

Fire Products > Personal Protective Equipment - PPE



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PPE Update

# Firefighter safety after the flood waters recede

Proper PPE and cleaning measures are necessary to protect firefighters wading through chemicals, biological biohazards and disease-causing microorganisms

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In the midst of flooding-related disasters, firefighters and other first responders are at the forefront of multiple-victim rescues and attempts to help the local populations cope with the ensuing aftermath of flooding and wind damage.

Certainly, members of the fire service have acted unselfishly in overwhelming circumstances and continue to take risks while mitigating the effects of powerful storms or other catastrophic events. Yet, this type of large-scale response effort creates a number of significant demands for maintaining personal protection and will continue to have long-term consequences during the extensive cleanup activities that follow.

From a gear perspective, firefighters are less likely to use turnout clothing during a hurricane or flood response, but often will continue to wear their standard PPE given the fact that downed power lines combined with multiple fire hazards warrant some form of protection despite the soggy conditions.



Floodwaters are a known source of extensive chemical contamination. (Jon Shapley/Houston Chronicle via AP)

Physical hazards including debris fields and unsteady structures will further contribute to exposure risks. However, the more ominous and persistent risk will be exposure to the contamination associated with floodwaters and its aftermath. How clothing and equipment are used under these conditions is an equally important consideration for maintaining health and well-being of firefighters and other first responders.

#### SPECIFIC HAZARDS OF FLOODING AREAS

Floodwaters are a known source of extensive chemical contamination. In urban areas, the hazards associated with contaminated floodwaters are much worse given the abundance of human activity, combined with industrial facilities.

Some areas have a large number of chemically-based production facilities, which – despite their best efforts for retaining the integrity of storage vessels and containers – can result in larges releases of chemicals into the runoff water.

Contamination can also include high levels of lead, arsenic, polychlorinated biphenyls and a host of other chemicals that now have leached into floodwaters. Simple household chemicals have also significantly added to the mix, resulting in a variety of chemical hazards which, though diluted, can still impact human health.

Moreover, many of the containers at facilities and structures that were flooded and that came in contact with floodwater for extended periods of time have become compromised and are creating additional hazards for release even after the water levels have receded.

Infectious organisms are larger and more persistent hazards. Compromised sewage systems, together with the runoff from agricultural areas, are expected to produce multiple forms of biological hazards including *E. coli*, Salmonella and Shigella, known to cause intestinal health issues; as well as Hepatitis A Virus, typhoid, tetanus and other disease-causing microorganisms.

Waterlogged structures and materials will also give rise to mold, fungi and other health hazards, which can make firefighters sick if they are not properly protected. Finally, the increase in standing

water in flooded areas is also going to result in a significant rise in the mosquito population and other insect-pests that carry various diseases.

## ADDRESSING PPE SELECTION AND CLEANUP FOR NATURAL DISASTERS

Unless watertight PPE is being worn, firefighters and other first responders operating in flooded areas are simply going to get wet with contaminated water. All firefighter footwear is designed to offer at least 1 foot of water protection off ground level, but any action for walking or wading through high water will quickly compromise the clothing and result in exposure.

Despite moisture barriers provided in turnout clothing, the outer shell and lining materials will absorb water and wick that water throughout the clothing. High rubber boots help, but cannot do anything about the clothing materials that come in contact with the water.

Individuals are most at risk when they have skin abrasions, cuts or lacerations that come in contact with floodwater.

Though there is a standard – NFPA 1952 – that specifies requirements for protective clothing and equipment for use in surface water operations, there are currently no certified products to the standard.

In principle, the standard represents the type of protective clothing appropriate for flooding disasters where it defines specific types of clothing, including dry suits along with the associated gloves and footwear. Unfortunately, many of the requirements are relatively severe and few manufacturers have even attempted to position products against this standard.

Short of there being compliant products to NFPA 1952, there are a variety of different clothing items that can work to help limit contact with contaminated water. Water-tight clothing that integrates socks and pants, such as waders and well-designed dry suits can prevent individuals from being exposed to floodwater, particularly when these types of clothing also provide good interfaces with gloves.

Generally, most fire departments will not have these types of resources and will rely instead on the types of clothing and equipment on hand.

With the resignation that protective clothing and other clothing is being saturated with contaminated water, specific attention must be given to properly cleaning the clothing. Any clothing that has been exposed to floodwater should be cleaned and sanitized before reuse.

In some cases, it may not be possible to effectively clean and decontaminate protective clothing, especially when the gear has been saturated for long periods of time and it is not possible to identify all of the potential contaminates. In these instances, it may be necessary to retire and dispose of the clothing in the interest of safety.

Ordinary cleaning may often suffice for removing biological contaminants, but the extensive soaking of clothing in floodwater will result in contamination throughout the clothing items. Therefore, extra

steps are needed to ensure that clothing does not become a repository for infectious microorganisms.

Contaminated clothing should not be allowed to stay wet for long periods of time and should be washed as soon as possible following use. Many manufacturers and independent service providers offer procedures or cleaning to address biological contamination, though they are mostly intended for body fluid exposure.

The use of *non-bleach* sanitizing agents either in a pretreatment or as a laundry additive is one way of helping to neutralize any residual microorganisms on the clothing. It is important to only use laundry-based products that do not contain any agents that could deteriorate the clothing, such as chlorinated bleach.

Therefore, check with the manufacturer of the clothing if any particular sanitizing agent or disinfecting is proposed. We recommend increasing the temperature used for washing the clothing to 140 degrees F as an aid to rid the items of microorganisms. However, you should check with your gear manufacturer before you undertake this practice as the current NFPA 1851 standard for cleaning of turnout clothing limits washing temperatures to 105 degrees F.

## STAYING PROTECTED IN FLOOD WATERS

With any continuing potential contamination exposure, good individual and facility hygiene practices are essential. Contaminated items should be handled with disposable gloves and it is also a good idea to wear goggles in combination with a face mask, such as a surgical N95 respirator. An apron is also suggested.

While many water-borne infectious pathogens are not necessarily spread through inhalation, the practice of wearing goggles and a facemask helps to prevent touches to the eyes, nose and mouth, which are common transfer points for microorganisms and other hazardous substances.

Frequent handwashing and use of disinfectants on surfaces are also complementary associated practices for avoiding the spread of contamination. It is important that the firefighters in the affected areas continue to apply appropriate hygienic practices to lower their chances for contacting the different hazardous substances around flooded areas and all types of associated emergency operations.

Flooding events mandate additional considerations for personal protection on a larger scale than generally encountered, but they can be adequately addressed with some forethought and appropriate actions for maintaining firefighter health and safety.

The views of the author do not necessarily reflect those of the sponsor.

*Editor's Note: This article was updated on May 20, 2020.* 

#### **Additional Resources**

1. https://www.osha.gov/OshDoc/data\_Hurricane\_Facts/Bulletin2.pdf

# About the author

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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 convener for international work groups on heat/thermal protection and hazardous materials PPE as well as the lead U.S. delegate for International Standards Organization Technical Committee 94/Subcommittees on Protective Clothing and Firefighter PPE. They participate in the Interagency Board for Equipment Standardization and Interoperability and have authored the book, "PPE Made Easy." Send questions or feedback to the Stulls via email.

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