

CANCER:

How Firefighter
PPE Increases
the Risk and
Preventative
Actions you
can Take



Smoke, heat and structural collapse have long been the chief external threats to firefighters in this inherently dangerous profession. Yet in recent years, data has shown that the greatest threats are lurking within us, typically in the form of cardiac disease and cancer. When it comes to the latter, firefighters contract several types of cancer at a much greater rate than do average individuals. This is increasingly being borne out in research on firefighter cancer rates. Further, it is well-established that the spike in cancer incidents is directly tied to what firefighters are exposed to in the fireground environment – and several reports, such as those by the [Firefighter Cancer Support Network \(FCSN\)](#), are showing causation. FCSN cites seven studies since 2006 that show a direct link between firefighting activities and cancer incidents.

FCSN says that firefighters have a 9 percent higher risk of being diagnosed with cancer and a 14 percent higher risk of dying from cancer than do members of the general population. For certain types of cancers, those risks are even greater. For example, firefighters have a 129 percent greater risk of dying from mesothelioma, FCSN reports in its [Firefighter Cancer Fact Check](#) report, which cites a National Institute for Occupational Safety and Health cancer study. Firefighters also have a 39 percent increased risk of dying from esophageal cancer.

Additionally, cancer has become the leading cause of firefighter line-of-duty deaths – accounting for 61 percent of LODDs between January 2002 and March 2017, according to FCSN. That number hit 70 percent for career firefighter LODDs in 2016. To get a handle on this problem, more than 30 states have adopted laws making cancer a presumptive illness for firefighters – meaning it is presumed, so long as certain conditions are met, that they contracted cancer due to work conditions rather than through genetics or lifestyle choices. The International Association of Fire Fighters has a state-by-state map showing which illnesses are presumptive in each state (phi.iaff.org/Map.aspx).

Experts like Robert Tutterow, a North Carolina-based PPE expert who heads the [Fire Industry Education Resource Organization](#), are confident these findings are valid. “There have been numerous studies from very reputable organizations that clearly show that the present-day fire environment releases cancer-causing agents,” he said. “There are fewer and fewer natural materials used in the construction industry and the man-made products used in construction and home furnishings, finishes, etc., are all contributors to a more contaminated fire environment than in previous decades. This toxic environment is also found in vehicle and dumpster fires.”

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Fire Industry Education Resource
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PPE Off-Gases Toxins

Researchers who are looking into the route these carcinogens (volatile compounds found in smoke, especially from burned plastic-based furnishings) take to infiltrate firefighters' bodies conclude that they are both breathed in and absorbed through the skin. One of the chief culprits in this exchange is the firefighter's own personal protective equipment – turnout pants and coat, helmet, gloves and boots – as was shown in a 2017 study published in the [Journal of Occupational and Environmental Hygiene](#) (JOEH). Using live burns and firefighters conducting typical fireground operations, those researches showed that PPE absorbs volatile compounds and releases them back into the air where they can be breathed in by firefighters – most likely while riding back to the station after the fire has been struck. There is also a greater chance firefighters' skin will come in contact with the contaminated PPE, thus providing a second entryway for cancer-causing agents.

“While the levels we measured are well below applicable short-term exposure limits or ceiling limits, these findings indicate that firefighters could inhale a number of chemicals in the period following a fire response. Although not a major focus of this study, semi-volatile compounds would evaporate much more slowly and could pose a longer-term inhalation hazard for firefighters,” authors of the JOEH-published study authors wrote. And while turnout pants and coats present the greatest risk of attracting cancer-causing materials due to their larger surface area and fiber construction, helmets, gloves and boots also can harbor toxins. Firefighters in Sweden conducted firefighter exposure research and from it developed the [Skelleftea Model](#), a recommended procedure for minimizing exposure through isolating and laundering PPE. Here's what that study's authors, Stefan Magnusson and David Hultman, said: “Helmets, gloves and boots are also surface layers, which are contaminated to the same extent as turnout gear. The difference between these and turnout gear is that helmets, gloves and boots are, in general, decontaminated even more seldom. Due to its function and design, the helmet can become contaminated inside and out. Furthermore, it is worn on the head, where it has close contact with both fine skin and airways.” Tutterow agrees, saying the most overlooked aspects cleaning turnout gear are “failure to clean the inner lining of helmets and not adequately cleaning gloves and boots.”

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Journal of Occupational and Environmental Hygiene

Cancers Firefighters Contract More Than Civilians

- Digestive
- Oral
- Respiratory
- Urinary
- Malignant mesothelioma

Gross Decon

There are two fairly simple steps fire departments can take to reduce the risk of exposing firefighters to the carcinogens carried on their PPE after a fire. They can perform gross decontamination on scene and they can isolate the contaminated gear.

Many departments that employ gross decontamination use a soap and water mixture. Two contaminated firefighter wearing full PPE and SCBA will take turns cleaning one another by using a small hose connected to the engine's tank to rinse, then using a scrub brush with a bucket of soapy water to clean the firefighter head to toe, followed by another rinse. The now-clean firefighter, then performs the same gross decontamination to the other firefighter. Both wear SCBA to keep from inhaling carcinogenic particles and gasses coming off their PPE.

Research shows that field gross decontamination reduces, but does not fully eliminate, cancer-causing agents on firefighter PPE. Of the three methods the JOEH-published study tested – soap and water, dry brushing, forced air blowing (with modified leaf blower) – soap and water was by far the most effective. PPE cleaned with that method had 90 percent to 95 percent less contamination than did gear that received no gross decontamination.

“Because soot can be composed of semi-volatile compounds or act as a sorbent for other organic substances, field decontamination could conceivably help reduce the levels of off-gassing semi-volatile compounds, and this should be investigated in future studies,” the JOEH-published study said.

Jeffery Stull, who along with his wife Grace Stull are NFPA PPE technical committee members and operate International Personnel Protection, says gross decon on scene is a must. “If it is possible, the best way to address clothing contamination at the scene is to have the clothing washed off the individual firefighter while they are still wearing all the clothing and are on air,” Stull says. “It is also effective to use a detergent, as this will help remove some chemicals that may otherwise remain on the clothing surfaces. It is important to realize that this technique removes only surface contamination, but nonetheless helps to control contamination at its source.”

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International Personnel Protection

Steps to On-Scene Gross Decon

- 1** Have mild soap, scrub brush, small-diameter hose and a bucket in a warm zone away from the fire and the apparatus
- 2** While both on air, one firefighter hoses off the other, then scrubs the PPE head to toe with the soapy brush, and rinses the soap away.
- 3** Now-clean firefighter repeats that process on the first firefighter.
- 4** Both firefighters doff their gear using and, wearing EMS gloves, store it in an air-tight bag.
- 5** The used, bagged PPE and SCBA is placed on the apparatus, ideally in compartment away from the cab.

Isolate PPE

Isolation, which can be used instead of or, ideally, in addition to on-scene decontamination, will prevent contamination from migrating from PPE to the apparatus' cabin. This protective measure involves removing all contaminated PPE on scene and storing it in an apparatus compartment for the ride back to the station, after which it is removed and properly laundered. If a call comes in before the firefighters reach the station, they can simply re-don their gear and repeat the isolation process once that call is complete.

"This practice is important because many forms of contamination can have exceedingly long persistency, meaning that the chemicals are available for continued exposure and transfer to other surfaces when used in handled," Stull said. "Removing this form of continued exposure therefore minimizes the amount of harmful contamination to which a firefighter can be exposed." The Skelleftea Model includes a detailed method for firefighters to remove PPE and SCBA on scene, place both in reusable bags and store them in non-cabin compartments. Several researchers in the United States have arrived at the same recommendation for safely moving contaminated PPE. For example, the [Washington State Council of Fire Fighters](#) published "[Health in, Healthy Out](#)", a best-practice manual for helping firefighters cut their risk of cancer. That publication also calls for on-scene decontamination and removing and isolating PPE prior to returning to the station. Reusable gear storage bags are also an option for soiled PPE, provided they are specifically used only for transport and storage of dirty gear.



Some apparatus manufacturers are adding options for compartments with no access from the cabin as a means to isolate dirty PPE and SCBA during transportation back to the station. They are also offering seats with no SCBA brackets to get those out of the riding area. In the June 2017 edition of the [International Association of Fire Chief's \(IAFC\) On Scene](#) publication, Germantown, Wisconsin Fire Chief Gary Weiss called on apparatus manufacturers and NFPA to set aside space for dirty gear.

"Our fire apparatus are designed so we doff our bunker gear and store it in the jump-seat area," Weiss wrote. "Our gear is still off-gassing. I would like to see fire apparatus manufactures, and even the NFPA 1901 committee, establish design parameters for a compartment to store dirty bunker gear where the off-gassing is vented out of the truck instead of around the firefighters. The additional cost is well worth the long-term health and safety of our firefighters."



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Steve Misiano
President, True North

Even if apparatus manufacturers, on their own or in response to revised NFPA 1901 requirements, design compartments for dirty turnout gear, it can still take a generation for those changes to reach most firefighters. Depending on how busy the department is, a piece of firefighting apparatus bought today can last 10 to 20 years – leaving many firefighters without engineered protection for some time to come.

True North President Steve Misiano says reusable bags make the most sense for isolating contaminated PPE. “Depending on a fire department’s needs and budget, each firefighter can get his or her own bag or the department can buy one bag for each riding position on each rig,” he said. “Either way they are ensuring every firefighter on scene has a way to safely transport their contaminated gear back to the station.”

Additionally, Misiano says that a reusable solution like True North’s 80L AMABILIS® Duffel combined with its 75L DeCon™ Dry Bag gives firefighters a water and air-tight container that’s durable enough for a rear storage area and safe enough for the riding cabin. “Bags, like AMABILIS® and DeCon, are also great for moving gear to and from firefighter training sites in personal vehicles. And that’s critical to helping volunteer and career firefighters keep the dangers of their job away from children and family who ride in their POVs,” he said.



Best Laundering Practices

Once the firefighting PPE is back in the fire station, cleaning it before returning it to service is the next important step in reducing cancer risks. Of course, laundering PPE is more complicated than is cleaning garments for everyday use. [NFPA 1851, Standard on Selection, Care and Maintenance for Protective Ensembles for Structural Firefighting and Proximity Firefighting](#) is the definitive source for how to clean PPE.

Patricia Freeman, technical service manager for Globe Manufacturing [wrote an extensive piece](#) for the National Volunteer Firefighters Association detailing how to best clean PPE. She says to remove the coat and pant liners and launder them separate from the outer shells to keep the contaminants on the shell from contacting the liner garments. She also says to turn the liners inside out and to fasten all shell hooks, zippers or other closures prior to washing. Never use chlorine bleach, as bleach can damage the Kevlar used in PPE, and do not exceed 105° F water temperature, she adds. Soap should have a pH range of not less than 6.0 and not greater than 10.5.

The Skelleftea Model instructs firefighters to use protective gloves and breathing mask while preparing PPE for laundering. The model also calls for laundry equipment to be kept in an isolated area with negative air pressure to stop air-borne contaminants from escaping into living or working areas of the fire station.

Stull goes one further and recommends the cleaning area be subdivided into clean and dirty areas. "Reassembling clothing on a dirty surface will negate any cleaning that has been performed," he said. "Therefore, it is important to keep dirty clothing on the dirty side of the process and have only clean clothing on the clean side of the laundering facility. Similarly, shells need to be segregated wash separately from liners and very dirty clothing should probably be kept separate from less soiled clothing to prevent transfer of contaminants between different items."

The Swedish model advises using a commercial dishwasher, as you would find in a restaurant, for cleaning SCBA, gloves, boots and helmets. Numerous industry experts also agree that washing protective hood is as important as laundering turnout gear. The hood, worn on the head and often left resting on firefighter's neck, is especially troublesome because the throat area is very susceptible to absorbing toxins.

Reusable bags used to transport contaminated PPE also need to be cleaned. True North's Product Development Manager Michael Batson says that the AMABILIS® and DeCon bags should be turned inside out before laundering to ensure the interior space is fully cleaned. The bags can be machine washed with warm water, or hand washed with mild soap and lukewarm water, then allowed to fully air dry.

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Jeffery Stull
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Be Proactive

Research takes a long time to plan, conduct and analyze. And when that's done, it must be peer reviewed and replicated several times before the findings are accepted as fact. Studies are revealing patterns linking firefighting and cancer, but more research is needed to better understand both the causes and best preventive measures.

"While it has been going on for some time, research in the area of firefighter clothing contamination is still in its infancy," Stull said. "Certainly, there have been a number studies that characterize contamination remaining in clothing sometime after the exposure event or over its service life. However, there is very little information that indicates how firefighters are actually exposed to contamination in the clothing. This level of detail is still not known with certainty, but it remains a legitimate concern that contaminated clothing does lead to part of the firefighter's overall exposure to hazardous substances on a reoccurring basis and in fact spread contamination to other parts of the firefighter's work environment if not adequately controlled."

Firefighters do not have the luxury of conducting "business as usual" while they wait for indisputable proof that firefighting leads to cancer. Neither can firefighters seal themselves off from risk; toxic-laden smoke comes with the territory. However, firefighters can and must be diligent in learning about the risk factors and mitigating those factors. That means wearing proper PPE, confining soiled PPE away from living and riding areas and cleaning themselves and their PPE as soon after a fire event as possible. Those measures will help reduce the growing odds of their contracting and dying from job-related cancer.

About True North

True North has invested over 25 years into the research, design and manufacturing of durable and innovative packs and bags designed to offer tested, dependable gear options to the fire industry. The company founder, Alyx Fier, began the company in his garage with a home sewing machine and cardboard boxes for pattern paper after he saw the fire community's need for dependable, accessible gear that was intentionally designed around customer needs. Since then, True North has grown from a one-person operation to an ISO 9001 registered company whose products are distributed worldwide.

Over the years, the company has continued to champion Alyx's tradition of seeking out and harnessing user feedback to create new, innovative solutions within the product line, or reworking existing designs to respond to user needs. Additionally, the company donates their fire products in order to support and protect the lives of first responders around the world who may not have the resources to buy it.

"At True North, our mission stretches beyond the customary work of just designing and delivering a quality product, and encompasses our desire to support and protect those first responders in the fire community that may not have access or means to obtain quality, durable gear. That's why we frequently donate True North fire products to volunteer departments across the country, and why we partner with Brothers Without Borders to send our gear to South America where fire departments are sorely under-equipped," says True North Marketing Manager Jacqueline LeClair.

For more information, please visit www.truenorthgear.com.



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