# PARTICULATE MATTER SENSOR W20

## USER GUIDE


cma-science.nl

## Short description

CMA Wireless Particulate Matter sensor W20 measures the concentration of fine particles (PM10) and ultrafine particles (PM2.5) in the air, within the range of 0 to 500 µg/m³.

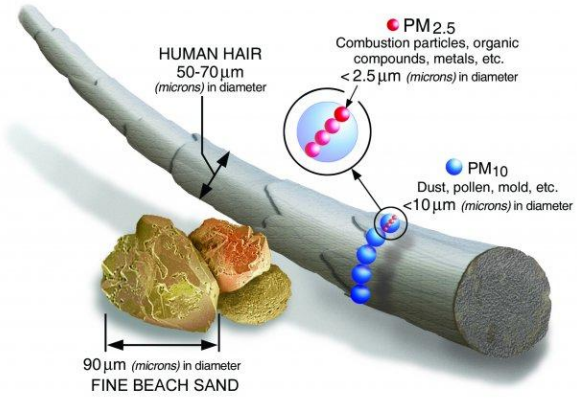
The power button located on the top of the sensor allows you to turn it on and off. The sensor is equipped with an OLED color display which shows sensor information and the measured values. This makes the sensor suitable to use as an independent measuring instrument. By default, sensor shows the concentration of PM2.5 particles. Briefly press the power button to display the concentration of PM10 particles. When using the sensor with the Coach software both ranges are displayed simultaneously.

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).

## Particulate Matter (PM) Pollution

Particle matter pollution refers to the presence of tiny solid or liquid particles suspended in the air. These particles vary in size, composition, and origin. Particle matter pollution is categorized based on the size of the particles.

**PM10** refers to particles with a diameter of 10 µm or smaller. These particles are so small that they cannot be seen with the naked eye. For comparison, the diameter of a human hair is 50 to 70 µm (see figure). The particles vary greatly in origin. Some are the result of human activities, such as combustion processes in industry and traffic, handling of bulk goods, livestock farming, wood stoves, and cigarette smoke. Others occur naturally, such as windblown (sand) dust and sea salt.



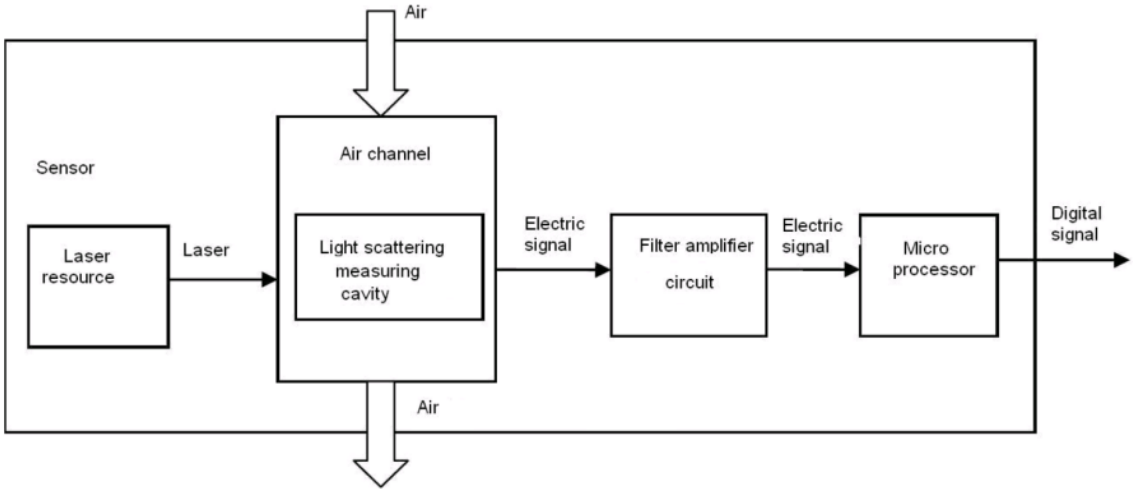

Source: https://www.epa.gov/pm-pollution

**PM2.5** refers to particles with a diameter of 2.5 µm or smaller. These particles are so small that they can penetrate deep into the lungs and even enter the bloodstream, posing serious health risks.

Exposure to particle matter pollution is associated with a range of adverse health effects but can also contribute to environmental issues such as reduced visibility, acid rain, and damage to ecosystems. In Europe for PM10, there is an annual average limit of 40 µg/m³ that must not be exceeded, and a daily average limit of 50 µg/m³ that must not be exceeded more than 35 times per year. For PM2.5, the annual average limit value is 25 µg/m³. Check the European Union standards at: https://environment.ec.europa.eu/topics/air/air-quality/eu-air-quality-standards_en.

## How the sensor works

The sensor uses a 'light-scattering' technique to measure the concentration of particles in the air. A beam of light inside the sensor is passed through a sample of air, and particles in the sample scatter the light beam. The scattered light is measured and used to calculate the concentration of particles in the air sample.




## Calibration

The Particulate Matter sensor W20 is supplied with a factory calibration in µg/m³. When working with the Coach program the pre-defined calibration can be shifted by using the **Set to Value** option.

## Software

You can use the sensor W20 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 7.11.

Check the CMA website for the latest installations.

https://cma-science.nl/downloads_en

## Collecting data without software connection

**Caution**: Make sure the air inlet of the sensor is not covered during the experiment. Any obstruction to the airflow can lead to inaccurate readings.

- Turn the Particulate Matter 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 off the sensor press and hold its power button for 3 s. 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 Particulate Matter sensor on.
- 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', meaning Bluetooth Low Energy is used.
- Start the Coach 7 or Coach 7 Lite program/app.
- Select the Dashboard Activity 'Measurement with Wireless sensors'.
- 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 Particulate Matter 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 sensor icon appears showing the measured values.
- Now you are ready to use the Particulate Matter sensor 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 Particulate Matter sensor 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', meaning 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 Particulate Matter sensor 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 sensor icon appears showing the measured values.
- Now you are ready to use the Particulate Matter sensor for your measurement.

## Collecting data via the USB connection

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

- Turn the Particulate Matter sensor 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 sensor icon shows measured data.
- Now you are ready to use the Particulate Matter sensor for your measurement.

## Practical information

- The information you get from a PM sensor provides a general indication of air quality.
- If you put your sensor in a box or near a wall, it may show a lower concentration of particles than if you put it in an open space.

- This also means if a sensor is moving, for example, if you take it on your bicycle, it will respond differently to when it's stationary.
- As a sensor ages, its fan gets dirty and slows down over time. This slows down air flow, which changes the response of the sensor and reduces the accuracy of its measurements.

## 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.

## Suggested experiments

The Particulate Matter (PM) sensor can be used in the following experiments:

- Measuring PM2.5/PM10 levels in various indoor locations (e.g., classroom, auditorium, in a kitchen) and outdoor locations (e.g., school entrance, bicycle shed where mopeds/scooters arrive and depart, street during and after rush hour, playground, parking lot).
- Measuring PM2.5/PM10 levels before, during, and after activities that generate particles indoors, such as burning candles, deodorants, hair sprayers.
- Collecting measurements of PM2.5/PM10 levels at various times of the day (morning, midday, afternoon) to investigate how air quality fluctuates over the course of a day.
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- Measuring PM2.5/PM10 levels during different weather conditions (e.g., sunny, rainy, windy) to explore how weather influences particulate matter concentrations.
- Measuring PM2.5/PM10 levels before and after using an air purifier.
- Measuring PM2.5/PM10 levels at home for a day, especially around the kitchen during cooking.

These experiments are suitable for school-level investigations and can help students understand the principles of air quality monitoring, environmental factors influencing particulate matter levels, and the importance of clean air for health and well-being.

## Technical Specifications

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|---|---|
| *Sensor kind* | Digital, on-sensor digital conversion |
| *Measuring ranges* | PM2.5 0 .. 500 μg/m$^3$<br>PM10: 0 .. 500 μg/m$^3$ |
| *Resolution* | 1 μg/m$^3$ |
| *Maximal sampling rate* | 2 Hz |
| *Conditions* | 10 ~ 40℃, ~ 85%RH |
| *Display* | OLED 0.96" (128*64 px) |
| *Battery* | Li-Poly Rechargeable Battery (3,7 V 700 mAh) |
| *Battery life after full charge* | Approximately 6 hours<br>Battery life varies by use, configuration, temperature, and many other factors; actual results will vary. |
| *Connection* | Bluetooth 5, Low Energy (Mac, Android, iOS)<br>Bluetooth 2.1, Classic (Windows)<br>USB 2.0 (type C) |
| *Bluetooth ID* | W20PART-xxx |

## Warranty:

The Particulate Matter sensor W20 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 intended for industrial, medical, research, or commercial applications.*

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