

Fire Engineering

IMPORTANCE of FIREGROUND VENTILATION PRACTICES and DYNAMICS IN FIREFIGHTING (PART I)

By Lt. Mike Mason

As we have stated previously there are two prominent areas that drive every fire ground and that is fire extinguishment and life rescue. In order for these to be accomplished a third very important component must be under our consideration in our tactics and strategies and that is ventilation. Ventilation provides the means for attaining success with extinguishment and rescue and also provides for the survivability of both our firefighters as well as the civilians we are trying to save. Ventilation practices at structural fires require sound coordination with fire attack and civilian rescues. We have all heard the saying “venting for life” and “venting for fire” both of which are urgent tasks to be addressed at every fire ground, the questions are how we do it, where we do it, when we do it and can we do it.

Because of our ability as firefighters involved in modern day firefighting we are able to penetrate faster and deeper into offensive procedures due to the improvement of fire technologies such as Thermal Imaging, improvements in protective outer turnout gear, efficient GPM nozzles and lighter jacketed hose just to name a few. Engine companies and their members because of this many times proceed with fire attack and are losing the important timing of addressing ventilation to provide for coordinated fire attack. Abandoning these basic elements many times becomes the recipe for disaster resulting in firefighter injuries and deaths as well as the same for our civilian counterparts. Aggressive interior firefighting requires coordinated ventilation to advance even remotely safely to the seat of the fire. Firefighters should be consciously aware of the presence of adequate resources in staffing and equipment to ensure that ventilation will occur before they commit themselves into structural fires. If these resources are not available then the engine company may very well have to address some form of ventilation before they advance on the fire. Many times it is the structure type that can also cause delayed ventilation objectives such as high rise buildings, office structures, multi apartment dwellings and large commercials to name a few.

The other side of coordinated fire attack with ventilation is venting for life. Engine company members are usually committed to advancing the hose line and nozzle to the seat of the fire while other companies are searching on the interior for life or possibly advancing to a specific location of a civilian in need of rescue. Many times ventilation is occurring in attempting to provide victims relief to increase their chances of survival and in other instances the rescuers as well; especially in providing a secondary means of egress the deeper they proceed into a structure. Because of this the firefighters searching and the fire attack team may expose themselves to intensifying the fire. The importance of situational awareness by those searching and those attacking requires diligent coordination of efforts by both in realizing the impact of ventilation within areas and rooms that will effect fire extinguishment, firefighter safety and civilian survivability.

Tactical Ventilation Practices and Considerations

Over the past few years several studies have been conducted pertaining to ventilation practices in structural firefighting as it relates to residential and commercial occupancies. Underwriters Laboratories (UL) has conducted numerous tests both in one and two story residential occupancies of various construction types and their layouts which have proven valuable for the American fire service and their applications in tactical considerations regarding fire development and ventilation. The technical data that they have provided is too large in scope to cover here but should be considered and reviewed by fire departments to better understand and apply their ventilation practices on the fireground. The studies have shown a dramatic change in the residential fire environment entailing larger home construction with more open floor plans along with drastic increases in synthetic fuel loads. This in turn has created a greater more intense fire behavior with an increased unpredictable fire dynamic that many times cannot be calculated by firefighters arriving at structural fires when applying aggressive interior firefighting tactics especially without properly timed and placed ventilation practices.

As we have all learned early in our careers as probationary firefighters the stages of fire development has its relationship to fire behavior. Many times when we arrive at structural fires the fires have not self vented or have limited ventilation occurring which should emphasize the existence of a possible decay period occurring within the interior. This then should spark the thoughts in our minds that any form of ventilation can possibly produce flashovers, back drafts and smoke explosions with the introduction of fresh air. None the less it should also indicate to us the importance of coordinated ventilation in proper locations to allow these fire behavior characteristics to occur before we make committed offensive entries into structural fires. Any aspect of forced entry especially through doors when beginning to advance with a hose line should be considered a ventilation tactic and can produce untenable conditions as the fire is fed fresh air. When we see visually through properly evaluated size-up's that heavy smoke is being contained or seeping out of a structure we should assume that the structure is ventilation limited and that interior conditions are in a decay period with flashover potentials ready to occur.

The importance of first-in companies applying coordinated fire attack, meaning advancement of a hose line along with ventilation cannot be over stated. Introducing air without water or water without air produces larger fires, untenable conditions and decreases the safety and protection of our members which in turn can cause catastrophic conditions. These untenable and catastrophic conditions can occur in seconds. We must pull back or be very cautious in our aggressive offensive procedures when the application of air and water are not coordinated.

When we provide forcible entry through front doors followed by hose line advancements we should before entry have not only control of the door but also to be able to recognize the immediate behavior of the smoke around the door. This means especially the movement of the smoke which seems to rush inward with great velocity. This is a serious indication that the fire is starving for air because the structure has limited ventilation. Charging into this environment without immediate coordinated fire attack is putting advancing crews into harm's way. Creating additional ventilation in another appropriate location ahead of the hose line either vertical or horizontal is what is required to advance on the fire as well as keeping an improved tenable condition for our members on the interior. Improper location of ventilation can also produce an air influx bringing fire into or behind the advancing hose line and its members. In structural firefighting the fire responds in one way or another to any and all ventilation provided. Structures can still be considered to have limited ventilation even when ventilation openings are provided causing fire conditions to spread more rapidly and in some cases still producing pockets of flashover and back draft conditions.

Further considerations and findings as we know is the ability in controlling doors on the exterior and interior between occupants or firefighters which is long known to help increase survivability in approaching fire. Firefighters that may be searching above fires through (VES) vent, enter and search tactics as well as firefighters searching ahead of hose lines know all too well that closing a door can provide enough protection and time to either find a point of egress or allowing for fire extinguishment while they are protected behind a closed door. The impact of flashover conditions is many times determined by whether doors have been left open or closed by occupants when they hurriedly exit a structural fire. Many times windows will fail prior to the fire departments arrival or be left open during warm seasonal temperatures. No matter what may be presented to first arriving companies upon arrival ventilated openings will help feed a fire while also increase its growth. Another important fact in fire behavior is firefighter's abilities through water application to move or push fire from one area of the structure to another. Depending on the choice of the nozzle application being used can influence this reaction. Straight streams seem to provide less thermal disturbances from room to room versus certain fog applications which produce a wider variance of steam throughout the structure.

For both applications straight stream or fog depending on the location and the coordination of ventilation by firefighters or the presence of existing ventilation it is possible that little or actual fire will be pushed throughout the structure. The impact of these tactical considerations is minimally negative versus the benefit of increased occupant survivability with water application.

UL (Underwriters Laboratories) Ventilation Limited Fires

New technology studies through Underwriters Laboratories has provided some new considerations and dimensions in our strategic and tactical approaches to ventilation in both contemporary and legacy residential construction pertaining to fire behavior. Predominately these studies have revealed the true nature of fire showing when we arrive on the scene and our efforts in providing more ventilation to a structure especially in the areas of horizontal ventilation. The revelations are of such magnitude that it is now apparent that increasing horizontal ventilation openings even beginning with the first additional opening of the front door as firefighters prepare to advance the first line actually creates more untenable fire conditions in our efforts to advance to the seat of the fire. Many department practices emphasize the incorporation of ventilation for not only the release of fire gases and heat but also for the purpose in helping locate the fire. The bottom line here through these studies is that fire companies should not be prohibited from opening up the structure but should rather consider the new consequences of creating multiple and random ventilation openings especially when the true area of the fires location is not known.

The utilization of horizontal ventilation openings even beginning with the front door provided for the fires response from the additional air in creating faster fire growths while the structure can still be considered ventilation limited. It also allows for fire within a structure to maintain higher temperatures versus the structure being more closed. What this is emphasizing to the American fire service is being prepared in establishing coordinated fire attack with ventilation while also making us understand that any existing or additional ventilation is providing air to the fire allowing it to sustain and grow. The considerations of fire companies and their officers should be in their attempts to locate fire while getting to the seat of the fire is the ventilation tactics that are initiated at the fire. Considerations should be given to how many windows or how many doors should be opened before our attempts in locating the fire. The importance of sizing-up a fires location and providing ventilation to help maintain tenable conditions can be problematic if firefighters aren't paying attention to several factors such as building construction and layout. This along with experience improves our decision making process.

Indications that help in locating fire begin with the dispatching of the alarm believe it or not. The initial alarm information can help with the areas within your community you are responding to along with construction features of homes within the fire area. Additional information can also reveal what side of the street the structure is on and its relationship to which side of the street hydrants may be located and in what part of the block or street they may be on. Also provided many times through the dispatched alarm from the occupants calling in is the location of the fire within the home. This enables firefighters upon arrival when little visible fire is showing to have a sound idea on not only the fire area but also the coordinated advance and ventilation methods they will use. Another words this may help us in our limiting the need for too many additional ventilation openings as well as wrong area ventilation openings that will accelerate fire and increase higher temperatures exposing our interior firefighters whether advancing hose lines or searching to increasing untenable conditions.

It should always be remembered that fire gets a head start on our response and affects everything we do from the first decisions being made to the last decision; this along with the constant threat of bad things happening. The initial ventilation point for any given structure fire is visible fire showing from a given window or door or the ventilation opening created by firefighters such as the front door creating hotter and faster fire progression throughout the structure. Fires in residential structures are more easily located then fires in larger or more complex structures due to compartmentalization features. The most unrecognized fire location with arriving companies in the fire service is the basement fire. Many times heavy thick smoke with no visible flame on the first floor of residential fires could be an indication of a fire below. This along with unrevealing basement windows with thick smoke because of a large starved oxygen deprived fire which obscures the visibility of flame to firefighter's unknowingly on arrival and during improper size-ups. Basement fires create tell tale signs of their presence especially when their only form of growing and getting air is through the natural ventilation travels up stairwells and up through chimneys in many structures. Any smoke especially emitting from a chimney in warm weather is a probable indication that fire is present in the basement or below grade area. The confirmed tactic is to always check for the presence of a basement fire before committing firefighters to working above one. Ventilating basement windows with the presence of recognized fire is many times the key element in progressing through the structure for extinguishment and searches. Avoid ventilating basement windows when fire is discovered when firefighters are operating on the interior. This could result in disastrous effects to those operating on the interior. It is better to spend few extra seconds on the 360 degree size-up which will aide for better strategic and tactical decisions in confining and extinguishing fire while increasing the safety of firefighters.

In larger residential structures and multiple dwellings it will require many times for firefighters to proceed to the interior because of little visibility of a limited ventilated fire while trying to ascertain the true fires location within a given area or apartment. The presence of limited horizontal ventilation from the exterior may be the key to maintaining tenable conditions within an apartment or floor. Multi-dwelling fires need to be located and defined as to the areas of involvement. Smoke emitting from around a particular apartment door along with exterior company members possibly seeing flames horizontally ventilating from the rear defines the fires location. It also provides for proper tactics and assignments to the floor above for this are the next area of life hazards and fire exposure.

Another important strategic assignment is getting firefighters to the roofs of these structures. It cannot be overstated the importance of this strategy. Firefighters assigned to the roofs of these structure types provide valuable information to all on the fire ground. They check a buildings condition from above on all sides relaying info on visible flame, emanating smoke conditions from soil stacks, skylights, vent stacks, scuttle hatches, bulk head doors as well as roof conditions and cockloft involvement. Firefighters assigned to the roofs of multi-dwelling buildings can also help locate victims and lives that need to be saved by gaining access to them through bulk head doors and their interior stairs. With this tactic though comes along the increase of available air that may increase the fires growth and rate of heat rise. Remember that these roof entryways may also trap firefighters into untenable conditions if they are not secured to open providing a means of egress.

Tactical Ventilation Perspectives

- **Fire Behavioral Stage of A Structure**
- **Entry Ways To Be Forced Or Already Open**
- **Evaluating Smoke Conditions and Limited Ventilation Openings**
- **Establishing Coordinated Fire Attack With Untenable Conditions and Ventilation**
- **Visualizing The Importance Of Smoke and Rapid Air Movements**
- **Establishing Fire Control and Ventilation Through Open and Closed Doors/Windows By Both Fire Attack and Search Companies**
- **Consequences of Decision Making Ventilation Points and Fire Flow Through The Structure**
- **Number of Ventilation Openings Affecting Speed and Growth of Fire Conditions**
- **Occupant Survivability Profile In Opening and Closing Doors and Windows**
- **Ventilation Conditions and Potential Flashover Conditions**
- **Stream Applications Affecting Fire Spread and Occupant Survivability**

Regardless of the types of structures that we have discussed ventilation limited fires need to be understood and the use of predominantly horizontal ventilation may not always be the best choice in helping to locate fire. On the other hand we should also provide sound tactical considerations in our vertical ventilation strategies for they too many times can increase a fires dynamic but with less ventilation limited consequences. No matter what ventilation considerations whether either horizontal or vertical it is necessary once a fire is located and an interior advance are being made on the fire. The importance in validating your strategies regarding ventilation is recognizing fires behavioral characteristics at any given fire and your knowledge and experience in helping the decision process.