FIRE AND RESCUE DEPARTMENTS
OF NORTHERN VIRGINIA
FIREFIGHTING AND
EMERGENCY OPERATIONS
MANUAL

ENGINE COMPANY OPERATIONS

Second Edition

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INTRODUCTION

The *Engine Company Operations* reference guide is designed for use as a resource and reference for all fire department personnel in Northern Virginia assigned to engine companies. This manual is intended to re-enforce basic firefighting knowledge and skills. Additionally, it will introduce advanced skills, tips, and tactics in engine company operations to complement basic skills and increase efficiency.

The engine company is charged with conducting a thorough size-up, developing and implementing the initial strategy/tactics, and conducting fireground tasks that often dictate the overall success of incident operations. A well-planned, well-prepared, and well-trained engine company places its members and all others operating on the fireground in the best possible position to render a successful outcome at the incident scene. The purpose of this manual is to provide both general and specific information relevant to engine company operations. The duties and responsibilities of each engine company member must be understood.

Response areas vary greatly across the Northern Virginia area, yet the basic duties of the engine company remain the same – establish a water supply and stretch, advance, and operate hoselines in a manner that renders success on the fireground. Engine companies vary in layout as the first due of the engine company dictates the manner in which the apparatus is setup. Various makes and models exist and the differences between the apparatus include hose bed size and layout, location and number of discharge outlets, location and number of compartments, position of equipment, and supply line connections.

This manual is based on engine company staffing that consists of one officer and three firefighters. Those jurisdictions operating with a crew of less than four will need to adjust the responsibilities of the members of the engine company as outlined in this manual to complete the necessary fireground tasks of the engine company. Engine company firefighters must be familiar with the apparatus currently in service. Details to other engine companies, use of reserve apparatus, and working with mutual aid companies should be taken into consideration prior to arrival on the fireground.

The purpose of this manual is:

- To provide guidelines and general information regarding engine company operations.
- To describe the duties and responsibilities of the engine company.
- To identify tactical and strategic considerations for engine company operations.
- To define engine company officer and firefighters’ roles and responsibilities.
- To establish guidelines for apparatus positioning on the fireground.

The key changes in the Second Edition of *Engine Company Operations* are as follows:

- Significant rewrite of entire document with substantial content changes.

PLANNING AND PREPARATION

Members should begin preparation for engine company responses as they enter quarters. Proper preparation begins with ensuring equipment is accounted for and in good working condition. This includes personal protective equipment (PPE), radios, hoselines, associated nozzles, hand tools, and self-contained breathing apparatus.

To ensure members are prepared for the workday, a roll call is normally conducted at shift line-up. This will provide the officer the opportunity to discuss expectations for those members assigned to the engine company. At a minimum, the nozzle firefighter and backup firefighter positions shall be assigned and associated duties discussed. The associated duties may include items such as radio channel assignments, meter bump testing, expectations, and safety considerations on highway incidents.

The pass-on book is normally reviewed at shift line-up for pertinent information in regards to engine company responses. Situations such as street closings, out-of-service hydrants or mains, inoperative standpipe or sprinkler systems, and equipment deficiencies or changes on the apparatus should be noted and possible alternate courses of action considered and discussed.

Immediately following shift line-up, members assigned to the engine company should inspect and examine all tools and appliances associated with the apparatus. Any deficiencies noted should be rectified, if possible, and notifications made by the unit officer or operator, as appropriate. Any items that will reduce the efforts to provide the highest level of service should be immediately reported to the unit officer. If a reduction in service is expected, consider placing the unit out-of-service, make appropriate notifications, and attempt an expedient return to service.

Engine company firefighters shall examine all hose loads, racks, nozzles, and appliances to familiarize themselves with the manner in which the hose is racked and will subsequently deploy. This is especially important for detailed or overtime members. The location and presence of all tools and equipment on the apparatus shall be known by all assigned members and shall be verified at the start of each tour. The absence of equipment should be discovered during a routine apparatus inspection rather than at the scene of a fire or emergency.

The effective delivery of water to the fire ground is dependent on the hose, appliances, and nozzles carried by the engine company. Firefighters must be familiar with all methods of loading and stretching hose as well as the use of appliances to adapt hose-to-hose or hose-to-appliances.

In Quarters

Members assigned to the engine company should consider all facets of their duties when training and pre-planning. Training for engine company-specific tasks is important for all members, but especially important for the operator and officer, as those riding positions typically remain static. The engine operator should make it his duty to remain proficient in all things related to the first due response area. Training should include street drills that consist of alternate travel routes, unit blocks, specific building addresses, and their associated fire department connection (FDC) locations and hydrants. It is important for members of the engine company to be familiar with the streets in their response area.

With the exception of single family dwellings, it is important to determine positioning for at least the first two engine companies and the first truck company during pre-planning. When planning for positioning of units, consider travel routes for the second due engine and first due truck companies, as these may affect the layout location. For instance, there may be a hydrant in front of the dispatched address but using the front intake may preclude the first due truck company from positioning appropriately in front of the structure, Figure 1. Whenever possible, avoid a layout that would place hand lines in the route of travel. If it is necessary to position in such a way, consider placing the hand line behind a speed bump or place the hand line in a position that crosses the street but rests in front of or behind the incoming truck company.

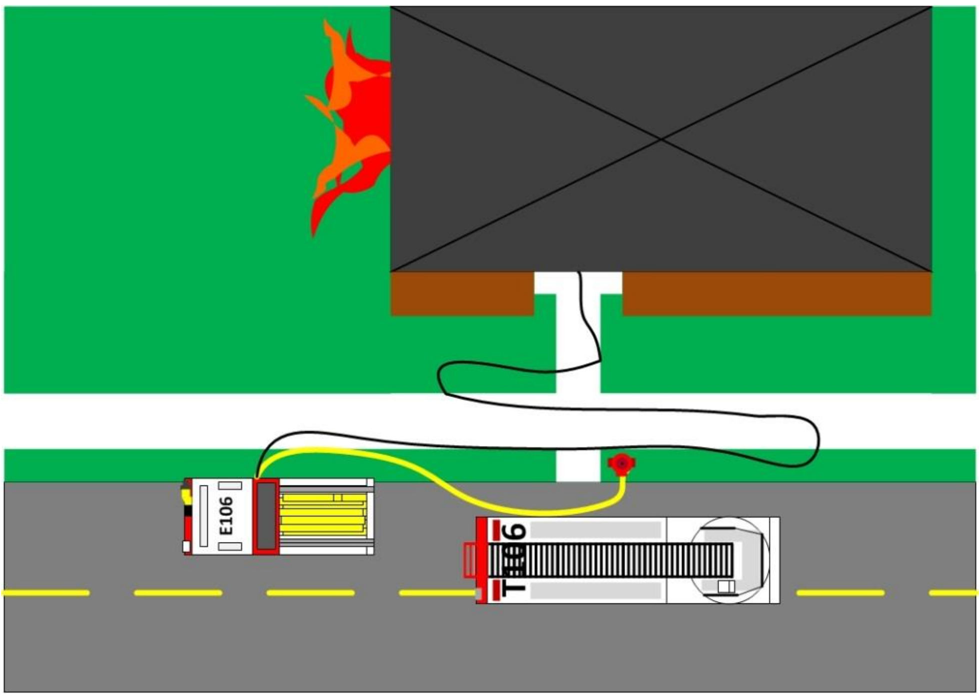

Figure 1: Pre-plan apparatus placement before the fire occurs, whenever possible

Realizing that there are many areas that place the engine beyond the reach of its longest pre-connected lines introduces the need to pre-plan for hoseline stretches as well. This information, if possible, should be noted in the map book (or database/software program) and disseminated to neighboring companies as well. Distance to the building, as well as considerations for building height, should be considered. When ascending to upper floors within a structure during building familiarization, determine if a well-hole is present and usable. A well-hole is the space between both handrails in a stairwell and allows engine companies to achieve the maximum length of the hose. If a firefighter’s fist does not touch either handrail, it is generally acceptable to perform a well-hole stretch without the possibility of the hose wedging in the well, once charged, Figure 2.

Engine company members must pre-plan and practice hoseline deployment to specific buildings within their response area. One way to quickly determine which hoseline is effective for a given building is to measure distances using 300 feet of small diameter rope, stored in a bag or used bottle. With this, companies will have a more efficient means to determine the hand line lengths needed. Members assigned to the engine company should inquire about special areas and be familiar with making up longer lines on the fireground.

Figure 2: Checking the well-hole space.

Training

Training is one of the most important functions of the engine company. Today's emergency responders are responsible for an enormous database of knowledge, skills, and abilities to operate. Training is conducted in order to program a firefighter's brain to function effectively and efficiently during a stressful, emergency situation. During an emergency situation, the brain reverts to knowledge, previous experiences, and training to make decisions. Scientists have been studying the human brain for centuries and use two distinct methods to describe the human decision-making process.

- The classical decision-making method is a step-by-step, logical sequence that the decision-maker uses to reach the best decision. The process includes analyzing the situation, identifying the problem, developing solutions to the problem, weighing the advantages, disadvantages, and the risks and benefits of each option, and finally choosing the option that best solves the problem.

- The naturalistic decision-making method is an intuitive reaction to a problem. In this process, the decision-maker recognizes sights, sounds, smells, and other sensory cues that trigger the memory of similar situations the decision-maker has experienced or learned in the past. Actions are chosen quickly based on previous actions that successfully addressed those past situations. This method is also known as Recognition Primed Decision-Making (RPDM).

Firefighters must use the basic skills learned in recruit school to mitigate all incidents. But many of those skills are lost or forgotten if not used or practiced regularly. Most line of duty death and close call incidents are a result of poor performance and decision-making involving basic firefighting skills. Repetition is the only way to develop muscle memory and learned experience (e.g., the naturalistic decision-making process) for basic skill sets. Experience is the only way to master the necessary skill to ensure proper application and technique for the emergency situation. Proper application and technique is critical to safety, efficiency, and effectiveness on the incident scene.

In order to plan and facilitate training, fire service training falls into three categories:

1. Self-study training is appropriate for individuals or small groups to cover the material and information that all members of the department should review on an annual basis to maintain their base knowledge of policies, procedures, manuals, and other source reference material. Soft-copy training presentations, online-based programs, and websites and web-based repositories are all acceptable resources for self-study training.

2. Company training should be conducted on a daily basis in an informal setting and cover hands-on practical skills such as handline deployment, ventilation tactics, search and rescue methods, and firefighter survival topics. Company training is designed to identify the deficiencies in the knowledge, skills, and abilities of company members and correct them before the next emergency incident occurs.

3. Multi-unit training should be conducted on an annual basis and should include neighboring companies and mutual aid companies. The purpose of multi-unit training is to practice and coordinate general strategies and specific fireground tactics common at a structure fire. Fire department training academies are designed to accommodate the training needs of multiple units, but training officers should also consider using target hazards and known structures within the response area for added realism.

Pre-incident Fire Planning

The most important part of pre-incident planning is for fire officers and firefighters to learn about buildings that could cause problems or injury to civilians or firefighters. Companies should attempt of conduct a building walk-thru at least once a tour. Below is a list of some general items that should be considered when conducting a building walk-thru. These drills should be informal and frequent. Known target hazards should be covered on a more frequent basis with consideration given to change in personnel and other potential response companies. Some good opportunities to conduct these drills are while running fire alarms or EMS calls.

General pre-incident template:

- Occupancy name and address
- Occupancy type (i.e., assembly, commercial, educational, industrial, or residential)
- Construction type
    - I- Fire Resistive
    - II- Non-Combustible
    - III- Ordinary
    - IV- Heavy Timber
    - V- Wood Frame (Lightweight wood truss)
- Combustibility of contents (i.e., non-combustible, limited-combustible, free burning)
- Accessibility (i.e., obstructions, entrances, stairways, Knoxbox location)

- Fire hydrants
- Fire protection systems
- Fire alarm systems
- Utility shutoff locations (i.e., electric, gas, water)
- Building specifics such as:
    - Number of floors
    - Roof access stairway
    - Potential target hazards
    - Firefighter safety hazards
    - Civilian safety hazards
    - Unique problems encountered (i.e., security access problems)

RESPONDING

All responses will be prefaced by receipt of the alarm. It is imperative that firefighters understand the type of emergency to which they are responding, the location or address, and position in the run order assignment. This information will be the beginning of a collection of evidence that members will use to perform a proper size-up and will aide in the strategy and tactics employed once on-scene.

In order to effectively mitigate an emergency it is imperative that crews arrive at the incident scene safely, ready to carry out their assigned task(s), and in a timely fashion. Apparatus response should be in accordance with each jurisdiction's respective procedures. Apparatus accidents delay or prevent members from rendering aide to those in need and often result in injuries to members and civilians. Based on the dispatch information, members shall don the appropriate PPE and begin their size-up en route. Knowledge of the response area, as well as pre-planning, will aid in an expedient response.

Specific tactics carried out by engine companies are based on their arrival order. It is imperative that, unless a unit is critically delayed, engine companies take their predetermined assignments based on their position number in the dispatched run order. If an engine company is already on the road and available upon receipt of the alarm, they must consider if their response will improve the outcome of the incident. If so, they shall add to the event following established policy. Every opportunity should be made to reduce radio traffic while responding.

Alarm Responses

Engine company members should monitor the radio while in quarters and on the road to maintain situational awareness of other units located in the immediate area. While responding, it is imperative that all members monitor the tactical channel as well as the Mobile Communication Terminal (MCT), if equipped. These tools will provide critical information about the current emergency and may indicate the need for a change in tactics upon arrival.

Engine company firefighters should be prepared for any situation, but specific tactics are based on the run order that each engine was dispatched, as outlined in the various NOVA firefighting operations manuals. The following is a list of broad tactics appropriate for the dispatched order and arrival sequence. However, members must remain ready if a change in assignment is ordered by command.

First Due Engine Company

The first due engine company will generally:

- Proceed ahead of the truck or rescue squad, if housed together.
- Lay the primary supply line.
- Deliver on-scene report.
- Perform the 360˚ lap of the structure.
- Communicate results of 360˚ lap and make command statement.
- Force entry, if without a special service, and control entry door.

- Advance the initial attack hoseline and extinguish fire.
- Perform search and coordinated ventilation, if needed, while advancing the hoseline.

Second Due Engine Company

The second due engine company will generally:

- Ensure the primary water supply is established.
- Assume command of the incident, if assigned.
- Ensure successful deployment/advancement of the initial attack line.
- Deploy a second hoseline.

Third Due Engine Company

The third due engine company will generally:

- Position on the opposite side of the involved structure from the first due engine company.
- Lay the secondary supply line.
- Perform a visual inspection of side Charlie and report findings to command.
- Deploy a third hoseline.

Fourth Due Engine Company

The fourth due engine company will generally:

- Ensure the secondary water supply is established.
- Assume the role of the Rapid Intervention Team (RIT).
- Take proactive measures to increase the safety of members operating inside the IDLH area (i.e., placing portable ladders, forcing doors, cutting security bars off windows) while maintaining readiness if a RIT activation occurs.

Response to Fire Alarms

The fire service has the unfortunate history of situations where a routine fire alarm incident has escalated to a working fire and ultimately a line of duty death; specifically Captain Jeff Bowen of Asheville Fire Department (July 28, 2011), Captain Matthew Burton and Engineer Scott Desmond of Contra Costa Fire Department (July 21, 2007), and Captain Robin Broxterman and Firefighter Brian Schira, Colerain Township (April 4, 2008). All three of these incidents were dispatched as fire alarms and ended in the unfortunate loss of firefighters' lives and they represent only a few incidents in recent history.

A key element to avoiding these types of unfortunate outcomes is eliminating complacency in incident operations. In an effort to eliminate complacent behaviors, personnel should expect the building to be on fire when they arrive and not assume it is a false alarm. Companies must treat every call as the most significant incident of their career until determined otherwise. All personnel shall wear all PPE, including SCBA, and bring a handlight and tools.

If the building is standpipe equipped, engine company personnel shall bring their respective high-rise packs while investigating. Additionally, engine company personnel should identify an established water supply and prepare to lay out, if necessary. If the decision is made to layout for the incident, all apparatus should position as they would if they arrived and found the building on fire. If the engine company stages at the water supply, the truck company should proceed to the front of the building and position appropriately.

Personnel should gather intelligent information from fleeing occupants and/or the building representative as to the exact location and nature of the alarm. If present, personnel should obtain Knox box keys prior to entering the structure, as they may be needed to obtain access to remote areas of the structure. Personnel shall ascertain the location of the fire control room and/or annunciator panel and verify the location, type, and number of alarms activated.

Truck or rescue company personnel should expect to arrive and travel to the reported floor or area of the alarm. Once they have arrived at the location of the alarm they must notify the engine company of a false alarm or exact location of the fire.

If an engine company arrives alone without a special service company, consideration shall be given to leaving one firefighter at the apparatus if staffed with four personnel. The firefighter and officer should investigate the alarm. If a fire is found, the officer can radio the remaining firefighter and engine driver. The remaining firefighter can initiate the deployment of the correct hoseline while the firefighter and officer return to the entry point to meet the remaining firefighter. Once the hoseline is deployed, the three personnel can than advance the hoseline to the fire location.

FIRE BEHAVIOR

Understanding fire behavior characteristics is a necessity for all members of the engine company to properly advance a hoseline and extinguish the fire in a safe and expedient manner. Today's fires burn at a rate ten times faster with rapidly increasing heat compared to fires of just 20 years ago, Figure 3. Fire behaves differently with each type of building construction. Some buildings hold heat and limit the amount of fire spread while other structural types have common spaces that allow for fire travel and extension. Differing types of construction can add fuel to the fire load. Understanding the stages of fire growth and how rapidly fire ignites and spreads allows engine company members to better function on the fireground.

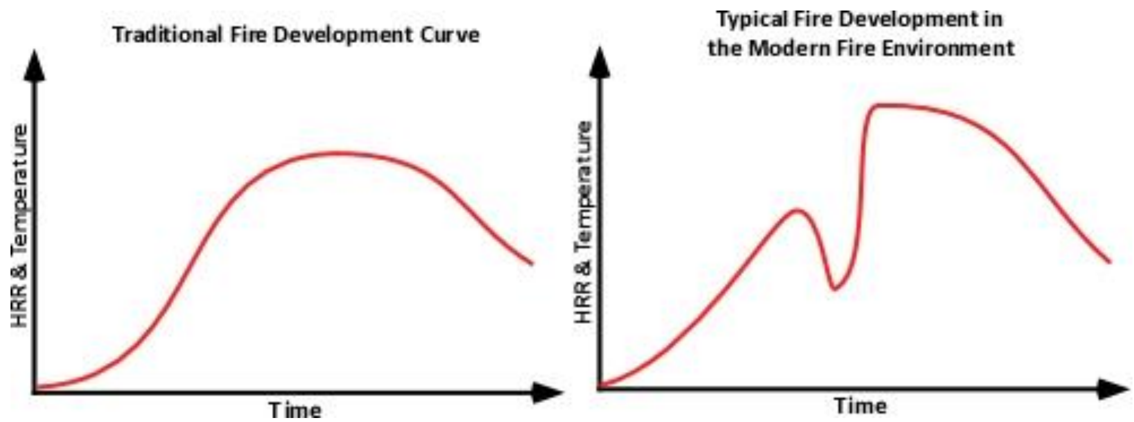

Figure 3: Traditional vs. modern fire development curve.

Fire stream selection must be coordinated with proper ventilation to confine and extinguish the fire. Various fire stream selections must be understood and their application used properly to advance to and extinguish the fire.

The Fire Tetrahedron

In order for combustion to occur, each component of the tetrahedron must be in place, Figure 4. If ignition has already occurred the fire is extinguished when one of the components is removed from the reaction.

1. Oxygen – Enables a fire to sustain combustion.
2. Heat – Needed to raise the material to its ignition temperature.
3. Fuel – Any combustible material in the form of a solid, flammable liquid, or gas.
4. Chain Reaction – Fire ignition when the three elements are present in their necessary condition.

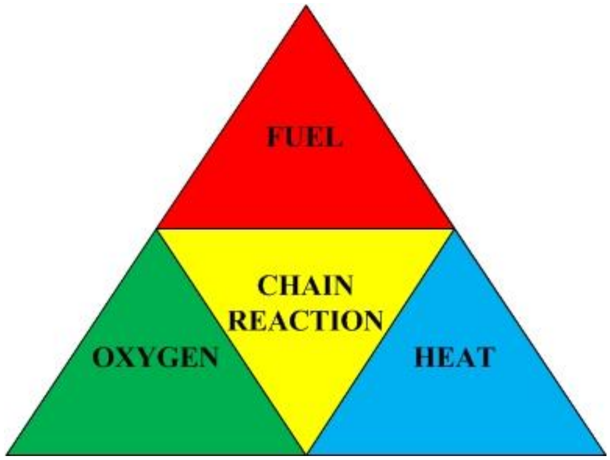

Figure 4: Fire tetrahedron.

Understanding the following IDLH conditions enables firefighters to have a better understanding of what is confronted when approaching or operating in an IDLH environment.

Flashover

Flashover is the stage of a fire at which all surfaces and objects within a space have been heated to their ignition temperature and simultaneous ignition of all surfaces and objects in the space occurs. Flashover occurs at the point between the growth and fully developed stages.

Backdraft

A backdraft is an explosion that occurs when additional oxygen is introduced into a smoldering fire as heated gases enter their flammable range and ignite with explosive force. Backdraft conditions typically exist during the decay stage after the fire compartment has consumed all available oxygen.

Rollover

Rollover is observed when flames present in layers of smoke as a result of heated gases that are pushed under pressure from the fire area into uninvolved areas.

Thermal Layering

Thermal layering is the tendency of gases to form into layers according to temperatures.

Stratification

Stratification is layering of smoke and gas clouds.

Pyrolysis

As solid fuels are heated, combustible gases are driven from the substance – this process is known as pyrolysis.

Stages of Fire Growth

Firefighters should understand how fire develops and changes during a fire. The four fire growth stages are 1) the incipient stage, 2) the growth stage, 3) the fully developed stage, and 4) the decay stage, Figure 5.

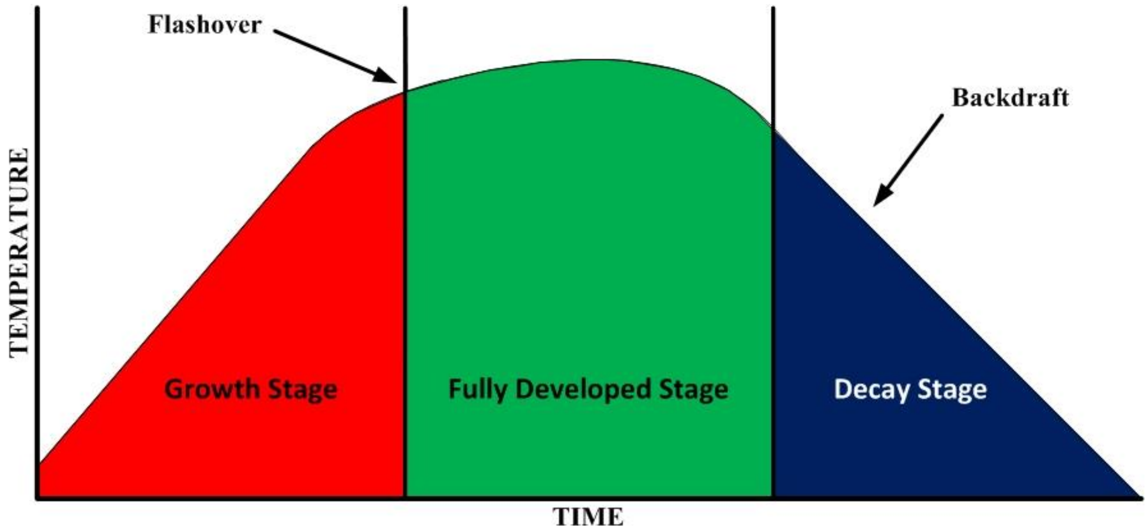

Figure 5: The temperature curve and stages of fire.

The Incipient Stage begins when heat, oxygen, and a fuel source combine and have a chemical reaction resulting in fire. This is also known as ignition and is usually represented by a very small fire which often self-extinguishes, before the following stages are reached.

The Growth Stage occurs when the fire increases in size from small flames to full fire that involves the entire room. It may be a rapid event taking seconds to occur or a prolonged event taking hours relying on the following variables:

- Combustible content (fuel load including contents and structure).
- Oxygen supply (pre-existing, fire created, or firefighter created ventilation).
- Room size.
- Insulating qualities of the compartment (room).

During the Growth Stage, fire develops and rollover is often seen in an adjacent compartment. This rollover should serve as a warning that the fire area may be reaching the point of flashover. As the fire progresses through the Growth Stage and into the Fully Developed Stage the potential for flashover exists. Radiation feedback from the ceiling and walls heats the smoke and gases given off by the burning materials and the combustible contents of the room. When the contents have been heated to their ignition temperature, flashover of the compartment can occur.

During the Fully Developed Stage, the entire room and contents are involved in fire. The fire will continue to burn until the available fuel and oxygen in the room or area is consumed or extinguished.

The Decay Stage occurs once all available oxygen is consumed. Although some oxygen remains in the fire area, visible flames start to diminish, and the fire continues to smolder. High heat and smoke conditions remain and the potential for a backdraft is present. A backdraft produces violent shock waves which can shatter windows and cause walls to collapse. Warning signs of a possible backdraft include:

- Heavy dense smoke with no visible flame in a tightly closed occupancy.
- Black smoke pushing around closed doors or window frames.
- Glass stained with smoke condensation and pulsating from the pressure of the fire.
- Reversal of air movement pulling smoke back into a building through a doorway.

Modern Fuel Loading

There has been a steady change in the residential fire environment over the past several decades. These changes include larger homes, more open floor plans, lightweight truss construction, and increased synthetic fuel loads. The difference between the new and the old is referred to as modern vs. legacy. Legacy materials consist of natural materials, such as cotton, wicker, solid wood, and dimensional lumber. Modern materials are man-made materials, such as plastics, synthetics, polyurethane, and polyester.

Firefighters must understand the difference between modern and legacy materials, especially as it relates to the Heat Release Rate (HRR). HRR is simply defined as the amount of energy released over time. It is the driving force for fire – the engine that is driving the fire. HRR is much higher for modern materials. This results in modern materials leading to flashover much quicker than legacy materials. Personnel should understand that HRR, combined with uncoordinated ventilation, will lead to early flashover.

Modern materials, with their very high HRR, present a significant hazard to today’s firefighters. It results in fires burning faster and hotter than ever before, with a high threat to life safety. This leads to fires reaching the flashover stage much quicker than with legacy materials. Companies must be efficient in their operations and deliberate in their actions to minimize any delays, especially with stretching and operating the initial attack line and performing ventilation.

Ventilation’s Effect on Fire

Effective engine company operations rely on the company’s ability to advance to and extinguish the seat of the fire and all other areas of fire extension inside and outside the structure. The quicker the engine company can advance the line into the structure the better chance they have of limiting fire damage and decreasing the time crews spend operating inside the structure in a potentially unstable environment. Coordinated ventilation is a necessity for today’s interior structural fire attack to enable the company to quickly and safely advance their line to extinguish the seat of the fire.

Ventilation needs should be identified when the fire officer complete their size-up. This occurs as the lap of the structure is conducted and the fire’s location is predicted, the ingress/egress points are identified, and the ventilation points are determined. These ventilation points include those that the fire created, those ventilation openings that were created by the occupants, and those ventilation openings the firefighters on the scene need to create to improve interior conditions. These openings enable the engine company to advance and place their hoseline in service. These ventilation openings should not be restricted to windows and doors, but should include horizontal ventilation such as windows, doors, and gable areas, and the need to determine vertical ventilation.

Ventilation openings are air intakes and exhausts into and out of the structure that are created by the occupant (e.g., an open door/window), by the fire, or by fire department personnel operating on the scene. Oxygen is one of the most important elements to a fire and firefighters operating on the fireground create ventilation ports by performing routine fireground tasks. Every door and window opening can have desirable and undesirable effects on the dynamics of the fire.

On most firegrounds, the first ventilation operation conducted is performed by the initial company arriving on-scene as they force entry. All personnel operating on-scene must understand that changing the ventilation status of a fire not only provides oxygen to the fire but also changes the chemical profile of the smoke and fire gases, potentially taking a mixture too rich to burn and dropping it into its flammable range, further setting the stage for rapid fire development. This could be the simple act of opening a door for entry, and the impact that this type of action could have on fire development must be understood.

A properly conducted structural ventilation process typically consists of the engine officer and outside vent crew exchanging information about the size-up, the engine company's hose stretch, and the ventilation openings that should improve conditions for the engine company advancing the hoseline. This information may be given face-to-face, over the radio, or through a predetermined plan that the companies plan for during routine training and drills.

A properly ventilated compartment/structure allows for a release of the smoke, heat, and fire gases that increases visibility and affords interior crews more favorable working conditions inside the IDLH environment. Proper ventilation decreases the likelihood of a flashover or rapid fire development event and increases the life safety factor of all occupants and firefighters within the fire structure.

Ventilation guidelines relating to fire attack include:

- Air is introduced anytime a door is opened or a window is broken.
- Ventilation must be coordinated with the progress of the hoseline and the engine officer's order.
- The outside vent crew and engine company must coordinate on where and when to ventilate.
- Charged hoselines should be in place prior to ventilation in most situations.
- The engine company should observe the change in conditions prior to entering the structure and while advancing their hoseline within the structure.
- Do not ventilate windows and doors that do not need opening.
- It is not necessary to ventilate compartments that are not on fire or do not have a hoseline in close proximity.
- Doors being forced open must be controlled (hinged doors should be pulled shut until the crews are ready to advance through them).
- Large glass sliding doors should be cautiously vented due to the large air intakes that may be created and the breaking of these doors does not allow for closing if needed.

- Controlling the air getting to the fire limits fire growth and extension.
- Understand the impact of ventilation on the development of the fire.
- Consideration must be given to limiting ventilation to a tactical position at the fire room.
- An active fire pulls air to itself while pushing hot gases, smoke, and fire away.
- Wind speed and direction may have a dramatic effect on the fire.
- Indiscriminate ventilation will spread the fire .

Hydraulic ventilation is the process of removing large amounts of smoke, fire gases, and heat from the interior of a structure within the fire compartment. Using this technique quickly improves conditions within the compartment and increases visibility to enable the engine company to improve their environment.

The primary advantage to hydraulic ventilation is that it is quick and simple to perform by the engine company from within the structure. Firefighters do not have to set-up fans or make time-consuming vent openings. Hydraulic ventilation is also very effective at clearing a single room after knockdown has occurred, Figure 6.

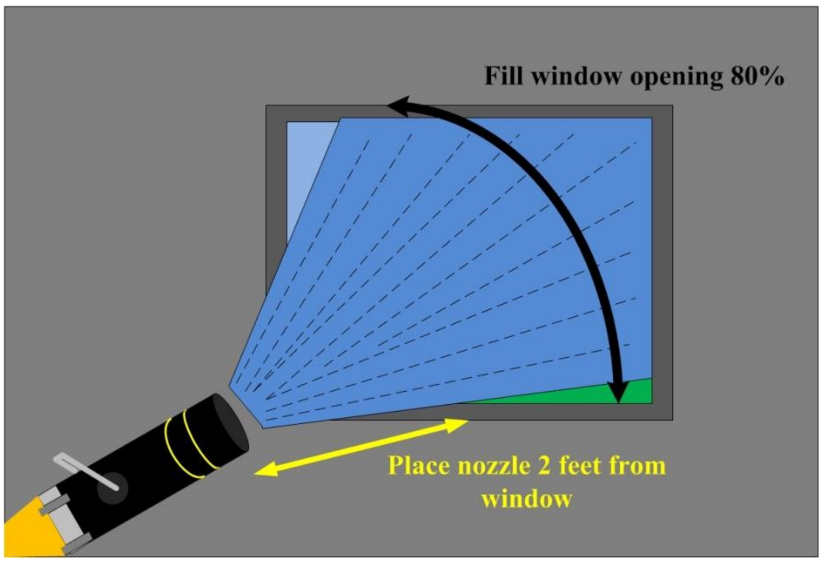

Figure 6: Hydraulic ventilation.

The only tool required to perform hydraulic ventilation is a hose line with a fog nozzle. After firefighters have knocked down the fire in a room, they should advance to the closest window or exterior doorway. If no opening exists, the engine company will have to clear the vent opening then position the hoseline two feet from the opening and set the nozzle to a fog that will cover 80% of the opening and flow the hoseline out of the structure. The idea is to cover most of the opening with the stream and allow the smoke and heat to be drawn out between the stream and the opening.

The effectiveness of hydraulic ventilation is based on the size of the ventilation opening and the amount of water flowing from the nozzle. When ventilation begins, the nozzle should be fully opened so that maximum ventilation can be achieved. Finally, firefighters should be cautious of the water and any debris that are forced from the structure and be mindful of personnel operating immediately outside of the opening (e.g., outside vent team, command post, etc.).

Reading Smoke

Understanding smoke and smoke behavior has become an important aspect on the fireground. Smoke contains many clues to the location and status of the fire. In order to understand and interpret the various smoke conditions, engine company members must have a fundamental understanding of the characteristics of smoke. There are numerous classes and articles pertaining to the art of reading smoke. Many of them are extremely detailed with technical data making it difficult to understand and apply on the fireground. Engine company members must be able to read and interpret all clues while conducting a size-up and throughout the incident. The fireground principles of smoke are:

1. Smoke is potential fuel.

2. Smoke density and color together are an indicator of the flammability.

3. Velocity (speed) and pressure are indicators of heat and flow path.

4. Volume is an indicator of fire intensity.

5. All of the above indicators form an incident profile regarding the location, status, and extent of the fire.

Potential Fuel

Products of combustion from modern day fuel sources produce an extremely toxic, highly flammable, and potentially explosive smoke filled atmosphere. The chemical composition of smoke varies from fire-to-fire based on the different fuel sources. All smoke is filled with high levels of carbon and carbon monoxide that if left unchecked will result in fire.

Density and Color

While many documents related to reading smoke separate density and color, it is acceptable to group them together to understand what they mean in context and application on the fireground.

Smoke color is an indicator of two things: what is burning and flammability of the smoke. What is burning is less important than the flammability. Engine companies must understand when smoke is too lean to burn and when it is too rich to burn. This is critical when evaluating ventilation profiles and flashover potential. While fires have the ability to produce many different colors, the following colors are normally seen:

- White
- White/grey
- Grey
- Grey/black or brown
- Black or brown

Black and brown smoke typically behaves the same regarding flammability but usually is an indicator of a different type of fuel source.

Table 1: Smoke color, fire status, and smoke flammability.

Color of Smoke	Fire Status	Smoke Flammability
White	Indicates moisture or early stage incipient Class A fire	Too lean to contribute to fuel load
White/Grey	Indicates moisture or early stage incipient Class A fire	Too lean to contribute to fuel load
Grey	Early stage incipient/free burning fire with Class A and B fuel sources	Smoke possibly reaching the LEL level
Grey/Black or Brown	Fully developed fire with Class A and B fuel sources that is most likely ventilation-limited	Smoke is in the flammable range and subject to burn if heat is available
Black/Brown	Fully developed or decaying stage fire that is extremely ventilation-limited	Smoke is typically too rich to burn

Density refers to the smoke's thickness, which in turn translates into its concentration in air. Since smoke is fuel capable of burning, thickness shows how much fuel is laden in the smoke. In essence, the thicker the smoke, the more potential energy and more spectacular the flashover or fire spread will be.

By combining the density and color, personnel can gain a much better snapshot of what is occurring and use this information to predict flashover potential and decide on ventilation status.

Velocity or Speed

Smoke will present as fast moving or slow moving. The speed provides two critical pieces of information on the fireground: general location of the heat source and the fire's current flow path or air track. Smoke emitting directly from the fire is typically fast moving, rapidly expanding, and very agitated. As smoke leaves the fire, it will flow upward to the ceiling and begin migrating away from the fire. The heat of the expanding smoke is absorbed as smoke flows across the ceiling, walls, and doors. As the heat is absorbed, the smoke will become calm, orderly, or free-flowing. Viewed from outside a building, slow moving smoke flow could mean the fire is distant or that the compartment is still absorbing heat. Conversely, fast moving smoke flow seen outside the building could mean the fire is near or that the compartment cannot absorb any more heat. The other reason that smoke does or does not move has to do with the air track. If smoke is moving, it is getting air from somewhere, meaning the fire is continuing to grow. If the smoke is not moving, it is not getting any air, meaning the fire may be lying dormant waiting for additional oxygen or burned out.

Volume

Smoke volume by itself indicates very little about a fire. It sets the stage for understanding the amount of fuels that are burning within a given space. This can help personnel understand the relative size of the event. For example, a small fast food restaurant can be completely filled with smoke from a small fire. Conversely, it would take a significant fire event to fill a big-box store with smoke. The volume of smoke leaving a building can help companies form an impression of the fire. Reading smoke volume is just a starting place that paints the picture of the size and intensity of the incident.

The fundamental understanding of these elements will give firefighters a better working knowledge of smoke and fire conditions. Recognizing a change in the smoke conditions is the best way for firefighters to maintain their personal safety by identifying, reacting, and preventing flashover or rapid fire propagation.

Examples of Reading Smoke

Figure 7: Reading smoke example 1.

	Description
Color	Black and grey
Density	Thick
Velocity/Speed	Moderate on Side Alpha /fast on Side Charlie
Volume	Box is full
Smoke Flammability (Potential Fuel)	Too rich to burn
Fire Status	Fully developed, ventilation limited
Fire Location	Probably Side Charlie, lower level – narrow fast moving smoke column
Ventilation Status	Ventilation limited – crews ventilated and smoke will begin to lean out and fall into the flammable range
Summary	Fully developed fire with a large volume of moving smoke. Atmosphere within the building was too rich to burn until ventilated by fire department personnel. Without the application of water, fire spread is imminent.

Figure 8: Reading smoke example 2.

	Description
Color	White/grey and black
Density	Thin on Side Alpha/ thick on Side Charlie
Velocity/Speed	Moderate on Side Alpha and Side Charlie
Volume	Box is full
Smoke Flammability (Potential Fuel)	Too rich to burn on Side Charlie
Fire Status	Fully developed on Side Alpha (white/grey smoke may be result of water application), substantial heat source on Side Charlie but ventilation limited to Side Charlie
Fire Location	Multiple compartments on first level
Ventilation Status	Ventilation limited on Side Charlie
Summary	Fully developed fire within multiple compartments that is extending into the attic; some compartments are ventilation-limited, however the fire has adequate airflow to grow

Figure 9: Reading smoke example 3.

	Description
Color	Brown
Density	Thin on multiple sides
Velocity/Speed	Moderate speed-pushing smoke throughout entire attic compartment
Volume	Box is full
Smoke Flammability (Potential Fuel)	Too lean on the outside and too rich inside the compartment
Fire Status	Decaying fire or extremely ventilation limited fire in the attic
Fire Location	Attic - A/B Quadrant
Ventilation Status	Ventilation limited
Summary	An attic fire that has a lack of oxygen. High temperatures in the attic space are indicated by the smoke staining on the exterior. The compartment is ventilation limited and careful coordination of reducing the temperature in the compartment and ventilation must occur to minimize damage to the building.

FIREFIGHTING OBJECTIVES

The objectives of any firefight should follow RECEO VS with the underlying goal of protecting life and property while maintaining a high level of awareness throughout the incident. RECEO VS stands for:

- Rescue
- Exposure
- Confinement
- Extinguishment
- Overhaul
- Ventilation
- Salvage

The strategy is the general plan or course of action decided upon to reach the objectives. This is most often indicated by the mode of operation: offensive (interior or exterior) or defensive.

Tactics are the specific actions employed to fulfill the strategy (e.g., a hoseline to the top of the stairs to limit fire extension and protect the search or a ladder to an upper-story window).

Many factors must be considered while developing a proper strategy and subsequent tactics to achieve the objectives of RECEO, beginning with a proper and ongoing size-up. Size-up begins with receipt of the alarm and continues throughout the incident. All members should size-up the incident as it relates to their specific duties. Officers should train their personnel to not only size-up the incident, but to voice any safety concerns. This is situational awareness.

Rescue

The rescue of life is the primary focus of any incident. The engine officer must analyze the situation to determine if there is or is not a life hazard. If there is a life hazard, a decision must be made on how to protect the victim and/or affect the rescue. Often, the fastest and safest action will be to simply extinguish the fire or position a hoseline between the victim and the fire. A rescue attempt without the protection of a hoseline or a coordinated fire attack is a risky proposition and should only be attempted in extreme circumstances. If it is determined that no life hazard exists, then the rescue objective can be prioritized below a more pressing issue.

Exposure

Exposures consist of interior and exterior sources. In order to effectively address this problem, the engine officer must have a good idea of the location and extent of fire as well as potential routes of fire travel while considering the different methods of heat transfer and construction materials. The primary goal of the exposure line is to minimize fire spread and to stay ahead of the fire. Often, the actions of this line will not be exclusive to protecting exposures. The line may sweep the outside of the fire building stopping the fire from extending into the roof or quickly sweeping the exposure before knocking down a garage fire.

Confinement

Confinement of the fire is often overlooked by firefighters. Most of the time, companies arrive on-scene and perform the rescue, exposure, and extinguishment components. Confinement is necessary on larger fires when extinguishment is impossible due to the lack of on-scene resources. Engine officers should attempt to determine early in the incident if the fire is manageable with on-scene resources. If not, the priority should shift to minimizing fire spread and containing the fire until appropriate resources are in place. This scenario could occur inside or outside of a structure. The goal is to hold the fire to a room, quadrant, or wing of a structure until additional resources or tactics are utilized.

Extinguishment

This is by far the most effective way to quickly mitigate an incident. When the fire is extinguished, all of the other fireground obstacles go away or get better. Extinguishment of the fire may be the first thing performed even when a rescue or exposure problem exists. The engine officer must determine the fastest and most efficient method to achieve fire control. Firefighters must work as a team to rapidly advance the hose line, interpret fire conditions and behavior, and appropriately attack the fire. When performed properly, extinguishment should be coordinated with the ventilation team(s).

Overhaul

Overhaul is a systematic look at the entire fire scene to make sure that there are no further traces of fire. Firefighters should check voids closest to the seat of the fire first, working outward until unburned material is reached. This step must be carefully weighed against the need for a thorough investigation. Should an investigation need to take place, the fire room and contents should be left as intact as possible. This will lead to a more rapid and accurate investigation. Firefighter should continue to use their SCBA during overhaul to reduce exposure to toxic gases and carbon monoxide. Fire officers should develop and communicate a plan for overhaul tasks. Firefighters should create layers of materials that get wet down thoroughly with a hoseline before pulling down an additional layer of debris.

Ventilation

Ventilation on the fireground can be one of the most dangerous and most important tasks performed by firefighters. The technique of horizontal ventilation involves the opening or removal of windows in the structure and accomplishes several objectives aiding in the extinguishment of the fire. It permits rapid advance of the attack hoseline to the fire area while reducing the danger of heat or fire passing over or around the nozzle team by allowing heat and smoke to escape through the newly created openings. It is critical that all ventilation (horizontal and/or vertical) be coordinated between the ventilation team (inside or outside) and the advancing hose team. Uncoordinated, poorly-located, or ill-timed ventilation (horizontal and/or vertical) can cause the fire to spread rapidly, subjecting personnel inside to extreme heat and flashover conditions. The introduction of ANY additional ventilation into the structure will increase fire intensity and fire spread. We must maintain a vigilance regarding the ventilation status of the fire. Failure to recognize changes in the ventilation status can result in personnel being caught in a rapid fire propagation or flashover event.

Before any ventilation takes place, the ventilation team must answer the following questions:

- What is the location of the fire?
- What is the current ventilation status?
- Will adding additional ventilation openings affect fire conditions?
- Where is the hoseline?

Salvage

Simply stated, salvage is property conservation. This limits damage from the fire or the fire control efforts and is often done in conjunction with firefighting efforts. All personnel operating on the fire ground are responsible for loss control and property conservation efforts. However, the engine officer should ensure specific actions and tasks are performed in such a way to minimize damage. Typically salvage measures are implemented after initial knockdown but before extension and overhaul operations are performed. Some of these actions include:

- Moving/covering furniture prior to pulling ceiling or flowing water.
- Removing pictures and other valuables off the wall.
- Placing hall runners down on floor to minimize damage from foot traffic in unaffected parts of structure.
- Relocation of contents and belongings to adjacent rooms if roof has burned away to protect from weather.

SIZE-UP

"Size-up, or estimate of the situation, is the mental evaluation made by the operational officer-in-charge of a fire or other emergency which enables him to determine his course of action and to accomplish the mission."[1] -- Lloyd Layman, 1953[2]

Size-up is one of the most misused and misunderstood terms in the fire service today. The engine officer must understand size-up components as well as the psychological limitations, such as perceptual blindness in order to perform an effective size-up. Perceptual blindness, or inattentional blindness, is an inability to perceive something that is within one's direct perceptual field because one is attending to something else. Understanding how to obtain, interpret, prioritize, and apply the information gathered is paramount to mission efficiency, effectiveness, and safety. The size-up is a continuous process which contains various benchmarks and decision points where information is obtained during an incident.

Size-up info is provided on an ongoing basis and is included in:

1. Pre-incident (know what needs to be on a pre-plan, barriers, layouts, etc.)
2. Pre-arrival
3. On-scene report
4. 360° lap or walk around
5. Situation report
6. Interior size-up
7. Ongoing size-up

Pre-Incident Size-Up

Pre-incident planning is paramount to successful fireground operations. Knowing the building layout, construction type, hydrant locations, specific building features, locations of fire protections systems (standpipes, ventilation points), occupancy type, and building access options will expedite fireground operations.

Pre-Arrival Size-Up

Pre-arrival size-up is somewhat of a natural instinct for fire officers. Pre-arrival size-up considerations include: occupancy type, time of day, class of construction, weather conditions, and water supply access. Much of the pre-arrival size-up information can be known by company officers through pre-incident planning.

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[1] Layman, Lloyd. (1953). *Fire Fighting Tactics*. (City Unknown): National Fire Protection Association.
[2] For information about Lloyd Laymen, see the following article in *Fire Chief*: http://firechief.com/mag/firefighting_father_fog_lloyd.

On-Scene Report

The on-scene report gives the initial arriving company officer the opportunity to gather more detailed information. The on-scene report should paint an image of the building type and conditions upon arrival of other incoming units. The on-scene report should be concise, but provide sufficient information to incoming units to permit proper apparatus placement and crew deployment. Information provided in the on-scene report should include: position of first arriving apparatus (side of the building), what is evident upon arrival, occupancy type, and exposure concerns.

360˚ Lap

The 360° lap, or building walk around, will allow the officer to view all sides of the building (if possible), and provide information for the officer to further paint a picture of the incident to incoming units. The lap will allow the initial arriving officer to determine the possible location of the fire, the presence of victims, the best location for initial line deployment, and any obstacle present that may impede smooth fireground operations. The first-arriving engine officer shall conduct a thorough 360˚ lap of the structure prior to implementing interior firefighting tactics. If physical barriers make the 360˚ lap impractical, the lap may be assigned to another unit; however, interior tactics shall not commence until a report from Side Charlie is received.

In situations where a reported life hazard exists, and the initial company officer identifies the need for immediate interior firefighting actions, a radio report shall be transmitted identifying the need to bypass the size-up from Side Charlie.

Figure 10: Often, conditions on side Alpha will not mirror side Charlie, or vice versa.

Situation Report

The initial arriving officer will compile all of the information that was gathered through the pre-incident, pre-arrival, on-scene, and 360˚ lap size-up. This compilation of information provides the tools necessary to allow the first arriving fire officer to make the decisions necessary to mitigate the emergency. All information that is gathered is relayed to units either on the scene or still responding, and dictates the actions necessary to bring together responding units and design a plan of action.

Interior Size-Up

Interior size-up comes from all units that are working inside of the structure. This information can include; amount of fire, interior building layout, location of victims, hazards encountered, positioning of hoselines, and prioritization of areas of search. With the continued effort of fire suppression activities and changing conditions, ongoing size-up is the next phase of fireground size-up.

Ongoing Size-Up

It is incumbent on the fire attack officer(s) to keep the IC apprised of the fire attack's outcome. The IC needs to know the progression of fire extinguishment, number of victims and progress of removal, status of the building, and the need for additional resources to mitigate the incident. Ongoing size-up will continue after the fire is knocked down to inform the incident commander of overhaul and salvage operations, CO levels in the structure, and other pertinent issues.

An easy way to answer or transmit a progress report is the CAN report; CAN stands for Conditions, Actions, and Needs. By using this report model, the person giving the report easily identifies how well the team is doing, the conditions faced, and any support or resource needs.

C – Conditions
A – Actions
N – Needs

In order to use these principles, the engine company officer must have a comprehensive understanding of the size-up process and all elements. The elements of a size-up encompass the potential variables the engine company officer must factor into the decision-making process. During size-up, information and intelligence on the following elements should be obtained whenever possible:

- Building
  - Occupancy type
  - Residential vs. commercial
  - Location of points of access and egress
  - Ventilation access points
  - Fire protection features

- Construction type
  - Fire Resistive allowing for limited fire spread

  - Ordinary Construction, concerns for collapse potential
  - Lightweight Construction, issue of rapid fire growth and increased collapse potential

- Occupant Interview
  - Fire location (basement, upstairs, main floor)
  - Occupant report (rescue potential, location of fire)
  - Location of utilities

- 360° Lap
  - Elevation of structure (front vs. rear)
  - Location and extent of fire(identify the lowest level of smoke and fire)
  - Ventilation status
  - Access and egress points
  - Victim location

The information obtained during size-up will assist the engine company officer to determine, develop, communicate, and implement the initial incident action plan.

Locating the Fire

Locating a fire inside of a building is the responsibility of the initial engine company officer. This task is accomplished many ways, but in general it includes direction from the building's occupants, direction from the dispatcher (after speaking with the 9-1-1 caller), and when smoke or fire conditions present to the engine company, making the fire's location obvious.

But when the location is not obvious and fleeing occupants cannot be found, how does the initial arriving officer locate a fire in a structure? While conducting the size up and 360˚ lap, company officers must identify clues to help locate the fire from the exterior of the structure. While operating in an IDLH environment firefighters and fire officers must pay attention to smoke behavior to successfully locate and extinguish the fire. Listed are some clues that the officer can use to help determine the location of a fire inside a structure.

Exterior Indicators

Smoke: Smoke can be an indicator of the location of the fire. The most reliable indicator to a fire's location is smoke velocity, or speed. Smoke rising or exiting the building fast and under pressure indicates that the smoke is closer to the heat source, thus narrowing down possible locations. Velocity or speed is relative, meaning it is compared or viewed as a big picture for a particular incident. Smoke volume is not a good indicator to the actual location of the fire.

Windows: Looking at the windows of a structure can give the initial company officer an indication of the location of the fire. Dark-stained windows may indicate the location of the fire. Dark windows should be further investigated and checked for heat. Dark windows may also indicate a fire in the decay stage that is ventilation-limited. Careful coordinated ventilation and fire attack must be employed in this situation. Crazed or cracked glass is also an indicator of intense heat inside the fire room indicating the fire's location.

Listening: As the initial arriving company officer completes his walk-around of the structure, they should be cognizant of the noises coming from the structure. Hearing crackling noises from inside the structure may give the officer an indication of the fire's location.

Interior Indicators

Smoke Levels: How far smoke has banked down on a particular level can provide significant information to companies. Smoke typically travels upward. When smoke is encountered from floor to ceiling, companies must check the floor below that location. Frequently, this condition is an indicator of a basement fire or a fire in the decay phase that is ventilation-limited. The smoke has had time to cool off and calm down, thus creating a floor-to-ceiling smoke scenario. After confirming that the floor below is clear, the fire officer should look for a compartment with an increase in heat to locate the fire. Careful coordinated ventilation should also be used with direct communications between the fire attack team on the interior of the structure and the ventilation team on the exterior.

Movement: The movement of smoke or air on the interior is an excellent indicator to the fire's location. Smoke and products of combustion exhaust, or move away, from the fire at the ceiling level. The fire will draw in fresh air at the floor level to support combustion. Firefighters and fire officers can use this draw of fresh air at the floor level to track down a fire location. The light smoke between the floor and the heavier smoke ceiling will typically be traveling toward the fire's seat. How fast the smoke is moving is a good indicator of the fire's intensity and its proximity to the fire's location.

Lift: Smoke lift is also a good way to gather information regarding the fire's location. When the companies open the door at a point of entry, a ventilation opening is created, providing additional air to the fire. Lift is described as the smoke level rising, increasing the distance of clean air at the floor level. How fast this lift occurs, coupled with how much lift occurs, provides detail of the fire's intensity, floor level of the fire, and the ventilation status of the fire. After the door is opened at the point of entry, pause to observe the smoke's conditions before advancing – this may point to the direction of the fire.

After opening the entry door and floor-to-ceiling smoke conditions exists, smoke often pours out of the opening at the top and rapidly lifts and begins to draw in at the bottom. When this is observed, it may indicate the presence of a significant fire that is relatively close to the point of entry, on the same level, that is ventilation-limited. The chances of rapid fire propagation are high and companies must be prepared for rapid fire development.

After opening the entry door and smoke lazily exhausts and lifts (if at all), this may indicate a fire that is located farther away from the point of entry, less intense, or located on the floor below.

Listen: Listening can be a great way to identify the location of the fire. Fires that are vented or free burning typically make the most noise. Fires in the decay stage may not produce any noise. Any fire that is actively burning will produce cracking and popping sounds that can be used by the firefighter to determine its location. Crews operating on the interior should occasionally stop and hold their breath for a several seconds and listen for the sounds of the fire. Crew members operating in close proximity may need to coordinate the holding of their breath so that the inspiratory and expiratory sounds of SCBA breathing do not overpower the sound of the fire.

Risk Assessment

Conducting a risk assessment and employing a risk management strategy if one of the most critical functions performed on the emergency scene. The task of safety is the responsibility of fire officers and firefighters alike. Threats to personnel safety come in many shapes and sizes. It is the primary role of the fire officer to successfully implement an action plan that best mitigates the incident while managing risk levels. The principle objectives of risk management include an internal process to identify and evaluate risks, then develop, select, and implement measures up front to lessen the probability of a harmful consequence.

On the fireground fire officers and firefighters use knowledge, skills, training, and experience to successfully evaluate and minimize risk. Primary concerns are issues of safety to fire service personnel followed by the safety affecting the public. The mission of the fire department is to protect life and property. Threats to safety on the fireground primary come from two categories:

- Advanced fire conditions and
- Collapse potential.

To assist with the risk assessment, several questions must be answered:

1. What is the life hazard?
2. What are the fire conditions?
3. What is the potential for victim survival or the victim survivability profile?
4. What is the structural stability and potential for collapse?
5. Do I have adequate resources to make a positive impact on the incident?

Life Hazard

Are there civilians trapped or possibly trapped? Sometimes this information is clear coming from a dispatcher on the phone or by a family member telling on scene. Other times, the status of possible victims is based on a neighbors account or time of day and cars in the driveway. Knowing the life hazard potential is critical when determining and managing risk.

Fire Conditions

Current and projected fire conditions, along with the building construction type, give personnel significant information to use when determining the timeframe they have to act. Large volume fires in combustible buildings increase the risk and decrease the time to act, while smaller fires in non-combustible buildings decrease the risk and increase the time to act. Understanding fire behavior and travel, as it relates to the various building construction types, is one of the most important tools firefighters and fire officers can use when assessing and managing risk as it relates to fire conditions.

Protection of Life

Engine companies are often faced with the decision of how to protect life during firefighting operations. Considerations to consider include the location of the fire and the advancement of the fire, state of the victims, the status of the environment in which the victims are located, and the victim's physical location within the structure. In most cases, the engine company should identify the fire's location and extinguish the fire as rapidly as possible as conditions improve when fire is extinguished. If victims are located on the fire floor and they can be protected in place or removed from the structure, then this action must be coordinated as the attack line moves into position to confine the fire. If people are trapped, resources must be committed to those areas to protect trapped victims in place by extinguishing fire or confining the fire until the victims can be rescued, even if it means that the fire will spread to other parts of the structure. In all cases, a risk assessment must be completed to determine if victims are viable and actual rescues can be made.

Victim Survivability Profiling

Victim Survivability Profiling (VSP) is a term that the fire service has used for many years. (It may less commonly be referred to as Occupant Survivability Profiling.) The core concept of VSP is that firefighters have to conduct a thorough size-up of a structure fire to determine the likelihood of a victim's potential to be rescued.

There are several background factors that must be understood regarding the physiology of the human body to conduct the VSP.

- The first is the human body's threshold for heat. The NFPA suggests that the upper range of temperature tenability for humans is around 212ºFahrenheit.
- The second is Carbon Monoxide (CO), the primary cause of fire-related death; at approximately 200,000 parts per million (ppm) the human body is rendered unconscious within 4-12 seconds with death following shortly thereafter.
- The third is oxygen. Earth's atmosphere contains 21 percent oxygen. Percentages of less than 10 result in death rapidly.

Last is the issue of other toxic fire gases, such as cyanide. Today's fires produce a tremendous amount of toxic gases that can rapidly incapacitate and cause death to fire victims.

Understanding the human body's response to fire conditions, coupled with a size-up of the structure, and location and extent of fire, the engine officer can determine the best course of action for mitigating the emergency. <u>Modern fire behavior studies also support the fact that the chances of survival can be greatly increased by shutting a door and creating a barrier between the compartments</u>. The 2010 UL study, *Impact of Ventilation on Fire Behavior in Legacy and*

Contemporary Residential Construction[3], demonstrates that during each experiment, conditions remained tenable for both temperature and oxygen thresholds in the compartment with a closed door.

VSP provides firefighters with an excellent tool to use during size-up. Caution should be given to drawing absolute conclusions regarding victim viability based on the profile alone.

Structural Stability/Collapse Potential

Is the building going to fall down? If so, how long can crews operate before collapse? Is there a safe zone that that crews can operate within to decrease the risk? What part of the building will collapse first? How will operations be affected? These are the kinds of questions fire officers must consider throughout each incident. As a general rule, large spaces and spans are the enemy when it comes to firefighter safety. Large box stores in the commercial arena, large span trusses, and concentrated loads in lightweight building construction present the highest risk to firefighters. Operations should be adjusted as necessary to avoid these high risk areas. Operating from smaller or adjacent compartments will often times substantially decrease risk and increase firefighter safety.

Resources

Each crew's knowledge, skills, abilities, training, and experience should be considered when determining the amount of time they have left to operate safely inside of the structure, in addition to the visual cues given by the structure itself. Companies must consider what actions can be taken to slow down or keep the incident from escalating until additional resources arrive.

[3] http://www.ul.com/global/eng/pages/offerings/industries/buildingmaterials/fire/fireservice/ventilation/

Figure 11: Size-up example 1.

	Description
Life Hazard	Probable given time of event and no occupants present on arrival
Fire Conditions	Advanced fire conditions throughout entire structure
Victim Survivability Profile	No survivable victims due to advanced stage of the fire
Structural Stability	Lightweight, wood frame construction
Resources	Fire conditions limit ability to safely execute interior operations.
Summary	Establish water supply, exterior fire attack Risk assessment of the building based on the construction type, fire conditions, resource availability, and time of day should all be critical consideration factors before any change in tactics

Figure 12: Size-up example 2.

	Description
Life Hazard	Probable given time of day, vehicle in driveway, and no occupants present on arrival
Fire Conditions	Advanced fire conditions throughout roof structure with spread to the living space
Victim Survivability Profile	Survivability is high—minimal smoke or fire in the living space and a person could still be inside and unaware (asleep, basement area)
Structural Stability	Lightweight, wood frame construction
Resources	Candidate for Blitz attack
Summary	Establish water supply, quick knock-down from the exterior with a large-caliber line An interior attack should only be attempted once the bulk of the fire has been knocked and structural stability is ensured Ground ladders may have to be utilized to access the upper compartments due to fire in stairwell

Figure 13: Size-up example 3.

	Description
Life Hazard	Probable given time of event and no occupants present on arrival
Fire Conditions	Advanced fire conditions in the attached garage
Victim Survivability Profile	Survivability high—minimal smoke or fire in the living spaces and a person could still be inside and unaware of the event
Structural Stability	Lightweight, wood frame construction
Resources	Blitz attack
Summary	Establish water supply, quick knock-down from the exterior with a large-caliber line An interior attack can be attempted once the bulk of the fire has been knocked down

Figure 14: Size-up example 4.

	Description
Life Hazard	Probable given time of day, vehicles in driveway, and no occupants present on arrival
Fire Conditions	Fire conditions in a lower-level compartment, no obvious fire on first floor, and large volume of smoke throughout the entire building
Victim Survivability Profile	No survivable victims due to fire intensity in the basement and smoke throughout all levels
Structural Stability	Conventional, wood frame construction
Resources	Interior attack on the level of the fire with a continuous evaluation of the structural stability
Summary	Establish water supply, interior fire attack If a report is provided from an upper floor about structural instability (spongy floor) then crews should be notified and a change in tactics may need to be immediately implemented

Figure 15: Size-up example 5.

	Description
Life Hazard	Probable given time of event and no occupants present on arrival
Fire Conditions	Upper floor-multiple compartments
Victim Survivability Profile	Survivability moderate—smoke in the living spaces on upper levels and minimal or absent on the lower levels
Structural Stability	Lightweight, wood frame construction
Resources	Interior attack on the upper levels with a continuous evaluation of fire spread
Summary	Establish water supply, interior fire attack If fire attack is not rapid, personnel will need to consider the possibility of fire spread to the attic space

Figure 16: Size-up example 6.

	Description
Life Hazard	Probable given time of day and occupancy type
Fire Conditions	Throughout box with extension through the roof
Victim Survivability Profile	Survivability low in fire unit—smoke/fire throughout the box Survivability in exposures high
Structural Stability	Non-combustible
Resources	Candidate for Blitz attack
Summary	Establish water supply, quick knock-down from the exterior with a large-caliber line An interior attack should only be attempted once the bulk of the fire has been knocked and structural stability is ensured

Figure 17: Size-up example 7.

	Description
Life Hazard	Probable given time of day and occupancy type
Fire Conditions	Compartment fire with possible extension
Victim Survivability Profile	Survivability moderate—vented room and contents fire
Structural Stability	Ordinary
Resources	Interior attack
Summary	Establish water supply, rapid interior attack should be attempted on the upper level Ground ladders may have to be used to access the upper compartment

FIREGROUND STRATEGY

Fireground strategies and tactics often change due to various factors and the engine company officer must react appropriately to each change in strategy.

Traditionally, it was a common practice to attack from the unburned side. There was a thought that fire was being pushed throughout the building. The UL study *Impact of Ventilation on Fire Behavior in Legacy and Contemporary Residential Construction* concluded that there were no temperature spikes in any of the rooms, especially the rooms adjacent to the fire room, when water was applied. It appears that, in most cases, fire was slowed down by the water application and that water application had no negative impacts to occupant survivability. While the fog stream pushed steam along the flow path, there was no fire pushed.

Fireground strategies and tactics often change due to various factors and the engine company officer must react appropriately to each change in strategy.

Retreats and Evacuations

Tactical Withdrawal

During the course of a firefight, conditions within a structure may change to the point that precludes fire department personnel from continuing to operate. As an example, this may be an area in danger of isolated collapse, advancing fire conditions, or temporary loss of water supply. The IC or company officer may order a tactical withdrawal. <u>A tactical withdrawal is a coordinated and specific relocation of units and their equipment operating from an area deemed untenable to a specific area deemed safe to continue operations.</u> A specific fireground example would be a temporary loss of water for units operating on the 8th floor of a highrise. The IC would order a tactical withdrawal of personnel on the 8th floor to the protection of a stairwell. Once water was re-established, the offensive attack would commence and units would advance.

Emergency Evacuation

An emergency evacuation differs from a tactical withdrawal as the emergency evacuation has a higher degree of urgency. An emergency evacuation shall be announced when conditions dictate the immediate evacuation of all personnel from an unsafe structure, or other dangerous area. The evacuation order may be given verbally or signaled over the radio by the transmission of a specific tone intended to alert personnel of an emergency evacuation. Engine companies that have evacuated and are outside of the IDLH should continue to staff handlines until all personnel (truck company/rescue squad) have evacuated. Due to the location of units and tasks being completed simultaneously, the truck/rescue squad may evacuate after the engine company. In this position the engine companies can support the evacuation of personnel and continue to deploy hose streams on visible fire that can potentially trap evacuating firefighters.

Strategies

Offensive Mode

Selection of an offensive mode involves taking direct action to mitigate the problem. This means personnel have selected to use an interior or exterior attack because they believe a life hazard exists or the fire can be stopped without total destruction of the structure. In addition, initial risk assessment has confirmed that the fire structure itself is not so involved and immediate collapse is not a factor, fire dynamics are understood, and truss impingement times can be estimated with some accuracy. More lives and property are saved by quickly extinguishing fire. Proper hose selection and placement enable companies to rapidly locate, confine, and extinguish fire.

Defensive Mode

The defensive attack is an effort of trying to prevent the area around the structure from being damaged. Defensive attacks are performed when it is decided that a building is not savable. Employ a defensive attack when the volume of fire is such that it cannot be managed with the amount of available resources. The objective is to stop fire from spreading to exposures that are savable rather than losing the entire block.

Transitional Modes

One of the most common changes in strategy is from offensive to defensive. When initial operations are developed and implemented, focusing on an offensive interior attack, and that primary strategy fails, units may be redeployed to the exterior temporarily while large caliber streams extinguish the bulk of the fire from the exterior. This may occur for many various reasons (i.e., building construction, heavy fire loading, underestimation of the amount of fire, or a lack of water).

During this change of strategy, the engine officer shall conduct a **tactical withdrawal** of personnel, hose, and equipment to a safe area (determined by the company officer). Usually engine companies evacuate from the top down, assuring all other working crews accompany them in a controlled fashion. Command will typically perform a PAR following this strategic change. The engine officer shall prepare to report to their appropriate supervisor. Engine crews are normally reassigned to staff exterior positions or relocated to protect exposures.

A transition to defensive strategy is not always a permanent transition, with no plans to re-enter the structure or return to offensive activities. There are circumstances on the fireground that may dictate a transition to temporary defensive strategy with the purposes of reengaging an offensive interior attack. An example might be when the fire in the structure is too great to keep interior crews operating. With this change, the IC recognizes the need for a temporary change in strategy. The intent is to withdraw personnel from interior offensive positions only long enough to darken down the majority of fire with large caliber streams from the exterior. Once deemed safe, interior offensive operations are resumed. During the transitional period between offensive and defensive strategies, the engine company officer shall conduct a tactical withdrawal of personnel, hose, and equipment to a safe location (as determined by the company officer). Usually engine companies exit from the top down assuring all other working crews accompany them in a controlled fashion.

Command will typically perform a PAR following this change of strategy. The engine officer shall prepare to report to their appropriate supervisor.

What is important to remember here is that firefighters should always be prepared to reenter a structure after a transition from offensive to defensive strategies, as it is possible the transition is temporary. The transition to defensive strategy provides an excellent opportunity for the officer to review the building from the exterior, noting smoke and fire conditions, ladder placement, and alternative attack points. This information can help in determining whether the transition from offensive to defensive will be permanent or temporary. The officer should also check their crew's air supply and physical condition. Personnel shall remain in a safe area and be prepared to reenter the immediate fire area quickly when ordered. If the crew is unable to reenter immediately upon request, the engine officer should advise the IC as soon as possible.

An **emergency evacuation** occurs when the IC recognizes a serious threat to firefighters and safe operation in a structure is compromised. The incident commander and units operating outside of the IDLH should remain cognizant of the units operating in the IDLH and their reported locations. Maintaining awareness of units evacuating in a top down manner can assist in accountability of units. The goal is to exit rapidly while keeping safety as the priority. Crews should consider exiting via portable ladders when possible. Engine companies outside of the IDLH should continue to staff handlines until all personnel (truck company/rescue squad) have evacuated. They can support the evacuation of personnel and continue to deploy hose streams on visible fire potentially trapping evacuating firefighters.

If crews must travel through the fire floor to exit, they should bring the hoseline. The engine company officer shall keep the crew together, focused on a safe rapid exit while remaining calm. The officer's primary objective shall remain the safety of the crew following the evacuation of the structure. Unless otherwise ordered, ladders, hoselines, and tools shall remain in place and the crew moved to a safe area. The officer shall check the physical and mental condition of each crew member. The officer should be prepared to respond to a PAR. If the hazard is mitigated, the engine crews shall be prepared to reenter the building. If the IC declares an exterior attack, personnel are normally reassigned to protect exposures or staff exterior streams.

Blitz Attack

Another common strategy is the blitz attack, which is commonly used when the initial attack is defensive then transitions to offensive once the fire is knocked down by the exterior streams. With this strategy, the engine crew knocks down the main body of fire from the exterior upon arrival, typically with a large caliber stream, and then progresses to an interior offensive attack using handlines. The engine company officer should assure their crew is ready for an interior attack as soon as the bulk of the fire has been darkened down. This includes having tools and hoselines charged and ready. Personnel should be prepared to go on-air as soon as they receive orders to commence interior operations. The main body of fire may redevelop if engine crews require too much time to transition to an interior attack. The transition from a blitz attack on the exterior of a structure back to an interior offensive attack should be rapid and coordinated.

The blitz attack is a very simple concept: hit the fire with as much water as possible to achieve a knockdown as quickly as possible. A simple rule of thumb to follow is to make it as easy as possible. The easiest method is a fixed master stream, usually the engine's deck gun. The limiting factor is engine placement in relation to the fire. Another method of applying the blitz attack in a timely fashion that can be moved to the desired location is a pre-connected monitor (e.g., Blitzfire, Mercury, R.A.M.) supplied by a single 2½- or 3-inch line, Figure 18. This line works well for exposure protection. It does not have to be staffed and can be easily deployed and placed in service in a short amount of time.

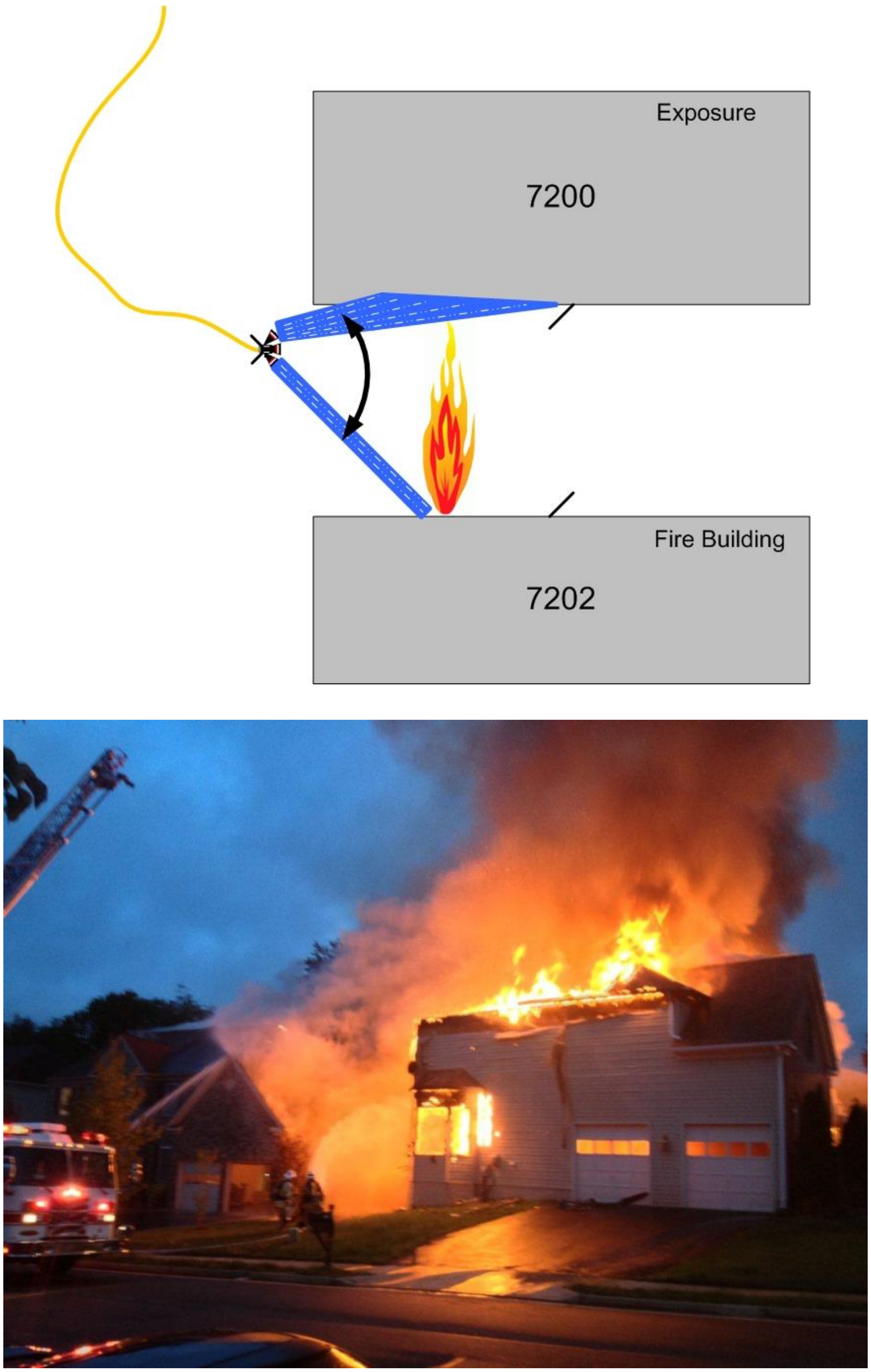

Figure 18: Pre-connected quick attack monitors are beneficial for exposure protection.

The blitz attack is a combined attack method that begins on the exterior of a structure with apparatus mounted master streams, and is completed inside the structure using handlines. The goal of this method is to slow fire progression while completing water supply and positioning handlines for interior operations. When applied correctly, the blitz attack will reduce interior temperatures, prevent fire spread to uninvolved portions of the structure, and provide a more tenable environment for interior crews to operate and possible victims.

The blitz attack should not be applied to all structure fires. Fires that are well developed (pre- or post-flashover stage) are the main focus for this type of attack. Crews should not create openings in a structure in instances where the fire has not caused failure of windows. Fires that have not self-vented are typically in the incipient stage and can be effectively controlled with a traditional interior attack. Consideration to possible trapped victims should also be given. This attack can be used on fires with trapped victims. However, their location should be known to prevent further injury from the master stream and its effects. Some instances may allow communication with trapped occupants and will give crews the ability to have them protect themselves before the attack commences.

A successful blitz attack requires crews to be familiar with their apparatus-mounted master stream device. This type of nozzle is pre-connected and will have the most influence in a successful blitz attack. Smooth bore stack tips are typically carried however, combination nozzles are also common. Knowledge of tip sizes and nozzle flow rates will enable crews to estimate how much time they will have on tank water for the blitz attack. Crews must know the maximum effective reach of their stream, both vertically and horizontally, Figure 19. This knowledge will ensure proper positioning to ensure the fire can be reached with an effective stream. Crews should also practice aiming at targets at various distances and heights to ensure accurate stream application.

This attack must be applied with great attention to detail to avoid wasting water because this attack is commonly initiated before a water supply is established. The engine must be positioned in a manner that will allow reach of the stream into the opening showing fire. Consideration must be given to the angle of the stream so that it is directed effectively to the bulk of the fire or the ceiling above the fire, and not the facade or other obstacle. A crew member must ready the nozzle and attempt to have it aimed at the objective before it is charged. The pump operator must throttle the engine to the appropriate pressure before charging the master stream. Once the master device is fully prepared, the pump operator should charge the device quickly to reduce the amount of wasted water. The crew member operating the device must quickly make any corrections to the stream direction to ensure the water reaches its objective effectively. The stream should only flow long enough to darken down the fire so interior line(s) can be advanced. Attacking with the master stream will only allow for 60 to 90 seconds of water flow without a supply, depending on the nozzle and tank size. It is imperative to establish a water supply quickly at this point and monitor the tank’s water level until a supply is established. Once the fire is knocked down, crews may be able to immediately advance handlines to complete extinguishment. Water supply will dictate if this is allowable. The handlines must move quickly to prevent the fire from rebuilding during the transition time.

Figure 19: Example of blitz attack.

FIRE STREAMS

Stream Management for 1¾-inch Hoselines

The firefighting nozzle is the final tool in the water delivery system that is advanced to the seat of the fire. It can have the greatest impact on the successful outcome of the incident. Therefore, it is vital that it is selected with consideration given to the fire conditions, skill, and competence of the operator, and the capabilities and limitations of the tool. The last of these factors should be based on the understanding of the various types of firefighting nozzles available in the NOVA region. The firefighting nozzle provides the reach, penetration, and controls the flow and shape of the water being delivered to the seat of the fire. Below is listed the various type of nozzles used in the region along with the pros and cons of each type.

Fog Nozzles

The fog nozzle revolutionized the fire service in the post-World War II era by providing a tool capable of providing an adequate stream of water to suppress fire. The idea was centered on the introduction of a broken stream of water that creates millions of water droplets that absorb the heat generated from the fire and cool the atmosphere. In turn, the expansion of water to steam ratio of 1:1,700 at 212 degrees F, and even greater expansion at higher temperatures, would suppress and extinguish the fire. The fog did an excellent job in suppressing fires in a confined, compartmented space but with little life expectancy.

The introduction of the various streams produced by the fog nozzle, specifically the straight stream, lessened the dangerous introduction of such a large amount of steam. A tighter and more compact stream of water could be achieved providing greater reach and penetration. Within the scope of the fog nozzle, the NOVA region has two basic types of fog nozzles:

Fixed-gallonage Fog Nozzle

This nozzle has a preset gallon per minute setting that allows it to flow the set gallonage at any stream setting (fog, straight, etc.) as long as the manufacturer rated nozzle pressure is maintained. They can be low pressure (50-75 PSI) but the standard fog pressure is 100 PSI. The benefit for the fixed gallonage is that an individual department can set the gallon per minute setting they deem necessary for their organization (e.g., 175gpm at 50psi).

Pros
- Limited amount of moving parts
- Lower maintenance cost
- One universal flow amount for ease in hydraulic computations
- Adequate gallonage for firefighting
- Versatility in stream selection from straight stream to wide fog

Cons
- One singular flow amount
- Substantial nozzle reaction

Selectable-gallonage Fog Nozzle

This nozzle has a selectable ring typically located behind the rubber bumper of the tip that allows the operator to change the required flow based upon the conditions. The range of gallon per minute selections will typically span from 90gpm to 200gpm for a 1¾-inch hoseline and can be adjusted by the nozzle firefighter at any time.

Pros
- Various gallonage amounts to select from for the firefight
- Versatility in stream selection from straight stream to wide fog

Cons
- Too many moving parts
- Higher maintenance cost
- Requires radio communication between the nozzle operator and pump operator if the flow is changed
- Substantial nozzle reaction

Smooth Bore Nozzles

The simplest design of all firefighting nozzles, the smooth bore is a tapered piece of material formed to deliver a specific amount of gallons per minute. The exact size of the orifice dictates the amount of gallons per minute that the nozzle will flow. The simple design of the smooth bore limits it to the specific flow but also allows it to deliver a solid and compact stream of water to the seat of the fire.

Pros
- Simplistic design with little to no obstructions between the water and the fire
- A solid, compact stream of water that can penetrate the heat of a working fire and apply water to the seat of the fire
- Less production of steam lessens the instance of injury to firefighters and increasing chances of better visibility
- Less air entrainment with stream to upset the thermal balance within a compartment on fire once fire is knocked
- Less nozzle reaction than fog nozzle
- Lower nozzle pressure equates to greater maneuverability of the hoseline within a structure

Cons
- Limited versatility in stream selection
- Cannot change gallonage without changing tips
- Not effective on flammable liquids fires and other type of fires that require the use of a narrow to wide-angle fog

Attack Methods

Direct Attack

The attack crew advances into the fire area and uses a straight or solid stream. The stream is applied directly onto the burning materials until the fire darkens down. This is the attack method most often used for interior firefighting. Before advancing, a sweep of the floor with the stream will cool embers and other hot material that could cause firefighter injury.

Indirect Attack

The crew attacks the fire from a doorway, window, or other protected area not entering the fire area. A narrow to wide-angle fog stream is directed into the fire room or area. The super-heated atmosphere will turn the water fog into steam. This method of extinguishment absorbs the heat and displaces the oxygen. This method of extinguishment ***must not*** be used in areas where victims may be located or firefighters are operating.

Combination Attack

This method utilizes both the direct and indirect methods at the same time. A narrow fog stream is used in a T-, Z-, or O-shaped pattern. The fog in the higher atmosphere turns to steam and the fog at floor level hits the burning material. As with an indirect attack, this method ***must not*** be used in areas where victims may be located or firefighters are operating.

Penciling

When no fire is evident in the compartment and the heat is increasing to a pre-flashover point with smoke banking down in the compartment the crew must consider changing compartment conditions or face the possibility of being forced to withdraw – this is the ideal time to use penciling. Interior crews must understand that a compartment with heat reaching temperatures of 800 degrees or more at the ceiling level and thick smoke banked down near the floor are pre-flashover conditions that should be recognized and changed if the crew needs to continue operating in that compartment.

Penciling is a maneuver used to move through a compartment where high heat or pre-flashover conditions exist to the point that the crew cannot safely advance their hoseline to extinguish the seat of the fire or initial room of involvement. Penciling will immediately decrease building heat within a compartment by 50% to 60%. This is a temporary decrease that will enable the crew to advance forward. Conditions will dictate how many times the nozzle firefighter needs to pencil in order to advance to the intended location.

To pencil, hold the hoseline and angle the stream at the ceiling. Open and close the nozzle fully with short, one second bursts at the ceiling while moving from one side of the compartment to the other in order to cover the entire width of the compartment.

There is no set number of bursts that should be placed at the ceiling; pencil as necessary to decrease the temperature in the compartment. Upon closing the bale of the nozzle with the last burst while penciling, the crew needs to rapidly advance until they get to the fire compartment or need to stop to pencil again due to heat building back up.

Penciling does not extinguish the fire. When confronted with fire that is exiting the initial compartment and moving towards the engine crew, the crew must stop penciling and initiate a direct attack.

Pushing In

Pushing in occurs as the nozzle team begins their advance to the room of origin and fire is encountered in the compartment leading to the seat of fire. The nozzle should be opened and water should be applied to all six sides of a compartment to include the floor, walls, ceiling, and contents. At no time should a crew advance an unopened nozzle into a room prior to placing water onto the fire; the fire attack must begin with the nozzle flowing water onto the fire compartment while advancing forward. The hoseline needs to sweep the floor to ensure the hose is not pulled across any material that could burn a hole through the hose, rendering it useless for fire attack.

Quick Attack Monitors

Using a quick attack monitor (e.g., Mercury, Blitz Fire, RAM) can assist with fire attack and exposure protection without having personnel in the collapse zone.

In practical testing, the reach is similar at 500 or 1000 GPM. Using a smoothbore nozzle at 80 PSI or a straight stream fog nozzle at 100 PSI yields a reach of approximately 185 feet. When using a medium fog pattern pumped at 100 PSI the reach is approximately 50 feet. On a wide fog pattern, the reach is approximately 25 feet, Figure 20.

Note: Wind will substantially alter the reach of these streams.

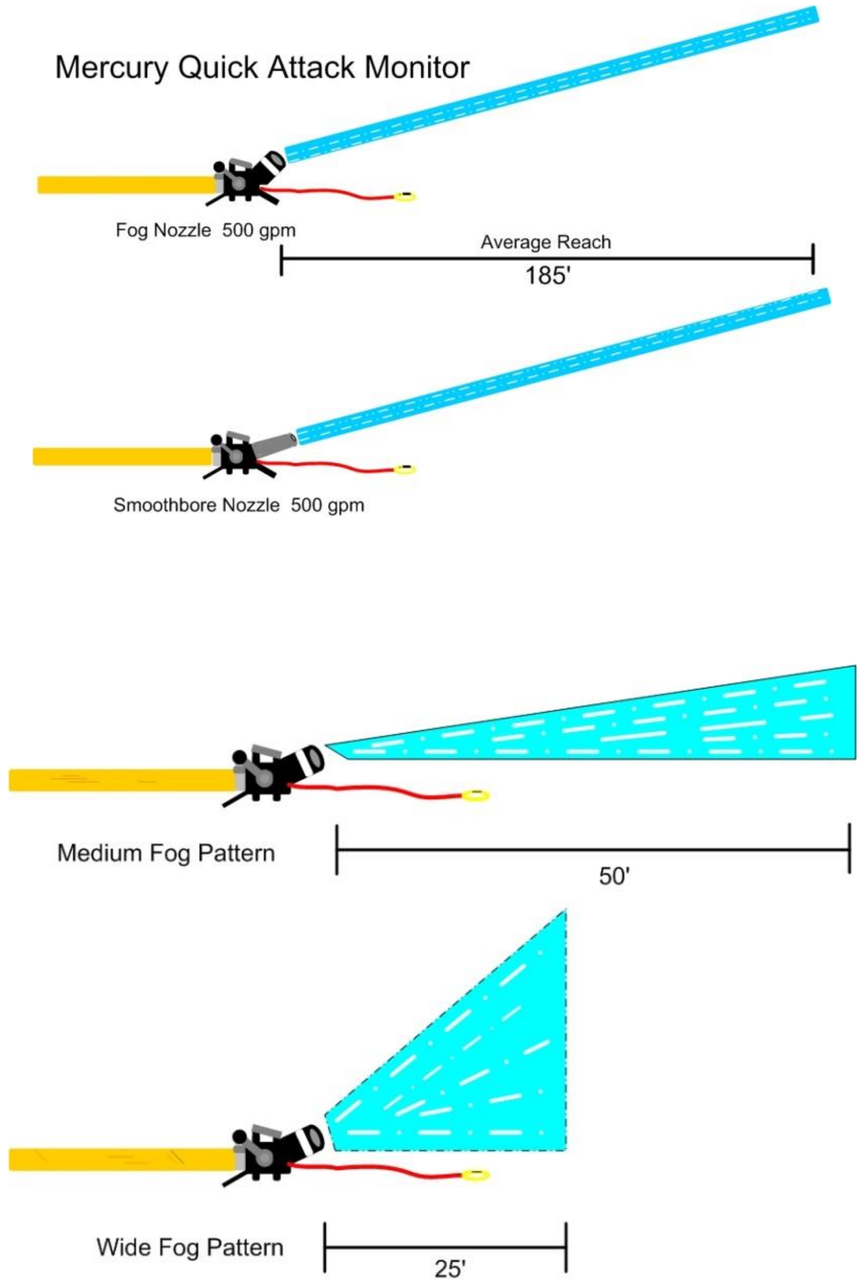

Figure 20: Ground monitor reach depends on the nozzle and pattern used.

Fire Attack Considerations

Where to Attack

Traditionally, it was a common practice to attack from the unburned side. There was a thought that fire was being pushed throughout the building. The UL study *Impact of Ventilation on Fire Behavior in Legacy and Contemporary Residential Construction* has concluded that there were no temperature spikes in any of the rooms, especially the rooms adjacent to the fire room, when water was applied. It appears that in most cases, fire was slowed down by the water application and that water application had no negative impacts to occupant survivability. While the fog stream pushed steam along the flow path, there was no fire pushed.

Searching with a Hoseline

When performing a primary search, firefighters are exposed to ever changing conditions, which can rapidly deteriorate. Hoselines can provide protection for these crews assigned to the primary and secondary searches. With the protection of a hoseline, crews can effectively search under more tenable conditions. While it is ideal to have a hoseline in place for the protection of the crews, one might not be available when needed. This demonstrates the importance that the crew performing the search must remain fully cognizant of their location, fire conditions, and constantly perform a VSP (victim survivability profile).

Second Line

Deciding on hoseline placement is one of the most important tactical decisions companies can make on the fireground when seconds count. The objective of the first hoseline will determine where it is placed. Deciding on whether its purpose is for egress protection, exterior knockdown, or interior extinguishment will determine where this line is placed.

Historically, the second line is often referred to as the backup line. However, changes in tactics due to modern lightweight building construction precipitate the need to call this line the second handline. The second line may be put into service as an interior attack line while the first line is being used to attack fire on the exterior of the structure. The second line can be used for protection of the stairwell while the first line operates in the basement. The second hoseline shall be coordinated with the first hoseline and positioned accordingly. Tactical communication is vital for the effective deployment of the second hoseline.

Crew Communications

Crew communications when members are operating on an incident can be difficult at best. Accepted practice has always been to be within sight, sound, or touch to maintain crew integrity. Background noise from other crews moving throughout the structure, saws operating on the roof, water flowing from hoselines, and apparatus noise from outside the structure can make it extremely difficult for crews to communicate. When officers call out to crew members for their locations and receive a response of “over here” in return, it makes it extremely difficult to maintain crew integrity; generalities in zero-visibility conditions are useless. A firefighter stating they are “near a door or window” can be more effective if the officer and crew took mental pictures while entering the structure and developed a virtual map in their own mind. Having members move toward the officer’s voice or the sound of a tool banging on the floor may also assist a member in locating their officer if they become disoriented. Company communication methods should be determined by the company officer while establishing company operating procedures and individual discipline in reporting back to their officer is paramount in maintaining firefighter safety.

Names

A company officer can keep track of their personnel in smoky conditions by calling out to their crew members. This will also be necessary when conducting a PAR. It must be noted that when calling out members by name, it is best to use the member's last name. It is possible to have crew members with the same first name which would cause confusion.

Touch

Another means of silent communication is when the officer touches or taps the member to point them in the required direction. An example may be tapping a member on the right shoulder would mean conduct a right hand search, a tap on the left shoulder, a left hand search, or tap directly on top of the head could mean to move straight ahead. Again, a method should be developed and practiced by crews prior to employment in an IDLH environment.

Thermal Imager

The thermal imager is a valuable tool in saving the lives of victims in a fire by giving firefighters the opportunity to see the victim even in zero-visibility conditions. The thermal imager is also a very good tool to allow company officers the ability to maintain crew resource management in like conditions. The company officer can observe their crew as they conduct searches and advance hoselines throughout a structure. The officer can position at the top of the stairs or in a doorway as a point of reference for a search to begin and maintain an eye on their crew, while monitoring conditions within the structure. Once the search of an area is complete, firefighters can make their way back to the officer and receive direction on the next task.

Fireground communication while inside an IDLH atmosphere is difficult. Effective communication between an officer and crew is paramount to the safety of the entire engine company. Several methods are available to maintain that communication; however, it is imperative that these communication methods be developed prior to implementation in an IDLH atmosphere. Crew accountability and safety are the ultimate responsibility of the company officer, but it is incumbent upon each member to communicate to maintain accountability and situational awareness.

HOSELINE DEPLOYMENT

Selection and Deployment of Hoselines

Stretching and operating hoselines is, and has always been, the primary function of the engine company. Personnel should remember the success of the initial hoseline will define the success of the incident. More lives are saved by the proper positioning and operation of hoselines than by all other lifesaving measures offered by the fire service.

The majority of structural fires are controlled and extinguished by this initial attack line. In some instances, two engine companies will pair up to place the first line in position. Some stretches may require all available engine companies to stretch the first line. <u>All companies must ensure that the primary hoseline is in place and making progress before deploying any other hoselines.</u>

Estimating the Stretch

There are many factors that lead to effective selection and deployment of hoselines on the fireground. After routine responses to gas leaks or EMS calls and before leaving the scene, companies should discuss the amount of hose that is required in a stretch. A fast and effective method of estimating the stretch is:

Setback + width of building + length of building + ½ length (25') per floor regardless of the floor reported + 1 length at the point of attack

An example of estimating the stretch is shown in Figure 21.

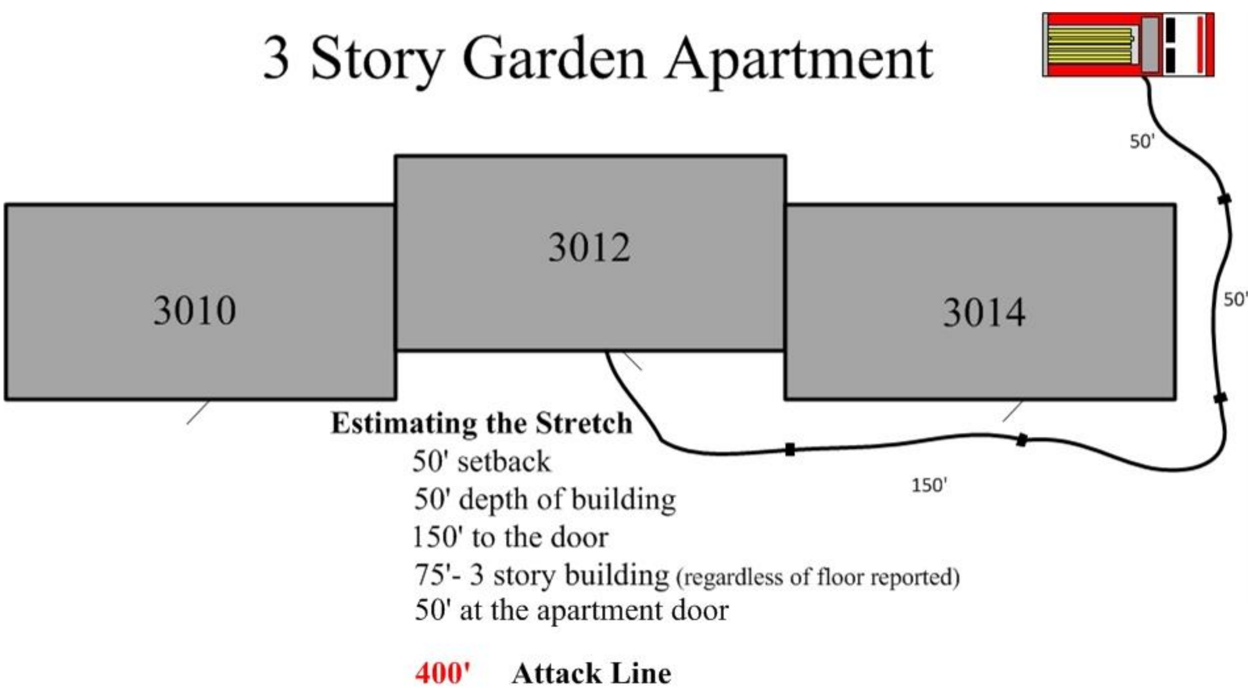

Figure 21: Estimating a hoseline stretch.

Personnel must maintain situational awareness and use certain cues to further assist with estimating the stretch. Some of these cues include:

- Apparatus Positioning – Trucks and tower ladders have positioning preference and will position on the fire side of the building. Engine company personnel should know the length of trucks and tower ladders as they can assist in estimating the distance between the engine company position and the aerial device. For example, a Pierce mid-mount tower is 48' long so estimating one section to cover this length would be accurate.

- Setback – Setback is the distance from the engine company to the entrance of the fire building. Personnel should remain cognizant of the obstacles en route to the fire building, usually the point where the line will catch car tires, bumpers, or the protruding tailpipe. It usually requires a member to remain at this position in order to keep the line free and moving. Additionally, many of the obvious features of the specific area can be of assistance in estimating the distance.

- Parking spaces – A typical parking space in garden apartment and strip shopping center parking lots are spaced approximately 10 feet apart. By quickly observing how many cars or empty space are between the engine company and the fire apartment, personnel can estimate a majority of the stretch. For instance, if you observe 5 empty spots, the setback from the engine company to the fire building is 50'.

- Telephone poles – On residential street, telephone poles are typically spaced approximately 75' apart. This can be helpful when a firefighter dismounts the engine company and can look down the street and count the poles between the engine company and the fire building.

- Location and severity of fire. – The engine company officer must evaluate the exact location of the fire and the path to reach that objective. Additionally, the volume and intensity of the fire is paramount in determining the flow requirement for the fire. A typical residential structure will require 150-175GPM, making the 1¾-inch line sufficient. When an advanced fire is located in strip shopping center is encountered, a 2½-inch line would be adequate given the fire load and large open area. A helpful mnemonic for 2½-inch line selection is ADULTS:

    - **A –** Advanced fire conditions
    - **D –** Defensive operations
    - **U –** Unknown fire location
    - **L –** Large open area
    - **T –** Tons of water
    - **S –** Standpipes

Line selection and placement is the engine officer's responsibility. All personnel should be aware of the proper size, number of lengths, and general positioning of hoselines in various types of construction and occupancies. Ultimately, no line should be completely stretched until the location of the fire is known and confirmed by the officer. The nozzle firefighter must maintain discipline and hold the shoulder load until the entrance is confirmed.

To minimize the number of lengths required and provide for rapid hoseline positioning, consideration must also be given to the use of:

- Well-hole stretch, Figure 22.
- Ground ladder stretch.
- Utility rope hoist via exterior of building.
- Utility rope hoist via interior stairs.

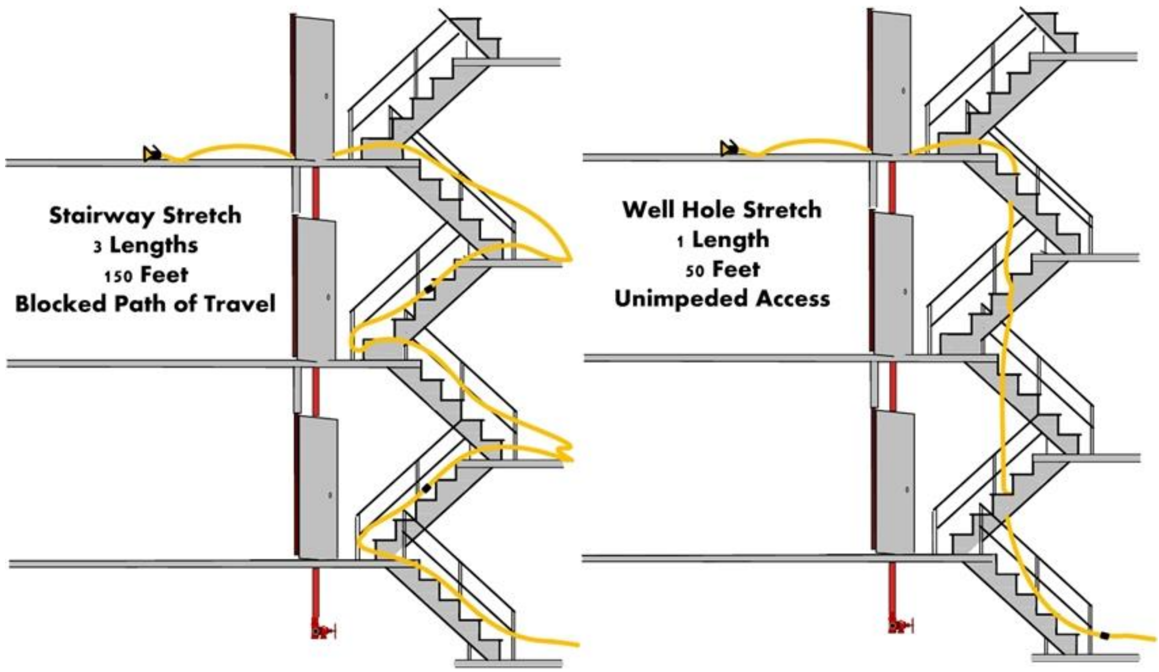

Figure 22: Stairway stretch vs. well-hole stretch

All doors through which dry hoselines are stretched must be chocked in some way to prevent the hose from running under the door. It is preferred to chock doors at a lower portion of the door in case personnel will have to retreat due to advancing fire conditions. By chocking low, the chock can be quickly removed to control the door. If placed high and advanced fire conditions chase personnel, they will have to enter the advanced fire area to remove the door chock.

The nozzle firefighter must not drop folds prematurely. Instead, wait until the line is taut before dropping shoulder loaded hose onto the ground. If possible, the nozzle firefighter should bring two lengths of hose to the fire floor, if the hallways or landing permits. The hose must be properly flaked out before charging. The hoseline must be charged before entering the fire area. Control of the door to the fire area must be maintained to protect people on the fire floor and above.

Members should avoid bunching up at the front of the hoseline. The backup firefighter is usually positioned at the entrance door to the fire area in order to feed additional line to the advancing nozzle team. Kinks are a common occurrence on the fireground and occur if:

- Personnel deploy a hoseline that is too long.

- Personnel fail to deploy the hoseline correctly.
- Personnel charge the hoseline prior to flaking it properly.

Kinks must be chased to ensure that an adequate amount of water and pressure reaches the nozzle.

The alley stretch is a viable option when the nozzle firefighter reaches the point where the attack commences and still has excessive hose on their shoulder, Figure 23. The alley stretch is performed as follows:

- The nozzle firefighter recognizes he/she has reached the front step and will need a charged hoseline to proceed further.
- The nozzle firefighter states, 'alley stretch' to the backup firefighter.
- The nozzle firefighter grasps the nozzle firmly and drops to one knee while maintaining the shoulder load on their shoulder.
- The backup firefighter will walk up to the side of the nozzle firefighter and find the one coupling contained within the shoulder load.
- Once located, the backup firefighter will confirm the nozzle firefighter has grasped the nozzle in their hand.
- The backup firefighter takes the coupling and quickly walks the hoseline in the direction desired for the hoseline to advance into the structure. In most instances, this will be in a straight line from the nozzle firefighter back towards the street but angled to the front of the door as shown in Figure 23.

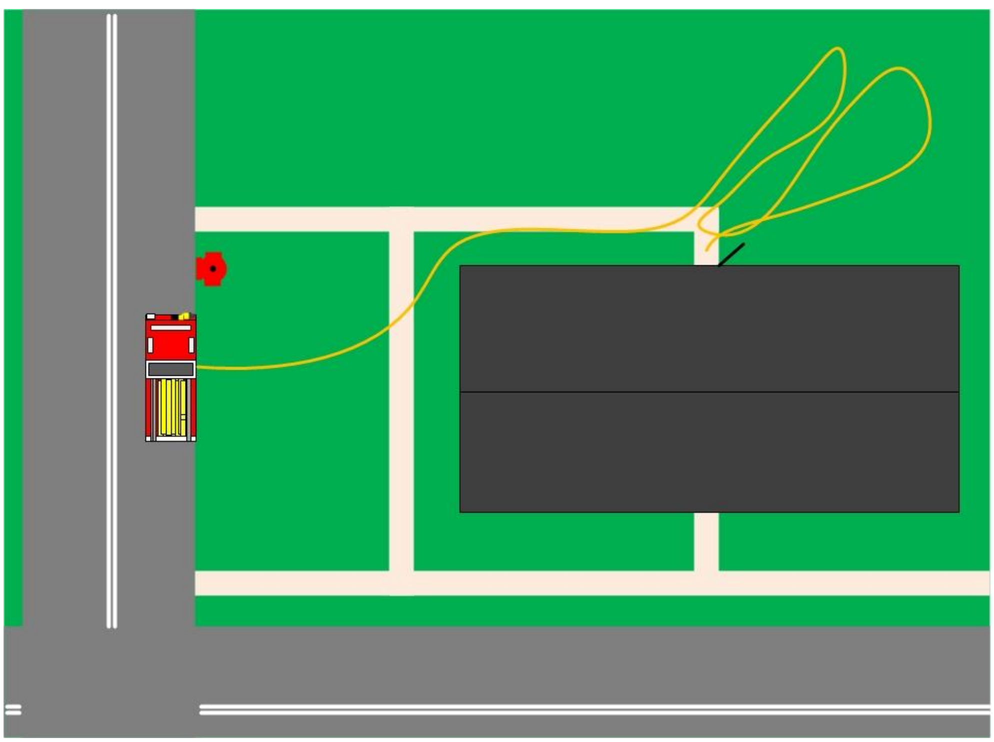

Figure 23: The alley stretch.

ROLES AND RESPONSIBILITIES

The following section will describe the specific roles and responsibilities of each member assigned to the engine company.

Nozzle Firefighter Responsibilities

The nozzle firefighter will be responsible, at a minimum, for the deployment of lines from the apparatus as well as operating the nozzle.

The deployment of lines should be done methodically, yet in an expedient fashion, in order to ensure hoselines are in place quickly, taking a path with the least amount of obstacles from the engine to the front entrance. The initial stretch by the nozzle firefighter must be well-organized to enable the backup firefighter to ensure that the line is not kinked or will be become hindered by obstacles. The backup firefighter should not have to completely reorganize the line.

The nozzle firefighter shall maintain control of the shoulder load until the entrance is confirmed, as the location of the entrance could change upon the officer’s completion of the lap. This will prevent unnecessary confusion should the line need repositioning prior to advancement into the structure. This would also be common practice for advancement into areas while stretching the line dry.

Once the location of entry has been confirmed, the nozzle firefighter shall lay the shoulder load on the ground and begin to don their face piece while the backup firefighter deploys and organizes the remaining hose. The backup firefighter shall then don their face piece.

There should be a reasonable expectation that the nozzle firefighter is competent in the judgment of hand line selection based on the distance of the stretch as well as size and location of the fire.

Backup Firefighter Responsibilities

The backup position is the least glamorous yet one of the most vitally important for successful engine company operations on the fireground. Often the position and associated tasks are assigned to later arriving personnel, least experienced personnel, or at worst, left to chance. Without a clear and definitive set of expectations and tasks for the position, an engine company will not be successful on the fireground. The backup position is the backbone of the operation and often is the linchpin to the successful deployment and movement of a hoseline.

To become a competent and proficient backup firefighter, knowledge of the expected tasks and skills must be known. Additionally, all firefighters must understand that the position of a backup firefighter can range from basic hose handling to fire behavior observation and room control. Fire is a dynamic process that demands attention to detail and a level of proficiency in all personnel. To be proficient at this position, the following tasks and skills should be considered:

Chasing Kinks

Kinks are not an action created by a hoseline; they become an issue when firefighters incorrectly deploy and advance a hoseline. They must be eliminated to ensure accurate fire flow and advancement. The backup firefighter must ensure the entire hoseline is clear of the hose bed. One section of hose charged within the confined hose bed can dramatically limit fire flow. The backup firefighter must also evaluate and isolate immediate kink potential. A nozzle firefighter deploying a handline to the seat of the fire will often be unable to view all hazards as they advance. The backup firefighter must identify and facilitate the rapid deployment. As an example, the tires of a parked car in close proximity of an engine company are often the initial point of a kink during deployment of a hoseline.

The nozzle firefighter often waits for the physical notification of a strong tug on the hoseline to indicate the need to start to deploy their shoulder load. Due to their lack of vision from the shoulder load, they cannot quickly determine if the hoseline is snagged or ready to deploy. The backup firefighter must eliminate kinks quickly but also advise the nozzle firefighter to 'stop' when necessary to ensure proper deployment.

Ensure the Shortest and Quickest Path to the Fire is Executed

The nozzle firefighter has a limited plane of view and may often choose a path to the fire that is not the quickest. As an example, the nozzle firefighter may deploy a hoseline down the sidewalk, turn left up the walkway, and through the front door. This is a subconscious act and may waste hose. The backup firefighter must recognize that the hoseline could be flipped over the line of hedges, a fence, or handrail lining the sidewalk and save hose that may be needed to make the attack on the seat of the fire.

The backup firefighter must also ensure at each point a hoseline comes in contact with a turn or corner that an extra wingspan of hose is pulled. This will prohibit the hose from rubbing against a potential hazard that can cut or scrap the hoseline.

Eliminate Excessive Hose not Needed in the Structure

Due to many factors, engine company members will arrive at the entrance to a structure on fire with an excessive amount of hose still on their shoulder. The shoulder load cannot be deployed within the structure and in zero visibility. To properly stretch the hoseline prior to deployment, the backup firefighter must be able to quickly recognize the issue and mitigate it. A firefighters jogging in a zigzag motion back and forth in the front yard of a burning home is not an efficient manner to deploy a hoseline. This crew should immediately perform an alley stretch.

Determine the Number of Turns to the Seat of the Fire

Depending upon the type of occupancy in which the fire is located, the backup firefighter can quickly estimate the number of turns to the seat of the fire. As an example, most firefighters are quite familiar with the layout of a single family dwelling. EMS calls and fire alarms provide an opportunity to understand and properly preplan the layout of the structure. There are several factors we can use to aid us:

- **The reported room on fire** – If you arrive at a reported kitchen fire in a colonial style single family dwelling, you have an expectation (from prior knowledge, pre-incident planning, etc.) that the fire will be in the rear of the home, in line with the front door, and behind the steps.

- **The occupancy type** – A single family dwelling, a garden apartment, and a strip shopping center all conjure up specific layouts in your mind. This information can give the backup firefighter an approximate layout including turns to the seat of the fire.

Maintain Correct Body Position

Historically, the fire service has taught a body position in search and hoseline advancement where the firefighter was on their hands and knees with their head down. This position promotes staying low in a toxic atmosphere but is not the most advantageous while operating in an IDLH environment. The correct body position is to be in a head up, leading leg out position, Figure 24. This position keeps the firefighters' eyes on the conditions in front of them along with observing the movement of the hoseline and personnel. Additionally, the leading leg in front aids in identifying obstacles and possible holes in the floor.

Figure 24: The correct body position is to be in a head up, leading leg out position. The position on the left is former position taught and is incorrect; the position on the right is the preferred heads-up, low-profile position.

When a pinch point or turn is identified, the backup firefighter must be on the outside of the turn or pinch point. This allows for rapid movement around the obstacle and deployment to the seat of the fire. While maintaining the correct body position, the backup firefighter can also maintain a vigilant watch on the movement of the hoseline and personnel.

Facilitate Path of Attack

If the backup firefighter is operating correctly, their actions may never be acknowledged. But if they perform incorrectly, their inactions will quickly be noticed. This is because the majority of hoseline movement occurs in the position occupied by the backup firefighter. Below are some techniques to aid in successfully facilitating the path of the attack:

- **Maintain a gloved hand on the hoseline.** The feedback received from a gloved hand placed on a charged hoseline can provide valuable information. The backup firefighter can determine if a hoseline is advancing and/or if a hoseline is flowing water. This can give the backup firefighter an indication if the nozzle firefighter is at the seat of the fire or still advancing.

- **Do not push the hoseline arbitrarily.** The nozzle firefighter is in a vulnerable position because he is operating in the most dangerous area and is attached to end of a rigid 200' + hoseline. If the backup firefighter simply pushes the hoseline continually, they could potentially push the nozzle out of the nozzle firefighter's hands or push them into the fire.

When the backup firefighter has established a correct backup position and is moving hose to the nozzle firefighter, he should maintain an 'S' formation in the hoseline. Once the 'S' formation is formed it should be constantly monitored. Once the 'S' formation is pulled straight, it should serve as an indication that the hoseline is moving and another 'S' should be formed. If the 'S' formation does not move and the backup firefighter can feel water flowing through the hoseline, this should be an indication that the hoseline has made it to the seat of the fire and the backup firefighter should advance up the line to the next pinch point.

Observation of Fire Conditions

When the nozzle firefighter and officer make their attack and begin applying water to seat of the fire their visibility goes to zero. Additionally, the physical feedback of the heat changes from solely the area of origin to 360˚ around them, which prohibits them from having an accurate assessment of fire conditions. The backup firefighter is remote from the exact seat of the fire and in the area of the entrainment of air, smoke, and fire. This position allows him to monitor fire conditions and relay pertinent information to the attack crew and possibly the incident commander.

Room Management

Successful hoseline management hinges on the smooth operation of the hoseline to reach the seat of the fire. Many obstacles lay in the way of the advancing hoseline that are permanent, such as walls, doors, and heavy furniture. Non-permanent obstacles, such as too many personnel in the immediate fire area, are prevalent on the fireground and can be mitigated. The backup firefighter can limit the number of personnel in his position by communicating to the next arriving units that are attempting to enter the immediate fire area.

Nozzle Reaction

Once the nozzle firefighter makes the push to the seat of fire, they pull back on the nozzle bale and must overcome the force of the nozzle. Nozzle reaction is the constant force the nozzle firefighter must overcome to properly and effectively place water on the fire. The backup firefighter can greatly assist in this procedure but the force they apply to counter it cannot be arbitrarily applied. When too much pressure is applied, the nozzle firefighter is pushed into the fire area. When too little is applied, the nozzle firefighter will become fatigued and affect the attack. To overcome this obstacle, the nozzle firefighter must know the nozzle reaction of each nozzle they carry on their apparatus. The recognized formula published by National Fire Protection Handbook, 20th Edition[4], for fog and smoothbore are as follows:

Smooth Bore= 1.57 x Bore Diameter squared x Nozzle Pressure

Fog Nozzle= 0.0505 x Rated Flow x √Nozzle Pressure

Armed with this specific information about their engine company, the backup firefighter can provide the correct amount of pressure to be an asset to the nozzle firefighter.

Engine Company Driver Responsibilities

The engine company driver plays an integral role in determining the success and failure of each engine company operation. Although the driver must multitask in order to accomplish specific objectives, the engine company driver's ultimate responsibility is the safe delivery of personnel to-and-from the scene. Additionally, the ability to deliver the correct flow of water to attack lines is paramount.

The engine company driver must be thoroughly familiar with their apparatus, know the function and location of all tools and equipment, and be able to recall all sizes and length of each hoseline. They must know which nozzles and streams are in operation and understand how to combat a burst length of hose.

The collective experience of the driver and officer working and communicating as a team dictates the position. When responding to a reported fire, the engine company driver must position the engine to allow for the most direct access for advancement of attack hoselines to the seat of the fire, while allowing the truck company to position directly in front of the structure, Figure 25. Often times, this means positioning near the front of the structure, but certain circumstances may require the engine to position elsewhere, like the side of the building where fire is visible (i.e., terrace-level walkout entrance on the rear of the structure). When spotting a hydrant, the engine company driver must take into account how the positioning will affect later arriving units, like truck companies. Using the side or rear intake still allows the engine company to quickly establish a water supply, but may prevent roadblocks into tight apartment complexes and pipe stems, inhibiting truck company access.

[4] http://www.nfpa.org/catalog/product.asp?title=2008-Fire-Protection-Handbook&category%5Fname=Fire+Service&pid=FPH2008&target%5Fpid=FPH2008&src%5Fpid=&link%5Ftype=category&icid=&Page=1

Figure 25: Engine companies must position to allow for the most direct access for advancement of attack hoselines to the seat of the fire while affording access to the truck company.

Having a properly maintained and equipped engine company means nothing if the company cannot arrive safely and quickly to the scene, so a strong knowledge of all streets within the first due response area ultimately rests with the driver. Additionally, the engine company driver must master all primary response routes within their respective second, third, and fourth due response areas, as well as gain familiarity with first due apartment complex layouts for difficult hose lays.

The location of the fire and the closest water source will dictate the method of the water supply layout, but the forward lay is often most appropriate. Regardless of the layout, each engine company driver must work together to ensure that the primary and secondary water supplies are established effectively. In order to reduce unnecessary radio traffic, engine company drivers can normally converse face-to-face.

The engine company driver must take into account the size of the engine's booster tank when firefighting operations are commenced when a water supply has yet to be established. When the water level is low, the driver must communicate this finding to the crew inside the IDLH. However, the engine company driver may consider charging a second attack line without a water supply established depending on the situation and the task needed for the second line (i.e., exposure protection, line to the attic space, RIT hoseline, etc.).

In addition to normal driver duties, engine company drivers should be prepared to perform non-traditional engine driver duties like placing portable ladders, advancing hoselines, forcing entry if arriving without a special service unit, and controlling exterior utilities.

Engine Company Officer Responsibilities

The engine company officer should be considered the quarterback for all incidents. Officers who are serious about training and expect a high level of professionalism from the members of their company will see it reflected in their unit's performance at drills, fires, and emergencies. The primary role of the engine officer is to facilitate, coordinate, and implement a plan of action appropriate for the emergency. This responsibility requires the engine officer to quickly and accurately size-up the situation and then communicate the plan to effectively mitigate the emergency. In addition to size-up, the engine company officer must provide a water supply report and give a command statement.

Water Supply Report

The water supply report is given by the first due engine company directly to the second due engine company identifying the primary hydrant used and the method to which supply line will be laid. In general, the closest hydrant to the incident scene is best choice, but certain situations may dictate the need to use an alternate hydrant. The water supply report must include the method of water supply delivery, for example, "I'm taking my own water," and noting a forward, reserve, or split lay, Figure 26 through Figure 28.

An additional water supply report may be given by the third due engine company directly to the fourth due engine company when a secondary water supply is established.

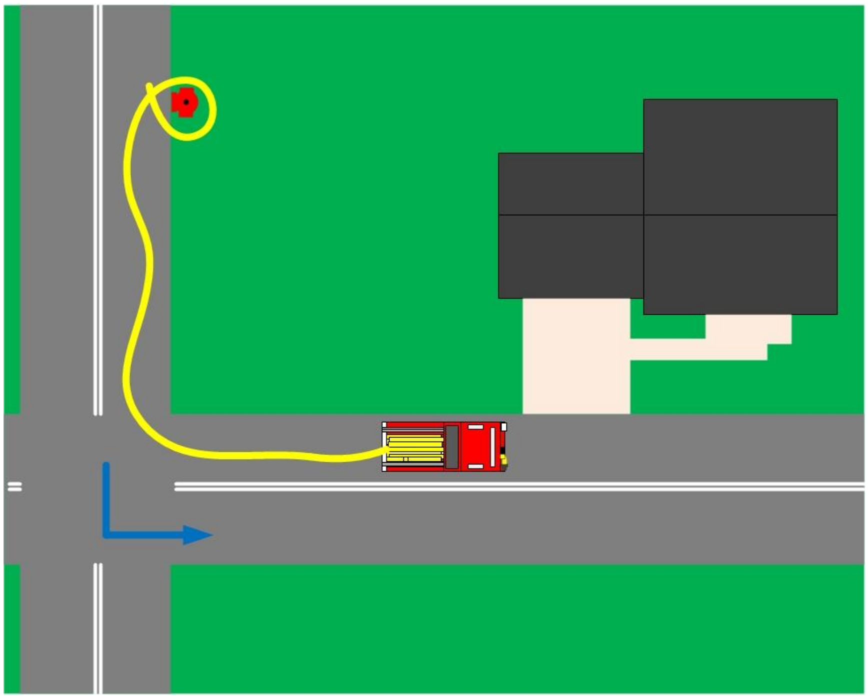

Figure 26: A forward lay is performed by laying supply hose from the hydrant to the scene.

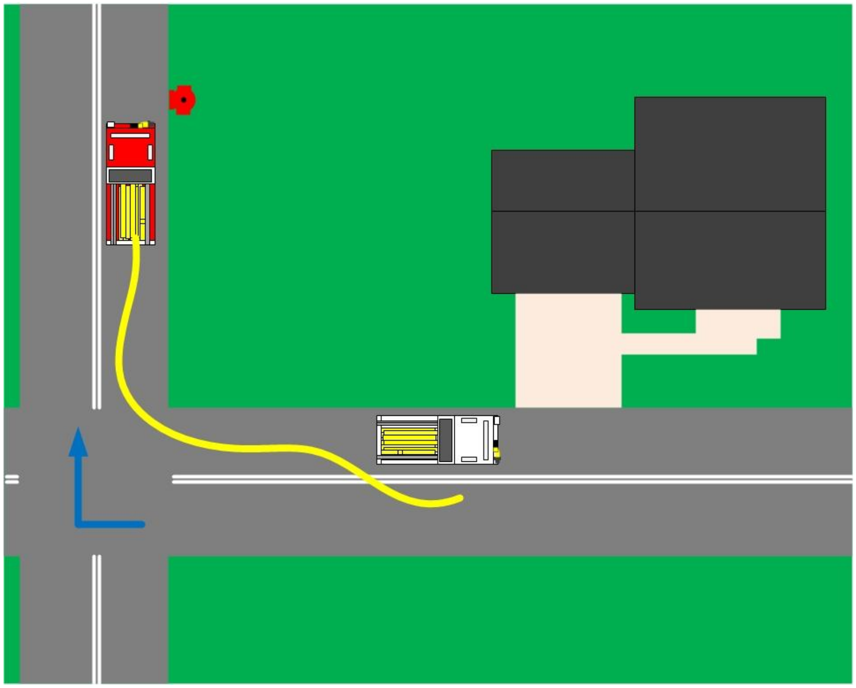

Figure 27: A reverse lay is performed by laying a supply hose from the scene to the hydrant.

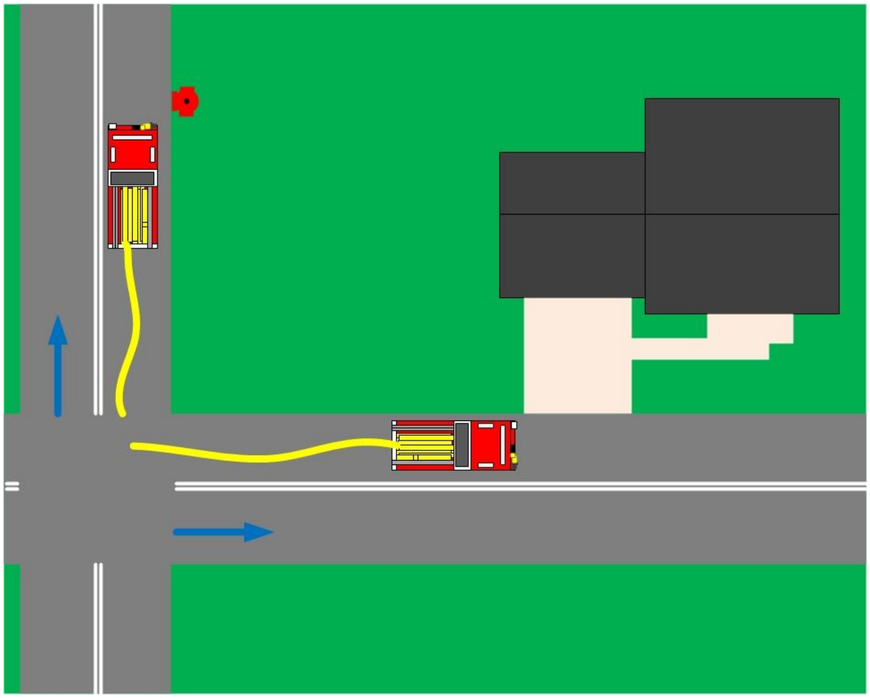

Figure 28: A split lay is used when either the distance from the hydrant to the scene is too great or when the first due engine will not pass the hydrant en route to the scene. Both engines lay supply hose at an identified point. The attack engine proceeds to the scene and the supply engine proceeds to the hydrant.

When performing the split lay, connecting each engine's supply lines together remain the responsibility of the water supply engine. This information must be communicated and ensured before the supply line is charged to prevent injury and property damage.

Command

The first due engine company officer is the interim incident commander by default. The formal action of establishing command can be accomplished at any time; however, regardless of the formality, the first due engine officer has command until assumed by another unit or command officer. After the engine officer has completed size-up and determined what actions must be taken, a command statement must be made. The engine officer has two options:

1. Hold Command: The engine officer may elect to hold command of the incident. This is typically done when the incident takes the shape of a lower priority event such as an investigation of an odor or a "nothing showing" event. This action is only appropriate when 1-2 units are operating. If the operating resources include three or more, the engine officer should not hold command for the entire incident

2. Request to Transfer Command: If the engine officer determines the need to initiate offensive operations they should request to transfer command through the first due responding Battalion Chief. This is typically performed after the completion of the initial size-up and situation report. The engine officer must understand that they remain the incident commander regardless of their work status until relieved by a command officer. This does not mean that the engine officer stays outside at the command post but rather the incident's coordination and communication remains the responsibility of the engine officer until command is transferred.

Initial Assignments/Action Plan

The initial actions of the first engine will typically determine the success or failure of the entire incident. The engine officer should make initial assignments and communicate the action plan based on information gathered during the size-up as well as using the following guidelines to determine tactical priorities:

1. Actions required to facilitate a rescue.
2. Actions required to minimize fire spread.
3. Actions required to extinguish the fire.

While using RECEO VS is appropriate, it must be understood that it is the responsibility of the engine officer to make tactical decisions based on what actions will make the biggest impact on mitigating the incident as safe and fast as possible. For example, the best course of action may be to extinguish the fire in order to make a rescue.

The situation may call for incoming units to take their "normal" assignments as stated in the NOVA operational manuals or the engine officer must make assignments via the radio if it is necessary to deviate from the standard protocols.

In addition to making assignments, the engine officer should communicate with units on-scene and briefly discuss specific actions and intentions. This brief exchange will give everyone on the fireground a clear picture of the situation and increases the operational safety for the crews. This may or may not occur over the radio. For example,

> *"Engine OIC to Rescue OIC- taking line in the front door to first floor Quad C*
> *Rescue OIC to Engine OIC-going to the second floor to perform a search"*

The engine officer should select the appropriate hoseline for the incident based on flow and length. The placement of the line should be based on information gathered during the size-up. The overriding objective is to advance to the seat of the fire as quickly and safely as possible.

If the entrance door to the fire area is found open by the engine officer and entry *is not possible,* it should be closed immediately to prevent the products of combustion from entering the hallway and contaminating the upper floors. This situation also prevents the escape or removal of civilians from the floor above the fire. Door control is **critical** to the safety of all firefighters operating above the fire.

Upon arrival of the nozzle team at the entrance to the IDLH, the officer should assure that each firefighter is properly equipped with all personal protective equipment. After ascertaining that sufficient hose has been stretched and flaked, the officer should call for water via the radio and see that the line is properly bled of trapped air.

Prior to opening the door to the fire area for advancement of the hoseline, the engine officer **must** ensure that unprepared firefighters or civilians will be not exposed in the hallway or on the stairs above as the fire attack is initiated. This can be done via radio or in person. When the door to a fire area or fire apartment is opened, particularly in buildings equipped with thermal pane windows that *have not* self-vented, there exists the possibility that fire will flash outward and upward and seriously expose or burn (anyone) any firefighters operating in unprotected positions above the fire.

Immediately before moving into the fire area with the hoseline, the engine officer should relay to the nozzle team information gathered while the line was being stretched. This information might include phrases such as: "two rooms, left, rear," "straight down the hall, second room on the left," or "holes in the floor, stay to your right hand wall."

The nozzle team *must* begin every interior fire attack through the door to the fire area crouched low, near the floor, *regardless of conditions.* A sudden ceiling collapse, rapid self-venting or a fire driven by wind could create a blowtorch effect at the entrance door and seriously injure any firefighter in its path. After entry is made into the fire area, the engine officer can evaluate conditions and adjust or modify the method of advance used.

Communication during the fire attack may be almost impossible due to the noise created by the stream striking walls, ceilings and furnishings. However, the engine officer must monitor the radio for critical information that may affect the nozzle team. This includes ventilation delays, water supply difficulties, collapse potential, Mayday, and/or urgent transmissions.

The engine company officer can provide the IC with vital information that may affect how the fire operation is handled. Messages such as those listed below should be transmitted to the IC, other units, or individual members on the scene:

Fire Extension

- "We have/don't have a fire in the attic."
- "We have two rooms knocked down, making progress."
- "Main body of fire has been extinguished."
- "Increase/decrease pressure."
- "We need a backup line."

Note the short and concise wording used in these messages.

During the advancement of the hoseline, the engine officer must constantly monitor the nozzle team's progress and the conditions around them. The protection afforded by bunker gear, masks, and hoods tends to insulate firefighters from the hostile fire environment which could cause members to penetrate unknowingly into severe conditions.

As the hoseline is advanced into the fire area, the engine officer should communicate orders and directions to the nozzle team using as few words as possible. As progress is made, the nozzle team can be encouraged with statements such as "you got it," "move in," and "good knockdown." The nozzle team should be advised of their progress and given estimates of how much fire remains to be extinguished.

The engine company officer's position when supervising the nozzle team must remain fluid. When the hoseline is advanced into tight quarters and the nozzle team is forced to make turns and bends, the officer may have to drop back on the line, switch sides or even move ahead of the nozzle momentarily to allow for optimum nozzle positioning. This must be practiced during company-level training.

After the main body of fire has been extinguished, the engine officer should order the nozzle to shut down. This action allows heat and smoke to rise and vent and any remaining fire to light up and indicate those areas requiring follow up extinguishment. At this time the officer can check adjoining rooms or areas for fire extension.

The nozzle team is composed of the nozzle and backup firefighter under the leadership of the officer. While some decision making authority is delegated to the nozzle firefighter, it must be understood that any actions taken are under the strict supervision of the officer in command of the hoseline. The officer must exercise the power of command under fire attack conditions and expect prompt, implicit, and unqualified responses.

The following listed tactics are of such importance to fire control efforts that the decision to implement them is reserved for the engine officer alone.

- Calling for water (charging the line)
- Opening the nozzle
- Initial stream direction (at ceiling, seat of fire, etc.)
- Direction of team advance
- Initiating line advancement

- Stopping line advancement
- Stream shut down
- Use of stream for cooling
- Use of fog for attack
- Use of fog or broken stream for venting
- Amount of water used
- Assignment of engine firefighter for venting or search
- Relief of nozzle team
- Need for relief of the unit
- Necessity to back the hoseline out

Decisions that may be delegated by the engine officer to the nozzle team include:

- Direction of stream
- Rate of advancement
- Opening nozzle in an emergency
- Partial shutdown of nozzle to reduce nozzle reaction and regain control
- Calling for more line
- Sweeping floors with stream

The high level of physical activity required for firefighting is well documented and the debilitating effects on firefighters must be recognized by company officers. The engine company officer should evaluate the members of their unit during and after the fire attack and promptly relieve individual members or request relief for the entire unit.