SPIROMETER W52

USER GUIDE

cma-science.nl

Short description

The CMA Wireless Spirometer W52 measures airflow rate during respiration in the range from -5.0 to 5.0 L/s. The sensor consists of a flow tube through which the air is inhaled and exhaled, and a differential pressure sensor.
To reduce the risk of cross-contamination between users, the spirometer is supplied with a disposable bacterial filter and 10 disposable mouthpieces. Replacement bacterial filters (CMA art. no. BT82fil) and packs of mouthpieces (CMA art. no. BT82mp) can be ordered separately from CMA.

The power button located on the top of the sensor allows you to turn it on and off. The sensor is equipped with an OLED color display which shows sensor information and the measured values. This makes the sensor suitable to use as an independent measuring instrument.
To reset the airflow to 0 L/s double-press the power button.

The sensor can be used wirelessly via Bluetooth or wired via USB with the Coach 7 or Coach 7 lite programs/apps on computers (Windows and Mac), Chromebooks and mobile devices (Android and iOS).

How the sensor works

The Spirometer includes a flow tube through which air is inhaled and exhaled. This flow tube is connected to a pressure sensor via a plastic tube. Inside the flow tube, a small resistive disc narrows the tube's middle section. As air moves through the tube, a pressure difference develops across the disc. A highly sensitive differential pressure sensor measures this pressure difference, which is directly proportional to the velocity of the air flowing through the tube. The sensor converts this pressure difference into an air flow rate. When air flows in the opposite direction, the sensor registers a negative value.

Calibration

The Spirometer W52 is supplied with a factory calibration In L/s.
If your sensor consistently displays a value other than zero when not in use, you can reset it using the following calibration procedure:

1. Turn on the device and immediately press the button **10 times quickly**. This will put the device into factory calibration mode.
2. While in calibration mode, press the button once more to start the calibration process.
3. The device will automatically power off when calibration is complete.
4. Turn the device on again and check whether the displayed value has returned to zero.

Software

You can use the Spirometer W52 with Coach 7 or Coach 7 Lite (free) program on computers (Windows and Mac) or Coach 7 and Coach 7 Lite (free) app on mobile devices (Android and iOS). For Chromebooks, we offer a special Android app. The support for this wireless sensor is added starting from Coach version 7.12.

Check the CMA website for the latest installations. https://cma-science.nl/downloads_en

Collecting data with the sensor

To take measurements:

- Connect the plastic tube to the pressure sensor opening on the sensor box.
- Attach the bacterial filter to the flow tube, then fit a disposable mouthpiece onto the filter.
- Double press the power button to set the sensor to zero.
- Have the test subject sit upright and comfortably.
- Place the mouthpiece in the test subject's mouth and have the subject close the lips firmly around it, ensuring all inhaled and exhaled air passes through the mouthpiece.
- Use a nose clip or have the test subject hold his or her nose to ensure that all breathing is done through the mouth.
- Hold the flow tube horizontally and still and allow the test subject to breathe normally.

Collecting data without software connection

- Turn the Spirometer sensor on by pressing its power button.
- The sensor briefly displays its Bluetooth identification code. This ID code is also printed on the sticker located on the bottom side of the sensor box.
- Then the display shows:
  - the Bluetooth mode, 'Mobile' or 'PC'.
    Mobile indicates Bluetooth Low Energy mode which should be used when working with mobile devices (Android, iOS), Chromebook and Apple computers.
    PC indicates Bluetooth Classic which should be used for Windows computers.
  - the battery level, and
  - the current measured value.
- Now you can use the sensor as an independent measuring instrument.
- To turn the sensor off press and hold its power button for 3 sec. To save its battery the sensor automatically turns off after a few minutes of inactivity (no connection to power, no communication).

Collecting data via the Bluetooth connection

Mobile devices, Chromebooks, and Apple computers

For mobile devices (Android, iOS), Chromebooks and Apple computers Bluetooth Low Energy technology is used for wireless communication. For these devices **do not pair** the sensor just use it directly in the Coach software.

- Turn the sensor on by pressing its power button.
- Ensure your sensor is set to Mobile mode.
  If the display shows in the top-left corner 'PC' first you must set the sensor to the Mobile mode. Turn off the sensor. Then press and hold the power button until the text 'Bluetooth mode Change Mobile' is shown, then release the button. The mode is set to 'Mobile' which means that Bluetooth Low Energy is used.
- Start the Coach 7 or Coach 7 Lite program/app.
- Select the Dashboard Activity 'Measurement with Wireless sensors'.
- On opening of the Activity Coach starts searching for sensors which are turned on and in the Mobile discovery mode. The found Bluetooth sensors appear in the list.
- Select the Thermocouple sensor you want to connect to. If needed check the sensor's Bluetooth ID which is located on the sensor's bottom label.
- When the connection is established the Bluetooth symbol appears in the top-left corner of the sensor's display and the icon of the sensor appears showing the measured values.
- Now you are ready to use the Spirometer for your measurement.

Windows computers

For Windows computers, Bluetooth Classic technology is used for wireless communication. Before you start to use the sensor for measurement in Coach **you have to pair it**.

- Turn the Spirometer on.
- Ensure your sensor is set to PC mode.
  If the display shows in the top-left corner 'Mobile' first you must set the sensor to the PC mode. Turn off the sensor. Then press and hold the power button until the text 'Bluetooth mode Change PC' is shown, then release the button. The mode is set to 'PC' which means that Bluetooth Classic is used.
- Pair your sensor.
  - Go to the Windows Settings **Bluetooth and other devices** and select **Add Bluetooth or other devices**. Select **Bluetooth device**.
  - Windows looks for Bluetooth devices and after a while lists discovered devices. The wireless sensors are listed with their Bluetooth IDs.
  - Select the sensor you want to connect to. If needed check the sensor's Bluetooth ID which is located on the bottom label of your sensors.

  - When the connection is successfully established Windows indicates that the sensor is paired and ready to go.
  - Click **Done** to accept it. The sensor appears in the list of paired Bluetooth devices.
- Start the Coach 7 or Coach 7 Lite program.
- Select the Dashboard Activity 'Measurement with Wireless sensors'.
- Coach starts searching and displays the list with detected sensors, even if they are not paired.
- Select the Spirometer you want to connect to. If needed check the sensor's Bluetooth ID which is located on the sensor's bottom label. If the sensor was not paired yet Coach will force you to pair the sensor first via Windows Settings.
- When the connection is established the Bluetooth symbol appears in the top-left corner of the sensor's display and the icon of the sensor appears showing the measured values.
- Now you are ready to use the Spirometer for your measurement.

Collecting data via the USB connection

For computers (Windows and Mac) the Thermocouple sensor can also be used as USB sensor.

- Turn the Spirometer on.
- Use the provided USB cable to connect the sensor to a USB port.
- Start the Coach 7 or Coach 7 Lite program.
- Select the Dashboard Activity 'Measurement with Wireless sensors'.
- The connected USB sensor should be detected automatically, and its icon appears on the first empty sensor position in the Wireless sensors panel.
- When the connection is established the USB symbol appears in the top-left corner of the sensor's display and the icon shows measured data.
- Now you are ready to use the Spirometer for your measurement.

Charging a battery

An internal rechargeable battery (Li-Poly 3.7 V, 700 mAh) powers the sensor. The battery symbol located in the top-right corner of the sensor's display shows the battery level. When the battery level becomes critical, the battery gauge shows an empty battery. Use the provided cable to connect the sensor to a USB port for charging. A fully discharged battery requires up to 2 hours of charge time to become fully charged again. To prolong battery life, automatic power down turns the sensor off after 5 minutes of inactivity.

To replace the battery, use **only** the approved rechargeable batteries provided by CMA.

Converting air flow data to volume

The Spirometer measures airflow rate, which is the speed at which air moves in and

out of the lungs. Volume is the total amount of air that passes through the Spirometer, indicating how much air has entered or left the lungs. Volume is calculated by integrating the airflow rate over time. In the Coach program, this can be done via *Analyze/Process > Integral* in the Graph Tool menu. A quicker method is *Analyze/Process > Area*, then dragging the red vertical lines to select the desired area. The software will automatically display the result in L/s·s (litres).

The measured inhaled and exhaled volumes may differ. For example, speaking requires holding and slowly releasing air. Additionally, inhaled air is usually cooler than exhaled air because it warms up inside the lungs. This can cause a gradual upward or downward drift in the volume data, which is normal, especially for open-flow spirometers. As long as this drift is less than 0.3 litres over 30 seconds, it can be ignored.

Practical information

- The flow tube may be used by more than one person, but only if all users are healthy. The instructor should ensure that the subject has no history of cardiovascular or respiratory problems, such as asthma.
- Use both a disposable cardboard mouthpiece and a disposable bacterial filter when students will inhale and exhale through the Spirometer. Ideally, each student should have their own bacterial filter and mouthpiece.
- You can use only a disposable cardboard mouthpiece when students will exhale through the Spirometer.
- Some people may feel discomfort when using the Spirometer. Reassure the subject, and stop the test if discomfort becomes too great.
- During use, condensation may form inside the Spirometer's housing tube. The amount will depend on room temperature and the intensity of breathing.

Cleaning

The flow tube can be cleaned using standard hospital-grade disinfectant.

Suggested experiments

The Spirometer is to measure airflow and lung volumes. It can be used for a variety of experiments, such as:

- Recording breathing patterns before, during and after exercise
- Measuring important lung capacities like:
    - Forced Expiratory Volume (FEV) - the volume of air exhaled after a short period of constant effort. When this test is done over a one-second interval, it is known as FEV1.
    - Forced Vital Capacity (FVC) - the total volume of air exhaled during a forced maximal exhalation after a full inhalation.
    - Tidal Volume (TV) - the volume of air, inhaled and exhaled at rest.

Technical Specifications

Sensor kind	Digital (on-sensor digital conversion)
Measuring range	-5 .. 5 L/s
Resolution	0.01 L/s
Conditions	0 ~ 60 °C, ~85 %RH
Maximal sampling rate	100 Hz
Battery life after full charge	Approximately 8 hours Battery life varies by use, configuration, temperature, and many other factors; actual results will vary.
Connection	Bluetooth 5, Low Energy (Mac, Android, iOS) Bluetooth 2.1, Classic (Windows) USB 2.0 (type C)
Bluetooth ID	W59SPIR-xxx

Warranty

The Spirometer W52 is warranted to be free from defects in materials and workmanship for a period of 3 years from the date of purchase provided that it has been used under normal laboratory conditions. This warranty does not apply if the sensor has been damaged by accident or misuse.

The sensor battery is consumable and is warranted to be free from defects in materials and workmanship for a period of 12 months from the date of purchase.

Discard batteries according to local regulations.

Note: *This product is to be used for educational purposes only.*
It is not appropriate for industrial, medical, research, or commercial applications.

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