

## Wildfire Smoke Exposure

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### Background

Wildfires are a natural hazard in most regions of the United States, posing a threat to life and property. When called upon, military personnel provide unique and diverse capabilities as part of a coordinated Federal or state response effort to fight these wildfires. There will be varying levels of risk for smoke inhalation dependent upon fire intensity, proximity to the fire, the work activity, weather conditions, and terrain. Smoke levels are unpredictable and change constantly. By the time public health officials can issue a warning, the smoke may have already cleared. Predictions of smoke inhalation levels are rarely accurate for more than a few hours.

### Composition of Smoke

Wood and naturally occurring debris smoke is composed mainly of particulate matter and some gases including carbon dioxide, carbon monoxide (CO), water vapor, nitrogen oxides, sulfur dioxide, trace minerals, and thousands of organic based compounds. The actual composition depends on fuel type, temperature of the fire, and wind speed. The organic vapor compounds are present in low concentrations and include compounds such as acrolein, benzene, and formaldehyde, as well as polynuclear aromatic hydrocarbons, such as benzo(a)pyrene.

### Health Effects

The primary inhalation hazard from wildfires is exposures to airborne particulates. Particulate matter can be inhaled into the deepest recesses of the lungs and cause respiratory tract irritation resulting in coughing and difficulty breathing. These particulates can also cause temporary eye irritation. The other primary concern is CO, which is a colorless and odorless gas. Exposure to CO, a chemical asphyxiant, can cause headaches, dizziness, visual impairment, and death (reference 1 and 2).

Formaldehyde and acrolein add to the cumulative irritant properties of smoke even if present at concentrations generally considered not a public health concern. The level and duration of exposure, plus the age, health status, and other factors of each individual play a significant role in determining whether or not the exposure will result in smoke-related health problems. Cancer risk from short-term exposure to wildfire smoke is low based upon studies on exposure to wildfire smoke that report no increase in the cancer risk for personnel fighting wildfires.

### Other Health and Safety Concerns

Hot smoke and gases can burn the passages of the nose, airways, and lungs. Burns to the hands, face, and other body parts from exposure to fires are a concern. A major hazard when working on the fire line or providing support to the firefighting operations can be heat and cold stress from working near the fire or outdoors in sun and then cooling off after becoming wet from water and sweat. Electrical hazards from working near down or damaged power lines are serious hazards that can cause injury or death. Injuries caused from slips, trips, and falls should be expected. Finally, fire fighters may be at risk for crash-related injuries while operating vehicles that have been modified for firefighting services (reference 3). Indoor Air Quality Outdoor air enters your home or workplace in several different ways and may contain fine particles from wildfire smoke. Open windows and doors are the most obvious entry; however, air can also enter through small openings and cracks around closed windows and doors. Outdoor air may also enter through mechanical ventilation including bathroom or kitchen fans that vent to the outdoors, as well as heating, ventilating, and air conditioning (HVAC) systems with a fresh air intake. Reducing exposure to wildfire smoke is important for everyone's health, especially children, older adults, and people with heart or lung disease. It is important to follow guidance from local officials and emergency alerts, especially if you are told to evacuate. Wildfires that are close to your home or workplace can spread quickly, posing an immediate threat to safety; and it can be impossible to keep dense smoke from building up indoors.

In situations where wildfires do not threaten homes and buildings, local officials may advise you to stay indoors because of higher smoke levels. To reduce smoke exposure—

1. Keep windows and doors closed and use fans and air conditioning to stay cool. Consult with an HVAC professional about installing a high-efficiency filter to capture fine particles. Close outdoor dampers and set the unit to recirculate mode.

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Defense Centers for Public Health—Aberdeen, Industrial Hygiene Field Services Division  
8252 Blackhawk Road, Aberdeen Proving Ground, MD 21010  
410-436-3118 or DSN 584-3118

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2. If you have a window unit, ensure a tight seal between the air conditioner and window. Do not use if outdoor damper cannot be closed.
3. Avoid—smoking cigarettes, using gas, propane or wood-burning stoves and furnaces, spraying aerosol products, frying, or broiling food, burning candles or incense, vacuuming (unless it has a high-efficiency filter), and other activities that increase particulates and smoke.
4. Avoid strenuous activity that increases your breathing rate.
5. Use a N95 or P100 respirator if you must go outside; other masks and face coverings do not filter out smoke.
6. Air out your home by opening windows or the fresh air intake on your HVAC system when the air quality improves, even temporarily (references 4 and 5).

### **Worker Safety and Health in Wildfire Regions**

Even when outdoor air quality is poor due to wildfires, it may be necessary or required to work outdoors. Workers may be affected by high temperatures in addition to smoke exposure. Employers may refer to the AirNOW PM2.5 Air Quality Index (AQI) to help inform decision making (reference 6). The AirNOW PM2.5 AQI classifies outdoor air quality and indicates when healthy workers may experience health effects. This guidance does not discuss the additional respiratory hazards to workers who work near active wildfires (e.g., firefighters).

The California Occupational Safety and Health Administration designates AQI for PM2.5 above 151 as unhealthy and recommends taking steps to protect workers when AQI exceeds that level due to wildfire smoke (reference 7). It is important to encourage workers to report wildfire smoke hazards by providing a reporting system that is easily understandable. Provide training to employees so that they understand and recognize the potential health effects of wildfire smoke exposure. Encourage and assist employees to seek prompt medical treatment when they show signs or symptoms of health effects related to wildfire smoke exposure. The following practices should be considered to reduce worker exposure: relocate work to less smoky areas, reschedule work until air quality improves, modify schedules to reduce the level or duration of physical exertion, provide enclosed structures with filtered air for employees to work in, and provide enclosed vehicles with air conditioning operating in recirculate mode (reference 8). Follow work-rest cycles and water intake as laid out in Technical Bulletin, Medical (TB MED) 507, Heat Stress Control and Heat Casualty Management, (reference 9). Whenever engineering controls are not feasible or do not reduce employee exposures to PM2.5, provide proper respiratory protection (reference 10).

### **Planning Actions and Considerations for Fire Fighters**

The APHC has developed a Wildfire Personal Protective Equipment Fact Sheet that can be referenced when the use of respirators or other personal protection equipment (PPE) is needed in the case of a wildfire (reference 10). It should be noted that air-purifying respirators do not remove carbon monoxide. Therefore, if an air purifying respirator is used and there is the potential to be close to the fire or when working in areas with limited ventilation, an audible and/or vibrating CO monitor that alarms at 25 parts per million (ppm) should be available and used by at least one member of the firefighting team. The team should be required to retreat from areas where CO levels exceed 25 ppm in air. Ensure that a heat and cold stress program is in place and that workers have been trained and are following these procedures. Confirm that each task and operation to be performed by the workers has been evaluated for potential safety and health hazards and that they have the appropriate training and personal protective equipment. When reporting to the site, the leader of the Department of Army (DA) team should communicate with the Civilian on-scene commander and their safety manager. The DA workers must follow the site safety and health requirements.

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