

Particles

Particle pollution is a mixture of microscopic solids and liquid droplets suspended in air. This pollution, also known as particulate matter (PM), is made up of a number of components, including acids (such as nitrates and sulfates), organic chemicals, metals, soil or dust particles, and allergens (such as fragments of pollen or mold spores).

The size of particles is directly linked to their potential for causing health problems. Small particles less than 10 micrometers in diameter (PM10) pose the greatest problems, because they can get deep into your lungs, and some may even get into your bloodstream. Exposure to such particles can affect both your lungs and your heart. Larger particles are of less concern, although they can irritate your eyes, nose, and throat.

Small particles of concern include "fine particles" (such as those found in smoke and haze), which are 2.5 micrometers in diameter (PM2.5) or less; and "coarse particles" (such as those found in wind-blown dust), which have diameters between 2.5 and 10 micrometers.

Where do particles come from?

There are both natural and human sources of atmospheric particulates. The biggest natural sources are dust, volcanoes, and forest fires. The biggest human sources of particles are combustion sources, mainly the burning of fuels in internal combustion engines in automobiles and power plants, and wind blown dust from [construction](#) sites and other land areas where the water or vegetation has been removed. Some of these particles are emitted directly to the atmosphere and some are emitted as gases and form particles in the atmosphere .

Dust in homes, offices, and other human environments is mainly generated by humans from their [skin cells](#) that slough off: An average skin flake has an equivalent diameter of 14µm. It is estimated that the entire outer layer of skin is shed every day or two at a rate of 7 million skin flakes per minute. Tests of indoor environmental dust in homes and offices have shown it to be primarily (70-90%) composed of skin flakes. Some comes from domesticated pets such as dogs, cats and birds. Some atmospheric dust from the outdoors is also present.

House dust mites are on all surfaces and even suspended in air. Dust mites feed on minute particles of skin flakes, the main constituent of house dust. They excrete enzymes to digest dust particles; these enzymes and their feces, in turn, become part of house dust and can provoke allergic reactions in humans. Dust mites flourish in the fibers of bedding, furniture, and carpets. The particles that make up house dust can easily become airborne, so care must be exercised when removing dust, as the activity intended to sanitize or remove dust may make it airborne.

Additional particles come from a variety of indoor activities, such as a wood stove.

Why measure particles?

People with heart or lung disease, older adults, and children are considered at greater risk from particles than other people, especially when they are physically active. Exercise and physical activity cause people to breathe faster and more deeply and to take more particles into their lungs.

People with heart or lung diseases such as coronary artery disease, congestive heart failure, and asthma or chronic obstructive pulmonary disease (COPD) are at increased risk, because particles can aggravate these diseases. People with diabetes also may be at increased risk, possibly because they are more likely to have underlying cardiovascular disease. Older adults are at increased risk, possibly because they may have undiagnosed heart or lung disease or diabetes. Many studies show that when particle levels are high, older adults are more likely to be hospitalized, and some may die of aggravated heart or lung disease.

Children are likely at increased risk for several reasons. Their lungs are still developing; they spend more time at high activity levels; and they are more likely to have asthma or acute respiratory diseases, which can be aggravated when particle levels are high.

Many different kinds of particles can also be asthma triggers.

Measuring particles in various indoor locations can help identify sources of particles for clean-up and remediation efforts. Particle measurements are also taken to identify the impact of activities such as operating wood burning stoves.

How do I measure particles?

Two basic methods typically are used to measure particles: air sampling over time and measurements employing real-time instruments. The type to use depends on the purpose for doing the measurements. For IAQ Building Assessments, the real-time instruments provide the information needed to conduct a timely investigation.

Start the measuring process outdoors to establish a baseline. In rural areas with low particle counts this outside measurement could become the goal for indoor measurements. If the building's intake air is filtered, you can subtract from the base-line measurement a percentage of particulates roughly equal to the efficiency rating of the filter to establish an indoor goal. For example, a 75% efficient filter effectively removes about three-quarters of all particles leaving 25% of the outside reading as the goal.

Inside, measurements are taken and compared to the baseline established. Seek levels of ultrafine particles greater than the goal to find sources of particles that might contribute to air quality problems. Often particle sources are activity related. For example a couch with no disruption may not give off particles; however, a couch with a person sitting on it may become a significant source of particles.

If levels of particles significantly higher than the baseline are found anywhere in the building, take steps to locate and identify the source. Using the particle counter much like a Geiger

counter, particles can be traced directly to their source. Once a source is located, remedial action to control, repair or remove the source can be done.

For a selection of real-time particle counters you can Google “particle counters” for a selection of meters. Pick a meter based on your needs and budget. For a selection of filter based particle measurement devices, Google “mini vol”.

What are normal levels that I might find?

Normal levels of particles are not well defined in the literature. In general, the goal is to keep particle levels low enough so they are not causing health issues.

What standards are there for particulate matter?

The EPA has not established standards for particles in inside air.

American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) Standard ASHRAE 62 recommends a maximum exposure limit for PM10 particles of 0.15 mg/m³ for a 24-hour average and 0.05 mg/m³ for an annual average exposure. This is consistent with the EPA's National Ambient Air Quality Standards.

The National Ambient Air Quality Standards (NAQS) for particulate matter for outside air measurement is

Particulate Matter (PM10) 150 µg/m³ 24-hour

Particulate Matter (PM2.5) 35 µg/m³ 24-hour