



Carcinogens and Contamination in Firefighter Equipment

Background, Analysis, and Best Practices for
Decontamination

Contact:
Snap-tite Hose
217 Titusville Road
Union City, PA 16438
Call us: 814-438-7616

Summary

Mounting evidence from decades of study suggests that firefighters are at particular risk for exposure to contaminants and cancer-causing carcinogens. However, we now know that firefighters are not only exposed to these contaminants and carcinogens while present at the site of an incident. Instead, contaminants and carcinogens linger on the firefighter's PPE (personal protective equipment), gear, and tools if not properly cleaned. It logically follows that his continued exposure to lingering contaminants furthers the firefighter's risk for cancer. Though the firefighting industry and science at large are still defining specific best practices for cleaning and decontamination, multiple agencies understand that thorough and effective cleaning of PPE, gear, and tools is necessary to substantially reduce and remove continued exposure to contaminants and carcinogens. We recommend that Fire Departments abide by current best practices for contaminant removal and support these practices with equipment that is most readily and easily cleaned. In this paper, we will focus specifically on the cleaning of tools, apparatus, and equipment that are more easily ignored due to the fact that contamination of such items is often less conspicuous than contamination in turnouts, clothing, and the physical body.

Background: Carcinogens and Contamination in Fire Fighting

Though we are still learning about risk of contamination and cancer for firefighters, there is now substantial enough evidence to say that firefighters are indeed in danger of contamination by hazardous substances, some of which have been shown to be cancer-causing. Indeed, the landmark study “Mortality and cancer incidence in a pooled cohort of US firefighters from San Francisco, Chicago and Philadelphia (1950-2009)” in the peer-reviewed journal Occupational and Environmental Medicine” established that “firefighting may be associated with increased risk of solid cancers.” (1) The study- noted for its large sample size (29,990 participants) and the sizeable timeframe over which members of that sample was employed (59 years)- explained that burning of various materials resulted in the release of dangerous substances (such as polycyclic aromatic hydrocarbons, or PAH) into the air; these substances can then accumulate on a firefighter’s exposed skin, or on the firefighter’s equipment and turnouts. As noted by a subsequent study published by the American Chemical Society, “Exposure to PAHs is of particular concern as the compounds can cause DNA mutations and are known carcinogens.” As you are likely aware, a carcinogen is a substance capable of causing cancer in human tissue. (2)

The study went on to find that PAH metabolites were present in the urine of firefighters at levels 2.9 to 5.3 times greater post-fire than they were pre-fire. Of particular interest to our topic is an author’s claim that a relationship does exist between “firefighters’ urinary PAH metabolite levels and levels of PAHs on their skin.” (2) Further research on PAHs tells us that PAHs are present in many environments-even soil, vegetable oils, and grains, which may lead one to believe these substances to be relatively innocuous. However, it is the frequency, length of exposure, and concentration of the PAHs that is important: continued exposure- such as repeatedly contacting PAH-contaminated equipment- has been shown to cause cancer in laboratory settings. (5)

In part due to these studies' findings, fire departments across the country are now taking decontamination of PPE, gear, and other equipment more seriously than ever. As the National Fire Protection Agency (NFPA) states in its introduction to PPE Cleaning Validation, "it is well understood that firefighters are exposed to contaminants... (that) soil firefighter PPE, and the soiled PPE cross-contaminates everything it contacts." The report goes on to agree that these long-term contaminant exposures represent "significant dangers to firefighter's immediate and long-term health." (3) However, the problem does not stop with PPE and clothing. Indeed, equipment and items that are sometimes ignored when it comes to establishing decontamination protocols also present contamination dangers. Hand tools, apparatus, and even fire hose can be contaminated with hazardous substances that can rub off on a fire fighter's skin, resulting in dermal contamination. (4)

Recognizing the Importance of Cleaning and Decontamination

Firefighters, firefighting companies, and support/awareness organizations such as the National Fire Protection Association (NFPA) are increasingly acknowledging the dangers that contaminants pose, even beyond and after the scope of an active fire. However, like with any industry still learning about the problem it's trying to solve, development of specific decontamination and cleaning standards has been and continues to be an ongoing process. Before delving into current, recognized best practices for cleaning equipment, tools, and apparatus, it's important that we touch upon some of the methods and modes of thinking that we know are outdated and dangerous:

- **If I wasn't too close to a fire, I'm fine:** Unfortunately, this assumption is unfounded. Structural fires can spew particulates and ash for hundreds of feet beyond the incident location, and these particulates can often be invisible. It's not uncommon for chlorinated compounds like vinyl chloride; hydrocarbons, polynuclear aromatic compounds, and even metals like cadmium and chromium- all dangerous to human health- to emanate from a single blaze. Furthermore, biological agents can contaminate PPE and other equipment if not properly cleaned. (6)

- **Decontamination and cleaning can happen whenever:** A hectic day at the scene of an incident can lead to the hasty packing of PPE, tools, and equipment. After all, cleaning can wait- it's just that we clean at all that's important, right? Wrong. Packing and transporting contaminated, unclean gear and tools- from PPE to hand tools to hoses and apparatus- can spread dangerous compounds to the interiors of vehicles and inside the firehouse itself, increasing exposure greatly.
- **You can tell a tough and experienced firefighter by how weathered their gear and equipment is:** In 2019, this should be an obvious, dangerous myth, but this “old school” line of thinking can still be prevalent in the firehouse. A dirty hose is an unsafe hose; the same is true for PPE, hand tools, and all apparatus. Dirt and grime can carry potentially carcinogenic contaminants that can be breathed in over time or transmitted via touch.
- **Overhaul is just a chore- it’s not that serious:** False. Overhaul presents myriad opportunities for inhalation of and dermal contact with hazardous contaminants. SCBA (self-contained breathing apparatus) should be worn by all fire crew and fire investigators throughout overhaul, including hydration, initial cleaning, and structural examination. Crews present during the blaze, or that had contact with the scene should be evacuated from the scene as early as possible and should take off-site showers. (7)

The above are just a few examples of how *not* to approach cleaning and decontamination.

In our next section, we’ll dive into some current best practices for dealing with potentially-contaminated equipment, tools, and apparatus.

Current Methodologies for Cleaning and Decontamination

The National Fire Protection Agency (NFPA) states that “contaminants... are present far from the fire ground: on hand tools, fire hose, apparatus, stations, and beyond- even into private vehicles and the homes of fire fighters.” Further complicating things is that doctors and researchers still “don’t fully understand which exposures are responsible for cancer in fire fighters, the mechanisms by which exposures cause cancer, nor the most effective means of reducing exposure.” (4) In part due to these complications, national organizations like the NFPA and state organizations such as the Washington State Council of Fire Fighters (WSCFF) are

working together like never before to improve outlooks for firefighter health and to reduce exposure to contaminants and carcinogens. Together, these organizations have produced documentation that we can use as standards for proper cleaning, decontamination, and care of firefighting equipment and apparatus. Here, we'll expound on best practices for those pieces of equipment and apparatus for which contamination is not immediately evident, but still presents real danger. Throughout, we will give consideration to the reality of the sometime hectic nature of firefighting scenes.

- **Hand tools: Location and transportation matter.** Before transporting contaminated PPE from site for cleaning, make sure to encapsulate PPE and small hand tools in plastic bags as to not contaminate other objects. Larger hand tools and gas-powered machinery should be cleaned at the site as part of gross contamination. Make sure to use appropriate disinfectants and detergents as per NFPA 1962. (8)
- **Treat your personal vehicle carefully.** Often, some turnouts, tools, and pieces of equipment are transported back to the station in a firefighter's personal vehicle. It's important to remember not to store any potentially contaminated items in closed compartments, such as a trunk. Instead, encapsulate these items (as described above) and transport them in open air (such as in the back of a pickup truck) after gross decontamination. (7)
- **Inspect apparatus after an incident and ensure regular cleaning.** As per WSCFF guidelines, it's imperative to inspect and decontaminate all quarters of the apparatus where people spend any amount of time (especially the cab). Thorough HEPA vacuuming and disinfection with designated rags/cleaning supplies should take place after each incident, as well as on a regular schedule. While present on the scene of a fire, make sure to locate upwind of the fire, keep windows closed, and turn off ventilation (heat or A/C) to avoid particulates and contaminants entering the cab. (7)
- **Hose must be thoroughly and properly cleaned to avoid contamination.** Here, the specific type of equipment used makes quite a difference in the cleaning process. For a traditional, jacketed fabric hose, first brush the hose (while dry) using a soft/medium bristle brush. If dirt or grime remain, or if the hose has touched any possibly

contaminated substances (such as leakage from the fire or biological residue, the hose must be thoroughly washed with approved disinfectant and detergent. As per NFPA 1962, unroll the hose and stretch it out in its entirety on a clean, level surface.

Thoroughly rinse the hose with clean water. Scrub the entire length of the hose, repeat on other side. Let dry while elongated. If in hot, direct sunlight, move to a shaded, cooler area. (7)

For covered rubber or nitrile hoses: these hoses are, by comparison, easier to decontaminate and clean from potentially hazardous materials. Covered rubber or nitrile hoses can be cleaned with appropriate disinfectant wipes or washed the traditional way but dried via a clean towel (rather than laying out for some time to air dry). Due to the time-sensitive nature of post-fire scenes and overhaul, firefighters may want to consider the easier cleaning and care of rubber and nitrile hoses when deciding how to most appropriately prepare for the necessary cleaning and decontamination of equipment after an incident.

In conclusion, it is heartening to know that best practices and methods for cleaning and decontamination of dangerous materials are keeping up with science. The medical community tells us that firefighters are greater risk of exposure to contaminants, but organizations like the NFPA, WSCFF, and thought leaders in the firefighting community are taking these threats seriously by updating decontamination procedures to reflect the most recent research. As firefighters better prepare themselves to fend off the dangers of exposure, the realities of dealing with a hectic fire scene must be considered. However, as this report has hopefully helped to elucidate, it is possible to prioritize safety efficiently and without compromise.

References Consulted

- (1) Daniels RD, Kubale TL, Yiin JH, et al Mortality and cancer incidence in a pooled cohort of US firefighters from San Francisco, Chicago and Philadelphia (1950–2009) *Occup Environ Med* 2014;71:388-397.
- (2) Elevated Exposures to Polycyclic Aromatic Hydrocarbons and Other Organic Mutagens in Ottawa Firefighters Participating in Emergency, On-Shift Fire Suppression
Jennifer L. A. Keir, Umme S. Akhtar, David M. J. Matschke, Tracy L. Kirkham, Hing Man Chan, Pierre Ayotte, Paul A. White, and Jules M. Blais
Environmental Science & Technology 2017 51 (21), 12745-12755
DOI: 10.1021/acs.est.7b02850
- (3) PPE Cleaning Validation Summary Document. Retrieved from <https://www.nfpa.org/-/media/Files/News-and-Research/Resources/Research-Foundation/Current-projects/PPE-Cleaning/PPECleaning.pdf>
- (4) NFPA Fact Sheet: Cancer Risk in Firefighting. Retrieved from <https://www.nfpa.org/-/media/Files/Code-or-topic-fact-sheets/FactSheetFFLungCancer.pdf>
- (5) Polycyclic Aromatic Hydrocarbons (PAHs) by Illinois Department of Public Health. Retrieved from <http://www.idph.state.il.us/cancer/factsheets/polycyclicaromatichydrocarbons.htm>
- (6) Expert Advice on Contaminated Gear Hazards and Cleaning. Retrieved from <https://www.firehouse.com/safety-health/article/10509593/expert-advice-on-contaminated-gear-hazards-and-cleaning>
- (7) Healthy In, Healthy Out Flipbook by WCSFF. Retrieved from https://www.wscff.org/?zone=/unionactive/view_page.cfm&page=Healthy20In20Healthy20Out
- (8) Standard for the Care, Use, Inspection, Service Testing, and Replacement of Fire Hose, Couplings, Nozzles, and Fire Hose Appliances. Retrieved from <https://www.nfpa.org/codes-and-standards/all-codes-and-standards/list-of-codes-and-standards/detail?code=1962> (membership required)
- (9) NIOSH Study of Firefighters Finds Increased Rates of Cancer. Retrieved from <https://www.cdc.gov/niosh/updates/upd-10-17-13.html>

