Fire Ground Survival

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Section IV - Technical Operations

Part 1 - IAFF Fire Ground Survival Manual - Second Edition

With permission from the IAFF, The SDFD has adopted in its entirity the IAFF Fire Ground Survival Manual.

Part 2 - SDFD Fire Ground Survival Skills & Procedures

Revised - February 2023

Preface

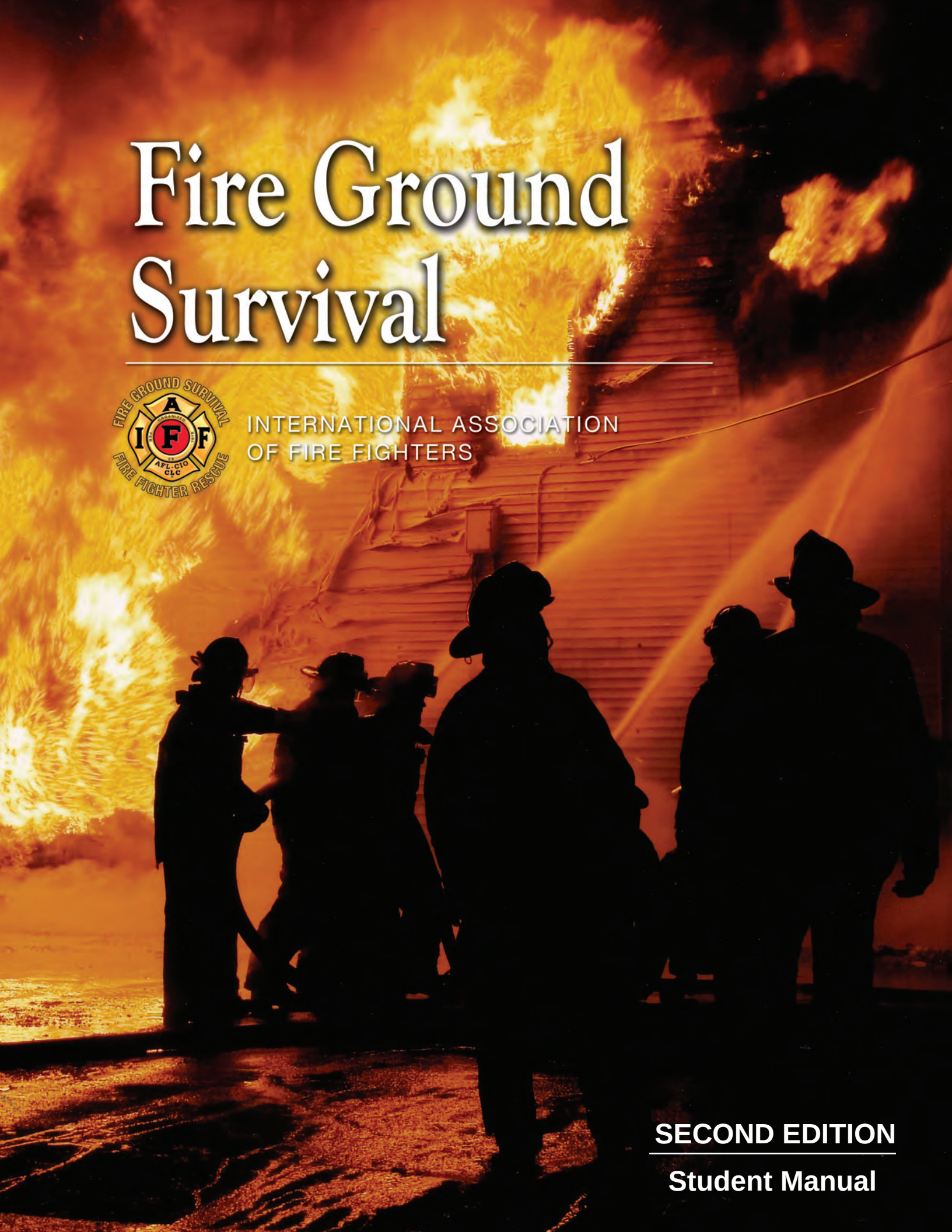
Part I - IAFF Fireground Survival Training Manual - Second Edition

With approval from the IAFF, the SDFD has adopted the entire Fireground Survival Training Manual as our curriculumn. This allows our training and performance to be consistent with the industry standard and utilizes an extensive field of subject matter experts.

Part II - SDFD Fireground Survival Skills & Procedures

Due to subtle differences in department specific equipment, PPE, and policies, Part II addresses the slight variations that exist within our department and the execution of the IAFF Fireground Survival Skills and Procedures.

Fire Ground Survival



INTERNATIONAL ASSOCIATION
OF FIRE FIGHTERS

SECOND EDITION

Student Manual

This program was developed by the International Association of Fire Fighters, Division of Occupational Health, Safety and Behavioral Wellness in cooperation with the International Association of Fire Chiefs.

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PREFACE

There is no other call more challenging to fire ground operations than the MAYDAY call—the unthinkable moment when a fire fighter's personal safety is in imminent danger. Fire fighter fatality data has shown that fire fighters becoming trapped and disoriented represent the largest portion of structural fire ground fatalities. The incidents in which fire fighters have lost their lives, or lived to tell about it, have a consistent theme—inadequate situational awareness put them at risk.

Fire fighters don't plan on being lost, disoriented, injured, or trapped during a structure fire or emergency incident. But fires are unpredictable, volatile, and ruthless – and they will not go according to your plans. What a fire fighter knows about a fire before entering a blazing building may radically change within minutes once inside the structure. Smoke, low visibility, lack of oxygen, combustible and explosive gases, structural instability, and an unpredictable fire ground can cause even the most seasoned fire fighter to be overwhelmed in an instant. It's not a matter of IF the Mayday happens, it's WHEN!

The guiding fire service philosophy for decades has been training for success—we teach how to put the fire out or mitigate other hazards and hope everyone goes home. What we failed to consistently do is drill for when failure does occur and without such training fire fighters do not have the practiced skills to rely on when they get into trouble.

This IAFF Fire Ground Survival (FGS) program is the most comprehensive survival skills and Mayday prevention program currently available within the fire service. Incorporating regulations and standards; proven incident management best practices; survival techniques developed by leaders in the field; and real case studies from experienced fire fighters, the FGS program aims to educate all career fire fighters to be prepared if the unfortunate happens.

From the first-in recruit to the experienced commanding officer, this FGS program provides all levels of fire department personnel standard, step-by-step tools to use if they become lost, disoriented, injured, low on air, or trapped; or are leading the rescue effort. We trust that you and your fire department will adopt and train to this life-saving program.

Fires will always be unpredictable and dangerous. We know our FGS training program will be the difference between life and death.

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INTERNATIONAL ASSOCIATION OF FIRE FIGHTERS

Fire Ground Survival Manual

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SURREY
FIRE
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INTRODUCTION
FIRE GROUND SURVIVAL

A Mayday exists when a fire fighter is in need of immediate assistance. There is no other call more challenging to fire ground operations than a Mayday. In these chapters you will learn how to prevent a Mayday and also how to manage and survive a Mayday.

INTRODUCTION

The need for a North American Fire Ground Survival Program is clearly evident. Fire fighter fatality data compiled by the United States Fire Administration (USFA) indicates fire fighters "becoming trapped and disoriented represent the largest portion of structural fire ground fatalities". The effectiveness of fire fighters is determined by how well they perform their duties while also maintaining a good measure of safety. Being safe in all situations is the goal for every incident. However, sometimes incidents do not go as planned. Often times there are unforeseen situations that arise that put fire fighters at risk.

Just as fire fighters prepare to fight fires successfully through the appropriate tactical deployment of resources, fire fighters must also prepare for the situation they hope to avoid. No fire fighter wishes to be lost, disoriented, injured or trapped during a structure fire. Fire fighter training must be focused on how to prevent these situations. However, all fire fighters must be prepared if the unfortunate happens.

Through the study of fire fighter fatalities and near misses we learn from past experiences. The reports from the National Institute of Occupational Safety and Health (NIOSH) Fire Fighter Fatality and Prevention Program and the National Fire Fighter Near-Miss Reporting System provide the fire service with learning opportunities. The incidents presented within each program can teach fire fighters how to avoid Mayday situations while also providing information on how to manage them.

The incidents where fire fighters have lost their lives, or where they lived to tell about it, have a consistent theme. NIOSH investigations have discovered that many fire fighters who have perished due to being lost, trapped, or running out of air, has been the result of inadequate situational awareness. The Fire Ground Survival Program includes training material to improve situational awareness so a Mayday is prevented.

This program also contains fire fighter survival techniques from leaders in the field from the United States and Canada. The techniques represent best practices from experienced fire fighters from progressive fire departments. Much of the training material within the program is currently in use in many fire departments throughout North America.

The comprehensive Fire Ground Survival Program aims to educate all fire fighters. Fire departments wishing to take advantage of the training can host a four-day training exercise at their training facility. These exercises are taught by IAFF Fire Ground Survival instructors. Refresher training is also offered on-line to all fire fighters through the IAFF's website.

The Fire Ground Survival Program is the most comprehensive program currently available within the fire service. However, the program can only save fire fighter lives if fire departments choose to use it. ■

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BACKGROUND
HISTORY OF FIRE GROUND SURVIVAL

BACKGROUND

LEARNING OBJECTIVES:

After reading this chapter students will be able to:

- Describe the changes since World War II that have affected fire fighting attitudes, practices, safety and survival.
- Identify the sources of fire ground survival policy.
- Describe the findings and implications of line-of-duty death investigations by National Institute of Occupational Safety and Health (NIOSH) and United States Fire Administration (USFA).
- State the current standards for company staffing.
- Summarize line-of-duty death trends.

BACKGROUND
HISTORY OF FIRE GROUND SURVIVAL

Fire ground survival has been an issue for as long as fire fighters have conducted offensive fire suppression operations. For the past 200 years, the dangers that fire fighters were exposed to have been considered part of the job. Risks of death and injury were what fire fighters were paid for. Protection of property was considered more important than the safety of fire fighters.

Since World War II, this attitude has changed. The risks of firefighting have been reconsidered, as have the economic costs of fire fighter injury and death. The safety engineering profession was created and has grown; fire departments have faced litigation for unsafe work practices; the creation and regulations of the Occupational Safety and Health Administration (OSHA) have mandated changes.

The moral and legal priorities of fire fighting strategies and tactics have been defined. Protection of life is the highest priority of fire fighting, and this includes the lives of fire fighters and the people they serve. Fire containment is the second priority of fire fighting. Property protection is now the last priority of firefighting strategy and tactics.

Over the past 20 years, fire fighting practices and procedures have been analyzed, and fire ground dangers have been identified and classified according to risk. This effort has led to a new understanding and insight into fire fighter safety and survival.[1] According to the National Fire Protection Association (NFPA) 1500 Standard on *Fire Department Occupational Safety, Health, and Wellness Programs*, "The acceptable level of risk is directly related to the potential to save lives or property. Where there is no potential to save lives, the risk to the fire department members must be evaluated in proportion to the ability to save property of value. When there is no ability to save lives or property, there is no justification to expose fire department members to any avoidable risk, and defensive fire suppression operations are the appropriate strategy." [1, 2]

Federal regulations such as the following have been the driving forces in improving the safety and health of fire fighters on the fire ground:

- The *OSHA Respiratory Protection Standard*, Title 29, Code of Federal Regulations, 1910.134
- The *OSHA Fire Brigade Standard*, Title 29, Code of Federal Regulations, 1910.156

Related National Fire Protection Association (NFPA) consensus standards including NFPA 1404 *Standard for Fire Service Respiratory Protection Training*; NFPA 1500 *Standard on Fire Department Occupational Safety and* Health Program; NFPA 1561 Standard on Emergency *Services Incident Management System*; NFPA 1981 *Standard on Open-Circuit Self-Contained Breathing Apparatus (SCBA) for Emergency Services*; and NFPA 1982 *Standard on Personal Alert Safety Systems (PASS).*

The National Fire Protection Association (NFPA) is a nonprofit organization that creates consensus standards for all aspects of the fire service. Standards related to the fire ground include:

- NFPA 1407 Standard for Training Fire Service Rapid Intervention Crews
- NFPA 1410 Standard on Training for Emergency Scene Operations
- NFPA 1500 Standard on Fire Department Occupational Safety, Health, and Wellness Programs
- NFPA 1710 Standard for the Organization and Deployment of Fire Suppression Operations, Emergency Medical Operations, and Special Operations to the Public by Career Fire Departments

All NFPA standards can be viewed via their free access website (http://www.nfpa.org/Codes-and-Standards/All-Codes-and-Standards/Free-access)

FIRE GROUND SURVIVAL POLICY

At present, consolidated information on fire ground survival and relevant fire ground survival training does not exist in one location. As noted above, a number of OSHA regulations and NFPA consensus standards identify components of fire ground survival issues, such as personal protective equipment and clothing, radio communication, RIC's, and the need for proper training. For example, NFPA 1404 *Standard for Fire Service Respiratory Protection Training* Paragraph 5.1.5 requires fire departments to train fire fighters on air management techniques so that the individual fire fighter will develop the ability to manage his or her air consumption while wearing a SCBA. NFPA 1404 paragraph 5.1.5.2 specifies that the individual air management program should include the following directives:

1. Exit from an IDLH atmosphere should be before consumption of reserve air supply begins.
2. Low air alarm is notification that the individual is consuming the reserve air supply.
3. Activation of the reserve air alarm is an immediate action item for the individual and the team.

Rapid Intervention Crews (RIC), deployed for the primary purpose of rescuing injured, lost or trapped fire fighters have been required by federal law (OSHA 29 CFR 1910.134(g)(4) *Procedures for interior structural firefighting* also known as the "2 in 2 out rule") since 1998. RIC's were first mentioned as a fire ground requirement in the 1992 edition of NFPA 1500. NFPA 1561 *Standard on Emergency Services Incident Management System* incorporates the requirement for a dedicated RIC crew.

NFPA 1561 also requires that all responders who are involved in emergency operations shall be trained in the incident management and personnel accountability systems to the anticipated level of their involvement.

The National Incident Management System (NIMS) establishes standardized incident management processes, protocols, and procedures that Federal, State, tribal, and local responders should use to coordinate and conduct response actions. With all responders using the same standardized procedures, they will all share a common focus, and will be able to place full emphasis on incident management when a homeland security incident occurs — whether terrorism or natural disaster. In addition, national preparedness and readiness in responding to and recovering from an incident is enhanced when all emergency teams and authorities are using a common language and set of procedures.

NIMS incorporates incident management best practices developed and proven by thousands of responders and authorities across America. Some of the key features of NIMS include Incident Command System (ICS), Communications, and Preparedness. NIMS establishes ICS as a standard incident management organization with five functional areas — command, operations, planning, logistics, and finance/administration — for management of all major incidents. To ensure further coordination, during incidents involving multiple jurisdictions or agencies, the principle of unified command has been universally incorporated into NIMS. This unified command not only coordinates the efforts of many jurisdictions, but provides for and assures joint decisions on objectives, strategies, plans, priorities, and public communications.

Standardized communications during an incident are essential, and NIMS prescribes interoperable communications systems for both incident and information management. Responders and managers across all agencies and jurisdictions must have a common operating objective for a more efficient and effective incident response. Preparedness incorporates a range of measures, actions, and processes accomplished before an incident happens. NIMS preparedness includes planning, training, exercises, qualification and certification, equipment acquisition and certification, and publication management. All of these serve to ensure that pre-incident actions are standardized and consistent with mutually-agreed doctrine.

TOP FIVE NIOSH CAUSAL FACTORS

The National Institute for Occupational Safety and Health (NIOSH) is the United States federal agency responsible for conducting research and making recommendations for the prevention of work-related injury and illness. Through the Fire Fighter Fatality Investigation and Prevention Program (FFFIPP), NIOSH conducts investigations of select fire fighter line-of-duty deaths to formulate recommendations for preventing future LODDs. NIOSH has identified the top 5 causal factors of firefighter deaths and injuries on the fire ground as the following:

1. Improper Risk Assessment
2. Lack of Incident Command
3. Lack of Accountability
4. Inadequate Communications
5. Lack of SOPs or failure to follow established SOPs

NIOSH AND USFA REPORT FINDINGS

Several NIOSH line-of-duty-death (LODD) investigations indicate that fire fighters may not be adequately trained on fire ground survival procedures, including how to call a Mayday and the actions to take while waiting to be rescued. The following are just a few examples of LODD investigations conducted by the NIOSH Fire Fighter Fatality Investigation and Prevention Program and "Lessons Learned" from each:

JACKSON, MI FD. JAN 20, 2005.

The NIOSH incident report can be viewed at http://www.cdc.gov/niosh/fire/reports/face200505.html.

Lessons learned include:

- Train FFs on proper radio discipline and how to initiate a Mayday.
- Train FFs on the actions to take while waiting to be rescued
- Use exit locators such as high intensity floodlights/ strobe lights.
- Ensure a RIC is in place before conditions become unsafe.

BRIDGEPORT, CT FD JULY 24, 2010

The NIOSH incident report can be viewed at https://www.cdc.gov/niosh/fire/reports/face201018.html

Lessons learned include:

- Monitor radio for Mayday
- Train fire fighters on Mayday procedures
- Train fire fighters on how to initiate a Mayday

BRYAN, TX FD. FEBRUARY 15, 2013

The NIOSH incident report can be viewed at https://www.cdc.gov/niosh/fire/pdfs/face201304.pdf

Lessons learned include:

- FD's should ensure that a complete situational size-up is conducted on all structure fires
- Team continuity
- Train FF's in SCBA emergencies

PHILADELPHIA, PA FD. APRIL 6, 2013

The NIOSH incident report can be viewed at https://www.cdc.gov/niosh/fire/pdfs/face201307.pdf

Lessons learned include:

- Ensure all fire fighters and fire officers are trained when to call a "Mayday"
- FD's should provide IC's with a "Mayday" tactical checklist in the event of a "Mayday"
- FD's should utilize a personnel accountability system that accounts for all resources assigned to an incident

BOSTON, MA FD. MARCH 26, 2014

The NIOSH incident report can be viewed at https://www.cdc.gov/niosh/fire/pdfs/face201409.pdf

Lessons learned include:

- FD's should develop procedures, training programs, and tactics for wind-driven fires
- FD's should integrate current fire behavior research findings developed by the National Institute of Standards and Technology (NIST) and Underwriter's Laboratories (UL) into procedures
- Train FF's on actions to take while waiting to be rescued

NEW YORK FD. JULY 5, 2014

The NIOSH incident report can be viewed at https://www.cdc.gov/niosh/fire/pdfs/face201414.pdf

Lessons learned include:

- Team continuity
- Ensure FF's are trained on hazards presented by hoarding and procedures are developed to guide FF's confronted with hoarding conditions
- Train FF's on air management
- Train FF's in SCBA emergencies
- Use of search or hose lines as a means to exit an occupancy

STAFFING AND FIRE GROUND SURVIVAL

Adequate staffing improves survivability and decreases the injury potential for fire fighters engaged in emergency operations. NFPA 1710 *Standard for the Organization and Deployment of Fire Suppression Operations, Emergency Medical Operations, and Special Operations to the Public by Career Fire Departments,* Section 5.2.2 (Staffing) states the following: Paragraph 5.2.2 states the following: The number of on-duty fire suppression members shall be sufficient to perform the necessary fire-fighting operations given the expected fire-fighting conditions. These numbers shall be determined through task analyses that take the following factors into consideration:

1. Life hazard to the populace protected
2. Provisions of safe and effective fire-fighting performance conditions for the fire fighters
3. Potential property loss
4. Nature, configuration, hazards, and internal protection of the properties involved
5. Types of fire ground tactics and evolutions employed as standard procedure, type of apparatus used, and results expected to be obtained at the fire scene."

The NFPA standard states that both engine and truck companies shall be staffed with a minimum of four on-duty personnel. The standard also states that companies shall be staffed with a minimum of five or six on-duty members in jurisdictions with tactical hazards, high hazard occupancies, high incident frequencies, geographical restrictions, or other pertinent factors identified by the authority having jurisdiction, these companies shall be staffed with a minimum of five or six on-duty members.

UL AND NIST

Underwriters Laboratories (UL) Firefighter Safety Research Institute (FSRI) https://ulfire fightersafety.org/ and the National Institute for Standards and Technology (NIST) https://www.nist.gov/el/fire-research-division-73300/firegov-fire-service have conducted research that focuses on the changing dynamics of structure fires and the impact they have on fire service strategies and tactics.

Their research has shown that the increased use of synthetic materials in the home has resulted in the availability of more fuel to burn. Today's structure fires burn faster, hotter and with more toxic byproducts than fires in the 20th century and place the fire fighter into a more dangerous fire environment. Ongoing changes in construction methods, building materials, structure design, and the products used in furnishings present new potential safety challenges to the fire fighter under fire conditions.

THE NEED FOR A FIRE GROUND SURVIVAL PROGRAM

The following information from NFPA summary reports presents an overview of fire fighter LODD trends over the past several years.

According to the NFPA, there are two major driving forces in the decrease in fire fighter LODDs over the past 40 years. First is the drop in the number of on-duty fatalities due to sudden cardiac death. The second significant drop is the number of deaths at structure fires.

Figure 1 shows that during the 40-year time period from 1977-2016, the number of structure fires and the corresponding number of fire fighter LODDs at structure fires both decreased, though the number of fires has leveled off over the past several years. Since 1977, the number of U.S. fire fighter LODDs at structure fires (shown by the red line) has dropped 87 percent. During the time period 1977-1981, an average of 79 fire fighter deaths occurred annually on the fire ground, with 59 of the 79 deaths involving structural firefighting. During the time period 2012-2016, an average of 28 fire fighter deaths occurred annually on the fire ground with 16 of these fire fighter deaths at structure fires. This has often been credited to improvements in protective clothing and equipment, fireground command and control, and training. While deaths at structure fires have dropped by 69 percent from 1977 to 2006, and continued to drop over the next 10 years, the annual number of structure fires (shown by the blue line) declined 53 percent over that same period before leveling off. Little attention has been given to the reduction in structure fires as a possible reason for the reduction in fire fighter deaths.[3]

Figure 2 displays a comparison of the number of structure fires and the rate of fire fighter deaths at structure fires using a rolling three-year average. Increases in death rates can occur in either of two ways:

1. If the number of deaths increases while the number of fires stays the same or decreases, rates will rise.
2. If the number of deaths stays the same, while the number of fires decreases, rates will also rise.

Figure 2 shows that the firefighter death rate per 100,000 structure fires remained high and even increased at some points between 1977 and the late 1990s, then began to fall as deaths continued to drop while the number of fires held steady.

Figure 1
The decrease in firefighter deaths at structure fires followed, and now surpasses, the drop in structure fires

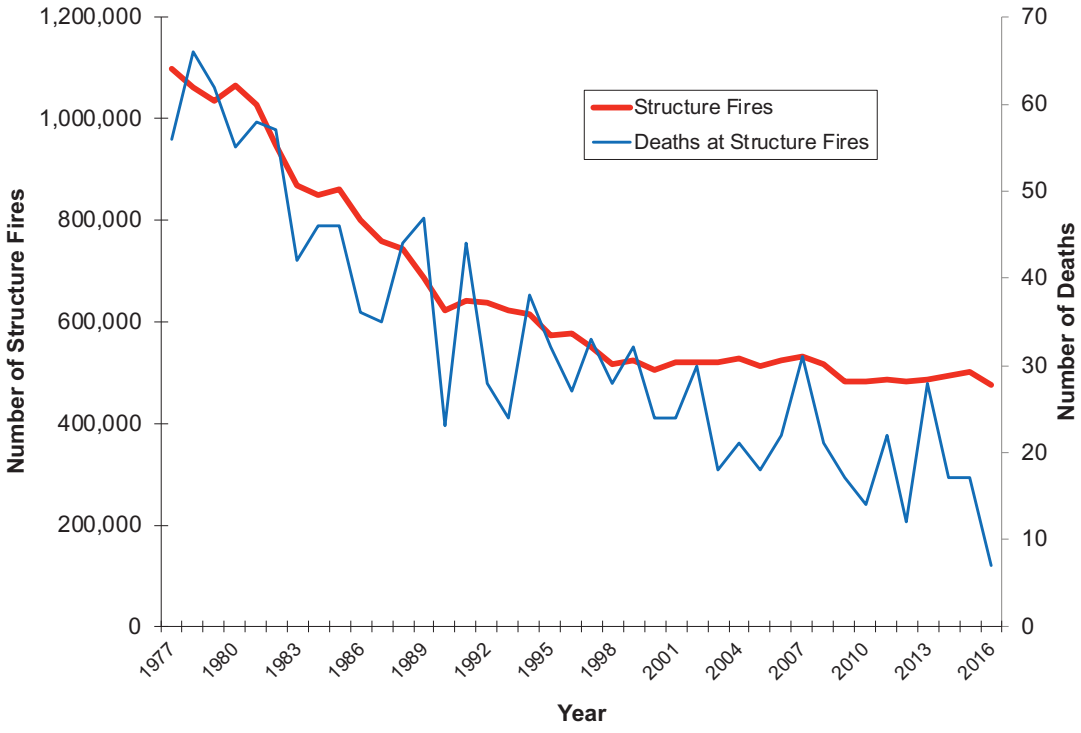


Figure 2
As the number of structure fires has leveled off, the rate of firefighter deaths at structure fires has dropped

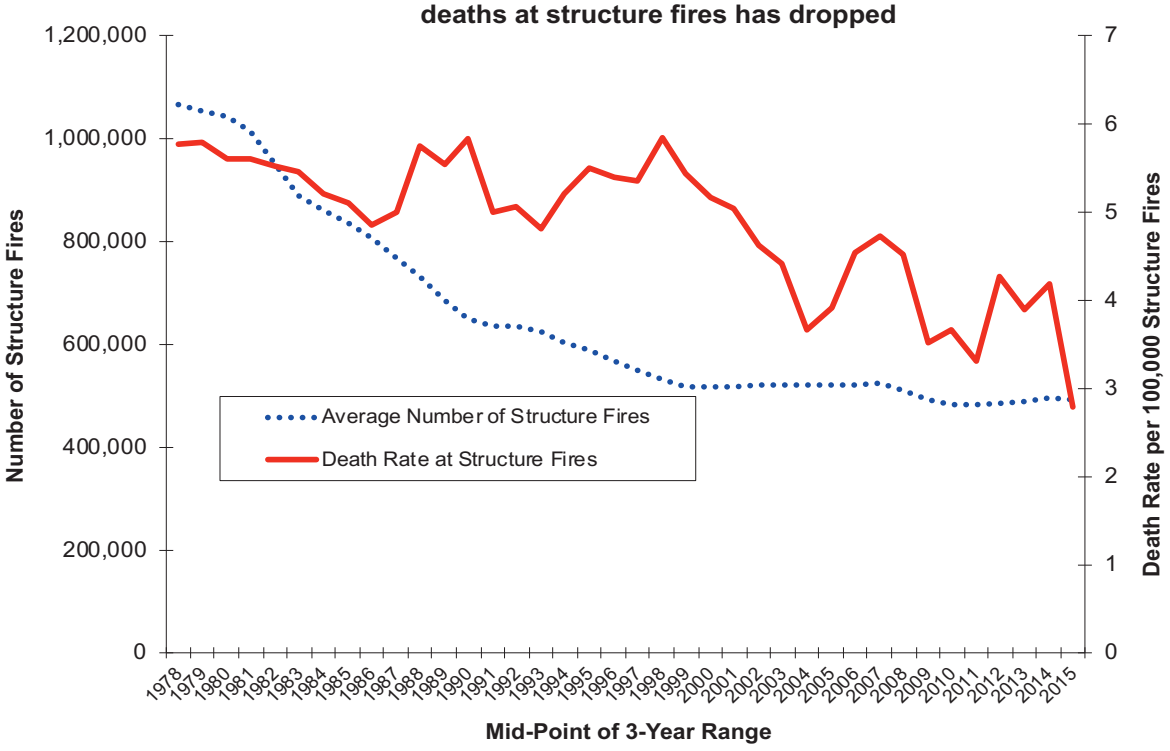


Figure 3
The rate of sudden cardiac deaths at structure fires and non-SCD deaths outside structure fires have been dropping, although the decrease for deaths inside has not been steady.

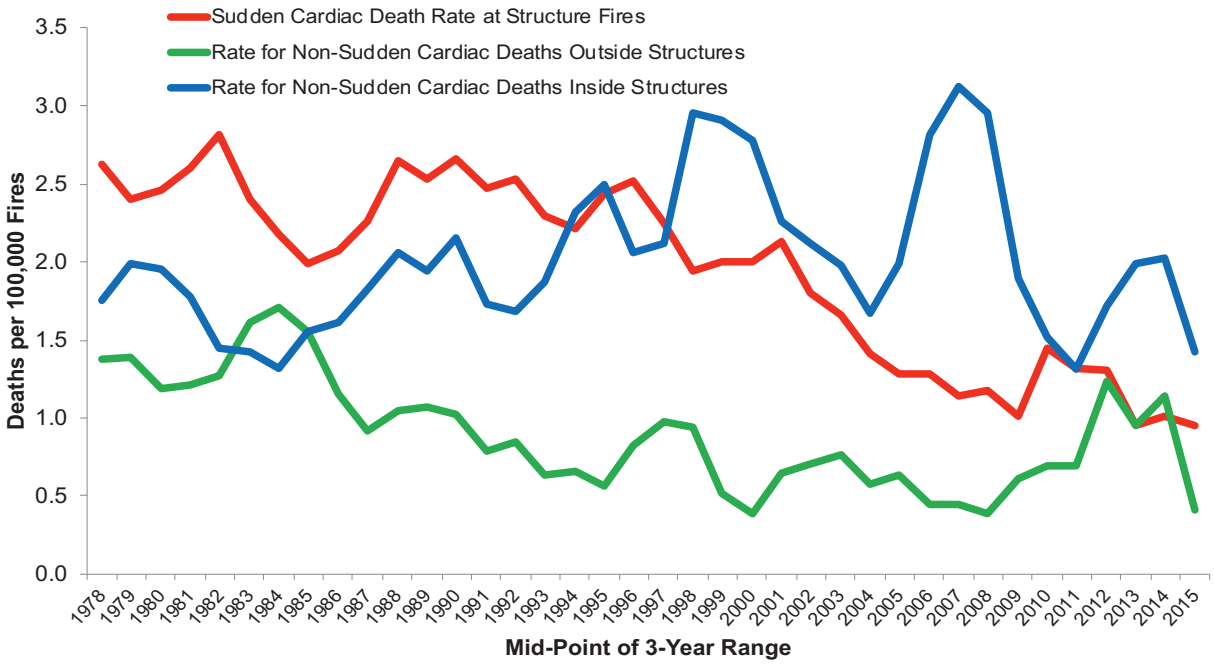


Figure 3 gives a comparison of the rates for fire fighter LODDs caused by sudden cardiac death (shown by the red line) while operating at structure fires, rates for traumatic fire fighter LODDs inside structure fires (shown by the blue line) and the rates for traumatic fire fighter LODDs outside structure fires (shown by the green line). This graph shows that sudden cardiac deaths at structure fires has been dropping since the early 1980s.

The rate of non-cardiac fatalities outside at structure fires dropped as well, since the mid 1980s, but rose again after 2008 before dropping in recent years. The five most frequent causes of these fatal injuries outside structure fires over the years were fire fighters killed in structural collapses (37.1 percent), caught in explosions (17.1 percent), falls (13.5 percent), struck by vehicles (8.2 percent) and electrocution (6.5 percent).[3]

Figure 3 shows that the rate of fire fighter LODDs caused by traumatic injury inside structure fires began rising in the mid 1980s while the other two categories were steadily falling. Since the late 1990s, the rate of traumatic fire fighter LODDs inside structure fires has also begun to fall, but still exceeds the other two categories. The sharp increase in the trend line around 2007 is largely due to two multiple-death fires that occurred that year, that together claimed 11 lives. Almost all non-cardiac fatalities inside structure fires were the result of smoke inhalation or asphyxiation (62.3 percent), burns (19.8 percent) and crushing or internal trauma (15.9 percent).[3]

Taken together, the leading causes of fatal injuries to fire fighters at structure fires over the past 40 years are sudden cardiac death (41.6 percent), followed by asphyxiation and smoke inhalation (26.4 percent), traumatic injuries and crushing (19 percent) and burns (8.9 percent).[3]

To summarize the leading causes of fire fighter fatalities while working inside structure fires over the time period from 1977 to 2016: Almost all of the non-cardiac fatalities inside structure fires were the result of smoke inhalation or asphyxiation (62.3 percent), burns (19.8 percent) and crushing or internal trauma (15.9 percent). These statistics point to the need for a Fireground Survival Training Program.

1 Dunn V [1992]. Safety and Survival on the Fireground. Saddle Brook NJ: Fire Engineering Books and Videos.

2 NFPA [2018]. NFPA 1500, Standard on Fire Department Occupational Safety, Health, and Wellness Programs 2018 edition, Quincy, MA: National Fire Protection Association.

3 NFPA [2018]. Fire Incident Data Organization (FIDO). Quincy, MA: National Fire Protection Association.

CHAPTER 1
PREVENTING THE MAYDAY

CHAPTER 1
LEARNING OBJECTIVES:

After reading this chapter students will be able to explain how each of the following helps prevent a Mayday:

- Pre-Planning.
- Size Up.
- Reading Smoke.
- Interior Layout Size Up.
- Room Orientation.
- Crew Continuity.
- Air Management.
- Deciding to go Defensive and Emergency Evacuation Procedure.
- Understanding Today's Fire Environment

CHAPTER 1
PREVENTING THE MAYDAY

INTRODUCTION

It happens daily all over North America: an alarm is received, fire fighters respond and arrive to find a building fire with smoke coming from a few of the windows. Fire fighters don their personal protective equipment, pull a hose line, make entry and begin searching for occupants and the source of the fire. During this search, smoky conditions hamper their progress. With reduced visibility, it is challenging to negotiate hallways and obstacles while advancing deeper into the darkness. It becomes increasingly more difficult to identify an exit should they need to get out fast. Such an event can escalate into a Mayday situation.

Preventing a Mayday must consciously occupy a fire fighter's thoughts during training and when responding to emergency calls. This chapter summarizes the knowledge and skills fire fighters must acquire during drills to prevent a real Mayday. Each of the following topics has contributed in some way to a fire fighter fatality or near miss. Preventing a Mayday requires attention to these often overlooked details of fire fighting.

MAYDAY PREVENTION KNOWLEDGE AND SKILLS

MAINTAINING SITUATIONAL AWARENESS

Aside from unexpected collapse and entrapment, fire fighters most often find themselves in trouble because:

- They develop tunnel vision on the task at hand and fail to maintain an awareness of the larger fire event and how it might affect them.
- They operate off the hose line and lose their "lifeline" to the exterior.
- They fail to monitor their SCBA air consumption and run out of air.
- They get separated from their partner or operate alone.

In order to stay safe and not get into a Mayday situation, fire fighters must stay on the hose line, or closely oriented to it, closely monitor their SCBA air supply and stay connected with their partner/team. Listening to radio traffic and what's going on about the fire ground improves situational awareness. Assessing the situation for changing conditions also improves situational awareness and safety. Fire fighters should never push the safety envelope. More details will be explained in the following chapters.

PRE-PLANNING

To increase survivability, fire fighters must become familiar with their response districts. Pre-planning allows companies to see construction elements, discuss strategies, and recognize potential response problems. Most importantly, the pre-plan can provide clues to where and when a building may fail and thus prevent a Mayday situation. Ultimately, this knowledge allows personnel to anticipate building compromise during fire involvement so fire ground safety is maintained. The following are elements of a comprehensive pre-plan:

CONSTRUCTION TYPE

One of the most critical findings during a pre-plan is building construction, and most importantly roof construction. There are two basic types of roof construction:

- *Conventional* construction uses regular timber or metal beams.
- *Light-weight* construction uses truss systems.

These construction types can also be further classified as *protected* and *unprotected*.

- *Protected* construction has a one-hour fire rated covering.
- *Unprotected* construction means the structural members are fully exposed.

Unprotected light-weight construction is the most dangerous. Buildings of this type must be identified on the pre-plan. While all construction types are subject to collapse, the potential for rapid failure of fire-damaged truss systems means that fire fighters are exposed to the hazards of collapse and entrapment much earlier into an incident.

LIGHT-WEIGHT TRUSS SYSTEMS

Between 1998 and 2017 NIOSH fire fighter fatality investigations reported that 22 fire fighters died in unprotected light-weight truss collapse events related to roof or basement truss system failures. A total of 12 injuries also occurred in these fatalities. Additionally, between 2005 and 2017, the National Firefighter Near Miss Reporting System http://firefighternearmiss.com/ reported 21 near- misses related to unprotected light-weight trusses. Considering this reporting system is self-reporting, it is likely that there are far more near miss incidents occurring than presently indicated.

Light-weight truss systems are inherently dangerous and must be considered high risk. Tests of unprotected light-weight truss systems by the National Institute of Standards and Technology and Underwriters Laboratories (UL) determined that once an unprotected light-weight "I-joist " was exposed to fire, the truss system collapsed in **only** six minutes. Similar tests conducted in Phoenix by NIOSH of light-weight roof trusses determined collapse occurred in **only** eight minutes.

These tests indicate collapse will occur about the time fire fighters arrive on scene. Plotting the time element from detection to the 9-1-1 call, through the response time, arrival on scene and stretching hose lines will typically equal or exceed the imminent collapse time. The roof or floor over the basement can collapse as fire fighters are entering the building. Tests also determined that when the truss system collapses,

it will generally involve a large area of the floor or roof, potentially taking more than one fire fighter with it.

UL also found that because of the insulation qualities of flooring and carpet above light-weight truss systems, heat levels on the floor above the raging 1,200 degree fire below were in a modest 100 degree range. These temperatures were measured just prior to collapse. This misleading "cool" environment places the un-expecting fire fighter in a serious life threatening situation if entering a structure with active fire on the floor below. UL's Firefighter Safety Research Institute's full report and on-line training course can be found at https://ulfire fightersafety.org/research-projects/structural-stability-of-engineered-lumber-in-fire-conditions.html

Another unexpected outcome of the test was the inability of thermal imaging cameras to detect the severity of fire below in the basement. Again, because of the insulating qualities of flooring and carpet, the cameras did not detect a serious fire below until moments before collapse. The only real indications were the white dots of nails along the top of the trusses that were conducting heat.

Project Mayday — In it's review of over 5100 Maydays, Project Mayday reported that approximately 19% of Maydays occurred when fire fighters fell into basements. (http://projectmayday.net/)

Caution should also be used for attic fires. The attic space above the ceiling has even greater insulating qualities that may also severely limit the camera's ability to detect a serious fire and impending collapse.

Bowstring truss systems are used to cover a large area. These large attic spaces can conceal a large volume of fire. While they may withstand fire for a longer period of time, they are also known to create a large area collapse. Fires burning in a truss attic space should be considered a high risk operation.

NIOSH ALERT:
Preventing Injuries and Deaths of Fire Fighters due to Truss System Failures (www.cdc.gov/niosh/docs/2005-132/) provides information on roof collapses in structures containing truss systems and includes case studies where fire fighters have become trapped and were injured or killed[1].

FUEL LOADS

All contents stored in a building add fuel to the fire and can determine the rate of spread. Knowing the fuel load can assist the company officer in making deployment decisions to ensure personnel are kept from entering buildings where they may become trapped by a rapidly advancing fire.

HEAT RELEASE RATE OF FUELS

The amount of heat released from burning fuels plays a significant role in fire spread. Heat release rate is measured in joules per second, or watts. The higher the wattage the more heat is released from a burning fuel. The heat release rate is dependent upon the molecular structure and configuration, or geometry, of the fuel and oxygen availability. Heat release rate, and time to peak heat release rate, is significantly enhanced when the fuel is contained within an enclosure. Generally, contemporary furnishings made of synthetics such as poly-urethanes and micro-suede fabrics, have higher heat release rates. The heat release rate is accelerated when these type of fuels are enclosed within a structure where they may reach their ignition temperatures sooner. Fire fighters must recognize that a fire with common building contents may develop faster than normal due to synthetic fuels.

Natural Material Furnished
265 Seconds (4 min. 25 sec.)

Synthetic Material Furnished
240 Seconds (4 minutes)
(Heat release information provided by Underwriters Laboratories Inc.)

Rapid fire growth due to synthetic fuels requires fire fighters to exercise caution when responding to the common building fire. Today's fires are contained in buildings that are better enclosed to improve energy efficiency. These same buildings contain more synthetic based furnishings than ever before. These factors contribute to rapid fire growth and hazardous smoke conditions. As these fires grow, smoke rapidly fills the occupancy, thus making it difficult for fire fighters to locate the fire. A decision to search above the fire floor, before having hose lines in place on the floor below, have resulted in fire fighter fatalities and numerous Mayday

situations. Preventing these situations requires fire fighters to properly identify the location of the fire, so hose streams can be appropriately positioned to prevent further fire spread.

OVERHEAD WEIGHT

Overhead weight includes Heating Ventilation and Air Conditioning (HVAC) units, solar arrays, tanks, excessive roofing material, and billboards. A pre-plan must identify the amount of weight carried on the roof. This overhead weight must be considered when a fire has burned for a long time. Mayday situations have been created by a roof collapse caused by the failure of the roof construction supporting an HVAC system. One example occurred at a restaurant fire in Texas in February of 2000, at which, two career fire fighters died following a partial roof collapse[2].

BUILDING HISTORY

Older buildings may have undergone several renovations over the years, and may have been damaged by previous fires. Company officers and chief officers must recognize the dangers of these types of buildings, because the unknown can lead to a Mayday. Many fire fighters have been injured and killed in structures that have undergone major renovation work. Such examples can be found in NIOSH reports 98F-17 NY, 2001-03 AR, F2004-14 TX, F2006-27 NY, and F2011-20 TX[3].

DERELICT BUILDINGS

Company officers and chief officers must identify buildings that are abandoned and in disrepair, because this identification can help determine fire ground tactics. Fire fighters should enter these structures only when people are known to be inside. Commanders should use defensive operations when these buildings are vacant. Four examples where fire fighters were killed in vacant and unoccupied structures can be found in NIOSH reports F2002-20 MO, F2005-09 TX, F2008-37 MI, and F2010-38 IL. In May of 2002, two career fire fighters died after becoming lost and running out of air while operating inside a vacant two-story commercial brick structure. All windows and doors were boarded up when the fire department arrived[4]. In February of 2005, a captain died due to a partial roof collapse in a residential structure fire. The house was vacant, in dilapidated condition, and known to be a "crack house"[5].

Additionally, in November 2008, a career fire fighter died after being crushed by a roof collapse in a vacant/abandoned building. In December 2010, two career fire fighters died when the roof collapsed during suppression operations at a rubbish fire in an abandoned and unsecured commercial structure.

The International Association of Fire Chiefs (IAFC) has issued "The 10 Rules of Engagement for Structural Fire Fighting and the Acceptability of Risk"[6]. These rules acknowledge that all fire fighting activities involve some inherent risk to fire fighters and highlight that NO PROPERTY is worth the life of a fire fighter and that building construction type, size, condition and occupancy should be considered when conducting the risk analysis for a structure fire. (See IAFC Safety, Health and Survival section website at http://www.iafcsafety.org/.)

SIZE UP

Size up is a critical fire ground survival task that must be performed on any incident. The size up is an assessment of the situation, for use by the Incident Commander (IC), so informed decisions can be made on the mode of attack for the operation. After the initial size up has been performed, the IC must assess the risk versus benefit to decide if an interior attack or an exterior defensive operation should be performed.

NFPA 1500 – Standard on Fire Department Occupational Safety, Health, and Wellness Program, 2018 Edition.

8.4 Risk Management During Emergency Operations

8.4.1 The incident commander shall integrate risk management into the regular function of incident command.

8.4.2 The incident commander shall determine the life safety profile of the incident and apply the most appropriate level of risk to first responders consistent with the principles in 8.4.2.1.

8.4.2.1 The concept of risk management shall be utilized on the basis of the following principles:
(1) Activities that present a significant risk to the safety of members shall be limited to situations where there is a potential to save lives.
(2) Activities that are routinely employed to protect property shall be recognized as inherent risk to the safety of members, and actions shall be taken to reduce or avoid these risks.
(3) No risk to the safety of members shall be acceptable when there is no possibility to save lives or property.
(4) In situations where the risk to fire department members is excessive, activities shall be limited to defensive operations.

8.4.3 The incident commander shall evaluate the risk to members with respect to the purpose and potential results of their actions in each situation.

8.4.4 Risk management principles shall be routinely employed by supervisory personnel at all levels of the incident management system to define the limits of acceptable and unacceptable positions and functions for all members at the incident scene.

The overriding benefit of any fire operation is to preserve life — fire fighter and civilian. The risk versus benefit analysis must take into account the safety of the fire fighters versus the probability that civilian lives can be saved in the current fire situation. Fire fighters should risk very little to save just the building and/or its contents[6].

Size up upon arrival has four critical components – Construction, Location and Extent of the fire, Occupancy, and Life Hazard. These four factors are assessed individually but must be seen as interrelated.

1. **Construction** size up is assessing the way the fire building is erected. Questions to ask include: How is the building built? How long will it contain the fire to its current location? How long will the building allow fire crews to operate inside if the decision is made to enter? Was the building built using light-weight truss construction?
2. **Location and Extent** refers to where the fire is located in the building and how it will spread inside due to the construction style. This is often based on the reading of smoke conditions. Identifying the color, velocity, density, and volume of the smoke help determine both the location and the development stage of the fire.
3. **Occupancy** should be evaluated when conducting the size up. This will help determine if there are possible civilians inside at the time of the incident. Is the building an empty factory, or is it an occupied residence? Determining if a residential occupancy is a single family or two-unit apartment building will also help when a lost fire fighter is searching for an exit. During the fire ground size up, fire fighters should consider secondary means of egress prior to entering the fire building.
4. **Life Hazard** refers to knowing the location of any civilian life hazard in the structure, which will assist in the risk versus benefit analysis. This is done by determining where civilians are likely to be at the time of the fire and if there is a chance for rescue. For example, bedrooms are most likely to be on the second floor of a two-story residence while a two-unit apartment building will have bedrooms in both living units. If significant smoke/fire conditions exist in the bedroom areas, the probability of finding live victims is reduced, and the risk versus benefit analysis should take this into account.

READING SMOKE

Would you enter a building filled with propane? The answer to this question is...absolutely not. Buildings filled with propane are extremely dangerous because they are susceptible to gas explosions if an ignition source is nearby. In comparison to propane, smoke filled buildings (which include high concentrations of carbon monoxide) are just as dangerous. A closer look at the physical properties of each reveals little difference.

READING SMOKE

PROPANE	SMOKE/CO
Flammable Range	
2.1% - 9.6%	12.5% - 74%
Ignition Temperature	
920 ˚F - 1120 ˚F	1128 ˚F
Ignition Source	
???	Yes

The flammable range and ignition temperatures of propane and smoke are very similar. The variable that is different is the availability of an ignition source. A building charged with smoke will likely have an ignition source, where a propane filled building may not.

Fire fighters must be able to recognize the dangers associated with the smoke conditions when en route, upon arrival, and during fire fighting operations. Missing signs indicative of flash over, smoke explosions, backdraft, or rapid fire development has proven deadly to fire fighters in the past. The ability to read smoke correctly will prevent a Mayday situation from occurring.

Being able to effectively read smoke requires practice. This section of Fire Ground Survival should only serve as a reminder of the importance of being able to read smoke conditions correctly. Additional training programs on the subject should be pursued to improve this important skill.

Reading smoke can determine if it's a "GO" or a "NO GO" situation for crews making the decision to engage in interior structural fire fighting. Making this decision requires each fire fighter to evaluate the smoke on the specific characteristics of smoke known as volume, velocity, density, and color.

The following is a description of each characteristic:

- *Volume* is the quantity of smoke. Volume indicates the fuel load and fire flow required to stop the progress.

- *Velocity* is the speed at which the smoke comes from the building. Velocity can help locate the fire. High velocity indicates high heat.

- *Density* is the thickness of smoke. Density is the most important factor in reading smoke. Dense smoke indicates continuous fuels burning and possible flashover conditions. Fire fighters should not enter structures where dense smoke is banking down the walls and nearing the floor.

- *Color* can indicate how long the fuel has been burning and/or the distance the smoke has traveled to the outside. If the smoke is gray/white and slow moving, this indicates a young fire.

a. Gray/white smoke exiting with high velocity indicates a hot fire where the smoke has traveled a distance.

b. Brown smoke is mid-to-late-heating and is produced by burning unfinished wood products.

c. Black smoke indicates the fire has been burning for a while. Black, dense smoke is a precursor to flash over…Get out!

INTERIOR LAYOUT SIZE UP
ROOM ORIENTATION

Staying oriented is critical to being able to get out of the building if conditions deteriorate. The basics of room orientation all fire fighters must know at all times are:

1. Where they are.
2. How they got there.
3. How they can get out.

Fire fighters can learn several skills to stay oriented and prevent a Mayday situation.

When an alarm is received, the fire fighters' first action should be to recall all that they know about the buildings on that particular street. All company personnel should anticipate what they expect to see when they arrive…the more knowledge of the district, the better the prediction will be. Most of the time, the information received from Dispatch is accurate. Use this information to create images of what you might see when you arrive to aid in making tactical and equipment decisions even before the apparatus is spotted at the address. Share with your crew any information that may be of value. Even the newest fire fighters should speak up when they have information related to the occupancy.

Prior knowledge of a building may allow responding fire fighters to make tactical decisions on how to search the building safely while en route. Anticipate what you expect to find inside. Consider the types of rooms, hallways, furniture, doorways, and windows that will be present. For instance, a fire fighter who enters a residential building through the front door should anticipate that they will likely be in the entry hall or living room. From here they should enter a hallway, bedroom, kitchen, dining room, bathroom, or a closet. Fire fighters must anticipate encountering furnishings. The mental imaging must also

include the location of windows. Knowing where a window is located can prevent a Mayday, since it may be the only egress available for escape.

Once on the scene await your assignment from the incident commander. Know what your assignment is before entering the building. The company officer must inform all crew members of the assignment and the general plan to complete the assignment so that everybody is clear as to what's happening. Talk before entering!

Fire fighters can use windows to determine the layout of the rooms in a building. The type of room may be determined by the type and size of the window. A large bay window adjacent to a front door is most likely a living room. A small rectangular window with a sill that is higher than the other windows is probably a kitchen window. Small windows with frosted glass are most likely bathroom windows. Before a fire fighter goes inside, he or she should have a good idea of the layout, and then they must remember the layout upon entering the building. Never enter a building during fire fighting operations without first sizing up the building to determine the layout.

Once entry is made, fire fighters must orient themselves to the inside of the building. Being oriented in a building with limited visibility means:

- **The fire fighter knows where he or she is**
  "I'm in a bedroom because I feel a bed and a window."

- **The fire fighter remembers how he or she got there**
  "I entered the bedroom from a hallway adjacent to the kitchen."

- **The fire fighter knows how to get out**
  "I can use the bedroom window if conditions worsen."

All three points are essential. Not knowing one point can create panic if a Mayday situation occurs.

The two most important tools a fire fighter can use for effective orientation are their hands, not a halligan, axe, or pike pole. Although fire fighters often carry hand tools to assist in forcible entry and search, tools cannot feel like hands can. A fire fighter can find objects with a tool, but his or her hands can identify these items and give valuable information about where he or she is. Sweep walls to locate windows. Feel furniture to determine the type of room the team is in. (Both search and nozzle teams should do this.) All this information is vital in determining location and viable egress.

MAPPING THE ROOM

As a fire fighter moves through a building, he or she must create a mental map of each room by identifying and memorizing each piece of furniture and its location in the room. Items may be used as landmarks if the crew must back out. For example, if a fire fighter finds a bed, then a nightstand, and then a toy box under a window, he or she knows the sequence of furniture that he/she must feel to find an exit.

Most importantly, fire fighters should also memorize the number, width and direction of swing for doors they encounter. Remembering the number of doors passed allows for the fire fighter to skip rooms while remaining oriented during a rapid egress of a structure. Identifying the width and direction of swing helps determine the type of room on the other side of the door and may indicate a room without windows such as a closet, bathroom or area of refuge or escape such as a bedroom.

CREW CONTINUITY

In order to maintain a high level of safety, crews must go in together and come out together. No single fire fighter should be permitted to enter OR exit alone. Crew continuity means the officer (or team leader) must be able to see, touch, or hear ALL other members (or partner). If these are absent, crew continuity does not exist and there may be an impending Mayday situation for a lost fire fighter. It's important that all crew members discipline themselves to stay closely connected with the team.

Crew continuity is also important for insuring constant accountability so the Personnel Accountability Report can be accurately provided when requested by the IC. The company officer is ultimately responsible for crew continuity but other members also bear some responsibility [NIOSH Reports F2002-20, F2005-05, F2004-04 and F2006-19].[7]

When strategies change from an interior attack to a defensive operation, the engine company officer must be able to account for the fire fighters on the hose line. When officers are positioned behind the nozzle fire fighter on an interior attack, they are able to stay in contact with the lead fire fighter. Should they need to quickly exit, communication is assured. The officer can also pick up any additional members behind the nozzle while exiting the building.

Split crews, such as truck companies where members will be both inside for search purposes and performing ventilation on the building's exterior, must have trained all members to closely monitor the radio for the order to exit. For example, specific language in the exit communications to a ventilation roof team should include terms like "abandon the roof" to guarantee the message is received. Fire ground discipline is also essential in these instances to be certain that the orders are obeyed. Fire ground training on this tactic must have occurred prior to the incident and be constantly reinforced by company officers.

AIR MANAGEMENT

The Self Contained Breathing Apparatus (SCBA) is designed to allow fire fighters to enter toxic atmospheres for a limited amount of time. Proper use of the SCBA increases survivability. Improper use puts a fire fighter in a potential life threatening Mayday situation, and places rescuers at unnecessary risk.

NFPA SCBA STANDARDS

Two NFPA Standards affect SCBA operations. The 2013 edition of NFPA 1404, *Standard for Fire Service Respiratory Protection Training* states, "…a fire fighter should exit before consumption of reserve air begins." The intent is for the fire fighter to always have reserve air in case the planned exit is blocked or there is an unexpected delay in exiting. This reserve air component is consistent with fire department SCUBA dive teams which have for decades applied a standard to surface with at least 500 pounds of reserve air. Note: Since the introduction of SCBA to the fire service, consumption of reserve air was never intended for operational use.

The 2007 edition of NFPA 1981, Standard for Open-Circuit Breathing Apparatus, reflects a change in the consumption rate of air for SCBA. Fire fighters for years have known the so called "30 minute" cylinder doesn't last 30 minutes during laborious work. So the standard was changed from 40 liters per minute (L/min) to 100 L/min of air consumption. This standard remains unchanged in the 2013 Edition of NFPA 1981. The table below provides projected times of use for common SCBA cylinder sizes at 100 L/min of use. (Note the projected time is until the cylinder is empty).

The 2013 edition of NFPA 1981, Standard for Open-Circuit Breathing Apparatus changed the end of service time indicator (low air alarm or EOSTI) to 33% of the cylinder's rated capacity from 25% in the 2007 edition. This will increase the amount of reserve air for a firefighter, however working time will be reduced. Fire fighters using a 2013 edition SCBA must be aware of this and manage their air supply accordingly.

In either case, the fire fighter must plan on exiting the building before the low air warning activates.

BEST PRACTICES FOR SCBA AIR MANAGEMENT

The fire fighter is ultimately responsible for proper management of his or her SCBA and air supply. The rule of air management is: Don't ever run out of air! There will be a very narrow window of survivability in a smoke filled building. Below are essential steps to increase survivability when wearing an SCBA.

- Thoroughly check your SCBA before each use.
- Check and know your air supply (pressure) before you enter the hazard zone.

SCBA Cylinder Size	Time to Empty	Working Time	Reserve Air Time (33%)
30 minute	12 minutes	8 minutes	4 minutes
45 minute	18 minutes	12 minutes	6 minutes
60 minute	24 minutes	16 minutes	8 minutes

** all times calculated using 100L/min air usage and a full air cylinder (4500 psi)

According to Project Mayday, air usage by fire fighters will increase under stressful conditions (i.e. Mayday). Air usage by a Mayday fire fighter can be 110-140 L/min. Air usage that high will reduce the times cited in the table above. Project Mayday also states that 15% of air cylinders surveyed were less than fully charged (below 4250 psi) when they were donned.

- Buddy up. No freelancing.
- Know your personal consumption rate and projected time of use.
- Know your teams plan and objective(s) before entering. Talk!
- Report your entry to the incident commander, division or group officer, or designated Accountability Officer.
- When exiting, report your exit.
- The hose line is your life line/Stay on it/Know where it is.
- CONSTANTLY monitor your air consumption and regularly report your remaining air supply to the company officer (or your buddy).
- The company officer (or team leader) should include the lowest pressure reported by a team member as part of radio progress reports to the IC or division or group officer.
- Know your turn-around pressure – and then get out!
- Plan to exit before the low air warning activates.
- Always wear your SCBA facepiece when operating above a fire (i.e. roof operations).

BENCHMARKS TO CHECK SCBA AIR SUPPLY

While operating in a toxic environment, there are certain benchmarks where the fire fighter should make a point of checking their remaining air to gauge how much longer to remain in the hazard zone.

- Check air supply before going up stairs and after coming down stairs.
- Check before entering a room (to search or advance a hose line).
- Check after going down a hallway or store isle.
- Check before and after each demanding physical task (i.e. venting roof).

TACTICAL MANAGEMENT OF AIR SUPPLY

Proper management of SCBA air supply on the fire ground goes beyond individual fire fighters monitoring their personal air supply. The company officer and the Incident Command Team also have responsibilities for the exterior tactical management of air.

The Company officer (or team leader) must maintain an on-going awareness of the team's air consumption by regularly obtaining reports from crew members. These reports allow the officer to continually be aware of remaining air and constantly adjust the crew's activities and exit plan. This allows the company officer to gauge the turn-around time to safely get the crew out.

The command team also needs to be aware of who is in the building and when they are expected out. Request for progress and air status reports by command maintains that awareness. Obtaining air supply reports as part of progress reports helps the command team to tactically manage air supply and logistics. Command will have an early awareness of crews over extending their air supply and will be able to safely withdraw them if they have this information. The sooner command learns of approaching turn-around time for the crew, the sooner a fresh crew can be ordered from staging to replace them.

AIR MANAGEMENT: "AIR = TIME" OR "PREVENTING THE MAYDAY"

Air Management training is a required component of SCBA training. More importantly, Air Management training is a Mayday prevention activity. Fire fighters who are well trained and practiced in the art and skill of effective air management techniques demonstrate increased situational awareness, increased orientation, improved tactical level thinking, and provide themselves a "margin for error" if a Mayday should occur.

The basic tenet of air management is captured in the Rule of Air Management or ROAM. The ROAM states: Know how much air you have in your SCBA, and manage that air, so that you leave the IDLH environment BEFORE your low air alarm activates. It can be summed up like this: Know what you got. Manage it as you go. Come out before your low air alarm activates.

Know what you got: Check your SCBA. Make sure the cylinder is full. Make sure it works. Then, check your air volume again, right before you head into the IDLH. Your cylinder should still be full. If you are running low before you even go in, then you have a problem. Stop now, fix the problem, and prevent the Mayday.

Manage it as you go: Check your air while you are operating. When you change levels in the building. When you finish a search area. When you complete an assigned task. Report in to the company officer. Check on your crew. Who has the most air? Who is working the hardest? How far are you from the door? What are the conditions? Have they gotten better? Worse? Will you be able to complete the assigned task? Do you need help? Keeping track of your air supply helps you answer these questions. Keeping track of your air supply helps prevent the Mayday.

Come out before your low air alarm activates: Air = Time. Simple enough statement to make. Air = Time. The last 25% of your air is yours. 75% of your air for the boss. 75% for the citizens you serve. 75% for entry into, work within, and exit from the most hazardous work environment on the planet.

If your SCBA is NFPA 1981, 2013 Edition compliant the low air alarm will activate at 33% cylinder pressure. This will result in a shorter working time on air compared to a 2007 Edition or earlier SCBA.

Air = Time: When the worst day comes. Air = Time. Time to give the RIT team a chance. Time to find that alternate exit. Time to transmit your position in a clear readable voice. Time to remain calm. Time to think. Time to plan. Time to act. Air = Time

Know what you got, manage it as you go, come out before the low-air alarm activates. ■

Phil Jose, Mike Gagliano, Steve Bernocco, Casey Phillips are the authors of "Air Management for the Fire Service", Pennwell 2008

THE RELATIONSHIP BETWEEN CARDIOVASCULAR FITNESS AND AIR MANAGEMENT

Robert Karwasky, LACoFD Exercise Physiologist, MS, CSCS, CES

A fire fighter must have the ability to increase and maintain energy expenditure well above their resting level just to meet the physical demands of the arduous tasks they perform.

Stair climbing and aerial ascents in turnouts while carrying equipment are good examples of this. A fire fighter's ability to perform these tasks will be determined by two components of their cardiovascular fitness levels.

The first is maximum oxygen uptake (MaxVO2), and the second is ventilatory threshold. Max VO2 is the greatest amount of oxygen that can be consumed during an all out sustained effort. Ventilatory threshold is also referred to as the anaerobic threshold or lactate threshold. It is the highest level of aerobic exercise that can be maintained before the body begins to exceed its ability to meet the oxygen demand of the task and must provide energy from anaerobic metabolism also. Exercise above the ventilatory threshold can typically be maintained for only a few minutes with great effort before fatigue will require a decrease in intensity or cessation. When exercise intensity is increased above the ventilatory threshold, there is a dramatic increase in respiratory rate and volume.

It is commonly recommended that fire fighters maintain a high level of cardiovascular fitness. Increased cardiovascular fitness will not only allow the fire fighter to be able to perform and endure arduous tasks at a tolerable level of exertion, they will also be working below their ventilatory threshold and will be utilizing their limited air supply efficiently. Conversely, inadequately conditioned fire fighters will only be able to tolerate these same work tasks for a brief period and will do so above their ventilatory threshold. One consequence of the corresponding wasteful and inefficient respiration will be a significantly reduced time before the air supply runs out. ■

FITNESS FOR SURVIVAL

Fire fighters must perform physically demanding tasks for extended periods of time with the limited air supply they carry on their backs. Sometimes fire fighters must perform several tasks quickly to locate victims, extinguish the fire, or ventilate the structure. A general principle of fire fighting is that the more tasks needing completion, the more air required. So how can a fire fighter perform more work with a limited air supply?

The answer to this question is fitness and training. Increased cardiovascular fitness, coupled with muscular strength and endurance, allows the fire fighter to perform arduous tasks while breathing less air, thus conserving air for more tasks later on. If a fire fighter wishes to complete more tasks with the same bottle of air, they must improve their fitness level. Professional skill training will also improve work efficiency. By improving technique, a fire fighter conserves energy while performing tasks. The less effort required for a task, the less air consumed, and the more air available for other tasks.

For more information, visit the IAFF/IAFC Wellness Fitness Initiative at https://www.iaff.org/wellness-fitness/

DEFENSIVE OPERATIONS

The decision to go defensive and to disengage is dependent on many factors. Fire fighters must recognize changing conditions that shout…"BACK OUT!"
These include:

- Pressurized smoke exiting the structure.
- Smoke coming from the walls of the structure.
- Truss roof assemblies exposed to fire upon arrival of the fire department.
- Fire is self-venting from the roof of the structure.
- Two or more floors involved with fire.
- Any factor that is likely to destabilize the structure during the time that fire fighters will be working inside.

The Fire Department Safety Officer's Association (FDSOA) has established the "Rules of Disengagement" to assist in this decision making process. The FDSOA uses the acronym AWARE to help fire fighters remember when to disengage. AWARE means the following:

- A — Attack Progress
- W — Water supply
- A — Air Supply
- R — Resources
- E — Environment

Command continuously monitors the fire scene conditions to determine the ongoing strategy and tactics. A risk/benefit analysis regarding the safety of fire fighters is conducted using the risk management principles as stated in NFPA 1500 8.4.2.1, as previously cited.

ATTACK PROGRESS

Interior crews must disengage immediately if the fire is getting larger and progress toward extinguishment is slow.

WATER SUPPLY

Interior crews must disengage immediately when the water supply is not sufficient to slow the progress of the fire.

AIR SUPPLY

Immediate disengagement should occur if any SCBA problem or failure exists. Additionally, disengagement should occur prior to the low air alarm activating. Per NFPA 1404 Standard for Fire Service Respiratory Training, 5.1.8(4), members should be able to identify the variables that affect the duration of the air supply. These include:

- Travel distance and time to the immediately dangerous to life hazard (IDLH) atmosphere
- Amount of air when entering the IDLH atmosphere
- Travel distance and time in the IDLH atmosphere
- Coordination of team activities in the IDLH atmosphere
- Travel distance and time to a safe zone after working in the IDLH atmosphere

RESOURCES

Interior crews must disengage immediately when staffing and equipment is not adequate to slow the progress of the fire.

ENVIRONMENT

Immediate disengagement of interior crews should be considered if any of these conditions exist in the fire ground environment: signs of collapse; weather contributing to instability of the incident; crews not adequately rehabilitated to sustain their operation.

EMERGENCY EVACUATION

Evacuation from a building is far from easy. When an interior attack crew enters a structure, their objective is to locate and extinguish the fire. In the best cases they achieve that objective. However, the objective is not always achieved. Sometimes the crew must back out to save themselves and avoid a Mayday. Fire Fighters are trained to extend a hose line into a building to find the fire, but are fire fighters trained to evacuate when they recognize conditions changing?

On emergency evacuations, Francis Brannigan stated: The time to identify the best method of evacuation is before the situation occurs. Fire fighters and company officers must have a plan to follow when the order is given to evacuate.

EMERGENCY EVACUATION PROCEDURE

One common technique for leading a line into a fire is to have three or four fire fighters positioned at the tip. However, experience has shown this may not be the most effective method. So, how many fire fighters should be on a hose line?

By nature and training, fire fighters are aggressive and often resist orders to back out. The overall gravity of the situation may not be apparent to those fighting the fire. "We've got a good shot at the fire" is often an excuse for delay. The authors know of no fire department that drills on immediate evacuation. This is a critical oversight.[8]

The question can be answered with NFPA 1710 *Standard for the Organization and Deployment of Fire Suppression Operations, Emergency Medical Operations, and Special Operations to the Public by Career Fire Departments*. Section 5.2.4.1.1(3) requires a minimum of two members to effectively and safely maintain the hose line.

Additionally, there are requirements for the protection of those within the fire IDLH environment. OSHA 29 CFR 1910.134(g)(4) *Procedures for Interior Structural Firefighting*, also known as the Two-in/Two-Out rule, requires that there are at least two fire fighters stationed outside during interior structural firefighting, prepared to enter if necessary to rescue the fire fighters inside.

NFPA 1500, section 8.6, *Members Operating at Emergency Incidents* requires fire fighters to operate in teams of two.

8.6.4 Members operating in hazardous areas at emergency incidents shall operate in crews of two or more.

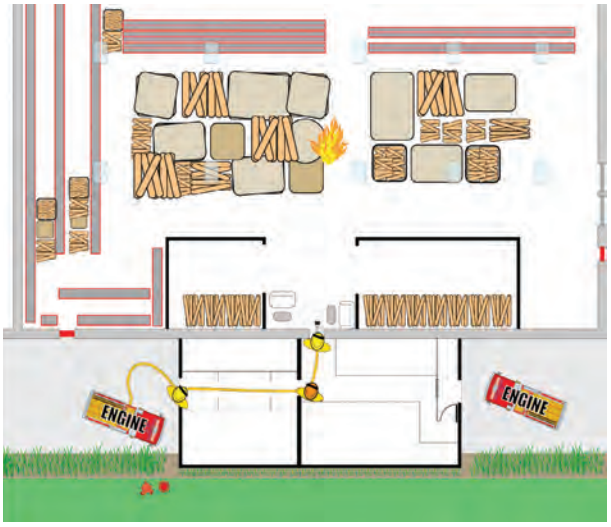
8.6.5 Crew members operating in hazardous areas shall be in communication with each other through visual, audible, or physical means or safety guide rope, in order to coordinate their activities.

8.6.6 Crew members shall be in proximity to each other to provide assistance in case of emergency.

However, two does not always provide for the most safety. The general rule is: The further the hose line must be extended, the more personnel required. Additional fire fighters are needed to guide the hose line around obstacles and to keep the hose line free from entanglement. The additional fire fighters on the line also act as safety personnel. As the hose line is advanced deeper into the structure, members should be added and positioned along the full length of the hose line.

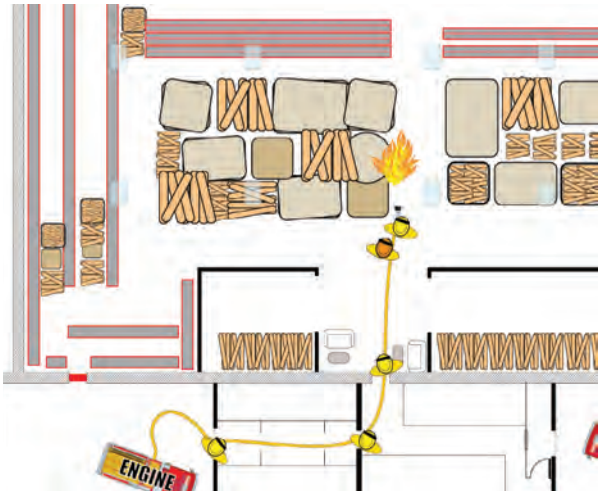
Safety is the priority when deploying a line into a building with limited visibility. Company officers must consider the reality of something going wrong and the need to back out. Members should be positioned on the hose line with egress in mind. This means personnel should be staggered on the hose line in specific areas where a point of egress is identified.

A crew of three entering a building should have a fire fighter on the tip, an experienced fire fighter or company officer backing up the tip, and another fire fighter at the door, or point of egress.



This positioning allows the most experienced member to communicate decisions to the fire fighter on the tip. If water must be used to cool the environment, the most experienced member is in the position to give the order. If the line must be extended deeper into the building, a request for more personnel should be transmitted on the radio or given through verbal relay.

When crew members must extend the line through multiple doorways and hallways, a fire fighter should be positioned approximately ten feet behind the most experienced member. This fire fighter is responsible for ensuring the hose line remains free of obstacles, while the line is advanced to the fire.



The last fire fighter at the door is possibly the most important member of the team. This fire fighter is responsible for maintaining a viable egress and monitoring conditions inside from a safe vantage point outside, and this fire fighter may also perform door control if deemed necessary." This fire fighter's sole responsibility is the safety of the personnel on the hose line. This fire fighter must monitor smoke and building conditions throughout the operations. If smoke conditions worsen and warrant backing out, the fire fighter communicates this information to those on the line.

When the order to back out is given, all personnel on the hose line have a responsibility to ensure the member initially positioned in front of them is now behind them. Sometimes the order to back out is not heard by all members on the hose line. For this reason, it is important for members to look out for one another.

When backing out, consideration must be given to the fire fighter at the tip. If all members on the line begin pulling the line toward egress, the fire fighter at the tip risks losing control of the nozzle. The tip fire fighter may want to keep the nozzle in his or her possession while backing out if the water stream is needed for protection during retreat. In other cases a fire fighter may leave the nozzle, turn 180 degrees, and follow the hose line outside. In either case, the movement of the hose must be dictated by those positioned at the tip.

The evacuation of crew members should be quick and orderly, which requires discipline from each member positioned on the hose line. Remember, because of worsening conditions and lack of visibility, it most likely will take longer to back out or evacuate the building. If conditions are worsening rapidly, abandon hose lines and equipment and get out fast! In this case, the most experienced fire fighter or company officer positioned behind the tip should position the tip fire fighter in front of him or her so accountability can be maintained and no one is left behind.

MAINTAIN AWARENESS OF CHANGING CONDITIONS

Awareness of worsening conditions, such as continued increase in heat or flame production, or cracking noises should alert the fire fighter that it's time to exit the building. Monitoring radio traffic may also indicate worsening conditions on the fire ground which could affect the fire fighter's safety. The fire fighter should never hesitate abandoning a position and exiting the building if conditions worsen.

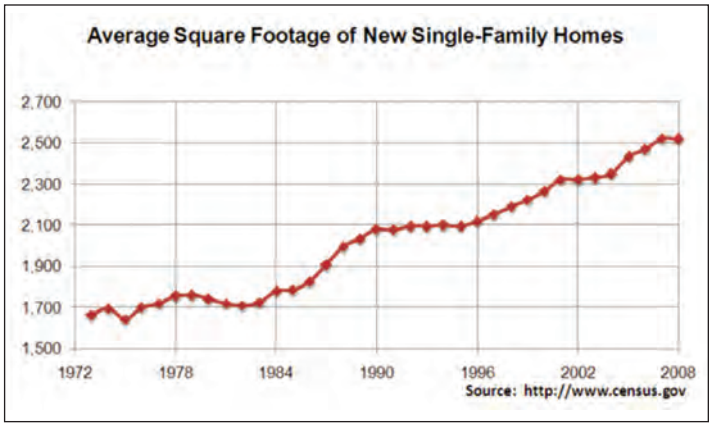
TODAY'S FIRE ENVIRONMENT

Underwriter's Laboratories has noted a number of changes in todays fire environment during their ongoing fire experiments. A summary of some of these changes can be found in module 2 of UL's *Study of the Effectiveness of Fire Service Vertical Ventilation and Suppression Tactics in Single Family Homes.* [9]

http://content.learnshare.com/courses/73/456883/story.html

The environment that fire fighters operate in today has undergone significant changes over the last 30 years. The fires that fire fighters face today are vastly different from those faced by our predecessors.

The average size of a single family home in North America has been steadily increasing since 1975. In addition, a home built today is likely to be 2 stories and contain an open floor plan with high ceilings and 2 story foyers or great rooms. Conversely, a house built in 1975 was equally as likely to have been a split level or a bungalow as a 2 story and would have had a very compartmentalized floor plan with lower ceilings. These characteristics of modern homes allow fires more air and more paths of potential growth and smoke movement throughout the structure as opposed to the compartmentalized nature of a legacy home. Fuel loads in all structures have also dramatically changed over this time period. Most home and commercial furnishings, wall and floor coverings and general building contents have transitioned from the use of natural materials (solid wood, cotton and wool) to hydrocarbon based low mass synthetic materials (engineered wood products, plastics and synthetic textiles).



The average North American family has an abundance of possessions, which are stored in their home. This contributes to the overall fuel load of the average home, not to mention most of these possessions are made from high heat release rate (HRR) synthetic materials. This does not take into account the growing problems that hoarders are posing for Fire Departments in North America.

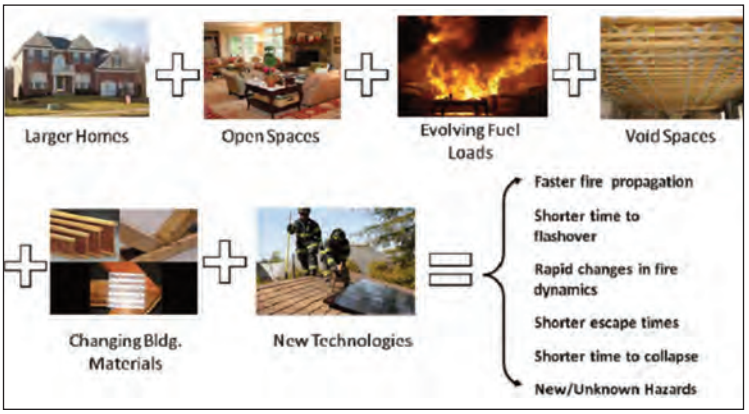
These materials decompose rapidly when heated providing an abundance of fuel to drive their high HRR. Some of these materials have HRRs as high as liquid hydrocarbons.

Legacy Vs. Modern — UL (2010)

These features of the modern home provide much more oxygen to fuel fire growth before the fire becomes ventilation limited and with today's fuels (structure contents) today's fires exhibit rapid growth and oxygen consumption. When fire fighters arrive at a fire today they are likely to face a ventilation limited fire with exponential growth potential. 30 years ago fire fighters likely arrived to a fuel limited fire with a much less explosive growth potential.

Couple these changes with the changes in construction methods and the transition to lightweight engineered materials in many building types and the fires of today are more volatile and dangerous than in the past. The fire environment will continue to change and evolve in the years to come as new technologies emerge. An example currently occurring is the more widespread use of alternative energy sources such as solar and wind power. We have yet to fully understand what the ramifications of these technologies will be in the future.

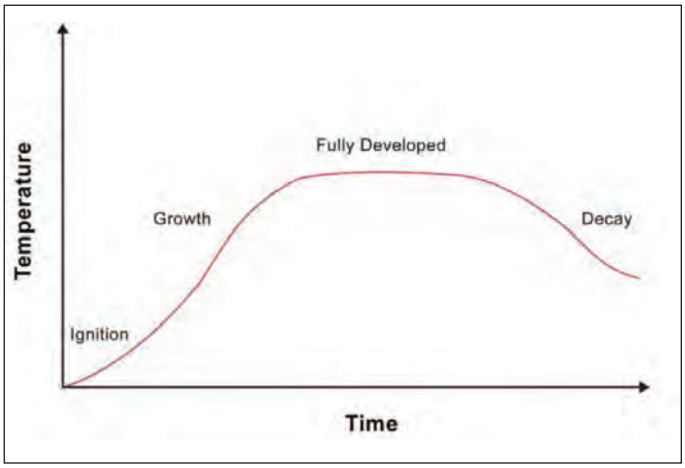
The fires of today exhibit faster fire propagation, shorter times to flashover, rapid changes in fire dynamics, shorter escape times for fire fighters and civilians, shorter times to collapse and new and unknown hazards.



Source: UL Fire Service Research Institute

TRADITIONAL FIRE DEVELOPMENT

The Traditional Fire Development curve shows the time history of a fuel limited or fuel controlled fire. In other words, the fire growth is not limited by a lack of oxygen but by the amount of fuel available. As more fuel becomes involved in the fire, the energy level continues to increase until all of the fuel available is burning (fully developed). Then as the fuel is burned away, the energy level begins to decay. The key is that oxygen is available to mix with the heated gases (fuel) to enable the completion of the fire triangle and the generation of energy. This type of fire growth curve would describe an object being burnt outside where oxygen is plentiful, e.g. a couch in a parking lot.

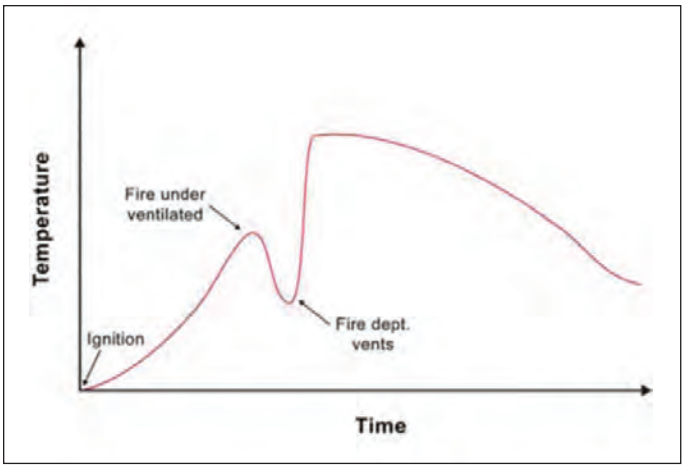


Fire Development: Traditional – NIST (2014)

FIRE DEVELOPMENT IN A STRUCTURE

The Fire Development in a structure curve demonstrates the time history of a ventilation limited fire. In this case the fire starts in a structure which has the doors and windows closed. Early in the fire growth stage there is adequate oxygen to mix with the heated gases, which results in flaming combustion. At this point the fire is fuel limited or fuel controlled. As the oxygen level within the structure is depleted the fire decays, the HRR from the fire decreases and as a result the temperature decreases.

When a vent is opened, such as when the fire department enters a door, oxygen is introduced. The oxygen mixes with the heated gases in the structure and the HRR and temperature begin to increase. This change in ventilation can result in an exponential increase in fire growth potentially leading to a flashover condition.



Fire Development in a Structure – NIST (2014)

RAPIDLY CHANGING FIRE CONDITIONS:

The NIOSH LODD Report and National Institute of Standards and Technology (NIST) Scientific Study of the June 2011 LODD of two San Francisco Fire Fighters in a hillside residential house fire.

Post incident analysis of fire fighter fatality incidents by NIST's Fire Dynamics Simulator (FDS) (NIST Technical Note 1856) have confirmed how quickly fires progress to create deadly conditions in enclosed structures. On June 02, 2011, a 48 year-old career lieutenant and a 53 year-old fire fighter/paramedic died in a multi-level residential structure fire while searching for the seat of the fire.

The fire floor was one floor below street level. Six companies and three command chiefs were dispatched to a report of an electrical fire at a residential home. When Engine 26, staffed with a lieutenant, fire fighter/paramedic (the victims), and driver arrived at approximately 1048 hours, they noticed light smoke showing as they made entry up an exterior half landing of stairs from the street and through the front door on the Alpha side of the building. Minutes later, the incident commander (IC) tried contacting them over the radio, but received no response. A battalion chief (BC) assigned to "the fire attack group" followed the hoseline through the door and spoke to the victims on the street level floor. The lieutenant stated to the BC that the fire must be a floor below them. The BC stated they would attack the fire from the side B of the structure and exited the front door. The victims did not follow. A few minutes later the IC again tried to contact Engine 26 via radio with no response. The crew from Engine 24, assigned to back up Engine 26, and a split crew from Rescue 1 tried to make entry through the door in the garage but could not advance due to the heat. The BC went to the side B door, located one floor below street level, and forced the door with the Engine 11 crew on the hoseline. They immediately felt a blast of heat from the fully involved basement area. The Rescue 1 crew backed out of the garage and re-entered on side Bravo after the Engine 11 crew knocked down the large room and contents fire. At about the same time, the Engine 24 crew also backed out of the garage and followed the Engine 26 crew's hoseline through the front door. In zero visibility conditions, separate members of the Engine 24 crew independently found a downed member of the Engine 26 crew. The Incident Commander was alerted of a downed fire fighter but, did not initially realize, until moments later that it was actually two downed fire fighters. Both victims were removed from the structure and immediate medical treatment was provided. The victims were transported to the local medical center where the lieutenant was pronounced dead and the fire fighter/paramedic died two days later.

Incident Time	Events	Simulation Time (seconds)
10:45:00	Dispatch for a curtain fire due to an electrical short at a residential structure.	
10:48:00	E26 arrives on scene, reports light smoke conditions, and makes entry into the front door with a 1 3/4 in hoseline.	
10:53:00	Fire Dynamics Simulator (FDS) begins.	0
10:54:00	E26 crew states that the fire is located below the first floor.	60
10:56:00	BC9 observes smoke but no fire at the left rear corner of the structure.	180
10:58:42	Fire self-vents from the rear side of the structure when a glass window in the basement fails. Additional glass windows on the rear side of the structure fail within the next two minutes.	342
10:59:23	BC9 forces open the basement door on the left side of the structure, reports heavy fire and smoke, and requests a second hoseline.	383
11:00:00	BC6 notices a severe change in conditions (heavy black smoke from garage).	420
11:01:00	Heavy fire and black smoke observed at rear of structure. Incident command (IC) attempts to contact E26 several times via radio with no reply.	480
11:02:00	E32 crew makes entry into the basement with a second hoseline and begins suppression operations. FDS simulation ends.	540
11:08:00	Two downed E26 fire fighters are found on the first floor.	
11:09:00	The downed E26 fire fighters are carried out of the structure.	

The NIOSH incident report indicated that fire fighters located in the interior stairwell on the front side of the structure determined that the fire was located in the basement. From the simulation results, the conditions in the interior stairwell were initially tenable. After the rear basement windows failed, the simulation results indicate a high-hazard area in the stairwell near the laundry room landing area that exceeded the conditions of a Class III exposure (temperatures greater than 500 ○F). The simulation results indicate that a flow path was established between the basement living room area and the doors located on the front side of the structure (the front door and the garage door) after the rear basement windows failed. The rear basement window failures resulted in a rapid change in the conditions within the flow path. After the rear basement windows began to fail, the combustion gases at elevated temperature and pressure in the basement flowed upwards towards lower pressure regions via the interior stairwell. The two fire fighters were located in the flow path between the basement and the doors on the front side of the structure.

A person is susceptible to second-degree burn injuries if exposed to temperatures greater than 130 ○F. Although fire fighters wear protective gear, gear only offers a finite amount of protection. Structural firefighting coats and pants are tested to withstand temperatures of 500 ○F. Prolonged exposure to elevated temperatures can result in a significant amount of heat transferred to the fire¬ fighter, putting him or her at risk. Exposure of equipment to temperatures of 500 ○F represents a Class III exposure. Fire fighters are at increased risk levels when encountering Class III exposure conditions for more than 5 minutes.

Based on the simulation results, after the rear basement windows failed, the simulated flow path temperatures in the interior stairwell were in excess of 1300 ○F and the flow velocities were approximately 20 mph. The conditions in the interior stairwell changed from tenable to high-hazard very rapidly following the rear basement window failure. Within the structure, the hot gases and smoke were moving along the flow path from the basement towards the doors located on the front side of the structure via the interior stairwell. The simulated temperatures are consistent with the post-incident conditions that were documented in the interior stairwell. The hot gases in the flow path were exiting the structure from the garage door and front door, as shown in the NIOSH incident report, at a time of 10:58:42 (approximately when the rear basement windows failed), another firefighting crew attempted to enter the house via the garage door into the first floor landing area leading into the basement and reported "untenable conditions in the garage door to [the] house that [forced] them to look for an alternate way to enter the structure."

THE NIOSH REPORT F2011-13

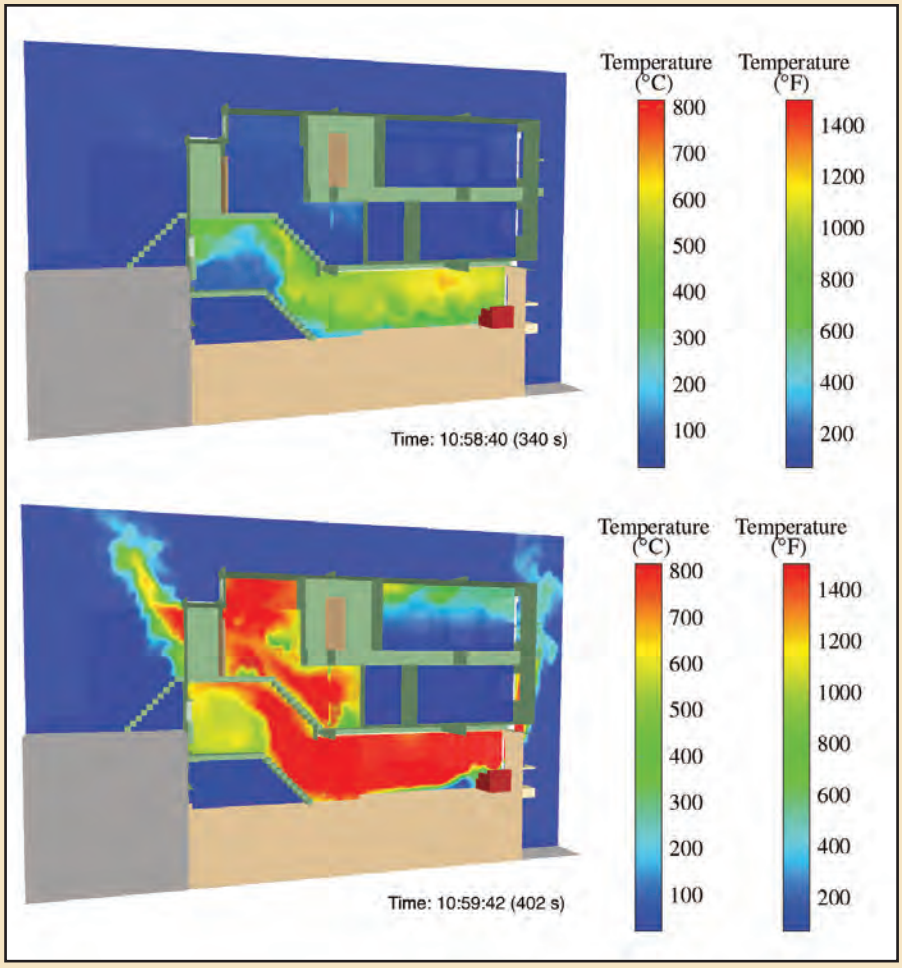
(https://www.cdc.gov/niosh/fire/reports/face201113.html), includes several findings and recommendations to avoid this type of incident in the future including the following:

CONTRIBUTING FACTORS

1. Natural and operational horizontal ventilation
2. Ineffective size-up
3. Fire fighters operating above the fire
4. Ineffective fire command communications and progress reporting
5. Lack of a personnel accountability system.

KEY RECOMMENDATIONS

1. Ensure that an adequate size-up of the structure is conducted prior to crews making entry
2. Ensure that a personnel accountability system is established early and utilized at all incidents
3. Ensure that fire ground operations are coordinated with consideration given to the effect horizontal ventilation has on the air flow, smoke, and heat flow through the structure
4. Ensure that fire fighters are trained in Mayday procedures and survival techniques



SUMMARY

All fire ground personnel are responsible for safety and must be aware of fire conditions that may lead to a Mayday situation. From the arrival at the incident to the extinguishment of the fire, all personnel must maintain situational awareness to prevent a Mayday. A coordinated effort with good communications will help with an ongoing assessment. Ongoing reports from interior operations, ventilation teams and exposure groups help the IC make better decisions to continue the current attack or move to a defensive, exterior position. Preventing a Mayday requires all personnel to communicate what they see, especially when conditions indicate immediate disengagement is necessary. ■

1 The NIOSH ALERT can be found on the NIOSH Fire Fighter Fatality Investigation and Prevention Program website at http://www.cdc.gov/niosh/docs/2005-132/pdfs/2005-132.pdf.

2 The NIOSH report (F2000-13) can be found at http://www.cdc.gov/niosh/fire/reports/face200013.html.

3 The complete NIOSH reports can be found at, respectively: http://www.cdc.gov/niosh/fire/reports/face9817.html, http://www.cdc.gov/niosh/fire/reports/face200103.html, http://www.cdc.gov/niosh/fire/reports/face200414.html, http://www.cdc.gov/niosh/fire/reports/face200627.html, http://www.cdc.gov/niosh/fire/reports/face201120.html

4 The full report can be found at http://www.cdc.gov/niosh/fire/reports/face200220.html.

5 The full report can be found at http://www.cdc.gov/niosh/fire/reports/face200509.html.

6 These rules of engagement can be found on the IAFC website at http://www.iafc.org/displayindustryarticle.cfm?articlenbr=39522

7 http://www.cdc.gov/niosh/fire/reports/face200619.html

8 Brannigan, Francis. Building Construction for the Fire Service, 4th Ed., p. 5, Introduction, Watch Your Language.

9 Kerber, S. (2013). Study of the Effectiveness of Fire Service Vertical Ventilation and Suppression Tactics in Single Family Homes. Northbrook, Ill: Underwriters Laboratories

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CHAPTER 2
BEING READY FOR THE MAYDAY

CHAPTER 2
LEARNING OBJECTIVES:

After reading this chapter students will be able to:

- Identify three key requirements that make a fire department “Mayday Ready”.
- Explain how to use Personal Safety Equipment to be “Mayday Ready”.
- Describe the communication system necessary during a Mayday.
- Identify recommended radio equipment and use.
- Describe the personnel accountability system.

CHAPTER 2
BEING READY FOR THE MAYDAY

INTRODUCTION

In this chapter you will learn why personal safety equipment, teamwork, and training are three key requirements that make a fire department and individual fire fighters ready for the Mayday.

You will also learn about the required and recommended safety equipment and tools that could help you survive a Mayday.

Finally, you will learn why the communication system is so important in a Mayday situation, and how communications should work to save fire fighters' lives.

MAYDAY-READY REQUIREMENTS

Fires of all sizes have taken the lives of fire fighters in all parts of North America. Each fire is different, and sometimes operations go poorly. Unforeseen situations often threaten fire fighters' lives, and fire fighters must be ready for them. This section explains three major readiness requirements.

SAFETY EQUIPMENT

Each fire fighter must be outfitted with the appropriate safety equipment. Fire fighters must have confidence in their equipment and know how to use it to both save themselves and to alert rescuers to their location.

A TEAM

A Mayday involves all personnel assigned to an incident: individual fire fighters, company officers, chief officers, dispatchers, and emergency medical service personnel. All must know their role and the role of the others, when a fire fighter calls a Mayday. A successful Mayday, is one that ends in a fire fighter's life being saved. Achieving this requires more than hope, and much more than luck. A successful Mayday conclusion is achieved through the coordinated effort of all personnel on scene.

TRAINING

Fire department personnel must be trained in Mayday procedures. Dispatchers must know how to respond to a Mayday call. ICs must know how to manage a Mayday incident. Fire fighters must know how to use their equipment to alert rescuers to their location. One person not performing their responsibilities can result in failure of the system. Frequent drills — touching all aspects of Mayday operations — is the only way for a fire department to be ready for a member needing immediate assistance.

The challenge for fire departments is providing realistic, safe training that accurately simulates fire conditions. This is absolutely necessary for Mayday training. Fire fighters must be placed in positions that closely simulate an actual fire to realistically exercise their Mayday skills.

PROJECT MAYDAY

"PROJECT MAYDAY" is a study of mayday responses, incidents and prevention. This on-going project is a groundbreaking study of more than 5,000 maydays from around the nation. The study has identified a number of commonalities including the following:

Contributing Factor	Percent of Mayday Incidents in Study
Time of Day	51% between midnight and 0600 hours 77% occur during the second half of a 24-hour shift
Incident Time	30% 5-20 minutes after arrival
Arrival Order	82% involved one of the first two arriving companies 57% first arriving 25% second arriving
Size Up	76% incomplete 360 survey of the structure 61% no 360 16% incomplete 360 48% of completed 360 surveys, confirmed smoke and or fire in a different location than what was initially scene
Occupancy Type	42% Residential 38% Commercial 24% Apartments
Command	71% the company officer of the Mayday crew, remained outside to be the Incident Commander 67% prior to the establishment of a stationary Command Post
Operations	40% of MAYDAYS occur after the fire was reported to be "knocked down" 66% had NO accountability process in operations at the time of the Mayday 29% of Mayday situations were NOT reported as Maydays
Radio	No contact with the victim – 35% were on the wrong channel 23% radio was OFF 16% radio had dead battery 60% had difficulty transmitting because of radio traffic.
Problem Type	41% falls through roof or floors 19% lost or separated 15% SCBA or out of air 12% trapped or unable to move
	Rescue
35%	Self-Rescue
26%	Member of the Mayday Firefighter Crew
26%	Adjacent Interior Crew
7%	Rapid Intervention Team

The frequency of Mayday training is not mandated by any international, national or state fire service training organization. To satisfy the need for Mayday training, most fire departments offer annual training on the topic. However, how can fire personnel actually perform all Mayday skills proficiently after only being exposed to the material once per year?

The Chesterfield Fire Department conducted a promotional exam where personnel were put through a Mayday situation to find how they would perform. The results identified many areas where additional training was needed. Sometime later, the Savannah Fire and Emergency Services implemented Project Impact. The design of the project was to put personnel through a simulated Mayday experience to identify the actions they would perform if they were faced with a Mayday situation. Tim Sendelbach of the Savannah Fire Department shared the results of Project Impact within the article titled, Putting it to the Test, Prepare Fire Fighters for their Own Worst Day, in the July 2006 issue of Fire Rescue Magazine.

Project Impact was based on the following belief:

> "If we know what a firefighter's reaction might be in a specific situation [due to proper training and standardization], we can react appropriately and with a higher degree of success [predictable actions = manageable rescue]."

The study included 160 fire fighters. The fire fighters were assigned to a crew and each crew was given a specific role within the simulation of a shopping center fire. Participants were told:

> "You and your crew are stretching a 1 ¾" hand line into a structure when you encounter cold smoke and zero visibility. While maintaining voice contact with your crew, you begin searching for the fire. Suddenly, you no longer have voice contact with your crew and become lost and disoriented. This is not a training scenario; your life depends on your actions."

The results speak to the need to train more frequently on Mayday procedures. Although it seems basic to use the radio to call a Mayday, only half of the participants used it. Even less activated their PASS. Although a large percentage looked for an exit, many did so silently, without the aid of calling a Mayday, making noise or signaling using a flashlight.

Test Actions	% Performing Action
Attempted radio contact	52%
Activated PASS	38%
Search for exit	82%
Noise with tool	8%
Signal with flashlight	3%
Follow hoseline	9%
E-trigger activation	4%
Initiated breathing techniques	1%
Lost PPE (glove, boot, etc.)	1%
Lost radio	<1%
Covered PASS to listen	<1%
Passed over hoseline	<3%
Removed glove(s)	15%
Exit building to safety	<4%

Mayday training is fire fighter safety training. It must be performed on a more frequently than once a year. Within the Executive Fire Officer Program research paper titled, "An Assessment of Skill Retention in Personnel Trained in Rapid Intervention Crew and Saving Our Own Techniques", Deputy Chief Robert Metzger of the Toledo Fire Department found that Mayday skills deteriorate if they are not well maintained with an on-going training program.

Fire personnel must have several opportunities throughout the year to exercise their Mayday skills and learn new techniques to prevent a Mayday. Training divisions must be the lead in offering these opportunities. They should schedule several multi-company Mayday simulations throughout the year. The simulations allow chief officers to act as IC's, while company officers direct fire fighters, in a simulated fire environment. Dispatchers should also be used in these drills so they may have an opportunity to improve their radio communication skills during a Mayday. These drills should require personnel to don all protective gear and to perform fire fighting skills as they would during an actual Mayday. Exercising all facets of an actual Mayday incident will help personnel create mental images of fire fighters performing actual skills during a Mayday. Mental images help in the recall of information during an actual incident. A safe fire ground is maintained with fire fighters who can recognize hazards, and can perform instinctively during a Mayday situation. This can only be achieved if all ranks and dispatchers routinely review and practice their Mayday procedures.


CAPT. JONES


AYER
CHAPLAIN

AUSTIN FIRE DEPARTMENT — 2000 MEDAL OF HONOR RECIPIENT
FIREHOUSE — FIRE FIGHTER OF THE YEAR

HERE IS A PERSONAL MESSAGE FROM AX:

My name is Alphonse X. Dellert. Everyone just calls me Ax. I've been a fire fighter with the city of Austin for 22 years. I'm on Engine 43 c-shift. Up until three years ago I had been on Engine 6 c-shift. Engine 6 is located in the south central Austin area. That station and territory had given me many years of experience.

On January 5, 2000, while on Engine 6, we responded to an apartment fire at about 5:30 a.m. Upon arrival the fire was reported to be a small fire and under control. We expected to be released very shortly, so we decided to go over to the crews on scene and say hello. My buddy took off his airpack before leaving the unit, thinking it wouldn't be needed. I kept mine on, along with the rest of my gear. It didn't take long to realize the fire was not out but growing very quickly.

On the inside of the apartment building, Ladder 35 was making their way in to investigate. Ladder 35 Captain sent his two fire fighters to get a smoke ejector. As he entered the structure he found the hallway filling with smoke. At this time he decided to do a quick right hand search of the apartment. As he made his way into the bedroom, it flashed over on him. He was knocked to the floor and couldn't get up. He later told me that it felt like a giant hand was pushing and holding him down on the floor. He tried to call for help on his radio, but couldn't because the cord to his mic melted. As flames rolled out the windows, he said he yelled through his mask, "Help me, I'm burning."

I was outside not far from one of the engines. Somehow I heard him very clearly, even with him having his face piece on and all the noise outside. He was in the second story apartment, and I was at ground level. Luckily, a ladder had been put into the apartment's window to break out the window and help ventilate. There was also a charged hand line lying at the foot of the ladder. I listened again to make sure I heard him again calling for help. I went up the ladder with the hand line and pushed back the flames to get in. Once I was in, the flames came back on me. Instantly I felt my left ear burning through my hood. I was wearing all of my protective gear. I heard the Captain call again. I turned and saw a sliver of light on the floor. It was his hand light. Once I got to John, I helped him up and to the window. Another fire fighter was on the ladder flowing water at the ceiling to keep it from flashing again. Once we made it to the window, the fire fighter on the ladder took the Captain from Ladder 35 from me and helped pull him out. The Captain tumbled out and landed on the ground while the fire fighter held on to break his fall.

Alphonse X. Dellert

At this time I felt myself burning, and I knew I had serious burns. I wanted to get out quick, so I followed the wall to the next window and jumped.

The Captain was burned over 53% of his body. He was transported to the burn unit in San Antonio and had numerous graft surgeries. I sustained numerous burns to both arms that required graft surgery.

I share my story because I want others to know how important donning your personal protective equipment is. I often wonder how severe our burns would have been had we not donned all of our safety equipment. What if the Captain did not have his light on? Would I have been able to see him? The answers to these questions are difficult to take.

I also can't overstate the need to be Mayday ready. You never know what will or can happen. You need to prepare for the worst situations on the fire ground. My philosophy is: it's easier to take safety equipment off on the way back to the station than to put equipment on in a rush. It could be your hood, flashlight or even gloves…keep it on so you're ready. Never assume the fire is out and all is safe until you're cleared from the scene and on your way home.

Thank you very much,
Ax Dellert

PERSONAL SAFETY EQUIPMENT

What fire fighters see upon arrival on the fire ground can change in minutes as fire burns through a building. In such an unpredictable environment, fire fighters must control the things they have control over. One item all fire fighters have control over prior to arrival is their personal safety equipment. Each fire fighter has a responsibility to themselves, and to their fellow fire fighters, to ensure their safety equipment is in proper working order everyday and at every incident. Being ready for a Mayday means your personal safety equipment meets current NFPA standards and is well maintained.

NFPA 1971 *Standard on Protective Ensembles for Structural Fire Fighting and Proximity Fire Fighting* specifies the minimum design, performance, and certification requirements for the structural fire fighting ensemble, as well as the test methods that must be used by manufacturers to demonstrate compliance to these standards. NFPA 1971's purpose is to "establish minimum levels of protection for fire fighting personnel assigned to fire department operations including, but not limited to structural fire fighting, proximity fire fighting, rescue, emergency medical, and other emergency first responder functions.

NFPA 1500 *Standard on Fire Department Occupational Safety and Health Program* requires that all fire fighters operating at any emergency scene wear the appropriate protective clothing and equipment suitable to that incident. (NFPA 1500, Section 7.1.2). Additionally, station uniforms worn by on-duty fire fighters should meet the requirements of NFPA 1975 *Standard on Station/Work Uniforms for Fire and Emergency Services.*

Personal safety equipment should be made of materials that possess the most protection in super-heated environments and minimize the restriction of physical movement so energy is conserved while fighting a fire. The following standards must be met:

PROTECTIVE CLOTHING

According to NFPA 1971, the full ensemble of protective clothing consists of the following:

- Helmet — Protects the head from impact, scalding hot water, and other products of combustion.
- Protective hood — Protects portions of the face, ears, and neck not covered by the helmet or the coat collar from heat.
- Protective coat and trousers (turnout garments) — Protect the trunk and limbs from cuts, scrapes, and burns; protect against heat and cold, and provide limited protection against corrosive agents.
- Gloves — Protect the hands from cuts, scrapes, and burns. Gloves must fit properly to allow the fire fighter to handle tools.
- Safety shoes or boots (footwear) – Protect the feet from burns and punctures.

NOTE: All of the above equipment must fit according to manufacturers' specifications, maintaining the appropriate amount of air space to assure protection from heat. Wear only equipment authorized and approved by your department. Do not modify your personal protective equipment (i.e. remove coat liner).

REQUIRED LABELS

All components of the personal protective ensemble must have an appropriate product label for that component permanently and conspicuously attached, which must contain the following information:

This structural fire fighting protective [....] meets the requirements of NFPA 1971, *Standard on Protective Ensembles for Structural Fire Fighting*, [current] edition.

NFPA 1981 *Standard on Open-Circuit Self-Contained Breathing Apparatus (SCBA) for Emergency Services* specifies the minimum design, performance, and certification requirements for SCBA. NFPA 1982 *Standard on Personal Alert Safety Systems (PASS)* specifies the minimum design, performance, and certification requirements for PASS devices.

REQUIRED PROTECTIVE EQUIPMENT

As per NFPA 1500, personal protective equipment required for structural fire fighting operations must include SCBA and the PASS.

- Self-contained breathing apparatus (SCBA) – Protects the lungs from heat, smoke, and other toxic products of combustion, and airborne particulates. Also provides some protection to the face and eyes from airborne particulates and flying objects. Fire fighters must know the quantity of air in their SCBA at all times. Air bottles should be maintained at full capacity. Fire fighters are Mayday ready when they can don, doff and manipulate all parts of their SCBA in a zero visibility environment, with gloved hands while remaining low to the ground,

- Personal alert safety system (PASS) – Provides an audible means by which a lost, trapped, or incapacitated fire fighter can be located. Fire fighters are Mayday ready when they are able to activate and de-activate their PASS devices with gloved hands quickly. This is necessary so radio transmissions can be transmitted and heard.

NOTE: Radio communications and personal radios will be discussed under the Communication section of this chapter.

FLASHLIGHT

Although not listed within an NFPA standard, all fire fighters entering an IDLH environment must ensure their flashlight is turned on. Fires often generate enough smoke to darken interior areas, even during the daytime. Therefore, regardless of time of day, the flashlight must be turned on prior to entering an IDLH environment.

The most versatile lights are hands-free models that can attach to the front of the turnout coat, direct the beam forward, and move with the fire fighter. Some fire fighters hang a light from a strap around their shoulders. When in the crawling position the light points forward providing light in the direction of travel. Helmet models are a good secondary light, provided they are low profile and do not increase entanglement potential. Lights that must be taken out of pockets and held are useless to fire fighters. Getting the light out of a pocket with gloved hands, with limited visibility, in a super heated environment is near impossible. Fire fighters who are Mayday ready have a light that works, and is accessible.

The flashlight not only assists the fire fighter in performing fire fighting and rescue operations; it can also assist a Rapid Intervention Crew (RIC) in finding a fire fighter calling a Mayday. Survival may depend on a rescuer locating the light.

ADDITIONAL RECOMMENDED EQUIPMENT

Additional equipment, though not required, has proven to improve fire fighter survivability. Consider the following factors when selecting equipment and tools:

- Building size and configuration (basement, multi story, warehouse)
- Building construction (masonry, wood frame, steel)
- Accessibility and obstacles
- Visibility
- Fire size and fire load
- Assignment (ventilation, fire attack, search and rescue)

TOOLS

With the increased smoke and heat production of modern synthetic materials, time management is critical, and survivability inside a structure is tenuous. The following tools have been shown to increase survivability:

- Escape and Rescue Ropes — Escape and rescue ropes and straps may be used for emergency egress from above-ground locations and for victim rescue. Every fire fighter should know the capabilities and limitations of their ropes and rescue systems. Rope systems selected for use should meet NFPA 2500, *Standards for Operations and Training for Technical Search and Rescue Incidents and Life Safety Rope and Equipment for Emergency Services*.

- Thermal Imaging Camera (TIC) — No longer is a search team walking blindly through smoke-filled rooms searching for victims or a way out. The TIC assists teams in finding victims or downed fire fighters in reduced visibility. Initial attack teams can use the TIC to track the progress of the team members and to monitor the temperature they are entering. This knowledge assists with making a decision to disengage and prevent a Mayday situation. TICs selected for use should meet NFPA 1801, *Standard on Thermal Imagers for the Fire Service*.

NOTE: Tests by Underwriters Laboratory indicate that the insulative qualities of wood floors and carpeting, as well as the insulated areas of an attic space above the ceiling prevents the TIC from sensing the true extent of a major fire in the basement or attic space. Only opening the spaces will provide a more accurate reading of fire involvement.

- Hand tools — Some fire fighters carry short handled axes around their waists. Axes can be used to breach a wall, to move debris, or even to make a tapping noise if he or she is lost. Engines, trucks, and rescues are rolling toolboxes. Fire fighters may find many creative uses for these tools, including "forcible exit" tools, to get out of rapidly deteriorating structures.

- Hose lines – Extending a hose line toward the seat of a fire enables fire fighters to control the incident and save property and lives. Deploying lines will also save fire fighter lives. There are many examples where a fire fighter was trapped on a floor above the fire while searching for victims. Some of these incidents have resulted in fire fighter fatalities. This can be avoided by positioning charged hose lines on the fire floor to contain the fire and to protect fire fighter egress. The hose line should also be viewed as a cooling device for fire fighters when necessary. As temperatures increase, water can be carefully applied to cool the environment to make it more tenable. Fire fighters should be trained in controlling the fire environment using water application, while preventing the disruption of the thermal layer.

  The hose line should also be viewed as a lifeline to the outside. Fire fighters must remain in contact with the hose line and be able to "read couplings by touch" to determine which direction leads to a safe egress.

- Search lines — Search lines are used to keep fire fighters connected to a point of egress while searching a large area. Although a hose line is preferred, search lines may be necessary due to the time available to make a rescue. The search line must be anchored to a fixed point that leads directly to a safe egress.

- Wire cutters — While there are varying opinions related to the type of wire cutters to use and the location to carry them, most will agree that whatever type carried, they should be capable of cutting through common types of wires and conduit found in residential and commercial structures.

  "Cable Cutters" are recommended because they have shown to be the best combination of cutting ability and ease of use. The advantages over other types of cutters include the size and shape of the cutting blade, which is larger than most and shaped to prevent the tool from slipping off the material during a cut. Another advantage is the entire head of the tool is designed to cut. This prevents the possibility of crimping wires instead of cutting them which often occurs in low visibility when using side cutters.

  The ideal location to carry cutters in a pocket accessible by either hand. In the past, the radio chest pocket found on most turnout coats was an excellent location. However, as radios have decreased in size, the radio pocket has also become smaller. Storing cutters in the smaller pocket often results in the handles of the cutters being exposed and possibly causing an entanglement hazard. If a chest pocket is not a viable option, the next best location is in a pocket accessible to the dominant hand. Because these pockets tend to be larger, a problem often encountered is that the cutters lie horizontally in the pocket and become buried under tools and other equipment. A simple solution to this problem is to use a short section of webbing attached to both arms of the cutter. When the cutters are placed in the pocket, the webbing is laid over the Velcro outside the pocket. This method keeps the cutters positioned vertically in the pocket and allows immediate access to the tool without having to place a gloved hand into the pocket. Another remedy is to add a golf ball to the webbing and a spring to the handle to allow for one-handed use.

- Ladders — Timely and adequate placement of ladders facilitates rescue, ventilation, and Rapid Intervention Team (RIC) operations. The general rule is to ladder all access and egress points of a structure where a victim or fire fighter could be. Fire fighters have been stranded at windows with no way to get down safely due to ladders not being in position.

  Care should be taken when placing ladders for egress to not break or damage windows when placing the ladder. A broken window could generate an unanticipated flow path within the structure endangering interior crews. Ladder tip placement should be at or slightly above the sill to allow fire fighters easier egress. Ladder location and placement should also be communicated to all interior crews at the scene.

  Setting the ladder at the proper climbing angle is critical. A flatter angle of 60 degrees, as opposed to the traditional 70 degrees is recommended for some ladder egress techniques. The flatter angle lessens the strain placed on the arms during descent for fire departments using the head first technique. Caution should be exercised when using the ladder at a flatter angle due to the ladder base potentially sliding away from the building if it is not properly tied off at the tip and anchored at the base. Other upper floor egress techniques are presented within chapter 4 that do not require the ladder to be placed at a flatter angle.

  Another factor to consider is the difference between aluminum and wooden ladders. Aluminum ladders provide much greater friction than wooden ladders. The rungs on an aluminum ladder are designed with grooves across their lengths. These grooves grab the turnouts and slow the fire fighter's decent. A wooden ladder used for a head first ladder slide needs to have the climbing angle reduced

even further since the rungs lack any type of friction material. Training on the drill ground under all possible conditions (e.g., wet turnouts) using safety harnesses, will help to determine what works best for your equipment.

No matter which ladders are available, fire fighters should all remember that ladders left on the apparatus are worthless on the fire ground. The time to put the rescue ladders in place is before they are needed.

COMMUNICATION

This section discusses critical elements of effective and efficient communication during a Mayday situation.

THREE-WAY COMMUNICATION

A Mayday initially involves three-way communication between the fire fighter, IC, and dispatcher. In some departments, the Mayday call is transmitted via a Dispatch frequency to both the IC and dispatcher. The dispatcher receives the call and then notifies all personnel assigned to the incident. The IC ultimately manages the Mayday by communicating with the fire fighter, other resources, and Dispatch.

In other departments, the Mayday call is transmitted via a tactical frequency, and Dispatch does not hear the transmission. In this case the Mayday call is acknowledged by the IC, who then notifies Dispatch.

In both systems, the IC must quickly order resources and assign companies to manage a successful rescue. The ultimate goal of the IC, is to put into effect an organized plan to minimize the fire fighter's exposure to the hazardous Mayday environment, and to return the fire fighter to a safe environment. There are many different plans that will arrive at the same conclusion, but only one plan is the most effective. It is the IC's responsibility to use the best plan. The best plan requires the effective use of the radio.

ROLE OF DISPATCH

The Dispatch Center plays an important role in the rescue of fire fighters during a Mayday. Unfortunately, in the past, their role has not been recognized or has been ignored.

Dispatch Center and communication system design is important for safe operations. The radio system should be designed so the Dispatch Center can receive portable radio communications from all locations of the service area. All radio communication must be recorded.
The Dispatch Center should also be equipped with an emergency traffic radio tone that alerts fire fighters on the scene of any emergency messages. Doing so will comply with NFPA standards.

Appropriate Standard Operating Guidelines (SOG's) must be developed for Mayday situations. One key element is related to major incident operations and Mayday situations. Often when the IC calls for multiple alarms for additional staff and resources at a major incident, the Dispatch Center is not backed up with extra staff during these events. Procedures must allow for this back up staffing.

ROLE OF DISPATCHER

Dispatchers should be the voice of calm during a Mayday. This takes practice. dispatchers must train in performing their responsibilities so when a Mayday is called, they react instinctively without delay.

Dispatch supports fire fighter safety best when it is adequately staffed. In addition to the call taker and dispatcher, at least one other dispatcher must monitor the fire ground tactical channel during working incidents. There have been cases where units on the fire ground DID NOT hear the Mayday, but dispatchers, and others did. In order to ensure fire fighter survivability the tactical channel must be monitored at all times during working incidents

Dispatchers must also be authorized to immediately contact the IC upon hearing any Mayday, or other emergency communications, to confirm he/she heard the message and is taking action. The same applies if Dispatch receives an emergency activation from a fire fighter's portable radio. The IC must be notified and take action to confirm an emergency or whether it was an accidental activation.

If the fire department's radios are equipped with other agency channels, Dispatch must immediately advise the other agencies of the Mayday situation. Fire fighters have accidentally selected the wrong frequency, and contacted another agency, on their radios. The agencies must be advised that if they hear communications from the distressed fire fighter, they must maintain contact with them. Do not change frequencies. The other agency must immediately advise the fire Dispatch Center of the contact, followed by a notification to the IC. The IC, or other designated officer, must go to that channel and communicate directly with the distressed fire fighter. DO NOT ask the fire fighter to change channels. He may not be able to do so, or even worse, end up on another channel.

Dispatchers can also aid in the quick deployment of resources. After receiving the Mayday call, Dispatch must notify all personnel assigned to the incident of the Mayday. This transmission aims to reduce radio traffic so the distressed fire fighter can transmit critical information regarding his or her situation.

The dispatcher can automatically dispatch additional resources using a scripted response for a Mayday. Additional resources for a commercial or residential structure fire may consist of:

- Additional alarm — At least three engines, one ladder truck, one Rescue Ambulance, and one Chief Officer.
  - Engines and trucks provide personnel and equipment to reinforce a rescue group and deploy additional RICs as back up.
  - Chief Officers expand the Incident Command system to manage the rescue.
- Other fire resources — Heavy rescue unit, hazardous materials unit, mobile air unit, ambulance, safety officer, communications plan consisting of an additional tactical frequency and exclusive use of the dispatch frequency.
  - Specialized units can aid in the rescue effort.
  - Additional tactical frequencies can handle the expected increased radio traffic. One frequency should be dedicated for use by the distressed fire fighter and RIC. The other should be for resources given tactical objectives to fight the fire.
  - Be aware that changing radio channels during an incident may lead to communication issues on scene. Fire departments should train with their specific protocols regarding additional tactical channels during a Mayday.

- Non-fire resources – Law enforcement, utilities (gas, electric and water), Media.
  - These resources provide incident stability.
  - Law enforcement can handle traffic control.
  - Utility companies can secure gas, electrical and water if needed.
  - Public Information Office (PIO) should be assigned to keep media apprised of the situation to prevent speculation and misinformation.

Dispatch has a unique perspective during a Mayday. Dispatchers participate in incident communications without the operational noise of the fire ground. Within this controlled environment, Dispatchers have opportunities to assist the IC. One way they can do this is by time stamping key events, which can help with:

- Predicting catastrophic structural failure due to burn exposure time.
- Managing crews' work/rest cycles.
- Re-calling the time key events that took place during the fire.
- Re-creating the incident during post-incident analysis.

Dispatch must have a plan in place prior to receiving the Mayday. Dispatchers must be trained in assisting an IC before the call comes in.

PERSONAL RADIOS

Fire fighters often work with limited or no visibility and with extreme noise levels: sounds of fire engines, saws, and smoke ejectors. Not being able to see or hear makes fire ground communications challenging.

During interior fire fighting operations, fire fighters use their personal radios to communicate with other members to find the status of incident operations, or to request specific fire fighting tactics. Fire fighters also use their radios to communicate with company officers to inform them of conditions. Most importantly, fire fighters depend on their radios to call a Mayday.

Personal radios allow fire fighters inside a structure to communicate with personnel on the outside who may have a better vantage point from which to assess conditions –the size and location of the fire and building conditions. Information from outside can prevent crews from advancing into dangerous conditions inside a structure.

RADIO COMMUNICATIONS TRAINING

Having a radio assigned to each person is not enough. Fire fighters must be trained in using the radio to request resources and, most importantly, to call a Mayday.

IAFF AND IAFC PERSONAL RADIO POSITION

It is the position of IAFF and IAFC that every fire fighter operating on the fire ground be equipped with a portable radio/two-way communications device (hereafter referred to as "portable radio"), preferably with an attached lapel microphone. Having a portable radio allows each fire fighter to immediately report, or be notified of, hazardous conditions or emergencies such as a missing or injured fire fighter or potential or impending structural collapse.

In 2003, NIOSH issued the *Firefighter Radio Report* (http://www.cdc.gov/niosh/fire/pdfs/FFRCS.pdf) detailing the challenges surrounding fire ground communications. Although the report is several years old, many of these same issues are still challenging the North American fire service. Under the topic of "Inadequate Training" it states:

"Though fire fighters receive hundreds of hours of training on emergency response, radio communications do not typically receive the same amount of attention. As such, fire fighters may not be aware of proper radio usage. Examples include how to use the radio in general, how to use the radio while wearing SCBA, and how radio communications are affected by a Mayday event." (Pg. 17-18)

Appropriate radio training begins with recruit fire fighters. Just as new fire fighters learn to hook up to a hydrant, lay out a hose line, and use an SCBA, they must also learn to use the portable radio. No probationary fire fighter should enter the field without having practiced requesting resources and calling a Mayday. Furthermore, fire departments must have an ongoing training program specifically focused on using the radio.

Radio training must also focus on transmitting clear messages that can be understood in difficult fire ground conditions.

THE 2003 NIOSH REPORT PROVIDED THESE RECOMMENDATIONS:

Well thought-out, clear, and concise messages are important characteristics for fire fighters to employ during their radio transmissions. On the fire scene, when fire fighters are excited or are panicked, radio transmissions can be loud and uncontrolled. Messages of this nature are difficult to understand. Discipline requires fire fighters to exercise discretion in messages transmitted over the radio. Non-critical messages increase the radio traffic and may prevent emergency messages, such as a Mayday event or impending building collapse, from being transmitted.

RADIO DISCIPLINE

Radio discipline refers to personnel using the radio conservatively to effectively achieve incident objectives so emergency Mayday transmissions can be heard. Keeping radio frequencies open requires personnel to use face to face communications as much as possible. Fire fighters should attempt to communicate their messages to their supervisors as much as possible so valuable radio time is not used.

Fire fighters should not bypass their company officer in radio communications to others, except for emergencies. Besides calling "Mayday" or requesting "Emergency Traffic", only the company officer should use the radio to communicate with the IC or the designated division or group officer. This reduces the amount of radio traffic on the channel and improves the ability of a fire fighter to get a Mayday out and heard by the command organization. A fire fighter in trouble should never hesitate to announce a Mayday.

COMMUNICATION ORDER MODEL

Lack of proper radio communications etiquette on the fire ground can create higher risk to the fire fighter. An IC who verbalizes orders without confirming contact with the appropriate company or officer has lost control of communications. Issuing orders without confirming that they were received by the intended party creates chaos and risk.

All members using radio communications should apply the National Incident Management System – Incident Command System (NIMS ICS) communications order model.

Sender Calls the company or member

"Engine 4, from Command."

Receiver responds with appropriate identification:

"Command, from Engine 4, Go ahead."

Sender provides order:

"Engine 4, from Command. Lay a supply line to the east side of the fire occupancy. Take an attack line in and protect the exposure. You'll be Division B".

Receiver acknowledges receipt of the order and repeats the order in brief and concise terms:

"Command. from Engine 4 copies. Lay supply to east side. Take in a line and protect exposure. I'll be Division B."

Fire fighters and the IC must understand that "Copy", "10-4", "Roger", etc. does not confirm that the receiver actually received the order. The higher powered (40 watt) apparatus radios have been known to over ride the weaker portable radio (8 watts) when simultaneously keyed. The "10-4" heard may be a response by a different company or member.

The importance of the order model is further illustrated had Engine 4 misunderstood the order from Command and replied, "Laying a supply line to the west side (rather than the intended "east" side). The repeat back allows the IC to recognize the misunderstanding and make a timely correction. Without the correction, the IC would have assumed the company was east. This type of fire ground mistake can negatively affect the fire fighters safety and survival in a significant manner.

PORTABLE RADIO SYSTEM DESIGN

Fire departments must be sure the personal radio is set up optimally to announce, and hear a Mayday. The safety equipment worn by fire fighters can make personal radios difficult to operate.

THE 2003 NIOSH REPORT IDENTIFIED SOLUTIONS TO THESE PROBLEMS:

As mentioned previously, the use of full PPE and SCBA makes it difficult to use a portable radio effectively. While the push-to-talk button is generally easy to use with gloves, the knobs and other buttons can be much more difficult. To overcome this, some departments are programming their radios so that the first and last position on the channel selector will automatically direct the firefighter to a channel monitored by the dispatch center. In the event of an emergency, the firefighter can turn the dial all the way in either direction and reach someone to alert them of the emergency.

The ability to access and use the radio during a Mayday is critical to survival. Radio manufactures have made improvements to radio design to make handheld radios more usable for fire fighters. One area of improvement is the lapel microphone. Most radio manufactures offer lapel microphones for their handhelds that have both microphone and speaker capabilities. Lapel mics make hearing and transmitting messages easier for fire fighters when the lapel mic is positioned near the collar closest to the fire fighter's mouth and ear.

Some radio manufacturers also offer lapel mics with a large channel changing knob, volume buttons, and an Emergency Activation Button (EAB). These lapel mics allow fire fighters to access the most critical radio features on the lapel mic without having to access the radio itself.

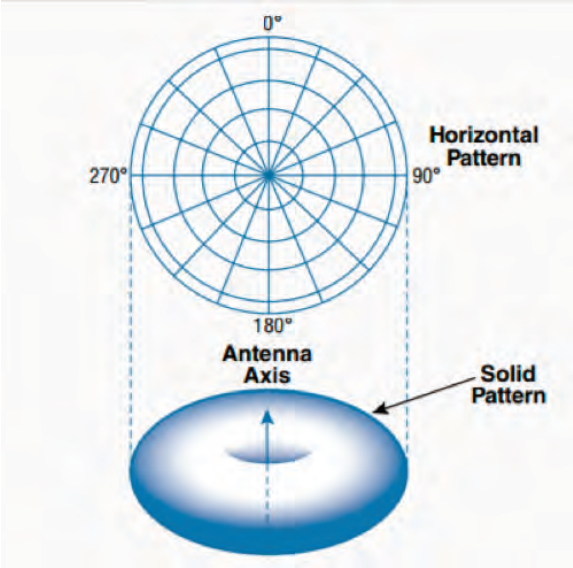
Another improvement is the Emergency Indentification Button (EIB), or Emergency Alert Button (EAB), which is positioned on the lapel microphone and portable radio. The EAB must be large enough to be depressed with a gloved hand. The EAB gives the fire fighter a simple method to call the Mayday. On some radios, the EAB alerts all personnel tuned to that frequency of a Mayday while also opening the microphone so the fire fighter can communicate his or her problem.

Manufacturers are working toward integrating a microphone into the face piece of the SCBA, and toward positioning speakers under the hood, in the ear of the fire fighter. These systems will decrease the feedback encountered when working close to other personnel with radios. Transmission clarity will also be improved due to the proximity of the microphone to the mouth.

The 2003 NIOSH report discussed the importance of portable radios having the ability to separate dispatch and tactical operations channels. This is especially important during large-scale incidents such as high-rise incidents and other multiple alarm incidents where multiple resources are deployed. In these cases radio usage is high due to multiple tactical operations taking place. Radio usage must not overwhelm any frequency. Fire fighters should have the ability to contact Dispatch if they cannot reach a supervisor to report a hazardous condition. Fire departments should seek to accommodate radio traffic on multiple frequencies, if necessary, to provide the space needed to handle a Mayday transmission.

PORTABLE RADIO LOCATION

There are two critical aspects to be considered when determining where to carry a portable radio. First is the antenna position. When a user transmits from a portable radio and the antenna is against the body, Radio Frequency (RF) energy is blocked altering the radio wave pattern. If a fog nozzle is set on wide and an object blocks part of the stream, that pattern is altered, and the stream may not be directed in the desired direction. The same happens with the RF energy when the radio is against the body. Some energy is absorbed, and the remaining signal is shadowed by the body. Antennas must be oriented in the correct position for optimal performance. When an antenna is tilted out of vertical, the signal received is not as strong as it would be if vertical. As a firefighter's position is changed, the effectiveness of the radio changes with the new position.



The second aspect to be considered is exposure of the Remote Speaker Mic (RSM) to thermal insult. The only NFPA requirements pertaining to the RSM in fire environment NFPA 1225 *Standards for Emergency Services Communications* "Portable radios shall be manufactured for the environment in which they are to be used and shall be of a size and construction to allow their operation with the use of one hand." The NFPA standard is not specific with regards to the details of the "environment" in which the radios are to be used. No testing procedures or performance criteria are outlined. Most portable radios directly marketed to the fire service list their maximum operating temperatures at 140 °F. The performance of the collar mics is well below the requirements of structural PPE Thermal Class III conditions which require equipment to survive 500 °F for five minutes. Failure of the RSM cord exposed to high temperatures has been noted in a number of LODD reports including the June 2011 LODD of two San Francisco Fire Fighters in a hillside residential house fire.

San Francisco LODD Victim 2 Portable Radio

Currently there are differing opinions in the fire service concerning the optimal location to carry the portable radio. Regardless of opinion, the location should take into account maintaining the antenna in a vertical position away from the body while in multiple positions and protecting the RSM from thermal insult.

■ **FEMA Report:**
https://www.usfa.fema.gov/downloads/pdf/publications/voice_radio_communications_guide_for_the_fire_service.pdf

■ **NIST Technical Note #1477:**
http://fire.nist.gov/bfrlpubs/fire06/PDF/f06015.pdf

NFPA 1802 *Standard on Two-Way, Portable RF Voice Communications Devices for Use by Emergency Services Personnel in the Hazard Zone:*

In 2012, the NFPA began development of NFPA 1802. The purpose of this standard is to define the minimum requirements for personal portable two-way radio communications devices used by fire fighters in the IDLH areas encountered in structural, wildland, and hazmat incidents. This standard will include requirements for surviving high temperatures and wet environments. As of 2019, the standard is listed as being in the developmental stages by the NFPA.

COMMON TERM: MAYDAY

Both the IAFF and IAFC encourage fire departments to adopt the radio term "Mayday" to identify when a fire fighter needs immediate assistance. Mayday is universally accepted by the National Incident Management System (NIMS), NFPA 1561, FIRESCOPE ICS-910, and the National Search and Rescue Committee (NSRC).

The term Mayday was selected for ease of use. Mayday is universally understood as a radio call for immediate assistance and is the most widely used radio term for announcing a fire fighter needing help.

With many North American Fire Departments responding within a mutual aid system, it is imperative all fire fighters use the same terminology. Mayday serves fire fighter's needs best because it is:

- Easy to hear over the radio.
- Easily remembered by a fire fighter in distress.
- Easy to pronounce, regardless of language or accent.

Other terms, such as "Emergency Traffic," "Fire Fighter Down," and "Fire Fighter Trapped," are not easily recognizable as emergency distress signals, perhaps because these terms are used to describe routine actions within incidents. For example, the term "fire fighter" is frequently used as a title before a name is verbalized over the radio. Using words that have multiple common uses to describe the most important message a fire fighter can verbalize over the radio is dangerous. "Mayday" is a single term that is easily recognizable over the radio as someone in need of immediate assistance.

ACCOUNTABILITY SYSTEM

Being ready for a Mayday includes having a system in place to account for each individual assigned to the incident. When a fire fighter is in distress, there must be a way for the IC to determine the individual's name, assignment, and location.

PERSONNEL ACCOUNTABILITY REPORT

The accountability system is critical to ensuring that a Personnel Accountability Report (PAR) can be completed during an incident. The ease with which the PAR is communicated by company officers and received by the IC depends upon the system used and the proficiency of the personnel using the system. Fire fighters, company officers, chief officers, and dispatchers must all be regularly trained in the use of the system. The system must also be able to identify personnel that are trapped or are injured and unable to use their radio.

The timing of the PAR is important. During the course of an incident a PAR should be completed:

- Upon completion of the primary search (a must for the search crews).
- Upon a report of a "Mayday."
- Upon report of fire under control.
- When switching strategies, for example from offensive to defensive.
- Anytime the IC desires (or per FD operating procedures).

If a fire fighter calls a Mayday, the IC must direct his/her immediate actions to aid the fire fighter. This means the IC must direct resources to assist in rescuing the fire fighter, while also deploying resources to fight the fire so survivable space is maintained. Once these priority actions are completed, the IC can then request a PAR from each unit. Initiating a PAR prior to deploying rescue units takes time and creates unnecessary radio traffic.

NFPA 1561 *Standard on Emergency Services Incident Management System and Command Safety* —Requirements for Accountability Systems

4.5.1 The Emergency Services Organization (ESO) shall develop and routinely use a system to maintain accountability for all resources assigned to the incident with special emphasis on the accountability of personnel.

4.5.2 The system shall maintain accountability for the location and status condition of each organizational element at the scene of the incident.

4.5.3 The system shall include a specific means to identify and keep track of responders entering and leaving hazardous areas, especially where special protective equipment is required.

4.5.4 The system shall provide for the use of additional accountability personnel based on the size, complexity, or needs of the incident.

4.5.5 Responder accountability shall be maintained and communicated within the incident management system when responders in any configuration are relocated at an incident.

4.5.6 Supervisors shall maintain accountability of resources assigned within the supervisor's geographical or functional area of responsibility.

4.5.7 Supervisors assigned to specific geographic areas shall be located in areas that allow each supervisor to maintain accountability of his or her assigned resources.

4.5.8 Where assigned as a company/crew/unit, responders shall be responsible to remain under the supervision of their assigned company/ crew/ unit supervisor.

4.5.9 Responders shall be personally responsible for following the personnel accountability system procedures.

4.5.10 Responders who arrive at the scene of the incident in or on marked apparatus shall be identified by a system that provides an accurate accounting of the responders on each apparatus.

4.5.11 Responders who arrive at the scene of the incident by means other than emergency response vehicles shall be identified by a system that accounts for their presence and their assignment at the incident scene.

4.5.12 The accountability system shall include an SOP for the evacuation of responders from an area where an imminent hazard condition is found.

4.5.13 The SOP described in 4.5.12 shall indicate the method to be used to immediately notify all responders.

4.5.14 The system shall also provide a process for the rapid accounting of all responders at the incident scene.

SUMMARY

A fire fighter is not Mayday ready until each member of the team is also Mayday ready. Individual fire fighters must be skilled in manipulating their SCBA's, PASS devices, and radios in environments with restricted movement and limited visibility. At the same time IC's, company officers, other fire fighters, and dispatchers must be able to perform their roles with precision so an effective rescue can be made.

The coordination of resources during a Mayday is essential to being ready. All members of the team must use common terminology to communicate the need for immediate assistance by using the term Mayday. All team members must train in performing their duties during a Mayday, so when the time comes all are ready and all can perform their responsibilities with precision. ■

CHAPTER 3
SELF SURVIVAL PROCEDURES

CHAPTER 3
LEARNING OBJECTIVES:

After reading this chapter students will be able to:

- Identify situations where a Mayday must be called.
- Describe the procedures that increase fire fighter survivability.
- Explain GRAB LIVES mnemonic and how to follow it in performing self-survival procedures.
- Recognize the conditions requiring emergency evacuation procedures.

CHAPTER 3
SELF SURVIVAL PROCEDURES

INTRODUCTION

In this chapter, you will learn to identify the situations where a Mayday must be called and the procedures that must be followed after a Mayday is called. You will learn how the GRAB LIVES mnemonic can help in remembering the actions to take to improve survivability.

MAYDAY SITUATIONS

Once a Mayday situation presents itself, the fire fighter must recognize it and call for help immediately. A delay can mean disaster on the fire ground. Fire fighters must memorize specific fire ground situations so they know when to call a Mayday.

Dr. Burton Clark of the National Fire Academy compared a fire fighter's decision to call a Mayday to a naval aviator's decision to eject[1]. Dr. Clark mentioned:

We can learn from how the military trains pilots to eject. First, there are very specific ejection decision parameters for each type of aircraft. The ejection decision parameters are a series of IF- THEN logic statements. For example: if conditions for no-flap carrier landing are not optimum, then eject. If neither engine can be restarted, then eject. If hydraulic pressure does not recover, then eject. If still out of control by 10,000 feet above terrain, then eject[2]. There can be a dozen or more ejection parameters for a specific aircraft.

A fire fighter's decision to call a Mayday is similar to a naval aviator's decision to eject. In both cases, awareness of their situation is of paramount importance. The naval aviator must be aware of how the aircraft is responding during flight. IF the aircraft does not respond appropriately, as dictated within the policy, THEN the pilot must eject. Similarly, the fire fighter must be aware of his or her situation to determine when to call a Mayday. IF any of the following situations exist, THEN the fire fighter must call a Mayday immediately:

THE SITUATIONS FOR CALLING A MAYDAY

IF	THEN
Lost or missing member	Call a Mayday
SCBA malfunction or large loss of air	Call a Mayday
Member seriously injured or incapacitated	Call a Mayday
Member trapped or entangled	Call a Mayday
Any *life threatening* condition that cannot be resolved in 30 seconds	Call a Mayday

■ LOST OR MISSING MEMBER

Company officers are responsible to account for all members of their team at all times. Any member on an incident who cannot be reached in person or via radio must be assumed lost, and a Mayday must be called.

■ SCBA MALFUNCTION OR LARGE LOSS OF AIR

A SCBA that is not working according to the manufacturer's specifications must be taken out of service immediately. If during an incident a SCBA malfunctions, or a large loss of air is experienced, and immediate exit is not achievable, a Mayday must be called.

■ MEMBER SERIOUSLY INJURED OR INCAPACITATED

Fire fighters are often injured, or experience chest pain and/or shortness of breath, while fighting a fire. If a member is injured or incapacitated by illness, and is unable to exit the building safely, a Mayday must be called.

■ MEMBER TRAPPED OR ENTANGLED

Working in environments where visibility is poor increases the risk of being entangled in wire or cords, or being trapped by falling objects. A trapped or entangled fire fighter who is unable to exit the structure must call a Mayday.

■ ANY LIFE THREATENING CONDITION THAT CANNOT BE RESOLVED IN 30 SECONDS

Minor problems, if not rectified, can escalate quickly. All fire ground personnel must call a Mayday when they're in imminent danger due to a situation that can't be resolved in 30 seconds.

NOTE: A Mayday can be called by anyone on the fire ground that recognizes one of the above situations. The rule is:

IF YOU SEE SOMETHING, SAY SOMETHING!

Fire fighters must change the culture from not wanting to make the Mayday call, to making the call as soon as the situation presents itself so the rescue can occur more quickly.

FIRE FIGHTER ACTIONS ONCE A MAYDAY SITUATION IS IDENTIFIED

Mayday situations are met with fear and anxiety. When a fire fighter recognizes a situation, the natural reaction is to panic. The heart races, breathing rate increases and the desire to remove oneself from the situation overrides the ability to reason and perform the necessary survival skills. Succumbing to these feelings of panic makes the situation worse. Panic is detrimental to survival. Survival is dependent on knowing how to suppress the feeling of panic.

In the book *Deep Survival: Who Lives, Who Dies, and Why*, Laurence Gonzales explains the biochemical changes that occur when a stressful situation is confronted:

> "Cortisol and other hormones released under stress interfere with the working of the prefrontal cortex. That is where perceptions are processed and decisions are made. You see less, hear less, miss more cues from the environment, and make mistakes. Under extreme stress, the visual field actually narrows. (Police officers who have been shot report tunnel vision.) Stress causes most people to focus narrowly on the thing that they consider most important, and it may be the wrong thing."
>
> ***Avoiding Panic***
> by Laurence Gonzales

Panicking in a Mayday situation may result in focusing on the wrong thing. A fire fighter's instinct is to find a way out, to find fresh air, to find the hose line, or to get away from the heat. All of these actions are necessary for survival, however moving too quickly toward those objectives may result in making the situation worse. Fire fighters must be disciplined to perform the steps that lead to survival rather than panicking. Simply knowing these steps can suppress the feeling of panic. Practicing and drilling on the steps will ensure these skills are deeply imbedded into your memory so they can be recalled with little or no thought.

AVOIDING PANIC

by Laurence Gonzales

When we hear the word "panic," most people think of someone running around screaming. But it often takes subtler forms. Panic can be thought of simply as any behavior that takes place when the level of stress or emotion is high enough to prevent conscious thought and deliberate decision making.

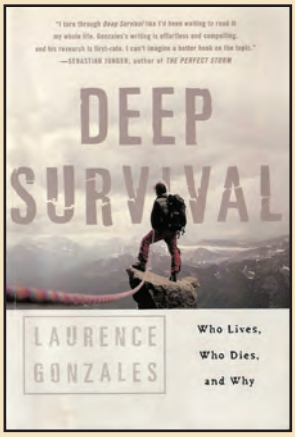
We have inherited the structure and function of our emotional systems from ancestors who lived in a very different environment where simple, automatic actions were required for survival. A form of panic — running away or fighting without thinking, for example — was good for survival. The emotional system functions by suppressing rational thought to clear the way for those automatic responses. If a lion is chasing you, you can't sit around and think it over.

While our environment has changed radically, our emotional system has not. When we need quick action that also requires logical thinking, panic can sometimes incapacitate us. Remember, the higher the emotion or stress, the lower the ability to think in a step-by-step fashion.
Here are three important ways to suppress panic:

- Breathe
- Organize
- Act

Breathe: Controlled steady and deliberate breathing--not gulping air or shallow panting--will calm you down. Be aware of your breathing. But don't wait for a panic situation to practice breathing. You can do it anywhere, such as while you're stuck in traffic or watching television. The more you practice, the more naturally it will come when you need it. Be aware that you can hyperventilate and make yourself dizzy. Practicing your breathing will help avoid this.

Organize: Survival instructors always emphasize this advice: Get organized or die. Have a plan or make a plan. The plan should have logical steps. The steps should be small and achievable and should lead to a clear goal. The plan doesn't have to be complicated. (For example, the hose leads to the outside. I'm going to follow the hose.) Because reason and emotion are at opposite ends of a see-saw, the act of organizing forces you to think in sequential steps and that in turn suppresses panic. Again, you can practice organizing by making up "what if" scenarios. You can do it any time and anywhere, such as when driving. ("What am I going to do if that kid on the bike pulls out in front of me…?)



Act: We think of panic as somebody who's screaming and running around. But panic may result in a person freezing in place. Freezing--known as tonic immobility--is a natural response of animals and birds. Inaction can be just as dangerous as aimless action. Once you have a plan, take action. Perform the steps in order. Any time you take purposeful, directed action, you suppress panic. Remember: Any organized, directed action pushes panic away. This, too, can be practiced anywhere. The more you practice creating organized plans and executing them step-by-step, the better you'll function in an emergency.
Lastly, repeated exposure to situations in which you may panic will gradually decrease the panic response. People can get used to anything. Frequent intense training works, as the military has shown. Train in situations as realistic as possible. Then when you are faced with potential panic, breathe, organize and act.

Laurence Gonzales is the author of Deep Survival: Who Lives, Who Dies, and Why and Everyday Survival: Why Smart People Do Stupid Things.

Before you can perform the self-survival procedures outlined in this chapter, you must follow a three step process to suppress panic. The first step in remaining calm is to control your breathing. By controlling your respirations you conserve air while your mind is focused on doing what you want it to do. Panic is in control when rational thought is overcome with fear. Slowing your respirations will help you think logically.

The next step is to organize your actions. Fire fighter's experiencing a Mayday must perform specific actions to save themselves. Every second counts. Order is necessary to assure you perform each survival action and leave none out.

The last step is to act. The procedure you have been trained to perform must be performed skillfully with no wasted effort or time. Mayday situations are time sensitive events. The fire fighter must perform each survival step knowing that each action will result in a measure of safety and eventual rescue.

Fire fighters must practice these steps so they can successfully suppress panic. Breathing, organizing and acting can be practiced in everything you do as a fire fighter. From the drill ground to an emergency incident, fire fighters should learn to monitor their respirations — remember, controlling your breathing will allow you to remain in control of your actions, rather than your emotions controlling you.

Suppressing panic is also achieved by anticipating the event that may cause you to panic. The anticipation of the event prepares the mind when the situation arises. This is

different from how we train. Fire fighters are success trained. We are taught to perform fire fighter skills on a drill ground that always results in success. Our minds are conditioned to anticipate the successful conclusion of the drill, and even the actual emergency event. The less we expect the Mayday call, the less likely we will be able to suppress the panic that results in being thrust into a situation we didn't anticipate. We are more likely to be able to control our breathing, to organize our actions and to act quickly if we recognize the event as being something familiar.

To improve survivability in a Mayday situation, a fire fighter must know how to alert rescuers to his or her location and perform self-survival techniques. Through the study of fire fighter fatalities, NIOSH has identified specific actions fire fighters can take to help save themselves.

When a career fire fighter died while conducting interior operations on a two-story house in Texas NIOSH recommended in report number F2014-15 that fire fighters should:

- First, transmit a distress signal while they still have the capability and sufficient air.
- Next, manually activate their PASS device. To conserve air while waiting to be rescued, try to stay calm and avoid unnecessary physical activity.
- If not in immediate danger, remain in one place to help rescuers locate them.
- Survey their surroundings to get their bearings and determine potential escape routes.
- Stay in radio contact with the IC and other rescuers.
- Attract attention by maximizing the sound of their PASS device (e.g., by pointing it in an open direction); pointing their flashlight toward the ceiling or moving it around; and using a tool to make tapping noises on the floor or wall.

Variations of this same NIOSH recommendation have appeared in numerous fire fighter fatality reports. These recommendations were used to create a self survival procedure that is easy to remember using a mnemonic (GRAB LIVES). Following these steps increases the likelihood of the rescuers finding and assisting the fire fighter to safety.

"… mnemonics are used in training to memorize a procedure, deeply imbedding it into the memory until it is second nature and can be recalled without hesitation or thought."

—Dr. Burton Clark

WHY A MAYDAY MNEMONIC?

Dr. Burton A. Clark, EFO, CFO, National Fire Academy, Management Science Program Chair

The need to memorize information is not new. Before the invention of the printing press, important information had to be memorized because there was no other way to store, retrieve, or pass information on to others. Information was transferred by stories, songs, poems, oral histories and mnemonics. In today's world, some information is memorized because it is critical to survival.

A mnemonic can help us remember large amounts of critical information that make up a process. The mnemonic helps in performing the process at the expert level. Some mnemonics assist in the memory of details. For example: Individuals in the medical field use the mnemonic PQRST (provoking factor, quality, region-radiating-reoccurrence, severity, and time) to remember the questions needed to be asked of a patient experiencing pain.

Other mnemonics are used when the recall of information needs to be instantaneous. These specialized mnemonics not only aid in memorization but indicate when and how they are to be used. A common example of this is, "Stop, Drop and Roll." Another example is "Little to Big, Back to the Rig." This mnemonic is used to remind the fire fighter that the small rockers found on the female coupling should be felt before the large rockers on the male couplings, when using the hose to find the exit. These critical mnemonics are used in training to memorize a procedure, deeply imbedding it into the memory until it is second nature and can be recalled without hesitation or thought.

GRAB LIVES, LUNAR, HELP, LIP and CLAN are all mnemonics commonly used by fire fighters throughout North America. These memory devices are designed to assist fire fighters in learning what to do and say when in a Mayday situation. They are best used when introduced in training. It is critical that the training continue throughout a fire fighter's career to assure it is deeply imbedded into memory. Ultimately, the true test of a fire fighter's learning of the steps included in the mnemonic is when an actual Mayday incident occurs. Oftentimes, 100 percent recall of the steps is required for an assurance of survival. ■

THE PROCEDURE INCLUDES FOLLOWING THE MNEMONIC:

G-R-A-B L-I-V-E-S

Each action is explained in the chart below.

GRAB LIVES is not only a mnemonic to aid in surviving a Mayday; it also has value in reminding fire fighters of the important items to check when arriving for their shift. Using GRAB LIVES as a checklist, fire fighters are reminded to: check the air in their SCBA cylinder; to make sure their radio is turned to the correct frequency and has adequate battery power; to ensure their PASS device is operable, to check their personal flashlight to be sure it adequately illuminates; and to make sure their hood and gloves are in good condition to be able to cover the air intake port if needed. Not having these items in proper working order during the most challenging times a fire fighter may be faced with can prove fatal.

GRAB LIVES also has application upon arrival at an incident when a survival situation is not encountered. To remind fire fighters of the need to manage their air, "G" reminds the fire fighter to check his or her air periodically. The "R" reminds the fire fighter to use the radio effectively to advise command of fire conditions and his or her individual location. The "L" reminds fire fighters to remain low to prevent from being burned by the super heated gases banking down from the ceiling. The "I" reminds fire fighters to keep their flashlights illuminated even during the daylight hours so they can see through the smoke. And the "E" reminds fire fighters to always identify points of egress while searching for victims and the fire. A simple reminder such as GRAB LIVES can assist fire fighters in caring for themselves as they seek out to rescue others.

Following GRAB LIVES sequentially during a survival situation is not necessary. Every survival situation is different and may require different actions. In some cases a fire fighter may recognize imminent flash over conditions and may only have time to call a Mayday, and find an exit to avoid being burned. In these cases, the fire fighter will likely use the "R" for radio, and the "E" for exit. The application of GRAB LIVES during emergency evacuation due to flash over is using the mnemonic to remind the fire fighter of the need to identify egresses while searching for victims and the fire. A successful self rescue is escaping the heat using the egress identified prior to the flash over event occurring.

Another application for using GRAB LIVES during a Mayday event is when a fire fighter is lost in a large commercial building fire. This situation may result for a variety of reasons. One reason may be due to losing the hose line during cold smoke conditions resulting from fire sprinkler activation. In this situation a fire fighter may perform all the actions of GRAB LIVES while attempting to locate the hose line, to find an egress, or to create an egress. Because the environment is not super heated, the fire fighter has time to perform all the actions of GRAB LIVES.

GRAB LIVES makes up a system for survival. Being able to effectively use the system requires one to refer to its elements as much as possible. This begins when you arrive for duty, when actively engaged in fire fighting and when a Mayday event is recognized.

Self Survival Procedure	
G auge	CHECK AIR GAUGE
R adio	RADIO FOR ASSISTANCE
A ctivate	ACTIVATE PASS
B reathing	CONSERVE AIR
L ow	STAY LOW
I lluminate	SHINE FLASHLIGHT
V olume (make noise)	MAKE A LOUD NOISE
E xit (find one)	FIND A N EXIT
S hield Airway	PROTECT AIRWAY

GRAB LIVES

Gauge

Step 1: Check Air (Chest Harness Gauge)
Fire fighters must routinely check their SCBA air gauge while working in an IDLH environment. During a Mayday situation, knowing the quantity of air in the cylinder gives an indication of the time available to find a more tenable atmosphere. A fire fighter in distress should advise the IC of the quantity of air in their bottle.

GRAB LIVES

Radio

Step 2: Initiate a "Fire Fighter Mayday" on the Radio
Current technology permits the transmission of a distress signal to Command and/or Dispatch by using the EIB/EAB, which is provided on most portable radios.

The basic steps that should be taken when verbalizing a need for immediate assistance are these:

The fire fighter must activate the portable radio EIB/EAB immediately. DO NOT WAIT. As soon as a fire fighter *thinks* he or she is lost, a report using the terminology outlined in this document or local Standard Operating Guideline should be communicated on the assigned fire ground channel or the radio channel most likely to be acknowledged.

NOTE: The radio channel must be predetermined in the emergency communications plan and be known to all members prior to the incident.

- The fire fighter should pause after each message and then repeat the message until acknowledged by Command.
- The Communications Center must relay any Mayday messages that are not immediately acknowledged by Command.

The initial radio transmission should be brief and should alert all personnel on the incident. The following is an example of an actual radio exchange where a member is separated from his/her crew and is lost:

(1) Fire fighter: "Mayday, Mayday, Mayday."

(2) *The Incident Commander (IC) ensures that all radio traffic ceases. This may require the IC to "clear the channel."*

IC: "All units assigned to the Central Incident clear this channel for a Mayday; unit calling Mayday identify."

(3) Fire fighter: "This is Fire Fighter Smith from Engine 1; I'm lost somewhere on the first floor."

When responding to the IC's request to "identify," fire fighters should answer these questions — The 3 W's:

- "Who are you?"
- "What is the emergency?"
- "Where are you?"

If unable to contact the IC, the distressed fire fighter or other crew member shall:

- Attempt to contact his/her supervisor.
- Transmit Mayday using a Dispatch frequency.
- Continue making Mayday calls until answered.

The size and duration of an incident determines the complexity of the command system. Mayday's occurring early in an incident will often be commanded by a company officer. In these cases, the company officer is responsible for controlling radio traffic and communicating with the distressed fire fighter. Larger fires, that have been burning longer, require more complex command structures where more overhead personnel are required to manage the incident. Maydays called late into a large fire may create more confusion due to the number of personnel with operational assignments. In these cases, it is important that a member of the command structure is designated to maintain communications with the distressed fire fighter. In some cases it may be the IC, in others the Operations Section Chief (OSC), and at times the Rapid Intervention Crew Group Supervisor (RICGS). In all cases it is important to communicate clearly with the distressed fire fighter and to confirm all urgent transmissions are correctly understood. The IC/OSC/RICGS should also communicate the following to the distressed fire fighter:

- Ascertain the quantity of air remaining in the distressed fire fighter's SCBA, which can determine the time needed to make a rescue.
- Provide a reminder of the **"G-R-A-B L-I-V-E-S"** procedure for the distressed fire fighter to assist the crew in the rescue process.
- Identify specific information required to assist with the rescue operation. Routes of access, methods of rescue, tools needed, and known hazards should be communicated.

See Chapter 5 for more information on Mayday communications.

WHO-WHAT-WHERE MNEMONICS

The minimum amount of information a firefighter must transmit to the IC in a Mayday situation is who, what, where. Several mnemonics have been created to remind fire fighters of the information to transmit during a Mayday. The following mnemonics are commonly used by fire departments throughout North America. Departments should select one mnemonic and provide sufficient training so all personnel *commit it to memory*.

WHO-WHAT-WHERE:

WHO are you?
WHAT is your emergency?
WHERE are you located?

LUNAR:

L location
U unit number
N name
A assignment (What were you doing?)
R resources (What do you need?)

HELP:

H handle (Radio term for name)
E equipment (Equipment assigned)
L location (Where are you?)
P problem

LIP:

L location (Where are you?)
I individual(s) (Name(s)?)
P problem

CLAN

C conditions
L location
A assignment or A apparatus
N name

GRAB LIVES
Activate PASS

Step 3 – Activate PASS and Allow PASS Light to Be Seen By Rescuers
The PASS device must be manually activated immediately after initiating the Mayday call. Fire fighters can maximize the strength of the device's audible alarm and light by positioning the device so it is best heard and seen by rescuers.

The device must be silenced to communicate via the radio. Not silencing the alarm will cause radio transmissions to be un-readable by rescuers. Fire fighters must be familiar with how to manually activate and de-activate their PASS alarms. This skill must be exercised while wearing gloves and breathing air. Because the SCBA mask reduces a fire fighter's field of vision, it is difficult to see the PASS alarm activation button. Fire fighters have also experienced difficulty feeling the PASS alarm button with their gloved hands. Overcoming these challenges is only achieved through practice and drill.

The PASS device can also be used to call the Mayday over the radio. If the Mayday is not acknowledged by the IC, one method of getting the attention of the IC is for the fire fighter to hold the radio microphone open near the activated PASS device. This allows the audible sound of the PASS device to be transmitted over the radio. This produces a very high pitched sound that will likely get the attention of someone on the fire ground.

GRAB LIVES
Breathing

Step 4 – Conserve Air, Control Breathing
Fire fighters must control their breathing and conserve air anytime they don the SCBA, especially in a Mayday situation. Because air is limited and work effort and duration can be unpredictable, it is important fire fighters learn to control their anxiety, breathe slowly, and minimize exertion. Mayday training is essential to accomplishing this, and can be added as part of the current SCBA training program. Fire fighters must learn to maximize breathing through the low air alarm and beyond, since a low air regulator stops activating below 100 +/- psi. A bottle should have air available even after the low air alarm stops sounding. Obviously, the volume of air remaining depends on the size of the cylinder (30 minute, 45 minute, etc.). Typically with a 30 minute cylinder there are approximately 8-12 breaths of air available after the low air alarm deactivates. However it is important to be aware that no two SCBA's are identical, just as no two individuals are identical. This is why it is important to train and be familiar with individual limitations.

There is a tested, and proven method to extend air supply known as the Reilly Emergency Breathing Technique (R-EBT), a.k.a. "the humming method." By humming during exhalations fire fighters can extend air time effectively, and in some cases by more than 40 percent. By controlling exhalations in this manner fire fighters can get the most from their air supply physiologically, and have focus, which can psychologically help ease anxiety. But like anything, training and practice enable proficiency. Practice by:

1. Inhaling as you normally would.

2. While exhaling, "hum" your breath out in a slow, consistent manner. The hum is low and usually cannot be heard over the low-air alarm. In situations where you need to disentangle your SCBA, or rapidly move around obstacles, it may be difficult to continuously hum after each breath. Breathe as you normally would and intermittently use the R-EBT. The more you use the R-EBT, the more it will increase your survival time.

GRAB LIVES
Stay Low

Step 5 – Stay Low
Fire fighters must position themselves near the floor to avoid super-heated toxic air collecting at the ceiling. Staying low also aids in visualizing the hose-line and finding an exit.

GRAB LIVES
Illuminate

Step 6 – Shine Flashlight at 45 Degree Angle
Flashlights should remain "on" while the fire fighter is working. Light from a flashlight can alert rescuers to a fallen fire fighter, even if the trapped or disabled fire fighter is incapable of getting to his or her flashlight. If the fire fighter is capable of manipulating the position of the light, the beam should be directed where rescuers may see it. The fire fighter may also move the flashlight beam around or activate the strobe function if so equipped. Consider momentarily turning your flashlight off to see if a rescuer's light can be seen.

GRAB LIVES
Volume

Step 7 – Make Noise
Noise originating from the fire fighter in distress will direct rescuers to his or her location. In addition to the audible alarm on the PASS device, the fire fighter must use a hand tool to make noise on the floor or wall. An axe, pike pole, rubbish hook, or any type of forcible entry tool can be used to make noise. Because RIC members will likely be located on the perimeter of the building, it is best if the sound is generated using an exterior wall.
Be loud, be heard, and be rescued.
Occasionally, stop making the sound to listen for rescuers.

GRAB LIVES
Exit

Step 8 – Find an Exit

If not pinned or trapped, a fire fighter should attempt to identify a potential exit or locate the hose line. Moving along exterior walls will often help locate windows that can serve as exits. Expansion joints in concrete floors can be used to mark a path of travel. If a hose line is available the fire fighter must follow it out, using the couplings as guides. The fire fighter should advise the IC that he or she is on a hose line, or looking for an exit.

Prior to entering the structure, fire fighters must know the configuration of the hose. This is important because if visibility deteriorates to zero, the couplings may be the only piece of equipment that points to the exit. Normally, fire departments connect the female coupling of the nozzle to the male end of the hose coupling. This means the male coupling is pointed toward the fire and the female coupling leads to the apparatus or exit. Some fire departments use the mnemonic "Little to Big, Back to the Rig" or "Bumps to the Pump" to remember which coupling they should feel first when searching for the exit.

"Little" refers to the small rockers found on the female coupling. These will be felt first if traveling in the correct direction toward the exit. "Big" refers to the larger rockers found on the male coupling.

GRAB LIVES
Shield Airway

Step 9 – Shield Airway

When the air in the SCBA is exhausted, fire fighters can disconnect their second stage regulator, flatten body out and move while placing regulator opening of mask as close to floor as possible. Staying low and shielding the port with gloved hand or hood (if able) will prevent debris from entering the mask. Take care not to place pressure on the facepiece.

CLEARING THE MAYDAY

Once a rescue has been made, the Mayday must be cleared. The responsibility for clearing the Mayday belongs to the IC (see Ch. 5). However, prior to clearing the Mayday, the IC must be informed immediately when the distressed fire fighter is in a safe area. The IC may receive this information from the fire fighter who called the Mayday, or another fire fighter who can accurately report his or her condition. The IC will clear the Mayday over the radio only after receiving a PAR noting "all accounted for" from each resource.

Clearing the Mayday allows radio communications to return to normal. This generally means companies are able to communicate on the radio without restriction until another Mayday is called. In some fire departments this may require all resources to return to their original frequencies. In others it may mean to remain on the current channel. Fire departments must document how radio channels are managed after a Mayday is cleared so all personnel know what to do.

SUMMARY

The fire fighter self survival procedure should be constantly performed throughout the rescue operations. The distressed fire fighter must keep the rescuers advised of his or her location, air cylinder quantity, physical status/limitations, and special rescue tool needs. The IC/OSC/RICGS must continue to communicate with the distressed fire fighter, even if the fire fighter is not responding. A fire fighter may be unable to transmit due to being trapped or entangled. In these cases it is important to reassure the fire fighter, even though radio transmissions are not returned. Hearing the GRAB LIVES procedures over the radio may be the information that saves the distressed fire fighter. ■

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CHAPTER 4
SELF SURVIVAL SKILLS

CHAPTER 4
LEARNING OBJECTIVES:

Participants will be able to demonstrate the following skills using proper technique:

- SCBA familiarization and emergency procedures.
- Self-survival procedures and following a hose line to locate an exit.
- Wall breach with low/reduced profile maneuvers.
- Disentanglement maneuver.
- SCBA confidence maze.
- Upper floor escape techniques.
- Condition Recognition and rapid evacuation

CHAPTER 4
SELF SURVIVAL SKILLS

INTRODUCTION

This chapter represents an overview of the Fire Ground Survival skills taught during the practical portion of this training. These skills have all been found to have contributed to a line of duty death, close call or near miss. These skills require props that must be built to the fire department standard for safety. All skills must be performed in full structure PPE's and SCBA. The skills include:

- SCBA familiarization and emergency procedures.
- Self-survival procedures and following a hose line to locate an exit.
- Wall breach with low/reduced profile maneuver.
- Disentanglement maneuvers.
- SCBA confidence maze.
- Upper floor escape techniques.
- Condition Recognition and rapid evacuation

Each skill is introduced with a NIOSH fire fighter fatality case study. The case studies point to the importance of these skills. The skills will be taught by trained instructors to small groups of students. Instructors will provide a background of the skill, followed by detailed instructions of the specific movements required to perform each skill safely. Instructors will also demonstrate each skill prior to student practice.

These skills must be performed quickly and safely once the Mayday situation arises. Fire fighters will not have the luxury of time. These skills must be practiced continually so they can be performed with 100 percent proficiency.

A CASE STUDY SUPPORTING THE TRAINING OF:
SCBA Familiarization and Emergency Procedures

(The following comes from the NIOSH FF LODD investigation report F2004-04: Career Fire Fighter Dies of Carbon Monoxide Poisoning after Becoming Lost While Searching for the Seat of a Fire in Warehouse - New York. The full investigation report is available at the NIOSH website www.cdc.gov/niosh/fire/reports/face200404.html.)

On December 16, 2003, a 30-year-old male fire fighter (the victim) died after he became separated from his crew members while searching for the seat of a fire at a furniture warehouse. His crew exited due to worsening conditions and a missing member announcement was made. Rescue efforts were initiated and the victim, who had a working radio, was found lying face down with his face piece removed and 900 psi left in his self-contained breathing apparatus (SCBA).

At 1228 hours, an alarm was received for a fire at a commercial structure. The six-member crew of Ladder 36 (including the victim) was first on scene at 1231 hours. They reported a working fire with heavy smoke and fire at the rear of the structure. Two L-36 crew members went to the roof to begin ventilation and one member went to the rear to open the rear door. Unable to open the rear door, he then went to the roof to assist the ventilation crews. The remaining three members of L-36 prepared to enter and search for the fire origin. The B13 Chief arrived at 1233 hours and assumed Incident Command. At 1234 hours, L-36 began forcible entry on the roll-down gates to the second floor entrance and Engine 95 began stretching a 2 ½-inch line to the entrance. The irons man (forcible entry; the victim) cut the locks on the pull-down security door at the bottom of the stairs leading to the second floor. Once the door was opened, the three L-36 crew members ascended the stairs and assembled at the top. At this time, visibility was good in the stairs but poor inside the warehouse. At 1239 hours, the D7 Chief arrived and assumed Incident Command from B13. He then sent the B13 Chief to take command of the fire floor. At approximately the same time, the L-36 crew donned their face pieces and, with the officer in the lead, crawled into the warehouse. They crawled in about six feet and turned right (because this area was passable) and moved toward the rear. The officer, who was using a thermal imaging camera (TIC), reported that the camera image "whited out" when aimed at the ceiling.

At approximately 1241 hours, the L-36 officer heard the victim say something to him in a non-urgent tone which he did not understand. At 1242 hours, E-95 brought their hand line up to where the L-36 crew was located. At this time, the victim was on the side of the line opposite his crew members - toward the interior. At about 1243 hours, they were ordered to open their line to cool down the structure and began spraying the ceiling where they could hear fire crackling. At about the same time, Engine 75 brought a back-up 2 ½-inch hand line up to the landing. At 1247 hours, E-75 entered the warehouse, positioned its line to the left of E-95, and began operating toward the two exposures. At approximately 1249 hours, due to high heat conditions, the L-36 officer yelled for his crew to get out. He then turned to the left and moved toward the stairwell. At approximately 1251 hours, when the L-36 officer did not see the victim in the stairwell, he sent his can man to the street to look for him and tried radioing the victim and yelling into the structure. At about the same time, E-75 withdrew its line to the stairs and the L-36 officer began checking the exiting fire fighters in an effort to locate the victim. At approximately 1253 hours, the E-95 officer and nozzle man thought they heard a scream from inside the fire building. They shut down their line and yelled into the structure for about 30 seconds and, receiving no response, began suppression operations again. At 1255 hours, the IC ordered an evacuation. At 1256 hours, the L-36 can man returned to the stairwell and reported that he could not find the victim in the street. The L-36 officer verbally informed B13 that he had a missing member. At 1257 hours, B13 transmitted a missing member message to the IC (D7) via an "Urgent" radio transmission. Shortly thereafter, the L-36 officer mistakenly identified one of the exiting engine crew members (nozzle man) as his missing member and cancelled the emergency stating that his crew member had been found. At about 1258 hours, the L-36 officer yelled into the occupancy and told the two remaining E95 members inside to leave, that he had found his missing member. B13 verified from the L-36 officer (face to face) that the missing member had been accounted for and radioed the information to the IC. By approximately1259 hours, all remaining members had left the fire floor and by 1301 hours everyone was off the roof. At about the same time, the IC ordered a defensive operation and L46 began master stream application through the windows. At 1303 hours, after doing a second personnel accountability report (PAR) at street level, the L-36 officer realized that his irons man was still missing and probably on the fire floor. He reported this verbally to the B13 Chief and, at 1304 hours, Rescue 3 and the L-36 officer returned to the fire floor and began searching for the victim with E-75 operating a hand line to protect them. At approximately 1309 hours, the IC ordered suppression to cease and to stop all commuter trains to be stopped. Note: Commuter trains, which passed nearby about every two minutes, were causing radio interference.

At 1313 hours, R-3 located the victim who was about 30 feet from the stairs near the center columns. He was lying beneath a skylight, face down in a pool of water with his head in the direction of the front windows. His face piece was off and the manual shut off switch on the regulator was depressed. The victim's radio was on and his left glove was off. The victim may have removed his facepiece in an effort to radio or yell for help. He was taken by ambulance to a nearby hospital where he was pronounced dead at 1349 hours. The total time the victim was in the structure from the time he was noted to be missing to when he was found was estimated to be approximately 30 minutes. ■

SCBA FAMILIARIZATION AND EMERGENCY PROCEDURES

The SCBA is the fire fighter's life pack. In an immediately Dangerous to Life of Health (IDLH) environment, the SCBA determines the amount of time a fire fighter can safely work. However the SCBA can only provide a measure of safety if it is working according to the manufacturer's specifications. Fire fighters must not assume their SCBA will always work. They must be ready if a failure or problem exists.

In fire fighter recruit school, new hires are often instructed on the specific donning and doffing methods of the department or academy who is administering the training. Although properly donning the SCBA is important, it is not the most critical issue associated with the SCBA. Knowing how to use the SCBA, and knowing what to do when the SCBA is having trouble providing air, are the most important elements of SCBA training.

SCBA familiarization begins with knowing all there is to know about the SCBA. This includes knowing the parts of the SCBA, the maintenance schedule, and the manufacturer's specifications for use of the device. Fire fighters must be skilled at disassembling and assembling the SCBA in all types of environments. Fire fighters must also be comfortable with using gloved hands to manipulate the SCBA in confined areas with limited visibility. These skills are all necessary if a Mayday occurs. All of these skills will be reinforced during SCBA familiarization training.

It is anticipated that fire fighters from several different fire departments using different SCBA's will attend the same Fire Ground Survival training session. In each training session fire fighters will be required to know the specifications for their SCBA. Fire fighters should also come prepared to share information on their SCBA with the other students. The sharing of information is designed to discuss compatibility concerns during RIC rescue operations in a mutual aid response.

If responding companies from different fire departments arrive with different SCBAs, radio channels, and hose fittings, operations on the fire ground can be severely hampered. A Mayday can exacerbate the problem, making rescue of a distressed fire fighter near impossible. It is critical fire departments responding within automatic and/or mutual aid systems are familiar with each other's equipment and apparatus. Fire Ground Survival SCBA Familiarization training will improve response to a Mayday by having all members on the fire ground become experts in SCBA use.

A CASE STUDY SUPPORTING THE TRAINING OF:

Self-Survival Procedures and Following a Hose Line to an Exit (GRABLIVES)

(The following comes from the NIOSH FF LODD investigation report F2001-13: Supermarket Fire Claims the Life of One Career Fire Fighter and Critically Injures Another Career Fire Fighter – Arizona. The full investigation report is available at the NIOSH website www.cdc.gov/niosh/fire/pdfs/face200113.pdf)

On March 14, 2001, a 40-year-old male career fire fighter/paramedic died from carbon monoxide poisoning and thermal burns after running out of air and becoming disoriented while fighting a supermarket fire. Four other fire fighters were injured, one critically, while fighting the fire or performing search and rescue for the victim. The fire started near a dumpster on the exterior of the structure and extended through openings in the loading dock area into the storage area, and then into the main shopping area of the supermarket. The fire progressed to five alarms and involved more than 100 personnel. Fire fighters removed the victim from the structure and transported him to a local hospital where he was pronounced dead.

NIOSH investigators concluded that, to minimize the risk of similar occurrences, fire departments should:

- ensure that the department's Standard Operating Procedures (SOPs) are followed and continuous refresher training is provided
- ensure that a proper size-up, using common terminology, is conducted by all fire fighters responsible for reporting interior/exterior conditions to the Incident Commander (IC)
- ensure that pre-incident plans are established and updated on mercantile occupancies in their district
- ensure that fire fighters manage their air supplies as warranted by the size of the structure involved
- instruct and train fire fighters on initiating emergency traffic (Mayday-Mayday) and on the importance of activating their personal alert safety system (PASS) device when they become lost, disoriented, or trapped
- ensure that multiple Rapid Intervention Crews (RIC) are in place when an interior attack is being performed in a large structure with multiple points of entry ■

SELF-SURVIVAL PROCEDURES AND FOLLOWING A HOSE LINE TO LOCATE AN EXIT

Fire fighters must be able to perform the self-survival procedures during a Mayday. The mnemonic GRAB LIVES identifies all actions a fire fighter must perform to alert rescuers and improve survivability. During this drill, fire fighters must demonstrate performance of each action within GRAB LIVES.

This drill will exercise the actions of both the distressed fire fighter and IC during a Mayday. This drill requires a fire fighter to initiate a Mayday using the radio, activate the PASS device, de-activate the PASS device during radio transmissions, use a light and noise to alert rescuers, find a hose line to determine coupling orientation to locate an exit, and to shield the air intake valve on the SCBA mask when the air in the bottle is exhausted. The fire fighter will communicate on the radio with the IC during the exercise. The IC will communicate with dispatch and other resources during the drill to better simulate an actual Mayday event.

The skill will be taught by two instructors. One instructor will be inside directing the activities of the distressed fire fighter, while the other acts in the position of Dispatch and the other fire fighting resources. Upon completion of this skill, fire fighters, engineers, lieutenants, captains, and chief officers will better understand the challenges with communications during a Mayday. This drill will also teach the skills of room orientation, and coupling recognition to locate an exit.

A CASE STUDY SUPPORTING THE TRAINING OF:
Wall Breach with Low/Reduced Profile Maneuver

(The following comes from the NIOSH Fire Fighter LODD investigation report F2013-16: 4 Career Fire Fighters Killed and 16 Fire Fighters Injured at Commercial Structure Fire – Texas. The full investigation is available at the NIOSH website: https://www.cdc.gov/niosh/fire/reports/face201316.html)

On May 31, 2013, a 35 year-old career captain, a 41 year-old career engineer operator, a 29 year-old career fire fighter, and a 24 year-old career fire fighter were killed when the roof of a restaurant collapsed on them during fire-fighting operations. The captain was assigned to Engine 51 (E51). The engineer/operator was assigned to Ladder 51, but was detailed to E51 and assigned to the left jumpseat (E51B). The two fire fighters were assigned to Engine 68 (E68). Upon arrival, the captain of E51 (E51A) radioed his size-up stating they had a working fire in the restaurant with heavy smoke showing plus a temperature reading from his thermal imager. E51 made an offensive attack from Side Alpha with a 2½ inch pre-connect hoseline in the restaurant. District Chief 68 (D68) arrived on scene and established "Command". He ordered E51 out of the building because the engine operator of E51 (E51D) advised that E51 was down to a quarter tank of water. Engine 68 had arrived on scene and had laid two 4-inch supply lines from E51 to a hydrant east of the fire building on the feeder road. Once E51 had an established water supply, E51's crew re-entered the building. Engine 68 (E68) was ordered to back-up E51 on the 2½ inch hoseline. Engine 82 (E82) (4th due engine company) was pulling a 1¾ inch hoseline to the front doorway that E51 had entered, when the collapse occurred. The roof collapsed 12 minutes after E51 had arrived on-scene and 15 minutes and 29 seconds after the initial dispatch. The fire fighter from E51 (E51C) was at the front doorway and was pushed out of the building by the collapse. The captain from E82 called a "Mayday" and Rapid Intervention Team (RIT) operations were initiated by Engine 60. During the RIT operations, a secondary wall collapse occurred injuring several members of the rescue group. Due to the tremendous efforts of the Rescue Group, a successful RIT operation was conducted. The captain of E68 was located and removed from the structure by the Rescue Group and transported to a local hospital. The engineer operator from E51 (E51B) was removed from the structure by the Rescue Group and later died at a local hospital. A search continued for the captain of E51 and the two fire fighters from E68. Approximately 2 hours after the collapse, the body of the captain from E51 was located on top of the restaurant roof debris. The two fire fighters from E68 (E68B and E68C) were discovered underneath the restaurant roof debris. The officer and two fire fighters were pronounced dead at the scene. ***Note:*** *The captain of Engine 68 (E68A) died on March 7, 2017 from complications of the severe injuries suffered in the restaurant fire on May 31, 2013.* ■

WALL BREACH WITH LOW/REDUCED PROFILE MANEUVER

Fire fighters will learn techniques to breach a wall with and without a hand tool. This skill is necessary when a fire fighter must move from a room where conditions are deteriorating to an area that is more tenable. Because existing egresses such as doors and windows may be difficult to locate or open, fire fighters may be required to breach a wall. Once breached, the fire fighter can pass through the space separating the studs.

Fire fighters will learn the following techniques to reduce their profile to pass through a small space:

- Full SCBA removal with obstructions
- Full SCBA removal
- Front swim
- Backstroke

Multiple techniques for reducing profile are presented due to different body types having success with one over the other.

This skill can be taught using the IAFF FGS Reduced/Low Profile Prop or using an actual wall within a building. This skill is taught to a small group of fire fighters so each has sufficient time practicing the skill. Fire fighters will be allowed to attempt all prescribed options for reduced and low profile to determine their best option. To demonstrate mastery, fire fighters are required to perform this skill without vision.

A CASE STUDY SUPPORTING THE TRAINING OF:
Disentanglement Maneuvers

(The following comes from the Regis Towers fire incident April 11, 1994. This incident was investigated by NIOSH and the findings were included in the NIOSH publication NIOSH Alert: Preventing Injuries and Deaths of Fire Fighters [DHHS (NIOSH) Publication No. 94-125] and is available at the NIOSH website http://www.cdc.gov/niosh/fire.html)

On April 11, 1994, at 0205 hours, a possible fire was reported on the ninth floor of a high-rise apartment building. This building had been the scene of numerous false alarms in the past. An engine company and a snorkel company were the first responders and arrived at the apartment building at 0208 hours. The engine company was the first on the scene and assumed command. Five fire fighters from the two companies entered the building through the main lobby. They were aware that the annunciator board showed possible fires on the ninth and tenth floors. Lobby command radioed one fire fighter that smoke was showing from a ninth-floor window. All five fire fighters used the lobby elevator and proceeded to the ninth floor. When the doors of the elevator opened on the ninth floor, the hall was filled with thick black smoke. Four of the fire fighters stepped off the elevator. The fifth fire fighter, who was carrying the hotel pack, stayed on the elevator (which was not equipped with fire fighter control) and held the door open with his foot as he struggled to don his SCBA. His foot slipped off the elevator door, allowing the door to close and the elevator to return with him to the ground floor.

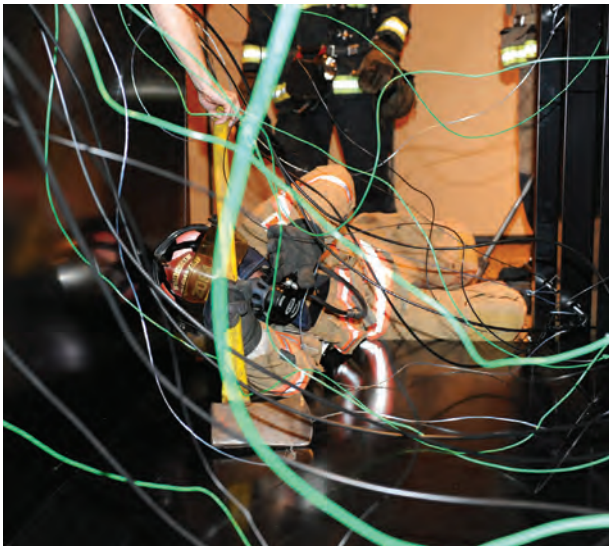
The remaining four fire fighters entered the small ninth-floor lobby directly in front of the elevator. One fire fighter stated that he was having difficulty with his SCBA and asked for the location of the stairwell. Another fire fighter said, "I've got him," and proceeded with him into the hallway, turning right. Later, one of the four fire fighters stated that he had heard air leaking from the SCBA of the fire fighter having difficulty and had heard him cough. The remaining two fire fighters entered the hallway and turned left, reporting zero visibility because of thick black smoke. Excessive heat forced them to retreat after they had gone 15 to 20 feet. They proceeded back down the hall past the elevator lobby. There they encountered a male resident, who attacked one of the fire fighters, knocking him to the floor and forcibly removing his facepiece. The two fire fighters moved with the resident through the doorway of an apartment, where they were able to subdue him. One fire fighter broke a window to provide fresh air to calm the resident. At about the same time, the low-air alarm on his SCBA sounded. The other fire fighter was unable to close the apartment door because of excessive heat from the hallway. Both fire fighters and the resident had to be rescued from the ninth-floor apartment window by a ladder truck.

Fire fighters from a second engine company arrived on the scene at 0209 hours. They observed a blown-out window on the ninth floor and proceeded up the west-end stairwell to the ninth floor carrying a hotel pack and extra SCBA cylinders. These fire fighters entered the ninth floor with a charged fire hose and crawled down the smoke-filled hall for approximately 60 feet (the hallway was 104 feet long) before extreme heat forced them to retreat. As they retreated, they crawled over something they thought was a piece of furniture. They did not remember encountering any furniture when they entered the hallway. In the dense smoke, neither fire fighter could see the exit door 6 feet away, and both became disoriented.

After the fire fighter from the first company rode the elevator to the ground floor lobby, he obtained a replacement SCBA and climbed the west-end stairs to the ninth floor. When he opened the ninth-floor exit door, he saw the two fire fighters from the second engine company in trouble. He pulled both into the stairwell.

When a rescue squad arrived at the scene at 0224 hours, lobby command could not tell them the location of the fire fighters from the first company. They proceeded up the west-end stairs to the ninth floor. The rescue squad opened the ninth-floor exit door and spotted a downed fireman approximately 9 feet from the door. He was tangled in television cable wires that had fallen to the floor as a result of the extreme heat. The downed fireman was from the first engine company; his body may have been what the fire fighters from the second engine company encountered in the hallway. He was still wearing his SCBA, but he was unresponsive. The rescue squad carried the fire fighter down the stairs to the eighth floor where advanced life support was started by other fire fighters. The rescue squad then entered the first apartment to the left of the exit door and found a second fire fighter from the first engine company kneeling in a corner and holding his mask to his face. He was unresponsive. The rescue squad carried the fire fighter down the stairs to the eighth floor where advanced life support was started.

Both fire fighters were removed within minutes and taken to a local hospital, where advanced life support was continued; but neither responded. Both victims died from smoke and carbon monoxide inhalation. Both victims wore PASS devices; but because the devices were not activated, no alarm sounded when the fire fighters became motionless. ■



DISENTANGLEMENT MANEUVERS

Fires inside an enclosed structure create a mess for fire fighters operating on the floor. Fire fighters often encounter debris that has fallen off shelves, and ceiling and wall fixtures that have burned and are left hanging to the floor. These hazards, coupled with the mess a fire fighter creates when searching for victims in smoky environments, can create egress problems for a fire fighter.

As fire burns draperies, blinds, lighting fixtures, computer wiring, and HVAC ducting, the possibility of encountering an entanglement hazard increases. The overhead ducting of the HVAC system contains wires that give the ducting its stability. If a fire breaches the ceiling and burns the ducting, the wires within the ducting fall to the floor. These wires can cause a dangerous entanglement hazard to fire fighters operating on the floor. Fire fighters must anticipate these hazards and have a plan to follow when egress is cut off.

The disentanglement prop simulates this situation. As fire fighters progress through the prop they must manipulate their bodies with full turnouts and SCBA through a prop having wire obstructions crossing the area of travel.

In addition to teaching disentanglement techniques, this skill also teaches the need to be flexible, physically fit, and to exercise good air management. The skill of disentanglement is a physically demanding process. Fire fighters must place their bodies in different positions to free themselves. This requires the fire fighter to twist and turn their bodies to avoid entanglement, and even to fully remove their SCBA's while in awkward positions. Fire fighters will learn to monitor their respirations and maximize efficiency of movement while going through the prop so air is conserved.

Fire fighters are required to perform this skill with and without vision. Prop difficulty is increased by adding entanglement hazards and obstacles as performance improves.

A CASE STUDY SUPPORTING THE TRAINING OF:
SCBA Confidence Maze

The following comes from the NIOSH Fire Fighter LODD investigation report F2007-18. Nine Career Fire Fighters Die in Rapid Fire Progression at Commercial Furniture Showroom – South Carolina. The full investigation report is available at the NIOSH website https://www.cdc.gov/niosh/fire/pdfs/face200718.pdf

SUMMARY

On June 18, 2007, nine career fire fighters died when they became disoriented and ran out of air in rapidly deteriorating conditions inside a burning commercial furniture showroom and warehouse facility. The first arriving engine company found a rapidly growing fire at the enclosed loading dock connecting the showroom to the warehouse. The Assistant Chief entered the main showroom entrance at the front of the structure but did not find any signs of fire or smoke in the main showroom.

He observed fire inside the structure when a door connecting the rear of the right showroom addition to the loading dock was opened. Within minutes, the fire rapidly spread into and above the main showroom, the right showroom addition, and the warehouse. The burning furniture quickly generated a huge amount of toxic and highly flammable gases along with soot and products of incomplete combustion that added to the fuel load. The fire overwhelmed the interior attack and the interior crews became disoriented when thick black smoke filled the showrooms from ceiling to floor. The interior fire fighters realized they were in trouble and began to radio for assistance as the heat intensified. One fire fighter activated the emergency button on his radio. The front showroom windows were knocked out and fire fighters, including a crew from a mutual-aid department, were sent inside to search for the missing fire fighters. Soon after, the flammable mixture of combustion by-products ignited, and fire raced through the maze-like main showroom. Interior fire fighters were caught in the rapid fire progression and nine fire fighters from the first-responding fire department died. At least nine other fire fighters, including two mutual-aid fire fighters, barely escaped serious injury.

The NIOSH investigators made 43 recommendations, to minimize the risk of similar occurrences, including the following:

Recommendation #10: Fire departments should ensure that the Incident Commander maintains close accountability for all personnel operating on the fire ground

Discussion: Personnel accountability on a fire ground means identifying and tracking all personnel working at the incident. A fire department should develop its own system and standardize it for all incidents. Accountability on the fire ground can be maintained by several methods: a system using individual tags assigned to each fire fighter, a riding list provided by the company officer, a SCBA tag system, or incident command board. Modern radio systems also incorporate a means of tracking the identity of fire fighters at an incident scene.

Recommendation #12: Fire departments should ensure that crew integrity is maintained during fire suppression operations.

Discussion: Fire fighters should always work and remain in teams whenever they are operating in a hazardous environment. Team continuity means team members knowing who is on their team and who is the team leader; team members staying within visual contact at all times (if visibility is low, teams must stay within touch or voice distance of each other); team members communicating needs and observations to the team leader, and team members rotating together to rehabilitation, staging as a team, and watching out for each other (practicing a strong buddy system). Following these basic rules helps prevent serious injury or even death by providing personnel with the added safety net of fellow team members. Teams that enter a hazardous environment together should leave together to ensure that team continuity is maintained. In this incident, there were numerous instances where fire fighters were working independently, entering and exiting the structure alone, operating hose lines, pulling walls and ceiling, and other related activities. Working alone increases the risk for themselves, and possibly to others during search and rescue efforts.

Recommendation #21: Fire departments should consider using exit locators such as high intensity floodlights, flashing strobe lights, hose markings, or safety ropes to guide lost or disoriented fire fighters to the exit.

Discussion: The use of high-intensity floodlights, flashing strobe lights, or other high visibility beacons can be set up at the entry portals of burning structures as an aid to assist fire fighters in situations requiring emergency escape.39 If staffing permits, a fire fighter can be stationed at the doorway to assist with flaking hose through the entrance and to assist exiting fire fighters. Hose lines can be marked with raised chevrons pointing in the direction of the pump (to the outside). Another option for locating exits is the deployment of safety rope lines as crews enter a structure. The end of the safety rope is secured outside the doorway and the rope is laid out as the crew advances inside.

During this incident, several fire fighters inside the structure became disoriented as the conditions deteriorated. Most of the fire fighters working inside the structure ran out of air. During the NIOSH interviews, fire fighters stated they had to search for a hoseline to follow outside. Other fire fighters reported hearing the sound of Engine 11 running in the parking lot and then moving toward the sound. Safety ropes were not deployed by the initial crews who entered the structure.

Recommendation #22: Fire departments should ensure that Mayday transmissions are received and prioritized by the Incident Commander.

Discussion: The Incident Commander must monitor and prioritize every message, but only respond to those that are critical during a period of heavy communications on the fire ground. A radio transmission reporting a trapped fire fighter is the highest priority transmission that Command can receive. Mayday transmissions must always be acknowledged and immediate action must be taken. As soon as fire fighters become lost or disoriented, trapped or unsuccessful at finding their way out of the interior of a structural fire, they must initiate emergency radio transmissions. A Mayday call should receive the highest communications priority from dispatch, the IC, and all other units on-scene. In this incident, there were multiple radio transmissions of fire fighters asking for assistance in finding the exit. There was no reaction to these radio transmissions for several minutes, possibly due to the large volume of radio traffic and/or the chief officers being distracted by engaging in fire ground activities.

Recommendation # 23: Fire departments should train fire fighters on actions to take if they become trapped or disoriented inside a burning structure.

Discussion: Fire fighters must act promptly when they become lost, disoriented, injured, low on air, or trapped. First, they must transmit a distress signal while they still have the capability and sufficient air, noting their location if possible. The next step is to manually activate their PASS device. To conserve air while waiting to be rescued, fire fighters should try to stay calm, be focused on their situation and avoid unnecessary physical activity. They should survey their surroundings to get their bearings and determine potential escape routes such as windows, doors, hallways, changes in flooring surfaces, etc.; and stay in radio contact with the IC and other rescuers. Additionally, fire fighters can attract attention by maximizing the sound of their PASS device (e.g. by pointing it in an open direction); pointing their flashlight toward the ceiling or moving it around; and using a tool to make tapping noises on the floor or wall.

Recommendation #25: Fire departments should implement joint training on response protocols with mutual aid departments.

Discussion: Mutual aid companies should train together and not wait until an incident occurs to attempt to integrate the participating departments into a functional team. Differences in equipment and procedures need to be identified and resolved before an emergency occurs when lives may be at stake. Procedures and protocols that are jointly developed, and have the support of the majority of participating departments, will greatly enhance overall safety and efficiency on the fire ground. Once methods and procedures are agreed upon, training protocols must be developed and joint-training sessions conducted to relay appropriate information to all affected department members.

Recommendation #29: Fire departments should ensure that fire fighters are trained in air management techniques to ensure they receive the maximum benefit from their self-contained breathing apparatus (SCBA).

Discussion: SCBA air cylinders contain a finite volume of air, regardless of the size. Air consumption will vary with each individual's physical condition, the level of training, the task performed, and the environment. Depending on the individual's air consumption and the amount of time required to exit an immediately-dangerous-to-life-and-health (IDLH) environment, the low air alarm may not provide adequate time to exit. Working in large structures (high rise buildings, warehouses, and supermarkets) requires that fire fighters be cognizant of the distance traveled and the time required to reach the point of suppression activity from the point of entry. When conditions deteriorate and the visibility becomes limited, fire fighters may find that it takes additional time to exit when compared to the time it took to enter the structure. ■

SCBA CONFIDENCE MAZE

Fire fighters must have confidence in their equipment when inside a building filled with smoke and increasing temperature. Confidence is built through exposure to situations where fire fighters are required to depend on their equipment for survival. As fire fighters become more skilled in negotiating around, over, and under obstacles in smoky environments, they progressively become more confident with their equipment. Confidence in the SCBA is critical since many fire fighters who have been lost inside a structure fire, panic, and remove their SCBA face piece in an effort to breathe clean air. This action often proves fatal due to the inhalation of super-heated gases.

Managing panic is a learned skill. This skill is learned through exposure to the situation that invokes the panic re-

sponse. The SCBA confidence maze is a series of obstacles within an enclosed structure that the fire fighter must negotiate in a darkened environment. The SCBA confidence maze challenges fire fighters to apply the techniques learned in the previous skill stations (low and reduced profile and disentanglement) to successfully get through all the obstacles. The SCBA confidence maze also teaches fire fighters the survival skills of air management, panic suppression, room orientation, and following a hose line and reading couplings.

Fire fighters will be allowed adequate time to practice all survival skills prior to performing the SCBA confidence maze. Once proficient in all skills, each fire fighter will enter the maze with their face piece darkened, on air and wearing full PPE's. No lights may be used at anytime. The fire fighter will communicate via a handheld radio with members on the outside. Communications between those on the inside and those on the outside will allow fire fighters to exercise accessing their radios in a zero visibility environment when space is limited. Fire fighters needing immediate assistance will announce a Mayday over the radio.

There are many options for the SCBA confidence maze design and construction. Some fire departments build them within a mobile environment so they can be transported to various fire stations. Some elect to build them inside buildings where they are protected from weather. Both of these options are acceptable. The important thing is that they simulate a challenging Mayday type environment. Fire departments are very creative in designing props for the maze. Some have included change in elevations with stairs, or ladders. Some have included movable doors, obstacles hung from the ceilings, entanglements, and collapsible floors or ceilings. All of these options are only as good as they are safe and realistic. A prop that injures fire fighters will be used as firewood before it can be used again. It is important that each prop be built in accordance with standard building code regulations, thus assuring a measure of safety, while

CASE STUDY SUPPORTING THE TRAINING OF:
Upper Floor Escape Techniques

(The following comes from the NIOSH Fire Fighter LODD investigation report F2005-03 Career Lieutenant and Career Fire Fighter Die and Four Career Fire Fighters are Seriously Injured during a Three Alarm Apartment Fire – New York. The full investigation report is available at the NIOSH website www.cdc.gov/niosh/fire/reports/face200503.html).

On January 23, 2005, a 46-year-old male career Lieutenant (Victim #1) and a 37-year-old male career fire fighter (Victim #2) died, and four career fire fighters were injured during a three alarm fire in a four story apartment building. The victims and injured fire fighters were searching for any potentially trapped occupants on the floor above the fire which started in a third floor apartment and quickly extended to the fourth floor. Fire fighters had been on the scene less than 30 minutes when they became trapped by advancing fire and were forced to exit through the fourth floor windows.

Ladder 27 (officer (victim # 1), chauffer (victim # 2), and four fire fighters (two were injured)) and Rescue 3 (officer, chauffer (injured) and five fire fighters (one injured)) were among the crews who responded on the first alarm. The L27 crew was the third crew on-scene (the second ladder company) and advanced up a stairwell and began searching on the floor above the fire for possible trapped occupants. Rescue 3 arrived and the IC ordered them to conduct a search on the 4th floor as well. The Rescue 3 Captain and two fire fighters ascended the stairs to the 4th floor to assist Victim #1 and the Ladder 27 crew already searching there. Later, the Ladder 27 Chauffeur (victim #2) joined his crew on the 4th floor to assist with the searches. After Rescue 3 confirmed that Ladder 27 was operating in the apartment above the fire they began to search the adjacent 4th floor apartment. After their search in the adjacent apartment, Rescue 3 moved to the apartment above the fire.

Engine 75 advanced a 1¾-inch hoseline up the stairwell to the 4th floor to the apartment above the fire. Once in the apartment, the Engine 75 Lieutenant conferred with Victim #1 who was operating a thermal imaging camera. Victim #1 said that heat was coming from behind a bedroom door in the hallway. Victim #1 ordered the padlocked bedroom door forced open and Engine 75 radioed for the hoseline to be charged. The 3rd floor Operations Chief radioed the crews on the 4th floor and said there was a loss of water on the 3rd floor and ordered Engine 75 to take their charged line to the 3rd floor. The Engine 75 Officer told Victim #1 that he was taking the hoseline downstairs. (Note: The departure of Engine 75 from the 4th floor left the remaining six fire fighters from Ladder 27 and Rescue 3 without a charged hoseline. The engine company going up the stairs to replace Engine 75 was Engine 42, which was the same company that had water pressure problems). The Engine 46 crew took Engine 42's uncharged hand line to the 4th floor. This hand line never received water again during operations. ■

Upper Floor Escape Techniques (cont.)

Victim #1 and his crew continued to search the apartment. They were also looking for the rear fire escape that they could use as a secondary means of egress. (Note: The crew was unaware of the interior partitions and floor layout).

At 0826 hours, the Rescue 3 Captain made an urgent radio transmission to command that heavy fire was present on the 4th floor and that "fire was blowing into the hallway." Heavy smoke was now pushing out of all the 4th floor windows directly above the original fire apartment. (Note: The fire department's investigative report indicated that gusty wind conditions had a dramatic effect on fire extension to the 4th floor). The IC responded that Engine 48 was bringing up a hoseline. Rapidly progressing flames trapped four Ladder 27 fire fighters (Victims #1 & #2 and injured fire fighters #1 & #2) and two Rescue 3 fire fighters (injured fire fighters #3 & #4) within the back of the 4th floor apartment in the rear bedrooms.

Upon reaching the 4th floor, the E42 officer radioed, "we have fire into the hallway on the floor above. You need a line upstairs." At 0828 hours, Victim #1 made a Mayday transmission. Victim #1 made two additional Mayday transmissions due to the intense heat and flame extending into the bedroom. (Note: At this time, neither Engine 42 nor Engine 46 had a charged hoseline on the 4th floor). The six fire fighters trapped on the 4th floor were now at the rear bedroom windows with intense heat at their backs. Victim #1 and injured fire fighters #1 & #2 were in the second bedroom crowded together at the third window which was covered by a metal child guard gate. The fire fighters could not remove it due to the intense heat. Victim #1 realized that one of his fire fighters was out of air and immediately pulled him to the window. Injured fire fighters #1 and #2 supported Victim #1 as he climbed over the child gate. The injured fire fighters believed that Victim #1 was making room for them at the window or initiating a self-rescuing maneuver. Injured fire fighters #1 and #2 were hanging on to Victim #1 just before he fell to the ground. The intense heat then forced injured fire fighters #1 and #2 to jump from the window. At the same time, Victim #2 made his way into a separate bedroom by himself and was forced to jump from the fourth window. (Note: The back yard of the apartment building is actually below grade. The distance was equivalent to a 5 story fall).
Injured fire fighter #3 became trapped in the first bedroom. He closed the bedroom door behind a wall of fire coming down the hallway. The conditions within the room were extremely high heat with zero visibility. As the transit window over the door vented, the heat within the room became intolerable. Injured fire fighter #3 sought refuge from the heat by hanging his torso out the bedroom window. With his head outside the window, he saw injured fire fighter #4 in the window of the adjacent bedroom. Injured fire fighter #3 remained calm and radioed a Mayday followed a few seconds later with "We're bailing out of here, hurry up." Injured fire fighter #4 handed fire fighter #3 the end of his personal safety rope (Note: This was accomplished from the exterior of the structure with both fire fighters hanging out of the windows. The personal safety rope, purchased independently by injured fire fighter #4, was NFPA approved and 50 ft long). Fire fighter #3 wrapped the end of the rope around his wrist several times, held the rope in his hands and stepped on the rope. Fire fighter #4 wrapped the rope under his arms, held the rope together and attempted to belay to the ground. When fire fighter #3 felt the rope go slack, he attached the carabineer end to the child window guard; he wrapped the rope around his shoulder and arm and slowly descended from the window. Fire fighter #3 reported that the rope had broken and he recalled hitting the ground feet first, looking up and seeing fire coming out of the 4th floor windows. Both fire fighters had fallen to the ground and suffered severe injuries. (Note: Although Fire Fighter #3 reported that the rope had broken, the rope was still attached to the window guard, unbroken, and hanging to the ground after the incident). Both injured fire fighters were wearing a safety harness but in their haste to escape the intense heat neither was able to attach the rope to the harness.

The six fire fighters fell to the ground between 0830-0831 hours. First aid was immediately administered to the injured fire fighters. Victim #1 and Victim #2 were transported to a metropolitan trauma center where they were later pronounced dead. Injured fire fighter #1 was hospitalized with minimal injuries. Injured fire fighter #2 suffered broken legs, shoulder and internal injuries. Injured fire fighter #3 was hospitalized with two broken heels and ankles, two broken legs, broken hip, minor hand burns and severe internal injuries. Injured fire fighter #4 was hospitalized with broken ribs, shoulders and pelvis, a skull fracture, burns on the legs and neck, and severe internal injuries. ■

Note: Injured Fire Fighter #3 died on November 22, 2011 due to complications from the injuries he suffered on January 23, 2005.

EMERGENCY UPPER FLOOR ESCAPE TECHNIQUES

Where and when a fire fighter may call a Mayday is unpredictable. Fire fighters must possess the skills necessary to save themselves if they are trapped on an upper floor when ladders are present and when they are not.

Fire departments throughout North America teach a variety of upper floor escape techniques. Each technique is designed to address a specific rescue situation and each has proven effective in saving a fire fighter's life. Several of these techniques will be covered within this program. However, only a few will be taught within the practical portion. To learn all of the techniques proficiently within the confines of

this program is not possible due to some techniques requiring specialized equipment and training.

The Fire Ground Survival Program includes upper floor escape techniques that require equipment commonly used by fire departments. This program also includes specialized self rescue equipment available for purchase by fire departments. The following techniques are included within this program and supported with lesson plans:

- Window hang
- Personal escape system (PES) – (Note: PES is only taught as an introductory skill within the FGS Train the Trainer program. Fire departments using PES devices should train at least annually with their equipment.)
- Rapid ladder escape
- Low profile ladder escape

SAFETY MESSAGE

Upper floor escape techniques can be dangerous maneuvers and shall therefore be demonstrated, taught, and practiced in a controlled environment under competent supervision. All safety equipment used by the host fire department shall be, at minimum, consistent with NFPA 2500-*Standards for Operations and Training for Technical Search and Rescue Incidents and Life Safety Rope and Equipment for Emergency Services*. Safety equipment shall be of the highest quality to assure the highest degree of reliability and safety. Personnel from the host fire department selected to set-up and tend the belay system required for all upper floor escape maneuvers, and to secure the ladder at the prescribed angle of 60 to 65 degrees shall be, at minimum, Level I Technical Rescuer trained as per NFPA 1006 – *Technical Rescue Professional Qualifications*.

AT NO TIME should any of these skills be practiced without proper supervision. Level I Technical Rescuer personnel assigned by the host fire department are responsible for the care, maintenance and storage of the safety equipment. These maneuvers will only be attempted while wearing a Class 3 harness.

WINDOW HANG

If a ladder is not available, a fire fighter has few options for rescue if trapped on an upper floor. Finding a window should be one of the first actions a fire fighter should consider. When at the window the fire fighter must clear the opening by breaking the glass and removing the sash. This will provide a clear egress point for the fire fighter to get outside.

The window hang technique requires the fire fighter to hang from the window sill after the opening has been cleared. The fire fighter should move head first out the window and hang using one arm and one leg. With most of the body outside off the window and below the sill, exposure to the heat and smoke is minimized.

Like all of the skills listed within this section, it is important to practice these skills frequently. If a window close to ground level is not available for practice, a prop to support this skill can be easily built.

ADMINISTRATIVE RESPONSIBILITY

Any upper floor emergency egress techniques must be approved by the fire department administration. The administration must ensure all required safety systems are in place.

A LIFE SAVED IN THE F.D.N.Y. WITH THE USE OF THE PERSONAL SAFETY SYSTEM

In December of 2007 a Brooklyn fire fighter became trapped while operating on the top floor of a four story wood frame structure. The fire fighter was positioned at the top floor window in the front of the building when his egress was cut off by fire. Two ladder company apparatus were positioned in front of the building with the aerial devices raised but not at the window of the trapped fire fighter. As the fire intensified, the fire fighter was forced to evacuate before the aerial could be positioned at the window. To escape the heat the fire fighter safely exited the fourth floor window by activating his Personal Safety System.

This self rescue was successful because the fire fighter was properly trained. Without the proper equipment, and without the skills necessary to perform the "Bail Out" technique, the fire fighter may have suffered serious, or even fatal burns. Mayday situations come suddenly and require the fire fighter to react quickly. In this case the fire fighter saved his own life because he performed the survival skill exactly as he had practiced.

Retired Captain Michael C. Hayes is a 31 year fire service veteran with 22 years in the FDNY. He served as the Unit Head of the FDNY's Personal Safety System project that trained 12,000 fire fighters.

EMERGENCY RAPPEL USING A PERSONAL ESCAPE SYSTEM

A personal escape system (PES) is a device worn by fire fighters to provide a safe lowering system from upper floors when no other means of descent are available. They are designed to be deployed by an individual fire fighter quickly out of a window when ladders are not in place. These devices have undergone considerable research and development since the Bronx fire in January 2005 when six FDNY members fell four stories after using a window to escape a rapidly advancing fire. Since 2005 PES designs have advanced so they are now more reliable and user friendly.

FDNY has been a leader in researching the application of PES technology within the fire service. Through a collaborative effort of FDNY personnel and manufactures of rescue devices specializing in mountaineering, rescue, fire fighting, and heavy construction the Personal Safety System (PSS) was designed. The PSS allows a fire fighter to descend from an upper floor using rope and a lowering device carried on a safety harness. The self deployed system is used when no ladders are available and the fire fighter needs immediate rescue from an upper floor. Since its introduction, additional manufactures have begun producing similar fire fighter PES's with varying degrees of safety and reliability.

There is often a misconception about these systems. Many fire fighters believe that they are only needed in mid and high-rise buildings. While exiting from a lower (second to fourth) floor window may not result in death, it can end a fire fighter's career. It is recommended that fire departments operating in buildings with more than one story equip personnel with a PES.

There are a variety of PES's on the market. They range from the simple carabineer to friction plates, to the more elaborate "hands free" devices. With all systems, it is important that each component is tested by a certified lab to meet the requirements of NFPA 1983 and 1500 regarding self-escape. In addition, each component must also operate effectively to complete a system. Fire departments using PES's must be sure their personnel are initially trained according to the specifications of the manufacturer of the components, and provided refresher training at least annually.

PERSONAL ESCAPE SYSTEM COMPONENTS

While it is not the intent of the FGS program to endorse any one PES or component manufacturer, most experts will agree that, there are important features and standards that each component of the system should meet. The following is the FGS program recommendations for each component of a PES:

HARNESS:

The harness should be NFPA 1983 Class II compliant, with an A-Frame attachment that prevents the wearer from rotating while under load. The harness can be worn over or under the outer shell, but should be an integrated component of the user's turnout pants. Finally, it should be designed with a quick connect waist belt to speed donning and should not restrict the movement of the wearer during normal fire fighting activities.

EQUIPMENT PACKAGING:

The term "package" is used to emphasize the need for a dedicated carrying case designed for the system. During the original development of the PSS, the FDNY spent more time determining how the system should be packaged than development of any other component in the system. The need for the system to deploy correctly 100 percent of the time is critical to successful use of any escape system. The system should be packaged in a carrying case that separates the components of the system. This is necessary to ensure each component of the system maintains operational integrity by preventing entanglement problems. The packaging should also ensure the system will not inadvertently be deployed during normal fire fighting activities.

ANCHOR:

The anchor should be light-weight, pre-connected to the escape rope, and allow the user to securely anchor themselves to a substantial object in the room, a wall stud or windowsill. The device should be certified by a third party examiner to meet the auxiliary equipment requirements of NFPA 1983.

ROPE:

The rope should be approximately 50 feet long, a minimum of 7.5 millimeters in diameter, have superior heat/abrasion (+400˚F) resistance and be certified by a third party examiner to meet the Escape Rope Performance Requirements of NFPA 1983.

DESCENT DEVICE:

The descent device should be preconnected to the escape rope and the user harness. In addition, the device should be a hands free auto-stopping (passive brake) design. It should also be designated and certified by the manufacturer as a fire fighter escape device in accordance with NFPA 1983.

RAPID (HEAD FIRST) LADDER AND LOW PROFILE LADDER ESCAPE

The rapid ladder and low profile ladder escapes are self-rescue techniques that allow a fire fighter to perform an emergency escape from an upper floor window when rapidly deteriorating interior conditions do not allow a normal window exit onto a ladder. While this is an effective self-rescue technique, it is meant to be used as a last resort — when a fire fighter is faced with no other options.

The most important elements of these techniques are the ladder type and angle. A fire fighter cannot use the ladder rescue technique unless a ladder is positioned properly at the window where he or she is located. Setting the ladder at the proper climbing angle is critical. **A flatter angle of 60 to 65 degrees, as opposed to the traditional 70 degrees, allows the fire fighter to control their descent as they exit the structure. Ladders placed at a flatter angle should be tied off to prevent the base from sliding away from the building.**

Aluminum ladders provide much greater friction than wooden ladders. The rungs on an aluminum ladder are designed with grooves across their lengths. These grooves grab the turnouts and slow the fire fighter's descent. A wooden ladder used for a head first ladder slide needs to have the climbing angle reduced even further since the rungs lack any type of friction material. Training on the drill ground under all possible conditions (wet turnouts); using safety harnesses, will help to determine what works best for your equipment.

No matter which ladders are available, remember, ladders left on the apparatus are worthless on the fire ground. The time to put the rescue ladders in place is before they are needed.

The Rapid (Head First) Ladder Escape requires the fire fighter to exit onto the ladder head first. After clearing the sash, the fire fighter remains low while exiting the window onto the ladder. While exiting the window the fire fighter should use their hands to grab the rungs with the palms only (DO NOT WRAP THUMBS AROUND RUNGS), and use their arms to slow progress down the ladder. The fire fighter should use their feet to slow the rate of descent by hooking them on the rungs.

The Low Profile Ladder Escape requires the fire fighter to exit onto the ladder head first, and then, using the arms and rungs, turn the body 180 degrees so the feet are facing down so a normal ladder descent is performed. This technique requires the fire fighter to remember to hook the number two rung with one arm, and grab the number four rung with the other hand in order to safely perform the technique.

Upon completion of the training evolution, fire fighters will demonstrate how to properly clear a window for emergency exit, properly exit the structure through the window head first, and proceed down a ladder in a controlled manner.

NEAR MISS 182 RALEIGH AVE TORONTO, ONTARIO LOCAL 3888

On March 29, 2007, I was the Captain assigned to Pumper 223. We responded as part of a normal assignment to a house fire at 181 Raleigh Ave. in Toronto's east end. Upon arrival we found heavy smoke coming from a multi-story structure and the crew from the first arriving truck advancing hand lines into the occupancy.

Shortly after arriving we advised the IC that we would perform a primary search of the second floor. For access we positioned a ladder at a window. As a crew of three, Captain, Acting Captain, and Fire Fighter, we climbed the ladder and made entry through a bedroom window with a hose line. The room was difficult to search due to clutter and the extreme smoke conditions. Visibility was near zero, but the heat was bearable.

A short time into our search the heat rose dramatically and fire began to roll over the ceiling of the room. The fire fighter attempted to knock down the fire but was unsuccessful. As the heat continued to bank down on us we proceeded back to the window so we could get out. The Acting Captain was the first to make his way to the window. As he climbed out the window his SCBA got hung up. Thinking quickly, he removed his SCBA and climbed down the ladder. In the period of time the Acting Captain was exiting the window, the temperature in the room had become unbearable. Realizing our situation was getting more urgent I initiated the Mayday sequence by pushing the emergency alert button on my radio. Just after pushing the button the Acting Captain had cleared the window making it accessible to myself and the fire fighter. We both exited through the window and down the ladder head first using our arms to control our descent. Because of the extreme heat, the only way for both of us to get out quickly and safely was to self-rescue down the ladder.

Fortunately no one was hurt during this incident. However, after reviewing the news video, it was evident that we only had seconds to spare before becoming overcome by fire.

This incident taught us all how valuable and necessary fire fighter survival training is. When I attended fire ground survival skills training I questioned the need of a headfirst ladder escape. My reasoning was, "If I have time to find the ladder with my hands, I should have time to find it with my feet." With this prejudice I practiced the ladder escape reluctantly. At the time of the drill I never anticipated actually having to use this skill. I'm now the biggest advocate of the training. Without it, all of us assigned to Pumper 223 may not have survived that day. ■

A CASE STUDY SUPPORTING THE TRAINING OF: Condition Recognition and Rapid Evacuation

(The following comes from the NIOSH FF LODD investigation report F2013-14: Career Probationary Fire Fighter Runs Out of Air and Dies in Commercial Structure Fire – Michigan. The full investigation report is available at the NIOSH website:
www.cdc.gov/niosh/fire/pdfs/face201314.pdf

On May 8, 2013, a 29-year-old male career probationary fire fighter died after running out of air and being trapped by a roof collapse in a commercial strip mall fire. The fire fighter was one of three fire fighters who had stretched a 1½-inch hoseline from Side A into a commercial strip mall fire. The hose team had stretched deep into the structure under high heat and heavy smoke conditions and was unsuccessful in locating the seat of the fire. The hose team decided to exit the structure. During the exit, the fire fighter became separated from the other two crew members. The incident commander saw the two members of the hose team exit on Side A and called over the radio for the fire fighter. The fire fighter acknowledged the incident commander and gave his location in the rear of the structure. The fire fighter later gave a radio transmission that he was out of air. A rapid intervention team was activated but was unable to locate him before a flashover occurred and the roof collapsed. He was later recovered and pronounced dead on the scene.

NIOSH Recommendation: Fire departments should ensure that all fire fighters and officers receive regularly scheduled, hands-on (practical) fundamental skills training and specialized training on building construction and modern fire behavior.

Discussion: Structure fires have decreased by 53% over the past 30 years, which in turn has limited the opportunities for today's fire service to gain necessary experience to understand the increasingly complex fires they are now up against [NFPA 2010c]. Many fire departments across the country are faced with challenges associated with the lack of fire fighter and officer experience in structural fire- fighting in both residential and (to a greater extent) commercial applications. With an increase demand for EMS and other service calls and the rapid retirement of experienced fire fighters and officers hired in the 60s, 70s, and 80s, fire departments can find themselves challenged to maintain experienced fire fighters and officers on the front lines. One way that fire departments can balance the lack of experience is to increase the frequency of hands-on, practical fire-fighting training. The military recognizes that practical battlefield or operational training is very important and provides consistent repetitive training such as war games for officers and fighting forces. Practical repetitive skills training on fire scenarios can help build a conditioned memory response (a slide tray of past events to draw from) for

fire fighters as well as officers (much the same as the military). This type of practical training can help to overcome a natural response of underestimating an event and using a conditioned response. This can occur when fire fighters may respond to a large number of incidents but not have any experience in another area. When sizing up an incident, the natural inclination of a fire fighter or officer is to search in their memory bank and apply a strategy or tactic used before. If there is nothing in their memory bank (from experience and training) for a specific incident, a fire fighter or officer may apply a strategy or tactic that may closely match the scenario based on their experience but that solution may be insufficient or underestimate the event. One area that fire departments need to recognize is the danger of a fire fighter or officer using a residential response (strategy and tactics) in a commercial setting. This can be overcome by training fire fighters and officers to recognize that, if they don't have anything in their "slide tray" for a large or complex incident event, they may want to reconsider their strategy and tactics.

Along with the challenges of experience faced by today's fire service, a lack of staffing is also a factor in many departments. Fire-fighting crews often have difficulty identifying hazards on the fireground simply because they are understaffed [Jakubowski and Morton 2001]. They may be busy performing multiple demanding tasks and overlook ongoing size-up. The fire fighter's natural desire to attack the immediate problem and finish the job quickly can result in critical errors such as checking voids in the ceilings, opening doors, and taking windows (creating flow paths) without charged hoselines readily available. With minimal personnel and multiple assignments, fire fighters may neglect ventilation, thus allowing built-up heat and smoke to intensify [Jakubowski and Morton 2001; NIOSH 2009a].

Identifying and predicting fire behavior can be a challenge for experienced fire fighters and officers and **even more difficult for a novice fire fighter**. Commercial structure fires may not be encountered frequently enough for fire fighters to build a "slide tray" of past events to draw from. While fire departments may have enough residential structure fire "slide tray" experience, the same tactics employed on a commercial structure fire may not yield the same results. A large issue here is when fire fighters draw on their residential experience of a quick attack with small lines in a large commercial structure fire. There are many more factors to consider with large commercial structure fires. Different styles of construction with significantly larger floor space and very high ceilings with large void areas (that conceal fire and products of combustion) make it harder to check overhead and the fire may get behind the crews stretching in. Chief Christopher Naum, SFPE (Command Institute) notes: "In most situations involving a structure fire, the probability of and anticipation for structural collapse or compromise are inevitably minimized, overlooked or at times disregarded until the catastrophic conditions present themselves with little to no time to react accordingly. The loss of situational awareness coupled with distracted attention to subtle or obvious pre-collapse building indicators and gaps in building and construction system knowledge combine to elevate operational risks to personnel on the fireground at structure fires."

As the number of fire calls is dropping nationwide, fire fighters are becoming less experienced in their main responsibility—fighting fires [Jakubowski and Morton 2001]. The number of calls for other types of service are increasing. Many departments have seen increases in emergency medical service (EMS) calls and automatic fire alarms. Fire departments that provide EMS typically answer two or three EMS calls for every fire call they run. In many cases, even career fire fighters who work every two or three days may go months or years before they work on a structure fire [Jakubowski and Morton 2001], and even longer before they respond on a large commercial structure fire. It is important for fire departments to understand how to overcome the experience gap by providing regularly scheduled, hands-on (practical) fundamental skills training for fire fighters and officers.

Fire departments should ensure that all fire fighters and officers receive fundamental and annual refresher training according to NFPA 1001 [NFPA 2013a] and NFPA 1021 [NFPA 2008a]. Initial and continual training provides an opportunity to ensure that all fire fighters and line officers are proficient in their knowledge and skills in recognizing and mitigating hazards. This annual training ensures that knowledge and skill retention are demonstrated and the training can be continually refocused to address needs. Training on structural fire-fighting should include departmental standard operating procedures, fire fighter safety, building construction, and fireground tactics. NFPA 1500, Chapter 5 [NFPA 2013], requires that the fire department provide an annual skills check to verify minimum professional qualifications of its members [NFPA 2013].

Fire departments should ensure that all fire fighters and officers receive additional annual training in building construction and fire behavior. For example, there have been many advancements in training curriculum available for building construction (predictability and performance of buildings on fire) and fire behavior. Underwriters Laboratories (UL) and the National Institute for Standards and Technology (NIST) have jointly conducted research that suggests a more innovative fire attack can make the fireground safer for fire fighters and occupants [UL 2013]. A large focus of the research is on ventilation and how ventilation effects the fire growth. Two types of ventilation most commonly used in the fire service are horizontal and vertical ventilation, and they can be either forced (positive- pressure ventilation) or natural (cutting a hole in the roof or cross ventilation by openings such as doors and windows). Improper or uncoordinated ventilation can have significant effects on fire behavior in structure fires. Horizontal ventilation allows for heat, smoke, and gases to escape by means of a doorway or window but is highly influenced by the location and extent of the fire, and special caution should be taken if the fire is in the attic or above the ceiling (as in this incident) [IFSTA 2008]. Ensuring that fire fighters and officers are trained in understanding the effects of ventilation on fire behavior is critical to fire fighter safety. The effects of ventilation may not be widely understood in the fire service and the new research by UL and NIST has provided scientific foundations for better understanding. ■

SUMMARY

Fire fighter survival skills are necessary due to the unpredictability of the fire ground. The fire ground is a hostile and ever-changing environment. As the fire progresses, the fire fighter must make quick decisions on engagement versus disengagement. In many fires, the fire fighter makes this decision based only on what is seen outside prior to entering the structure. Once inside, fire fighter's vision is limited due to the amount of smoke produced by burning synthetic furnishings and composite building materials. The ability to feel heat is also compromised due to the insulative properties of the turnout. The limited information a fire fighter has on the fire contributes to the possibility of human error.

Not having all of the information to make a good decision can result in making a bad decision. As fire fighters, we must improve our ability to process the limited information available to make good decisions. If it were possible to always make good decisions, learning fire ground survival skills would not be necessary. However, this is neither reasonable nor possible. Fires will always be unpredictable, and they will always be dangerous. Due to the additional factors of weather, wind, time of year, budget, staffing, and equipment, a fire department cannot provide for a safe fire ground experience 100 percent of the time. For this reason it is critical that fire departments be prepared 100 percent of the time for the Mayday event. If you are in the fire service long enough, it will not be a matter IF a Mayday event arises, it will be WHEN the Mayday event arrives. Fire fighters must be ready for that 100 percent of the time. ■

CHAPTER 5
MANAGING A MAYDAY

CHAPTER 5
LEARNING OBJECTIVES:

After reading this chapter students will be able to:

- Identify the two major types of fire fighter rescues.
- Identify the most common progression of rescue.
- Describe the characteristics of a leader when a member is experiencing a Mayday.
- Identify the fire service standards that encourage training on Mayday operations.
- Explain the Incident Commander's role in preparing for a Mayday.
- Explain the Incident Commander's role during a Mayday.
- Explain the Incident Commander's role after a Mayday is concluded.
- Explain how expanding the incident command system can assist in successful operations during a Mayday.

CHAPTER 5
MANAGING A MAYDAY

INTRODUCTION

The calling of a Mayday is a radio transmission that no Incident Commander (IC) wishes to hear. A missing, trapped, lost, or medically incapacitated fire fighter is among the most difficult and stressful situations an IC will experience. This chapter identifies the two major types of Fire Fighter Mayday/Rescues, the most common progression of rescue, and explains Command's role within the three primary phases of a Mayday (pre-mayday, mayday, post mayday).

Over the past decade, research by the IAFF FGS program, National Fire Academy, and Project Mayday have all independently identified incorrect assumptions and training practices associated with preparing for and managing a fire fighter Mayday. The two most important changes to current perceptions and training methods concern who will be in Command when a Mayday is called and who will perform the rescue of the fire fighter(s).

Traditionally, Mayday command training has focused on the Chief Officer level. During these training evolutions, the Chief Officer normally has had time to establish a formal Command Post and a Rapid Intervention Company with all the needed equipment is in place. While Maydays do occur under the above circumstances, research has shown that a large percentage of Maydays occur while Command is held by a Company Officer or prior to the establishment of a formal Command Post and a capable Fire Fighter Rescue Team is in place.

Fire Fighter Mayday/Rescues can be generally categorized into two types. The first type which includes the vast majority of Maydays involves a fire fighter encountering one of the following problems:

- Lost or separated from crew.
- SCBA – Low/Out of air or Face piece problem.
- Fall through a portion of the structure.

The common factor with these problems is that the fire fighter is able to assist in their own rescue. These types of emergencies are dealt with quickly and involve a rescue approach consisting of self-rescue or the fire fighter being rescued by their own crew or another crew already operating inside the structure.

The second type of Mayday consists of events where the fire fighter is entrapped, entangled or incapacitated and an extended operation or additional equipment may be required to affect a rescue. These types of emergencies makeup less than ten percent of all Maydays called, but are generally much more dangerous to both the Mayday fire fighter and the crews involved in the rescue. In fact, studies have shown that depending on the complexity of the rescue, approximately 1 out of 8 members of a Rapid Intervention Crew that enter the structure after a Mayday is called will call their own Mayday.

While Rapid Intervention "Crews" may not be the answer in many instances, "Rapid Intervention" is. Knowing that resources staged with additional equipment to assist on the exterior of a structure to rescue a firefighter is important, fire

fighters operating near a fire fighter with an emergency can offer initial assistance. Emphasis in training should be placed on identifying which crews can be re-tasked with rescue (e.g. primary search team) and which should maintain their initial assignment (e.g. fire attack team). In addition, a focus on training company level officers in managing a mayday with limited resources available should be a high priority.

Finally, Incident Commanders should be trained to recognize "rescue versus recovery." Any serious Mayday command training must include scenarios where a firefighter rescue is not viable.

"NO MORE"
DECEMBER 3RD 1999
CHIEF MIKE MCNAMEE —
WORCESTER FIRE DEPARTMENT

As the heat, smoke, and steam descended, the search was forced lower, floor by floor. The sixth floor had been impenetrable since McNamee encountered the flood of smoke on the AB stairwell around 6:35. The fifth floor, where Spencer and Jackson had been lurching blindly through a miasma of burning petroleum products—the industrial equivalent of napalm—was lost shortly after 7:30. Then, at 8:00, a panting firefighter emerged at the bottom of the stairs. "It's too hot, chief," he told McNamee. "I couldn't make it past the third floor."

McNamee took another look at the smoke roiling above him and ran through the situation in his head. Brotherton and Lucey were probably dead, Tom Spencer wasn't answering his radio, and Tim Jackson was with him. The warehouse was winning, taking his men two by two. Sending another man up, McNamee realized, would be sending him to die. He turned his back to the stairway. Fifteen fire fighters were crowded in front of him, ready to climb back into a solid wall of black heat.

"No more," McNamee said.

For one stunned second, no one said anything. The only sound McNamee heard was the deafening white noise from above, punctuated by snaps and pops and hisses. Then the men started yelling, surging forward, bellowing at the chief. "They're still up there, goddammit! They're still in there!"

McNamee stood his ground, guarding the stairs, pushing his hands into the chests of the men. "Listen to me!" he hollered. "You listen to me! We've already lost four. We're not going to lose any more." McNamee watched as his men collapsed, their shoulders slumping, their heads bowing, as if he had thrown a great crushing weight down upon them. "I want the building evacuated," he told them. "I want everybody out." ■

Excerpt taken from "The Perfect Fire" Esquire Magazine, July 2000

The information provided will enhance the efficiency and effectiveness of managing a Mayday. However, this information is a guideline that represents one way, but it is not necessarily the only way, to command a Mayday.

Many Departments currently have Standard Operating Procedures (SOGs) for Mayday operations designed around their communications, dispatching, and state/provincial fire fighting requirements. Therefore, Mayday guidelines differ from department to department. Having different Mayday SOGs is acceptable if fire departments do not depend on the resources of other agencies, but this is rarely the case. Most North American fire departments are linked by mutual or automatic aid systems where fire departments from different agencies respond together to structure fires and major events. Because of this cross-agency cooperation, it is critical that all agencies have consistent Mayday SOGs. If there is one area in the entire North American fire service where neighboring jurisdictions must operate in exactly the same way, it is in managing a Mayday.

What does the fire fighter in a Mayday situation expect from the IC? The obvious answers are:

- **Listening:** so the IC can hear the call for help.
- **Acting:** assigning resources quickly to locate and remove the distressed fire fighter.
- **Responding:** providing appropriate medical care to the distressed fire fighter.

According to the many articles, books, and protocols written on the topic of Mayday, the fire fighter who calls the Mayday expects the IC, above all, *to Command!*

Improving Command in the face of a Mayday requires experience, training, and education. As the number of fires across North America steadily decreases, it is becoming more difficult for our fire fighters to gain experience. Without experience, fire fighters are forced to rely on their training and education. Fire fighting is a high-risk/low-frequency event. Maydays are even less frequent and certainly put fire fighters at higher risk. Unlike many other evolutions, the Mayday scenario is typically not practiced routinely.

The goal of this chapter is to provide a foundation to achieve the successful outcome of saving a fire fighter after he or she has called a Mayday. This chapter covers the IC's responsibilities.

THE INCIDENT COMMANDER…THE LEADER

When a fire fighter calls a Mayday the expectation is that the IC is listening and will do everything needed to make a successful rescue. These expectations begin with the fire fighter being confident in the IC's abilities to command the Mayday. Panic and irrational thinking are avoided if the fire fighter believes the IC is in control and acting correctly.

The trust the fire fighter has in the IC's ability to lead during a Mayday is determined largely by the IC's competency.

This is built over time. An IC who has not regularly exercised Mayday procedures and incident management elements compromises his or her ability to lead when an actual Mayday situation arises. Survival in a Mayday situation is determined by the effective coordination of companies on scene. If fire fighters have not personally witnessed the IC's skills and abilities in commanding a Mayday during drills, they will not trust the IC's ability to do so during an actual incident.

THE NEED FOR COMMAND LEVEL MAYDAY TRAINING

The Fire and Emergency Services Higher Education (FESHE) model created by the National Fire Academy has three arms: Education, Training and Experience. While education is the knowledge portion of the triad, training is the application of that knowledge into action. Training all officers how to manage a Mayday situation should be the rule, not the exception. NFPA standards are considered consensus standards that present "best-practices" for the fire service. Many current standards speak to this need, as illustrated on the following pages.

A fire fighter must have confidence that the Incident Commander will respond appropriately to the Mayday. Any pre-Mayday education and training the IC receives will assist in building fire fighter confidence should an unfortunate event occur.

Because the calling of a Mayday has often been viewed as either a failure or a sign of weakness, fear of ridicule often prevents fire fighters from initiating a call for help. It is imperative that the fire service corrects this cultural

MAYDAY LEADERSHIP — COMPETENCE AND FOCUS

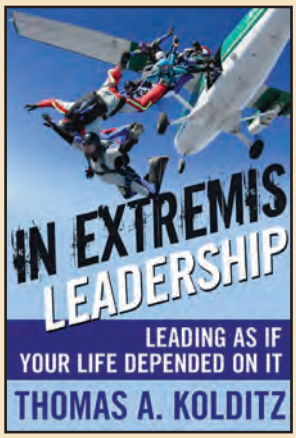
By: Thomas Kolditz

It's hard for those of us who lead in both routine and dangerous conditions to recognize how we change, as leaders, when lives are on the line. But there is a unique leader character demanded by followers when leader decisions may influence their physical well being or survival. Army researchers have systematically studied leaders in dangerous contexts, and have developed some principles that describe how leadership in dangerous settings differs from day to day leadership.

Extremis leadership is part of the job. It's very important at the outset to recognize that leading in extremis (where followers believe that their physical well-being is on the line) is not something unanticipated that we hope will never occur. To quote former Army Chief of Staff Gordon Sullivan, "Hope is not a method." Maydays are a rendezvous with destiny; your time will come. Think ahead. Be ready.

Competence becomes the primary basis for trust. Business leaders can build levels of trust in their organizations through social interaction like golf and team dinners. In contrast, among fire fighters, soldiers, and other public servants who operate in dangerous contexts, competence is the primary basis for trust. In Iraq, during research in combat operations, competence was measured as the number one characteristic leading to trust in the leader. Once a Mayday is called, no one cares if the leader is sociable or friendly—it's all about ability. Leaders need to develop competence, and reinforce perceptions and recognition of their competence, long before a fire fighter's life depends on it.

There is such a thing as too much motivation. In training and routine contexts, good leaders develop habits that motivate their people. When crisis occurs, the situation itself becomes inherently motivating. Therefore, leaders should calm down, not spin up, during a Mayday. Focus energy, don't create it. Quiet, steady competence is what people need from leaders during crisis, and the worse the crisis becomes, the more important self-control becomes. The Hollywood characterization of "drill sergeant types" who scream into microphones and bombastically express anger and frustration is a terrible example for real leaders who manage real crises. Mayday leaders control arousal, excitement and fear, both their own and among the people around them.



Focus outward. At any given point in time, leaders can be introspective, focusing internally, or focus outward on the environment. Crisis is no time for balance. The leader's focus needs to be outward, on the environment and the problem at hand. Such outward focus can be practiced and developed with experience, and is important because it enables the leader to accomplish three specific tasks:

1. **Make sense** of the (always) ambiguous environment that's causing the Mayday, or other crisis; and
2. **Control emotions,** since sufficient outward focus makes it very difficult to experience emotions; and
3. **Orient on learning** from the event, so that the lessons of experience are capture and paid forward.

Be there. Sharing risk and experiencing the misery of the elements right there with fire fighters is an inspirational necessity, and sends the unmistakable message to the rank and file — "I feel your pain and I'm with you." Lead and manage as close to the action as you possibly can.

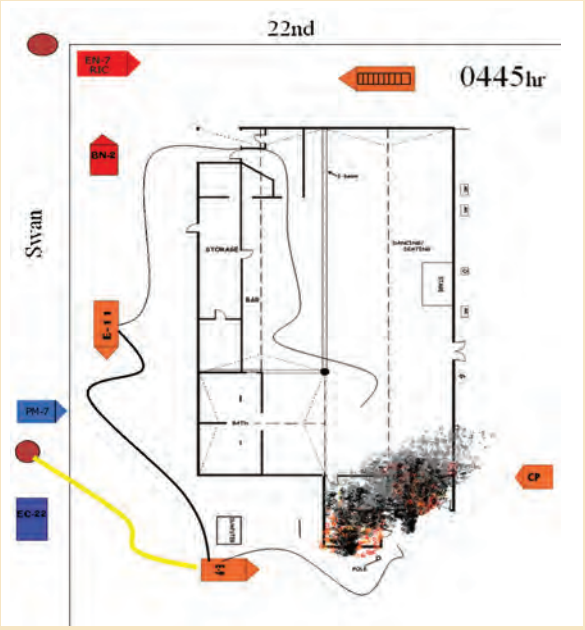
Colonel Tom Kolditz, Ph.d, is Professor and Head of the Department of Behavioral Sciences and Leadership at the United States Military Academy at West Point. He is the author of In Extremis Leadership: Leading as if Your Life Depended on It. ■

MAYDAY THOUGHTS FROM AN INCIDENT COMMANDER

On February 25, 2002, at 0438 hours, Tucson Fire Department units arrived at the country music bar and dancehall known for 30 years as The Maverick - King of Clubs. Twenty-three minutes later catastrophic roof collapse occurred, trapping five fire fighters. In the opinion of the IC, three important keys led to each fire fighter's survival: self-rescue training; composure; and courage.

The fire was initially thought to be small, starting on the south end of the 6,000-square-foot building, and showing ten percent flame involvement. The fire moved rapidly from ground level to the roof's attic. The first-in officer implemented fire attack consisting of: forcible entry, hoseline deployment from the unburned area, and vertical ventilation. Fire in the office and storage spaces was readily controlled, but getting to flames in the attic space proved problematic. The cork-covered ceiling was difficult to pull down, and ventilation of the wood shake roof was terminated when fire appeared to burn through in the general area of Ventilation Group.

Moments after the Ventilation Group got off the roof, Command called a Code Red (bail-out) after noticing the roof beginning to sag due to fire involvement in the attic.



Shortly after the Code Red was called, the light weight trusses supporting the roof collapsed in a domino fashion. Flames reached high into the sky through the burned out roof. Command quickly realized fire fighters assigned to Interior were in a Mayday situation. After several attempts to contact the fire fighters on the inside went unanswered, Command deployed RIC and requested a third alarm.

In addition to the primary RIC, an engine and ladder company were added to the rescue assignment. As rescue operations were taking place, personnel thought to be trapped slowly emerged from the flaming debris. A head count would find four fire fighters accounted for and one missing. A minute later the fifth fire fighter emerged from the building after having self rescued. A post incident review found all five fire fighters self rescued within two minutes of the collapse.

Post-collapse thoughts: After witnessing the collapse, and knowing that fire fighters were still inside; Command quickly understood the gravity of the event and refused to think negatively. Command initiated a plan to first make contact with the distressed fire fighters, and then to effect a rescue. Not having the fire fighters respond on the radio made getting information about interior conditions impossible. Although this contributed to the anxiety felt by Command, it did not take over the incident. With Command doing their part to reach out to the fire fighters on the radio, RIC doing their part to make access to the fire fighters, and the fire fighters doing their part to self rescue, the incident came to a successful conclusion with only minor burns suffered to the hand of one fire fighter. Commanding a Mayday is not an individual effort. It takes a team. A successful rescue requires all members of the team to do their part. ■

- NFPA 1021 *Standard for Fire Officer's Professional Qualifications,* Section 2-6.3 states: "...all officers have the ability to implement the IMS, to communicate verbally, and to supervise and account for personnel under emergency conditions."

- NFPA 1500 *Standard for Fire Department Occupational Safety adn Health Program,* Section 5.1.11 states: "…all members who are likely to be involved in emergency operations shall be trained in the incident management and accountability system used by the department.

- Section 5.2.9 states: "…the fire department shall adopt or develop training and educational curriculums that meet the minimum qualifications standard covering the members assigned function."

This section speaks directly to the idea of an Incident Commander being able to manage a Mayday situation. One could argue that it not only should be a strong portion of education and training, but also the testing process for promotion to officer.

- Section 5.3.4 states: "…the fire department shall provide an annual skills check to verify minimum professional qualifications of its members."

This section also directly speaks to the continuing education and training after promotion—on a regular basis. Because Maydays are infrequent, on-the-job training is not an option. However, just as fire fighters don and use their SCBAs from muscle memory learned from frequent drill, the company officers and chief officers must be able to manage a Mayday. It is critical that officers be able to perform as David Dodson, the father of Incident Safety Officer states, "with unconscious competence."

- Section 8.1.4 states: "…the incident management system (IMS) shall be applied to drills, exercises and other situations that involve hazards similar to those encountered at actual emergency incidents and to simulated incidents conducted for training and familiarizations purposes."

- NFPA 1561 4.5.4 states: "…the system shall provide for a routine process of escalation as additional resources are utilized."

This is possibly the single biggest area where we, as a collective fire service, can improve. The need to escalate the level of response to a Mayday is critical to the outcome of the rescue effort.

- Coleman and Lasky[1] state "many fire departments have a lost/trapped fire fighter standard operating procedure in place, but many do not train the RIC officer or the incident commander in how to manage the fire ground emergency." ■

defect, allowing fire fighters to realize they have support behind them when they do call a Mayday. All officers should set the expectation that fire fighters recognize a Mayday situation, use their training, and call the Mayday.

The fire fighter will expect that the IC has done several things prior to the Mayday to create a rescue contingency plan. The IC must prepare for the potential Mayday well ahead of time and call for the necessary resources early. The type and scale of the incident, the building size and shape, and the building contents all contribute to the resources needed to prepare for a possible Mayday. As additional resources are requested, it is important to expand the incident command system (ICS) so each resource has a specific role to fill within the incident action plan. Resources not immediately needed should be placed in staging.

The following describes the actions a fire fighter expects the IC to take at the scene of a structure fire prior to the Mayday, during the Mayday, and after the Mayday has been cleared.

1. Pre-Mayday IC Responsibility
1.1 Assures Appropriate Levels of Resources are Available
1.2 Identifies Geographical References
1.3 Accountability Tracking System Functional
1.4 Appropriate Medical Resources on Scene
1.5 Assigns Fire Fighter Rescue Resource(s)
1.6 Actively Listens to Radio for a Mayday

PRE-MAYDAY

1.1 IC Assures Appropriate Levels of Resources are Available: Consider adding extra resources to the original alarm if it is determined that all the initial resources will be tasked with an assignment. Requesting additional units early gives the Incident Commander multiple options in the event that a Mayday is called. Additional units and a chief officer can assist in handling a Mayday call. Operate on the assumption that someone on the fire ground will call a Mayday and be prepared with appropriate levels of staffing. Resources can always be cancelled if not needed.

1.2 IC Identifies Geographical References of the Structure: The sides of the structure should be designated as early as possible (ideally by the first arriving officer) using the phonetic alphabet (Alpha, Bravo, Charlie, Delta etc.) in a clockwise rotation. Multiple stories should have each level identified as Divisions (beginning at ground level) through the number of stories of the building. Basements and underground parking structures should either utilize Sub 1, Sub 2, etc., or use the building's designation (e.g., P1, P2). This divides the incident scene into smaller, more manageable areas and decreases the time needed to locate and rescue a distressed fire fighter.

1.3 IC Ensures Resource and Personnel Accountability Tracking System is Functional: IC should have a Mayday checklist accessible at all times as you never know when the call will come. Prior to the arrival of a Chief Officer, accountability must be designated through either SOG preassignments (First Engine Fire Attack, First Truck Vertical Ventilation Third Unit Primary Search etc.) or through individual assignments issued by the company officer in Command. Chief Officers should use a command board, personnel accountability board/roster, T-cards, tactical command sheet, etc., to assist with incident management and organization. Units determining independently what assignment to take without a common plan and command structure should be prohibited. Locating a fire fighter can be time consuming if each resource position is not tracked throughout the incident. Knowing where each resource is assigned will ultimately decrease the time necessary to locate and rescue a distressed fire fighter.

DIAGRAMMING THE FIRE

All fire fighters should have a radio, but not everybody should talk on the radio. Think before you speak. Ask yourself, "Does It Matter What I Transmit?" (DIMWIT) Radio discipline leaves radio channels available for necessary transmissions. All members must listen to the radio. Time and time again, Mayday calls are being missed. Radio transmissions are one of the ways in which operating crews are tracked. Officers and fire fighters should give their location with every radio transmission when inside a hazard area.

Example:

Command from Truck 4: Second floor kitchen, we have fire running the stud spaces with possible extension to the attic.

This information is not only beneficial for command, but also allows other companies, such as the RIC, to track crews. If a Mayday is given that is missing some information, it allows for a starting point to locate the member(s) that is in trouble. Fire companies not given an assignment should monitor the radio and track crews on their own, so they know where personnel are located so they may assist in the rescue response if needed.

Frank Ricci, Anthony Avillo and Jay Woron researched missed urgent and Mayday messages as well as critical information missing for distress calls. This information is printed with permission from Fire Engineering. ■

1.4 IC Ensures Appropriate Medical Resources are On Scene: Stage a dedicated EMS unit/resource with easy access/egress to and from the scene. If EMS is assigned to treat and/or transport victims on scene, call another unit dedicated to RIC.

1.5 IC Identifies or Assigns Fire Fighter Rescue Resource(s): Assign crew(s) to recon/size up while creating an action plan for a potential Mayday. Teams should soften the building to ensure all access and egress routes are clear. Examples of RIC duties include establishing a tool and equipment cache, placing ladders for escape, providing adequate lighting, removing bars from windows, and deploying a hose line from another source for use during a Mayday.

1.6 IC Actively Listens to the Radio for a Mayday: Project Mayday research identified that over half of all Maydays are initially missed by the Incident Commander. Actively listening not just for an actual Mayday but for the most common statements that precede a call for help can allow the IC to better prepare or even prevent a Mayday from being called. In over 85% of the recordings submitted to Project Mayday, three or more of the attached "trigger statements" preceded a Mayday call. (see box pg 95)

IC ACTIVELY LISTENS TO THE RADIO FOR A MAYDAY: TRIGGER STATEMENTS

1. "We have zero-visibility conditions"
- Crews reporting that they have zero-visibility conditions 10 to 15 minutes after entry.

2. "We have fire above our heads"
- The IC needs to know where the fire is located, how much fire is present, and whether crews are able to apply water to the seat of the fire.

3. "We have fire below us"
- These words usually accompany basement fires, but are also heard at upper floor fires.

4. "We need more line to reach the fire; extend our line"
- This report is typically heard at commercial structure fires. In interviewing company officers who requested their lines be extended, most said the problem was that they could not reach the seat of the fire.

5. "We have not found the seat of the fire"
- This report is a major concern, particularly when we have been in the structure for 15–20 minutes, and it appears from the outside that conditions are deteriorating.

6. "We are running out of air" (or indications of a "low-air alarm")
- This alert becomes most critical when it comes from multiple units around the same time.

7. "This is a hoarder structure"
- Project Mayday reports that many occupancies contain heavy fire loading from many years of collecting material belongings.

8. "We have had a flashover"
- In almost half of the flashovers that resulted in Maydays with injuries, most of the injuries were results of the crew already having wet PPE (steam burns) or from failing to pull up their hood, put their ear flaps down, gloves on or collar up.

9. "We have had a ceiling/roof collapse"
- In many cases with a ceiling collapse, fire fighters become entrapped (covered with drywall or wrapped in electrical wiring, ductwork or insulation).

10. "We have lost multiple windows"
- Losing windows can create a flow path issue. Most Mayday victims from these events said that depending on the location in the structure, the situation went from bad to worse immediately.

11. "It's really getting hot in here; we are backing out"
- In most cases, crews experiencing this problem found that they either did not recognize the situation fast enough to fully react (situational awareness) or did not back out far enough to be safe.

12. "Our exit has been blocked"
- Fire fighters involved in this type of situation reported looking for any landmark that would direct them to another exit, but in many cases, a Mayday was not initially called because they spent time looking for alternatives.

13. "We are sending a firefighter out with a problem"
- It is important for the IC to identify the problem and then consider actions that could be taken. For example, if the problem is air-related (low air, bad seal of the face piece or a regulator problem), consider the time and actions that must be taken to reach the exit.

14. "We have a hole in the floor" or "we have had a floor collapse"
- The first part of this problem is identifying that there is a hole in the floor. Often the hole is not found until it's too late. Chapter 2 details shortcomings of the TIC in identifying temperatures below a floor system.

15. "Command has lost communications with multiple crews"
- This situation has occurred most often in high-rise and commercial buildings. When fire departments investigated the problem, they found that most of the portable radios had battery levels below 85% resulting in lower transmission output.

16. "We have a lot of sprinkler heads going off in here"
- According to NFPA, in 97% of fires in sprinklered buildings, five or less sprinkler heads were required to contain the fire.

2. IC's Initial Responsibilities During a Mayday
2.1 RADIO
2.2 ACKNOWLEDGE
2.3 PASS
2.4 IDENTIFY
2.5 DEPLOY

MAYDAY AND RESCUE

Regardless of whether the Incident Commander is the first arriving company officer or a chief officer with an established command post, the response to a Mayday radio transmission should be the same. The Acronym R.A.P.I.D. outlines steps that could be taken to initiate the rescue of a firefighter.

- **R** – Radio (2.1)
- **A** – Acknowledge the Mayday (2.2)
- **P** – Pass - Activate the PASS Device. (2.3)
- **I** – Identify the Problem(s) (2.4)
- **D** – Deploy Available Resources (2.5)

2.1 RADIO: Immediately after a call for help is made, the Incident Commander must announce a Mayday has been called, order radio silence and indicate to the distressed fire fighter to proceed with their WHO – WHAT – WHERE. If the IC does not attempt immediately to try and contact the fire fighter, Dispatch must do so and request the IC confirm they received the message once it's completed.

Contact Not Established with the Fire Fighter: If the distressed fire fighter is unable to transmit on the radio, the IC must identify the fire fighter's last known location. The last report received from the fire fighter's crew may indicate where he or she is located. The IC should also contact the fire fighter's company officer, division/group supervisor, or adjoining officers. Each of these personnel can help identify the fire fighter's location.

The fire fighter calls:

"Mayday, Mayday, Mayday"

The IC ensures that all radio traffic ceases. This may require the IC to "clear the channel".

The IC transmits the following:

"All units assigned to the Central Incident clear this channel for a Mayday. Unit calling Mayday identify."

"This is Fire Fighter Smith from Engine 1,
I'm lost somewhere on the first floor."

2.2 ACKNOWLEDGE: The IC must listen carefully to the distressed fire fighter's response and repeat back to the fire fighter WHO he/she is, WHAT the emergency is, and WHERE he/she is located.

"E1 Fire Fighter Smith from IC, I copy that you are lost on the 1st floor. RIC is deployed. Stay calm, conserve your air, and turn your light on, we're on our way."

2.3 PASS: Once the critical information has been repeated, the IC should have the firefighter activate their PASS device and make noise with a tool as they begin to attempt self-rescue. Project Mayday reporting shows that over 90% of Mayday fire fighters self-rescue or are rescued by their partner or an adjacent interior crew. If a fire fighter calls for help and activates their PASS device, they have completed the two most critical steps in being rescued.

"Emergency Traffic – All units assigned to the Central Incident, we have a Mayday from a fire fighter from E1 lost on the first floor, maintain your current operational assignments unless re-directed for rescue."

2.4 IDENTIFY: Prior to giving tactical orders or making strategic changes, the IC must identify the type and extent of the problem that has caused the Mayday. There is a natural tendency in humans to want to stop things from getting worse. In Mayday situations, this often leads to the IC calling for a building to be evacuated to remove the risk to other fire fighters. A fire fighter rescue is a "Risk a Lot to Save a Lot" event and the IC must identify the problem and needs of the situation before implementing a new plan.

- Name and assignment.
- Geographical location or last known location.
- Radio channel the fire fighter is using to communicate (should be primary tactical channel.)
- Special rescue considerations, and specialized equipment needed for rescue.

2.5 DEPLOY: In the past, fire fighter rescue training centered around a fully prepared and competent Rapid Intervention Crew staged on the exterior of a structure. While there is a need for prepared crew(s) staged on the exterior for rapid intervention ("Outside-In" operations), the need represents less than 10% of Mayday rescues. The IC should first consider redeploying crews (e.g. the primary search crew) already operating inside the structure to rescue the Mayday fire fighter. Interior crews will move toward the Mayday fire fighter(s) unless the IC quickly assigns crews and ensures other important tasks, such as fire attack, continue.

Continued Communication with the Mayday Fire Fighter: Reminding a distressed firefighter to start their GRAB LIVES procedures is good technique to help calm down a panicking member and remind them that they have been trained for this type of situation. It should be remembered that the mnemonic may be too much to recall in a high stress environment without coaching. The IC or member designated to communicate with the fire fighter will need to remind them of the self-survival procedure step by step. This takes time. Remember to keep all radio transmissions brief, because the distressed fire fighter will have difficulty processing wordy transmissions. It's also important to limit questions that need a response. Whenever possible statements or reminders should be transmitted that do not require the fire fighter to stop what they are doing to respond on the radio.

2. IC's Responsibilities During Extended Rescue Operations
2.6 Advises Dispatch of Mayday and Requests Additional Resources and Tactical Radio Frequency
2.7 Expands the ICS to Accommodate the Mayday
2.8 Confirms Tactical Assignments and Obtains a PAR From Each Unit not assigned to the Rescue
2.9 Expands the Command Support Team (Additional Command Post Personnel)
2.10 Obtains Follow-up Reports on RIC Rescue Efforts
2.11 IC Re-evaluates the Incident Action Plan
2.12 IC Terminates the Mayday

EXTENDED RESCUE OPERATIONS

If, due to the nature of the problem, the rescue cannot be handled quickly by crews near the fire fighter(s) requesting help, the Incident Commander must switch to a RIC operation. The following steps are needed to expand the incident management system in order to accommodate the added complexity of an extended rescue operation.

2.6 IC Advises Dispatch of Mayday and Requests Additional Resources and Tactical Radio Frequency: Contact Dispatch only after communication is established with the fire fighter, and currently assigned resources have been given direction for rescue and fire containment. Dispatch is critical to managing the Mayday efficiently. The IC should request all resources needed for immediate and projected rescue needs and should consider adding resources to assist with potential rescue of the RIC members. Prepackaged alarms or automatic aid should be considered to eliminate the need for the IC to call for needed resources in a piecemeal fashion. Additional tactical radio channels should also be requested. Additional tactical channels will give the Incident Commander options that could include the following:

- If so equipped moving the units not involved in the rescue to a separate channel. Separating the rescue and fire fighting operations allows the distressed fire fighter exclusive use of the original channel, while all resources with operational assignments communicate on a second channel.
- Switch the distressed fire fighter(s) to a separate channel. Some portable radios can be programmed so that if the Emergency Alert Button is triggered, the radio switches to a predesignated emergency channel that is monitored at dispatch and the command post. A second option is to program the first and last channel on a portable radio as the same emergency channel so that the firefighter can twist the radio in either direction to reach it. Finally some radio systems include a feature called "Dynamic Regrouping" which allows a portable radio channel to be changed remotely.
- Consider assigning members of the rescue group to a separate channel.
- Consider assigning responding additional alarm units to an alternate channel.
- Consider assigning a Command Channel.

Regardless of what option is chosen, any emergency radio procedure involving the movement of channels must be predetermined well before the incident and trained on continuously by everyone that may be involved.

2.7 IC Expands the ICS to Accommodate the Mayday: An extended rescue requires overhead positions to be added at the Command Post. An IC cannot expect to manage both fire and rescue effectively, so the IC must split the two tasks as soon as possible. Depending on the complexity of the incident the IC has a number of options.

- Consider passing Command to another officer. If the initial IC is a company officer or if the IC believes that their situational awareness is better served directly managing the fire fighter rescue, Command could be transferred to another on-scene command officer.

- Consider maintaining Command and assign an officer to the position of Rapid Intervention Group Supervisor (RIGS). The RIGS is responsible for managing the rescue, using the assigned tactical frequency to direct resources assigned to the rescue. This allows the IC to focus on fire containment and extinguishment to protect both the distressed fire fighter and rescue teams.

In either situation, the IC should assign a member of the command team as the Mayday Communications Officer to communicate directly with the firefighter(s) who called the Mayday. Priority must always be given to the distressed fire fighter. The Communications Officer would be responsible for gathering additional information and coaching the fire fighter(s) through GRAB LIVES but the most important role of this position is to listen.

2.8 IC Confirms Tactical Assignments and Obtains a PAR From Each Unit not assigned to the Rescue: Providing survivable space to the fire fighter is of paramount importance. This requires the protection of access and egress corridors using aggressive suppression and ventilation techniques. Putting out the fire removes a myriad of problems. The IC should confirm tactical assignment with each officer or Division/Group Supervisor not assigned to the rescue. The PAR should not disrupt the rescue efforts. It should initially be conducted without radio communications at the company level through face-to-face communication. Company officers or Division/Group Supervisors, should confirm their PAR at the same time they confirm their tactical assignment.

2.9 IC Expands the Command Support Team (Additional Command Post Personnel): Consider adding safety officers, personnel to monitor radio channels, an accountability officer, situation/resource status officer and chief officers to further strengthen the management of the rescue effort.

2.10 IC Obtains Follow-up Reports on RIC Rescue Efforts: Obtain a situation report from the RIGS to include, conditions, actions, and needs. This will assure the rescue operation is being given the appropriate resources.

2.11 IC Re-evaluates the Incident Action Plan: The IC should constantly evaluate the following:

- Is the building structurally compromised?
- Is fire complicating the rescue operation (access and egress)?
- Can fire fighting and rescue crews remain in the same mode of operation and affect a rescue?
- Are the fire fighters effective or do they need rehab?

NOTE: When available, the IC can rely on the Incident Safety Officer and Technical Specialists to evaluate the building structurally, read the smoke, and assess the fire fighters.

2.12 IC Terminates the Mayday Once confirmation of the rescue has been received, or the IC determines that the rescue attempt will not be successful the Mayday should be terminated. Once terminated, all units must conduct a PAR. The IC must also confirm that all rescued fire fighters are treated and/or transported to the appropriate medical facility. **The IC should also assess the emotional and physical operational status of the remaining crews.**

3. IC Responsibility After Termination of the Mayday
3.1 Return Incident Communications to Normal Operations
3.2 Reassess Incident Priorities
3.3 Assure Fresh Crews Available
3.4 Utilize Public Information Officer (PIO)
3.5 Determine Need for Investigation Team
3.6 Considers Behavioral Health Needs and Available Resources
3.7 Direct Post-Incident Review

POST MAYDAY TERMINATION

3.1 IC Returns Incident Communications to Normal Operations: Return to standard radio operations (clear Mayday) by contacting Dispatch and requesting normal radio operations. This will signify to those operating on scene that the Mayday has been successfully handled. The IC's radio transmission will sound like this:

"Dispatch from Central IC… E1 fire fighter is outside the structure with no injuries; all units report PAR. Return incident communications to normal operations."

This transmission should be made on all radio channels in use on the fire ground. This includes:

- Command or Dispatch channel.
- The tactical channel used by the distressed fire fighter and the resources used in the rescue.
- Any additional tactical channel used by resources having operational assignments outside of the rescue operation.

3.2. IC Reassess Incident Priorities: Just as the IC must continually re-evaluate the incident action plan, the IC must also consider redefining the incident priorities. Life safety is the most important priority to be considered. Mayday incidents requiring a large number of resources are physically, mentally and emotionally taxing for all personnel involved in the incident. Consideration should be given to changing tactics from offensive to defensive in these cases.

3.3 IC Assures Fresh Crews Available: The IC must anticipate the needs of the fire fighters on scene. Mayday operations are stressful and require high degree of mental awareness, which is fatiguing. The IC should assign a Fire Fighter Rehabilitation Unit to address rehabilitation needs. To ensure personnel are rehabilitated and ready to work, crews must be rotated between the operational and rehab areas. Any incident that results in significant injury or death of a firefighter should result in a complete change out of crews on the scene and the crews involved in the incident sent to a single location. This location should provide a sheltered environment where the fire fighters can be evaluated and immediately updated as to the status of any injured members as information becomes available.

3.4 IC Utilizes Public Information Officer (PIO): News organizations often scan fire department dispatch and tactical frequencies to learn of newsworthy incidents. News people will be on scene quickly after learning of a Mayday. They will want the story complete with names, times, and other information that make the story newsworthy. All information released must be approved by the IC. Simultaneously with continued mitigation efforts and prior to any news briefings, the IC should assign a Liaison Officer to contact the family. With the advent of social media, there is a high probability that family members of injured or killed fire fighters will already be aware that an incident has occurred. Sympathy posts on deceased fire fighters' social media accounts have occurred within minutes of their death. Department social media accounts should be updated as soon as permissible and updated often. Studies have shown that the public will return to sources that they first identify as having the most (not necessarily accurate) information. Updating social media early and often helps in preventing misinformation from being reported and creates a single point for both media and the public to return to for updates as additional information becomes available.

3.5 IC Determines the Need for Investigation Team: It is important to establish a perimeter and limit unnecessary personnel to the area. This is due to the possibility of the incident becoming a crime scene.

3.6 IC Considers Behavioral Health Needs and Available Resources This is often a forgotten step, but a critical one. Emotions run high during incidents involving a Mayday, and follow-up must be performed to protect the health of personnel involved. The IAFF has a comprehensive Behavioral Health Program http://www.iaff.org/behavioral-health/. Behavioral health programs are most effective if a program has already been established. Departments without effective behavioral health resources should consider external resources and establish activation agreements with them well before a Mayday occurs.

3.7 IC Directs Post-Incident Review: There is much to be learned from a Mayday experience. Before leaving the scene, the IC should direct an investigation team to collect incident operation information. This information can assist with re-creating the incident for a post-incident analysis. The IC must also give the opportunity for personnel assigned to the incident to share what they learned. The lessons learned from a Mayday incident can result in improved department SOGs.

SUMMARY

Just as the officers have expectations of fire fighters under their command, fire fighters have expectations of officers having command responsibilities. When a fire fighter calls a Mayday these expectations must be met or tragedy may result. A prepared IC is one who anticipates the call and takes the actions necessary to receive it, well before the call is heard over the radio. Being prepared prior to and during a Mayday requires the performance of many specific actions. Failing to perform just one of the actions may result in extending the time necessary to make the rescue. During a Mayday seconds count because a distressed fire fighter has limited air, and can only take so much heat. A Mayday is not the time to improvise. During a Mayday the distressed fire fighter expects the IC to be efficient, orderly and to follow a proven plan that works. ■

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NFPA 1001 Standard for Fire Fighter Professional Qualifications

NFPA 1026 Standard for Incident Management Personnel Professional Qualifications

NFPA 1225 Standard for Emergency Services Communications

NFPA 1250 Recommended Practice in Emergency Service Organization Risk Management

NFPA 1404 Standard for Fire Service Respiratory Protection Training

NFPA 1407 Standard for Training Fire Service Rapid Intervention Crews

NFPA 1410 Standard on Training for Emergency Scene Operations

NFPA 1500 Standard on Fire Department Occupational Safety, Health, and Wellness Programs

NFPA 1521 Standard for Fire Department Safety Officer

NFPA 1561 Standard on Emergency Services Incident Management System

NFPA 1710 Standard for the Organization and Deployment of Fire Suppression Operations, Emergency Medical Operations, and Special Operations to the Public by Career Fire Departments

NFPA 1800 Standard on Electronic Safety Equipment for Emergency Services

NFPA 1801 Standard on Thermal Imagers for the Fire Service

NFPA 1802 Standard on Two-Way, Portable RF Voice Communications Devices for Use by Emergency Services Personnel in the Hazard Zone

NFPA 1851 Standard on Selection, Care, and Maintenance of Protective Ensembles for Structural Fire Fighting

NFPA 1852 Standard on Selection, Care, and Maintenance of Open-Circuit Self-Contained Breathing Apparatus (SCBA)

NFPA 1800 Standard on Electronic Safety Equipment for Emergency Services

NFPA 1982 Standard on Personal Alert Safety Systems (PASS)

NFPA 1983 Standard on Life Safety Rope and Equipment for Emergency Services

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■ Fire Fighter Close Calls	www.firefighterclosecalls.com
■ National Institute for Occupational Safety and Health	www.cdc.gov/niosh/fire
■ Fire Department Training Network	www.fdtraining.com
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■ Rapid Intervention Training Associates	www.rapidintervention.com
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■ Underwriter's Laboratories Firefighter Safety Research Institute	www.ulfire fightersafety.org/
■ National Institute of Standards and Technology National Fire Research Laboratory	www.nist.gov/el/fire-research-division-73300/fire gov-fire-service
■ Project Mayday	www.projectmayday.net/
■ National Firefighter Near Miss Reporting System	www.firefighternearmiss.com/

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APPENDIX A
FIRE FIGHTER MAYDAY CHECKLIST

❑ **Look at screen & document Radio Identifier** _____

❑ **Transmit: "All units assigned to the _____ incident, clear this channel for a MAYDAY. Unit calling MAYDAY, identify."**

❑ **Receive & Document:**

WHO: **Name** _____

Unit _____

WHAT: **Lost Trapped Injured Out of Air SCBA Malfunction**

Other _____

WHERE: **Floor** _____, **Side** _____

Area _____, **Division** _____

❑ **Transmit: "Fire Fighter _____, I copy your MAYDAY (Repeat WHO, WHAT, WHERE information). RIC is being deployed. Initiate your G-R-A-B-L-I-V-E-S procedures."**

❑ **Deploy RIC/RIG**

❑ **Transmit: (On Command and Tactical Channels): "All units on the _____ Incident, we have a fire fighter MAYDAY. Maintain your current assignments and keep this channel clear."**

❑ **Transmit: "Fire Fighter_____, remain calm, control your breathing, turn on your PASS alarm and shine your flashlight. RIC is coming to get you."**

❑ **Transmit requests to Dispatch:**

- ○ **"Requesting _____ additional alarm(s), including _____ ambulances."**
- ○ **"Requesting _____ Communication plan" OR "Requesting additional tactical channel(s)."**

❑ **Assign additional companies to RIC and RIC Group Supervisor (RICGS)**

❑ **Conduct a Roll-Call (PAR) prior to clearing the MAYDAY**

NOTES:

NOTES:

International Association of Fire Fighters
1750 New York Ave., NW Washington DC 20006
www.iaff.org

PART II - SDFD Specific Fireground Survival Skills & Procedures

Due to subtle differences in department specific equipment, PPE, and policies, Part II addresses the slight variations that exist within our department and the execution of the IAFF Fireground Survival Skills and Procedures.

SDFD Firefighter Personal Escape System

1. DESCRIPTION

XTREME Rescue HALO Personal Escape System (PES). The HALO PES is designed for rapid deployment and exit of firefighting personnel from above-ground situations where injury or death is imminent. It consists of a rescue belt, low profile rope/bag and an auto-locking cam that enables users to repel and control their descent with one hand for a fast and secure exit from any building or structure.

2. USAGE

The PES is only to be used for emergency egress in situations when the following exist

- 2.1. Firefighter is cutoff from other means of egress (stairs, fire escapes, ladders, etc.) and conditions warrant an emergency bailout via PES.
- 2.2. Firefighter is low on air and unable to locate a normal means of egress
- 2.3. Firefighter is low on air and exiting the structure would require entry into the IDLH conditions.
- 2.4. Fire conditions are deteriorating with no sign of control and emergency egrees is necessary.
- 2.5. There are many other conditions where an emergency bailout should be used. It is ultimately the decision of the firefighter in distress to bail out when they feel death or injury could occur if not used to escape.

3. SPECIFICATIONS

3.1. Class 1 harness belt

1. NFPA certified fire resistant (FR) escape/ladder belt
2. Certified to NFPA 1983 : 2012 edition by UL as an escape belt and ladder belt when used with multi-use strap (MUS)
3. 2 NFPA certified attachment points (D-rings)
    1. 1 fixed: Future uses with MUS
    2. 1 slider: escape system attachment point

3.2. 50’ Escape rope

1. 7.5mm Technora sheath/nylon core
2. 3,912 lb. minimum breaking strength
3. Heat and abrasion resistant

3.3. HALO descending device by XTREME Rescue

1. One hand operation
2. Few moving parts
3. Lightweight (8 oz. w/tether)
4. Simple operation / auto-stopping / easy payout of rope
5. Certified to NFPA 1983 - 2012 as an escape device

3.4. Hook

1. Sterling lightning GT hook
2. Aluminum – heat treated
3. Weight – 8.2 oz.
4. Carabiner-like hitching slot
5. NFPA 1983 - 2012 certified by UL as an escape anchor

3.5. SAFE-D carabiner

1. Three-stage self-locking design
2. Captive eye pin keeps carabiner connected to the HALO device
3. Captive eye pin prevents side loading of the carabiner

3.6. Storage Bag / Pull Strap

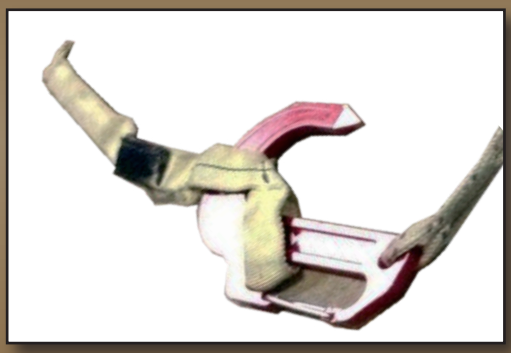
1. Low profile rope bag, stored in your right bunker pant pocket
2. Inside pocket for rope storage
3. 2 outside pockets for hook and HALO storage
4. System weight: 2 lbs. 14 oz.

PERSONAL ESCAPE SYSTEM COMPONENTS

Class I Harness Belt

50’ Escape Rope

HALO Descending Device



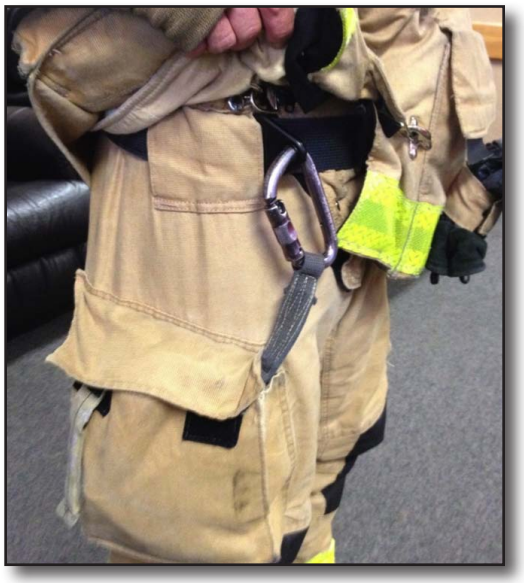
Hook

SAFE-D Carabiner

Storage Bag / Pull Strap & Co. ID Tag for Tracking

4. OPERATION

4.1. SYSTEM CONNCECTION



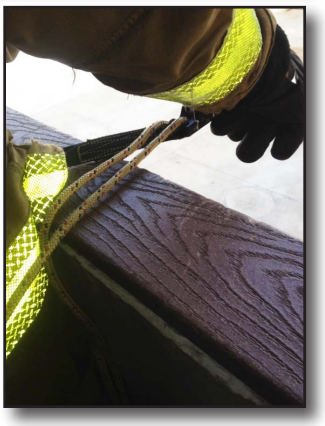
1. Rope and carabiner attached to belt at the sliding attachment ring with carabiner spine facing forward.
2. All connections should be made on the right side of body
3. Pull strap shall be hanging out of center of the right pant pocket

4.2. CONSIDERATIONS

1. L-E-T Acronym
    1. L - Location of Fire
    2. E - Exits (doors, windows, fire escapes)
    3. T - type of Building
2. Pre-Bailout Considerations
    1. RECOGNIZE and ACKNOWLEGDE that you are in trouble
    2. Communicate MAYDAY
    3. RAPIDLY and AGGRESSIVELY SEARCH for an exterior opening
    4. Close the doors/isolate the space
    5. Select your EXIT and ANCHOR POINT
    6. Windows: breach and clear

4.3. ANCHORING & EXIT

1. Remote Anchoring & Exit
    1. Most secure but time consuming
    2. Suitable anchor should be used (wall stud, structural member, etc.)
    3. Requires horizontal travel while connected to system. Achieved by pulling the handle toward you and moving toward the exit while FACING your exit
    4. Once you are at the sill ensure the HALO extends past the sill and is outside of the structure
    5. Never give slack to the anchored rope while rolling over the sill, otherwise you will fall this distance before the rope comes taut



6. Roll out of the window into a window hang, if possible, to load the system.
7. If the window is too small to perform a window hang, a hands free window exit may be used.

2. Tool Anchoring and Exit
    1. Requires a tool (axe, halligan, pike pole).
    2. Requires a window large enough for a firefighter to perform a window hang maneuver to properly set the anchor on the sill.
    3. Roll forward head first, "Sniffing the Sill" until your upper body and leg are out of the window.
    4. Lock your interior leg over the sill.
    5. Evaluate the situation.
    6. Maintain the position of your left hand on the interior wall/tool.
    7. Hand MUST continue to hold the interior wall/tool until your body weight loads the HALO.
    8. Continue to punch downward on the rope to set the tool on the inside of the window.
    9. Your tool hand is the last thing to leave the structure.
    10. Release interior leg, roll to an upright position outside of structure

3. Sill Anchoring & Exit
    1. Less secure than both remote anchoring and tool anchoring
    2. Provides for quickest escape
    3. Requires good hook placement and has the smallest margin for error
    4. Locate and clear window sill for PES deployment
    5. Pull strap or hook directly up
    6. Grasp the rope OVERHAND in your RIGHT hand, the hook is in your LEFT hand, remember to cup the hook with your hand.
    7. Select a 90 degree edge if possible / Position hook so it does not move when loaded / Maintain tension on the hook with your hand / Force tip to bight into the structure
    8. While staying as low as possible deploy system / Hand cupped around the hook
    9. Roll forward head first, "sniffing the sill" until your upper body and leg are out of the window / Lock your interior leg over the sill / Evaluate the situation / Maintain the position of your left hand on the interior wall and hook
    10. With the rope in your right hand, "punch" towards the ground to create tension on the rope and anchor / Roll out the window / Maintain the position of your left hand on the interior wall and hook
    11. Release interior leg, roll to an upright position outside of structure / Hand MUST continue to hold the interior wall/hook until your body weight loads the HALO / Your hook hand is the last thing to leave the structure

4.4. DESCENT

Note: The following descent procedures are the same regardless of the method used to exit the window.

1. Once on the exterior pause to correct body position
2. Slide vertically down the wall slowly, trying to minimize bounces which can dislodge the anchor
3. Use your feet and/or hand to maneuver around obstructions
4. Maintaining an arm extended at the 2-3 o'clock position provides the most control

5. INSPECTION

5.1. Inspected and repacked quarterly or after suspected damage

5.2. Rope

1. Feel for dents, bumps, cuts, abrasion over entire length of rope
2. Sewn eye stitches intact and not frayed

5.3. HALO

1. Does it feed though when pulled and stopped when released?

5.4. Hook

1. Not deformed
2. Gate operates properly

5.5. Carabiners

1. Gates operate as designed, not deformed

5.6. Escape Belt

1. Stitching intact and not frayed
2. No cuts or significantly worn spots on belt

6. MAINTENANCE

6.1. Wash off any contaminants

6.2. Use lukewarm water only

6.3. DO NOT use detergents such as Tide or extractor chemicals

6.4. You CAN wash all the components of the system

6.5. Always dry out any wet or damp components before repacking

6.6. Air dry by avoiding direct sunlight/UV rays (do not put in dryer)

7. PACKING SYSTEM

7.1. Zig zag rope into segments the width of the bag

7.2. Bundle four to six flakes at a time

7.3. Push into bag and repeat

7.4. Leave about 6 inches of free rope between HALO and hook

7.5. Slide HALO and hook into bag EXACTLY as pictured

Tool Anchoring & Exit

Step 1

- Requires a tool (axe, halligan, pike pole)

- Requires a window large enough for a fire-fighter to perform a window hang maneuver to properly set the anchor on the sill.

Step 2

- Roll forward head first, "Sniffing the Sill" until your upper body and leg are out of the window.
- Lock your interior leg over the sill.
- Evaluate the situation.
- Maintain the position of your left hand on the interior wall/tool.

Step 3

- Hand MUST continue to hold the interior wall/tool until your body weight loads the HALO.

- Continue to punch downward on the rope to set the tool on the inside of the window.

- Your tool hand is the last thing to leave the structure.

-Release interior leg, roll to an upright position outside of structure.

Sill Anchoring & Exit

Step 1

Locate and clear window sill for PES deployment

Step 2

Pull strap or hook directly up

Step 3

- Grasp the rope OVERHAND in your RIGHT hand

- The hook is in your LEFT hand

- Remember to cup the hook with your hand

Step 4

- Select a 90 degree edge if possible and position hook so it does not move when loaded

- Maintain tension on the hook with your hand

- Force tip to bight into the structure

Sill Anchoring & Exit (continued)

Step 5

- Staying as low as possible
- Deploy system
- Hand cupped around the hook

Step 6

- Roll forward head first, "sniffing the sill" until your upper body and leg are out of the window.
- Lock your interior leg over the sill
- Evaluate the situation
- Maintain the position of your left hand on the interior wall and hook

Step 7

- With the rope in your right hand, "punch" towards the ground to create tension on the rope and anchor
- Roll out the window
- Maintain the position of your left hand on the interior wall and hook

Step 8

- Release interior leg, roll to an upright position outside of structure
- Hand MUST continue to hold the interior wall/hook until your body weight loads the HALO
- Your hook hand is the last thing to leave the structure

Descent

Step 1 - Body Position

Once on the exterior pause to correct body position

Slide vertically down the wall slowly, trying to minimize bounces which can dislodge the anchor

Use your feet and/or hand to maneuver around obstructions

Step 2 - Safe Descent

Maintaining an arm extended at the 2-3 o'clock position provides the most control

Packing the System

Step 1 - Orient Hook & HALO

1. Ensure hook is approximately 8" from HALO (fold hook back on itself to judge this measurement)
2. Allow 1" space between hook and HALO

Step 2 - Bag Rope

1. DO NOT stuff like a rope
2. Create about 5 flakes of rope (no wider than the bag) in your hand.
3. Stuff this group into the bag so it comes out without twists, feeding from the top.

IMPORTANT - Repeat until 2 feet of rope is left outside of bag.

Step 3 - Position Hook & HALO for Insertion to Bag

1. Rope attached to hook is on top of hook
2. HALO writing is facing OUT
3. Rope attached to hook is UNDER the loose rope going into the bag
4. Extra feed rope from bag as pictured makes the task of packing easier

Packing the System

Step 4 - Place Hook & HALO into Bag

Place Pull Strap on hook and insert hook & HALO all the way into bag

Step 5 - Stuff remaining loose rope into bag

Step 6: Finished System

Key Points:

1. Rope feeding from bag goes OVER rope coming from hook

2. Rope attached to hook is on TOP of hook when in the storage slot

Media & Link Index

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Credits

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NOTE: If you have any additional information or content that you feel would be appropriate to contribute to this Chapter or would like to report any errors or misrepresentations, please contact the SDFD Training Division or email the Drill Manual Revision Staff at

SDFDDrillManualTeam@SanDiego.gov