

## Estimating particulate matter levels

Particulate matter levels are measured as micrograms ( $\mu\text{g}$ ) of particles per cubic meter of air. Most particle monitoring devices measure either particulate matter with a median diameter of 10 micrometers or less ( $\text{PM}_{10}$ ) or smaller particles with median diameters of 2.5 micrometers or less ( $\text{PM}_{2.5}$ , also known as fine particles).

Jurisdictions with particulate monitors, whether they are filter-based or continuous methods, will get a good idea of how bad the smoke was *after* the event. However, the goal is to relay information to the public in a timely manner, so they can make decisions about how to protect their health when the smoke levels are high. Continuous PM monitors give an instant reading of particulate matter concentrations and usually provide a number of averaging periods (e.g., one-hour and running 24-hour averages). Areas without continuous monitors may be able to get temporary, portable measuring devices through their state air quality program or the Forest Service.

Many communities do not have access to continuous PM monitoring, and therefore need other ways to estimate particle levels. This is true even in areas which do have continuous monitors, because smoke concentrations can vary widely within a couple miles and can change rapidly. Visibility can sometimes serve as a good surrogate. In addition, a visibility index gives the public a quick way to assess smoke levels for themselves.

**Table 1 Estimating particulate matter concentrations from visibility assessment Categories**

Categories	Visibility in Miles	Particulate Matter Levels* (1-hour average, $\mu\text{g}/\text{m}^3$ )
Good	11 miles and up	0 - 38
Moderate	6 to 10	39 - 88
Unhealthy for Sensitive Groups	3 to 5	89 - 138
Unhealthy	1 ½ to 2 ¾	139 - 350
Very Unhealthy	1 to 1 ¼	351 - 526
Hazardous	less than 1 mile	over 526

\*In wildfire smoke, most particles are less than one micrometer, so the values obtained by measuring either  $\text{PM}_{10}$  or  $\text{PM}_{2.5}$  are virtually interchangeable, and are treated as such in this document. Therefore, in the table above, the different particle levels can be measured using either  $\text{PM}_{10}$  or  $\text{PM}_{2.5}$  monitors.

When using the visibility index to determine smoke concentrations, it is important to:

- Face away from the sun.
- Determine the limit of your visibility range by looking for targets at known distances (miles). The visible range is the point at which even high-contrast objects (e.g., a dark forested mountain viewed against the sky at noon) totally disappear.
- After determining visibility in miles, use Tables 2 and 3 to identify potential health effects and appropriate cautionary statements.

**Table 2 Health Effects and Cautionary Statements**

Category (see Table 3)	Health Effects	Cautionary Statements <sup>1</sup>	Other Protective Actions
Good	None expected	None	None
Moderate	Possible aggravation of heart or lung disease.	<p>Unusually sensitive individuals should consider limiting prolonged or heavy exertion.</p> <ul style="list-style-type: none"> <li>▪ People with heart or lung disease should pay attention to symptoms.</li> <li>▪ If you have symptoms of lung or heart disease, including repeated coughing, shortness of breath or difficulty breathing, wheezing, chest tightness or pain, palpitations, nausea, unusual fatigue or lightheadedness, contact your health care provider.</li> </ul>	<ul style="list-style-type: none"> <li>▪ If symptomatic, reduce exposure to particles by following advice in box below.</li> </ul>
Unhealthy for Sensitive Groups	Increasing likelihood of respiratory or cardiac symptoms in sensitive individuals, aggravation of heart or lung disease, and premature mortality in persons with cardiopulmonary disease and the elderly.	<p><i>Sensitive Groups:</i> People with heart or lung disease, the elderly, children, and pregnant women should limit prolonged or heavy exertion.</p> <ul style="list-style-type: none"> <li>▪ Limit time spent outdoors.</li> <li>▪ Avoid physical exertion.</li> <li>▪ People with asthma should follow asthma management plan.</li> <li>▪ If you have symptoms of lung or heart disease that may be related to excess smoke exposure, including repeated coughing, shortness of breath or difficulty breathing, wheezing, chest tightness or pain, heart palpitations, nausea, unusual fatigue or lightheadedness, contact your health care provider.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Keep doors and windows closed, seal large gaps as much as possible.</li> <li>▪ Avoid using exhaust fans (kitchen, bathrooms, clothes dryer, and utility room).</li> <li>▪ Keep the garage-to-home door closed.</li> <li>▪ If cooling is needed, turn air conditioning to re-circulate mode in home and car, or use ceiling fans or portable fans (but do not use whole house fans that suck outdoor air into the home).</li> <li>▪ Avoid indoor sources of pollutants, including tobacco smoke, heating with wood stoves and kerosene heaters, frying or broiling foods, burning candles, vacuuming, and using paints, solvents, cleaning products, and adhesives.</li> <li>▪ Keep at least 5-day supply of medication available.</li> <li>▪ Have supply of non-perishable groceries that do not require cooking.</li> </ul>

<sup>1</sup> Higher advisory levels automatically incorporate all of guidance offered at lower levels.

**Table 2 Health Effects and Cautionary Statements (continued)**

Category (see Table 3)	Health Effects	Cautionary Statements <sup>1</sup>	Other Protective Actions
Unhealthy	Increased aggravation of heart or lung disease and premature mortality in persons with cardiopulmonary disease and the elderly; increased respiratory effects in general population.	<p><i>Sensitive Groups:</i> should avoid prolonged or heavy exertion</p> <ul style="list-style-type: none"> <li>▪ Stay indoors; avoid exertion.</li> </ul> <p><i>General Population:</i> should limit prolonged or heavy exertion</p> <ul style="list-style-type: none"> <li>▪ Limit time spent outdoors.</li> <li>▪ If you have symptoms of lung or heart disease that may be related to excess smoke exposure, including repeated coughing, shortness of breath or difficulty breathing, wheezing, chest tightness or pain, palpitations, nausea or unusual fatigue or lightheadedness, contact your health care provider.</li> </ul>	<p><i>Sensitive Groups:</i> Stay in a “clean room” at home (where there are no indoor smoke or particle sources, and possibly an air cleaner is used).</p> <ul style="list-style-type: none"> <li>▪ Go to a “cleaner air” shelter (see Appendix D) or possibly out of area</li> </ul> <p><i>General Population:</i> Follow advice for sensitive groups in box above.</p> <ul style="list-style-type: none"> <li>▪ Identify potential “cleaner air” shelters in the community (see Appendix D).</li> </ul>
Very Unhealthy	Significant aggravation of heart or lung disease, premature mortality in persons with cardiopulmonary disease and the elderly; significant increase in respiratory effects in general population.	<p><i>General Population:</i> should avoid prolonged or heavy exertion</p> <ul style="list-style-type: none"> <li>▪ Stay indoors, avoid exertion</li> </ul>	<p><i>General Population:</i> If symptomatic, evacuate to cleaner air shelter or leave area, if safe to do so.</p>
Hazardous	Serious aggravation of heart or lung disease, premature mortality in persons with cardiopulmonary disease and the elderly; serious risk of respiratory effects in general population.	<p><i>General Population:</i> should avoid any outdoor activity.</p>	<p><i>General Population:</i> If symptomatic, evacuate to cleaner air shelter or leave area, if safe to do so.</p>

<sup>1</sup> Higher advisory levels automatically incorporate all of the guidance offered at lower levels.