



Fire Fighter Cancer Awareness and Prevention



Exposures to Carcinogens

INTRODUCTION

Fire fighters are occupationally exposed to combustion products of modern residential, commercial, vehicle, wildland and other fires that contain many hazardous substances. These include carcinogens (i.e., cancer-causing chemicals) present during fire responses and at the fire station.

Years of research have clearly documented fire fighters' exposure to carcinogens in all phases of fire response, including overhaul. Recent studies have also addressed combustion of all the new synthetic products present in homes, cars and factories. A carcinogen exposure to products of combustion does not require visible smoke.

Chronic exposure to heat, smoke and toxicants puts fire fighters at higher risk for developing cancer when compared to non-fire fighters. Inhalation, ingestion and absorption of toxic substances causes cell damage that may lead to cancer.

EXPOSURES ON THE FIRE GROUND

When responding to a fire, there are many opportunities for exposure to carcinogens. A wide range of chemicals have been detected in smoke and soot during fire suppression and overhaul. These contaminants cover personal protective equipment (PPE) and the equipment used for fire activities and they remain there until washed off. These lingering contaminants can lead to additional exposures if fire fighters remove their self-containing breathing apparatus (SCBA) at any time while on the fire ground and – if they do not perform preliminary exposure reduction (on-scene and post fire gross decontamination) – these contaminants can spread to the apparatus' cab and/or back to the fire station.

EXPOSURES IN FIRE STATIONS

Many of the contaminants that fire fighters encounter during fire responses can be tracked back to the fire stations where they live throughout their shifts when not responding to a call. In a study of dust samples in 26 fire stations in five states, Shen and colleagues¹ documented phosphorous-containing and polybrominated diphenyl ether flame retardant levels that were higher than those previously reported in homes and other occupational settings around the world. The study was replicated in Canada where it demonstrated the same findings.

Daily exposure to diesel exhaust in the firehouse can also contribute to the development of cancer. Analysis of the kitchen and bunkroom walls and furniture in firehouses reveals a tremendous amount of diesel exhaust particles. These dangerous particles are inhaled and absorbed every shift and cause

significant harm to fire fighters. Diesel exhaust was classified as a group 1 carcinogen by the World Health Organization (WHO) and the International Agency for Research on Cancer (IARC).

ROUTES OF EXPOSURE

1. Inhalation Exposures

The most common route of exposure to carcinogens for fire fighters is through inhalation. When responding to a call, the chemicals released in the smoke and soot do not disappear when the fire is extinguished. These chemicals remain airborne through all phases of fire activities. Research has confirmed carcinogen exposures during the overhaul phase, a period when fire fighters have traditionally not worn SCBA. Inhalation can also occur from various sources including off-gassing from contaminated equipment and PPE and diesel exhaust commonly at the station. It is important to wear your SCBA through all fire suppression activities and perform on-scene gross decontamination to minimize the risk of inhaling carcinogens.

2. Dermal Exposures

Exposure can also occur through dermal absorption when contaminated particulates are absorbed through the skin. Commonly, dermal absorption to carcinogens found in soot can occur even while wearing turnout gear when soot is transferred to the fire fighter's skin either during firefighting activities or while removing contaminated PPE. Elevated temperatures, as routinely experienced by fire fighters, have been associated with increased dermal absorption. Steps can be taken to reduce dermal exposure and include on-scene gross decontamination, wiping of skin, and showering and laundering station work uniform upon arrival back at the station.

3. Ingestion Exposures

For fire fighters, ingestion is a less common route of exposure, but it does occur. Soot is the typical exposure source as it transfers to fire fighters' hands and if not washed can then be ingested through eating, drinking and putting hands in your mouth. In a 2020 research study that evaluated chemicals in the air and on fire fighter ensembles, researchers identified that gloves are some of the most contaminated.² Some gloves had high contaminant levels and were generally more contaminated than turnout coats. The study identified that routine gross decontamination appeared to reduce many of the contaminants. **This highlights the importance of on-scene gross decontamination of PPE and equipment, hand washing and showering within the hour of returning to the station.**

To protect yourself from exposures, the following actions are recommended:

- Use SCBA from initial attack through overhaul. (Not wearing SCBA in both active and postfire environments is the most dangerous voluntary activity in the fire service today).
- Perform on-scene gross decontamination on PPE to remove as much soot and particulates as possible. Wet decon is the most effective.
- Use wet wipes to remove as much soot as possible from head, neck, jaw, throat, underarms, hands and all exposed areas of skin immediately and while on the scene.
- Bag contaminated gear on scene and store them in an outside compartment. Never in the cab.
- Change your clothes and wash them immediately after a fire. If possible, have a change of clothing in a personal bag.
- Shower thoroughly after a fire.

- Clean PPE, gloves, hood and helmet (including helmet liner) immediately after a fire. Follow NFPA 1851 recommendations.
 - Decontaminate the interior of apparatus after fires regularly.
 - Keep bunker gear out of living and sleeping quarters.
 - Use a diesel exhaust capture system.
 - **The importance of annual medical examinations cannot be overstated – early detection and early treatment are essential to increasing survival and improving outcomes.**
 - Track your exposures using the NFORS Exposure Tracker app to log exposure and incident details in a private, encrypted and secure online environment.
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Resources:

1. Shen B, Whitehead TP, Gill R, et al. Organophosphate flame retardants in dust collected from United States fire stations. *Environment International* 112 (2018) 41–48.
2. Kenneth W. Fent, Mark LaGuardia, Drew Luellen, Seth McCormick, Alexander Mayer, I-Chen Chen, Steve Kerber, Denise Smith, Gavin P. Horn. Flame retardants, dioxins, and furans in air and on firefighters' protective ensembles during controlled residential firefighting. *Environment International*, Volume 140, 2020.