

FIRE OVERHAUL, REHAB, AND A COMPREHENSIVE RESPIRATORY PROTECTION PROGRAM

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After firefighters extinguish a structure

fire, they typically re-enter the building to conduct overhaul activities.

During overhaul, firefighters often open up and look in the walls, ceilings, attics, and any other void space where these still-burning embers might be located. To accomplish the strenuous task of overhaul, firefighters use thermal imaging cameras (TICs), and other tools such as axes, chainsaws, and pike poles to search for hidden fire after the main body of the fire has been extinguished.

During overhaul, there may be little or no smoke, so most firefighters remove the face piece of their SCBA (self contained breathing apparatus) and work in the environment without any respiratory protection. Firefighters falsely believe that due to the reduced amount of smoke and fire during overhaul, they are not being significantly exposed to the products of combustion. Science has proved this notion to be false. Firefighters are, in fact, routinely breathing toxic gases and being exposed to dangerous carcinogens in the post-fire environment.

These products may include hydrogen cyanide (HCN), aldehydes, benzene, nitrogen dioxide (NO₂), sulfur dioxide (SO₂), polynuclear aromatic hydrocarbons (PNA), and other substances.

Recent scientific studies show that the post-fire environment may be more dangerous than firefighters realize.

Based on that concept, all fire departments should have an overhaul policy that requires firefighters to wear respiratory protection throughout the overhaul phase of the fire.

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In their excellent study of firefighter exposure during fire overhaul, authors

Bolstad-Johnson, et al, found that contaminants in the “overhaul atmosphere exceeded occupational exposure limits and could therefore result in adverse health effects in firefighters without respiratory protection.” In this important study, the authors found that in many fires, concentrations of acrolein, CO, formaldehyde, and gluteraldehyde exceeded exposure limits set by the Occupational Safety and Health Administration (OSHA). They also found that concentrations of coal tar pitch volatiles (PNAs) exceeded the OSHA and NIOSH limits. In other words, the post-fire environment, though there is little or no smoke present, is extremely toxic and dangerous to firefighters. The authors conclude that respiratory protection should be worn by firefighters during overhaul activities, and that the SCBA is a far better choice of respiratory protection than full-face air purifying respirators, which provide only limited protection to the firefighters as compared to the positive pressure SCBA.

Many fire departments allow firefighters to take off their SCBA during overhaul if carbon monoxide (CO) readings are below acceptable levels. However, CO levels have no correlation to irritants, other toxic gases, or carcinogens that are present in the post-fire environment. The current air monitors/gas detectors used by most fire departments do not monitor these carcinogens and toxic gases - gases like hydrogen cyanide, which is proving to be one of the most deadly compounds in the fire and post-fire environment. To that end, the practice of allowing firefighters to take off their SCBA during overhaul should stop. Because of this uneducated and dangerous practice, too many firefighters are being injured, contracting various kinds of cancers, and suffering from respiratory illnesses.

Having firefighters wear their SCBA during fire overhaul, however, is just one piece of a comprehensive respiratory protection program.

RESPIRATORY PROTECTION PROGRAM AND AIR MANAGEMENT

First and foremost, firefighters must become educated about their SCBA. They must understand the limitations of the SCBA and how it functions. They must be fitted with the proper face-piece. They must be properly

trained on how to use it under normal operating conditions, and how to handle a low air emergency. All of this is mandated by NFPA 1404, *Standard for Fire Service Respiratory Protection Training*.

The SCBA is widely recognized in the fire service as the biggest single improvement for firefighter safety and health. By providing a reliable supply of uncontaminated air for the firefighter operating in a highly dangerous and contaminated environment, the SCBA allows firefighters to work for extended periods while protecting their respiratory system. SCBA have improved over the years and now represent a relatively lightweight and reliable piece of equipment that firefighters should use at all times.

Exposure to products of combustion is an unnecessary and therefore unacceptable risk for firefighters in the modern era. In addition, improved air management techniques and an effective work/rest interval while operating in SCBA and maintaining an appropriate margin for safety. And while a SCBA will provide a significant increase in overall safety, there is a cost to the wearer. A complete self contained breathing apparatus can easily add in excess of 25 pounds to the firefighter. In addition, the backpack carrying system compresses the thoracic cavity and restricts the ability of the respiratory muscles to function normally.

Each 1 kg increase in the weight of the SCBA ensemble has related impacts on the respiratory rate, heart rate, and energy expended. This increases the workload of the firefighter thereby increasing the rate of metabolic heat that is produced simply through the effort of breathing.

Additionally, a comprehensive respiratory protection program must ensure that firefighters wear and use their SCBA while fighting fire. Unfortunately, there are many fire departments around the US that either do not mandate or do not enforce the policy that every firefighter must wear and use their SCBA during fires. Another component of a comprehensive respiratory protection program should require firefighters to manage their air supply, ensuring they maintain a supply of emergency reserve air in case they run into trouble. Ideally, this reserve air must only be used in case the firefighter encounters an unforeseen

emergency - it should not be used as part of the working air for fighting the fire.

The commercial and recreational SCUBA diving industry has used the concept of air management for decades. Every SCUBA diver knows that they never breathe into their emergency reserve air unless they run into trouble underwater. In fact, dive masters expect every diver to return to the dive boat with their reserve air intact. If they do not, and they had no emergency, those divers are deemed unsafe, and are not allowed to dive again for that day or that company. Currently, the American fire service does not enforce such stringent penalties for utilizing emergency supplies of air. It is commonplace to see firefighters working past the low-air warning whistle or bell, failing to have any air in reserve.

The last step of a comprehensive respiratory protection program is a comprehensive fire overhaul policy; a policy requiring firefighters to wear and use their SCBA during fire overhaul. Since overhaul is can be more physically demanding than extinguishing the initial fire, there should be more firefighters on scene to share in the overhaul workload. Overhaul operations should also include mandatory rest breaks for firefighters, providing personnel time to cool off and hydrate. Safe work-rest intervals should be observed, since overheating, dehydration, and fatigue will all be working against the firefighters performing overhaul. The practice of leaving one unit on scene to perform fire overhaul should be discontinued - multiple units working together should do overhaul. This provides firefighters with regular rest breaks - a concept consistent with following safe work-rest intervals.

Company Officers and Incident Commanders must take all of the above into account when determining when crews must rotate through an assignment and move toward rehabilitation (rehab). Current recommended practice identifies work-to-rest intervals in terms of "30-minute" cylinder rotations for interior operations and time-based 20-minute work cycles for outside operations. Company officers or crew leaders should perform selfrehab after one "30-minute" cylinder use or 20-minutes of intense work.

This rehabilitation process is informal and is most often conducted and supervised by the company officer during the SCBA cylinder exchange at the apparatus. The recommended work-to-rest interval includes 10 minutes of rest for each "30-minute" cylinder work cycle. Incident Commanders must be able to forecast incidents where rehab will be needed beyond the company level and establish a formal rehab area early.

Industry accepted standards for the "30-minute" cylinder work interval may also be extended to the "45-minute" cylinder if air management is practiced in accordance with the Rule Of Air Management (ROAM). Firefighters who follow the ROAM will have work cycles that closely match those of firefighters operating in "30-minute" cylinders while working in the hazard area until the low-air alarm activates before beginning to exit. Firefighters who use the ROAM recognize that the time to exit is before the low air alarm activates. Without adhering to the ROAM, Company Officers should follow the recommended practice of using only one "45-minute" cylinder before rotating to a designated rehabilitation area. Any use of a "60-minute" cylinder should be followed by an assignment to the formal rehab area.

Formal incident scene rehabilitation is a tactical level function normally assigned as a division, group, or sector. The rehab supervisor should be trained in all the functions and responsibilities inherent to the position and should understand how rehab operates within the Incident Management System (IMS) and the standard operating procedures (SOP's) of the department. Rehabilitation areas should be far enough from a working incident to provide protection from the products of combustion and from apparatus exhaust. They should also be close enough so ready access can be made between the incident scene and the rehab area. Rehab should also provide appropriate protection from the environment, whether this includes hot or cold weather. Companies should be able to re-supply and stage firefighting equipment before entering the rehab area. Departmental SOP's or trained observations of company officers may dictate when and how units are assigned to rehabilitation. Minimum standards for rehabilitation programs

should include:

- **Identified work-to-rest intervals before company level rehab are listed below and should require a 10-minute company rehab including rest, hydration, and an evaluation of the company's readiness for re-assignment at the completion of the 10-minute rehab**
- **One "30-minute" cylinder without air management**
- **One "45-minute" cylinder following the ROAM**
- **20 minutes of intense work**
- **Identified work-to-rest intervals before assignment to the rehabilitation area**
- **Two "30-minute" cylinders without following the ROAM including a 10-minute rest and hydration period between cylinders**
- 15 • **Two "45-minute" cylinders following the ROAM including a 10-minute rest and hydration period between cylinders**
- **One "45-minute" cylinder or "60-minute" cylinder work cycle without following the ROAM**
- **One "30-minute" cylinder without following the ROAM or One "45-minute" cylinder following the ROAM after having rotated through rehab previously. This requirement recognizes the cumulative impact of repeated work-rest intervals over the course of an incident and promotes coordinated company rotations and incident accountability**
- **In addition to the work-rest interval considerations, any SOP should include the following for assignment to rehab**
- **The company officer recognizes the company needs to move to the rehab area at any time**
- **The incident commander assigns the company to rehab**

Once units are assigned to report to rehab they should report to the rehab supervisor for check in and recording of their arrival time. Personal Protective Equipment (PPE) should be removed and SCBA should be re-supplied with full cylinders. The company should then be given an initial medical screening by assigned EMS personnel in accordance with department SOP's. This initial evaluation should include:

- **Symptoms of dehydration**
- **Heat/Cold stress**
- **Physical exhaustion**
- **Cardiopulmonary abnormalities**

- **Emotional/mental stress**
or exhaustion

FINAL THOUGHTS

Fire overhaul is necessary to assure that the fire is out and will not rekindle.

However, the post-fire environment is dangerous due to irritants, toxic gases, and carcinogens in the atmosphere.

Firefighters must wear their SCBA during this overhaul phase of firefighting to protect them from breathing in these harmful compounds. Fire departments must adopt a comprehensive respiratory protection program that mandates the wearing and use of SCBA during all phases of the fire and adheres to safe and effective air management practices.