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PPE Update

New research: How clean is firefighter gear?

There's little empirical evidence on how clean firefighter turnout gear is after laundering or the best ways to clean it; that is all about to change

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Over the past year and half, a task group under the NFPA Technical Committee for Structural Firefighting Protective Clothing and Equipment has been designing **a landmark research program** to understand firefighter protective clothing contamination and decontamination.

The Fire Protection Research Foundation launched the study to define the most prevalent, persistent contaminants in firefighter protective clothing and then validating the effectiveness of cleaning procedures to remove those contaminants. The objective of this research is to establish better information that can be reflected in improved requirements and guidance in the next edition of the NFPA 1851 standard on the selection, care and maintenance of structural firefighting protective ensembles.

It is well established that during structure fires, protective clothing becomes contaminated with a variety of different chemical, biological or particulate hazards. Research has been carried out by multiple organizations identifying various contaminants and their levels in different types of firefighter protective equipment including garments, hoods, and gloves under both simulated and actual fire conditions.

What we don't know

These studies have shown that certain contaminants — including known carcinogens such as polynuclear aromatic hydrocarbons, phthalates (plasticizers), phenol-based chemicals, and a variety of different fire retardant chemicals — are present at the scene and contaminate clothing. Some research shows the presence of these substances or their metabolic derivatives in firefighter blood and urine samples following exposure.

A large and diverse array of toxic and carcinogenic substances can show up in turnout gear following any structural fire. The type, number, and levels of these substances will vary tremendously based on several factors including the materials subject to combustion, the fire conditions, and the length of exposure.

A system for determining which substances are important and at what level these contaminants pose likely continuing exposure hazards has not been adequately established. Moreover, current laundering methods that include a range of cleaning equipment, agents and processes are not validated for their effectiveness in removing many different contaminants.

Frequent laundering of firefighter protective clothing should be the right approach, but no specific verification is carried out to show that all hazardous contaminants have been removed or reduced to safe levels. In many cases, clothing manufacturers are reluctant to endorse specific cleaning products because there are no standardized validation procedures.

Seeking validation

This leaves the fire service to continue approaching clothing care and maintenance by relying on best intentions.

The Fire Protection Research Foundation is starting a multi-phase project that will establish procedures to determine if laundering and other cleaning processes effectively remove these contaminants.

The first phase will characterize contamination levels in used, soiled clothing that has been collected by task group members throughout the country. Initial work will require that a selected contractor develop procedures to appropriately sample and analyze the clothing for priority contaminants.

This step is not as straightforward as it may seem since conventional methods used to extract and sample clothing for chemical contaminants can have certain drawbacks that make interpreting results relatively difficult. For example, most clothing fabrics include finishes, dyes, and other chemical residues that can interfere with the analytical results.

In addition, the ability of contaminants contained in clothing materials to cause exposure with firefighter skin does not occur in the same manner in which the contaminants are extracted and evaluated in a laboratory.

Early objectives

One of the key objectives for the early part of this work is to identify marker substances that are believed to be generally found at most structural fires that can serve as the target compounds for conducting contamination analysis of gear.

After the initial characterization of primary contamination within firefighter clothing, the Fire Protection Research Foundation plans to develop test methods to contaminate unused clothing in a laboratory setting in representative manner similar to what occurs on the fireground.

This is important because most laboratory methods involve placing droplets of liquid chemicals on materials and relying on that technique to represent the process of clothing contamination. In structural firefighting, most chemical contaminants transfer to clothing as vapors and more often as vapors absorbed into smoke particles.

Thus, for a test method to truly provide contaminated material that represents structural firefighting exposures, a similar contamination approach must be developed.

The intended outcome of the first phase of the project, estimated to take a minimum of eight months, is the preparation of a comprehensive test plan that will provide a means for using the validated contamination test method to determine how well different laundering or decontamination approaches work to remove persistent contaminants.

Phases II and III

The second phase will involve a thorough investigation of selected cleaning processes and agents to specify parameters — such as detergent type, cleaning temperatures, and rinse times — for how cleaning firefighter clothing should be undertaken to remove the majority of persistent contaminants.

A third phase will examine biological contamination that includes blood-borne pathogens and drug-resistant bacteria as well as emerging diseases. A similar level of research is anticipated to address biological contamination to understand chemical contamination and decontamination of firefighter protective clothing.

From this research, Fire Protection Research Foundation's goal is to develop the basis of specific changes that can be made to NFPA 1851 that in turn can promote better practices for removing contamination from protective clothing and equipment.

The Fire Protection Research Foundation is also seeking sponsors for the study. The National Fire Protection Association has invested some of its resources in this project but the foundation is looking to have a number of industry partners.

In addition, the Fire Protection Research Foundation will establish a technical review panel that includes experts from relevant disciplines to help guide the research efforts.

This project and the results it will bring should usher in a new awareness for turnout clothing cleaning and direct the industry to limit clothing as a continuing source of contaminant exposure to firefighters.

While it is not the sole answer to the contamination problem, it is an important part of an overall needed practice for reducing firefighter contamination.

About the author

*Sponsored by **Globe***

Jeffrey and Grace Stull are president and vice president, respectively, of International Personnel Protection, Inc. They are members of several NFPA committees on PPE as well as the ASTM International committee on protective clothing. Mr. Stull was formerly the

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