



Wildfire Smoke Exposure

FACT SHEET 55-018-0512

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 difficult 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. 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).

Respiratory Protection

Respiratory protection is not normally used by firefighting personnel who fight wildfires. If worn, the type of respirator should be based upon the operations or tasks to be performed. In all cases only NIOSH approved respiratory protection shall be worn. The selection of respirators should only be performed by an occupational health and safety professional (e.g., safety specialist or industrial hygienist). There is currently no air purifying respirator available that will protect exposed personnel against all potential toxic components present in wildfire smoke. If respiratory protection is required for a wide range of chemical air contaminants at unknown concentrations, a supplied air respirator would be required. However, due to their limitations, supplied air respirators should only be used when fighting fires in situations where ventilation is limited, high CO concentrations are expected, and /or where there is the potential for the generation of high concentrations of highly toxic compounds (such as structural fires or fires at industrial sites with hazardous materials storage). When away from the base camp for extended periods of time, the use of supplied air respirators in most outdoor situations is not practical or feasible. Supplied air respirators should only be considered for operations where airborne contaminant exposures are expected to be high or considered immediately dangerous to life or health (IDLH) and/or there is a potential for low oxygen concentrations (below 19.5% oxygen, adjusted for altitude).

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Respiratory Protection for most Operations and Tasks performed by Department of Army Personnel

Department of Army (DA) personnel assess hazards of a wildfire operation to determine the specific respiratory protection requirement for each task performed before participation. In most cases where DA personnel are providing support to wildfire operations, exposures to smoke particulates are the primary concern; thus, personnel should use an air purifying respirator equipped with a R95 (Resistant to oil, 95% filtration of particles 0.3 micron in size or higher) particulate filters based on guidance from the National Fire Protection Association (NFPA) 1984 standard, 2011 Edition (reference 4). If moderate to heavy smoke exposures are unavoidable, an air purifying respirator with higher levels of protection such as P100 (Oil proof, 99.97% filtration of particles 0.3 micron in size or higher) particulate filters should be worn. **All respirator users must be informed that air purifying respirators only filter air and do not provide oxygen; thus, will not provide protection when oxygen concentrations are below 19.5 percent.**

Planning Actions and Considerations

A written respiratory protection program is required if DA personnel are to use respiratory protection. The program should include as a minimum: medical clearance for workers using the respirators fit testing, training on respirator use and limitations, and respirator maintenance, cleaning, and storage procedures. In addition, a procedure outlining the frequency for filter or respirator change-out must be developed and be included in the program. If R95 filtering face piece (disposable) respirators are going to be available for use, then as a minimum workers should be trained on the use and limitation of the respirator, and the worker should be evaluated by a licensed healthcare provider to ensure they are medically fit for using the respirator. **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 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 parts per million in air. Ensure that a heat and cold stress program is in place, and 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.

Response Actions and Considerations

When reporting to the site, the leader of the 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.

References:

1. Title 29 Code of Federal Regulations, Part 1910, Occupational Safety and Health Administration, July 2011.
2. Army Regulation 11-34, The Army Respiratory Protection Program, 15 February 1990.
3. National Institute for Occupational Safety and Health (NIOSH) Web site on Fighting Wildfires: [Preventing Death and Injuries of Fire Fighters Operating Modified Excess/Surplus Vehicles](#) and [Hazard ID: Traffic Hazards to Fire Fighters While Working Along Roadways](#) at: <http://www.cdc.gov/niosh/topics/firefighting/>.
4. National Fire Protection Association (NFPA®). 1984. Standard on Respirators for Wildland Fire Fighting Operations, 2011 Edition. (NFPA® is a registered trademark of the National Fire Protection Association.)
5. Department of Health and Human Services, NIOSH Publication No. 96-101, NIOSH Guide to the Selection and Use of Particulate Respirators, January 1996.
6. NIOSH Web site on Wildfires at: <http://www.cdc.gov/niosh/topics/firefighting/>.
7. American Conference of Governmental Industrial Hygienists (ACGIH®), 2012 Threshold Limit Values for Chemical Substances and Physical Agents & Biological Exposure Indices, ACGIH, 2012. (ACGIH® is a registered trademark of the American Conference of Governmental Industrial Hygienists.)

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