 different velocities v_max v_max_2.

  - *V_max_2 (Approach velocity):*   Velocity from the start of force control up to the middle position .
  - *V_max (velocity):*   Velocity from the middle position to the position where the force is equal to the braking value.

  Click on velocity switch to set the middle position and approach velocity (v_max_2).

  - *Act:*   Activation of velocity switch
  - *Middle position [mm]:*   At this position, the velocity starts to be reduced from v_max_2 to v_max.
  - *Approach velocity [mm/s]:* Velocity from the start of force control up to the middle position (v_max_2)

- **Limits:** If any of the limits is exceeded (other than the force tolerance), either the selected "failure reaction" is executed or the process is interrupted.

    - *Max. position [mm]:*   The process is interrupted if this position (absolute) is exceeded.
    - *Max. force [N]:*   The process is interrupted if this force value is exceeded.
    - *Time limit [ms]:*   Specifies the maximum permissible duration of force control. If the selected duration is exceeded, force control is interrupted
    - *Force tolerance [%]:*   Maximum deviation from target force as of which the tolerance is deemed complied with and holding time begins. Later non-compliance with the specified tolerance range has no effect.

➜ **Note:**
- No evaluation method! If applicable, compliance with a tolerance range must be evaluated separately.

- *Target force :* The desired press force to be applied .

    You may enter this value in one of three ways :
    - _Value:_   Input the value directly from the keyboard . It's a fixed value in the sequencer, which only can be changed by editing the program.
    - _Variable:_   The value has to be set either in the sequencer or via the host-PLC. It can be adjusted before each cycle without editing the program itself. (to see how to add variables, you may go to „variable" in page 58).
    - _Teach:_   the system will use the „actual position" value as a „target position/target distance".

- **Holding time:** The time period to maintain the desired force.

You may enter this value in one of two ways :
- _Value:_   Input the value directly from the keyboard . It's a fixed value in the sequencer, which only can be changed by editing the program.
- _Variable:_   The value has to be set either in the sequencer or via the host-PLC. It can be adjusted before each cycle without editing the program itself. (to see how to add variables, you may go to „variable" in page 58).

- **Velocity:** The maximum possible velocity during the pressing procedure (v_max).

You may enter this value in one of two ways :
- _Value:_   Input the value directly from the keyboard . It's a fixed value in the sequencer, which only can be changed by editing the program.
- _Variable:_   The value has to be set either in the sequencer or via the host-PLC. It can be adjusted before each cycle without editing the program itself. (to see how to add variables, you may go to „variable" in page 58).

Examples of how this function works

1. Using this function without velocity switch option:

1. Click on control settings and set the followings:
   - Click on Default parameters to set these parameters automatically:

   - Kv :   0.950000
   - Kp :   1.000000
   - Ki : (Active)   1.000000

2. Click on velocity switch and set these values:

   - Uncheck activate

3. Click on limits and set these values:

   - *Max.position :*   25 mm
   - *Max.Force :*   300 N
   - *Time limit :*   7000 ms
   - *Force tolerance:*   3%

4. Set these values:

   - *Target force:*   280N
   - *Holding time:*   3000 ms
   - *Velocity:*   3 mm/s

Before executing this function
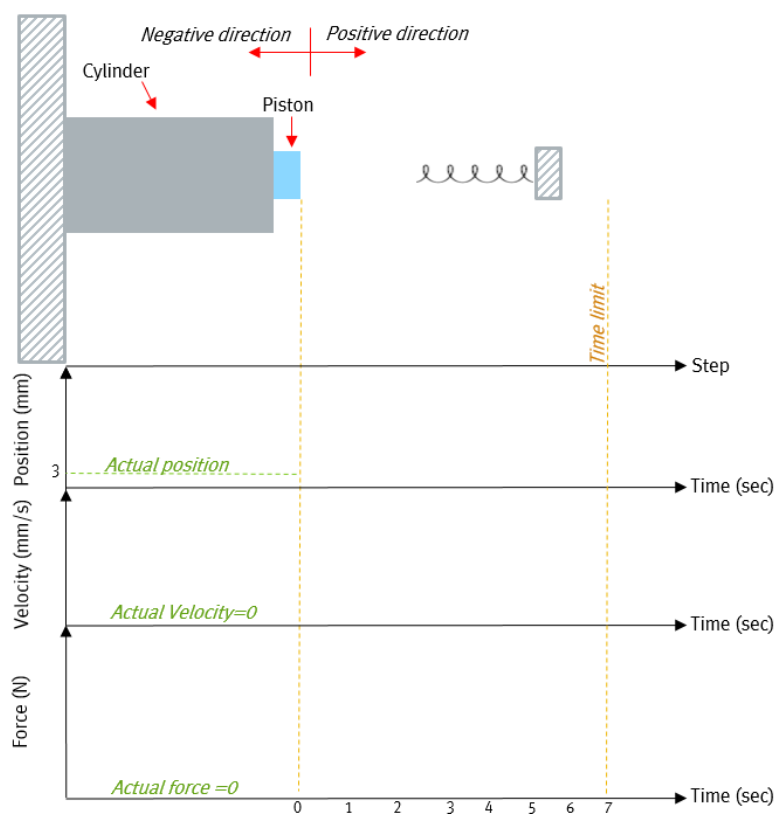
After executing this function ,the cylinder will react as shown in the figure below.
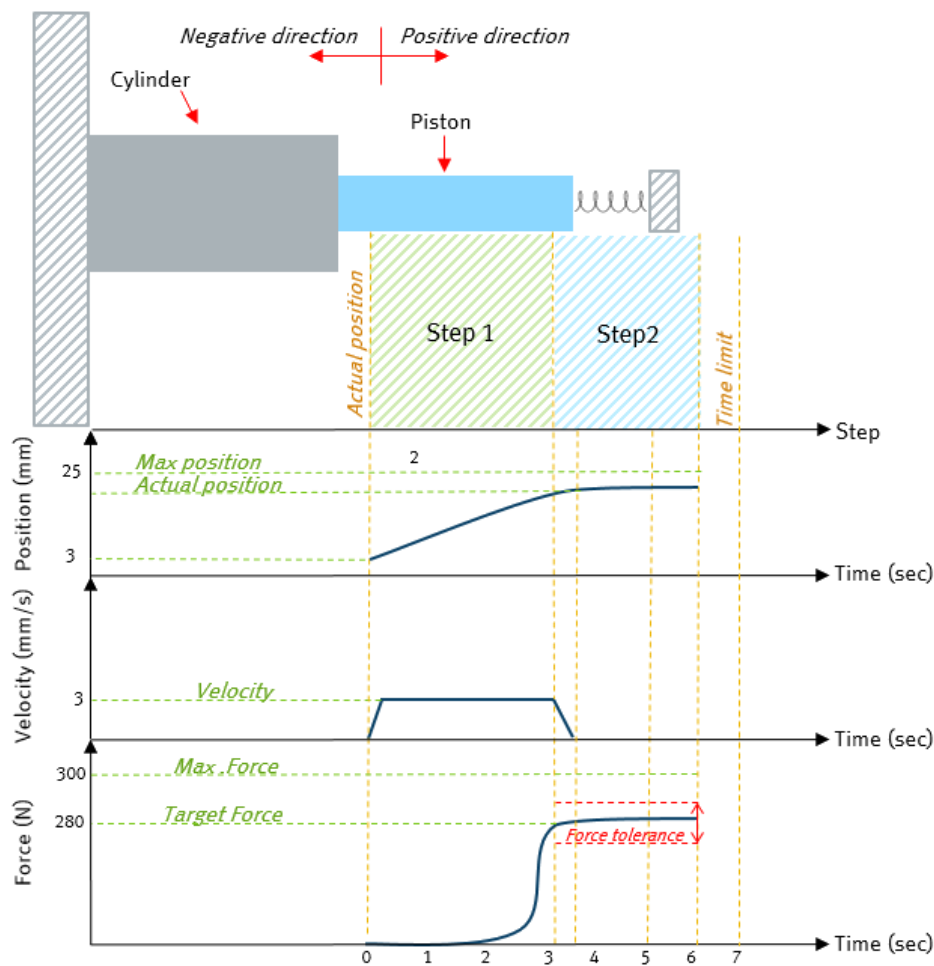
In this figure we identify only 2 steps resulting from the movement of the cylinder:

Step 1:

- *Position:*   this step starts at the position 3 [mm] (actual position) and ends at position x [mm] (a position where the actual force is equal to target force) .
- *Velocity:*   the speed of the cylinder increases from 0 [mm/s] (actual velocity) to 3 [mm/s] (velocity of force control function).
- *Force:*   the force value increases after touching the spring from 0 [N] to 280 [N] (target force).

Step 2:

- *Position:*   the cylinder will remain at x position (a position where the actual force = Target force) for 3 seconds.
- *Velocity:*   the speed of the cylinder decreases from 3 [mm/s] (velocity of force control function) to 0 [mm/s] (stop point).
- *Force:*   When the sensor reading reaches the value of 280 N (target force) , the PI controller will maintain this value for 3 seconds by moving the cylinder in the positive and negative direction as long as the value of the actual force doesn't exceed the force tolerance domain .

2. Using this function with velocity switch option:

   1. Click on control settings and set the followings:
      - Click on *Default parameters* to set these parameters automatically:
      - Kv :   0.950000
      - Kp :   1.000000
      - Ki : (Active)   1.000000

   2. Click on velocity switch and set these values:
   - *Check activate*
      - *Middle position :*   12.5 mm
      - *Approach velocity :*   6 mm/s

   3. Click on limits and set these values:
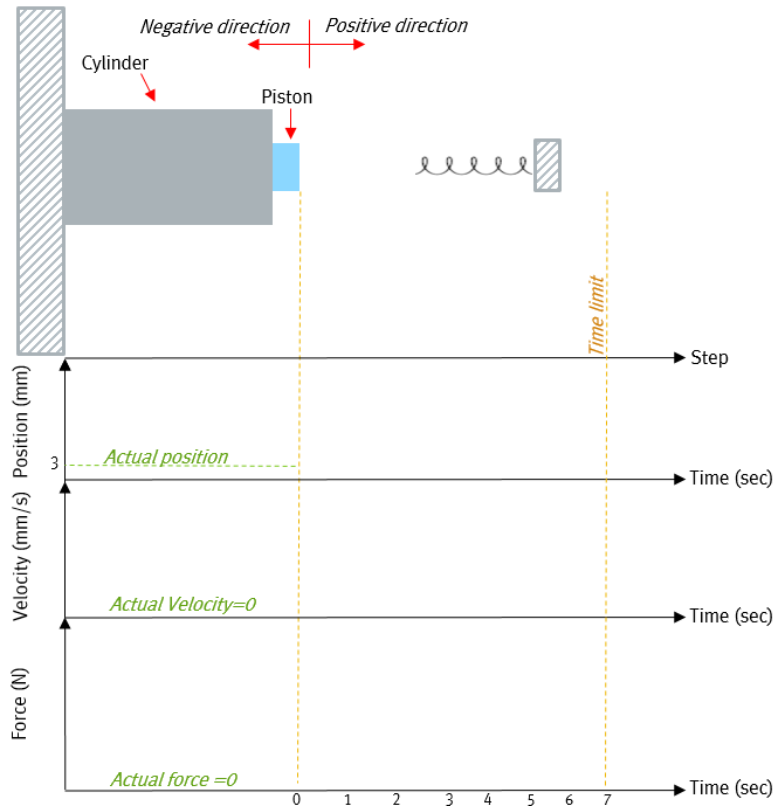   - *Max.position :*   25 mm
      - *Max.Force :*   300 N
      - *Time limit :*   7000 ms
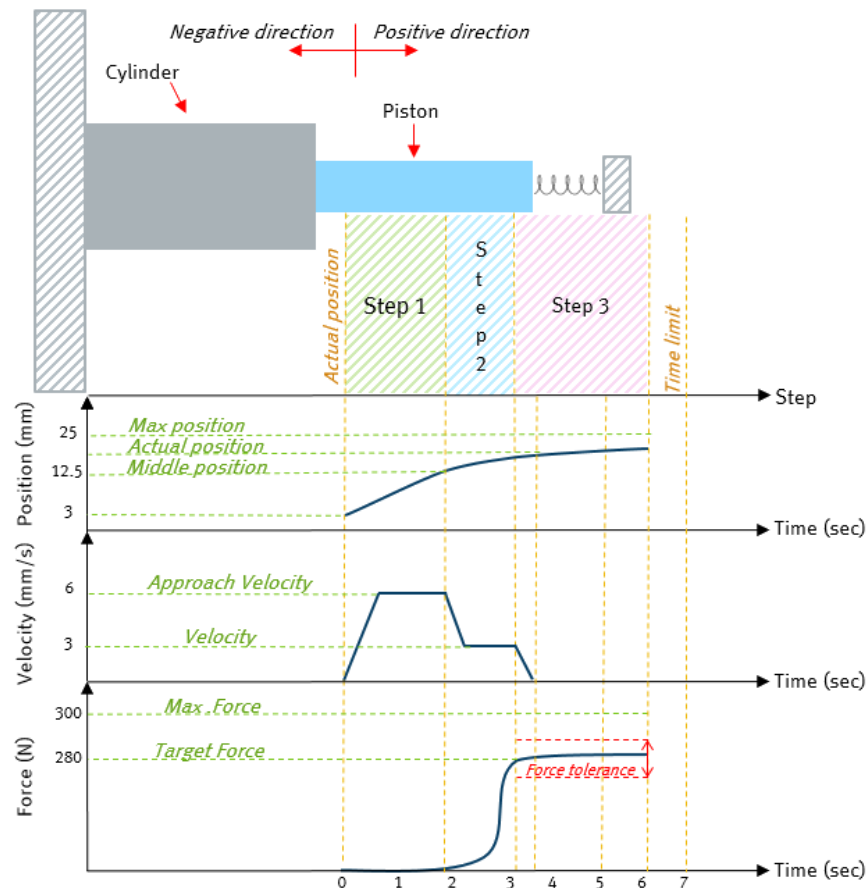   - *Force tolerance:*   3%

4. Set these values:
   - *Target force :*   280N
   - *Holding time :*   3000 ms
   - *Velocity:*   3 mm/s

Function	Force control ▼
☐ Record	**Control settings**
	Velocity switch
	Limits
Target force	280.00 N ▼
Holding time	3000 ms ▼
Velocity	3.00 mm/s ▼

Before executing the function:

After executing this function, the cylinder will react as shown in the figure below.

In this figure we can identify 3 steps resulting from the movement of the cylinder:

Step 1:
- *Position:* this step starts at the position 3 [mm] (actual position) and ends at 12.5 [mm] (middle position).
- *Velocity:* the speed of the cylinder increases in this step from 0 [mm/s] (actual velocity) to 6 [mm/s] (approach velocity).
- *Force:* the value of press force value remains at 0 [N].

Step 2:
- *Position:* this step starts at the position 15 [mm] (middle position) and ends at x [mm] (a position where the actual force is equal to brake force value).
- *Velocity:* the speed of the cylinder decreases from 6 [mm/s] (approach velocity) to 3 [mm/s] (velocity of advanced force mode function).
- *Force:* the force value increases immediately after touching the spring from 0 [N] to 280 [N] (Target force).

Step 3:
- *Position:* the cylinder will remain at x [mm] position (a position where the actual force = Target force) for 3 seconds
- *Velocity:* the speed of the cylinder decreases from 3 [mm/s] (velocity of force control function) to 0 [mm/s] (stop point).
- *Force:* In this step , a PI controller will maintain the target force on the value of 280N for 3 seconds by moving the cylinder within the force tolerance domain .

Conclusion „velocity switch":

- The main advantage of the velocity switch is to set the cylinder speed high at first and then reduce the speed at a certain point to complete the press process more quickly.
- If you don't use the velocity switch option , then you have only one velocity value to be set. If this value is too high, that will increase the probability of overshooting issue to appear. If it is too low , it will increase the cycle time of the process.

3. Exceed the limit:

In this example ,you will see how the system responds if the limits are exceeded

5. Click on control settings and set the followings:
   - Click on Default parameters to set these parameters automatically:

   - Kv :   0.950000
   - Kp :   1.000000
   - Ki : (Active)   1.000000

6. Click on velocity switch and set these values:
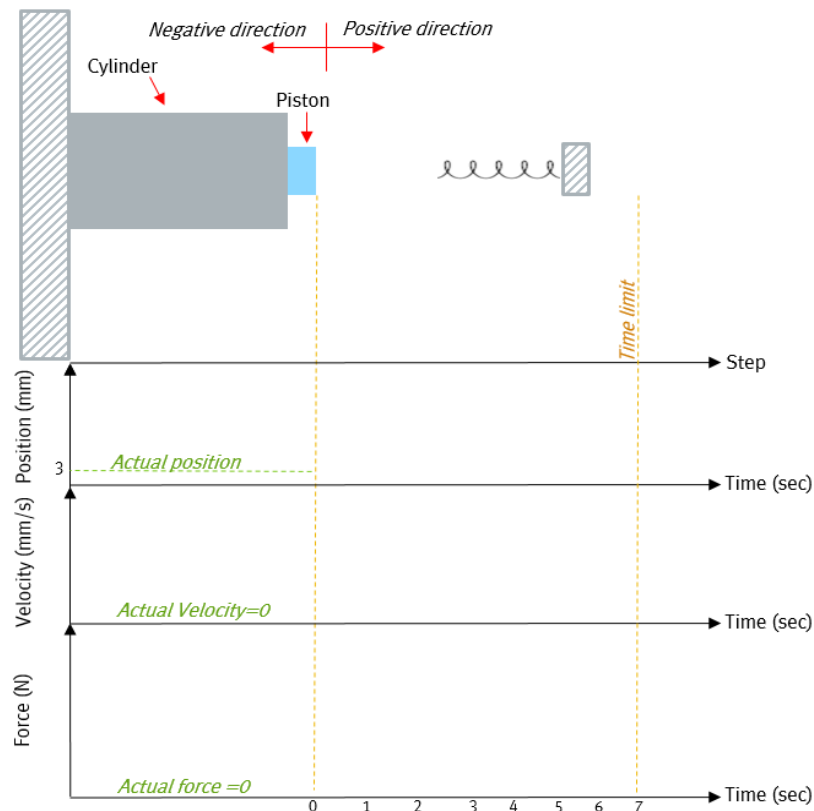   - Uncheck activate

7. Click on limits and set these values:
   - *Max.position :*   25 mm
   - *Max.Force :*   300 N
   - *Time limit :*   3000 ms
   - *Force tolerance:* 3%

8. Set these values:
   - *Target force:*   280N
   - *Holding time:*   3000 ms
   - *Velocity:*   3 mm/s

Before executing this function

After executing this function , the cylinder started moving from the actual position (7 mm) in the positive direction, but when the time limit is exceeded (3000 ms) , the process was terminated (terminated at 273N) even though the pressing force didn't reach the desired force .
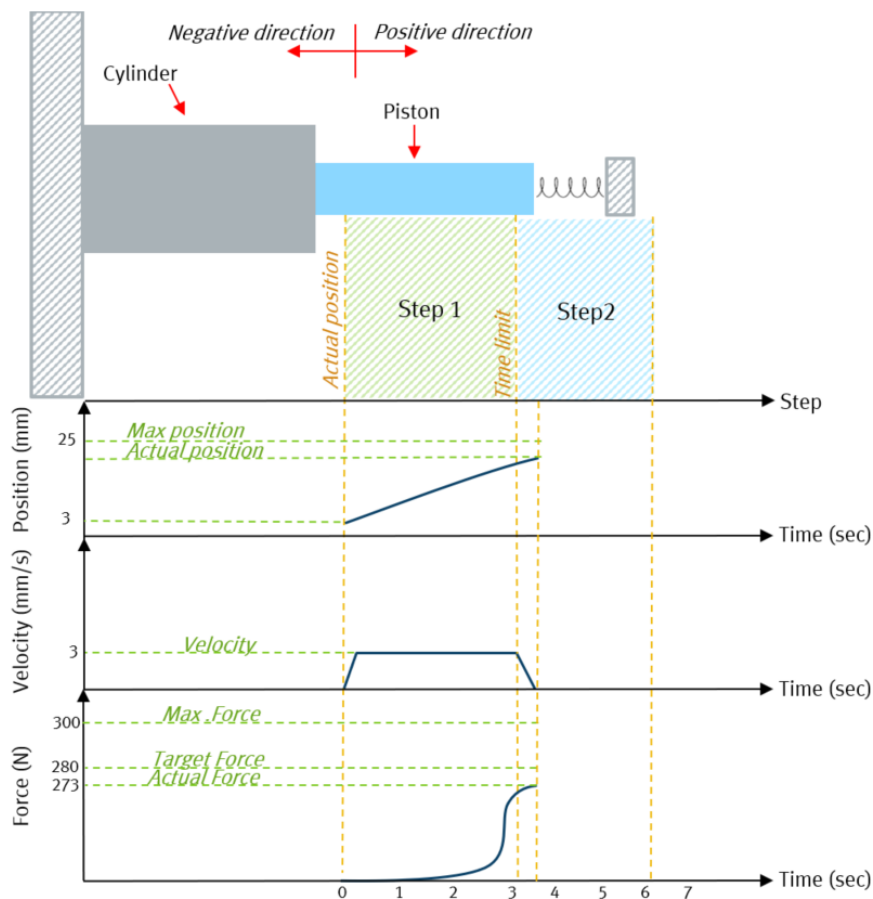
2.2.4 Summary

The differences among the „force control" , „advanced force mode" , and „force mode" are :

- Force mode :It is a function for moving the cylinder in the positive direction only. This step is considered to be completed once the desired force value is reached , after that another function in the sequencer is set to be executed . The movement is stopped <u>after</u> reaching the target force.

- Advanced force : It is a function for moving the cylinder in both the positive and the negative directions. This step is considered to be completed once the desired force value is reached , after that another function in the sequencer is set to be executed . The stopping of the movement can be directly modified by an internal braking ramp <u>before</u> reaching the target force.

-

- Force control :It is a function for moving the cylinder in both the positive and negative directions . Once the desired value is reached it uses the PI controller to maintain this value for a certain amount of time .

2.3 Digital signal mode (DSM)

It is a function to read a digital input during the movement of the cylinder.

The cylinder moves at a specific speed awaiting a configured digital input before reaching a maximum position.

Here we can define 2 cases:

- If the digital input value becomes true before the cylinder reach the max position, this step will be passed , and the next step will be executed.
- If the cylinder reaches the maximum position without a signal at the digital input (input value = false), the process will be aborted and the press status will indicate not ok (NOK).

This function is used in many applications that need to use external sensors at the input of plc, such as using a distance measurement sensor.

How to configure this function:

- *Record:* is an option to record a force/position curve, which results from the movement of the cylinder when executing this function.

➔ **Note :**
- Further information about using the curve to analyze the function performance , please see „AppNote Servo Press Kit YJKP - Configure_monitoring".

- **Position method:**
    - *Absolute:*　it is a method to move the cylinder to a target position based on the homing position of the cylinder.
    - *Relative:*　it is a method to move the cylinder a certain distance based on the current position of the cylinder.

- **Digital signal:** definition of the digital input, which is used to read the digital signal.

    You can define one of 16 inputs to read:
    - 8 hardware inputs directly at the press controller CECC-X-M1-YS (X2.0 … X2.7)
    - 8 <u>virtual</u> inputs via the host interface of the higher-order controller (digital inputs bit 9 … bit 16)

- **Maximum position** [mm] **/ Maximum distance [mm]:** The process is interrupted if this position/distance is exceeded.

    You may enter this value in one of three ways :
    - *Value:*　Input the value directly from the keyboard . It's a fixed value in the sequencer, which only can be changed by editing the program.
    - *Variable:*　The value has to be set either in the sequencer or via the host-PLC. It can be adjusted before each cycle without editing the program itself. (to see how to add variables, you may go to „variable" in page 58).
    - *Teach:*　the system will use the „actual position" value as a „target position/target distance".

- **Velocity [mm/s]:** Velocity from the start of digital signal mode up to the maximum position (absolute)/maximum distance (relative).

    You may enter this value in one of three ways :
    - *Value:*　Input the value directly from the keyboard . It's a fixed value in the sequencer, which only can be changed by editing the program.
    - *Variable:*　The value has to be set either in the sequencer or via the host-PLC. It can be adjusted before each cycle without editing the program itself. (to see how to add variables, you may go to „variable" in page 58).

Example of how to adjust a digital signal mode:

Description of the application:

In a servo-press system , a spring is pressed by using 2 functions :

1. The first function is "digital signal mode ", this function checks the position of the piece via the position sensor that is connected to the X2.0 controller input .
2. The second one is a force mode.

In this example you can see the difference between using „Absolute" and „Relative method" in the digital signal mode :

1. *by using an absolute position method :*

   a) Add " digital signal mode" to the sequencer list and set the following values :

   - *Position method:*   check absolute
   - *Digital signal :*   DI 1 (X2.0)
   - *Maximum position:*   20 mm
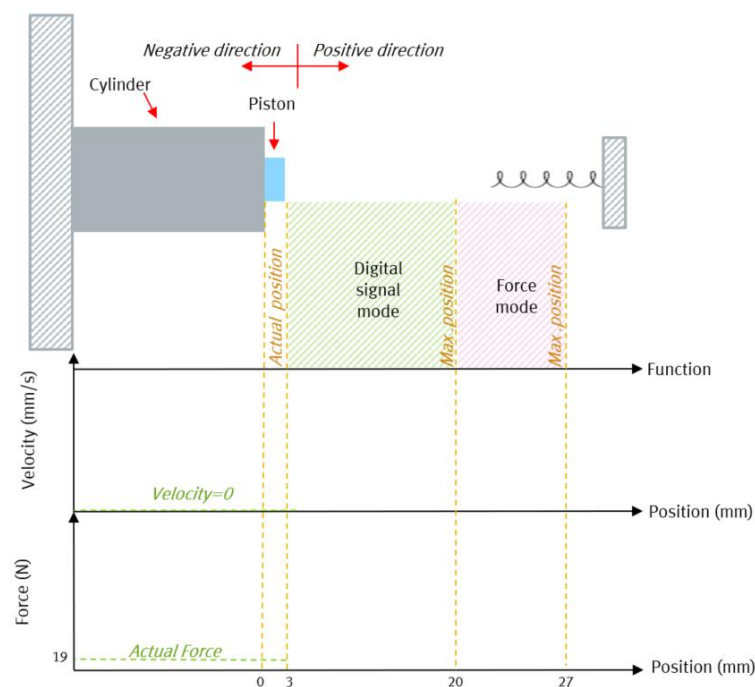   - *Velocity :*   5 [mm/s]

   b) Add "force mode " and set these values :

   - *Position method :*   Check Absolute
   - *Target force:*   200 [N]
   - *Maximum position :*   27 [mm]
   - *Velocity :*   5 [mm/s]

Before executing the function: Actual position =3 [mm] , velocity = 0 [mm/s]

After executing the function: When executing this function , the system can response in two ways depending on the signal of the X2.0 controller input :

1.1. <u>First case :</u> The cylinder moves from actual position to max position ,but the status of the X2.0 controller input remains false (meaning there is no signal from the sensor output that is connected to the controller input). In this case the cylinder will brake and stop at position 20 mm. The force mode function will NOT be executed.

The process will be aborted at this step with a NOK result.

In this figure you can see the movement of the cylinder when executing :
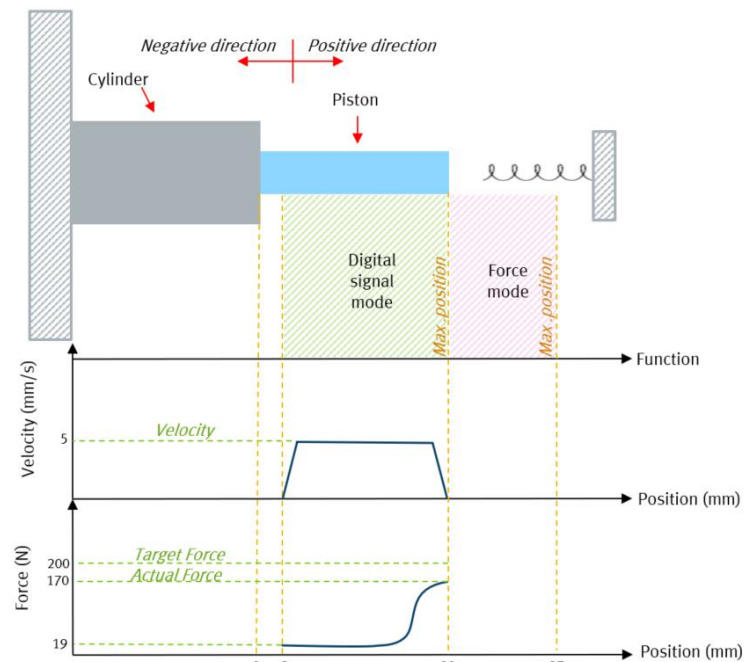
1.2. <u>Second case :</u> The cylinder moves from actual position to max position. The status of the X2.0 controller input is changed to TRUE at position 10 mm, The system will stop and start to execute the force mode function .

The following figure demonstrates the cylinder working mechanism .
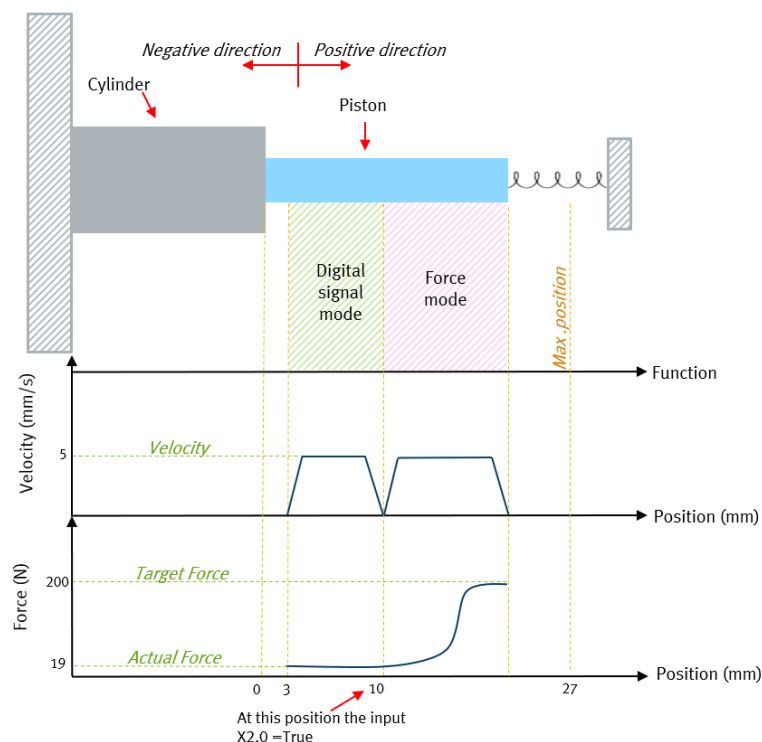
2. _by using a relative method :_

a) Add "digital signal mode" and set the following
values :

- _Position method:_   check relative
- _Digital signal :_   DI 1 (X2.0)
- _Maximum distance:_   20 mm
- _Velocity :_   5 [mm/s]

| Function	Digital signal mode ▼
☐ Record	
Position method	
☐ Absolute	■ Relative
Digital signal	DI 1
Maximum distance	20.00 mm ▼
Velocity	5.00 mm/s ▼

b) Add "force mode" and adjust it as follows :

- _Position method :_   Check Absolute
- _Target force:_   200 [N]
- _Maximum position :_   27 [mm]
- _Velocity :_   5 [mm/s]

Function	Force mode ▼
☐ Record	
Position method	
■ Absolute	☐ Relative
Target force	200.00 N ▼
Maximum position	27.00 mm ▼
Velocity	5.00 mm/s ▼

The following figuer demonstrates the YJKP system mechanism when using digital signal mode.

Before executing the function: Actual position =3 [mm] , velocity = 0 [mm/s] , actual force = 19 [N]
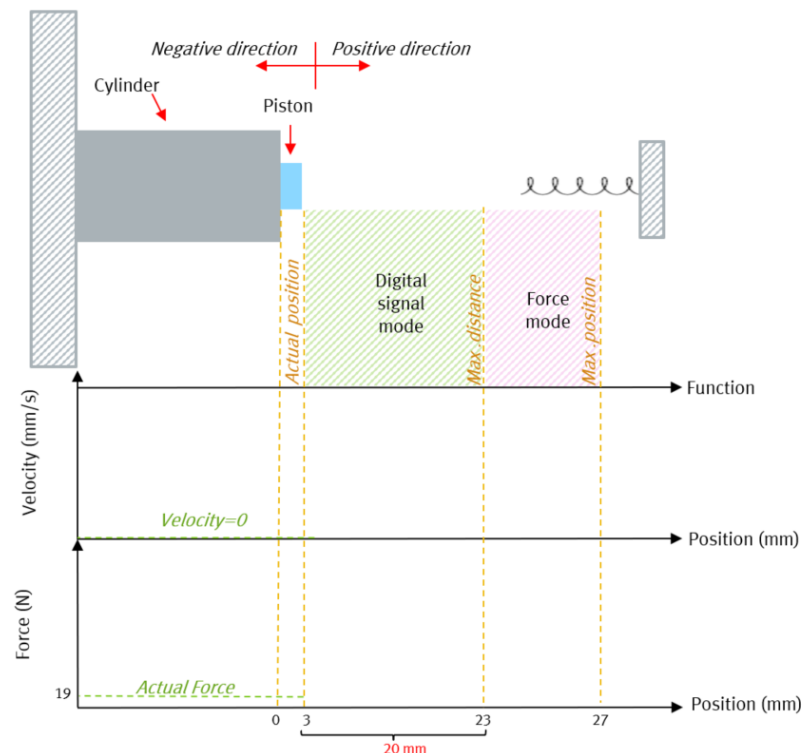
After executing the function: When executing this function the system can respond in two ways depend-ing on the X2.0 controller input signal :

First case : The cylinder moves from actual position to max position, but the status of the X2.0 controller input is FALSE (meaning there is no signal from the sensor output that is connected to the controller input) , in this case the cylinder will brake and stop position 23 mm. The force mode function will NOT be executed ,and the process will be aborted at this step with a NOK result.

In this figure you can see the cylinder movement when executing .
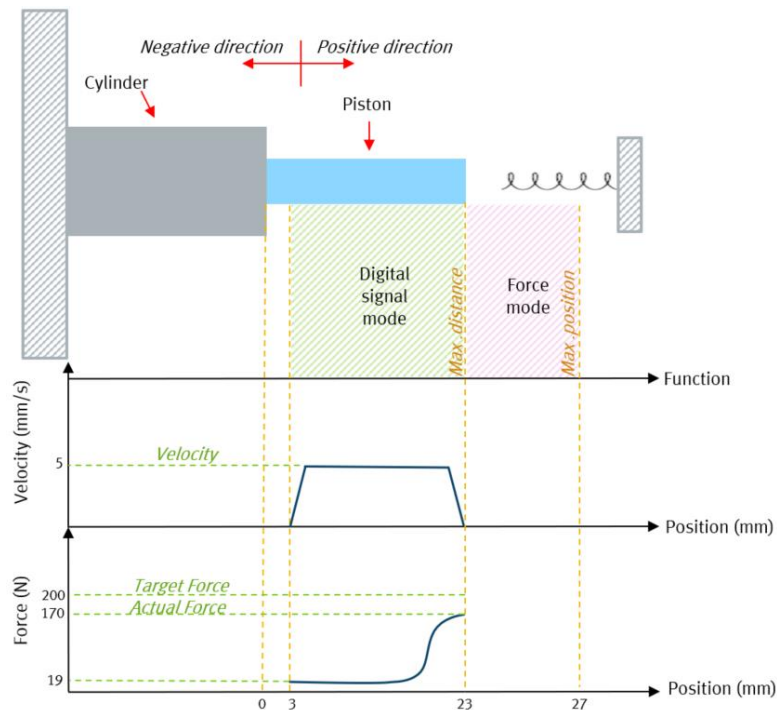
2.2　Second case : The cylinder moves from actual position to max position. The status of the X2.0 controller input is changed to TRUE at position 10mm. The system will stop and start to execute the force mode function .
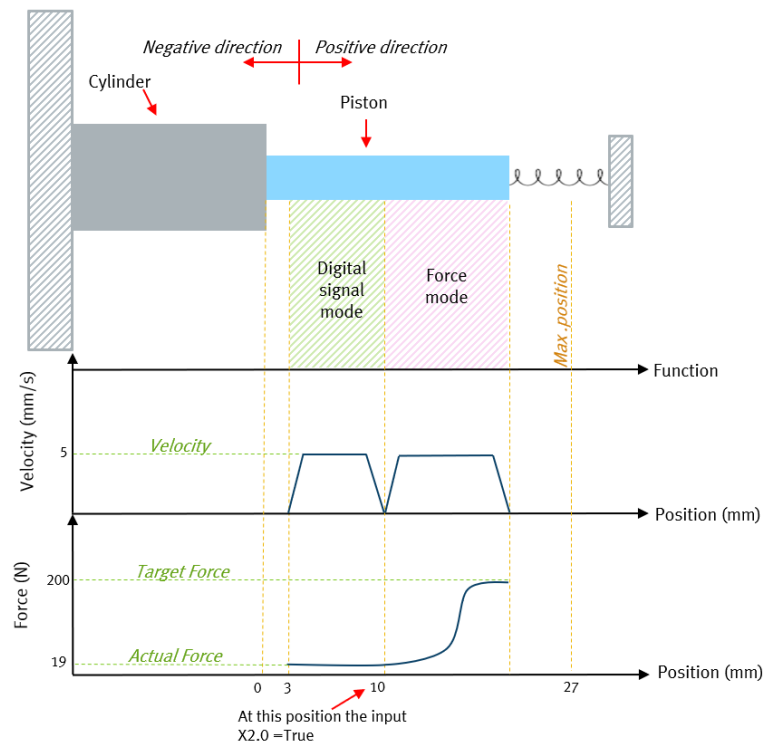
2.4   Delay time (DT)

It is a timer used to add a certain amount of time before executing the next step in sequencer..

Function	Delay time ▼
Time	0 ms ▼

Example:

In this example we will use delay time function so the system will wait for 3 seconds before executing the position mode function .

How to configure it:

1. Insert a delay time function and set this value:

   • *Time :*   3000 ms

| Function	Delay time ▼
Time	3000 ms ▼

2. Insert a position mode function, and set these values:

   • *Position method :*   Absolute
   • *Target position*:   10 mm
   • *Maximum Force :*   30 N
   • *Velocity :*   5 mm/s

Function	Position mode ▼
☐ Record	
Position method	
■ Absolute	☐ Relative
Target position	10.00 mm ▼
Maximum force	30.00 N ▼
Velocity	5.00 mm/s ▼

In the following figures you can see the curves of the position and the speed before and after executing the program .

Before exceuting :
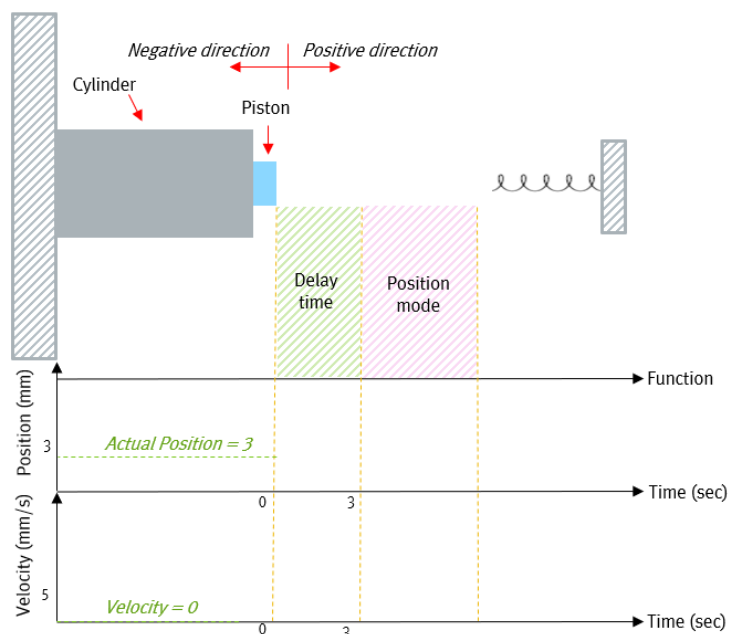
After exceuting : When the function is executed the system will wait for 3 seconds at 3 mm location before moving to the position 10 mm.
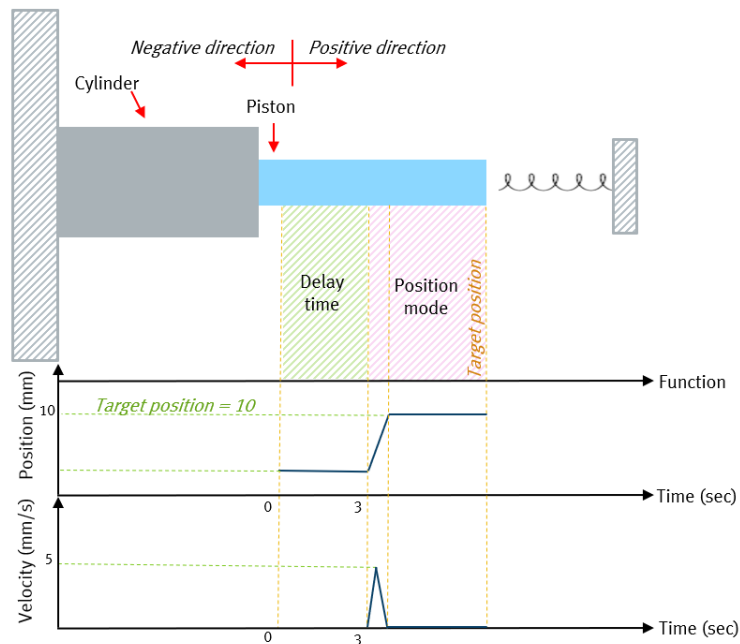
2.5   Tare (Tare)

It is a function used to manipulate the actual force value .

When implementing the YJKP device , you can notice that the actual force value in WebVisu do not equal zero (as shown in the below figure). This value is a result of the system implementing method (horizontal or vertical) and the weight of the mechanical parts, that is mounted to the press . Thus when you need to press with a certain amount of force , the actual force needs to be reset before starting the pressing process .
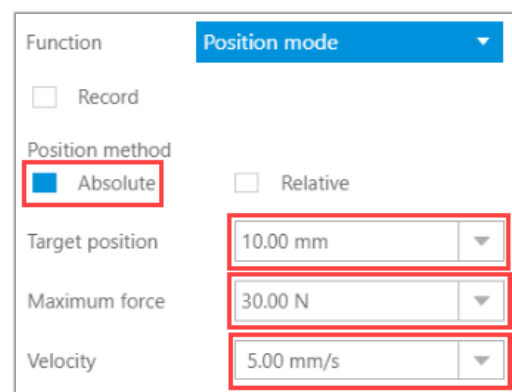
How to configure this function:

- **Check tare :**   Activate/Deactivate this function.
- **Offset :**   This value is added to the actual force value.

Example:

This example program consists of 2 functions: Tare function and position mode.

1. position mode function:
   - *Position method* :   check Absolute
   - *Target position* :   10 [mm]
   - *Maximum Force* :   30 [N]
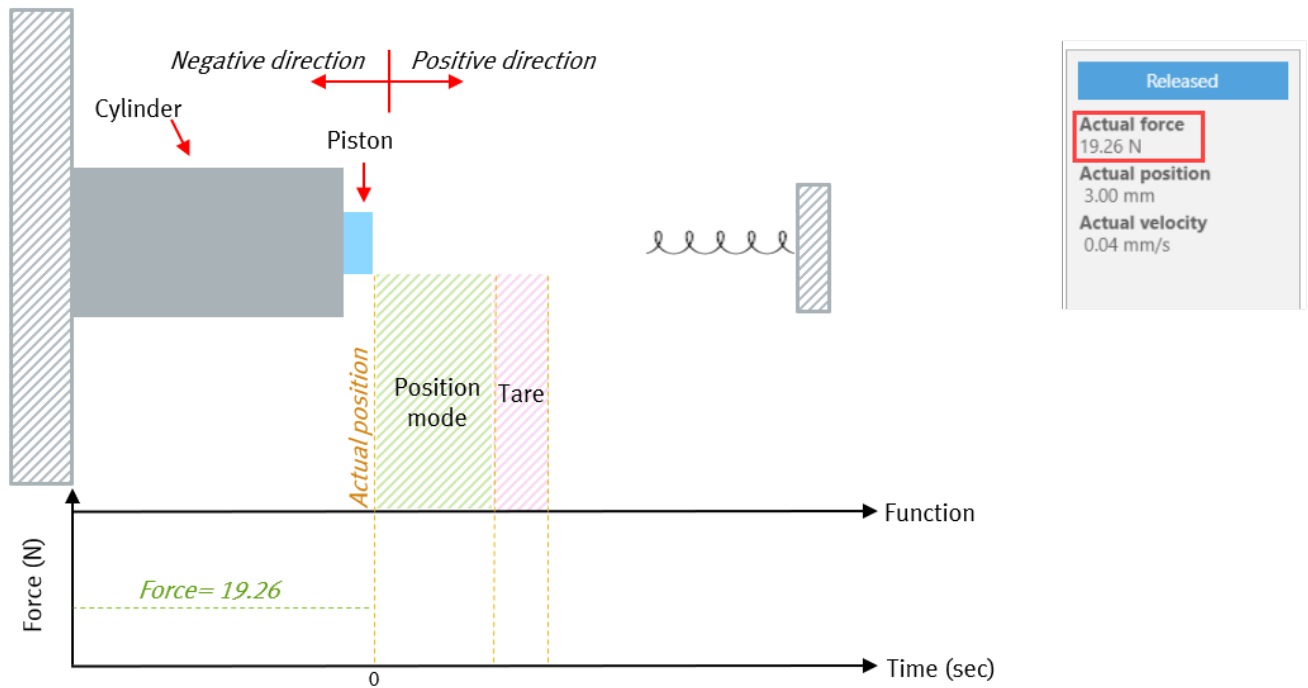   - *Velocity:*   50 [mm/s]

2. Tare function :
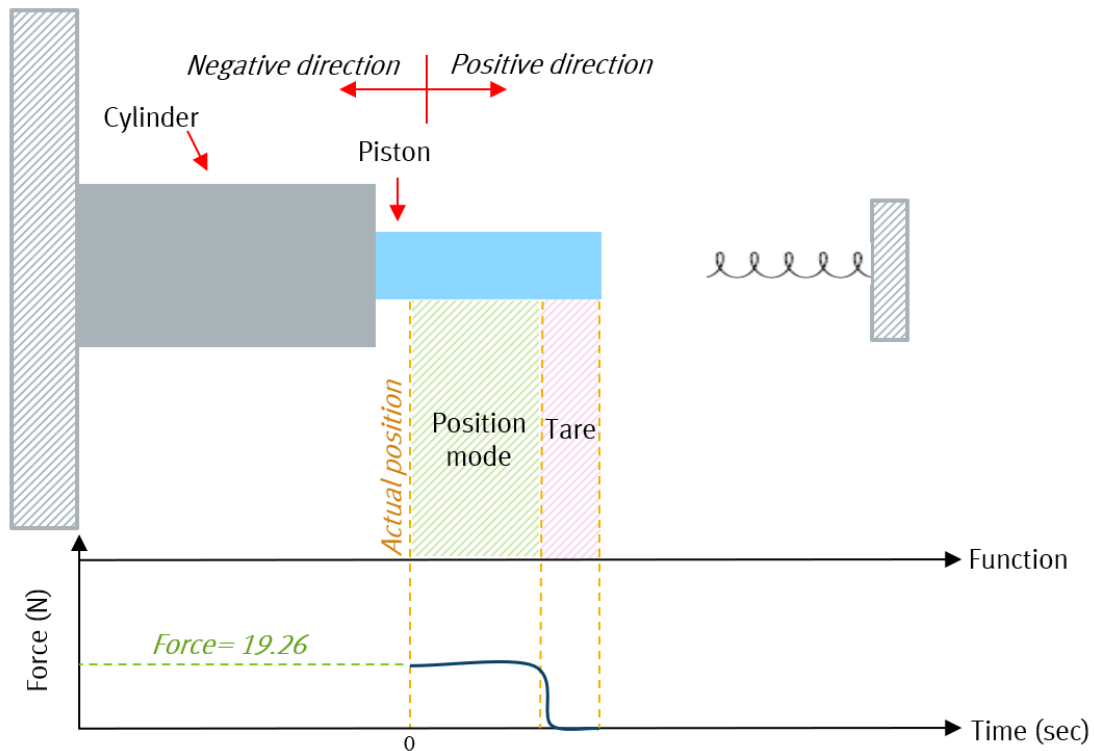   - *Tare :*   Active
   - *Offset:*   0 [N]

Before executing the program: The actual force is 19.26N (this values varies depending on the application (tools, workpiece,…).

This figure demonstrates the situation of the cylinder before executing :

After executing the program:

From the previous figure you can notice that when executing the program the force curve in the first stage (position mode) maintained a value of 19.26 N . In the second stage (Tare) the force value reduces to 0N (the value that is set as an offset in the Tare function)

➜ **Note :**
- The function „Tare" must be used with caution. If it's executed in the wrong place, it leads to wrong results of the press cycle.

Example:

"Tare" is used as the first step of a sequence.

- Case 1 = good case:
  Press is in start position without an applied force. Actual force (i.e. 20N) is tared to 0N, which means a delta of 20N. Process can continue.

- Case 2 = bad case:
  Press has an applied force, because of a previous wrong cycle. Actual force is 200N. If the function is executed in that moment, it is also set to 0N, but with a delta of 200N between real and software force value.

Tare function should only be executed in steps of the sequencer, where the customer is sure that a certain defined state exists.

2.6   Read input (RI)

It is a function to use the controller inputs as a condition to complete or stop the program .

You can use this function in many applications , like using a position sensor that is connected to one of the inputs to check that a part is in the right position before starting the pressing process .

For example, add this function to your pressing sequence and define the condition for this input. The input status will be read. when it reaches this step , if the status is TRUE it will proceed in the program , and if the value is FALSE then the condition is not valid ,the process will stop and wait for that signal.

How to configure this function:

Input:

1. Choose the desired controller input that needs to be read .
2. Set the value of the chosen input that needs to be checked when executing the program .

➜   **Note :**

- You can set up to 16 controller input , whereas.

- 8 hardware inputs directly at the press controller CECC-X-M1 (X2.0 ….X2.7)
  (DI 1 …DI 8 = X2.0 … X2.7)
- 8 virtual inputs via the host interface of the higher-order controller (digital inputs bit 9 … bit 16)

2.7   Set output(SO)

It is a function for setting the outputs of the controller on a certain value (True or False) when the sequencer reaches this step .

This function is used in a lot of applications like controlling pneumatic valves , where these valves will move the pieces from the pressing location to another location after finishing the pressing process .

How to configure this function:

Output:

1.   Choose the controller output that needs to be read .
2.   Set the controller output value

➡   **Note :**
- You can set up to 12 controller outputs , whereas.

- 4 hardware outputs directly at the press controller CECC-X-M1-YS (X4.0 … X4.3) (DO 1… Do 4= X4.0 … X4.3)
- 8 virtual outputs via the host interface of the higher-order controller (digital outputs bit 9 … bit 16)

2.8   Variable(Var 1)

It is a function that is used to set values to variables and then use these values in other functions .

How to configure this function:

Variable:
1. Enter the number of the variable that needs to be changed .
2. Set the variable value .

2.9 Jump (JP)

It is a function that is used to jump into another step if the entered condition is valid .

How to configure this function:

As you can see in the previous figure , this function consists of 3 main fields :
1. The condition that needs to be fulfilled for jumping into another step .

   The WebVisu allows you to choose from many options and processes to create the condition statement as it is shown in the following figure :
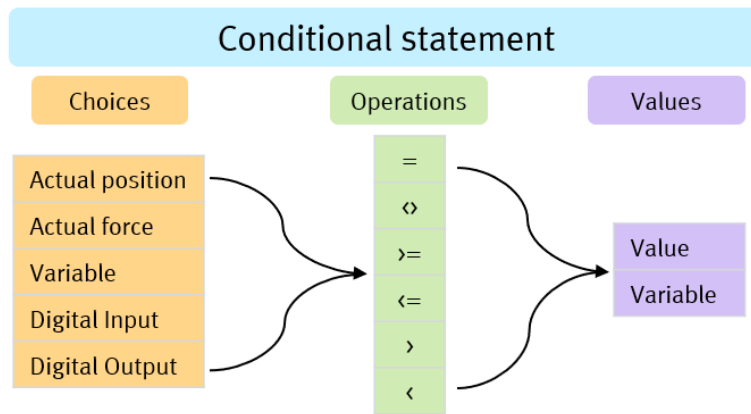
2. Here you can set the target step that needs to be jumped to in case the condition is true .
    - Step: Set the step number that needs to be jumped to .
    - Next Step: The program will execute the next step.
    - End: The system will move to the last step of the sequencer .

3. This is an option for executing another jump task in case the condition is invalid . If you press Active else , the following window will appear :

-   Step: Set the step number that needs to be jumped to .
-   Next Step: The program will execute the next step.
-   End: The system will move to the last step of the sequencer.

Example:

In a YJKP system that consists of 3 functions :

1. Position mode
2. Jump function :set these values:
   - *IF Condition :*   Actual position = 10.00mm
   - *Then Jump to :*   Next step
   - *Activate Else*
   - *ELSE Jump To :*   Step 1
3. Force Control

When executing this program the system in this step will check, if the actual position equals 10.00 mm. If it is true, it will move to the next step (force mode) , or else it will move to the first step (position mode).