How to run a simulation in CATIA V5: piston and cylinder mechanism

This guide shows you how to run a simulation in CATIA V5 for a piston and cylinder assembly. You create a mechanism, fix the cylinder, add a cylindrical joint, and drive the piston along its axis. You then set the piston travel range, loop the motion, and slow the playback so you can watch the piston move.

Prerequisites

Before you start, make sure you have the following:

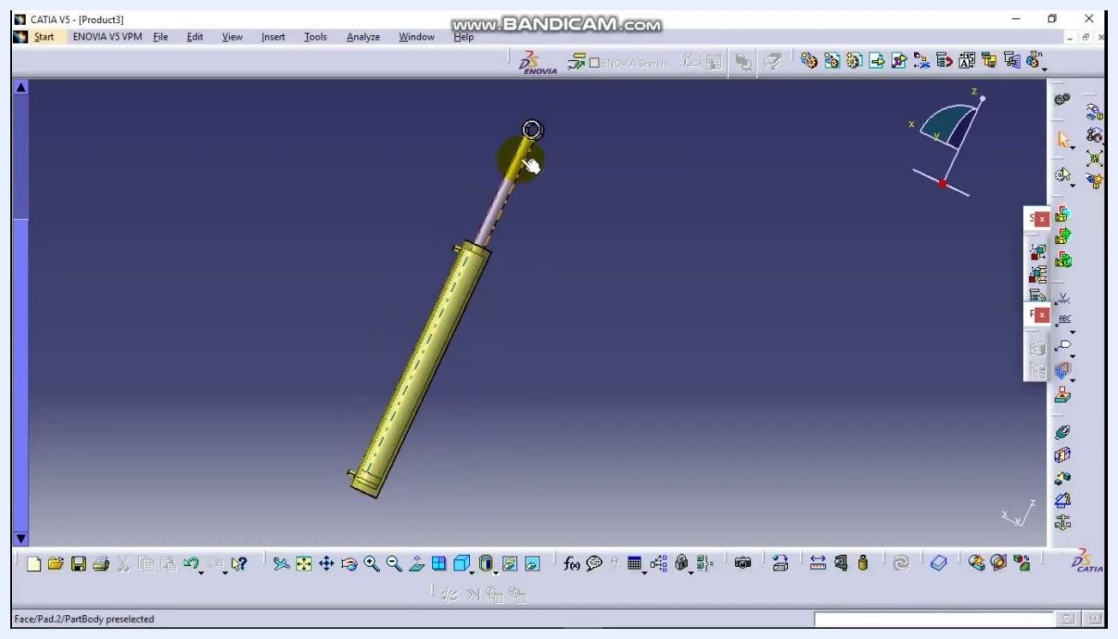
- A piston part and a cylinder part, fully assembled in CATIA V5.
- The correct product file open (for example, Product3), with the assembled model visible in the main view area.

The piston and cylinder move with a cylindrical movement. The piston travels up and down inside the cylinder.

Set up the simulation environment

Step 1. Open the assembled model

Open your assembled piston and cylinder model. Confirm that the main view area displays the assembly and that you are working in the correct product file.



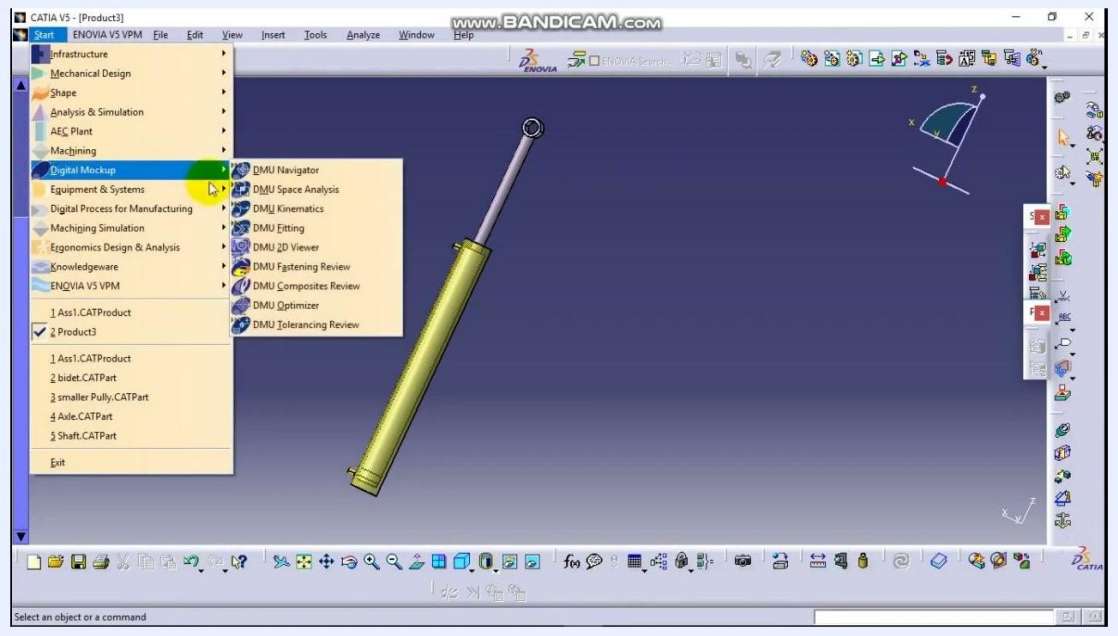
CATIA V5 window showing the assembled piston and cylinder model, with the main toolbar and navigation cube visible

Step 2. Open the simulation workbench

To run a simulation in CATIA, first enter the kinematics workbench:

1. Click **Start** in the top menu.
2. Hover over **Digital Mockup**.

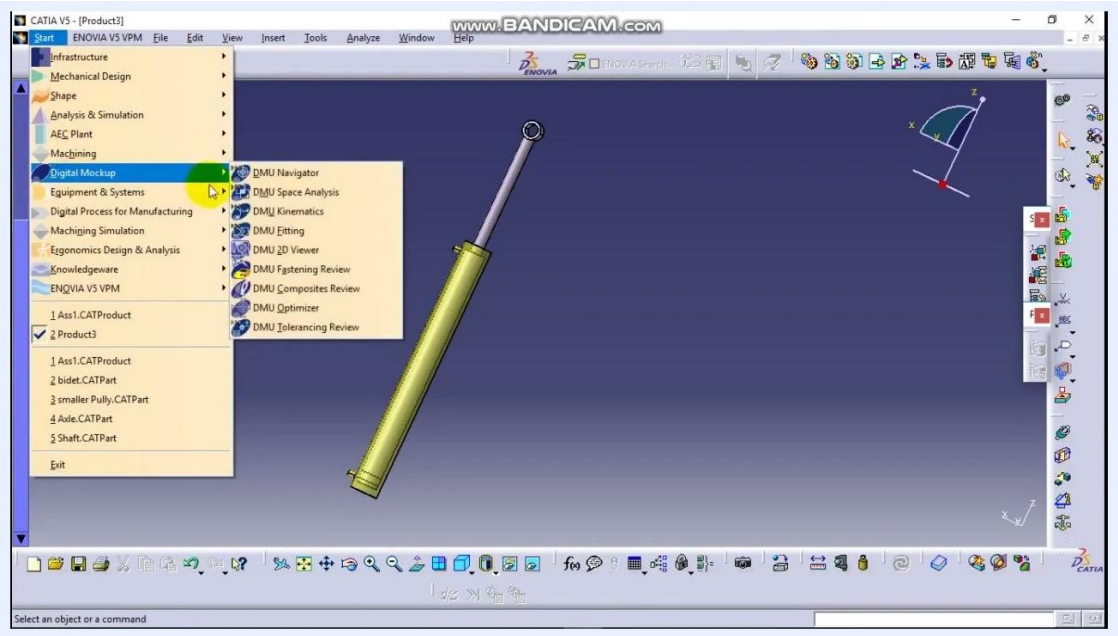
3. Select **DMU Kinematics** in the submenu.



The Start menu open with Digital Mockup highlighted and DMU Kinematics visible in the submenu

Step 3. Zoom in on the cylinder

Use the zoom and pan tools to focus on the cylinder. This makes the part easier to select in the next step.



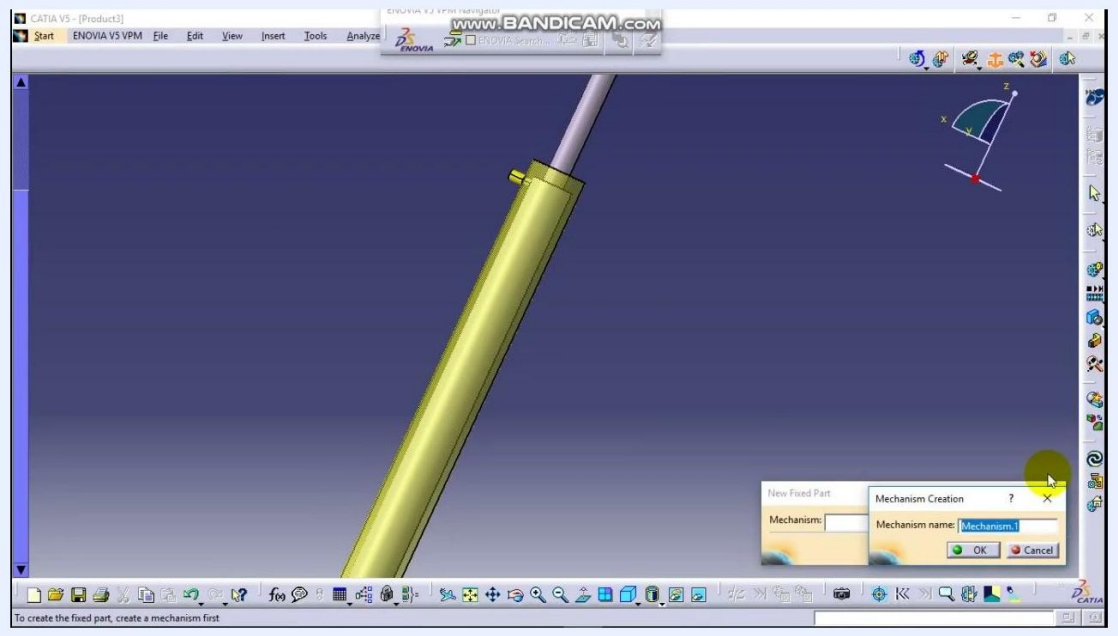
The 3D view zoomed in on the cylinder, ready for part selection

Step 4. Create a mechanism and fix the cylinder

Decide which part stays stationary and which part moves. Here, the cylinder is fixed and only the piston moves.

Select the cylinder, then right-click it or use the simulation toolbar to choose the option to fix the part. If CATIA prompts you, you must create a new mechanism first.

1. When the "New Fixed Part" dialog appears, choose to create a new mechanism.
2. In the "Mechanism Creation" dialog, enter a name. You can use any name, such as Mechanism.1, Simulation1, or Mechanism1.
3. Click **OK**.

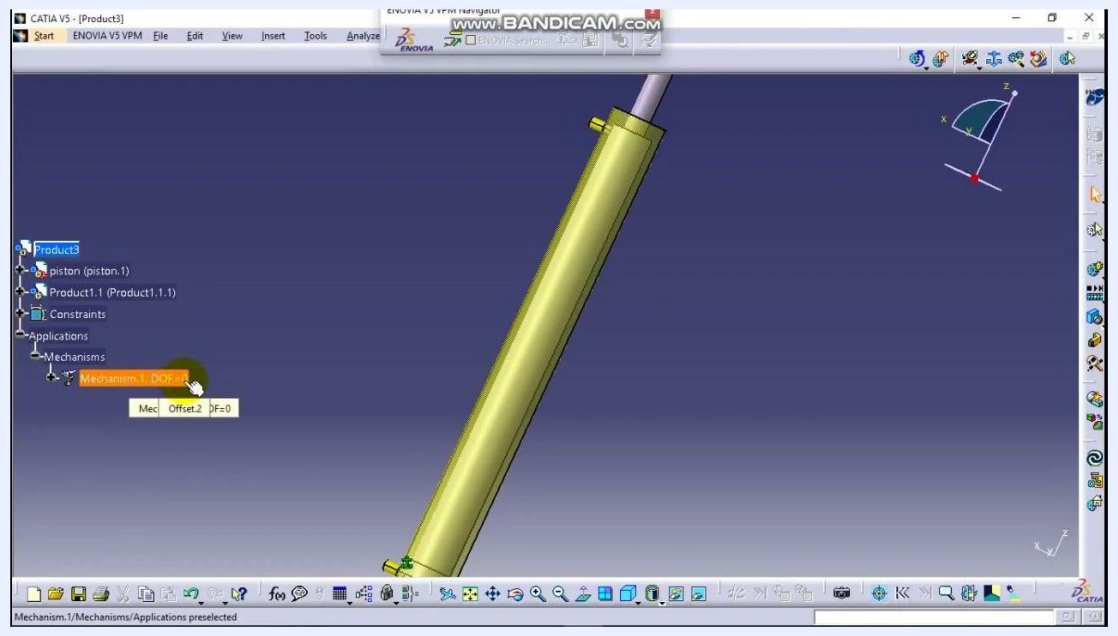


The Mechanism Creation dialog with Mechanism.1 entered as the name and the OK and Cancel buttons visible

Step 5. Verify the fixed part and the mechanism

Confirm that the cylinder is the fixed part and that CATIA created the mechanism. In the model tree on the left, expand **Applications > Mechanisms** and check that Mechanism.1 is listed.

The mechanism shows DOF=0 (zero degrees of freedom). This means it is ready for joint definition.



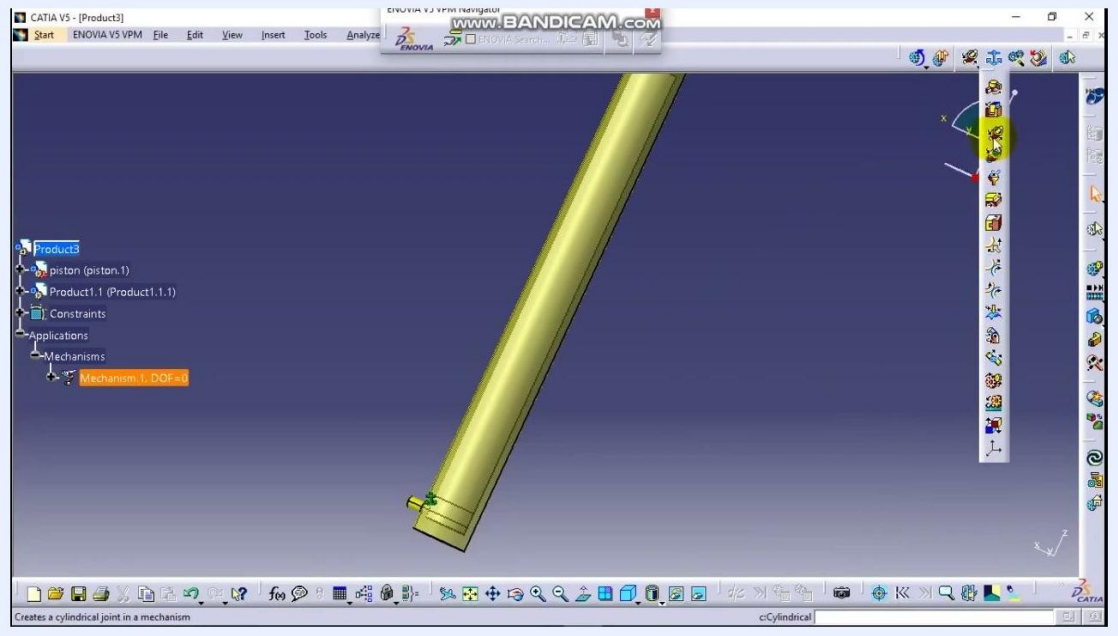
The model tree showing Mechanism.1 with DOF=0 under Applications > Mechanisms, and the piston-cylinder assembly in the main view

Create the cylindrical joint

Step 6. Open the cylindrical joint dialog

Find the joint toolbar on the right side of the CATIA window. It offers several joint types, including Revolute, Prismatic, Cylindrical, Screw, Spherical, Planar, Rigid, and Slide Curve joints.

For a piston and cylinder mechanism, click the **Cylindrical Joint** icon.

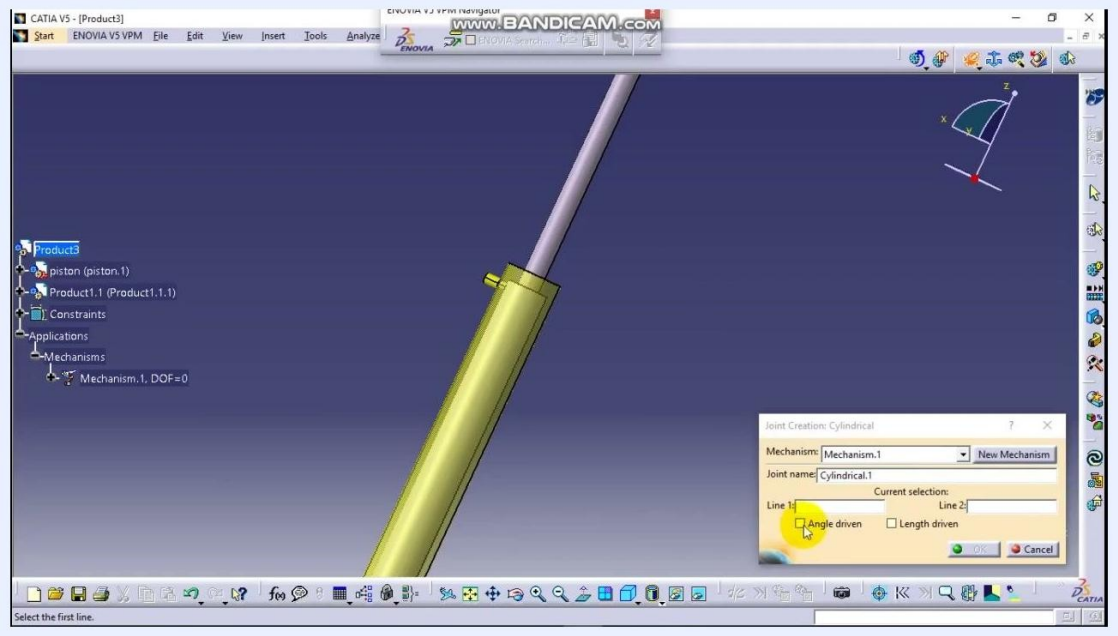


The Cylindrical Joint icon highlighted in the right toolbar, with the piston-cylinder assembly visible

The "Joint Creation: Cylindrical" dialog appears. Check the following fields:

- **Mechanism:** Mechanism.1
- **Joint name:** Cylindrical.1
- **Line 1:** to be selected
- **Line 2:** to be selected

- **Angle driven** and **Length driven:** checkboxes that define the joint's driving parameters



The Joint Creation: Cylindrical dialog with Mechanism.1, Cylindrical.1, the Line 1 and Line 2 fields, and the Angle driven and Length driven checkboxes

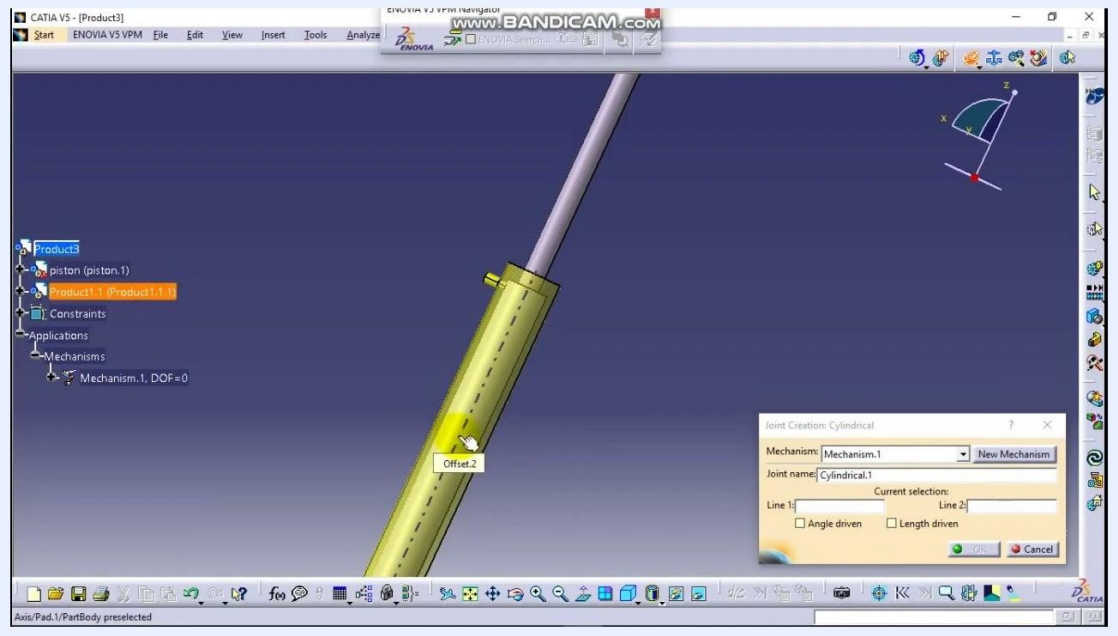
Step 7. Select the cylinder axis as Line 1

A cylindrical joint needs two lines. Line 1 is the center axis of the cylinder, and Line 2 is the center axis of the piston. Together they define the axis along which the piston moves inside the cylinder.

You can optionally check **Angle driven**, **Length driven**, or both. Your choice depends on whether you want to control the joint by rotation, translation, or both.

1. In the dialog, click the **Line 1** field.
2. In the 3D view, click the center axis of the cylinder (highlighted as Offset.2).

3. Confirm that the dialog shows the selection as Product1.1/Solid.1.

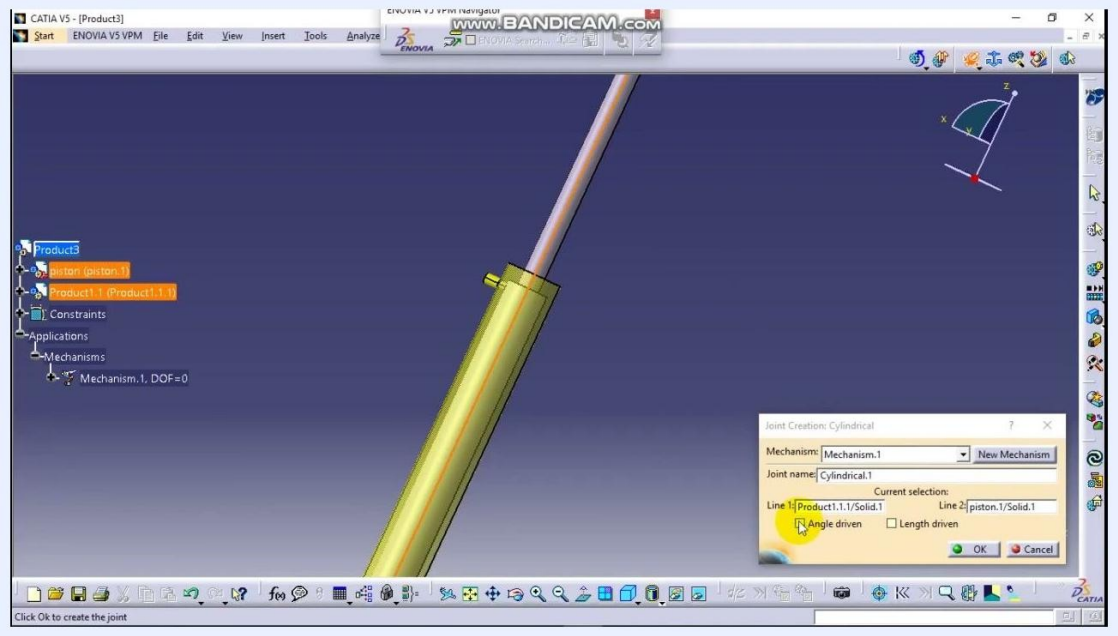


The Joint Creation: Cylindrical dialog open while the cylinder axis is selected as Line 1

Step 8. Select the piston axis as Line 2

1. Click the **Line 2** field in the dialog.
2. In the 3D view, click the center axis of the piston.

3. Confirm that the dialog shows Line 1: Product1.1/Solid.1 and Line 2: piston.1/Solid.1.



The Joint Creation: Cylindrical dialog with both Line 1 and Line 2 selected, matching the cylinder and piston axes

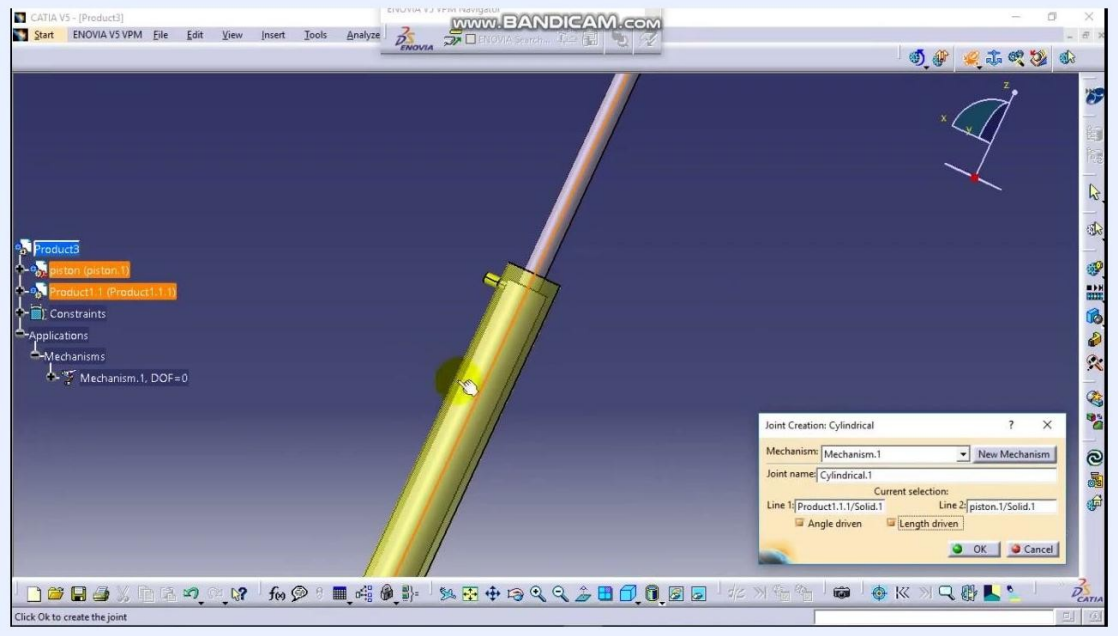
Step 9. Set the joint to length driven

Check **Length driven**. Leave **Angle driven** unchecked, because the piston only moves in translation.

Review the dialog to confirm these values:

- **Mechanism:** Mechanism.1
- **Joint name:** Cylindrical.1
- **Line 1:** Product1.1/Solid.1
- **Line 2:** piston.1/Solid.1
- **Length driven:** checked

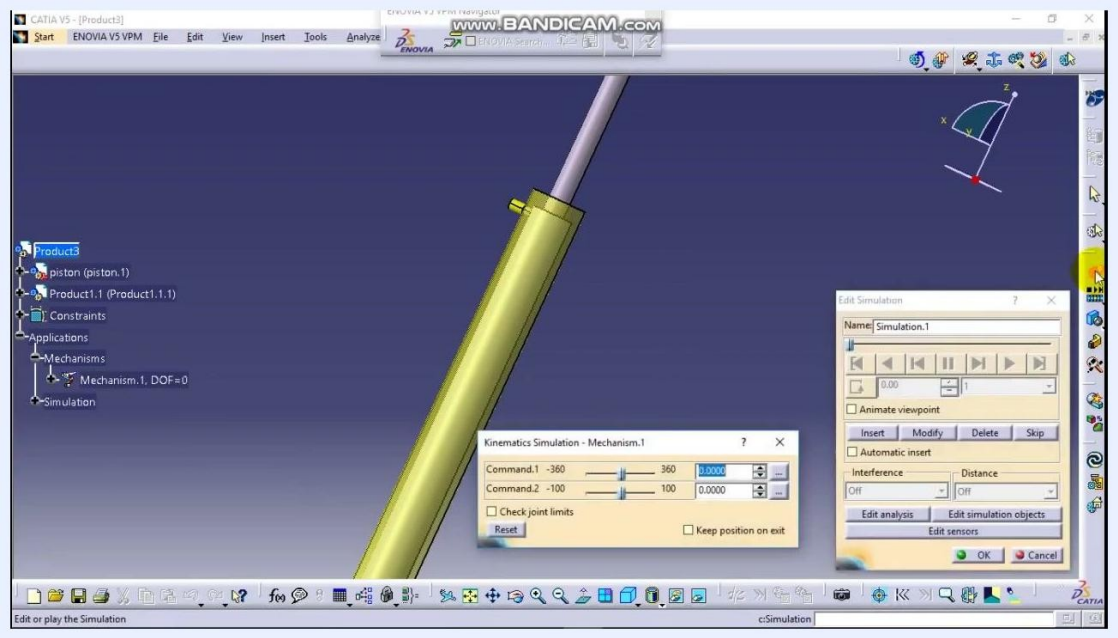
- **Angle driven:** unchecked



The Joint Creation: Cylindrical dialog with both axes selected and the Length driven checkbox enabled

Step 10. Create the joint

Click **OK** in the dialog to create the joint. An information message appears: "The mechanism can be simulated." Click **OK** in the information dialog to continue.

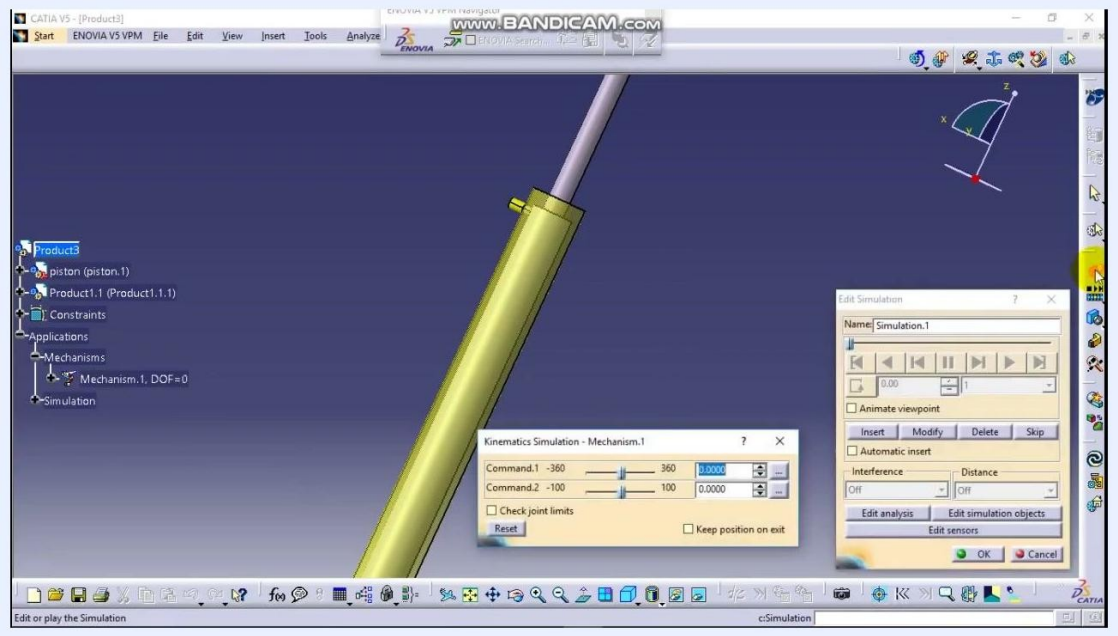


The information dialog stating that the mechanism can be simulated

Run the simulation and move the piston

Step 11. Open the kinematics simulation controls

Click the **Simulation** icon (gear and pinion symbol) on the right toolbar.



The Simulation icon highlighted in the right toolbar, with the piston-cylinder assembly visible

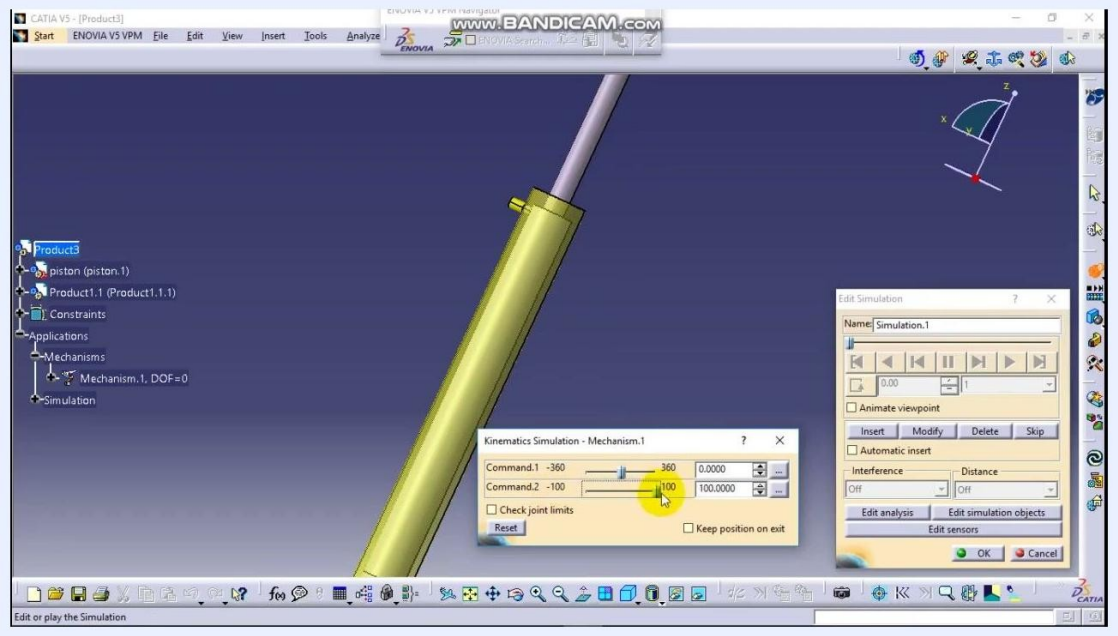
The "Kinematics Simulation - Mechanism.1" dialog appears with the "Edit Simulation" panel. It includes these controls:

- **Command.1:** ranges from -360 to 360. This is the degree command, which this mechanism does not use.
- **Command.2:** ranges from -100 to 100. This is the length command, and it controls the piston movement.
- **Check joint limits** option
- **Reset** button
- **Edit Simulation** panel with playback and animation controls

Step 12. Move the piston with Command.2

To run a simulation in CATIA with this mechanism, leave **Command.1** alone, because the piston does not rotate. Use the **Command.2** slider or input box to move the piston along its axis.

Adjust the value from **-100** to **100** to cover the full range of piston movement. The piston moves in the 3D view as you change the value.



The Kinematics Simulation dialog with the Command.2 slider set to 100 and the piston extended in the cylinder

Configure piston travel and playback

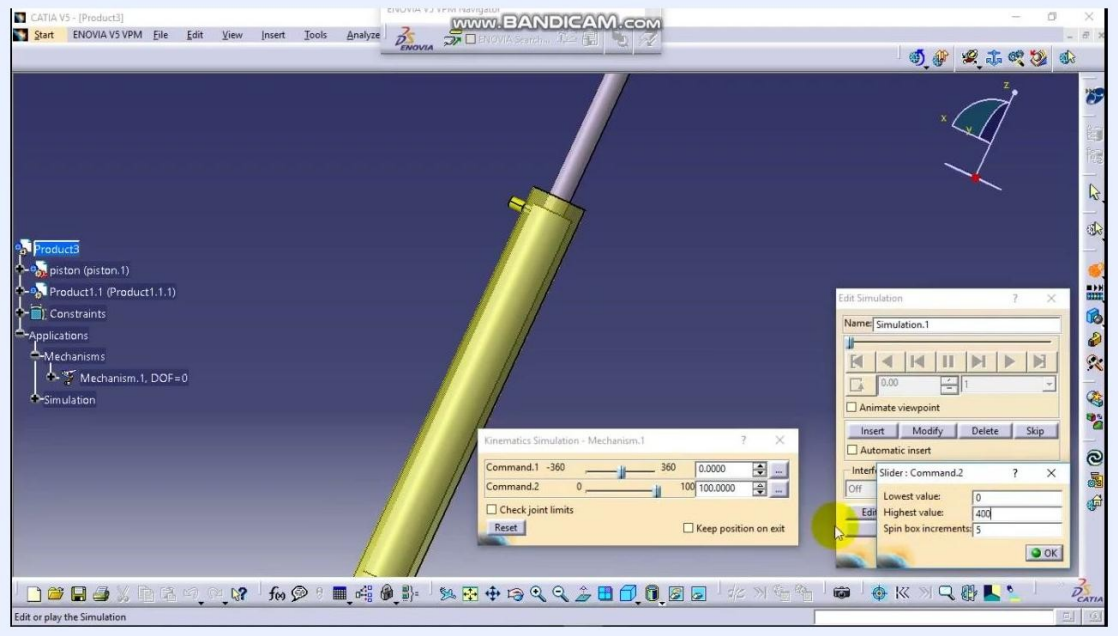
Step 13. Edit the Command.2 slider properties

The value 100 for **Command.2** represents the distance the piston can move in the simulation. To change the range, click the three-dots (ellipsis) button next to the **Command.2** slider.

In the "Slider: Command.2" dialog, set these values:

- Lowest value: 0
- Highest value: 400
- Spin box increments: 5

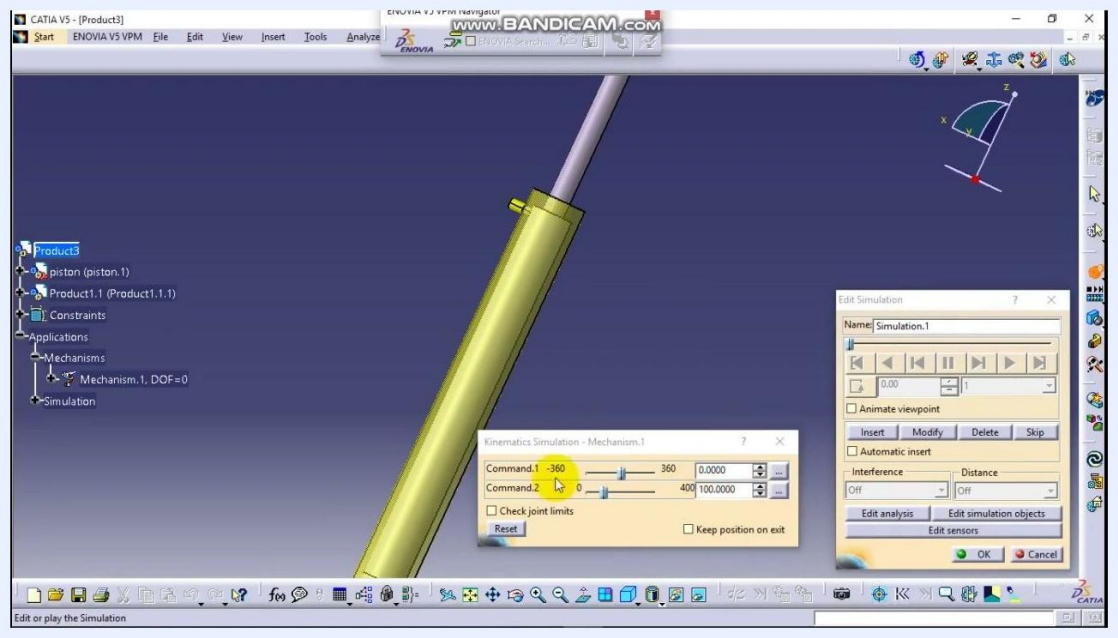
Click **OK** to apply the changes.



The Slider: Command.2 dialog showing Lowest value 0, Highest value 400, and Spin box increments 5

Step 14. Test the piston at the maximum value

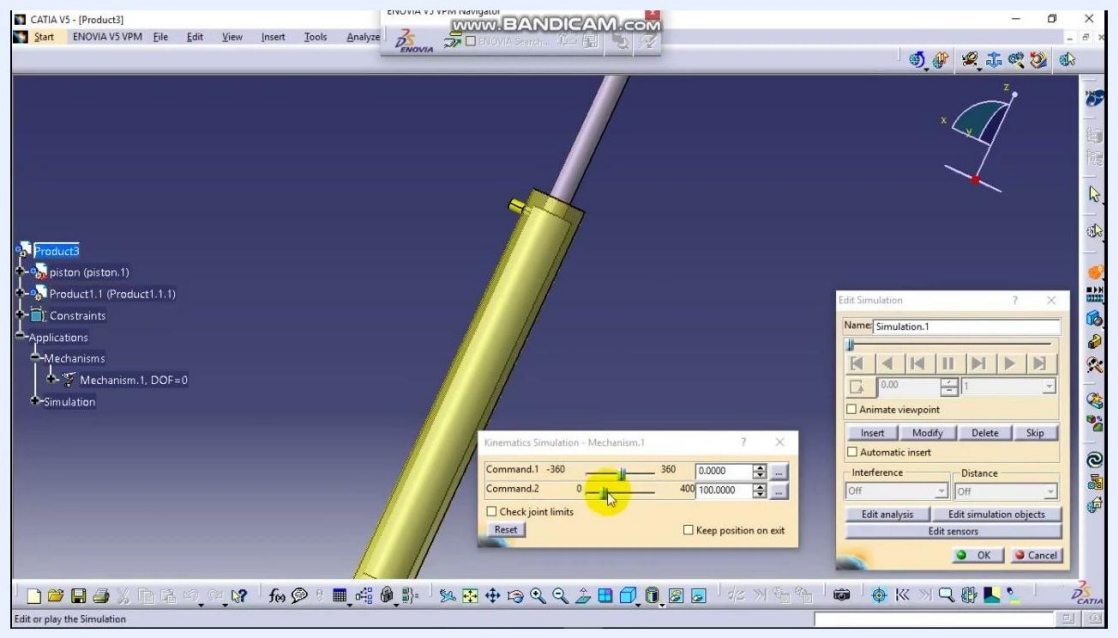
Set the **Command.2** slider to 400 and watch the piston extension in the 3D view.



The Kinematics Simulation dialog with the Command.2 slider set to 400 and the piston extended in the 3D view

Step 15. Retract the piston and check for a gap

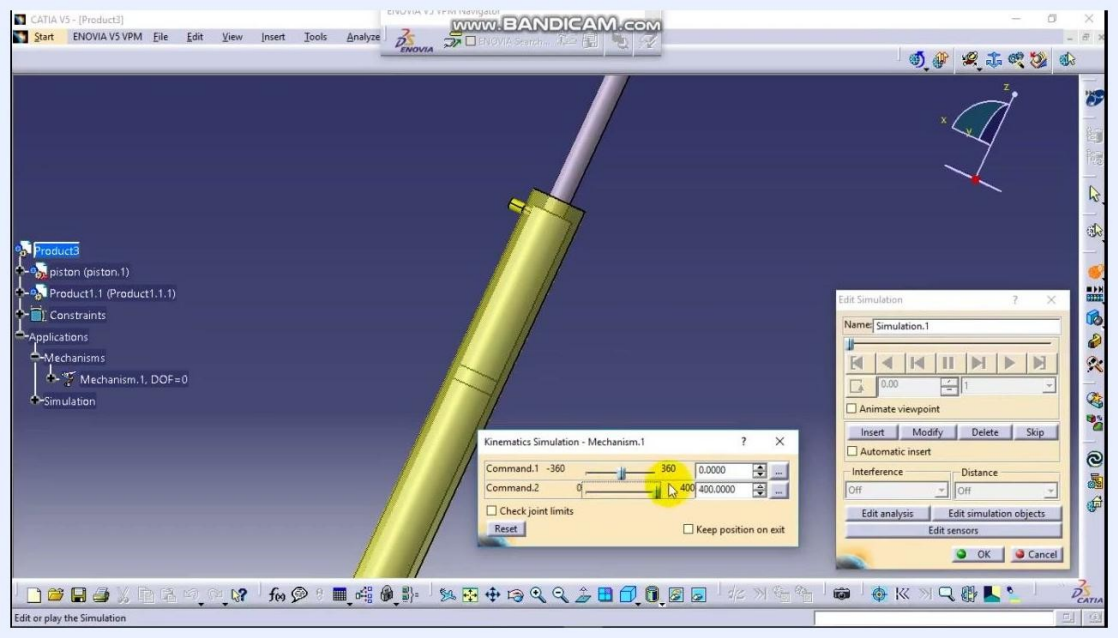
Move the **Command.2** slider back to 0 to retract the piston. A gap remains between the piston head and the outlet. This means you may need to increase the maximum value.



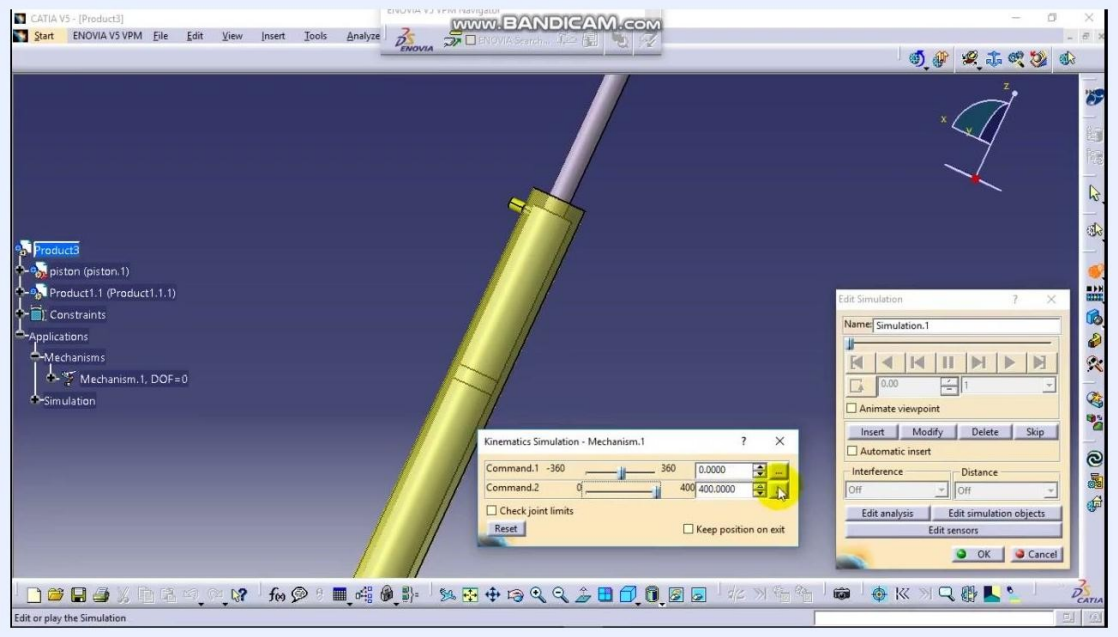
The Command.2 slider set to 0 with the piston retracted and a gap remaining between the piston head and the outlet

Step 16. Increase the maximum value

Set the highest value of **Command.2** to 500 and test the slider again. If the gap persists, keep increasing the maximum in steps, for example to 600.



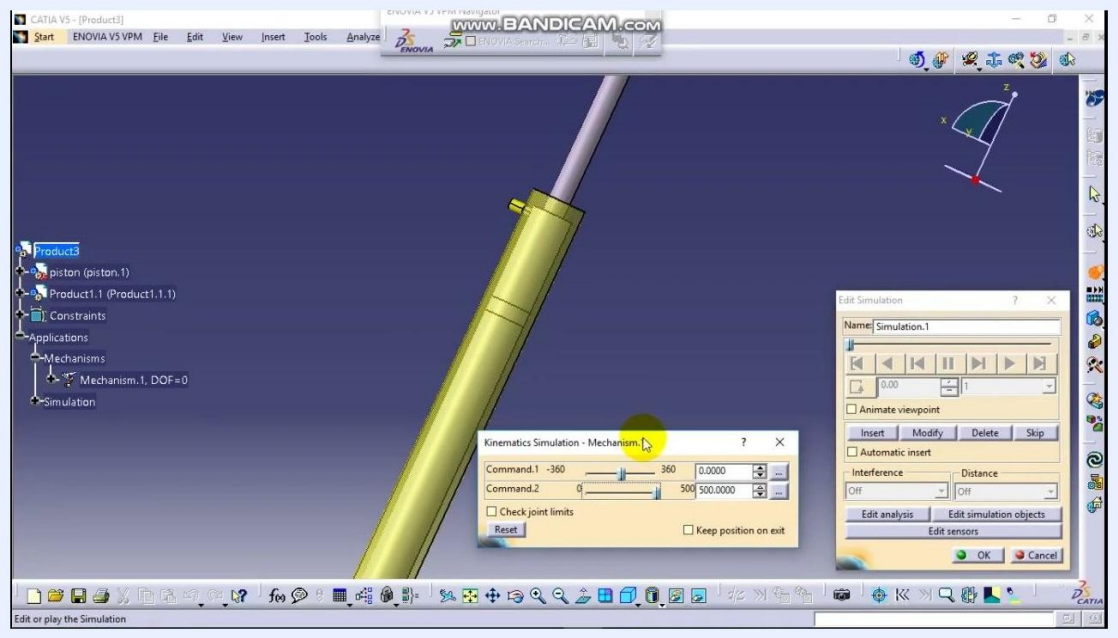
The Command.2 slider set to 400, showing the piston's extension before the increase



The Command.2 slider set to 500, with the piston extending further but possibly still not reaching the outlet

Step 17. Continue until the piston reaches the outlet

Keep raising the maximum value as needed. For example, set it to 600 and test the movement. When the piston head reaches the outlet or your desired position, move on to the next step.



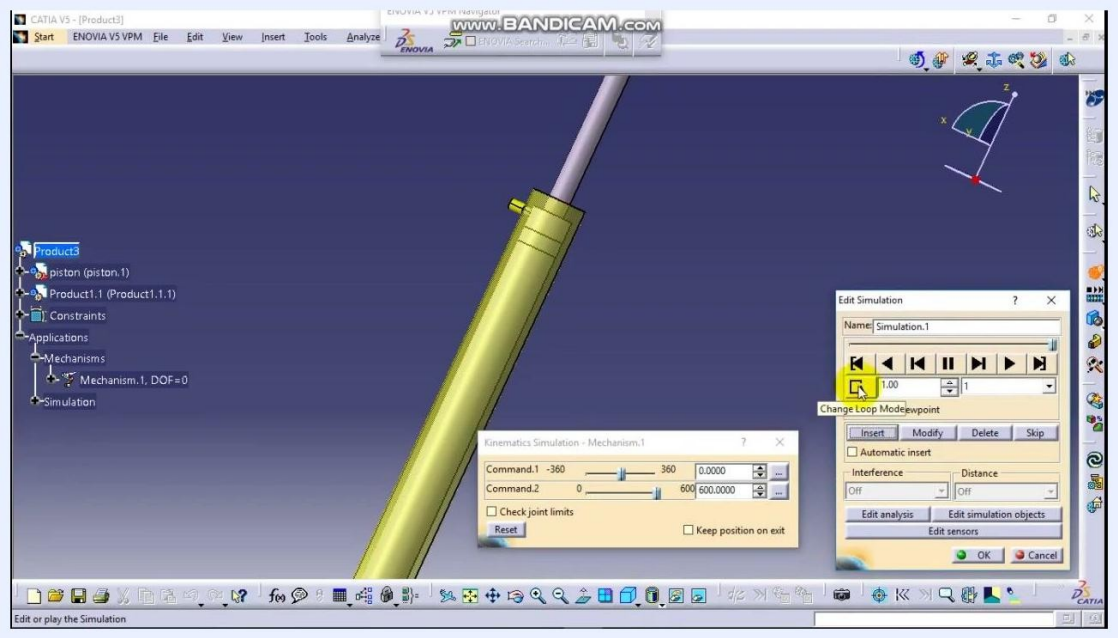
The Command.2 slider set to 600 with the piston fully extended to the outlet

Step 18. Insert the simulation step

Click **Insert** in the "Edit Simulation" dialog. This records the simulation step with the updated piston travel and saves the current configuration and movement range.

Step 19. Turn on loop mode

Click the **Change Loop Mode** button (the icon with up and down arrows) in the "Edit Simulation" dialog. The simulation now plays back and forth automatically.



The Edit Simulation dialog with the Change Loop Mode button highlighted and Command.2 set to 600

Step 20. Switch to one-direction playback (optional)

To play the simulation in only one direction, click the loop mode button again until the arrows point in the same direction.

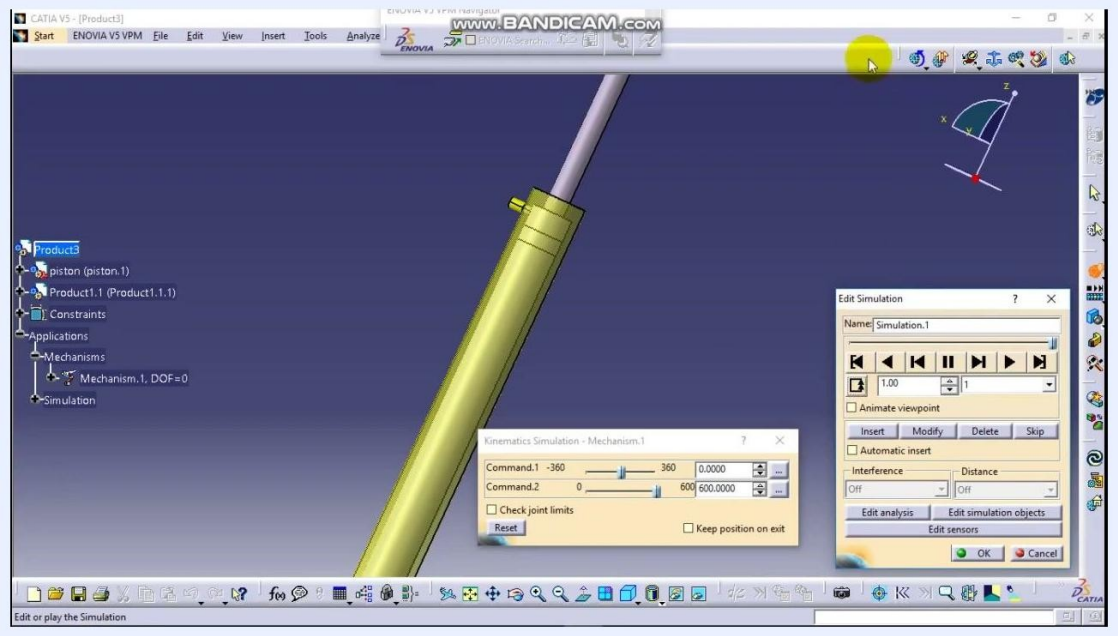
Adjust the simulation speed

Step 21. Slow the playback to make the motion visible

When you run a simulation in CATIA with the default speed, the piston can move too fast to see. At this point, the 3D view shows the piston extended from its cylinder. The dialogs show the following:

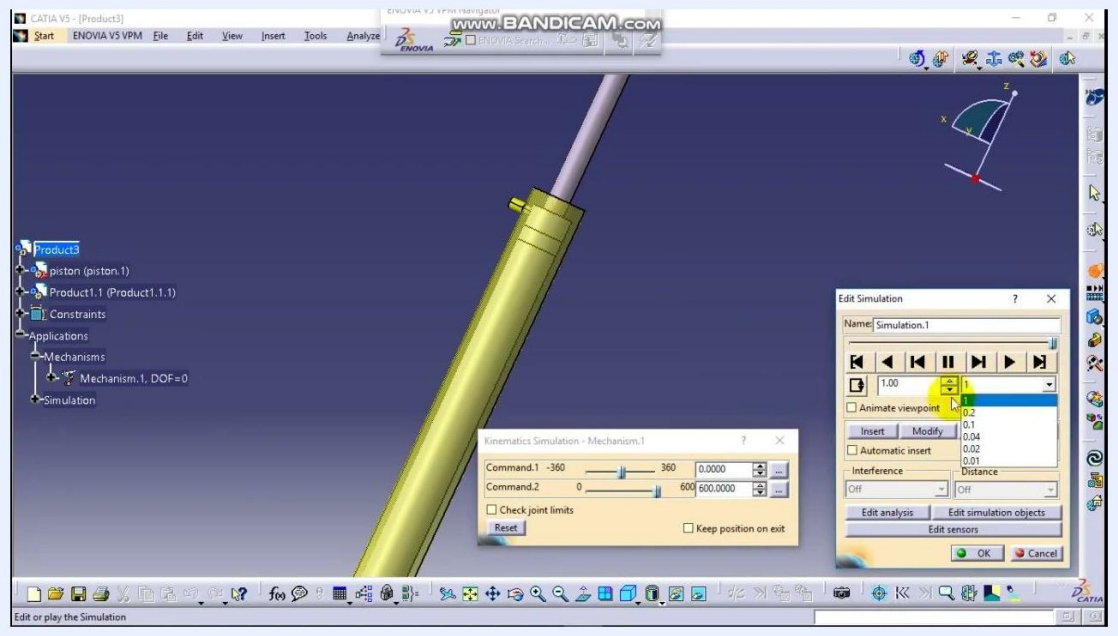
- "Kinematics Simulation - Mechanism.1": **Command.1** ranges from -360 to 360 with a value of 0.0000.
- **Command.2** ranges from 0 to 600 with a value of 600.0000.
- **Check joint limits** is enabled.

- "Edit Simulation": the playback controls are visible and the speed is 1.00.



The CATIA V5 interface with the piston extended, the Kinematics Simulation dialog with Command.2 at 600, and the Edit Simulation dialog with the speed set to 1.00

A speed of 1.00 can make the piston movement nearly invisible. In the "Edit Simulation" dialog, open the speed dropdown to the right of the playback controls. It offers 1, 0.2, 0.1, 0.04, 0.02, and 0.01. Select a lower value, such as 0.1 or 0.04.

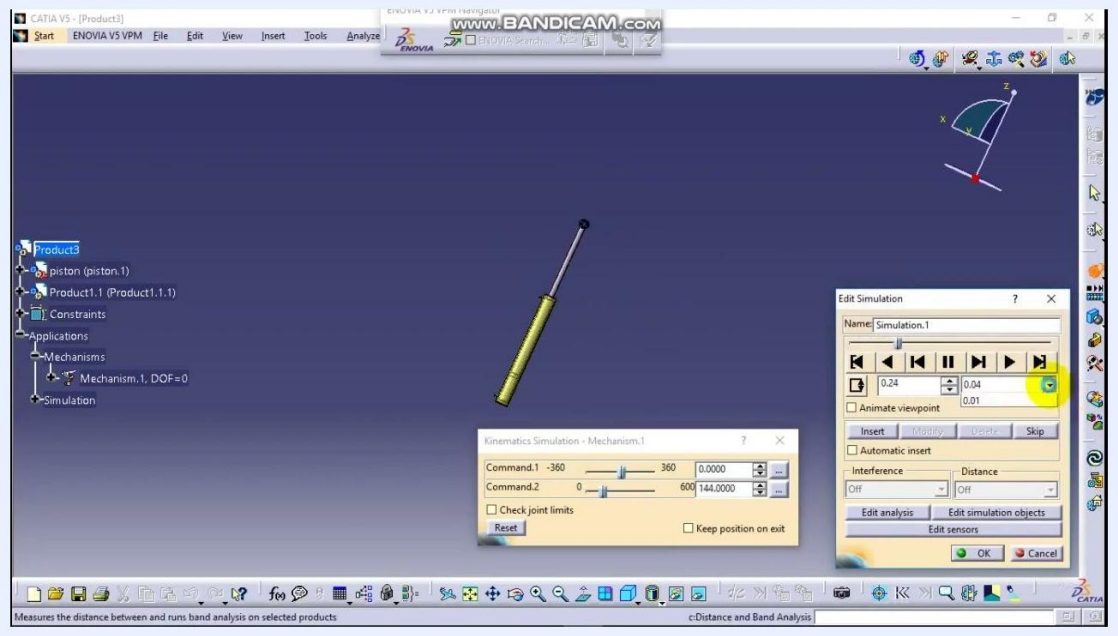


The Edit Simulation dialog with the speed dropdown expanded, showing the options 1, 0.2, 0.1, 0.04, 0.02, and 0.01

Step 22. Play the simulation at the reduced speed

Click the play button in the "Edit Simulation" dialog. The piston now moves slowly and visibly between its retracted and extended positions.

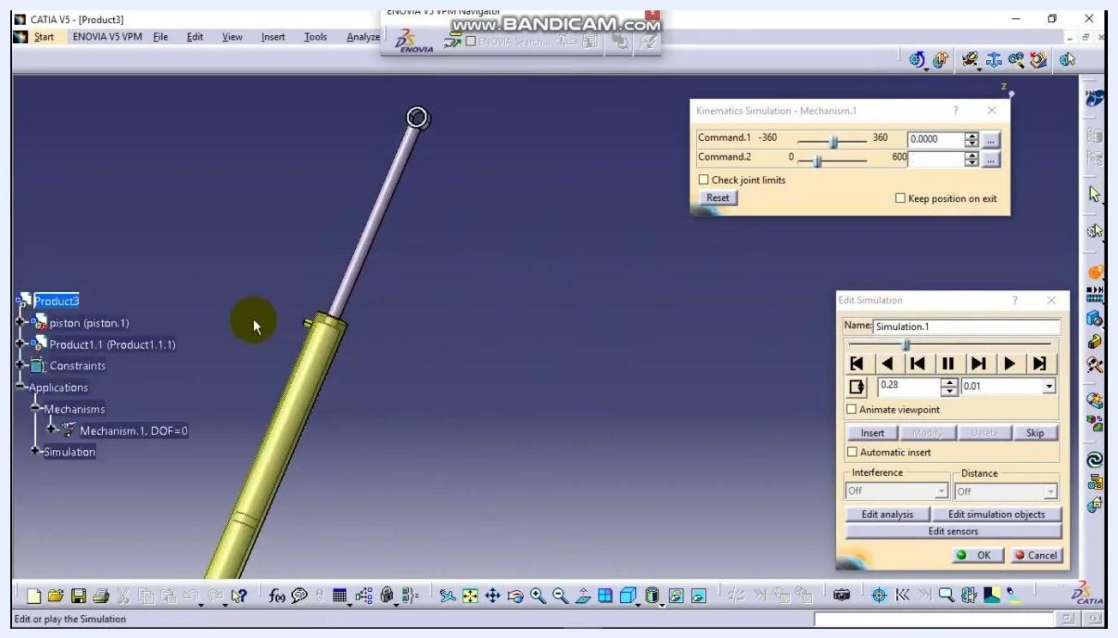
The **Command.2** value in the "Kinematics Simulation" dialog updates as the simulation progresses, for example 300.0000 and 144.0000.



The simulation running at reduced speed with the piston partially extended, Command.2 at 144.0000, and the speed set to 0.01

Step 23. Zoom and pan the 3D view

Use the mouse or navigation tools to zoom and reposition the 3D view. You can watch the simulation from different angles to confirm that the motion is what you expect.



The 3D view zoomed in on the piston with the Kinematics Simulation and Edit Simulation dialogs visible and the simulation running at slow speed

Summary

You now know how to run a simulation in CATIA V5 for a piston and cylinder mechanism:

- You created a mechanism and fixed the cylinder.
- You defined a length-driven cylindrical joint using the cylinder and piston axes.
- You moved the piston with **Command.2** and extended its travel range until it reached the outlet.
- You turned on loop mode and lowered the playback speed so the up-and-down motion is easy to see.

What's next

Continue with further analysis of the mechanism or with exporting your simulation results.