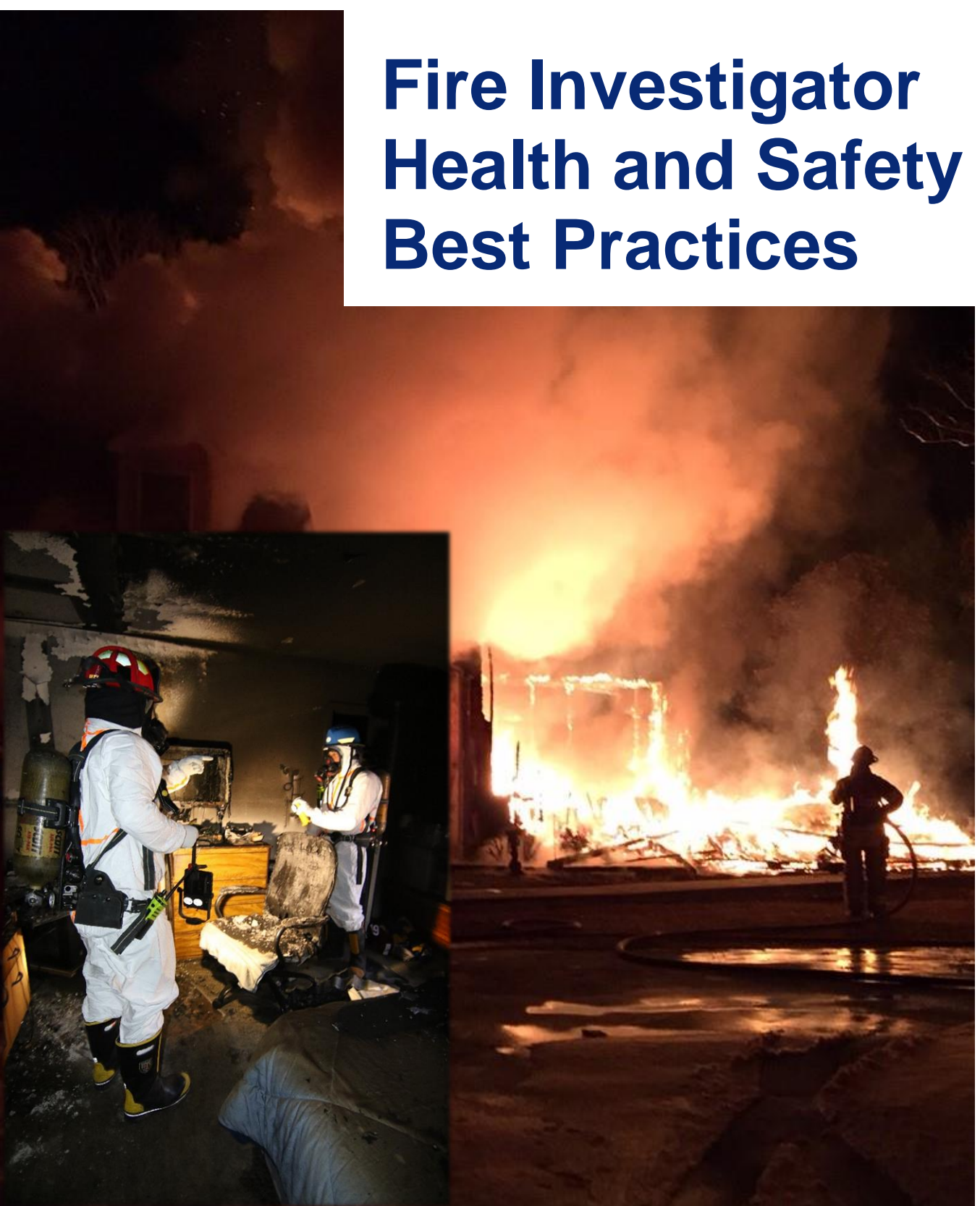


# Fire Investigator Health and Safety Best Practices



Second Edition

May 4, 2020

The International Association of Arson Investigators, Inc.  
Health & Safety Committee

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## What's New in this Edition

The groundbreaking first edition of Best Practices published in June 2018 contained a lot of important information for fire investigators, but we had to draw a line in the sand regarding content to get it out the door. This second edition includes updates, additions, and enhancements that improve the overall content, including:

- Adding a table of contents, index, and list of references
- Adding introductory, explanatory, and background material
- Adding training recommendations
- Enhancing the vehicle section to address investigator vehicles and examined vehicles
- Numbering the best practice recommendations to make them easier to reference and cite
- Additional recommendations to help improve fire investigator health and safety
- Additional explanatory footnotes
- A revised respiratory protection minimum recommendation
- Revised decontamination procedures
- Improving the overall look of the document, including the addition of photos and graphics



*Figure 1 - Lithium battery test burn while wearing proper PPE, including a powered air purifying respirator. Credit: Dr. Peter Mansi.*

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TODAY'S FIRE SCENE IS NOT LIKE YESTERDAY'S. AS WE LEARN MORE ABOUT THE HAZARDS FIRE INVESTIGATORS ARE EXPOSED TO, IT BECOMES VITALLY IMPORTANT TO UNDERSTAND THE HEALTH AND SAFETY BEST PRACTICES ALL FIRE INVESTIGATORS SHOULD BE FOLLOWING.

WHILE IT IS RECOGNIZED AND UNDERSTOOD THAT EVERY FIRE SCENE IS DIFFERENT, THE HEALTH RISKS ASSOCIATED WITH FIRE SCENES ARE BROAD-BASED AND APPLY TO MOST EVERY FIRE SITUATION.

This edition of Fire Investigator Health and Safety Best Practices was prepared by the Health & Safety Committee of the International Association of Arson Investigators, Inc. (IAAI), its advisory panel of subject matter experts and other technical advisors. It has been reviewed and approved for publication by the IAAI Training & Education Committee and the IAAI Executive Board.

Correspondence regarding this document should be sent to:

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The International Association of Arson Investigators, Inc. does not endorse specific products for fire investigators. By necessity, this document does describe certain product types or specifications.



*Figure 2 - Properly attired public fire investigator for most fire scenes. Credit: Mesa, AZ Fire & Medical Department.*



*Figure 3 - Properly attired private fire investigator for most fire scenes. Credit IAAI.*

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## **Health & Safety Committee Members:**

**Chairman: Jeff Pauley** IAAI-CFI and FIT, CFEI, MIFireE, Fire Investigator, EFI Global, Inc.; Partner/COO and Fire Group Manager, Pacific Pointe Consulting, Inc.; retired Bedford County (VA) Fire & Rescue Battalion Chief/Fire Marshal

**Co-Chair: Dr. Peter Mansi** Ph.D., Eng Tech, IAAI-CFI and ECT, FIFireE, FFireInv, MCSFS, Partner, Fire Investigations UK; retired London Fire Brigade Borough Commander and Group Manager of the Fire and Arson Investigation Unit; IAAI Past President

**Devin Palmer** SSA/CFI, ATF/NCETR, IAAI Director Liaison

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A special thanks to these additional subject matter experts who assisted with the content development and technical review of this second edition:

**Barbara Millet** Ph.D., Director of the User Experience Lab, Assistant Professor of Interactive Media, Department of Cinema & Interactive Media, School of Communication, University of Miami

**Heidi Sewchok** MPH, Physical Scientist, NIOSH, National Personal Protective Technology Laboratory, CVSDB, and Secretary/Treasurer, International Respiratory Protection Society – Americas

**Vicki Sheppard**, co-chair of the statewide F.A.C.E. Team (Firefighters Attacking the Cancer Epidemic) of the Florida Firefighters Safety & Health Collaborative and retired division chief, Training & Safety Division, Palm Beach County (FL) Fire Rescue



*Figure 4 Private fire investigation team working in the post-fire environment. Credit: Kevin Hays Fire Consulting, LLC.*

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## Introduction

In recent years, research regarding fire investigator health and safety, and the resulting practice changes, has not kept pace with that of firefighters and, while some information can be brought from the firefighter environment to that of the fire investigator, some cannot. In 2016 the International Association of Arson Investigators (IAAI) re-established its Health & Safety Committee with a mission “to promote health and safety knowledge, awareness, discussion, and action among members of the IAAI, its chapters, and the fire investigation community in general.” One of the first steps in this process was to conduct a benchmark survey to determine the current state of knowledge, awareness, and practices.<sup>1</sup>

The next step was to develop this first of its kind, peer, technical, and administratively reviewed best practices white paper to help ensure the health and safety of all who attend fire scenes. Based on the most current research and information available, it identifies the practices that fire investigators and fire investigation companies/agencies/entities should be following.

This paper can also serve as a training guide and policy template for companies/agencies/entities that wish to follow the latest fire investigator health and safety best practice guidelines. Fire investigator health and safety is a dynamic subject area. As new information becomes available, this document will be updated to provide a concise resource of the latest information regarding fire investigator health and safety.

The first edition of this document represented almost two years of work by members of the IAAI Health & Safety Committee, assisted by a panel of subject matter experts. This second edition includes new and updated information on this continually evolving subject. It also contains technical information provided by the staff of the U.S.

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**By necessity, this document includes many footnotes and appendices to further explain certain items. Please take the time to read and understand all the information in this paper.**

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National Institute for Occupational Safety and Health’s National Personal Protection Technology Laboratory, clinical researchers, and other subject matter experts.

While parts of this document refer to standards of the U.S. Occupational Safety and Health Administration (OSHA) and the U.K. Health and Safety Executive (HSE), this is not by any means a primer on government standards and regulations as they apply to the post-fire environment. Readers should review the applicable OSHA standards found in Subpart I of Part 1910 for the full information regarding personal protective equipment, and any other relevant sections of the OSHA General Industry standards or the corresponding HSE standards.

Governments can have a difficult time implementing new standards and amending existing ones. This means that some U.S. OSHA standards are still based on research data from the 1960s and 1970s. Understanding the shortfalls of some of OSHA’s regulations can help readers understand the importance of occasionally going beyond what is the regulatory minimum. This approach is sometimes called best practices. For this reason, and because the recommendations herein outpace research so that adequate protection can be taken, the IAAI has developed this best practice document. Some U.S. OSHA material is presented in this document as things that should be done, in keeping with the conventions throughout, even though compliance with the regulation may be required. U.S. agencies/companies that must comply with OSHA,

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<sup>1</sup> The benchmark survey results and supporting documentation are available at [www.iaaiwhitepaper.com](http://www.iaaiwhitepaper.com)



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and agencies/companies in other countries that follow HSE guidance, should review the actual regulations.

Like NFPA 921, [1] this document is a guide that provides the latest health and safety best practices information for fire investigators. It is a tool for voluntary use by individuals, companies, and organizations that want to minimize the risk of harm by using effective safety practices.

The guidelines in this paper also apply to any entity providing fire investigator training and live burns, including burn cells conducted for training or demonstration purposes. A new subsection on training was added to Part I.

Achieving the committee’s goal of improving the overall health and safety of fire investigators will require a fundamental culture change within the fire investigation profession. Changing culture is not an easy task. However, whether you are a public fire investigator, a privately employed fire investigator or another interested party, there is something we can all do that is simple and could easily be the most significant shift yet toward that culture of safety envisioned in the first Firefighter Life Safety Initiative [2]: ***Define and advocate the need for a cultural change within the fire service relating to safety, incorporating leadership, management, supervision, accountability and personal responsibility.*** To achieve this, we must change attitudes and beliefs.

Adopting the practices identified in this paper simultaneously may be difficult. Still, small changes initiated over time, including the addition of new safety practices and procedures, will lead to significant health and safety improvements and set a positive example for our colleagues [3].

It is understood and acknowledged that every fire scene is different, and no recommendation made here is absolute. These are all recommendations on how best to do things in most situations based on the unique situation found by the fire investigator upon arrival at the scene.

While this is a stand-alone document, companion training is provided by the committee through an IAAI-approved presentation that includes in-depth information regarding many of these recommendations and the hazards present at post-fire scenes. For information on this training, please contact [iaai-safety@firearson.com](mailto:iaai-safety@firearson.com).

This paper is supported by an Infographic, a Respiratory Protection Fact Sheet, Best Practices Quick Facts, and a Fire Investigator Physical Exam letter. All IAAI Health and Safety-related documents are at [www.iaaiwhitepaper.com](http://www.iaaiwhitepaper.com)

This paper references various U.S. regulations/standards, documents, and agencies, as well as U.K., E.U. and international regulations/standards and documents. Readers from other countries should refer to the similar appropriate items for their country or, if none exist, use the U.S. or U.K. ones for reference.

All listed website links were valid as of the publication date. The committee and the IAAI are not responsible for any broken links after the date of publication.

References and citations are listed within this document. In some cases, this material is based on the best practice recommendations of the advisory panel or other subject matter experts.



## Background

Even though the first edition of this document, published in June 2018, has started to turn the tide, fire investigator health and safety continues to be one of the most neglected areas of training throughout the fire investigation community; few organizations consider it a priority [4]. The IAAI is committed to changing this. Through a resolution adopted by its executive board in September 2018 the IAAI:

- Has taken a position of supporting, enhancing and educating its members regarding the latest research information and best practices regarding fire investigator health and safety matters throughout all its activities, efforts and publications;
- Urges every committee to incorporate, where practical, health and safety awareness through their publications and activities utilizing information provided by the IAAI Health & Safety Committee and approved by the executive board;
- Urges each chapter to embrace and educate its members on fire investigator health and safety matters through their activities, efforts, and publications, utilizing the educational materials approved and provided by the IAAI; and
- Urges every member to follow the health and safety best practices information supplied by the IAAI.

*“There are many hazardous chemicals in the post-fire environment, and how they combine to form other hazardous compounds is presently unknown.”*

**Miriam Calkins, Ph.D. CDC/NIOSH**

## Health Hazards

In addition to all the physical and environmental hazards that can be present at fire scenes (see NFPA 921 for additional information), fire investigators also need to be aware of the biologic and toxic hazards that may be present.

Biologic hazards may come from human and animal bodies, poisonous plants, bug and animal bites, and mold. These hazards can usually be mitigated by the effective use of proper personal protective equipment (PPE).

While the above hazards/conditions must be considered during a scene safety assessment, they are present, or they are not. Toxic hazards, on the other hand, are present at every fire scene (forest, brush, crop, structure, vehicle, trash). While fires are typically short-duration events, the chronic exposure effects can have a long-term health impact on those involved.

The primary toxic hazards are from the many gases and vapors contained in the smoke and the fire debris, as well as skin exposure to products of combustion. Smoke consists of invisible vapors and gases, visible particulates, and invisible nanoparticulates<sup>2</sup>, and all are hazardous to fire investigator health.

Fire debris also contains many different chemicals, gases, and particulates that are hazardous. During and immediately after a fire, there are many fire gases present. But after the fire, and often for a considerable time after, there are particulates, nanoparticulates, vapors and gases present that can be a threat to the fire investigator. While much has been written in the last ten years about the effects of these toxic gases on firefighters, not enough has been said about their impact on fire investigators.

A 2010 study by Underwriters Laboratories, Inc. found that “99+% of smoke particles collected

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<sup>2</sup> Particulates that are < 5 micrometers or microns in size. These are invisible to the naked eye and can penetrate deep into the lungs through inhalation where clearance mechanisms are less effective and where inflammation and systemic

absorption can occur. They can also enter the body through dermal absorption. In most instances, references in this paper to particulates includes nanoparticulates.

during overhaul were less than 1 micron in diameter. Of these 97+ % were too small to be visible by the naked eye suggesting that ‘clean’ air was not really that clean.” [5] These nanoparticles persist through the fire investigation stage and beyond.

There are over 100 known carcinogens in fire smoke and many different toxic gases. We know that during the fire, and for an undetermined time after that, carbon monoxide (CO), hydrogen cyanide (HCN), and formaldehyde (FM) are present. Still, it is difficult to judge the extent of their formation in fires. Gas composition varies widely, depending on the type of burning material, the temperature, and the oxygen supply. It is believed that between 60 and 80% of all deaths related to fire are attributed to toxic fumes. Carbon monoxide is commonly thought to be the primary cause. However, hydrogen cyanide is also formed. Still, the exact contribution of HCN to fire-related fatalities is unknown. [6]

Because the extent of this problem in the post-fire environment is fluid due to the many scene variables present, this means that precautions need to be taken, especially by public fire investigators who are often at the scene before extinguishment.

A hidden hazard found in most structures is Teflon®, which is a PTFE (polytetrafluoroethylene) and included in per- and polyfluoroalkyl substances (PFAS). Not only is this product found in virtually every residential kitchen, but many consumer electronics and commercial electrical insulation products also contain PTFE. Studies have shown that their thermal degradation leads to the slow breakdown of the fluorinated polymer and the generation of a litany of toxic fumes. Tests have shown that Teflon®-coated pans heated to temperatures commonly found in kitchen fires can release harmful gases and particulates, including chemicals that the National Toxicology Program considers to be reasonably anticipated human carcinogens [7]. There may also be other formations of PFAS present at the fire scene.

A particulate hazard of note is asbestos. From the 1930s to the 1970s, American manufacturers mixed asbestos into a wide range of building materials as a cheap way to make almost anything more durable.

Fires in these structures can release asbestos fibers from many sources. While the use of asbestos was significantly reduced in the U.S. after its health hazards became better known, the material is still used today in some new products so it can be present after any structure fire. [8] Additionally, the regulations in other countries vary greatly, so the possibility of asbestos exposure in the post-fire environment is possible anywhere.

Another relatively unknown particulate hazard is lead. In addition to lead paint in houses built before it was banned (in the U.S.) in 1978, there are many things in today’s homes that contain lead, including jewelry, pipes, stained glass, antiques, electronics, and toys. [9] Lead vaporizes at 932°F (500°C) [10] and when it cools and solidifies, the lead dust is contained in the post-fire nanoparticles. Exposure to lead nanoparticles is especially hazardous to young children, newborns, and fetuses.

Most occupational exposure happens little by little on a regular basis. But for firefighters and fire investigators, exposure may come in the form of one or more single encounters with contaminated smoke or debris.

**The recommendations in this document are designed to help protect fire investigators from these hazards.**

## Research

One of the first documented research findings relating to fire investigators was the NIOSH/ATF study in 1996-97 that looked at actual fires & test burns. They found that fire investigator exposures to irritants that cause acute effects and carcinogens that have chronic effects are of concern and that the use of respiratory protection and mechanical ventilation equipment can reduce the potential for exposure. [11]

A 2010 survey of 70 fire investigators attending an IAAI Arizona chapter seminar found that nearly 50% of the investigators did not routinely use any type of respiratory protection. As a follow-up to this survey, in 2011, a Phoenix (AZ) Fire Department fire investigator using a four-gas meter and two

sampling pumps that tested for O<sub>2</sub>, CO, H<sub>2</sub>S, HCN, and broad-spectrum aldehydes took air samples while conducting investigations at 16 fire scenes. Eight of the scenes contained detectable levels of airborne hazardous toxins with three approaching or exceeding the ceiling exposure limit levels. Ventilation appeared to be the most significant factor in influencing the amount of dangerous airborne toxins that remained in the fire scene after overhaul. Time, by itself, however, was not a good predictor of possible hazards. In one instance, high levels of formaldehyde were found at a scene three days after the fire. Other findings included:

- The size of a fire is not a good indicator of the potential hazards
- The size of a fire in relation to the structure is not a good predictor of possible hazards
  - A small kitchen fire produced the highest readings
- Many factors affect the results:
  - Amount and type of ventilation
  - Size/location of fire
  - Type of structure
- Ventilation may help with gases but may not with particulates [12]

As reported in 2013, NIOSH carried out a study at a fire service training facility to determine if airborne polycyclic aromatic hydrocarbons (PAHs) and other aromatic hydrocarbons generated during live-fire training contaminate and pass through the skin of firefighters. Their recommendations include providing “as much natural ventilation as possible to burned structures before starting investigations” [13]. This can reduce gases/vapors but not particulates.

There have been several other studies conducted with similar results. The cumulative results of this research tell us that:

- Fire investigators generally are at more fire scenes than most firefighters
- More particulates are present during and after overhaul
- Fire investigators generally wear less PPE than firefighters

- Fire investigators have a high exposure risk to toxic hazards
- While we see more SCBA use by firefighters during overhaul, fire investigators are generally not using adequate respiratory protection<sup>3</sup>

In the Fall of 2018, fire investigators were added to the U.S. federally funded Fire Fighter Cohort Study <https://www.ffccs.org/>. The project’s purpose is to develop a framework for establishing a long-term firefighter multicenter prospective cohort study focused on carcinogenic exposures and health effects. The IAAI is represented on the Study’s Oversight and Planning Board.

The IAAI Health & Safety Committee is at the forefront of promoting new research into the post-fire environment. Four research projects are underway or planned to measure various parts of this environment, with others coming.

- With London South Bank University, particulate filters that have been worn one time by fire investigators are being analyzed to measure the quantity and size of particulates present.
- As part of a federal grant that was expanded at our urging, the Sylvester Comprehensive Cancer Center at the University of Miami is examining the presence of gases in the post-fire environment as measured by analyzing a silicone material worn by fire investigators during a scene exam.
- If their FY2021 AFG request is approved, the Textile Protection and Comfort Center at North Carolina State University will be analyzing the effectiveness of various apparel ensembles in the post-fire environment.
- The Underwriters Laboratories, Inc.’s Firefighter Safety Research Institute will be conducting experiments to measure the amounts of gases and particulates in burned structures over time. This work looks at the post-fire structure in various situations to simulate typical fire investigator activities, including with no one present, just walking through the scene and digging out the scene.

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<sup>3</sup> There is a growing trend among public fire investigation units to wear SCBA during the entire post-fire scene examination.

When activities are well-planned and staffed there is typically only a minimal increase in on-scene time.

The results of these important research projects will be published as they become available and included in future editions of this document.

## Discussion

What does all of this mean for fire investigators? Investigator safety and welfare need to be a higher priority than it is in many agencies and companies. Effective, fact-based policies and procedures should be adopted and embraced by fire investigators to ensure their long-term health and well-being. The consistent availability and use of appropriate PPE, coupled with basic knowledge of the toxic and cancerous hazards that exist in the post-fire scene environment, is imperative. Research has shown that inhalation and absorption hazards remain hours and even days after fire suppression. Fire investigators must be educated on the warning signs of acute toxicity and ensure that area monitoring for carbon monoxide (CO) and hydrogen cyanide (HCN) is conducted ongoing during the scene investigation at a minimum. Not all hazards are immediately visible, and the effects of toxic exposure may take years to appear. Low readings obtained from monitoring should not preclude us from using the minimum required level of respiratory protection; they do not mean the atmosphere is entirely safe, only that alert thresholds have not been met. Levels are likely to fluctuate as we disturb fire debris during our scene examination.

Today's fire scene is vastly different than that of twenty or more years ago, and it is getting more hazardous as the use of man-made materials continues to increase. Years ago, what is now called legacy furniture was commonplace. These items were made of natural products that burned slower and generally did not off-gas large quantities of harmful chemicals. Households today are full of man-made products that off-gas many toxic chemicals and the list of potential sources is long, including these common sources in addition to others previously mentioned:

- Plastics – trash bags, pipes, electronics
- Petroleum – upholstery, carpet, clothing
- Pesticides – home & agricultural
- Formaldehydes – insulation, carpet dyes, glues
- Creosote – roofing, wood preservative

Most of these items produce known carcinogens when they burn. The effects of some substances are not yet fully understood.

The list of harmful and, in many cases, cancer-causing chemicals in fire-produced gases is long. Most fires also give off polycyclic aromatic hydrocarbons (PAH), which are products of incomplete combustion that can exist as particles and gas so it can be inhaled AND absorbed. Of the 18 PAHs commonly produced in today's fires, nine are known carcinogens. [13]

When you are exposed to these carcinogens, the effects may be acute or chronic. While acute problems are typically dealt with in the short-term, chronic issues can take many years to manifest and are affected by the concentration and duration of the exposure(s), and the entry route. **The two most common entry routes for fire investigators are inhalation and dermal absorption.** Not coincidentally, the body's two largest organs are the lungs and the skin. And just to make matters more complicated, the body's natural defense mechanisms and each person's susceptibility are also factors in whether exposures result in cancer formation.

The body's natural respiratory defense mechanisms include nasal hair, which typically traps particles >10 microns, cilia, and the mucociliary escalator in the lungs. Unfortunately, nanoparticulates are too small to be caught and expelled through these processes so they can work their way into the furthest depths of the lungs. Adequate respiratory protection is necessary to help prevent this.

When you get hot and sweaty,  
your skin can more easily  
absorb toxins, so it is important  
that all skin areas be  
adequately protected.

The skin is very porous, with many potential pathways for toxins to enter the body. Of particular note to fire investigators entering the post-fire



scene is the fact that skin permeability increases as the skin temperature increases<sup>4</sup>. [14]

Unlike inhalation exposure, there are no occupational exposure limits (OELs) for dermal exposure. The regular removal of soot and unseen particulates from the skin helps limit the absorption of the many harmful chemicals found in the post-fire environment [15]. The World Health Organization notes that dermal occupational exposure limits are hard to determine due to the number of variables involved and that knowledge of the hazardous characteristics of the compound are necessary [16]. This is virtually impossible to determine in the post-fire environment.

Even though we crawl around in and dig up fire debris that contains particulates and can release toxic gases, or the gases just ride along on the particulates on their trip into your unprotected lungs, the culture of the past has been, “It hasn’t hurt me yet so why should I change?” or “That’s the way we’ve always done it” or even worse, “It isn’t manly to wear all that stuff.” Unfortunately, this old school mentality is exacerbated by the fact that, absent something bad happening at or immediately after being at a scene (acute symptoms), we go home feeling pretty OK and not thinking about the cumulative or chronic effects of these exposures so when medical issues do develop in later years it is too late to go back and change things. This is an inherently dangerous attitude that needs to change.

Chronic exposure symptoms of disease typically do not present themselves for years<sup>5</sup>; this is known as latency. Establishing, following, and enforcing scene safety protocols today will save fire investigator’s lives in the future. The number one way to accomplish this is through the proper use of PPE, especially respiratory protection. [17]

## Related Activities

In July 2018, the Firefighter Cancer Registry Act was signed into law in the U.S. The Act requires the Centers for Disease Control and Prevention (CDC) to develop and maintain a voluntary registry of firefighter exposures. This National Firefighter Registry will include the number and type of fires each firefighter attended. Information in the registry will be used to improve the monitoring of cancer incidents among firefighters and to collect and publish information about the occurrences of cancer among this population. Registry data will be available for research for free if the findings of the research are made public. [18] Fire investigators will be included in this registry.



*Figure 5 Public fire investigators working a fire scene. Credit: Mesa, AZ Fire & Medical Department.*

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<sup>4</sup> Multiple documents and websites state that, “skin’s permeability increases with temperature; for every 5°F increase in skin’s surface temperature, absorption increases

400%.” While there can be an increase, the original author of this statement has recanted it as not valid.

<sup>5</sup> Chronic exposures can lead to leukemia in as little as three years while lung cancer can take as long as thirty years to appear, according to Dr. Burgess.

## Part I – Fire Investigator Health and Safety Best Practices

### Section 1.0 Employers *should*:

**1.0.1** Have written policies covering all aspects of fire investigator health and safety, including but not limited to:

**1.0.1.1** Conducting a site safety survey<sup>6</sup> before starting every fire scene investigation, and at the start of each day it continues.

**1.0.1.2** Specifically addressing environmental, biologic, and chemical/toxic hazards, in addition to other possible hazards.

**1.0.1.3** Air quality monitoring for hot and warm zones.

**1.0.1.4** A hazard communications plan<sup>7</sup>.

**1.0.1.5** Personal protective equipment (PPE) ensemble definition, requirements, and use<sup>8</sup>.

**1.0.1.5.1** Including the identification of when to use respiratory protection equipment (RPE) and scene placarding to identify areas of required RPE use.

**1.0.1.6** A respiratory protection program that addresses (U.S.) 29 CFR 1910.134.

**1.0.1.6.1** See Appendix A for additional information regarding respiratory protection.

**1.0.1.7** Requiring that employees not have facial hair that impedes the effectiveness and protection of respiratory PPE<sup>9</sup>.

**1.0.1.8** Providing annual respirator fit testing

**1.0.1.9** When to use respiratory protection equipment<sup>10</sup>.

**1.0.1.10** Identifying the support mechanisms necessary to have on-site whenever SCBA use is required.

**1.0.1.11** The transportation of contaminated tools/equipment and PPE.

**1.0.1.12** Decontamination procedures (See Appendix B).

**1.0.1.13** Cleaning of contaminated clothing.

**1.0.1.14** Adequate personal hygiene practices to reduce contaminant effects.

**1.0.1.14.1** Including the recommendation to shower within an hour of concluding the exposure.

**1.0.1.15** Regular/annual physicals/health checks.

**1.0.1.16** A protocol for exposure to occupational stress that includes a time out/hot wash immediately after the event and trauma screening 3-4 weeks after the event.<sup>11</sup> [19]

**1.0.1.17** Providing the training identified in Section 4.0 of this document.

**1.0.2** Provide employees with an annual physical (see Appendix C).

**1.0.2.1** This should include behavioral health screening.

**1.0.3** Provide employees with annual skin screening by a dermatologist.

**1.0.4** Have a program for employee behavioral health awareness and support.

**1.0.5** Ensure that at large-scale investigation scenes, including multi-agency investigations and joint scene exams, a safety officer/manager is designated and following **3.1.12** below.

**1.0.6** Conduct all fire investigator training following the best practices described herein.

**1.0.7** All employers and entities conducting fire investigator live burn training, including burn cell demonstrations, should ensure that all participants

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<sup>6</sup> An exterior and interior survey conducted to identify the presence of physical, toxicological and biological hazards (structural stability, toxic substances, electrical hazards, etc.).

<sup>7</sup> In the U.S., OSHA regulations (29 CFR 1910.1200) requires employers to communicate hazard information to employees.

<sup>8</sup> Rely on known authorities, equipment manufacturers, and industrial hygienists to assist the authority having jurisdiction in generating written procedures addressing replacement, change out, reuse, and controlled disposal of contaminated respirator cylinders, backframe assemblies, faceblanks, filtration elements, clothing, gloves, boots and other human factors PPE.

<sup>9</sup> This is required in 29 CFR 1910.134(g)(1)(i)(A)

<sup>10</sup> While respiratory protection equipment is a part of the full PPE ensemble, because of its importance it is listed separately in this document. What is proper is defined by the situation as found by the fire investigator, using the guidelines established by your employer's competent decision maker or, if self-employed, using the information and resources identified herein.

<sup>11</sup> See the Stress First Aid model for firefighters and EMS personnel for further information <https://www.everyonegoeshome.com/training/behavioral-health-training/stress-first-aid-sfa-firefighters-emergency-services-personnel/>

and observers in the hot and warm zones are using appropriate PPE including respiratory protection, including the precautions identified in this document and NFPA 1402 [20] and NFPA 1403 [21].

## **Section 2.0 Vehicles**

**2.0.1** Vehicles used by fire investigators should support the clean cab concept and be able to store and transport tools and materials separately, with contaminated items physically separated from the passenger area.

**2.0.1.1** Vehicles should not have carpeting or cloth seats. If a vehicle does have these, they should be covered with something that is easily decontaminated or washed.

**2.0.1.2** Vehicle electronics should be off the floor to facilitate cleaning.

**2.0.1.3** Vehicles should have a portable or fixed water system for the decontamination of persons and tools, and immediate cleaning of injuries or direct contact contamination.

**2.0.1.4** Vehicles should be equipped with a pressurized water extinguisher and an ABC dry chemical fire extinguisher.

**2.0.2** The vehicle's cab interior should be cleaned regularly, regardless of contamination potential.

**2.0.3** Containers of collected evidence and soiled/dirty tools and clothing should all be stored in an area other than the vehicle's passenger compartment or trunk/boot to prevent off-gassing and airborne particulate exposure.

**2.0.3.1** If this is not possible, all items used and worn at the scene should be placed in tight-sealing tubs/containers or sealed in sturdy plastic bags<sup>12</sup>.

**2.0.3.2** All evidence containers should be appropriately packaged and sealed before being placed in the vehicle.

**2.0.4** When examining vehicles, all relevant safety precautions and PPE usage noted in other sections of this document, including the use of proper respiratory protection listed in Appendix A, should be followed.

**2.0.5** Fire investigators should recognize that special hazards exist when examining alternative fuel vehicles and educate themselves regarding these hazards before beginning any examination on this type of vehicle. [22]

## **Section 3.0 Individual Fire Investigators should:**

**3.0.1** Maintain a healthy lifestyle to manage modifiable health risk factors.

**3.0.1.1** Get seven to nine hours of sleep a night.

**3.0.1.2** Have a healthy diet.

**3.0.1.3** Exercise regularly.

**3.0.1.4** Limit alcohol intake.

**3.0.2** Be physically fit and able to perform the job, to include being fit-tested on assigned respirators and being able to safely wear and doff an open circuit pressure-demand SCBA when necessary.

**3.0.3** Not have facial hair that impedes the effectiveness of respiratory PPE.

**3.0.4** Have an annual physical (see Appendix C).

**3.0.5** Because the fire investigation profession could have an increased risk of skin cancer, have an annual skin check by a dermatologist.

**3.0.5.1** If there is, or has been a prior, positive skin exam, these may need to be done more frequently.

**3.0.6** Have an annual fit test for the respiratory protection equipment being used.

**3.0.7** Immediately clean and bandage any skin area that gets a cut or abrasion.

**3.0.7.1** Any existing cut or abrasion should be bandaged before starting the scene examination.

**3.0.7.2** Follow agency/company procedures for documenting any first report of injury.

**3.0.8** Maintain a written log of every scene examination that includes at a minimum:

**3.0.8.1** Date, location, and nature of each incident.

**3.0.8.2** The number of hours spent at the scene.

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<sup>12</sup> Turnout gear PPE should be in a minimum 6-mil plastic bag because thinner bags have been shown to tear. Softer PPE, such as that worn during warm and cold scene exams can be

placed in any bag that will contain particulates and off-gassing, and not tear. Both types are to be sealed after being filled. See Section 3.3 for additional information.

**3.0.8.3** Notations of the presence of any hazardous condition, or any injury or unprotected exposure possibility.

**3.0.9** Self-report information on all operational and behavioral incidents to a reporting database<sup>13</sup>.

### **3.1 Before Going, Enroute to, and Arriving at the Incident**

**3.1.1** It is important to know where you are going, the best route of travel, and the weather conditions that may be encountered. It is also important to drive safely so that you can arrive at the incident scene in a timely fashion and do the job in a more relaxed and positive state of mind.

**3.1.2** Know about and understand the type of scene you are responding to before going.

**3.1.2.1** Ask any necessary questions to gain a full understanding of the scene, including potential health and safety hazards that may be present.

**3.1.3** Locate and plan a route to the closest emergency medical facility to the scene. Have readily available the phone numbers to emergency services for the area in which you are working.

**3.1.4** Ensure that you have and use proper clothing for the current and forecasted weather conditions.

**3.1.5** Consider the wind direction and park your vehicle upwind to help keep particulates from entering your vehicle. Ensure that the vehicle's HVAC system is off to keep particulates from being pulled into the vehicle.

**3.1.6** If still an active fire scene, check in with the incident commander first.

**3.1.6.1** Ask about any known safety concerns/issues.

**3.1.6.2** Coordinate and communicate all scene activities with the incident commander.

**3.1.6.3** Ask if foam was used; if so, see **3.1.7.2** below.

**3.1.7** Conduct a site safety survey and assessment of the entire scene before beginning any work and at the start of each subsequent day thereafter.

**3.1.7.1** Check for the presence of hazardous materials, including asbestos, and physical and biological hazards, including mold.

**3.1.7.2** If firefighters used foam, determine the type used<sup>14</sup>. It should be PFAS-free. If not, ensure you are wearing ALL PPE recommended in this document.

**3.1.7.3** Identify and implement as necessary any hazard elimination methodologies or engineering controls to reduce hazards.

**3.1.7.4** Determine the need for additional or specialized resources, including but not limited to additional personnel and equipment.

**3.1.8** Inspect and verify the status of all utilities before entering any structure.

**3.1.8.1** Use a lockout/tagout system and procedures for electrical systems/equipment, as necessary.<sup>15</sup>

**3.1.8.2** In residential structures, leather gloves and rubber-soled footwear should be used when removing electric panel covers or conducting similar activities.<sup>16</sup>

**3.1.8.3** In commercial structures, only properly trained personnel wearing proper arc flash PPE should examine electrical service equipment. **[23]**

**3.1.9** Ensure that you are wearing proper PPE<sup>17</sup> for the incident before approaching the scene for any reason, including an appropriately selected respirator that is approved by the regulatory authorities of your country for fire scene entry.

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<sup>13</sup> At present, the University of Miami's Personal Exposure Reporter app, is the only electronic data collection tool that includes fire investigators. Others may be forthcoming.

<sup>14</sup> This can be easier said than done. Even the SDSs often don't indicate if there is PFAS in the foam so it might be hard to determine quickly.

<sup>15</sup> See OSHA regulation 29 CFR 1910.147 for additional information.

<sup>16</sup> Arc flash hazard minimum is 200 volts; however, shock hazard minimum is 50 volts.

<sup>17</sup> Defined as PPE manufactured and evaluated to a known scientific standard of performance (i.e. ANSI, ASTM, ASSE, NFPA, NIOSH, EN, etc.). Specific information regarding respirator selection is found in Appendix A.

**3.1.10** Recognize that special hazards exist when examining solar panels, especially when located on the roofs of structures, and educate yourself regarding these hazards before beginning any examination.

**3.1.11** Recognize that there are special hazards when refrigerants are present. Newer refrigerant blends especially are more flammable and produce toxic byproducts when burned, and these can remain after the fire is extinguished. Use caution and appropriate respiratory protection when working fire scenes that involve items that may contain or did contain refrigerant chemicals, including refrigerators, air conditioning units (including vehicles), and commercial chillers<sup>18</sup>.

**3.1.12** At large-scale investigation scenes, including multi-agency investigations and joint scene exams, a safety officer/manager should be designated.

**3.1.12.1** This person should be familiar with and preferably certified as a fire service Incident Safety Officer and have a full understanding of this best practices document and regulatory requirements.

**3.1.12.2** This person should be responsible for conducting the site safety survey (see **3.1.7** above), establishing scene PPE use requirements, and monitoring compliance.

**3.1.12.3** This person should have the responsibility to issue a stop-work order should a safety hazard present itself.

## **3.2 During the Incident**

**3.2.2** When available, use air quality monitoring during all interior and exterior examinations<sup>19</sup>.

**3.2.2.1** Understand monitoring limitations, detection ranges, interferences, maintenance, and sustainment requirements.

**3.2.2.2** Monitor CO (carbon monoxide) and HCN (hydrogen cyanide) at a minimum.

**3.2.2.3** H<sub>2</sub>S (hydrogen sulfide) and LEL (lower explosive limit) are also useful to monitor.

**3.2.3** Use powered ventilation fans to physically move ambient air and propel contaminants downwind from the investigation scene. For gases and vapors, ventilation is your friend.

**3.2.4** Wear appropriate PPE for the incident attended; every scene is somewhat different. This includes:

**3.2.4.1** Respiratory protection that meets or exceeds the minimum standards found in Appendix A.

**3.2.4.2** Steel-toed leather or rubber boots/shoes<sup>20</sup> with a puncture-resistant sole, understanding the limitations of each type<sup>21</sup>.

**3.2.4.3** Disposable protective outer garment with a hood<sup>22</sup>.

**3.2.4.3.1** If these are not available, wear fire-retardant coveralls or long pants and a long sleeve shirt.

**3.2.4.3.2** The goal is to prevent the skin absorption of hazardous chemicals and particulates.

**3.2.4.4** Protective safety helmet that meets or exceeds ANSI Z89.1-2014 Type II<sup>23</sup> for industrial use or its equivalent, with a chin strap and high visibility markings<sup>24</sup>.

**3.2.4.5** Hearing protection that meets or exceeds ANSI A10.46-2013 or its equivalent.

**3.2.4.6** Eye protection that adequately protects the wearer from flying particles and sparks, liquid

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<sup>18</sup> Fire investigators are encouraged to view the NFPA online training module and materials on this subject at

<https://www.nfpa.org/refrigerants>

<sup>19</sup> Many variables determine how long gas and vapor hazards persist post-fire, however, disturbing the scene in any way and at any time post-incident is known to stir up and make particulates airborne and this may release trapped gases and vapors, thus requiring the use of proper PPE including certified respiratory protection.

<sup>20</sup> Rubber boots can pick up static electricity that will attract particulates but are easier to clean. Leather boots may absorb certain chemicals and can be harder to clean. It would be best

to have a pair of each and determine appropriate use based on the scene circumstances found.

<sup>21</sup> See also OSHA regulation 29 CFR 1910.132 and 136.

<sup>22</sup> Users should recognize that these are not fire retardant and therefore should not be worn at any scene where fire re-ignition could occur. These will also not adequately protect the user from harmful vapors and gases that may be present at a fire scene. In instances where gases and/or vapors may be present, the user should wear a protective ensemble adequate for the situation.

<sup>23</sup> A Type II hard hat is designed to protect workers from blows to the top and side of the head.

<sup>24</sup> See also OSHA regulation 29 CFR 1910.135 and 1926.100



splashes, and meets or exceeds ANSI standard Z87.1-2015.

**3.2.4.6.1** Vented safety goggles should be worn when wearing a half-mask respirator.

**3.2.4.7** Disposable, leather palm, outer gloves or similar, and nitrile<sup>25</sup> inner gloves.

**3.2.5** Ensure that all PPE technologies in use are pre-determined as being compliant with existing standards development organization published technical standards and do not interfere with other PPE in use.

**3.2.6** Ensure you have an operable and reliable communication system with you, and, if you are working alone, that someone knows where you are and what you are doing.<sup>26</sup>

**3.2.7** Conduct all scene examinations with at least two persons<sup>27</sup> unless the status or nature of the scene indicates that it is safe for one person.

**3.2.7.1** Whenever a single investigator is present, have a methodology in place where you are checked on regularly but no less frequently than every half hour.

**3.2.8** Use a non-contact voltage detector to verify all circuits that may be interacted with are de-energized before any arc mapping, circuit tracing, or removal of electrical evidence. **[24]**

**3.2.8.1** Use electrically insulated tools whenever working on electrical equipment.

**3.2.9** Recognize that wearing PPE while performing strenuous work in higher environmental temperatures can lead to heat stress.

**3.2.9.1** Heat stress issues vary from scene to scene based on the type of fire, the duration of your work, the kind of work performed, and the environmental conditions. **[25]**

**3.2.9.2** You should take regular breaks as needed, well away from the fire scene.

**3.2.9.3** If you are going to eat or drink anything, remove all PPE and wash hands and face with soap and water, decon wipes<sup>28</sup> or a waterless cleaner.

**3.2.9.4** All exposed and transition skin surfaces should be cleaned, as noted above, at every break or rehab visit and after final PPE removal.

**3.2.9.5** All nitrile gloves and leather/canvas gloves or similar are one use and done. In addition to any evidence collection requirements, these need to be replaced each time they are removed.

**3.2.9.6** The use of SCBA, high temperatures, humidity, or extensive digging may necessitate more frequent and/or more prolonged breaks and hydration.

**3.2.9.7** Follow rest, hydration, and cooling procedures for your specific environment.

**3.2.10** Understand the definition of a confined space and be able to recognize their presence at a fire scene.<sup>29</sup>

**3.2.10.1** Do not enter a permit-required confined space under any circumstances.

**3.2.10.2** Before entering a non-permit confined space, do the following:

**3.2.10.2.1** Ensure that the atmosphere within the space is not oxygen deficient.

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<sup>25</sup> Nitrile has a higher puncture resistance than any other glove material. Nitrile also has a better chemical resistance than Latex or Vinyl gloves. Latex comes directly from rubber trees. Some people are allergic to Latex.

<sup>26</sup> Public fire investigators are encouraged to advise their dispatcher "Note in the CAD interior examination started" and, when finished, "Note in the CAD interior examination complete" so as to have quantitative data to support the length of time personnel are in an IDLH environment.

<sup>27</sup> While having two or more persons at a scene is desirable, it is recognized that this is not always possible. However, it is also not necessary that this second person be a fire investigator. It could be a firefighter, neighbor, the property's owner or tenant, or anyone who could alert others should the fire investigator become injured or incapacitated.

<sup>28</sup> While there are a variety of decon wipes on the market, with some marketed especially to the fire service, they contain a variety of ingredients and there currently is no independent research regarding their effectiveness. Decon wipes used by fire investigators should not contain alcohol.

<sup>29</sup> The U.S. Occupational Safety and Health Administration defines a confined space as a one that: "(1) is large enough and so configured that an employee can bodily enter and perform assigned work; and (2) has limited or restricted means for entry or exit and (3) is not designed for continuous employee occupancy." 1910.146(b). These spaces are further divided as permit-required confined spaces and non-permit confined spaces. The typical non-permit confined space encountered by a fire investigator is a residential crawl space.

**3.2.10.2.2** Ensure the electrical service to the structure is off.

**3.2.10.2.3** If gas service is present, ensure it is off.

**3.2.10.2.4** Ensure that the space does not contain any other hazard that could cause death or serious physical harm.

**3.2.10.2.5** Wear proper PPE, including appropriate respiratory protection.

**3.2.10.2.6** Ensure enough lighting is present to work in the space, to be able to detect potential hazards, and to safely exit the confined space in the event a hazard is detected.

**3.2.11** Recognize that all post-fire scenes are dynamic; situations can change without notice. Continually conduct a risk assessment of the scene you are working in and maintain situational awareness at all times.

### **3.3 After the Incident**

**3.3.1** Following proper doffing/de-robing procedures (see Appendix B), remove all PPE:

**3.3.1.1** Place all disposable items in a sturdy plastic bag, seal it with duct tape or similar and dispose of it properly. See also footnote 12 above.

**3.3.1.1.1** Do not leave this bag at the scene unless you know that it will be appropriately disposed of by a remediation company.

**3.3.2** Place all to-be-cleaned clothing items in a sturdy plastic bag and seal it with duct tape or similar or use a tight-sealing container. See also footnote 11 above.

**3.3.2.1** When this bag is reopened, you should wear nitrile gloves and proper respiratory protection.

**3.3.2.1.1** It is best to open this bag in a well-ventilated area or outdoors to allow any volatile substances to evaporate before handling the contaminated items.

**3.3.2.2** These items should be decontaminated and washed as soon as possible (see **3.3.9** for additional information).

**3.3.2.3** If you are using a reusable tight-sealing container, it should be cleaned inside and out after every use.

**3.3.3** Close, seal, and discard all used bags to prevent any further exposure or contamination.

**3.3.4** Using soap and water or decon wipes, clean all skin areas that may have been exposed to soot contamination.

**3.3.5** Clean tools and respirator assembly<sup>30</sup> immediately after use with an approved cleaning agent<sup>31</sup> and water and before returning them to your vehicle.

**3.3.5.1** If this is not possible, store them out of the vehicle's passenger compartment and trunk/boot.

**3.3.6** Do not transport dirty tools and contaminated clothing or PPE, or evidence containers containing samples in your vehicle's passenger compartment or automobile trunk/boot to avoid off-gassing and airborne particulate exposure.

**3.3.6.1** Remove all outer clothing using the proper methodology (see Appendix B).

**3.3.6.2** Replace contaminated footwear with clean before entering the vehicle, or

**3.3.6.3** Thoroughly clean footwear before entering the vehicle (see Appendix B).

**3.3.6.4** If this is not possible, place all items in a sealed container and out of the passenger area.

**3.3.7** If you are an accelerant detection canine handler, when deployed at a fire scene, the dog becomes as contaminated as you in the same ways and should be decontaminated before being placed back into the vehicle.

**3.3.8** Do not enter or allow others to enter your vehicle's passenger compartment unless ALL

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<sup>30</sup> Follow the respirator manufacturer's user instructions for cleaning and maintenance of the respirator. For example, alcohol wipes should not be used as they can degrade the facepiece material over time.

<sup>31</sup> See "An Examination of Decontamination Procedures," [Fire and Arson Investigator](#), July 2017 for additional information.

potentially contaminated clothing has been removed, and all exposed skin areas have been cleaned.

**3.3.8.1** In an emergency, such as an evacuation or injury, disposable seat covers or similar should be used to minimize cab contamination.

**3.3.9** While disposable coveralls are preferred, do not wash contaminated clothing in a personal washing machine if possible. [26]

**3.3.9.1** Use an extractor-type washing machine (found in many fire stations), or

**3.3.9.2** Use a commercial laundry/dry cleaner and tell them the items are contaminated.

**3.3.9.3** Do not use local laundromat machines.

**3.3.9.4** If a personal/home washing machine must be used, wash fire-contaminated clothing articles by themselves. When finished, run an empty, complete wash cycle with soap or bleach.

**3.3.9.5** Follow established decontamination procedures for tools, PPE, and other contaminated items.

**3.3.9.5.1** See Appendix B for additional information regarding decontamination.

**3.3.9.6** As soon as possible, and preferably within an hour of leaving the scene, take a shower to clean any remaining particulates from your hair and skin.

**3.3.9.7** Properly dispose of all contaminated and biohazard items.

**3.3.9.8** Regularly check all your equipment, including all tools and non-disposable apparel items, to ensure they are in proper working order and good condition.

**3.3.9.9** Periodically clean all tools and PPE even if they do not appear to be soiled.<sup>32</sup>

## Section 4.0 Training

**4.0.1** All employers should train their employees to recognize fire scene health and safety hazards and issues.

**4.0.1.1** New employees should receive respiratory protection and fire scene health and

safety training and be properly equipped before attending any fire scene.

**4.0.1.2** All employees should receive annual retraining on applicable agency policies and all OSHA-required training items. (See the OSHA publication Training Requirements in OSHA Standards for additional information).

**4.0.1.2.1** Some U.S. states have different or more restrictive training policies, and those should be followed.

**4.0.1.2.2** For entities not covered by OSHA, please refer to your appropriate governing agency for training requirements. Absent any requirements, the OSHA requirements would be good to follow and should include annual training in the following at a minimum:

**4.0.1.2.2.1** Respiratory protection

**4.0.1.2.2.2** Lockout/Tagout

**4.0.1.2.2.3** Hearing protection

**4.0.1.2.2.4** Fire extinguisher use

**4.0.2** All employees who work at fire scenes and do not have a medical facility, trained personnel, or another treatment methodology in proximity to the scene should be adequately trained to render first aid to others and themselves.

**4.02.1** These employees should have adequate first aid supplies readily available.

**4.0.3** All training should be conducted in a manner that allows the trainee to have access to the trainer to ask questions about the training.

**4.0.4** All participants in any live burn training, including burn cell demonstrations, who are in the hot or warm zones,<sup>33</sup> should do so using the PPE precautions identified in this document, including the use of appropriate respiratory protection.

**4.0.5** Instructors, managers, and trainees should understand that training evolutions can present unique heat stress-related challenges, especially when doing repeated evolutions.

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<sup>32</sup> Per NFPA 1851, ensemble elements (exposed to the hot or warm zones) that have not been cleaned and appear to be unsoiled have been shown to contain numerous fire gas chemicals, including carcinogenic polynuclear aromatic

compounds. Periodic cleaning is required to avoid use of ensemble elements that could be contaminated without visible evidence of soiling.

<sup>33</sup> See definition in Appendix B footnote.

**4.0.5.1** Instructors should understand the signs and symptoms of heat stress and have appropriate countermeasures and treatments available.



*Figure 6 Fire investigator training. Credit: Virginia Department of Fire Programs.*

## Part II – Fire Scene Investigator Precautions and PPE Protection Categories

All fire scenes have the potential for being unsafe in many ways, and the proper use of PPE and safety procedures can mitigate these risks. However, many fire investigators do not fully understand and appreciate the health risks associated with fire investigations. To help fire investigators understand the precautions that should be taken at the various types of fire scenes, a hazardous materials-style, time-based scene classification system is provided to denote the various stages of fire scenes, from an investigative perspective.

Likely one of the most misunderstood post-fire scene concepts has to do with particulates. Some investigators believe that if they do not see any particulates in the air or the fire has been extinguished for days or weeks, then things are OK. However, nanoparticles WILL be present and can be stirred up merely by walking into the scene and can then penetrate deep into unprotected lungs through inhalation and can be absorbed. Repeated exposure to nanoparticles could lead to chronic health conditions in the future.

It should be noted here that the need for the use of PPE comes only after the implementation of other control methodologies has been completed or are not able to be completed based on the circumstances found at the scene. While the proper use of PPE does offer a level of protection, that protection is not absolute; exposure to the harmful byproducts of fire can still occur.

THE PPE listed here is more fully described in Part I above. Additional respiratory protection equipment information is found in Appendix A.

**HOT SCENE A – *A fire scene where the fire has been extinguished, but overhaul has not yet commenced or is in progress.***

In this situation, fire investigators sometimes need to enter the structure or scene after consultation with the incident commander to identify those areas that can be overhauled and those areas, usually the probable area of fire origin, where overhaul should either be limited or not done at all.

While it is strongly recommended that fire investigators not enter fire scenes during this period, the fire investigator is usually only entering to make a quick, initial determination and possibly take some initial photos, and should be wearing the following PPE.

- Structural firefighter turnout gear, including bunker pants and coat, helmet, particulate-blocking hood, boots, and gloves over nitrile gloves.
- Proper respiratory protection equipment offering the below NIOSH (or similar in other countries) awarded protection:
  - SCBA<sup>34, 35, 36</sup> as a primary technology with the ability to downgrade to APR<sup>37</sup> or PAPR<sup>38</sup> after site characterization and determination of an accurate maximum hazard ratio.
- Work duty coveralls or similar underneath turnout gear to aid in self decontamination.

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<sup>34</sup> See NFPA 1981, 1986 and 1987 for additional information

<sup>35</sup> 2019 research by Stack, Griffin and Burgess at the University of Arizona concluded that a CBRN APR is not a substitute for SCBA during the overhaul phase due to benzene and formaldehyde breakthrough.

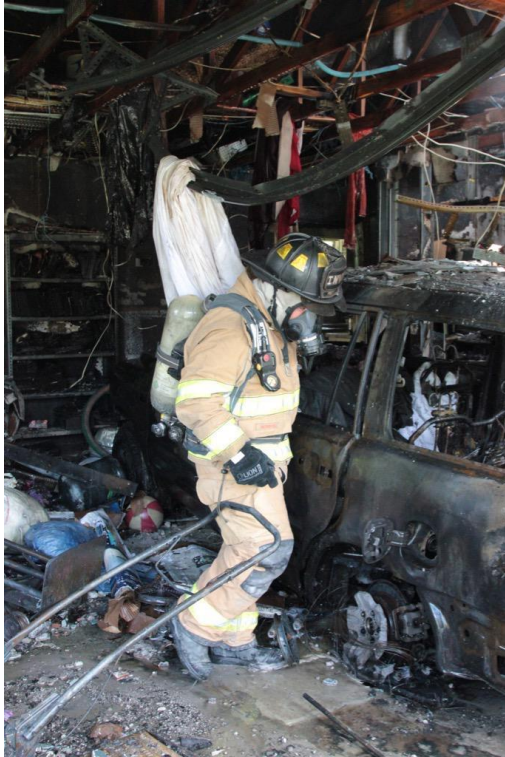
<sup>36</sup> At some agencies fire investigators are getting approval to wear lighter industrial SCBA for the first 24 hours post-fire, with the ability to step down thereafter.

<sup>37</sup> An elastomeric air-purifying respirator that utilizes a particulate filter, cartridge, or canister. Filters can be either N, R, or P series.

<sup>38</sup> An elastomeric powered air-purifying respirator that can utilize a full-facepiece, half-facepiece, or loose-fitting head covering and can be used with either a HE (high-efficiency) filter or gas and vapor cartridge or canister.



**Note 1:** Fire investigators should only enter scenes that have not yet been fully extinguished under the most extenuating circumstances, and then only when wearing full structural firefighter PPE including SCBA.



*Figure 7 Appropriate Hot Scene A Attire. Credit Palm Beach County, FL Fire Rescue.*

**Note 2:** Research has shown that there is potential exposure to carbon monoxide (CO) and volatile organic compounds (VOCs) hazards in the upwind and downwind areas of the fire scene warm zone. The referenced paper states, “Strategies to monitor multigas detection and to implement the use of PPE by firefighters are necessary” and recommends the use of a filtering half-mask (of the type recommended in this paper) in the warm zone. [27] This necessarily also applies to fire investigators operating in the warm zone of a hot scene.

**HOT SCENE B – A fire scene that has been fully extinguished/overhauled for less than two hours.**

Regardless of the amount of ventilation, these scenes are hazardous for fire investigators because of the potential for high levels of gases and particulates (e.g., smoldering items). It is strongly recommended that fire investigators not enter fire

scenes to undertake any investigative actions during this period. If there is a need to enter, fire investigators should limit their activities and time in the scene while following a vetted respirator selection logic (i.e. (U.S.) NIOSH Respirator Selection Logic 2004: <https://www.cdc.gov/niosh/docs/2005-100/pdfs/2005-100.pdf> ) and wearing the below PPE.

- Structural firefighter turnout gear, including bunker pants and coat, helmet, particulate-blocking hood, boots, and gloves over nitrile gloves, or
  - Coveralls (preferably disposable with hood) that completely cover the arms and legs. As noted in Part I, these should not be worn if there is a chance of fire re-ignition.
  - Helmet with chin strap.
  - Boots with steel toe and puncture-resistant sole (see footnote above).
  - Disposable outer gloves over nitrile gloves.
- Respiratory protection
  - SCBA (see U.S. OSHA <https://osha.gov/Publications/3352-APF-respirators.pdf> or
  - Other proper respiratory protection equipment, as identified in Appendix A.



*Figure 8 - Appropriate Hot Scene B Attire. Credit: Charlotte, NC Fire Department.*

- Multi-gas area monitoring that includes VOCs, PAHs, oxygen enrichment/deficiency, carbon monoxide, and hydrogen sulfide.

See **Note 2** above, which also applies in this instance.

**WARM SCENE** – *A fire scene that has been fully extinguished at least two hours but for less than 72 hours.*

This is the typical period when many public investigator fire scene examinations are conducted. Some private fire investigations may also be done during this period. It is also the time when a significant particulate and gas/vapor exposure hazard exists. All fire investigators conducting any type of examination within the fire scene during this period should wear the below PPE and be aware of or have immediate access to environmental monitoring data stay times, escape times, and time-weighted averages of toxic industrial chemicals while on scene.

- Coveralls (preferably disposable with hood) that completely cover the arms and legs.
- Helmet with chin strap.
- Boots with steel toe and puncture-resistant sole.
- Proper respiratory protection equipment, as identified in Appendix A.
- Disposable leather gloves with nitrile gloves underneath.
- Multi-gas area monitoring, including VOCs, PAHs, oxygen enrichment/deficiency, carbon monoxide, and hydrogen sulfide.

**Note 3:** The 72-hour threshold is used here because the Tualatin Valley Fire & Rescue study [28] and the Nelson study [29] have shown that some gas residue can be present at some fire scenes for as long as 72 hours. Should future research amend this number, this may be revised accordingly.

**COLD SCENE** – *A fire scene that has been fully extinguished for at least 72 hours and not*

*generating detectable or visible dust, fumes, mists, particulates, gases, vapors or aerosols.*

Current research indicates that particulate and gas hazards are significantly reduced after 72 hours when the debris is not disturbed. However, when walking through the scene, moving fire debris or digging of the scene occurs, particulates are introduced into the localized air and gas pockets can be released, thus creating a health hazard for the fire investigator. Even the mere act of walking through a scene post-fire can create this hazard. Fire investigators conducting any type of examination within the fire scene during this period should wear the following PPE and address the rehabilitation/recovery needs of fire investigators.

- Coveralls (preferably disposable with hood) that completely cover the arms and legs.
- Helmet with chin strap.
- Boots with steel toe and puncture-resistant sole.
- Proper respiratory protection equipment, as identified in Appendix A.
- Disposable leather gloves with nitrile gloves underneath.



Figure 9 - Appropriate warm or cold scene attire. Credit: Palm Beach County, FL Fire Rescue.

“FIRE INCIDENT RESPONSE STRATEGIES THAT ENCOURAGE AND SUPPORT THE USE OF RESPIRATORY PROTECTION FOR RESPONDERS OPERATING IN THE WARM ZONE ARE NEEDED. . . AND MAY LIMIT EXPOSURE TO CANCER-CAUSING PARTICULATES PRESENT.”

Dr. Alberto Caban-Martinez

The “Warm Zone” Cases: Environmental Monitoring Immediately Outside the Fire Incident Response Arena by Firefighters

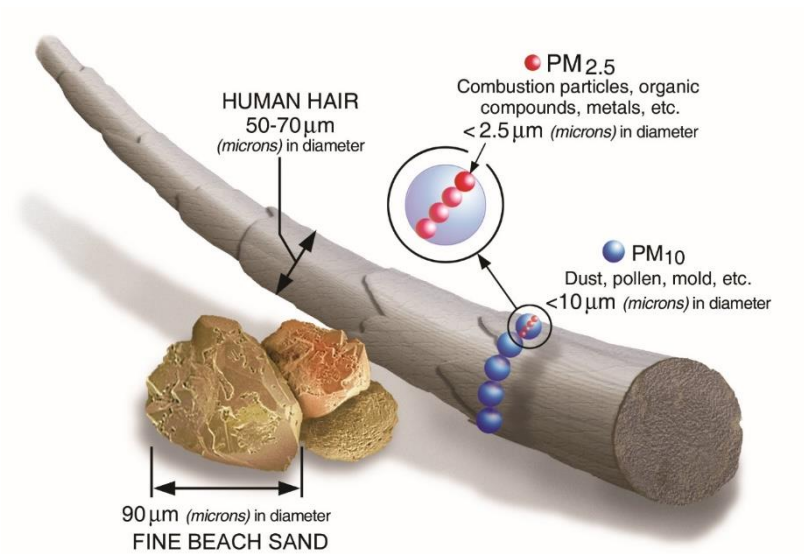


Figure 10 – The size of nanoparticulate matter (red circles) in reference to other very small things. Source: U.S. Environmental Protection Agency.

## Appendix A – Respiratory Protection Guidelines

The United States Department of Labor, Occupational Safety and Health Administration’s (OSHA) Respiratory Protection Standards<sup>39</sup> establishes OSHA’s hierarchy of controls by requiring the use of feasible engineering controls<sup>40</sup> as the primary means to control air contaminants. Respirators are required when “effective engineering controls are not feasible, or while they are being instituted.” It also requires employers to provide employees with respirators that are “applicable and suitable” for the purpose intended “when such equipment is necessary to protect the health of the employee.” Whether or not an agency or business is required to follow the OSHA standards, the information contained therein provides useful guidelines for respiratory protection best practices. At most fire scenes, reducing hazards through other control measures to the point where PPE is not needed, will not occur.

In the U.K., Health and Safety Guide 53 (HSG53) is the primary document for information regarding the use of respiratory protection equipment (RPE) and says that you should only use RPE after you have taken all other reasonably practicable measures to prevent or control exposure. [30]

OSHA has a tool on its website to assist with proper respirator selection and related information at <https://www.osha.gov/SLTC/etools/respiratory/index.html>. One of the information subsets provided discusses the employer’s responsibility to conduct an exposure assessment. “Employers must make a ‘reasonable estimate’ of the employee exposures anticipated to occur as a result of those hazards, including those likely to be encountered in reasonably foreseeable emergencies, and must also identify the physical state and chemical form of such contaminant(s).” This includes an identification of the respiratory hazards that could be present.

While it is known that some hazards, such as particulates/nanoparticulates, are present at virtually every post-fire scene, we do not know their precise make-up and typically do not know what gas or vapor hazards might be present unless extensive sampling is done. While sampling is the “gold standard” of hazard detection, it is often not practical in these situations. There are other alternatives:

- *“You can use data on the physical and chemical properties of air contaminants, combined with information on room dimensions, air exchange rates, contaminant release rates, and other pertinent data, including exposure patterns and work practices, to estimate the maximum exposure that could be anticipated in the workplace.”*
- *Data from industry-wide surveys by trade associations for use by their members, as well as from stewardship programs operated by manufacturers for their customers, are often useful in assisting employers, particularly small-business owners, to obtain information on employee exposures in their workplaces.”*

From [https://www.osha.gov/SLTC/etools/respiratory/change\\_schedule\\_exposure.html](https://www.osha.gov/SLTC/etools/respiratory/change_schedule_exposure.html)

In the U.K., the law requires you to adequately control exposure to materials in the workplace that cause ill health. The Control of Substances Hazardous to Health Regulations (COSHH) requires:

- identifying which harmful substances may be present in the workplace
- deciding how workers might be exposed to them and be harmed

---

<sup>39</sup> 29 CFR 1910.134

<sup>40</sup> Fire scene engineering controls includes such things as demolition, shoring, wetting areas to control particulates and the use of positive pressure fans to put fresh air into a scene.



- looking at what measures you have in place to prevent this harm and deciding whether you are doing enough
- providing information, instruction, and training
- in appropriate cases, providing health surveillance [30]

And, like in the U.S., to select RPE that will protect the wearer, you will need a basic understanding of:

- the hazardous substance and the amount in the air (exposure);
- the form of the substance in the air (e.g., gas, particle, vapour);
- the type of work being carried out;
- any specific wearer requirements, such as other PPE or a need for spectacles/eyeglasses.

Regardless of your country, the respiratory protection equipment selected and used must also be adequate – right for the hazard and reduce exposure to the level required to protect the wearer’s health, and suitable – right for the wearer, task and environment, such that the wearer can work freely and without additional risks due to the RPE.

Although there is ample information that identifies the many harmful gases and vapors that could be present at a post-fire scene, very little research data exists today regarding the actual composition and amounts. There are so many scene variables that definitive numbers may be impossible to come by. The IAAI Health & Safety Committee is working to conduct studies to help identify the presence and levels of gases, vapors, and particulates in the post-fire environment and, at some point, this information may help with respirator selection. Until then, the OSHA website says that *“you should account for potential variation in exposure by using exposure data collected with a strategy that recognizes exposure variability, or by using worst-case assumptions and estimation techniques to evaluate the highest foreseeable employee exposure levels. The use of safety factors may be necessary to account for uneven dispersion of the contaminant in the air and the proximity of the worker to the emission source.”* [31]

Even with this information, deciding on the best respirator solution for fire investigators can be challenging. To use the OSHA respirator selection advisor genius software, you must know the several workplace parameters, two of them being the OSHA permissible exposure limit and the maximum exposure level in the workplace of a single contaminant and its physical state: gases, vapors, and particulates. This, of course, requires the identification of specific items, which, as discussed above, is very challenging in the post-fire environment. (See [https://www.osha.gov/SLTC/etools/respiratory/advisor\\_genius\\_nrdl/work\\_categories.html](https://www.osha.gov/SLTC/etools/respiratory/advisor_genius_nrdl/work_categories.html) )



**Figure 11 Acceptable fire investigator respiratory protection equipment options.**

In the U.S., OSHA regulations require that a competent decision-maker determine the best respirator for employees to use based on recognized hazards. Based on the best information presently available regarding the



potential hazards to fire investigators, as discussed elsewhere in this document, the following recommendation is made:

**The IAAI-recommended minimum respirator assembly for all fire investigators while in the hot and warm zone of every warm and cold fire scene is a half-mask facepiece with goggles,<sup>41</sup> or a full facepiece<sup>42</sup>, that has a P100 particulate filter with an OV/AG/FM<sup>43,44</sup>, gas/vapor cartridge<sup>45, 46</sup> if following U.S. descriptions OR a half-mask facepiece with eye protection, or a full facepiece, with an A3P3 combination filter if following U.K. descriptions.**

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**Note:** Zones are geographical – based on the fire situation as found (see footnote 48 below),  
Scenes are time-based (see Part II above).

---

There have been adverse respiratory effects while wearing P100/OV/AG cartridges during overhaul (Burgess et al., 2001), with a likely cause being formaldehyde breakthrough (Anthony et al., 2007). SCBA should be used by fire investigators who must enter a fire scene during the overhaul phase or within two hours after that.

CBRN Cap 1 canisters can also be used for fire scene examinations when specified in an agency's policy, the incident commander or lead fire investigator approves it, and used as subcomponents of industrial respirators<sup>47</sup>.

In the U.K., based on the information in Health and Safety Executive Guidance 53, the recommendation is the P3 particulate filter and A3 gas/vapour filter in combination. The U.S. and U.K. require SCBA (an open circuit, pressure-demand, self-contained breathing apparatus respirator) if it is necessary to enter an IDLH (immediately dangerous to life or health) environment, which includes the post-fire overhaul phase.

In the U.S., to meet the IAAI minimum protection guideline, the respirator must have a P100 particulate filter as well as gas and vapor protection, including organic vapors, acid gases, and multi gases, including formaldehyde. P100 filters are required to be magenta or have a magenta label. A cartridge with the appropriate gas and vapor

---

**There are numerous other respiratory protection masks on the market that are not NIOSH or HSE approved or do not meet the IAAI minimum respiratory protection guidelines. Readers are cautioned that these masks are not suitable for use during fire investigations.**

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<sup>41</sup> In instances where toxic gases/vapors and/or particulates are likely present in the warm zone, such as during Hot Scene A or B operations, the above minimum recommended respirator assembly should also be worn.

<sup>42</sup> NFPA 1500 Standard on Fire Department Occupational Safety, Health and Wellness Program (2018 ed.) advocates the use of at least a fitted full-face air purifying respirator (APR) with protection against fireground contaminants for entry into the post-fire environment before or after overhaul (7.10.9) and with the safeguards and criteria identified in Section 14.4.2.1.1. present.

<sup>43</sup> Formaldehyde (FM) protection has been added in this edition as an additional minimum protection requirement.

<sup>44</sup> P100/OV/AG/FM is a respiratory protection filter/cartridge assembly that removes 100% of particulates down to .3 microns in combination with protection for organic vapors (OV), acid gases (AG) and formaldehyde (FM). Organic vapors typically refer to liquids that evaporate quickly (hence giving off vapors) and are petroleum based. Examples include solvents in paint, nail polish remover and gasoline. An acid gas is any gas that contains significant amounts of acidic gases such as carbon dioxide or hydrogen sulfide.

<sup>45</sup> An N95 filter mask is not suitable for fire investigation or scene examination work under any circumstances.

<sup>46</sup> 29 CFR 1910.134 (OSHA) and 42 CFR 84 (NIOSH)

<sup>47</sup> CBRN Cap 1 canisters can be used as a subcomponent of an industrial respirator if the configuration is NIOSH approved. The NIOSH approved configurations can be found on the approval label.

protection has an olive-colored band on the label. The filter and gas/vapor cartridge can come as one complete assembly or can be combined before being attached to either a half-facepiece or a full-facepiece. An assembly with this filter/cartridge combination (magenta and olive) meets the IAAI minimum respiratory protection guideline.

In the U.K., filters are color-coded according to the HSE. The particulate filter is white. The A filter for Organic gases and vapours with a boiling point above 65 °C is brown.

### Maintenance and Cleaning

Cartridges, filters, and masks get old. To maintain their effectiveness, they must be cleaned after each use, properly stored, and replaced when necessary. If the filter cartridges are outdated, have been open to the air, or are damaged, you may not be protected. Cartridges that contain charcoal or other chemicals for filtering the air should be kept in air-tight packages until use. If cartridges are open or not packed in air-tight packaging, they should not be used. Even cartridges in original packaging have expiration dates that should be checked before use. Also, over time your mask can get old and break down. Keep your mask in a clean, dry place, away from extreme heat or cold. Inspect it before and after use according to the manufacturer's instructions. Cartridges also have a limited service life and must be changed periodically. Users should consult the manufacturer's recommendations regarding filter and cartridge service life.

How long a filter or cartridge lasts typically depends on how much filtering capacity the respirator has and the amount of hazard in the air at each scene – the more chemical or biological hazard in the air (higher concentration), the shorter the time a filter may last. There is no absolute time limit, and it varies by each respirator model's capacities and the concentration of the hazard. [32] At the very least, filters and cartridges should be replaced after 40 hours of use, when you can sense outside air or when breathing becomes slightly labored. Tracking this is another reason keeping a scene examination log is essential. The use of an SCBA eliminates the concern for filter saturation and the possibility of contaminants getting through a filter or cartridge.

### Program Administration

Respirator users and competent decision-makers should read the relevant literature and information available at the website of the NIOSH National Personal Protection Technology Laboratory (<https://www.cdc.gov/niosh/npptl/>) regarding respirator approval standards, respirator recognition, and access to the NIOSH certified equipment list when developing procedures to validate a written respiratory protection program based on U.S. Department of Labor, OSHA requirements.

Workplace administrators charged with writing and managing written respiratory protection programs play a vital role in working with management personnel on the use of engineering controls to eliminate the airborne respiratory hazards, and if not able to remove them, control them by implementing feasible engineering controls, workplace environmental sampling and monitors, administrative signage/area restrictions and as necessary introducing workplace-specific personal protective technologies and equipment designed to lower the potential or actual exposure of assigned workers.

A field sample of a written industrial respiratory protection program is found at the following link: <http://www.radford.edu/content/dam/departments/administrative/ehs/Respiratory%20Protection%20Program.pdf>. This is an evolving document that is tailored to a specific workplace and demonstrates a concerted effort to address all the known and implied variables present. It also shows how perishable the information is/can be if the document responsibilities are not revisited, reevaluated, improved, and republished over a known period.

## Appendix B – Decontamination Procedures

### Crime Scene Decon and PPE Doffing Procedures

In addition to cleaning and decontaminating tools and PPE after every scene exam use, it is also sometimes necessary to decontaminate (decon) investigative personnel at some fire scenes. There are two types of special decon situations that fire investigators must be aware of:

1. Persons entering the scene who may contaminate it (IN)
2. Persons leaving the scene and are contaminated from the scene contents (OUT)

These recommended procedures or similar should be implemented for the investigation of all fatal fires, arson fires, other crime scenes, and any other fire scene where dictated by the circumstances of the incident. The incident commander or lead fire investigator should determine when these procedures are necessary and implement them accordingly.

### IN Procedures

Each person entering the fire scene hot zone<sup>48</sup> must wear new gloves, disposable coveralls or other approved clean outerwear, and any other necessary pristine PPE as further defined elsewhere in this document. In those instances where the possibility of scene contamination exists, all persons entering the scene should clean their boots, using the below procedures, immediately before entering. The lead investigator/scene manager is responsible for determining if this procedure is necessary and, if so, ensuring that the decon station is in place and properly used before anyone entering to ensure that all items are either new or thoroughly cleaned to prevent any cross-contamination. (If this procedure is used, it is to be documented in the investigation report and photographed.)

### **Knowledge vs. Practice**

**A 2018 study of 482 firefighters from four south Florida fire departments showed that while firefighter attitudes were overwhelmingly favorable towards cleaning gear (knowledge), their actual decontamination and cleaning behaviors (practice) did not follow at the same level.**

**As a fire investigator, is there a gap between your decon and cleaning knowledge and practice?**

**Tyler R. Harrison, Jessica Wendorf Muhamad, Fan Yang, Susan E. Morgan, Ed Talavero, Alberto Caban-Martinez & Erin Kobetz (2018) Firefighter attitudes, norms, barriers and behaviors towards post-fire decontamination processes in an era of increased cancer risk, Journal of Occupational and Environmental Hygiene, 15:4, 279-284, DOI:10.1080/15459624.2017.1416389**

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<sup>48</sup> For the purposes of Appendix B, a fire scene hot zone is defined as that portion of the scene that includes the structure or similar burned area and any adjacent debris field/area, and to which access is restricted to only those required to enter. It should be visually defined/outlined with red scene tape. The fire scene warm zone includes that area immediately outside the hot zone of sufficient size and shape to limit exposure to contaminants and shall contain the necessary decon areas. Access to this area is limited to decon personnel and those accessing the hot zone. Based on the research of Dr. Caban-Martinez and his team, proper respiratory protection should be worn in this area if the fire is still in progress and/or smoke is present or is indicated by monitoring. It should be defined/outlined with yellow scene tape. The cold zone includes all areas of the scene outside the warm zone.

- If the ground is dry, set up two buckets or similar containers filled with water. To the first bucket, add the recommended amount of cleaning solution<sup>49</sup>. Using a poly-fiber, long-handle brush or similar, each person cleans their boots in the first bucket, rinses them in the second one, and then enters the scene.
  - It may be necessary to rinse and refresh one or both buckets regularly.
- If the ground is wet, it may be necessary to place a tarp under these buckets and to add a pre-rinse bucket in the first position. If used, the wet tarp will be slippery, and users need to exercise caution.

### OUT Procedures

The decon procedures to be used after exiting a fire scene vary depending on the situation and weather conditions.

At crime scenes, including all fatal fires, a decon station should be established at the hot zone exit point. This process often requires the assistance of additional personnel who should be wearing PPE and respiratory protection because of off-gassing and particulate dispersal. While there are specific methodologies for this process in HazMat literature, a detailed discussion of this process is outside the scope of this document.

### Hot Zone A & B PPE Decon and Doffing

When wearing the PPE referenced in Part II above for hot zone post-fire scene examinations, decon and doffing/de-robing should be done in the cold zone, away from the immediate scene and away from one's vehicle, in the following order.

1. Tools:
  - a. Wash tools using a bucket of clean water containing the recommended amount of cleaning solution, scrubbing with a poly-fiber or similar brush for at least 30 seconds and then rinsing in a bucket of clean water or with a hose, or
  - b. Wipe them down with a damp cloth\*
  - c. Allow tools to air dry
  - d. Properly dispose of the dirty water
  - e. If available, this can be done by another team member wearing full PPE including respiratory protection
2. If available and temperature permits, after loosening SCBA straps, use a low-pressure hose to rinse off the turnout coat, pants, and boots, including soles, starting at the neck and working down. If water is not available or weather does not permit, use a poly brush to lightly brush off the turnout coat, pants, and boots including soles, starting at the neck and working down.
  - a. This procedure is done by a second person wearing full PPE including respiratory protection (SCBA or APR)
3. Remove structural gloves and place in bag\*\*
  - a. If your agency has a glove or hood on-scene replacement program, follow those procedures after removal
  - b. If you are wearing nitrile gloves under the structural gloves, leave them on for now
4. Take off the helmet, clean off any debris, and place in a bag
5. Holding your breath, pull back the hood, and then remove it and put it in bag
6. Remove the SCBA
7. Remove turnout coat and place it in bag
8. Gently fold down the turnout pants
9. Remove boots and pants and place them in the bag

---

<sup>49</sup> See M. Evans and S. Trimber, "An Examination of Decontamination Procedures," Fire and Arson Investigator, July 2017, pp 10-15 for additional information regarding effective cleaning products.

10. Remove nitrile gloves and place in the disposables bag
11. Close and seal the bags
12. Clean all exposed and transitional skin areas with decon wipes or soap and water
13. Put on clean/dry clothing and footwear
14. Place tools and bags in the vehicle's utility or storage area
15. Shower within the hour
16. While wearing nitrile gloves and respirator, and in an open area, remove items from the bag and place in the washing machine/extractor
17. Wash all apparel items as noted elsewhere in this document
18. Clean helmet, boots, SCBA and mask, and all tools used with warm water and mild soap. If the helmet liner or neck cover is removable, add it to the washing machine/extractor

NOTE: NFPA 1851 Standard on Selection, Care, and Maintenance of Protective Ensembles for Structural Fire Fighting and Proximity Fire Fighting contains additional information regarding this subject.

### Warm and Cold Zone PPE Decon and Doffing

When wearing the PPE referenced in Part II above for warm and cold post-fire scene examinations, decon and doffing/de-robing should be done in the cold zone, away from the immediate scene and away from one's vehicle, in the following order.

1. Tools:
  - a. Wash tools using a bucket of clean water containing the recommended amount of cleaning solution, scrubbing with a poly-fiber or similar brush for at least 30 seconds and then rinsing in a bucket of clean water or with a hose, or
  - b. Wipe them down with a damp cloth\*
  - c. Allow tools to air dry
  - d. Properly dispose of the dirty water
2. Brush off any visible debris and particulates from outer clothing
3. Do an initial rinse of boots including soles
4. Remove outer gloves and place in proper disposable trash bag\*\*
5. Take off the helmet and wipe it off with a damp cloth\*
6. Gently remove the hood portion of the disposable outer garment\*\*\*
7. Gently unzip the suit and pull out arms. Roll down the suit with the inside out, to the top of boots
  - a. If wearing another type of protective outer garment, follow the same procedure
8. Remove boots and set aside
9. Remove suit and outer gloves and place in the disposables bag
10. Clean boots using the same methods as for tools
11. Remove goggles and then respirator, taking care not to cross-contaminate facial areas in the removal, and wipe them off with a damp cloth\*
12. Remove inner gloves and place in the bag
13. Close and seal the bag all bags
14. Clean all exposed and transitional skin areas with decon wipes or soap and water. Place used wipes in the disposables bag
15. Put on clean, dry clothing to travel
16. Place tools, boots, and sealed bags in vehicle's utility area
17. Shower within the hour or as soon as practical
18. While wearing nitrile gloves and respirator, and in an open area, remove items from the bag and place in the washing machine/extractor
19. Wash all apparel following the instructions noted elsewhere in this document



20. Clean tools, helmet, boots, goggles, and respirator with warm water and mild soap. If the helmet liner or neck cover is removable, add it to the washing machine/extractor

\* If you are going to dispose of these used cloths, they go in the disposables bag. If you are going to wash and reuse them, place them in a separate bag that is then sealed and placed in your vehicle's utility area. Follow the best practices, storage, and cleaning information.

\*\* Contaminated items that are going to be disposed of should be placed in a sturdy plastic bag that is then sealed. Items that are going to be cleaned later should be placed in a sturdy plastic bag and sealed or in a container with a tight-fitting lid. See footnote 11 on page 14 for additional information.

\*\*\* If wearing something else, such as coveralls or long pants and a long-sleeved shirt, substitute as appropriate following the same steps.

Studies by the Textile Protection and Comfort Center at North Carolina State University have shown that firefighter PPE placed in a sealed container, and checked periodically, can off-gas for an extended period. All persons opening sealed containers containing any items contaminated at a fire scene should wear proper respiratory protection as defined in Appendix A of this document, and nitrile gloves.



*Figure 12 Appropriately attired fire investigator at a Cold Scene.  
Credit: Kevin Hays Fire Consulting, LLC.*

## Appendix C - Comprehensive Physical Exam Letter

### FIRE INVESTIGATOR COMPREHENSIVE PHYSICAL EXAM LETTER

Dear Primary Care Provider:

Thank you for providing medical care to fire investigators. You play a vital role to help prevent the disturbingly high incidences of cancer and heart disease in this profession. Performing fire investigations in a toxic environment places tremendous demands on the cardiovascular system that can lead to premature structural heart and coronary artery disease. In addition, fire ground exposures place fire investigators at significant risk for developing respiratory, gastrointestinal, genitourinary, skin and blood cancers.

Fire investigators are exposed to numerous cancer-causing chemicals from the byproducts of combustion of common household items made of plastics and synthetics as well from furniture covered with flame retardants. These carcinogenic chemicals are absorbed, inhaled, and ingested into their skin, airways, and gastrointestinal system at every structure and vehicle fire investigation. Chronic exposure to the carcinogens from diesel exhaust fumes in the firehouse also promotes occupational cancer in fire investigators.

Fire investigators should be considered “high-risk” patients because of their unique occupational exposures and deserve comprehensive physicals and screening tests for the prevention and early detection of heart disease and cancer annually.

#### Recommended Fire Investigator Physical Exam and Screening Tests

Annual Exam	Annual Labs and Screening Tests
<input type="checkbox"/> Blood pressure, pulse	<input type="checkbox"/> Comprehensive metabolic and chemistry panel
<input type="checkbox"/> Respiratory rate, temperature	<input type="checkbox"/> Liver function tests
<input type="checkbox"/> Oxygen saturation	<input type="checkbox"/> Hepatitis profile
<input type="checkbox"/> Weight and body-fat index	<input type="checkbox"/> Complete blood count
<input type="checkbox"/> Thorough skin exam	<input type="checkbox"/> Thyroid panel
<input type="checkbox"/> Eye exam and hearing testing	<input type="checkbox"/> Hemoglobin A1c (for diabetes monitoring)
<input type="checkbox"/> Oral, throat and thyroid exam	<input type="checkbox"/> Fasting lipids and blood glucose
<input type="checkbox"/> Heart and lung exam	<input type="checkbox"/> Urinalysis
<input type="checkbox"/> Abdominal and testicular exam	<input type="checkbox"/> EKG
<input type="checkbox"/> Prostate and rectal exam	<input type="checkbox"/> PSA ( <b>begin at age 40</b> for prostate cancer screening)
<input type="checkbox"/> Fecal occult blood testing	<input type="checkbox"/> Pulmonary function test every 3 years
<input type="checkbox"/> Pelvic and Pap for females	<input type="checkbox"/> Low-dose helical chest CT scanning ( <b>begin at age 50</b> )
<input type="checkbox"/> Vascular and neurological exams	<input type="checkbox"/> Colonoscopy ( <b>begin age 40</b> and every five years)
<input type="checkbox"/> Behavioral health, smoking and substance abuse evaluations	<input type="checkbox"/> Exercise stress echocardiogram test ( <b>begin age 40</b> and every three years)
<input type="checkbox"/> Musculoskeletal exam	<input type="checkbox"/> Mammograms for females ( <b>begin age 35</b> )

I have gained a unique perspective and understanding of the tremendous dangers and health risks associated with fire investigations from my 20 years of combined experience as a Boston firefighter and the department

physician for the BFD. Now, as a practicing PCP who treats many fire investigators, I am convinced that these screening protocols work. These comprehensive exams, along with full compliance with respiratory and personal protective equipment guidelines\* at all fire investigation scenes and practicing better self-care, are all very effective tools for early detection and prevention of these serious occupational-related illnesses.

These high rates of cancer and heart disease in fire investigators are no longer acceptable. Thank you for taking the time from your busy schedules to review these recommended medical surveillance evaluations. I do hope you seriously consider using these screening protocols for all your fire investigator patients. Please contact me with any questions or concerns about these recommendations.

Sincerely,

***Michael G. Hamrock, MD***

michael.hamrock@steward.org

(Dr. Hamrock is working closely with the Last Call Foundation to prevent occupational injuries and illnesses in firefighters. He practices primary care and addiction medicine at Steward St. Elizabeth's Medical Center in Boston, MA.)

September 26, 2018

\* See the Fire Investigator Health and Safety Best Practices white paper, published by the International Association of Arson Investigators, Inc.

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