



calmetrix

PHEO USER MANUAL



**CALMETRIX INC.**

**PHEO CONCRETE RHEOMETER**

**USER MANUAL**

## IMPORTANT SAFETY RULES



- **Exercise caution when handling the Pheso rheometer, to avoid back or other injuries. Consider a four person lift or mechanical aid.**
- **Risk of electrical shock. Never open the electrical cabinet during operation. Make sure the power cable and any other cables are disconnected before opening the electrical cabinet, or before cleaning the rheometer**

## DISCLAIMER

Calmetrix does not assume any liability as related to the accuracy, relevance or interpretation of results while using the Pheso rheometer.

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## A. BEFORE YOU START USING YOUR PHESO RHEOMETER

### Installation requirements

Before installation, you will need to prepare the following:

- A flat and level surface of about 1.5 x 1.5 meters to place your rheometer, with access from three sides. It is recommended to place the rheometer directly on the floor inside or near the concrete laboratory, as it facilitates material handling and cleaning of the sample bowls.
- A source of power. Pheso is available in different configurations, depending on your power source, for example a 3-phase 220 V / 35 A / Delta configuration or 3-phase 380 V / 35 A / Star configuration. The available power source must be communicated and confirmed before delivery of the Pheso rheometer. It is not interchangeable once the equipment has been delivered.



### Installation and electrical connection

Your rheometer is shipped fully assembled in a crate. Open the crate, and remove any straps and packaging materials. Make sure you do not discard any cables or the computer as you unpack. Lift the rheometer off the pallet (a four-person lift is recommended). Use proper lifting techniques to avoid back or other injuries. Place the rheometer on the flat and level surface.

Your rheometer is delivered with a 4-wire cable, where the green cable is the Ground and the three other cables are the three phases. Connect the rheometer to the source corresponding to the rheometer model that was delivered to you (220 V 3-phase or 380 V 3-phase as indicated on the plaque affixed on tye h Pheso rheometer). The electrical connection should be set-up by a certified electrician.



**Make sure you have the power source that corresponds to the model of Pheso rheometer you purchased. Connecting your rheometer to the wrong power source can result in severe damage.**



Connect the USB cable to the laptop computer that was delivered with your order. You are now ready to use your Pheso rheometer.

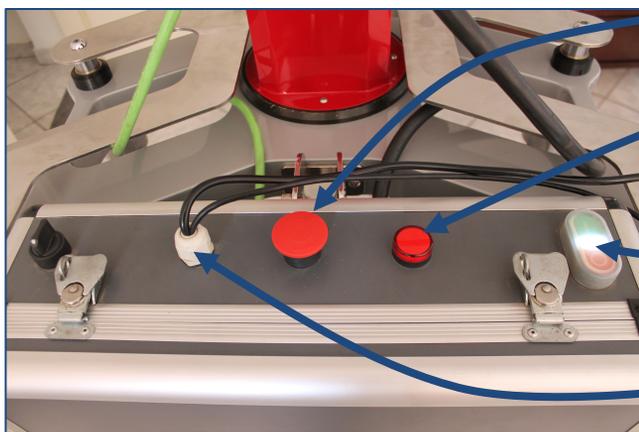
## B. START-UP INSTRUCTIONS

### Calibration

Your Pheso rheometer was calibrated before shipping. You do not need to recalibrate it. The calibration parameters are already in place on the computer that was shipped with your order.

### Turning your rheometer on

Locate the ON/OFF switch on top of the electrical cabinet. Push it to the “I” (green) position to turn on the rheometer.



*Emergency STOP button*

*ERROR Light. Stop using and switch off your rheometer, then contact [support@calmetix.com](mailto:support@calmetix.com).*

*ON / OFF switch*

*Computer Power cable and USB connection cable*

With the computer connected, open the Pheso software by double-clicking on the Pheso icon located on your desktop.

## Lock / unlock the bowl

To lock / unlock the bowl:

**1.** Grab bowl with two hands.



**2.** Push the bowl into the guide. Make sure you push it in all the way.



**3.** Turn clockwise to lock in place



To unlock, follow the steps above in reverse order.



## Choice of impeller

Pheso has two axes: the central axis and the planetary (off-center) axis. A given impeller should be attached to one or the other axis, depending on the type of testing you wish to perform.

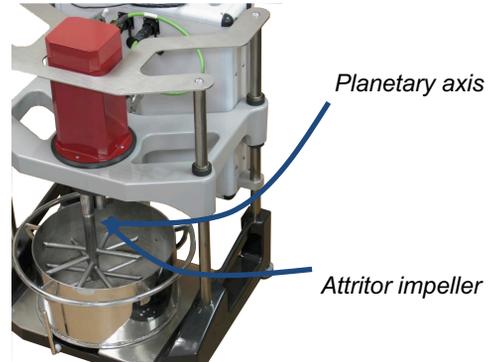
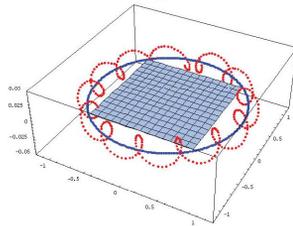
Example of study	Recommended Bowl	Recommended Impeller	Axis
Measure viscosity/yield stress in paste or mortar	6 liter bowl	Vane	Central
Measure viscosity / yield stress in concrete	25 liter bowl	Vane	Central
Comparative study of concrete mixes	6 liter bowl	Attritor	Planetary
Long term measurement in mortar	6 liter bowl	Attritor	Planetary
Long term measurement in concrete	25 liter bowl	Attritor	Planetary
Assessment of concrete performance in real world (e.g. pumpability, mixing efficiency)	25 liter bowl	Attritor	Planetary



**Note:** when using the attritor impeller, it is recommended to use an *anticlockwise* motion during mixing and measurements. The attritor impeller geometry is such that anticlockwise motion pushes particles upward to promote better mixing action.

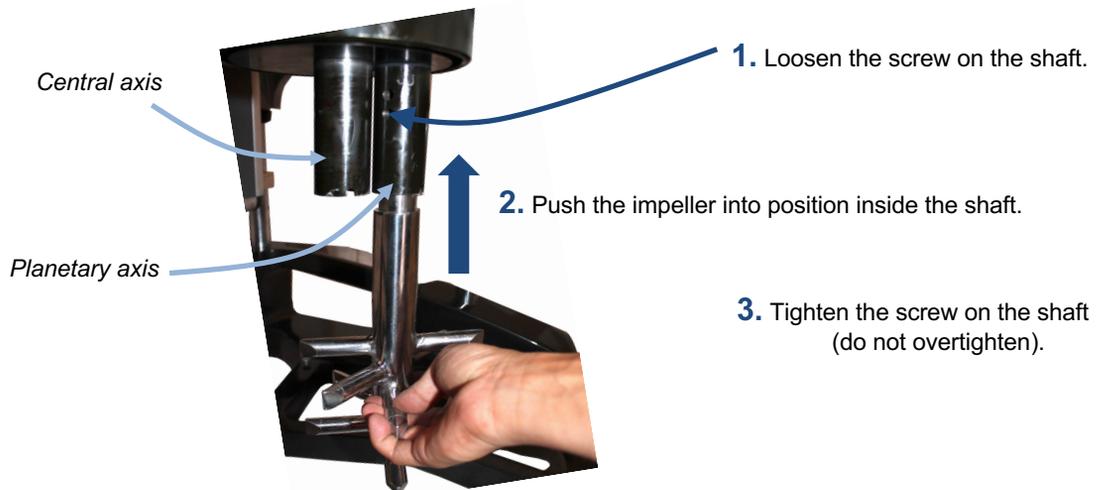
Attritor impellers are typically used for studies of real concrete, with coarse aggregates. They are mounted on the planetary axis, where their shape and off-axis movement promotes continuous mixing while the measurement takes place, thereby avoiding segregation of particles

*"Planetary" movement*



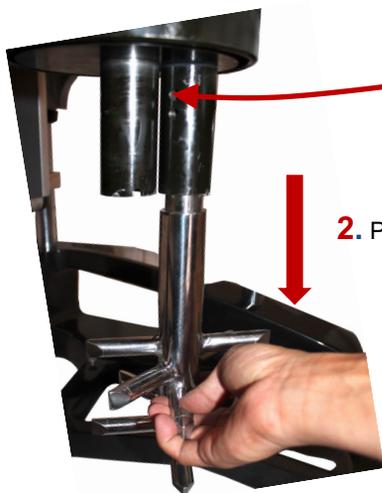
### How to attach the impeller.

Attaching, or exchanging impellers is easy, takes less than a minute and requires nothing more than an Allen key.





If the impeller ever gets stuck in the shaft after a test, do not try to force it out by applying pressure or by hammering it out. To loosen the impeller, use the release screw as shown below:



**1.** Tighten the release screw (upper screw) on the shaft. This will let air enter the shaft and release the vacuum formed during testing

**2.** Pull downward firmly but without pressure or impact



## C. HOW TO OPERATE YOUR RHEOMETER – PHEO SOFTWARE

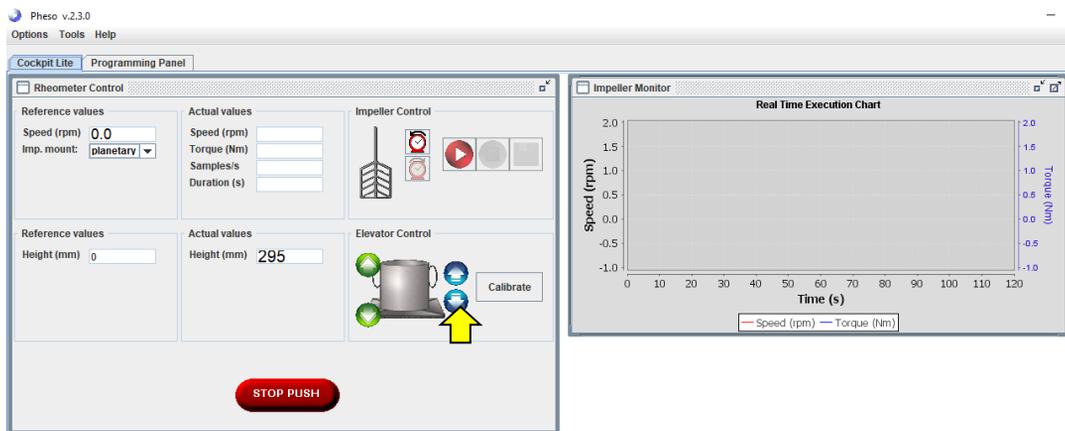
Your rheometer was delivered with a laptop computer and pre-installed Pheso software. Make sure the computer is connected to the rheometer using the USB cable, and that the rheometer is turned on. Then open the Pheso software on the computer.



Before going any further, you will need to calibrate the impeller elevator. The impeller elevator controls the height of the impeller, measured from the bottom surface of the bowl to the lowermost point of the impeller. It needs to be recalibrated each time one of the following events occur:

- When you turn on the switch located on the top of the electrical cabinet, or
- When you change the bowl

To calibrate the height of the impeller elevator press the CALIBRATE button in the Cockpit tab.





## Impeller position

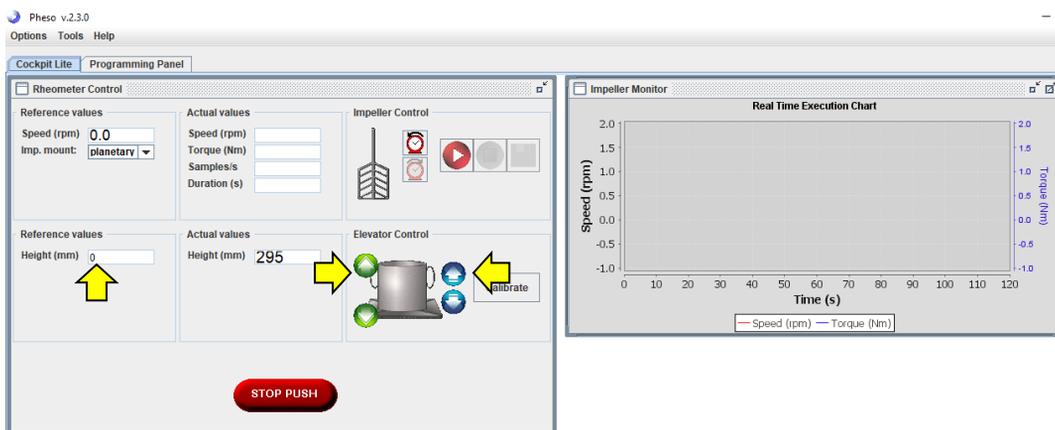
The vertical position of the impeller is changed by using the software interface.

You can enter a specific value of impeller position in the HEIGHT field. This is the height of the lowest point on the impeller above the inner bottom surface of the bowl.

Alternatively, you can also raise or lower the impeller position by pressing the blue or green UP/DOWN arrows.



Always make sure that the impeller is rotating (minimum speed 25 rpm) during vertical movement when entering sample material. Introducing the impeller into the sample without rotation may result in severe damage to the equipment.



If the impeller ever stops turning during a test run, there are two common causes:

- Jamming of the impeller due e.g. to agglomeration of material. In this case, pressing the Pause and then again the Play button usually solves the issue.

- The rheometer has reached the maximum torque level. In this case it is necessary to change the mixing procedure. An example of alternate mixing procedure is shown on page 22 of this manual.

## Rotation speed and direction

Choose the rotation speed for the impeller, and the axis it is mounted on (Planetary or Central). NOTE: The maximum rotation speed is 550 rpm in Planetary mode and 140 rpm in Central axis mode.

The screenshot displays the Pheso v.2.3.0 software interface. The main window is titled "Cockpit Lite" and "Programming Panel". It is divided into several sections:

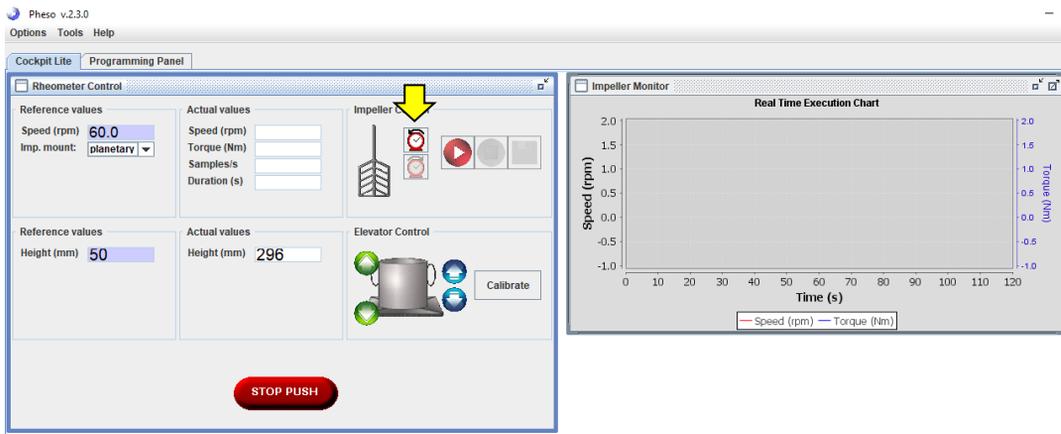
- Rheometer Control:** This section contains two "Reference values" and "Actual values" panels. The "Speed (rpm)" is set to 60.0. The "Imp. mount" dropdown menu is open, showing "planetary" and "center" options. A yellow arrow points to the "planetary" option. Below this, the "Height (mm)" is set to 0. The "Actual values" panel shows "Height (mm)" as 295. To the right, there are "Impeller Control" and "Elevator Control" sections with various icons and a "Calibrate" button. A red "STOP PUSH" button is located at the bottom of this section.
- Impeller Monitor:** This section features a "Real Time Execution Chart" with a graph showing "Speed (rpm)" on the left y-axis and "Torque (Nm)" on the right y-axis, plotted against "Time (s)" on the x-axis. The legend indicates that the red line represents Speed (rpm) and the blue line represents Torque (Nm).

To choose the direction of rotation click on the Clockwise or Anticlockwise button



**Reminder:** when using the attritor impeller, it is recommended to use an *anticlockwise* motion during mixing and measurements. The attritor impeller geometry is such that anticlockwise motion pushes particles upward to promote better mixing action.

Make sure to keep enough space between the lower tip of the impeller and the bottom surface of the bowl to avoid jamming and smashing of aggregate. It is recommended to keep a distance of at least 1.5 x the diameter of the largest aggregate. For instance, for coarse aggregate with a maximum diameter of 19 mm, you should keep a distance of 30 mm.

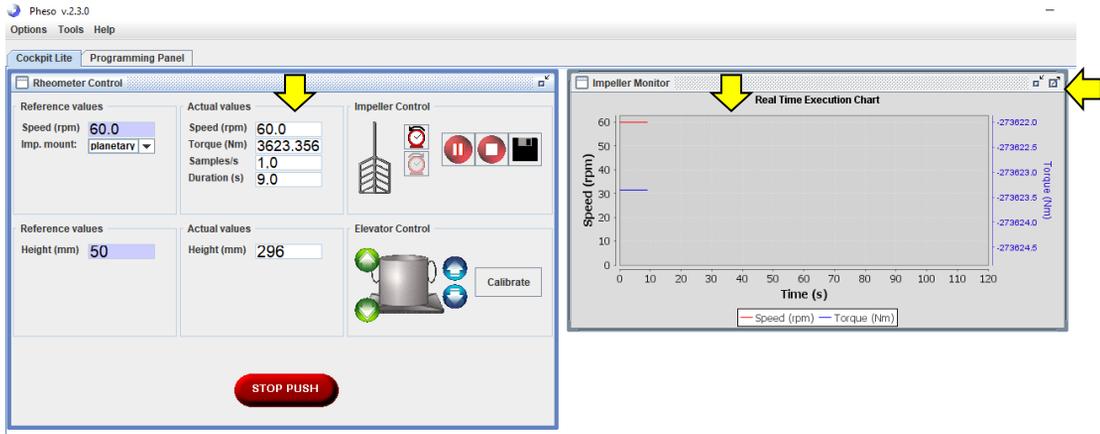


## Run a simple experiment

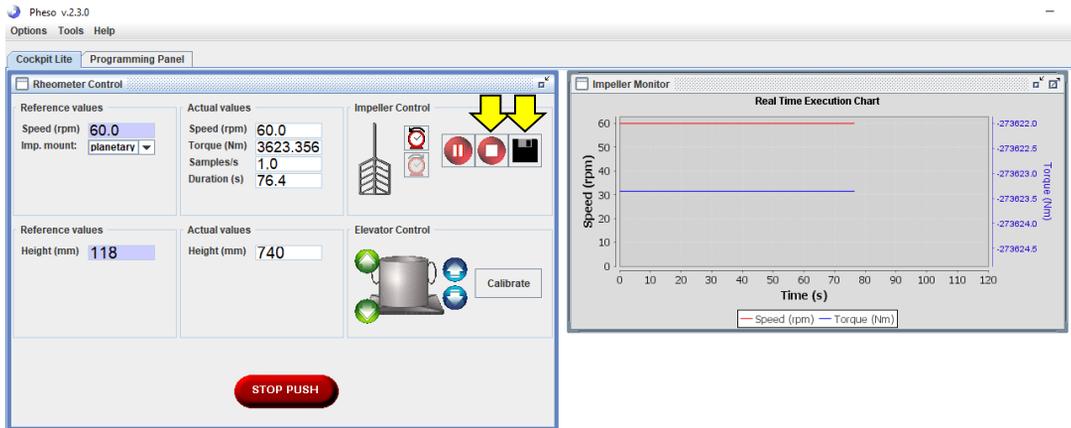
Once you selected your impeller height, speed and direction of rotation, you are ready to start a measurement.

To run your experiment, prepare a sample to be measured. You can either prepare the sample in an external mixing device, transfer it to the Pheso bowl when ready and then press the PLAY button, or if you use the attritor impeller, you can add individual components of the sample and mix them in the bowl.

The Impeller Monitor window on the right will now display rotation speed and torque over time. The default sampling rate is one data point per second. Real time values are also shown. To display the Impeller Monitor in Full Screen mode, click on the Full Screen icon in the upper right corner.

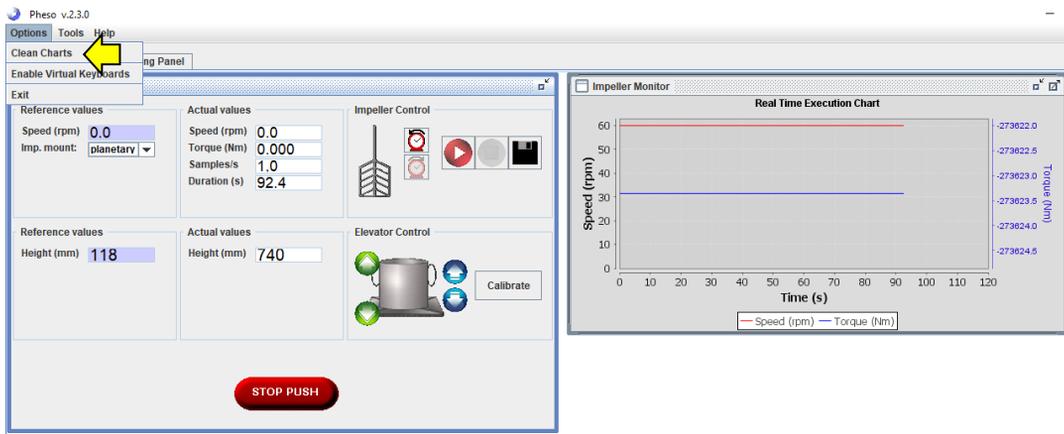


At the end of your experiment, press the STOP button. You can save data at any time during or at the end of your experiment by pressing the SAVE button.



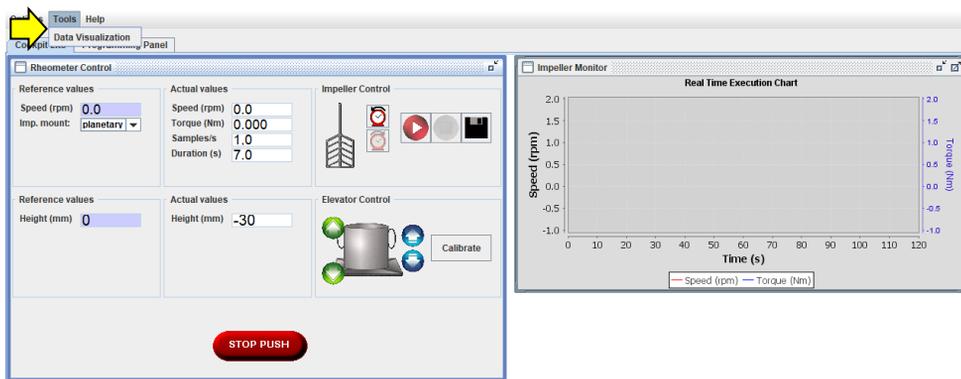


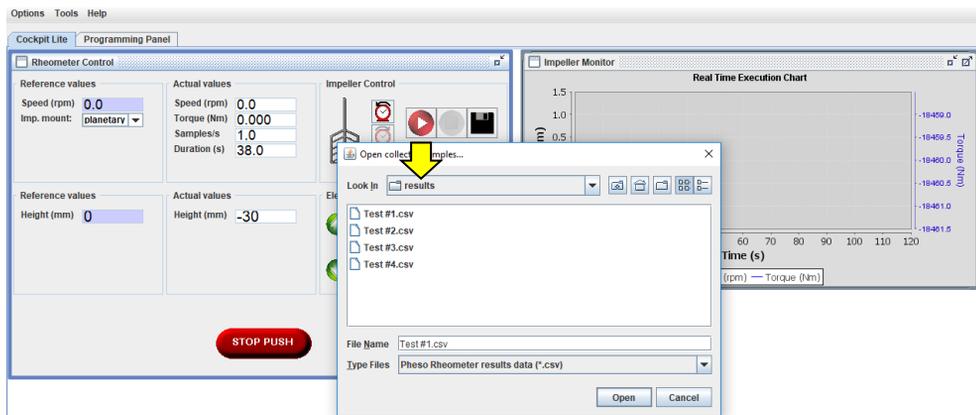
To erase the Speed and Torque charts from the Impeller Monitor window, select “Clean Charts” from the Options menu.



## Visualize and process data

Data files are located in the Users/ ... /Pheso/results folder. You can quickly visualize a data set by selecting Data Visualization in Tools from the Menu bar.





The Pheso data files can also be opened directly in third party software compatible with the ubiquitous CSV format, such as Excel or MATLAB for user-defined custom data processing.

## Programming a Mixing / Measuring Sequence

In most instances, you will want to program a sequence of events with different speeds or impeller heights. To do so, click on the Programming Panel tab. This tab allows you to configure these sequences of events (called “Projects”) and save them for future use.

Examples of frequently used sequences are:

- mixing of materials in the Pheso bowl, with different mixing speeds, followed by torque measurements over an extended period of time at different speeds
- shearing cycles
- simulation of mixing in industrial mixers to determine mixing efficiency or admixture efficiency, etc.

In the Programming Panel, click on “csm” (Constant Speed Movement) in the JOBS window to configure a step with a certain rotational speed for a given period of time. Choose the speed, duration, sample rate, direction of rotation and impeller axis.



Pheso v.2.3.0  
Options Tools Help

Cockpit Lite Programming Panel

Project: Impeller Monitor  
Real Time Execution Chart

[1] Constant Speed Movement

Job name: 1-0 Shearing cycle

Speed (rpm): 5

Duration (s): 30

Samples/s: 1.0

Impeller rotation: clockwise

Impeller location: planetary

Speed (rpm) — Torque (Nm)

Speed (rpm)

Torque (Nm)

Time (s)

Click on “elev” (Elevator Positioning) to change the elevation of the impeller. Choose the rotation speed, the target height of the elevator (in mm above the inner bottom surface of the bowl), the direction of rotation and the impeller axis.

Pheso v.2.3.0  
Options Tools Help

Cockpit Lite Programming Panel

Project: Impeller Monitor  
Real Time Execution Chart

[1] Elevator Positioning #

Job name: Elevator Positioning #

Speed (rpm): 0.0

Height (mm): 15

Samples/s: 1.0

Impeller rotation: anticlockwise

Impeller location: planetary

Speed (rpm) — Torque (Nm)

Speed (rpm)

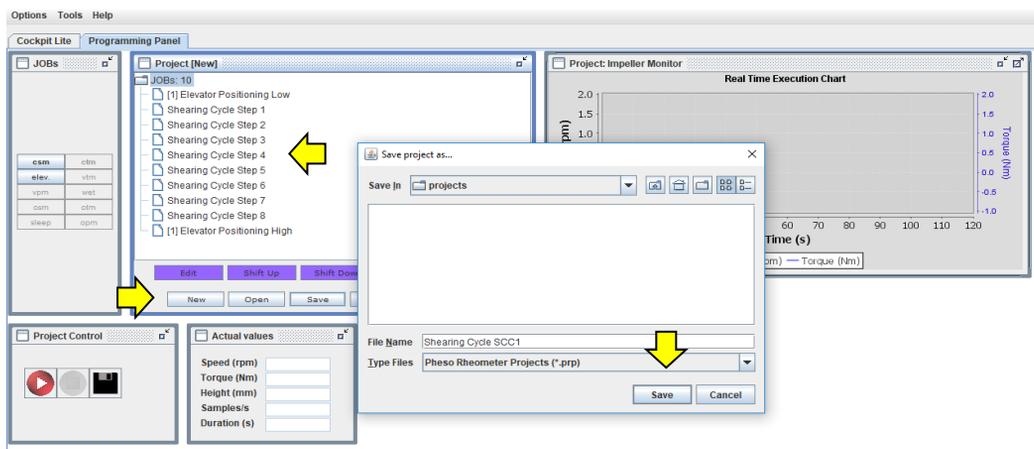
Torque (Nm)

Time (s)

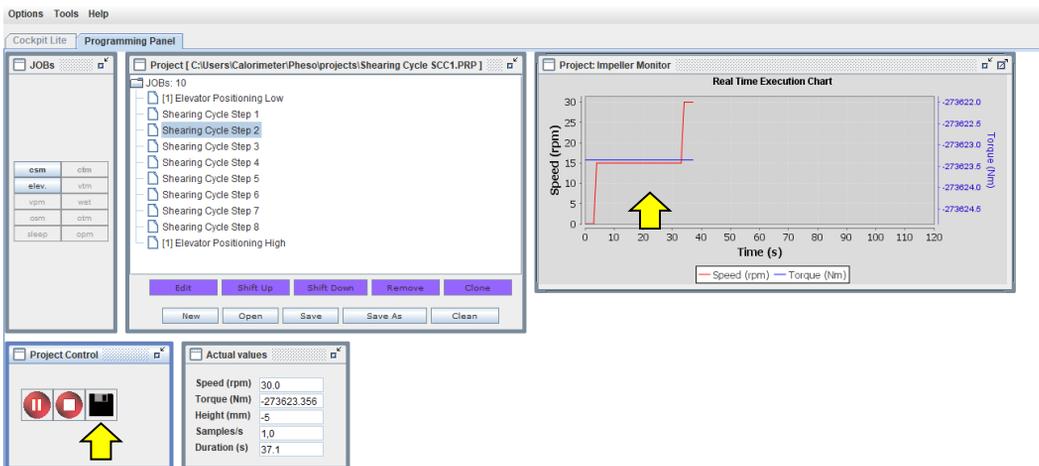
As you add “csm” and “elev” steps, your Project is taking shape. You can move individual steps up or down by pressing the SHIFT UP and SHIFT DOWN buttons. You can also EDIT, CLONE or REMOVE them. After you have configured all the steps in your Project, you can SAVE it for future use. You can also OPEN an existing Project at any time to modify it and then SAVE the modified project under a new name.

When running a new Project, it is recommended to double-check all Jobs, by reviewing rotation speed, duration, and impeller position to ensure they are correct.

When repeating or comparing several test runs with the same Project, make sure to control the water flow rate to ensure that all evaluated samples follow the same procedure



At any time, you can OPEN a Project and press the PLAY button to run an experiment that will follow the sequence of events you have configured. Use the SAVE button to save data at any time, just like in the Cockpit mode.



**Note:** a non-zero torque measurement will show even when you run a project on an empty bowl, without any sample. This is due to the equipment's baseline value.

To offset the baseline, and get reproducible results, the proper procedure is the following:

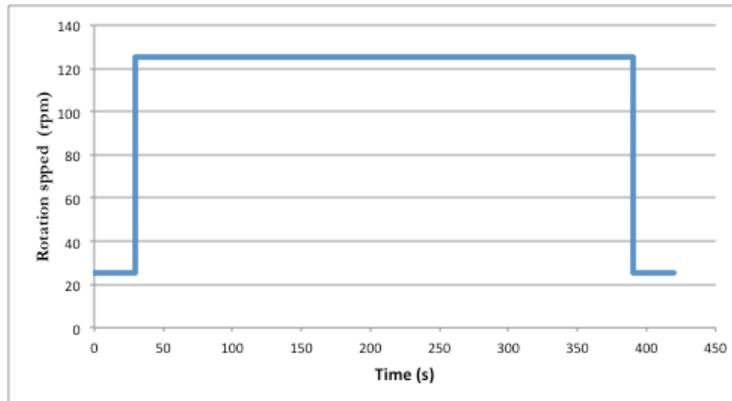
1. run your project with your sample
2. run the same sequence again on empty, without any sample
3. export both data files (with sample and without sample). In any application such as Excel, Open Office, or Office online, subtract the data obtained with the empty bowl from the data obtained with the actual sample
4. the result is the true measured torque data from the sample

## Examples of Projects / test protocols

The procedures shown here are illustrative of overall protocols for a concrete or a mortar. However, the duration of each step and rotation speeds may vary depending on several variables, such as material characteristics, water flow rate, rotation speed, etc.

*Example 1: mixing protocol, e.g to assess mixing efficiency by measuring rheological behavior during mixing*

Job #	Duration (s)	Rotation (rpm)	Description
1	30 - 40	25	Impeller movement
2	360	125	Mixing
3	30 - 40	25	Impeller movement

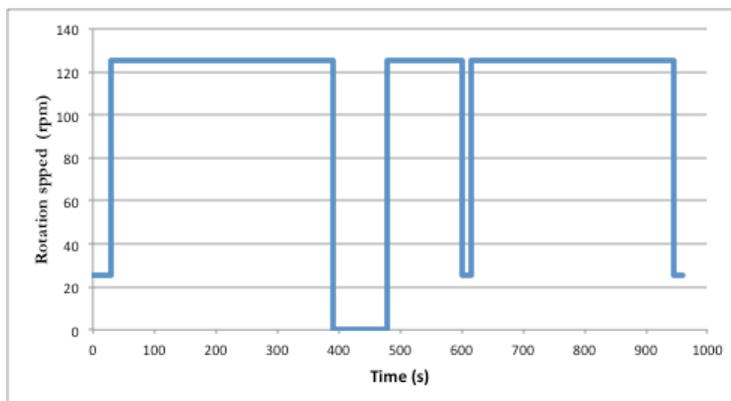


This simple mixing procedure is adapted for most concrete and mortar samples.



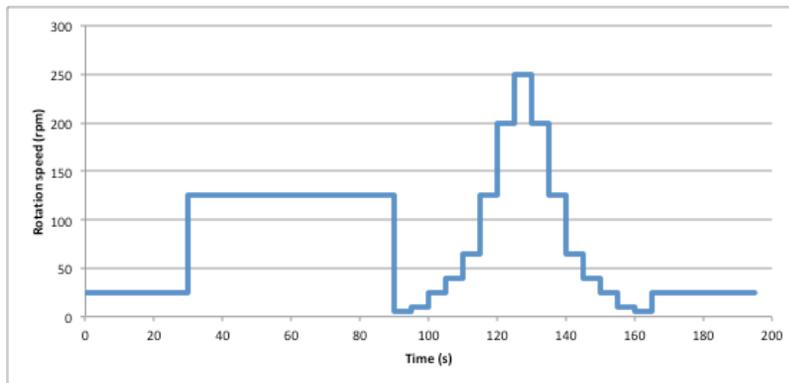
The following mixing sequence is more suitable for concrete that requires high torque during mixing:

Job #	Duration (s)	Rotation (rpm)	Description
1	30 - 40	25	Impeller movement
2	360	125	Mortar mixing (cement paste and sand)
3	90	0	Scrap inner sides of bowl
4	120	125	Homogenization
5	15 - 20	25	Impeller movement
6	330	125	Addition of coarse aggregate and mixing
7	15 - 20	25	Impeller movement



Example 2: stepped flow / shearing cycle process

Job #	Duration (s)	Rotation (rpm)	Description
1	30 - 40	25	Impeller movement
2	60	125	Homogenization
3	5	5	Stepped flow
4	5	10	Stepped flow
5	5	25	Stepped flow
6	5	40	Stepped flow
7	5	65	Stepped flow
8	5	125	Stepped flow
9	5	200	Stepped flow
10	5	250	Stepped flow
11	5	200	Stepped flow
12	5	125	Stepped flow
13	5	65	Stepped flow
14	5	40	Stepped flow
15	5	25	Stepped flow
16	5	10	Stepped flow
17	5	5	Stepped flow
18	30 - 40	25	Impeller movement





**Questions? - Find us at:**

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