Fire Engineering

EMERGENCY AIR MANAGEMENT PREPAREDNESS and CONTROL IN STRUCTURAL FIREFIGHTING

By Lt. Mike Mason

In order to be prepared in air management skills individuals and departments need to take into consideration the grave and serious nature of SCBA's and the wearers of this very important tool of the fire service. Not only can we not function without it but without question we could not perform many of the aggressive offensive procedures without it let alone its life saving potential for both civilians and firefighters. The line of duty deaths relating to air management problems and misuse is undeniable with plenty of lessons learned throughout our long history when we were first introduced to them. An approximate decade before 2005 there has been many related deaths to firefighters caused by running out of air leading to asphyxiation. As we have progressed since then we have learned some hard lessons which have improved our relationship in creating sound air management skills and the importance in the accountability of those skills required by every individual within a fire department throughout their entire careers. Every department and its members by now should be providing an adequate air management program especially in the areas of training and skills related to the wearing and functions of SCBA within fire environments. The emphasis from the NFPA standard 1404 which is the standard for Fire Service Respiratory Protection Training tells us that a responsible effort in providing directives in the areas of training in creating an individual air management program be attained without question. The three top priorities that must be applied to the use of SCBA at structural fires are:

- **Individuals must exit an IDLH atmosphere before the consumption occurs of their reserve air supply.**
- **That a low air alarm when activated is notification to all members on the fire ground that that individual is consuming his or her reserve air supply.**
- **That the activation of a low-air alarm requires an immediate action plan for the individual as well as the team.**

These priorities when occurring may indicate that an individual could be in trouble or approaching the need for assistance through rapid intervention or worse in need of presenting and or providing a Mayday. ROAM which is indicated through the applicable text entitled Air Management For The Fire Service tells us that every firefighter should know how much air they have in their SCBA and to be able to manage that air so when they are approaching their low-air alarm status that they have enough air to exit the structure before its activation. It should be realized that even the new NFPA requirements will be requiring manufactures of SCBA to create a new reserve air alarm status at 33% requiring activation of low air alarms. This then emphasizes the importance that every firefighter be well versed in SCBA functionality as well as potential malfunctions. All air management programs should provide for dealing with emergencies and their potentials in SCBA operations. Providing training and accountability in the use of SCBA should be maintained to the level of 100% proficiency by each individual: in doing so we can enhance our capabilities and survivability at structural fires.

Training should relate to functioning with SCBA in high intensity environments that create high pressure situations which will help firefighters function in highly stressful situations which will improve the overall skills sets in using SCBA. Panic states can be easily arrived at when they involve someone's air supply and it will be their training that can direct panic into a methodical controlled event that will help a firefighter resolve or remove himself from a emergency situation involving his SCBA. Learning to function in emergency situations with SCBA involves many times a person's physical conditioning as well as his mental ability and state of mind. Firefighters and their training programs should create many forms of mask drills simulating malfunctions along with scenarios that put firefighters in compromising positions with their SCBA in getting into safe areas as well as attaining egress from structures. Firefighters should be trained in emergency check procedures and resolutions to their air management emergency even to the point of removing their regulators if necessary while breathing through their hoods or gloved hands while crawling either to a safe area or an egress point from the IDLH atmosphere for their ultimate survival. All air mask confidence drills should be conducted with a gloved hand simulating the worst of smoke and fire conditions. Solid training in air management skills installs high habitual performance levels which will be needed in high stress situations. Training firefighters with consistent mask drills provides more accurate reactions with less thinking which controls panic or least directs it into something manageable. This not only involves the actual SCBA emergencies themselves but also the training should provide for sound habits regarding air management on the entire fire ground at every fire or incident no matter how large or small. SCBA emergencies which include managing your air can present itself in many ways on the interior or exterior of any given structural fire. The aggressive fire attack as well as seeking out fire extension and overhaul carries with it potential dangers to firefighters and their air supply when working in and around IDLH atmospheres.

Breathing Smoke: Unrecognized Dangers

Without a doubt the American firefighter is an aggressive bread of men and women. At structural fires you can find us at one time or another being exposed to the products of combustion. There are countless situations where the wearing of our face pieces with connected regulators is not present while operating at structural fires, some are very brief moments during size-up or just before entering IDLH environments while others are perhaps longer moments when working on the inside during overhaul or seeking fire extension. Smoke and the off gassing at structural fires is a constant presence on the battleground of firefighting.

Every phase of fire from the incipient stage on through the growth and free burning stage to the decay stage and the extinguishment of fire in any one given stage produce smoke and its hidden dangerous contents. The fire service needs to require a new drastic review of its members and their exposure to smoke at structural fires. New studies and revelations along with smoke chemistry reveals smokes lethal aspects to not only civilians but firefighters and the new found warnings of what's in this stuff that can kill within minutes as well as what it can contribute to in later deaths over time either through pulmonary problems and cancers. We need to improve our attitudes and culture regarding exposures to smoke and reinforce the importance in using and applying respiratory protection through on air usage with our SCBA. This along with knowing that the on-air application should be applied more often than not even with the slightest amount of smoke presence as well as the presence of off gassing within or around any structure during a firefight and its aftermath. We must incorporate these realizations as part of our air management skills. Within our history and right to present that we are in smoke so much that we consider a whiff of the stuff as a routine unavoidable occupational nuisance. The American fire service need s to not only addresses the immediate and obvious dangers from smoke but also its affects on the long term to firefighters.

The New Threat in Smoke: Cyanide Exposures

Ever since a study and an investigation into an incident in March of 2006 with Providence Rhode Island Fire Dept. in which several members were reported to have had exposures and tested levels of cyanide in their blood due to working at structure fires throughout a given 24 hour period it became apparent that further investigations in general was and is now warranted throughout the fire service. It is now known that exposures to cyanide at structural fires is more prevalent then first suspected and that many within the fire service to this day are unaware or have not received information regarding the seriousness of its presence at structural fires. It is now also known that even in training fires within burn towers whether concrete or metal

utilizing class “A” materials such as wood pallets and straw that the presence of cyanide gasses has been recorded in which the levels even in these environments are too high. Throughout our careers we are warned and taught about the presence of hydrogen cyanide as being one of the products of combustion at structural fires and automobile fires but until the incidents in 2006 we had no idea how prevalent and to what degree we were breathing in this compound while we were working even for short periods of time intermittently with our face pieces off and on at any given fire.

With the information we have now it is time for the fire service to include within their training parameters the serious awareness to firefighters about products of combustion and the detrimental exposures to cyanide as the prominent off gas in firefighting even superseding the well known presence of carbon monoxide. Departments should now be utilizing the latest in technologies in cyanide detection equipment along with a heavy concentration in mandatory mask wearing regulations at fires, air management accountability and testing for inhalation exposures and injuries to firefighters. Cyanide exposures to firefighters are occurring at alarming rates some we know about but there are far more occurring even as we read this text that are not detected or reported until the ill effects short term and long term are discovered. Firefighters and their departments by now should be passing the word on the exposure to this deadly gas and its presence at all fires and that enforcing the member to his right or his left is wearing mask protection at structural fires even in many cases well after the fire is out whether it be interior or exterior in regards to its potential presence.

WE have clearly seen throughout the past few years and up to the present firefighters performing tasks while not wearing their masks and being on air. We especially see these tasks during roof ventilation operations and during overhaul while many times heavy smoke conditions are swirling around them or smoke rising from off gassing of materials drifting and hanging in the air as they work with their masks hanging off to the side. These activities and actions are still common place at all structural fires without a doubt and this is why it is imperative that we change the culture of our actions. We should be asking for and developing much stronger standards within our air management programs in addressing these behaviors. Scientist and the several studies conducted through various organizations have proven time and again that modern day construction and insulating materials are now producing extremely high levels of cyanide in fire smoke. Eating smoke should be and is no longer acceptable within the modern day fire service. Many NIST studies have also proven the presence of different ranging levels of hydrogen cyanide in fire smoke through almost every given material either bought or used in construction in building homes and their contents within. The data collected from all these studies whether from NIST or organizations like the Swedish National Testing Research Institute (SNTRI) have all revealed positive results that prove that hydrogen cyanide is a major contribution within fire smoke in all structural fires whether residential, assembly or

commercial. Anything before, during and after fires that is pyrolyzing and flaming produces emissions of hydrogen cyanide along with prominent other gases such as the well known carbon monoxide gas. Whether the materials contained therein have contents of wool, nylon, polyurethanes, rubber or other plastic compositional make-ups it is now a known fact that these substances under fire produce high quantities of hydrogen cyanide along with carbon monoxide. The facts also reveal that the common carbon monoxide along with hydrogen cyanide is such a deadly cocktail that we now know that hydrogen cyanide is 35 times more toxic then its counterpart carbon monoxide at structural fires.

Firefighters are constantly working within fire environments that produce incomplete combustion states from the early stages of fire throughout the growth of a fire which is constantly putting into the air combustions products while within these areas oxygen content is diminishing. The ever constant recycling of the products of combustion within limited ventilated structures during and many times after direct extinguishment provide for the increase of hydrogen cyanide and carbon monoxide possibly up to ten fold. Realizing many of these facts it is no wonder that civilians as well as firefighters in structural fires without SCBA protection become disoriented and incapacitated very quickly through just a few gulps of these products of combustion. We should remember that even our discussions her regarding hydrogen cyanide and carbon monoxide there are a host of other lethal gases in smoke many times with even higher contents than HC or CO that ride along within the smoke. Think of the many building materials and pre-manufactured products put into homes with the predominate materials such as plastic and adhesives comprising almost everything imaginable within the construction of a home down to all of its contents. They all under fire conditions are off gassing into the smoke any and all unknown cocktails of carcinogens that we breathe in when our air mask is dangling off to the side even when we think the fires have long since dissipated. The bottom line is that with the conglomerate of the presence of all these gases along with the concentrations of carbon monoxide should be included in producing the toxic effects that our firefighters are exposed to during fire ground operations at structural fires. The amounts of cyanide along with all the gasses produced at fires varies from fire to fire as well as their locations and confinements while also taking into consideration ventilation aspects and compositions of burning materials should influence our air management practices.

The Need for Air Management

As much as we have learned about the severities and need for air management firefighters are still running out of air at structural fires. This fact also incorporates many close calls, many of which are not reported. A recommended text that has helped in understanding the need for firefighter air management is the informative book entitled “Air Management for the Fire Service by Gagliano and Bernocco from Seattle F.D. We are just learning now as well the long

term affects debilitating firefighters on and off the job such as cancers and respiratory diseases which are directly linked to either line of duty deaths or not wearing their air masks periodically throughout their careers. It goes without question that probably every firefighter within the American fire service has been exposed to smoke and has on several occasions breathed the smoke and the gasses and particles of incomplete combustion within the smoke at structural fires and even more frequently at training fires. The obvious ones reported as line of duty deaths reveal the attributions and causes as asphyxiation, thermal burns, cardiac arrest and unconsciousness all as a result of exposure to smoke and fire. At structural fires what appears to be routine for our brothers in battle many times turns deadly in seconds shortly after our arrival.

- **Extreme Temperatures/Flashovers/Rollovers/Smoke Explosions/Backdrafts.**
- **Asphyxiating atmospheres/mask removals/unknown oxygen deficient environments.**
- **Caught in structural collapse/running out air/dislodged masks/unconsciousness.**
- **Explosive atmospheres/unconsciousness/dislodged masks.**
- **Entanglements and entrapments/depleted air supply/asphyxiations.**

New NFPA guidelines within NFPA 1404 are emphasizing the need for stricter requirements in the areas of providing respiratory protection training programs while also requiring departments to enhance their procedures in air mask usage during fire suppression, overhaul and rescue related tasks conducted at these incidents. NFPA 1404 is also quite clear in emphasizing that departments provide a management program as well as training in an individual air management program making clear the importance in the ability of an individual to manage his or her own air consumption. Knowing how much air is in your cylinder and being able to manage that air during suppression activities so you can exit preferably with a partner before your low air alarm activates is what all this is driving at. This idea is in direct correlation with NFPA 1404 in directing individuals and departments to operate within the Rule of Air Management (ROAM). It is no longer acceptable to allow individuals to work in IDLH environments consuming up to 75% of their air supply while leaving only 25% of their residual air supply left to exit a structure or an IDLH environment. What we have done in the past leaves little to operate in a margin of error that is simply not warranted. The following no air situations and their end results are the result of smoke, thermal insult, structural collapse partial or complete and getting lost and disoriented.

No-Air End Results

- **Toxic smoke leads to asphyxiation.**

- **Thermal insult resulting in respiratory burns.**
- **Structural collapse exceeding time limits of rescue efforts leading to asphyxiation.**
- **Lost/disorientation leading to depleted air supply contributing to panic and asphyxiation.**
- **Removal of mask after air supply depletion leading to exposure to toxic smoke.**

It is obvious that fire departments and their members will be more scrutinized regarding their liabilities. Everyone in the fire service from chief to rookie by now knows all too well that a 30 minute cylinder in no way reflects the actual working time a firefighter can draw upon his or her own air supply. The best practice is for fire departments and their members is to realize that the 30 minute cylinder truly only provides 16-20 minutes of working time. This again depends on the type of work or task being conducted and the physical conditioning of each individual member. The Rule of Air Management is a simple concept for all to understand.

Rule of Air Management:

Know how much air you have in your SCBA, and manage that air so that you leave a hazardous environment before your low-air alarm activates.

Even though this concept is simple to understand there are still firefighters that do not check their air supply before entering at structural fires as well as when they are inside during offensive procedures. The reason for many is that the original behaviors were many times based on working until the low-air alarm sounded which then turned your brain on to let you know it was time to leave or even worse for many old time behaviors that you could keep working for just a little longer. Because of this behavior many injuries and deaths were simply caused by time running out allowing the margin of error to be too great which ended in disastrous results. This type of behavior should now be eradicated within the fire service. Another aspect regarding operations when using SCBA by the individual was not routinely checking his air status during assigned tasks or a particular operation they were performing whether it is extinguishment, roof operations or search and rescue. Things would change in our favor with better outcomes if partners and crews would remind themselves of their individual and overall air supply status to assist in making sound decisions in realizing when it was time to exit. If we can grasp the concept of exiting a structure with our full reserve intact and available then we are better prepared while exiting for the unexpected such zero visibility contributing to possible disorientation or an unexpected collapse possibly causing our entrapment. This would allow for more air time available to those endangered while all out efforts are being conducted for rescue such as members from other nearby crews implementing the rescue effort as well as rapid intervention crews.

Fire Overhaul Activities

Another aspect of our responsibilities to the rules of air management is our present and past practices regarding overhaul after the main body of fire is extinguished. Firefighters continually are assigned overhaul duties shortly after the main suppression efforts at structural fires. We renter the structure opening up walls, pulling ceilings, checking attic spaces and a host of other activities related to insure that no rekindles will occur, this along with assisting in investigation methods while many times the presence of smoke and off gassing are occurring in compartmentalized areas. More often than not firefighters while performing these tasks are removing their face pieces many exposing themselves unknowingly to the byproducts of combustion. It is possible that in some cases an overhaul environment with smoldering debris and off gassing of particles can be just a dangerous as smoke and flame during fire attack.

Fire departments now need to realize the importance in establishing some type of overhaul or post fire condition air management policy emphasizing the importance for firefighters to continue staying on air in the majority of cases during overhaul, fire extension and fire investigations. When establishing these policies an important tool or piece of equipment to have is a 4-gas monitor that is programmed for common fire gasses most importantly hydrogen cyanide and carbon monoxide. For departments that may not have these monitoring devices it is better to error on the side of caution and implement air management procedures by insuring that firefighters are on-air during tasks involved in post fire conditions. It is now known that by products of combustion contaminates in post fire condition atmospheres has exceeded the limits of occupational health standards that were set by OSHA and NIOSH. The fire service and its members must fully recognize that even with little or no smoke present during post fire conditions that extremely toxic atmospheres can and usually are present during our activities in these types of environments. Further studies have proven that carbon monoxide levels do not necessarily correlate with the presence of other gasses. Many monitoring devices that departments are using may not be set up or have the ability to monitor certain types of toxic gasses especially the more deadly gas hydrogen cyanide.

Air Management, Fit Test and Air Consumption Rates

The importance in providing air management, fit testing and air consumption rate exercises should be in the forefront of every fire departments policies and procedures. In order to accomplish this every fire department should hold accountable its training division and or designated training officer, by doing so we can better educate firefighters in the use of their

SCBA and its limitations. The prominent areas of training and education in accordance with guidelines such as NFPA 1404 are:

- **SCBA manufacture recommendations and functions.**
- **Yearly fit testing of face pieces.**
- **Handling low air emergencies.**
- **Establishing exercises in air consumption rates.**

Realizing that exposures to byproducts of combustion is now no longer acceptable behavior by firefighters there is also the responsibility for firefighters to be physically and mentally fit to perform their duties in wearing one. Wearing SCBA's throughout a firefighters career also takes its toll because of weight factors and the limited ability to breathe normally due to the restrictions that induce the normal capacity to breathe regularly in normal atmospheric and daily life conditions. This along with increased strenuous activities and elevated heart rates over many years probably does take its toll eventually regarding the future qualities of life that other professions would not be exposed to.

Using the typical 30 minute cylinder with 4500 psi by firefighters throughout the American fire service we must address its true ability to provide a specific amount of air and time relationship for any given firefighter. It is now known to be unrealistic to think in terms of a 30 minute on air time for any given firefighter performing on the fire ground. The truer reality when firefighters are involved in strenuous tasks, zero visibility compounded with stress, elevated respiratory rates and elevated heart rates is that the best we can hope for in a physically fit firefighter is an operating time between 12 and 16 minutes before low air alarm activations. All firefighters must truly respect and understand that while wearing their SCBA and being on-air and working in hostile environments that a direct path of exit or getting to a safe area within any given structure may change or be interrupted. When we add in the possibilities of disorientation, entanglements, collapses and fire ground tasks gone wrong we can see the importance of having acquired the critical skill of air management.

In order to begin acquiring sound principles and skills in air management firefighters need to know what their individual air consumption rate is. This is easier said than done because we cannot predict what the fire ground may impose in any given situation as well as ever changing contributing factors such as age and fitness variables throughout a firefighter's career.

Variables That Affect Firefighter Air Consumption Rates

- **Overall health and fitness.**

- **Age**
- **Task or activity**
- **Stress level**
- **Experience**
- **Cylinder size**

When providing air consumption drills and training we need to insure that when setting up these exercises that they are relevant to fire ground tasks and operations in structural firefighting. We must also be careful in how we record the results when conducting these exercises. Recording results include:

- **Working singularly or with a partner.**
- **Cylinders fully pressurized.**
- **Starting time when going on air.**
- **Working time before low-air activation.**
- **Starting time and completion time during low –air activation.**
- **Finishing time of depletion of the entire cylinder pressure.**

When setting up consumption drills and testing fire departments and their training divisions should utilize a sound working model that is task related to fire operations. A good working model is to design a repetitive set of evolutions that puts firefighters to work actually performing fire ground tasks. No more than 6 stations or tasks should be set up and repeated in a consecutive manner for any one consumption drill. There should be two types of consumption drills used the single firefighter consumption drill or the partnered consumption drill. Never run both on the same day. The single firefighter consumption is performed by one firefighter repeating the working stations where as the partnered consumption drill is shared by two firefighters performing the work at the six stations. The single firefighter consumption drill reveals to the individual his personal air consumption abilities and his physical condition. The two partnered consumption drill has recently become popular because it more closely relates to the American fire service concept that we will most of the time be working in teams of two. This type of consumption drill provides a bigger picture of possibly longer work times or where more energy is needed in performing a task such as pulling a charged hose line or searching. It does not provide for an individual personal evaluation of on-air time but more of a team on air time. Both types are extremely valuable to assess and benefit from for your members.

Whichever is performed it is important that those participating are performing the tasks at each station with a purposeful moderate to fast or hurried rate. It does little good for an individual to stroll or performed at a dogged pace because this reflects little to the fast paced demanding pace on an actual fire ground. We hear many times how an individual got 26 to 29 minutes out of a 30 minute cylinder when doing a consumption course and patting himself on the back when we know that on the fire ground you can throw that time out the window, it's simply not a relevant or true fire ground working time. Those that conduct themselves in this manner are only misleading themselves. Perform a consumption course with meaning and a hurried purpose which will reflect more about your abilities and your air usage providing you with a truer reality in your consumption rates.

There is one aspect regarding setting up and performing on a consumption course that is many times misconstrued and that is the time your low-air alarm activates until you run out of air. Many departments and their training divisions continue to have a firefighter whose low air alarm has activated still perform on the course repeating the stations till he runs out air and then recording the time from low air alarm till cylinder depletion. This should be considered unrealistic. A more improved method should be considered because this is where the firefighter is to maximize conserving air as to reflect that he has activated his low air alarm either by not managing his air correctly or that something has prevented him from exiting the structure. This is where the firefighter needs to slow down planning every move while concentrating on his breathing techniques to conserve and make the residual left in the cylinder go on as long as possible. The most important fact for any firefighter is in knowing "how long can I go and how much can I do and can I conserve my air long enough given the situation I am in to get to a safe area". In order to provide for a more realistic portion of any given consumption course is to create a section on the course that is used strictly for survival activities. When the firefighter is on the main consumption course and his low-air alarm activates he should be brought over to this pre set area that strictly deals with survival actions. The following is a listing of activities set up as a separate module just off and a few feet away from the main consumption course. A separate member is stationed there just to facilitate the tasks or actions along with recording the low-air alarm activation time to full cylinder depletion time of the firefighter being tested.

Low-Air Alarm Survival Mode Module

- **Breaching a wall stud simulator going through to a safe area.**
- **Calling a Mayday**
- **Following a hose line (recognizing couplings)**
- **Navigating entanglements**

- **Skip breathing or control breathing techniques.**

The above list should incorporate some or most of these actions while also considering that the firefighter towards the end of depletion time should probably resort to the least amount of actions except possibly radio communications in order to get the most time out of his air supply. The time of low-air activation to complete cylinder depletion is one of the most personal and valuable piece of information to a firefighter when practicing this type of training. Below is a training example of a 7 station module as part of an air consumption course.

7 Station Air Consumption Course Model

Start/Cycle Repeat/Once low-air alarm activated move FF to survival mode module listed above.

1. **Raised 4x4 walkovers**
2. **Crawling through 12 ft Sona Tube minimum of 42 inch diameter.**
3. **Civilian Manikin Drag 50ft**
4. **Advancing a charged line 75ft.**
5. **Raising an extension ladder/positioned and climbed with a tool.**
6. **Chopping or battering with an axe or a mall.**
7. **Carrying a horseshoe load 100ft 1 ¾ up and down a flight of stairs.**

Another important aspect of air management for the firefighter is the monitoring of his SCBA pressure gauge which reads in psi and is recommended that this pressure gauge be within 100 psi of the main cylinder pressure gauge. Depending on the manufacturers these pressure gauges can be designed in an analog format or a digital read out format. The newer digital read out gauges provide a more accurate digital number then their analog counter parts. Both gauges are usually back lit to see them though the digital gauges many times are more difficult to read as well as their digitals numbers to be misinterpreted in zero visibility environments. There are also more electronics incorporated into these pressure gauges along with all the other components in the alerting and pass device systems. Failures of the electronics are rare but have been reported as well as fewer failures in the analog types. Many firefighters and their respective departments prefer the analog type because they are based more on mechanical function along with a more visual image of the actual gauge which through its back lit component is more easily visible in zero visibility environments and when quickly looked at with a firefighters flashlight can be more easily interpreted. This along with additional systems in both types also providing heads displays indicated by color changes letting the firefighter know

when he is approaching is low-air alarm status. Heads up displays may vary widely regarding the true reserves left in a cylinder which is why it is more important for a firefighter to monitor his pressure gauge for better accuracy. Whichever type of pressure gauge is used by the individual firefighter the importance of monitoring these gauges is a firefighter's firm responsibility while ignoring them is careless and jeopardizes not only the individual but those also working alongside each other in an IDLH environment.

In order to enhance the rules of air management especially in larger structures it is highly recommended that some type of safety officer or entry officer be assigned to oversee certain tasks and functions such as in search operations and high rise operations. It may also be advisable to assemble a team of firefighters that have available a cylinder of increased capacity such as a 45 minute supply instead of 30 minutes for large area searches. Never mix cylinder sizes within a team on the fire ground especially when they are committed to large area search assignments. With presence of a safety officer or entry officer we can better monitor teams and individuals while working in these types of structures insuring their air times as well as their reaching their point of no return and the need for egress when it is time. Safety and entry offices must know certain factors before members enter these structures as well as monitoring consumption rates while they are in these structures working. The following are list of concerns that need to be addressed by a safety or entry officer when they are available at these assignments.

Safety or Entry Officer Control Responsibilities

- **Ensure all members are in proper PPE.**
- **Ensure all members are clear as to the specific assignment.**
- **Ensure all members have a completely functioning SCBA**
- **Ensure all members have the same size cylinders**
- **Record all members main valve cylinder pressure**
- **Ensure the presence of a RIT air pack.**
- **Record the teams overall in and out time based off of the lowest members cylinder reading. (Recommended never to allow any firefighter to enter with a team if the difference is more than 10% deficient from the main cylinder pressure). (Example 10% of a 4500 psi cylinder 450psi/4500-450 is 4050psi).(Example 10% of 3800psi is 380 psi/3800-380 is 3420 psi).**

- **It is not recommended that an individual firefighter as part of a team not be allowed to participate in large area searches with less than 3800psi in a rated 4500 30 minute cylinder. 3800 psi is the working time applied to the team.**
- **When in doubt of individual air consumption rates resort to applying the rule of 10's or the rule of thirds to the individual as well as the entire team.**

When utilizing the above listing we can better control and asses appropriate times for getting in and getting out while ensuring that upon exit there is reserve air left in any one individuals air supply. Using the rule of tens or the rule of thirds is one of the most basic employments of controlling and monitoring a team's air supply. Simply put it takes 10 minutes to get in and get there and task while it takes 10 minutes to exit while also leaving ten minutes for the unexpected. We can rob Peter to pay Paul so to speak depending on conditions and what tasks are facing the team but only through careful air management control. By being conservative we can improve our odds. This along with intermittent notifications to members on the interior regarding the amount of minutes being used during tasking will better help the interior firefighters and also remind them to continue to monitor their pressure gauges which in turn can help them regulate their usage of air. It should be fully realized that the best accountability in air management is the individual firefighter's ability in knowing his physical conditioning and his air consumption rates through proactive training before ever entering an IDLH environment.

There are many other considerations regarding air management for individuals and their departments. Learning some form of skip breathing method is important and should be utilized by firefighters during structural firefighting when necessary. An individual firefighter must learn to conserve air not only during an emergency or Mayday but also while tasking on the fire ground. By doing so you are disciplining yourself to maintain your emergency reserve which is when your low-air alarm activates. Learning techniques in skip breathing can many times provide a firefighter going the distance on air sometimes reaching 30 minutes of air time from a 30 minute bottle. Although this would never be recommended practice but if you had gotten into trouble it would give considerable more time for RIT's or nearby rescuers to relieve you of your situation. Firefighters know they are performing good air management skills at fires when they are exiting from their tasks and the structure before a low-air alarm activation, this is sound discipline which in turns improves the safety of all. When a firefighter exits the structure the questions posed to many departments is can they go back in if they simply change out their cylinders? This comes down to establishing standard procedures and accurate accountability measures when allowing firefighters to cycle back into the firefight. Many departments provide for 2 cycles of work and then a cycle of rehab which according to NFPA and other governing agencies is a must at all working incidents. These guidelines should be applied to both the

duration of interior aggressive actions all the way through overhaul activities to their completions.

Additionally many departments are considering going from 30 minute cylinders to 45 minute cylinders which will give a greater working time while ensuring a better managed reserve time. It should be noted that the new standards for all manufactured SCBA's is that low-air activations are now moved to 33% to your low-air alarm activation no matter what size cylinder you are using. When considering going to 45 minute cylinders additional weight and size can be a concern. Questions remain regarding these issues. Increased weight can work individuals harder while increased size may diminish individual mobility in navigation in certain environments both may induce increased consumption rates which can diminish the benefits in gaining the extra minutes of air. No matter what size cylinder being employed all things become relative regarding air consumption to the low –air alarm activation at 33%.

Other issues to consider regarding managing your air supply is the use of SCBA's providing heads-up displays which to provide us a visual alert in zero visibility environments through the use of a series of color coded lights. These displays are designed off of basic colors meaning that green means you have a good supply of air, while yellow means you're probably approaching 50% usage or at the end of it while red means you are using or about to use your 33% reserve. These features are not as accurate as some might think and the wide range of variances and percentages in relation to the actual residual air within a cylinder when viewing these displays may vary. It is more valuable for firefighters to look at their pressure gauge which may provide a more accurate summation of your air supply throughout your maneuvers. Other features provided by manufacturers are buddy breathing systems. Be careful with the use of these systems, these are truly systems made available by manufacturers that are a last ditch effort for you and your partners survival. That should never be relied upon or be thought of as part of managing your air. Most of these systems utilize 2 members breathing off one bottle which greatly diminish the chance of rescue and survival. Some manufacturers even boast that you can hook up an additional firefighter or more within the system which is ludicrous thinking that 2 firefighters breathing off one bottle of air could be raised to 3 or 4. These types of behaviors need to be realized for what they are which is almost impossible to accomplish in near zero visibility, with glove hands while also maneuvering through a structure possible breaching to get into a safe area or to an exit. Don't riley on these concepts instead learn to manage your air and train extensively in acquiring the skills that will save you and your partner's life through sound air management practices.