

THE DOCTRINE OF SCBA
by
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From the ancient days of the Roman Empire until today, firefighters have had to deal with nasty atmospheres. The term “smoke eater” was probably coined in those early days. However, not until recently was it recognized that those entering such dangerous conditions were exposing themselves to deadly poisons that could either kill them immediately, or cause their untimely death later. Once, firefighters were simply encouraged to wear beards. When required to enter these situations, they were told to soak their beards in water and cover their faces with bandanas, which was perhaps the first filter-type mask. Those improvised filter masks were used for a long time. Ultimately, respiratory protection evolved into the basic self-contained breathing apparatus (SCBA) design we know today.

But the limitations of SCBA remain a serious firefighter safety factor. Different risk factors in modern firefighting demand a better approach. For example, hazardous materials require more than just airway protection. Running out of air under some conditions is serious. Although SCBA users may recognize that they can assess risk in advance and make plans to overcome the risk, they can never take these plans for granted.

Risk management consists of identifying, assessing, and prioritizing risks, and then applying resources to minimize, monitor, and control the probability and impact of unfortunate events. Whenever we ask firefighters to enter a dangerous atmosphere in which it is possible they may be killed or injured, we are asking them to take a *calculated* risk. **That is, one in which the exposure to a serious danger is outweighed by the greater benefit to be obtained, and the dangers have been so mitigated that success is likely.**

Taking calculated risks should be based on a set of guidelines or rules or they can become downside risks.

As dangerous as firefighting is, committing personnel to enter this dangerous atmosphere requires more than just a few simple rules. It requires a doctrine, an authoritative statement of principles, beliefs, and ideas. The fire service needs a comprehensive doctrine to encompass the use of SCBA in immediately dangerous to life or health (IDLH) atmospheres that encompasses all SCBA-related activity. It’s not just about the equipment.

IDLH DEFINITIONS

The National Institute for Occupational Safety and Health (NIOSH) defines IDLH as an exposure to airborne contaminants that is “likely to cause death or immediate or delayed permanent adverse health effects or prevent escape from such an environment,” e.g., smoke or other poisonous gases at sufficiently high concentrations. The Occupational Safety and Health Administration (OSHA) regulation (1910.134(b)) defines IDLH as “an atmosphere that poses an immediate threat to life, would cause irreversible adverse health effects, or would impair an individual’s ability to escape from a dangerous atmosphere.”

Both definitions provide a basis for a fire service program designed to ensure that firefighters entering IDLH atmospheres are adequately protected. IDLH values often guide the selection of breathing apparatus technologies available to workers or firefighters for specific situations.

But what does that really mean? Is it just about having the right equipment? Or do the rules determine when the equipment should be used? The answer is that the doctrine of IDLH requires that an entire system be in place to ensure that a firefighter will emerge from an IDLH atmosphere in full health. This is the essence of a calculated risk.

The NIOSH definition does not include oxygen deficiency (i.e., below 19.5 percent) although atmosphere-supplying breathing apparatus are also required in an oxygen-deficient conditions, e.g., high altitudes or unventilated, confined spaces.

The OSHA definition is arguably broad enough to include oxygen-deficient circumstances in the absence of “airborne contaminants,” as well as many other chemical, thermal, or pneumatic hazards to life or health (e.g., pure helium; super-cooled or super-heated air; hyperbaric, hypobaric, or submerged chambers). It also uses the broader term “impair” rather than “prevent” with respect to the ability to escape. For example, blinding but nontoxic smoke could be considered IDLH under the OSHA definition if it would impair the ability to escape a “dangerous” but not life-threatening atmosphere (such as tear gas).

The OSHA definition is part of a legal standard, the minimum legal requirement users must follow. These users or employers are encouraged to apply proper judgment to avoid taking unnecessary risks, even if the only immediate hazard is “reversible,” such as temporary pain, disorientation, nausea, or nontoxic contamination.

Where do we find an IDLH? There are two answers: Wherever there is a fire, there is a possible IDLH; wherever there is a confined space, there is a possible IDLH. Hence every fire department, full time or volunteer, may encounter this condition, and so every firefighter must be prepared to enter that environment, expecting to come out alive. It also follows that every fire chief is responsible to ensure that all factors leading to a successful IDLH entry and exit are present, or entry should never be commanded. Most importantly, the organization and its individual personnel should be adequately assured that *all* of the elements for success are in place. This is the right of every firefighter. Although here we focus on the United States, every nation of the world uses SCBA for the same purpose. The difference is whether any statutory or regulatory requirements drive any and all of their components.

To highlight this criterion’s importance to the fire service, look at National Fire Protection Association 1404, *Standard for Fire Respiratory Protection Training*, Section 1.3.2: “The use of self-contained breathing apparatus (SCBA) shall always be assumed to be in an atmosphere immediately dangerous to life or health (IDLH) because there is no way to predetermine those hazardous conditions, concentrations of toxic materials, or percentages of oxygen in air that exist in a fire environment, during initial overhaul (salvage) operations, or other immediate emergency conditions involving spills or releases of chemicals or other toxic materials.”

DOCTRINE OF SCBA

It follows that if a firefighter is ordered to enter an IDLH atmosphere, the individual has some rights to be concerned about. There are four basic elements to the use of SCBA under IDLH conditions.

Every firefighter deserves the following:

1. Equipment that is properly designed for the anticipated conditions.
2. Proper training on that equipment and the physical fitness to wear it under stress conditions.
3. Proper leadership and supervision of fire crews under these emergency conditions.
4. Proper support and sustained operations for these crews until the unsafe conditions no longer exist.

Before even talking about the using SCBA, an agency should assess the risk of scenarios in which SCBA use is likely to be required. These will likely include, but not be limited to, structural fires, confined spaces, hazardous materials leaks, and perhaps even vehicular fires. However, this assessment should go even further to determine specific subcategories of such risk, such as single-family dwellings, multifamily dwellings, high-rises, tunnels, subways, underground vaults, and so forth. Pre-planning every kind of scenario that could require SCBA protection may result in a wide complexity of variation in the other elements of training, leadership, and support.

This model proposes that you consider all four factors to ensure that you have an adequate SCBA program to protect firefighters under all conditions. For example, training for entering a single-family dwelling has certain minimum requirements. But attacking a fire on the 30th floor of a high-rise may introduce different requirements in the remaining three components beyond just having the right equipment. For example, different types of emergencies may have different protocols. There may be your access and proximity to the problem may create different logistical requirements.

Properly designed equipment. Once, “state-of-the-art” meant a leather hood with a tiny canister that was pumped by hand. Thank God that is no longer true. But when is a technology “properly designed” for current use? The standards answer, if a breathing apparatus complies with an existing standard, it can likely be considered “state-of-the-art.” However, these standards are changed periodically; when that happens the older equipment becomes “existing non-compliant.”

The old equipment may not be of a proper design when donned by a wearer under current conditions. But the reality is that thousands of breathing apparatus in service right now “exist non-compliant.”

So, how often should a department reevaluate its equipment to determine its safe use? Today, three standards provide guidance in the area of SCBA. The first is NFPA 1852, *Standard on Selection, Care and Maintenance of Open-Circuit Self-Contained Breathing Apparatus, (SCBA)* (2008 Ed.). Section 1.1.1 specifies the “minimum requirements for the selection, care, and maintenance of open-circuit self-contained breathing apparatus (SCBA) and combination SCBA/supplied air respirator (SAR)” that are used for respiratory protection during emergency operations in environments where the atmosphere is IDLH, or could become oxygen deficient or IDLH. The scope of this document is focused.

Notably this document states in Section 1.1.2, “This standard shall not specify *requirements* for other respiratory protection program components of the organization, such as SCBA training, appropriate use of SCBA for operations, and breathing air quality as these program components are under the jurisdiction of other NFPA standards.” (Author’s emphasis.)

The second is NFPA 1981, *Standard on Open-Circuit Self-Contained Breathing Apparatus (SCBA) for Emergency Services*, (2007 Ed.). Section 1.1.1 specifies the “minimum requirements for the design, performance, testing, and certification of new compressed breathing air open-circuit self-contained breathing apparatus (SCBA) and compressed breathing air combination open-circuit self-contained breathing apparatus and supplied air respirators (SCBA/SARs).”

It also addresses the requirements for the replacement parts, components, and accessories for these respirators. A very significant statement that is made in the scope of this document (Section 1.1.7), “It shall be the responsibility of the persons and organizations that use compliant SCBA and combination SCBA/SARs to establish safety and health practices and to determine the applicability of regulatory limitations prior to use.” The document says in section 1.1.8, “This standard shall not be construed as addressing all of the safety concerns, if any, associated with the use of this standard by testing facilities. It shall be the responsibility of the persons and organizations that use this standard to conduct testing of SCBA and combination SCBA/SARs to establish safety and health practices and to determine the applicability of regulatory limitations prior to using this standard for any designing, manufacturing, and testing.”

NFPA 1500, *Standard on Fire Department Occupational Safety and Health Program*, (2007 ed.) recognizes that SCBA practices cannot be taken for granted. It addresses in Section 76.14 the need for assuring that equipment be inspected frequently and that a fire agency has an obligation to conduct a “risk assessment process that shall incorporate standard operating procedures to identify those situations in Section 7.14.6.” In this case it is referring to having proper procedures to protect firefighters when refilling cylinders under emergency conditions.

The last example is NFPA 1989, *Standard on Breathing Air Quality for Emergency Services Respiratory Protection*, (2008 Ed.). This standard specifies the requirements for the “breathing air quality” component of the respiratory protection program required by NFPA 1500. The critical guidance provided helps protect fire and emergency services personnel during fire

fighting, rescue, hazardous materials, and special operations where respiratory hazards can or do exist.

The overall impact of these Standards and the real world is that at any time your breathing apparatus may or may not be in compliance with the current standard and it is your responsibility to know how the differences can impact operations on the fireground.

The users, the evaluators, and the manufacturers are constantly researching the function of this equipment, which can result in newer equipment having greater capabilities that older generation equipment lacked. Right now, an intensive project is underway to create a new generation of SCBA that will outperform its parental predecessor.¹

Over the last decades, several collateral devices breathing apparatus devices have emerged, e.g., the rapid intervention team and the universal air couplings and the personal alert safety system (PASS).

Older PASS devices required firefighters to manually arm it prior to entering a dangerous environment, but the current application integrates the PASS device into the SCBA so that it is automatically armed when the air supply is engaged or when the SCBA is removed from its mounting bracket. These battery powered devices are easily activated while wearing gloves, and are intrinsically safe to operate in flammable or explosive atmospheres.

When activated, according to OSHA standards, which apply in the United States, the PASS device emits a high-pitched audible alert of at least 95 decibels. On a fireground, the sound of an activated PASS device indicates a true emergency and results in an immediate response to rescue the firefighter(s) in distress.

However, these features have not erased the basic issue of firefighter safety and accountability, nor has this technology prevented events from injuring and killing firefighters. That is why a truly comprehensive system needs several more components to create a safe work environment.

Proper training. Purchasing sophisticated equipment requires sophisticated training. In general, the fire service regards SCBA training as an entry-level rookie task. The reality is that firefighter's need breathing apparatus training throughout their careers. The Europeans seem to think that we in the United States do not train adequately on our breathing apparatus. It's not just about how hours we devote to donning masks. It's about developing an entire skill set that will ultimately allow an SCBA wearer to save his life by overcoming failures and entanglements and knowing his limitations with breathing apparatus.

Several good programs on training requirements are available for firefighters even at the smallest department level. Again, NFPA standards include minimum performance requirements at the entry level. As individuals proceed through the remainder of their careers, becoming company and chief officers, wearing breathing apparatus under emergency conditions does not go away. Yet most training programs are aimed almost entirely at entry-level firefighters. A truly comprehensive program should incorporate every single person that may wear an SCBA under any emergency, even the fire chief. A comprehensive department training program should start with rookie training, but should also include annual recurring training for all members. Officers

need to know that to place their firefighters into hazardous situations with inadequate training may violate federal statutes.

The Firefighter's Close Call Web site www.firefighterclosecalls.com offers some of the best examples of this holistic training approach for download. These drills are simple but can be used repeatedly to maintain skill sets. The European fire service has gone so far as to create a subcategory of firefighter close calls for breathing apparatus scenarios at a site provided by a German fire organization www.atemschutzunfaelle.eu.

A secondary source of training is to review the NIOSH reports for firefighters who have died wearing breathing apparatus. Numerous case studies identify the strengths and weaknesses of the training and education aspects of wearing SCBA. For further information on this topic, visit the NIOSH Web site, www.cdc.gov/niosh/fire/.

Physical fitness. Adequate training using top-notch equipment is not of much value if you are overweight and physically unfit. This one factor cannot be overemphasized. A firefighter who remains in flaccid physical condition, expected to respond physically to extremely high-stress conditions, is a candidate for the Fallen Firefighter Memorial. There is no glory in dying of a heart attack when you haven't put the fire out. The International Association of Fire Fighters (IAFF) has put together an excellent program that helps maintain physical fitness from probation to retirement on its web site, www.iaff.org. Not providing firefighters with physical training is dangerous. Read the IAFF Dispatch focused on breathing apparatus.² The International Association of Fire Chiefs and the IAFF have joined forces to create a physical fitness program that can be adopted by any fire organization.³

Another emerging training factor is the use of biometrics. More and more fire agencies realize life signs (e.g., heart rate, blood pressure, vital lung capacity, and other characteristics) are indicators of physical limitations during an actual event. Moreover, biometrics also ties in with the concept air management as a component for baseline operations.

Proper supervision and accountability. Our third doctrine statement is that fire crews should be properly lead and supervised under emergency conditions. It is absolutely essential that firefighters be restrained from freelancing and that they conform to incident command protocols. In this case, the chain of command is also a chain of accountability and responsibility. Any SCBA program that lacks adequate command and control structures and fails to address accountability could compromise the safety of every firefighter on the fireground. Although there are several different incident command models a department could adopt, having no system at all is intolerable. The more comprehensive SCBA programs have high degree of personal accountability built in between the company officer and the firefighter. The chain of command also emphasizes the role of the incident commander the safety officer in ensuring that "everybody goes home" is more than just a set of buzz words.

The air management concept is entering the area of supervision and accountability. A textbook on this topic is clearly as much of a safety factor as previous forms of air monitoring.⁴ If a department lacks air management policies and procedures; it is encouraging its firefighters to

reach potentially very dangerous thresholds. Any department without an air management or rehabilitation component in place is deficient in planning for SCBA operations.

Properly supported to sustain operations. Our last doctrinal statement is that fire crews must be properly supported and their operations properly sustained until the unsafe conditions no longer exist. Once a decision is made to enter for firefighters to enter an IDLH atmosphere and to rely on SCBA, the equipment must be supplied and supported or the operation will fail. The manner in which operations are supported is every bit as important as starting the operations in the first place.

Firefighter fatality case studies in NIOSH’s Firefighter Fatality Investigation and Prevention Program confirm that failure to adequately supply air has had serious consequences.

In the past, the manner of sustaining adequate air cylinders on the fireground ranges all the way from the most primitive where the only bottles available are whatever the crews brought by hand up through various levels of manual delivery systems (including apparatus with contain mobile air compressors) and the imposition of a cache room requirement, and other techniques for complex structures such as high rises and tunnel fires.

Modern technology now allows us to sustain operations in some structures through a “standpipe for air.” Breathing air is supplied to a building or confined space in the same fashion that fire flow is now provided by a building standpipe. The firefighter breathing air replenishment system follows this concept by using steel tubing that is installed from the ground level to the top of the structure. The end result is having the ability to supply air continuously until conditions have been reduced to normal.

Summed up, all of the above indicates that SCBA is not just a piece of equipment. It is an entire doctrine of beliefs that must be reviewed and updated often and critically. In Figure 1, Doctrine of SCBA Evaluation offers questions your agency should ask itself to determine its level of belief in the concept.

The design of self-contained breathing apparatus has undergone constant innovation and will become even more sophisticated in the future. Fire departments acquiring this new technology must fully understand that purchasing this sophisticated equipment does *not* make a safe firefighter, nor do extensive training programs or certification processes. The community risk factors require that all four of the components of an SCBA program be present 100 percent of the time. Omitting or allowing any one of the four components to deteriorate compromises the full implementation of the doctrine.

A comprehensive system should resemble a continuous quality improvement program. Risk drives design, design drives training. Training encompasses physical fitness. Once training is established, it must be executed under command and control that assures accountability. Finally, the system must support until the atmosphere is normal. Each year, a department that adopts this doctrine will implement changes to make their firefighters safer, more effective, and more efficient in the long run.

There is actually a fifth “right” increasingly recognized by in leadership: The right of every firefighter to go home at the end of his tour of duty. As Chief Jeff Meston of the Novato (CA) Fire Protection District once put it, “Every firefighter deserves a round trip, and to that end we must constantly remind ourselves that the life of a firefighter is far more valuable than any forest or structure they may be asked to protect.” It is up to the leader of every organization to assure that the first four rights are protected and the fifth one will occur naturally.

Figure 1. The Doctrine of SCBA Evaluation

To evaluate how closely your department complies with the Doctrine of SCBA, answer to the following questions.

1. Has your fire agency adopted all of the following National Fire Protection Association standards?
 - NFPA 1404, *Fire Service Respiratory Protection Training.*
 - NFPA 1500, *Standard on Fire Department Occupational Safety And Health Program*
 - NFPA 1852, *Standard on Selection, Care and Maintenance of Open-Circuit Self-Contained Breathing Apparatus (SCBA)*
 - NFPA 1981, *Standard on Open-Circuit Self-Contained Breathing Apparatus (SCBA) for Emergency Services*
 - NFPA 1989, *Standard on Breathing Air Quality for Emergency Services Respiratory Protection*
2. How many SCBAs does your department own?
3. Are they all from the same manufacturer?
 - a. How many from one manufacturer?
 4. How many from a second manufacturer?
5. How many replacement bottles does the department maintain?
6. How many SCBA bottles are maintained in locations outside the fire department, e.g., in high-rise equipment rooms?
7. What maintenance program is there for these bottles?
8. Are the written specifications and the purchase on file for each breathing apparatus purchased with the date of purchase?
9. For each breathing apparatus, is there an inventory and maintenance record?
10. Is there a designated department’s liaison for SCBA-related matters?
11. Does the department have a written policy on SCBA use and maintenance?
12. For which ranks that may be required to enter an IDLH as part of their duties, has the department adopted minimum training requirements, as per NFPA 1404?
 - Firefighter
 - Apparatus Operator
 - Company Officer
 - Battalion Officer
 - Division Officer
 - Chief of the Department
13. Has the department adopted an annual physical checkup to ensure that all firefighters conform to the minimum health and physical requirements to wear SCBA’s?

14. Has the department adopted a physical training exercise or fitness program to ensure physical capabilities when wearing SCBA?
15. Has the department adopted a rapid intervention team process for entry into an IDLH atmosphere?
16. Has the department adopted accountability processes and procedures at all levels of fireground command?
17. Does the fire training division review lessons learned from NIOSH and other case studies to reduce errors or omissions?
18. Does the training division participate in the Firefighter Close Calls program to identify potential flaws in policy, process, or procedure?
19. Has the department adopted an “All Out” policy and procedure to evacuate unsafe conditions?
20. Has the department adopted a “firefighter down” protocol?
21. Has the department adopted a rehabilitation policy or procedure?
22. Has the department adopted any form of “10-minute” rule for checking the status of companies engaged in interior fire suppression operations?
23. Has the department developed an adequate means of firefighter air replenishment so that interior operations can be sustained until control is achieved?
24. Do these policies and procedures address the need for mutual aid or deployment of outside resources?
25. Are there resources subsequent to the same planning considerations identical in all of the previous questions?
26. Does the fire department have an adopted policy, practice, or procedure to evaluate or critique all operations that require deployment of SCBA and the activation of rapid intervention teams on any incident?
27. Does the fire department have an adopted policy, practice or procedure that requires conducting pre-fire planning on major risks that could require deep penetration of fire crews wearing SCBA?
28. How often are SCBA replaced with newer technology?
29. Does the fire department have separate line items for the SCBA purchase and for SCBA maintenance?
30. Are technicians who work on repair and maintenance adequately trained and certified by the equipment’s manufacturer?
31. What which of the following systems is used to replenish air supply;
 - a. A fixed location in a fire station
 - b. A mobile vehicle assigned to events
 - c. A private vendor who responds when called
32. Does the department have on file a current copy of NFPA 1981?
33. Does the Department have on file a current copy of NFPA 1989
34. Does the department use any form of command exercise that deals with any of the following scenarios?
 - a. Buddy breathing
 - b. Actuality of RIC/RIT
 - c. Confined space
 - d. Disentanglement

35. Overall, how would you rate the proficiency of members of the department on wearing SCBA under stressful emergency conditions?
- Unsatisfactory, action is needed
 - Inadequate, major improvement needed
 - Average, significant improvements are possible
 - Better than ever, but further improvement is still possible
 - Outstanding
36. Overall, how would you rate your department's performance with the comprehensive use of SCBA doctrine?
- Unsatisfactory, action is needed
 - Inadequate, major improvement needed
 - Average, significant improvements are possible
 - Better than ever, but further improvement is still possible
 - Outstanding

Endnotes

- First field test of the new Flat Pack Firefighter SCBA held in Prince George's County, Maryland by the IAFF,*” *firefighterclosecalls.com*, www.firefighterclosecalls.com/news/fullstory/newsid/108093.
- SCBA Use and Medical Requirements*, IAFF Dispatch, www.iaff.org/hs/pdf/scbause.pdf.
- Fit to Survive*, IAFF Web site, <http://www.iaff.org/HS/FTS/ftsdefault.asp>.
- Gagliano, Mike; Phillips, Casey; Jose, Phillip; Bernocco, Steve. *Air Management for the Fire Service*, Fire Engineering, 2008