

Preparing for Personal Air Sensors: Definition, Opportunities, and Data Limitations

(updated July 2020)

This fact sheet is designed to provide an understanding of how personal air sensors, and the data they produce, differ from the monitoring networks used for regulatory purposes.

Defining Personal Air Sensors

Low-cost and portable air sensors may have varying definitions. Personal air sensors may not meet the stringent standards established for monitors operated by state, local, or federal agencies and monitoring data used to inform compliance with National Ambient Air Quality Standards (NAAQS). An emerging technology, personal air sensors are sensing devices for air pollution that are designed to provide short-term information regarding an individual's immediate environment. Quality assurance and quality control measures may not exist for personal air sensors or their data, and the result may be questionable data quality and a high variability between instruments.

Opportunities

Low-cost, portable personal air sensors can have useful classroom and citizen science applications. Used properly, these tools can allow students and citizens to explore their local environment as well as learn about air quality and the Clean Air Act in the broader context of state, local, and national air pollution control efforts. For example, these sensors could be used in student-led research, efforts to engage communities in air quality awareness, or to help inform siting of regulatory monitors.

Recognizing Data Limitations

While no standard definition exists, Personal Air Sensors:

- May not have established quality control and quality assurance measures and may not conform to quality assurance documents established by the U.S. Environmental Protection Agency (EPA) or other federal regulatory bodies, including standards set forth in [EPA Information Quality Guidelines](#), [Guidance for Quality Assurance Project Plans](#), [Guidance on Environmental Data Verification and Data Validation](#), [EPA Quality Manual for Environmental Programs](#), [EPA's Quality System-Related Regulations](#), [Good Laboratory Practice Standards](#), and in EPA [guidance documents on risk characterization, assessment, communication, and management](#);
- May have questionable data quality, and provide data that might not correlate with Federal Reference Method (FRM) or Federal Equivalent Method (FEM) monitors used for regulatory purposes;
- May not have completed rigorous FRM/FEM testing and analysis, and are likely not being operated according to FRM/FEM requirements;
 - A full listing of FRMs and FEMs as of December 15, 2018 can be found [here](#).
 - While a limited number of personal air sensors have designated FEM, users would need to ensure that the instrument is used according to FEM protocol, including appropriate ambient conditions and calibration.
- Are outside of the various networks used to establish attainment status for the [NAAQS](#), which include:
 - [State and Local Air Monitoring Stations \(SLAMS\)](#)
 - States must provide U.S. EPA's Office of Air Quality Planning and Standards with an annual summary of monitoring results at each SLAMS monitor, and detailed results must be available to the EPA upon request.
 - [Photochemical Assessment Monitoring Stations \(PAMS\)](#)
 - PAMS are used to monitor ozone, oxides of nitrogen, and volatile organic compounds as part of state implementation plan monitoring networks in ozone nonattainment areas.

- May display air quality information differently than those data used by air agencies, including averaging time, units of measure, level, exposure, and method;
- Are likely not used for regulatory purposes;
- May lack a scientific basis for assessing health effects from short-term exposure, as there is often not enough scientific data to support health effects evaluations of short-term (1-minute or 1-second) measurements from sensors;
- Might not be operated in ambient conditions or by siting requirements found in [Title 40, Part 58 of the Code of Federal Regulations \(CFR\), Appendix E](#);
- May have diminished accuracy from humidity, temperature, transitioning from indoors to outdoors (or vice versa), as well as cross sensitivities to other gases;
- May not have the geographical information and documentation that are necessary to ensure consistent and comparable data;
- May not be built to accommodate an air metering system, and likely does not provide a known volume of air in order to appropriately calculate a concentration of contaminant;
- Need regular calibration and may be subject to drift and decreased sensitivity over time;
- May have a high variability between instruments; and/or
- May or may not be certified by third parties or regulatory agencies.

Other Relevant Background Information

National Ambient Air Quality Standards (NAAQS): [Section 109 of the Clean Air Act](#) (CAA) requires EPA to establish both primary and secondary NAAQS. Primary NAAQS are “standards the attainment and maintenance of which ... are requisite to protect the public health,” while secondary NAAQS “specify a level of air quality the attainment and maintenance of which ... is requisite to protect the public welfare from any known or anticipated adverse effects associated with the presence of such air pollutant in the ambient air.” EPA has established NAAQS for six principal pollutants (or [criteria air pollutants](#)), which are periodically reviewed, and may be revised.

U.S. EPA’s Federal Reference and Equivalent Methods: [Section 103 of the CAA](#) directs EPA to “conduct a program of research, testing, and development of methods for sampling, measurement, monitoring, analysis, and modeling of air pollutants.” In accordance with Title 40, Part 53 of the CFR ([40 CFR Part 53](#)), EPA establishes FRMs and FEMs for specific criteria pollutants, which are used in compliance monitoring of the NAAQS.

Monitoring Ambient Air Quality with Appropriate Data: [40 CFR Part 58](#) specifies requirements for measuring and reporting ambient air quality information. These requirements include:

- Quality assurance procedures for monitor operation and data handling;
- Methodology used in monitoring stations;
- Operating schedule;
- Siting parameters for instruments or instrument probes;
- Minimum ambient air quality monitoring network requirements used to provide support to state implementation plans (SIP), national air quality assessments, and policy decisions. These minimums are described as part of the network design requirements, including minimum numbers and placement of monitors of each type; and,
- Air quality data reporting, and requirements for the daily reporting of an index of ambient air quality.

Recommended Sources for Additional Information about Personal Air Sensors

- U.S. EPA Office of Air & Radiation [memorandum on Air Sensors](#) (June 22, 2020)
- U.S. EPA's [Air Sensor Toolbox for Citizen Scientists, Researchers and Developers](#)
- U.S. EPA's [Air Sensor Guidebook](#) and [Handbook for Citizen Science Quality Assurance and Documentation](#)
- U.S. EPA's National Advisory Council for Environmental Policy and Technology (NACEPT) has issued the following reports:
 - April 2018 – [Information to Action: Strengthening EPA Citizen Science Partnerships for Environmental Protection](#)
 - December 2016 – [Environmental Protection Belongs to the Public - A Vision for Citizen Science at EPA](#)
- AAPCA [topical sessions](#) on *New Tools for Air Quality Evaluation* (August 26, 2019) and *Preparing for Personal Air Sensors: Communication, Context and Perspectives* (September 21, 2016) – Presentations from both sessions can be seen [here](#).

Recommended Sources for Additional Information about Air Quality

- State and local air agencies
- AAPCA's [2020 State Air Trends & Successes: The StATS Report](#)
- U.S. EPA's [Air Quality Trends](#), which provides yearly trends on the six criteria pollutants
- U.S. EPA's [Green Book](#), which provides detailed information about NAAQS designations, classifications and nonattainment status
- U.S. EPA's [Report on the Environment \(ROE\)](#), which evaluates [air quality trends](#)
- U.S. EPA's [Air Quality Index \(AQI\)](#), which is EPA's index for reporting daily air quality

For more information from the Association of Air Pollution Control Agencies,
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