# Ultrasonic Personal Air Sampler (UPAS) v2+

## PM sampling / Optical PM sensor / $CO_2$ / Light / Motion

Revision 2.1
June 20, 2022


(Actual device size)

| HIGHLIGHTS |
|---|
| Integrated size-selective PM inlets |
| Wireless setup via mobile application |
| Active, accurate sample flow control |
| Small and quiet; minimal ergonomic burden |
| Comprehensive, high-resolution data logging |
| GPS tracking |
| Long battery endurance |

ACCESS SENSOR TECHNOLOGIES
Sampling made simple.

Access Sensor Technologies' UPAS is a compact, filter sampler built around ultrasonic pumping technology. The UPAS is smaller, lighter, quieter, more affordable, and easier to use than conventional air sampling equipment.

The UPAS v2+ adds time-resolved PM, $CO_2$, light, and motion (acceleration) sensing to our base model UPAS v2. These new sensors provide data useful for evaluating spatial-temporal aspects of exposure. On-device pairing of the optical PM sensor and integrated filter sampler allows the user to normalize the PM sensor data by the "gold standard" filter-derived exposure metric.

The UPAS is silent and light enough to be worn directly in the subject's breathing zone. The interchangeable size-selective sample inlets and filter cartridges integrate directly with the pump, so no cumbersome tubing is needed!

| SPECIFICATIONS | |
|---|---|
| Exterior size | 128 mm × 70 mm × 36 mm |
| Weight | 265 g (with $PM_{2.5}$ 1 L $min^{-1}$ inlet) |
| Noise | <40 dB |
| Filter sample flow rate range | 1 to 2 L $min^{-1}$ ± 4% (active, automatic control) |
| Size-selective inlets | $PM_{2.5}$ (1 L $min^{-1}$ and 2 L $min^{-1}$), Respirable (2 L $min^{-1}$), and $PM_{10}$ / Thoracic (2 L $min^{-1}$), per relevant EPA, ACGIH, and ISO criteria. |
| Filter size | 37 mm (quick-change filter cartridge) |
| Battery type | Li-ion, 24 W-h |
| Battery endurance | >24 h when sampling $PM_{2.5}$ onto a PTFE filter at 1 L $min^{-1}$ with all sensors on; extendable via sampler and sensor duty cycling or external battery/power |
| On-board sensors monitor: | • Fine particulate matter mass concentration (Sensirion SPS30)<br>• $CO_2$ concentration (Sensrion SCD41)<br>• VOCs and NOx (Sensirion SGP41)<br>• Light (Lux, IR, UV, UVindex)<br>• Motion/acceleration (linear and angular, 6 DOF)<br>• Temperature/pressure/relative humidity<br>• GPS location of UPAS (can be deactivated)<br>• Sample flow rate<br>• Differential pressure across the sample filter |
| These specifications are dependent on the filter used. Values reported here were determined using a 3 µm pore size PTFE filter from Measurement Technology Laboratories, LLC (PT37P-PF03). | |

## Filter sampling

The UPAS has been laboratory- and field-tested alongside gold standards like the Harvard Impactor and the Mesa Labs/BGI Triplex Cyclone.

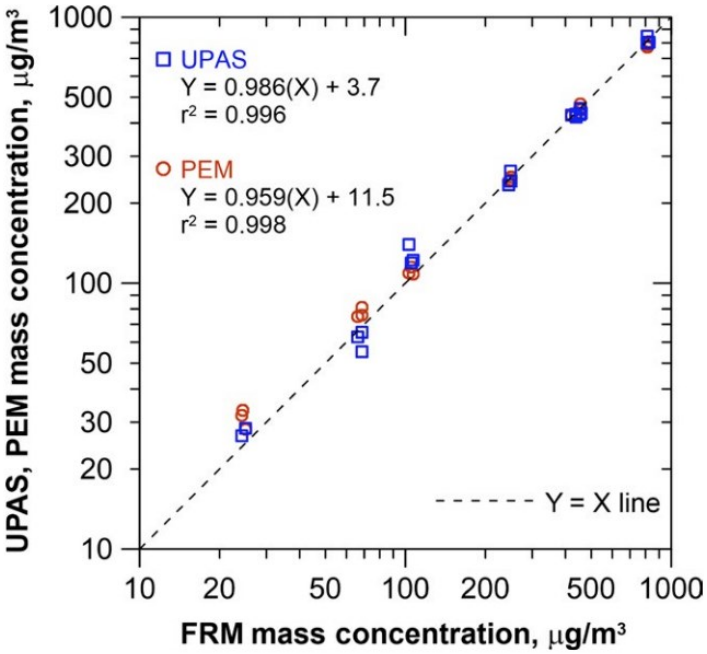
Right: Performance of the UPAS and a Personal Environmental Monitor (PEM + XR5000 pump) relative to an EPA Federal Reference Method (FRM) sampler for $PM_{2.5}$ mass.

For more information, see the following peer-reviewed publications:

Volckens et al., 2017:
https://doi.org/10.1111/ina.12318

Arku et al., 2018:
https://doi.org/10.1016/j.envint.2018.02.033

Pillarisetti et al., 2019:
https://doi.org/10.1016/j.envint.2018.11.014

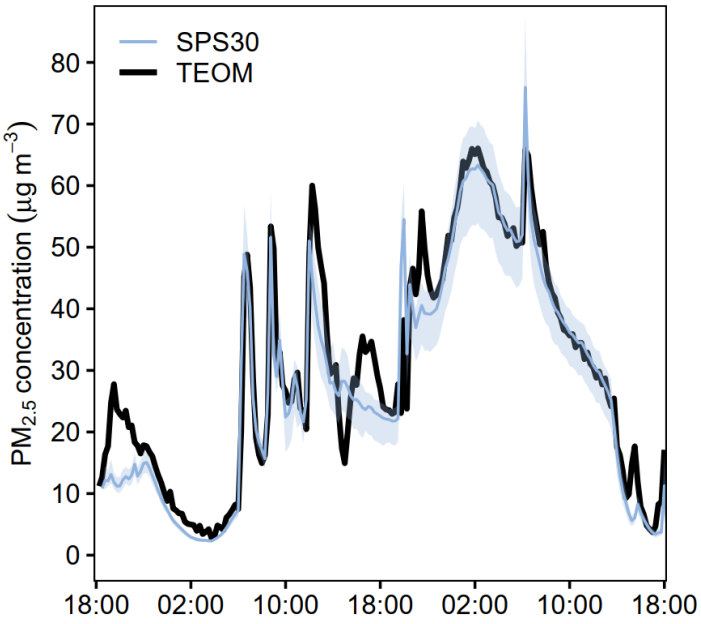



## Particulate matter sensing

We included the Sensirion SPS30 sensor in the UPAS v2+ because (a) its small size is compatible with our goal of minimizing the ergonomic burden of the UPAS, (b) we measured a small relative standard deviation between replicate units, and (c) the sensor includes features to prevent contamination in the types of highly-polluted environments where we know many of our customers collect data.

For more information, see Tryner et al., 2020, https://doi.org/10.1016/j.jaerosci.2020.105654

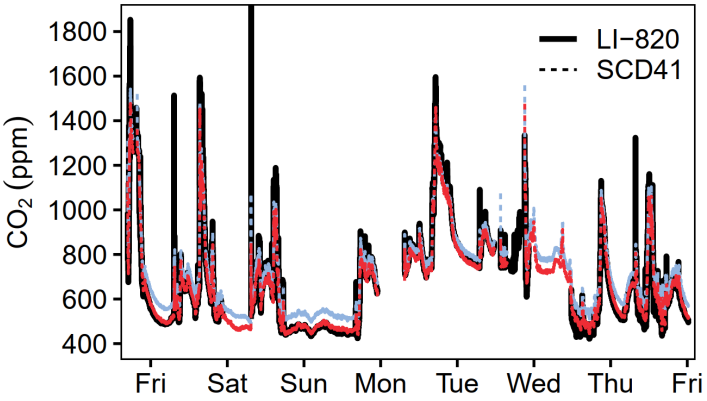
Left: 15-minute average $PM_{2.5}$ concentrations measured in a home kitchen over 48 h using a tapered element oscillating microbalance (TEOM) and five Sensirion SPS30 sensors. The blue line and shaded area indicate the mean and range of concentrations measured by the five sensors.




## $CO_2$ sensing

Before integrating the Sensirion SCD41 photoacoustic $CO_2$ sensor into the UPAS v2+, we tested it alongside a research-grade NDIR $CO_2$ monitor in a home with a gas-fueled cooking stove.

Right: $CO_2$ concentrations measured in a home kitchen over one week using a calibrated LI-COR LI-820 NDIR $CO_2$ monitor (solid black line) and two Sensirion SCD41 $CO_2$ sensors (dashed blue and red lines).




**Access Sensor Technologies**
www.accsensors.com 970-818-7520 @AccessSensor
320 East Vine Drive, Suite 221, Fort Collins, CO 80524