GENERAL STRUCTURAL FIRE OPERATIONS

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The Western Reserve Joint Fire District has residential, educational, institutional, and commercial occupancies within its jurisdiction. The National Fire Protection Association recognizes over 35 different types of property classes which involve different occupancies or uses. Specific NFPA listed property classes found within the Fire District include library and museum collections, assembly occupancies, educational occupancies, health care facilities, board and care facilities, apartment buildings, lodging or rooming houses, business occupancies, industrial occupancies, storage occupancies, mining methods and equipment, telecommunication equipment facilities, rail transportation systems, and motor vehicles. Each type of facility requires different suppression methods. No two fires, even in the same type of occupancy, will ever be fought alike. For that reason, the following "procedures" should be used as guidelines only, recognizing that the Incident Commander will have to adopt the general guidelines to each emergency situation. Nonetheless, each Fire District member should be familiar with the general guidelines and principles which follow:

A. RESPONSE

In the event of a structural fire call, the department shall respond with the specified apparatus set forth in these SOGs. All apparatus should be operated in conformity with the standards relating to emergency vehicle operations.

B. SIZE-UP AND INITIATION OF IC

"Size-up" can be described as an estimate of the situation, made by the firefighter or officer in charge of an emergency, through which one determines what to do and how to do it. Size-up information provided to incoming companies helps them to better understand the conditions that exist or are likely to develop, and allows appropriate consideration to be given to actions that may be required of them. Size-up is a continuous process during the entire duration of emergency. It involves an almost constant gathering and evaluation of information during the incident so that the status of the situation can be periodically evaluated.

With respect to structural fires, a size-up must be performed. Immediately after a size-up, the incident command system should be implemented in accordance with these Standard Operating Procedures.

C. APPARATUS/VEHICLE PLACEMENT

Apparatus placement is an important consideration for all responding drivers. It is unlikely that once an apparatus is parked at a scene that it will later be moved without difficulty. Generally, the following procedure shall be used for placement of apparatus at all structural fire scenes:

The fire due-in engine shall pass the structure, so that the firefighter or officer in charge shall be able to make his size-up having seen three exposures (sides A, B and D) of the structure. Space should be made available immediately in front of the structure for the placement of an aerial device. The first

due-in squad may be placed behind the engine and ladder. If room permits, the rescue should situate in the driveway of the structure or an adjoining home. The next due-in engine should wait by the nearest hydrant, until instructed to lay a supply line or have its manpower proceed to the scene. In a commercial or other large structure, additional apparatus should proceed to the rear (and/or sides) of the structure. If necessary, additional apparatus should be prepared to standby secondary hydrants to provide additional water supply to the scene.

Where the structure in question is located on a residential or other narrow street, all fire department apparatus shall be placed on the side of the street closest to the fire. This will permit free movement of additional vehicles coming in to, or leaving from, the scene.

Firefighters who drive personal vehicles to the scene should park their vehicles in private driveways or a sufficient distance from the scene so as to not impede the flow of vehicles to, or the placement of apparatus at, the scene.

D. WATER SUPPLY

Water will continue to be the primary extinguishing agent for the vast majority of structural fires that will be fought, at least for the foreseeable future. Obviously, having the sufficient quantity of this agent available is a very high priority for all firefighters, from the incident commander down the ranks to the apparatus operator or the members performing search above the fire.

Proper water supply means ensuring that the proper volume of water is available for firefighting. To know the volume of water available to fight a fire, hydrants must be flow tested.

Where the available flow or pressure is not known, caution must be taken to avoid permitting the pressure to drop below 20 PSI residual pressure. If the discharge flow is not sufficient to produce the GPM to extinguish the fire, an additional supply with another source must be found. To minimize restrictions and flow, the largest available diameter hose should be used for a supply line. Where the flow capacity of an engine is 1000 GPM or less, a four inch hose line should be used. Where the pumpers flow capability is 1250 to 1500 GPM, one five inch supply line or two four inch supply lines should be used. The most efficient method of delivery is positive pumping where the pumper is located on the hydrant. All supply pumpers should be pumping in the "volume" mode.

E. FIRE SUPPRESSION (Also see separate Engine Company S.O.P.)

With each type of structural fire, three possible strategies exist:

- an offensive attack;
- a defensive attack; or,
- no attack at all.

Each type of action is generally dictated by factors beyond the department's control - the size of the fire, the threat to exposures, or the possibility of loss of life if firefighters are committed to the operation. A defensive operation assumes efficient resources are available to perform the needed

tasks and that the threat to exposures is minimal. An offensive operation is interior, for the most part, although in larger fires, exterior streams could be used for attack. Defensive operations are generally exterior with the highest priority being placed on protecting exposures. Defensive tactics should not be utilized in an occupied building. Usually defensive operations are dictated by a massive body of fire which is beyond the ability of the units present to control. In this case, when a company cannot reasonably expect to gain control and extinguish the fire before it spreads, they must instead position themselves to prevent the spread. This may often be only a temporary measure until additional units arrive. For this reason, units should select positions where they can accomplish exposure protection and alternatively hit the fire, if possible, being prepared to shift to an offensive attack when the needed additional resources are in place.

1. Offensive (Interior) Attack

When human life is at stake, an offensive (interior) attack is mandatory.

The decision to change from an offensive to a defensive mode as operations progress should be made using the same logic – "are there any more people inside who can be saved?" As long as the answer to that question is yes, all needed resources must remain committed to the task of life saving, even though in the time it takes to complete rescue and removal the fire may extend greatly.

Begin suppression as soon as possible. This guideline has a variety of possible inferences, but it should be the cornerstone of engine company philosophy. The sooner water application has begun, the sooner things will get better. While actual extinguishment efforts may have to be delayed by the need to perform rescue, or to protect exposures, the engine company must always be alert to take the earliest moment possible to put the fire out. It makes every other fire ground task go much faster and smoother. Search, rescue, removal, overhaul, and salvage are better performed when the heart of the problem is extinguished.

The engine company should get the first hose line in operation to cover the worst case before getting involved with additional lines. The first in engine company must place the first line between the fire and the occupants as soon as possible or, if the structure is unoccupied, in a position to confine the fire. All available personnel must be committed to this task if required.

At least four members shall be assembled before initiating interior fire fighting operations at a working structural fire. An exception may exist if, upon arrival at the scene, members find an imminent life threatening situation where immediate action may prevent the loss of life or serious injury. In such case, interior operations may be permitted with less than four persons on the scene. If members are going to initiate actions that would involve the entering of a structure because of imminent life threatening situation where immediate action may prevent the loss of life or serious injury, and four members are not yet on the scene, the members should carefully evaluate the level of risk that they would be exposed to by taking such actions. If it is determined that the situation warrants such action, incoming companies should be notified so that they will be prepared to provide necessary support and backup upon their arrival.

Such action is intended to apply only to those rare and extraordinary circumstances when, in the members' professional judgment, a specific incident requires immediate action to prevent the loss of life or serious injury, and four persons have not yet arrived on the fire ground. Assembling the four members for the initial fire attack can be accomplished in many ways. This may include the arrival of four persons by apparatus, or in personal vehicles. However, all persons operating within the interior of a working structural fire shall use self contained breathing apparatus when entering the hazardous area.

Members who arrive on the scene at a working structure fire prior to the assembling of four persons may initiate exterior actions and preparation for an interior attack. These may include, but are not limited to, actions such as the establishment of a water supply, the shutting off of the utilities, the placement of ladders, the laying of attack line to the entrance of a structure, or exposure protection.

Once firefighters begin making an offensive attack, the attack should be constantly moving forward. As the hose line become stationary, the fire continues assaulting the building, undermining its ability to stand up, and pumping life threatening produces of combustion right past the nozzle team to all the areas of the structure. If a team stands still for too long, the fire will out-flank them, spreading through all kinds of hidden voids until the firefighters are forced to withdraw. The entry company must recognize this situation and take steps to alleviate it.

There should only be two things preventing a hose line's advance - heat and flame. The solution to the problem depends on the root cause. If what is causing the inability to advance the hose line is heat, with no obvious visible body of fire, ventilation must be performed, preferably opposite of the advancing hose line. On the other hand, if flame is impeding the hose line's advance, insufficient water is probably being used for extinguishment. An increase in flow may be the answer.

If an increase in water supply or ventilation is not effective in gaining on the fire, a change in tactics will have to be made. Otherwise, the building will eventually be lost.

a. Attack Line Selection

The key to successful hose line selection is to look at the situation briefly before any hose is taken off of the apparatus. Make sure that the line stretched is appropriate for the task and not just stretched as an unthinking, "knee jerk" reaction.

Regardless of the method of attack chosen or the type of stream employed (solid or fog), there are two factors of nature to determine whether the effort will be successful in extinguishing the fire. The first requirement is that the amount of water discharged be of sufficient volume to remove the heat being generated. The second requires that the water actually reach the heart of the fire and not be carried away by convection currents or turned to steam before it reaches the seat of the fire. These two factors combine to determine what size hose line will be required.

The first consideration, required volume, is relatively simple. Firefighters must supply enough water to absorb all the heat being given off or the fire will continue to extend. For fires in small spaces

with light fire loading, a smaller line may be used. But if the fire is in a larger area, or involves materials that have a high rate of heat release, a larger line is required.

Generally, one and three quarter inch hose will suffice for initial attack in residential occupancies. Certain occupancies, such as commercial and industrial occupancies, dictate the stretching of a two and half inch hose line, whenever any sizable body of fire is present. Straight tip nozzles are preferred over toggle combination nozzles.

b. Placement of Hose Lines

In deciding where to position the hose line, remember the priorities: Protect human life, confine the fire, and then extinguish it. This usually involves placing a hose line between the fire and the victims. That is, in fact, the highest priority for hose line positioning. Keep in mind that in unusual circumstances a separate line may be required to protect each individual rescue. This should not, however, delay the stretching of a hose line to the seat of the fire.

In any multi-level building (including a residential structure), barring the need to place hose lines to protect a specific life hazard, the next priority must be to position a hose line to protect the interior staircase.

In an above grade fire, it is acceptable to stretch a dry line into a building carried up just beneath the fire floor, as long as the fire is above the attack team. When a fire is below grade, such as in a basement, and even a light to moderate fire condition is present, the hose line must be charged before starting down the stairs.

For fires in one-story buildings or outside fires of significant proportions, the hose line should be placed to cut the fire off, not to chase it. Generally, this involves attacking from the unburned side.

There is an exception to positioning a line to attack from the unburned side: When a fire involves means of egress from the building. When a fire begins in a lobby or stairway, no time should be lost in stretching through from a remote area. It is of utmost importance in this case to get water on the blaze as soon as possible to keep the primary escape route open.

An additional exception occurs in the case of a vacant or abandoned building. In this case, if it is less punishing on firefighters and the fire will not be seriously extended by doing so, attack from whichever location will involve the least danger and discomfort. If some extra fire and water damage occurs within this type of structure, that is preferable to injury or even discomfort to a firefighter.

A final guide for engine company firefighters: “When in doubt, lay it out”. In other words, if a firefighter suspects that a hose line will be required at a location, go ahead and call for it.

2. Exterior or Defensive Attack

When the first company arrives, a decision must be made about whether to commit to interior operations or to act as an exposure protection line. In making such a decision, several items must be considered. If the fire is already so large that the initial attack lines are unlikely to darken it down before it extends, the first line should be placed in the defensive position to protect exposures. The line should be of sufficient length and capacity so that when additional help arrives, they will be able to being offensive operations.

If an interior attack is made, and the fire has not been darkened down within 20 minutes of hose line operations, something may be wrong. If the tactics of increasing ventilation or GPM flow, or both, have not succeeded, the full involvement of a structure must be the next anticipated result, for if the engine companies have not succeeded in at least reducing the intensity of the blaze in this time frame, structural elements exposed to the blaze will begin to fail. These partial collapses will be the danger signal that all interior forces must be withdrawn to safe locations outside of the building.

When the incident commander recognizes that he or she may be forced to withdraw from the offensive interior attack, the IC shall immediately begin preparing his defensive positions. This may require calling additional resources, even though pumping capacity and apparatus at the scene are not overtaxed. Sufficient personnel must be available to get the outside streams into position and charged, allowing an orderly withdrawal of interior lines. Particularly where exposures might be threatened, it is not sufficient to wait for a company to come out of a building and then have them go off to stretch a defensive line. By the time the line is positioned and in operation, the fire may have extended to exposures.

Exposure protection is best accomplished by bathing the exposed surface with a coating of water. Avoid the use of high velocity straight streams at close range. This will prevent breaking windows, something that greatly aids fire spread. Use a fog stream, or use a reach of a straight stream to keep the members further back out of the danger area.

When forced into a defensive mode, consider the possible effects of the total involvement of the structure. When interior attack is neither possible nor practicable, fire traveling in void spaces has the advantage over fire forces. It can break out in areas quite remote from the original fire area, possibly out flanking the fire forces. If fire manages to reach several areas nearby simultaneously, it is possible for the entire structure to become fully involved. Once the department is forced to accept a defensive mode, additional resources should be called for. These resources should be of sufficient type and quantity to prepare for the worst case scenario. Recognize the fact that radiant heat can cause extension to exposures even across wide avenues. A master stream from a lower ladder can cover a frontage of about 100 feet in length, if it can operate in front of the building. Ground, pump or mounted master streams may also need to be used, but have even less flexibility under extreme circumstances than aerial ladders. But, due to their added reach and penetration, ground, pump or mounted master streams are far superior to hand lines in similar situations.

Ground crews must be notified and evacuated from areas from which aerial ladders will be operating with master streams. Exterior streams, whether hand lines, master streams or aerial streams, must

not be operated into an area where interior crews are operating. This procedure is intended to prevent injuries to personnel due to the effect of driving fire and/or heat back onto interior attack crews.

When member are operating from aerial devices, they shall be secured to the aerial device by an approved safety harness.

A master stream should not be played through a hole in the roof in order to stop the fire. This will never stop the fire, but will instead merely drive flame, heat and smoke back under the roof where it spreads out. A far more successful approach, where available, is to get a stream up under the roof from below.

3. Sprinkler Operations

A properly designed automatic sprinkler system is a firefighter=s best ally, if it is properly used. It is not a means of eliminating manual fire fighting. On the other hand, the presence of an operating sprinkler system should not be blamed for hindering firefighters to the point of abandoning the building. When properly maintained, automatic sprinklers are proven to be the most effective means of protecting life and property.

When a building is equipped with a sprinkler system, one of the first arriving engine companies will be assigned the duty of supplying the sprinkler siamese or 4" Storz connection. When planning to supply connections, the engineer should supply the system early, before residual pressures in the main start to drop; and, supply the system with multiple lines of the largest size hose possible, as a minimum of two lines of 2-1/2 hose should be used.

If possible, the engineer should establish a separate water supply to reinforce the sprinklers. If the fire requires a supply of more than one hand line for mop up, a separate pumper will be used to supply the hand lines. Another pumper should feed the sprinklers, preferably with large hose, using a hydrant on a main separate from the ones supplying the hand lines or master streams. The pumper should keep the lines to the siamese as short as possible, and operate in volume, discharging at 150 PSI.

Sprinklers create a draft pattern similar to fog pushing the smoke and gases down to the floor. Increased carbon monoxide production, sinking fire gases, and smoke pushed down remove the fresh air layer often seen at sprinklered fires mandate the use of masks, even though the heat intensity is lessened. Mechanical ventilation will be required to move this "cold smoke", especially in below grade fires.

In buildings equipped with partial sprinkler systems, the sprinkler systems cannot be relied upon to extinguish fire in a room where there is no sprinkler head. A member should be sent immediately to locate the shutoff and standby for orders to shut it down. Once it has been determined that the fire will not extend, the system will be shut down and a firefighter will be left at the valve to await further orders. It may be necessary to reopen the valve if conditions drastically change.

Generally, only after the fire is definitely under control should the sprinkler system be shut down, drained, and restored to service by an approved technician.

4. Stand Pipe System Operations

Stand pipe systems are sometimes confused with sprinkler systems. The stand pipe system is a very passive device, and in some cases is no more than a vertical pipe requiring fire department pumpers even to supply water.

If a stand pipe is present, it is useful to know whether the water source can supply fire department lines, and if not, how the fire department can supply the needed water. When attacking a fire in a building with a stand pipe, the IC must consider the location of the fire to determine whether the stand pipe will be used at all. Just because a fire is located in a stand pipe equipped building does not mean that the first hose line should be stretched from the stand pipe.

Generally, the stand pipe is used where the fire is located above the second floor. Before stretching hose from a stand pipe, the location of the fire must be verified to ensure that a sufficient length of hose is available to stretch from the stand pipe to the seat of the fire. This can sometimes be accomplished by dropping to the floor below the fire to get the layout before entering the smoke filled room. This survey may be carried out by the officer of an attack team, while the other attack line members are assembling the necessary equipment.

In addition to having enough hose, selecting the closest stairway/stand pipe is important for other reasons. Remember that once a hose line is advanced through a stairway door, that door is blocked open, turning that stairway into a chimney. It is usually better to use staircases remote from the fire rather than one right near the blaze to bring civilians down.

The hose line should be connected to a stand pipe outlet on the floor below the fire. This places all the spare hose down low, out of danger of being burned. Spare hose should always be flaked out on the floor below if any indication of a serious fire is present.

A pump operator should remain with each apparatus supplying a stand pipe or sprinkler siamese. A good starting discharge pressure for stand pipe system operations is 100 PSI plus 5 PSI for each story above grade. If the hose line is to be equipped for the fog nozzle, this pressure should be increased to 150 PSI plus 5 PSI for each floor above grade. This will provide a suitable nozzle pressure with allowance for friction loss through three lengths of 2-1/2 inch hose, the stand pipe and three inch supply hose from the pumper to the siamese. The use of smaller diameter (1-1/2, 1-3/4, or 2 inch) hose may require an increase in this starting figure, since it usually has higher friction losses than does 2-1/2 inch hose for their "design" flows, i.e., 1-3/4 inch hose at 180 GPM equals 40 PSI per 100 feet friction loss; 2-1/2 inch hose at 250 GPM equals 15 PSI for 100 feet.

While Fire District members may discount the need to understand stand pipe and sprinkler operations due to the minimal number of buildings currently existing within the District, each firefighter cannot rule out the possibility that he or she may be called to adjoining jurisdictions in which sprinkler systems or stand pipes are located (i.e., the Holiday Inn, the Southern Park Mall,

etc.). For this reason, all firefighters should be aware of the general principles of sprinkler and stand pipe operations.

5. No Fire Attack

Interior and exterior fire attacks have been reviewed. A last option for the incident commander is to conduct no attack at all. This is sometimes necessary when conditions impose an undue threat on firefighters lives, such as a potential BLEVE, a potential danger at all incidents where the fire exposes closed containers of liquids (i.e. drums, cans, tank cars, etc.). It may be the tactic when faced with fires in poison or pesticides warehouses where the run off water of hose streams could spread toxic materials over side areas. In this case, letting the fire burn will be the safest, least costly, and fastest means to solve the problem.

6. Collapse Zone

In the event that the fire department initiates a defensive attack or no attack at all, collapse zones must be established. These collapse zones, once established, must be strictly maintained. Apparatus must operate from safe locations. Likewise, firefighters operating in buckets or elevating platforms must ensure that they maintain a safe distance from the collapse zone.

Establish a collapse zone equal to the height of the wall. All firefighters must be withdrawn from the burning building for a distance at least equal to the height of the wall - the so called "vertical" or "outward collapse" danger zone.

The Incident Commander and each firefighter must also estimate how much of the wall's horizontal area may collapse. This area is the "horizontal" collapse danger zone. It may be necessary to establish a horizontal collapse danger zone equal to the entire wall frontage or building width.

A collapse danger zone must also be established for aerial devices. The collapse danger zone for an aerial stream will vary from the collapse danger zone for a ground stream. The apparatus must be positioned in the street outside the collapse danger zone, and the raised aerial ladder or platform should never enter inside the arching path of the unstable wall, which could collapse at a 90-degree angle.

The safest area, in guarding against collapse, and positioning apparatus and master streams, are the four corners of the building, where walls collapsing directly outward will not fall on the equipment.

In summary, the most effective method of extinguishing a building fire is by interior attack. At some fires, however, due to the area of flames encountered upon arrival, the high flammability of contents within a structure or the combustible nature of the structure itself, an outside attack may be the only strategy. An outside attack at a rapidly spreading fire can be more dangerous to firefighters than an interior attack. At these fires, the flames are so large and the radiated heat so intense that the firefighting forces cannot even approach the burning structure. Fire apparatus initially positioned at hydrants, or with ladders raised, have to be hastily repositioned to avoid the radiated heat waves and

collapsing walls caused by the fire. At these rare fires, the strategy may be simply to protect exposed buildings and let the original fire building burn itself out.

F. PRIMARY AND SECONDARY SEARCH

Searches for victims can be divided into primary and secondary searches. A primary search is a quick search for live victims before the fire is brought under control. In some cases, it may be necessary to perform a search before a hose line has water. A primary search is a quick once over of the entire assessable area, with the emphasis placed on the most likely locations to find victims. On the other hand, a secondary search is performed after the fire is under control. The secondary search must be an extremely thoroughly search to insure that there is no possibility of a fire victim remaining undiscovered.

The primary search is often the first action taken on entry to a fire building. While it may occasionally be part of a specific rescue attempt, it must be so ingrained in all firefighters that it is routine function to be performed to some extent at every structural fire. When manpower is very restricted, the primary search may consist of only the nozzleman=s looking along the floor under the smoke as he tries to locate the fire.

Members assigned the task of making a primary search should be prepared for the task mentally, physically, and equipment wise. Preferably, the firefighters conducting the primary search should be thoroughly experienced personnel. Personnel must be able to extricate themselves from any dangerous situation encountered, and should be physically fit and able to rescue not only themselves but any victims which may be encountered.

Tool assignments must ensure that each interior search team is equipped with forcible entry tools to gain access to any locked areas, as well as to facilitate egress, if necessary. A pike pole or halogen hook is very useful for venting windows, probing under furniture, as well as for closing doors to isolate the fire, allowing the search to proceed. Each search team should be equipped with a radio to be able to call for help. A good light should also be used even though visibility may be severely restricted. The light should be arranged on a quick release sling to allow it to be carried and keep both hands free from carrying tools, climbing ladders, etc. A quick release feature is needed in the event that the sling becomes caught on an entanglement, thereby permitting the light to be dropped and the firefighter to escape.

Before conducting at search, the firefighter should gather as much information as possible regarding the presence and whereabouts of any victims. In conducting the search, the firefighter should be accompanied with a hose line, or if a hose line is not available, a minimum 3/8 inch diameter rope should be used as an alternative. The hose line or rope can be used to retreat to the entrance should interior conditions rapidly deteriorate.

The search should be initiated on the fire floor by moving as quickly as possible to the area that is as close to the fire as is safe, and then working backwards towards the entrance. This assures that any victims in the immediate area are removed in the event the fire extends into the next room before it is darkened down by engine company members. After ensuring that no victims are located in the direct

fire area, the search team can then move back to safe areas where any victims may have been less exposed to the fire products, and thus would have longer survival times than those victims located closer to the seat of the fire.

When firefighters are beginning the search of areas above the fire, it is often better to begin the search as soon as firefighters enter the floor area and progress in the direction of the fire. This differs from the fire floor practice of advancing directly to the flame because of the differing condition on the two floors. While it is often possible to travel below the heat and smoke on the fire floor, the floor above the fire is quite often banked down to the floor, even with just moderate fire conditions. In addition, the likely spread of fire from room to room within the occupancy would usually be much faster than from floor to floor. All occupants above the fire directly threatened by gases, while those within the fire area are threatened by both gases and fire.

In conducting a primary search, emphasis must be placed on searching escape routes people normally use to enter or exit the structure. This is also one of the key locations for hose line placement. For this reason, exit ways and stairways must be searched as soon as possible. Another high priority for conducting an immediate primary search are the bedrooms of a dwelling. All searches should be coordinated. Search teams should not duplicate primary searches of areas that have already been searched. The incident commander should assign different locations for searches to incoming engine or ladder companies.

When firefighters perform the primary search, they should make the conditions as bearable as possible. Firefighters should vent as they move along, providing the fire will not light up the area if venting is performed. Closing doors can be helpful, provided the firefighter can exit the building from a secondary means.

Once the visible fire has been extinguished and conditions start to improve, it is time to begin the secondary search. This is often combined with the overhauling phase. As areas are examined for hidden fire, they are also being inspected for victims. Care must be taken not to bury either smoldering material or casualties under debris when ceilings and walls are open and debris removed. Since the fire has been darkened down, the search should be somewhat slowed. Before moving items, thoroughly examine the area where they will land. The secondary search must include the perimeter of the building, including any roof tops or set backs to which people may have jumped, as well as the area beneath any windows. Be sure to examine any shrubbery in those areas that may be concealing an unconscious victim. All these areas must be examined before firefighters will allow any debris to be thrown out of a window from the fire area. All these areas must be examined before firefighters will allow any debris to be thrown out of a window from the fire area. Different people should do the primary and secondary searches in an area. By switching crews, or even just rooms between searches, each room is now a new, uncharted area that must be thoroughly examined.

A difficulty in performing the secondary search is simply recognizing the remains of severely burned persons as being human, particularly where fire debris, ceilings, etc., have landed on the body. Before any items are tossed out of the window or dragged to the street, they should be completely examined. This procedure should be routinely performed, even if no one is reported missing. More than once, occupants have assured firefighters that everyone is out of the house, having forgotten

about a guest or relative sleeping over. Even at seemingly routine fires, firefighters must search all areas above the fire, and all assessable areas below the fire. If a room or area in the fire floor or floors above the fire is locked, forcible entry may be required. Generally, areas two or more floors below the fire do not warrant forcible entry unless they show specific problem signs. An exception may be below grade areas where carbon monoxide may settle from smoldering fires. Firefighters should wear SCBA masks whenever they descend below grade in a fire building, even if the fire was confined to the first floor.

Performing an adequate secondary search requires a sufficient commitment of manpower to complete it in a reasonable time. Generally, a two man team should be sent to search each moderate area floor of an open floor area such as an office or store. A similar two man team should be available for each apartment in a dwelling. This number can go up or down depending on smoke and fire conditions. In light smoke conditions, the two man team will be able to move rapidly through an area and will not require SCBA or relief. When considerable smoke remains, or if conditions exist such as heavy stock piled up or very cluttered housekeeping, then additional personnel may be required.

It may be too dangerous at times for firefighters to enter the fire building without having a way to guide them rapidly back to a safe exit point. Where there is a risk that the fire may overrun the searches, a hose line must be in place. There are other times, however, where the immediate danger is not from fire, but from the firefighter losing his way due to disorientation. This can occur where the structure is configured in a maze-like arrangement, where there are large open areas, or there is extremely heavy smoke present that cannot be readily removed. In these circumstances, a guide rope, also called a tag line, should be used. Use of a small diameter rope for directional purposes is relatively simple. However, in order to be successful, a plan that is understood by all members must be used. Generally, 1/4 or 3/8 inch nylon rope, two to three hundred feet in length should be used. Where necessary, several of the search ropes can be tied together for use in large building areas. The end of the rope should always be secured to a substantial object outside of the building. The rope is then carried by one of the members designated by the officer in charge of the search. This firefighter's job is to ensure that the rope remains tied at all times. If it is necessary to back track at any time, the firefighter must retrieve the rope that has been let out and redeploy the rope along a new route.

Other required equipment, besides the search rope, includes a radio, a good working flashlight, a personal alert safety system (P.A.S.S.) Device, and a set of forcible entry tools. An SCBA should be worn at all times, and if possible, a large high intensity flood light positioned at the entrance way is also recommended.

When searches are performing within a building, a firefighter should be left outside of the entrance way to monitor how many search teams enter, where they are operating, and to monitor the firefighters entry and exit times. In some cases, the monitoring firefighter should have a radio, and should notify crews when they are not quite one half into their "air time", thus allowing for adequate return to fresh air.

G. RAPID INTERVENTION OR RESCUE OF MEMBERS

(Also see separate R.I.T. S.O.P)

The District shall provide personnel for the rescue of members operating at emergency incidents if the need arises.

A rapid intervention crew shall consist of at least two members and shall be available for rescue of a member or a team if the need arises. A rapid intervention crew should be fully equipped with the appropriate protective clothing, protective equipment, SCBA, and any specialized rescue equipment that might be needed given the specifics of the operation underway.

The composition and structure of any rapid intervention crew shall be permitted to be flexible based on the type of incident and the size and complexity of operations. The Incident Commander shall evaluate the situation and the rescue operating teams, and shall provide one or more rapid intervention crews commensurate with the needs of the situation.

In the early stages of an incident, the rapid intervention crew(s) shall be either:

a. On-scene members designed and dedicated as rapid intervention crew(s); or

b. On-scene members performing other functions by ready to redeploy and perform rapid intervention crew functions.

As the incident expands in size or complexity, the rapid intervention crew shall be either:

a. On-scene members designated and dedicated as rapid intervention crews; and

b. On-scene company or companies either in a staging area, or designated and dedicated as rapid intervention crews.

Whenever members are operating in positions or performing functions that include special operations or would subject them to immediate danger of injury in the event of equipment failure or other sudden event, at least one rapid intervention crew shall be standing by with equipment to provide assistance or rescue.

H. FORCIBLE ENTRY

The forcible entry size-up begins with the alarm information, as does the fire size-up. The time of response will indicate the need for forcible entry: Businesses that are open to the public usually require less forcible entry in the premises after hours. In addition, the type of occupancy can also indicate which way the doors open: Most residential doors open into the occupancy, while the exact opposite is true of commercial establishments, places of assembly, etc. This will also assist in determining the method of attacking the door, which type of the tool to use, or which end of the tool to use. A flat-head axe is a great compliment to the halogen tool in most buildings, although it does have some draw backs. Its six pound head does not give a great deal of driving force when used to

hammer, a trade off for its axe blade which may be used to cut floorings or roofings, etc. But when responding to fire resistive buildings, the axe can be replaced by an eight or ten pound sledge hammer, as there is no need to chop wood in these buildings, and the added impact of the sledge is very useful on the substantial steel doors likely to be found.

As the building comes into view, the forcible entry size-up should continue: Determine the location of the fire, any visible victims, and the door to be used for entry (usually the front door). (Despite the obvious appearance of the front door, look for the easiest way to get in.) If there is fire in proximity to a door, prepare for the worst. Other factors should also be considered:

1. What is the type of door? (wood, glass, aluminum, steel clad)

2. What type of jam does the door have? (Steel or wood)

3. What type of material is the jam set in? (brick, wood, or some other material)

4. How many locks are there and where are they?

5. Does the door open inward or outward?

Before opening the door, attempt to open the door. After determining that the door or other entrance way is locked, make sure that the doorway is clear and that everyone is ready to proceed. Firefighters should be located to one side of the door, and at least crouching, if not kneeling. The door now should be checked for heat. If there is intense heat behind the door and if the door swings inward, the door must be held closed or its inward swing controlled in some manner during forcible entry in order to prevent air from rushing into the fire area. The failure to maintain the integrity of the door or the failure to control the entrance way itself may result in a backdraft explosion. In somewhat less serious cases, the fresh air may intensify a smaller fire.

The same may occur by the breaking of glass which will result in a lack of control over the oxygen supplied to the fire. Even if a charged hose line is in place, this is not the best idea, for if the line loses water, perhaps being cut by the glass chards, the window or unmanageable door cannot be closed again to cut down the oxygen supply. It is particularly important to leave interior doors exposing stairways or other vertical openings intact, since a closed door may be all that keeps the fire from going up the stairway being used by escaping occupants or firefighters.

All firefighters must recognize the signs of a backdraft, which include a reverse flow of smoke back into a doorway, smoke puffing out around a door frame or window, and the movement of a large plate glass window in and out in a pulsating manner. A backdraft is a combustion explosion or smoke explosion, which is defined as a result of a chemical reaction of heat, oxygen and fuel - the same ingredients that create a fire. An explosion differs from a fire, though, because the speed of the reaction and the rapid expansion of gases causes shock waves.

Not all explosions occurring at fires are backdrafts. Most are caused either by natural gas leaking from broken or melted gas piping during the fire or by residual vapors of the flammable liquids an

arsonist may have used to start the fire. Other causes of explosions may include propane cylinders, kerosene containers used for space heaters, imploding television tubes, and gas piping in turn of the century houses which used to serve lighting fixtures.

A firefighter should not believe he can avoid injury from a backdraft or an explosion by looking for warning signs. Explosions happen too fast - there is no time to react. The only protection the firefighter has against explosion blasts is his or her protective equipment. Therefore, again, all firefighters must wear issued protective equipment, including gloves, masks, helmets, coat and pants, and boots. If a firefighter does not wear protective clothing, he or she will probably never again perform forcible entry or extinguish another fire.

Other safety precautions a forcible entry team can use to prevent or reduce the effects of a backdraft explosion include, in addition to controlling the door, the ventilation of a roof, including the ventilation of skylights, or the controlled horizontal ventilation of another area of the building which is likely to pose a less serious hazard to the firefighter.

All search and rescue teams, and forcible entry teams, should be aware of the principles of entry, including:

1. Convention forcible entry:

    a. Residential - inward opening doors;

    b. Commercial - outward opening doors;

2. Through the lock forcible entry;

3. The multi-locked door;

4. Metal gates/roll-up doors.

When using an axe and a halogen tool to force entry, coordination, control, and practice are methods to ensure safety and prevent injury. The firefighter holding the halogen tool should be the team leader and should control the operation.

I. VENTILATION

1. Reasons for Ventilation

Ventilation is the systematic removal of heated air, smoke, and gases from a structure, followed by the replacement of a supply of cooler air, which facilitates other firefighting priorities. The importance of ventilation cannot be overlooked. It increases visibility for a quicker location of the seat of the fire. It decreases the danger to trapped occupants by channeling away hot, toxic gases and reduces the chance of backdraft. Unfortunately, ventilation may be misunderstood by the public because it requires doing limited damage to a building; but it results in greater reduction in damage.

As a result of the use of modern technology in developing cheap household products, the fuel load in all occupancies has been increased, and one can also expect increases in the amount of products of combustion produced during fires. Prompt ventilation for the saving of lives, suppression of fire, and reduction of property damage becomes more important every day.

Modern energy conservation policies may also be creating additional ventilation problems with increased insulation requirements. This is because the insulation will retain heat much better and will raise the temperature of combustibles in the fire area to ignition temperature and may cause flashover to occur much faster. Therefore, the need of ventilation has increased and must be accomplished much sooner than has been practiced in the past. Insulation installed over roof coverings of fire-rated roof construction will effectively retain heat and may reduce the fire rating drastically, causing premature roof failure.

The major objectives of a firefighting force are to reach the scene of a fire as quickly as possible, rescue trapped victims, locate the fire, and apply suitable extinguishing agents with a minimum of fire, water, smoke and heat damage. Ventilation during firefighting is an aid to the fulfillment of these objectives. When proper ventilation is accomplished to aid fire control, there are certain advantages that may be obtained from its application.

Proper ventilation simplifies and expedites the rescue of victims by removing smoke and gases which endanger occupants who are trapped or unconscious, and by making conditions safer for firefighters. The removal of smoke, gases, and heat from a building permits firefighters to more rapidly locate the fire and proceed with extinguishment. Proper ventilation not only reduces the danger of affixation, but also reduces the obstacles which hinder firefighters while they perform fire extinguishment, salvage, rescue, and overhaul procedures, by improving vision and removing the discomfort of excessive heat.

Heat, smoke, and fire gases will travel upward to the highest point in the area due to convection until they are trapped by roof or ceiling. As they are trapped and being to accumulate, they bank down and spread laterally to involve other areas of the structure. This phenomena is generally termed Amushrooming@. Proper ventilation of a building during a fire reduces the possibility of mushrooming. It tends to draw the fire to a point by providing escape for the raising heated gases.

The requirements for the plan of attack must be considered before the Incident Commander or a Fire Officer directs a crew to begin ventilation. The Incident Commander or Officer must consider the following facts:

1. Is there a need for ventilation at this time? The answer to this question must be based upon the heat, smoke and gas conditions within the structure and the life hazard.

2. Where is ventilation needed? The answer to this question involves construction features of the building, contents, exposures, wind direction, extent of the fire, location of the fire, top or vertical openings, and cross or horizontal openings.

3. What type of ventilation should be used? The answer to this question may be derived from a fire officer's knowledge of the following three methods of ventilation:

   a. Providing an opening for the passage of air between interior and exterior atmospheres;

   b. Using the application of water fog and the expansion of water into steam to displace contaminated atmospheres; and

   c. Using forced air ventilation.

2. Visible Smoke Conditions

Smoke conditions will vary according to how burning has progressed. A free-burning fire must be treated differently than one which is in the smoldering stage. Smoke accompanies most ordinary forms of combustion and differs greatly with the nature of the substances of materials being burned. The density and color of the smoke is a direct ratio to the amount of suspended particles. A fire that is just beginning and is consuming wood, cloth and other ordinary furnishings will ordinarily give off grey, white, or blue-white smoke of no great density. As the burning progresses, the density may increase, and the smoke may become darker because of the presence of large quantities of carbon particles.

3. The Building Involved

Knowledge of the building involved is a great asset when making decisions concerning ventilation. Building type and design are the initial factors to consider in determining whether horizontal or vertical ventilation should be accomplished. The number and size of the wall openings, the number of stores, staircases, dumbwaiters, ducts, roof openings, the involvement of exterior fire escapes and exposures are determining factors.

4. Life Hazards

Dealing with the danger to human life is of utmost importance. Certain fire conditions may suggest that ventilation come first to draw away heat and smoke, or that the spreading flames must be attacked immediately; sometimes both must be done simultaneously. All variables cannot possible be listed, but the point is that the first consideration is the safety of occupants. The life hazards are generally reduced in an occupied building involved by fire if the occupants are aware of the situation. If, however, the occupants were asleep when the fire developed, and are still in the building, either of two situations may be expected. First, they may have been overcome by smoke and gases; second, they might have become lost in the building and are probably panicky. In either case, proper ventilation will be needed in conjunction with the rescue operations.

In addition to the hazards that endanger occupants, there are potential hazards to firefighters and rescue workers. The type of structure involved, whether natural openings are adequate and the need

to cut through roofs, walls or floors (combined with other factors) add more problems to this decision process.

5. Location and Extent of the Fire

In most instances, ventilation should not be carried out until the location of the fire is established. Opening for ventilation purposes before the fire is located may spread the fire throughout areas of the building that would not otherwise have been affected. Smoke that is coming out of the top floor does not always indicate a fire on that floor since it may be on a lower floor or even, perhaps, the basement. Likewise, smoke that is gently flowing from an opening is not necessarily close to the seat of the fire. Obviously, extensive roof ventilation may be impractical or extremely dangerous if the location of the fire is such that vertical ventilation will draw the fire in the parts of the building which are not involved.

The fire may have traveled some distance through a structure by the time the fire department arrives, and consideration must be given to the extent of the fire, as well as to its location. The severity and extent of the fire usually depend upon the kind of fuel, the time it has been burning, installed fire protection devices, and degree of confinement of the fire. The phase to which the fire has progressed is a primary consideration in determination ventilation procedures. Some of the ways by which vertical extension incurs as follows:

a. Through stairwells, elevators and shafts by direct flame contact or by convected air currents;

b. Through partisans in walls and upward between the walls by flame contact and convected air currents;

c. Through windows or other outside openings where flame extends to other exterior openings and enters upper floors;

d. Through ceilings and floors by convection of heat through beams, pipes, or other objects that extend from floor to floor;

e. Through ceiling and floors by direct flame contact;

f. Through ceiling and floor openings where sparks and burning materials fall through to lower floors; and

g. By the collapse of floors and roofs.

6. Basements and Windowless Buildings

Except in private dwellings and where automatic sprinklers are present, outside stairways, windows, hoistways, provide access to firefighters. However, most outside entrances to basements may be blocked or secured by iron gratings, steel shutters, wood doors, or combinations of these for

protection against weather and burglars. All these features served impeded attempts at natural ventilation.

Another important factor that should be considered when a basement is involved in fire is its relationship to the rest of the building. Structural features such as stairways, elevator shafts, pipe chases and other handling systems, and other vertical openings contribute to a spread of fire and smoke to upper floors. Ventilation below street level is difficult in that it rarely provides an opportunity to use normal smoke evacuation techniques. Basements will usually require mechanical ventilation.

Many buildings, especially in business areas, have windowless wall areas. While windows may not be the most desirable means of escape from burning buildings, they are an important consideration for ventilation. Windowless building designs create an adverse effect on firefighting and ventilation operations. The ventilation of a windowless building may be delayed for a considerable time, allowing the fire to gain headway or create backdraft conditions.

Problems inherent in ventilating this type of building are many and varied, depending upon the size, occupancy, configuration, and type of material from which the building is constructed. Windowless buildings usually require mechanic ventilation for the removal of smoke. Air handling systems should be shut down as soon as possible.

7. Horizontal and Vertical Ventilation

Horizontal ventilation is the removal of the heated air, smoke and gases through the horizontal introduction of cooler air. Horizontal ventilation may be accomplished by natural means (i.e., the opening of windows or doors on the windward side of the building), by hose lines, or by mechanical means (forced ventilation through smoke blowers or ejectors).

Vertical ventilation is the systematic removal of heated air, smoke and gases from the structure in a vertical manner, with the introduction of a supply of cooler air from below, which is usually accomplished by creating an opening above the fire allowing the by-products of combustion to escape. When an opening is made in the upper portion of a building during ventilation, a chimney effect is created which draws air currents throughout the building in the direction of the opening.

Structures which lend themselves to application of horizontal ventilation include:

a. residential type buildings in which a fire has not involved the attic area;

b. buildings with windows high up the wall near the eaves;

c. the attics of residential type buildings which have louver vents in the walls;

d. the involved floors of multi-storied structures;

e. buildings with large supported open spaces under the roof in which the fire is not contained by fire curtains and in which the structure has been weakened by the effects of burning.

Many of the aspects of vertical ventilation also apply to horizontal ventilation. A different procedure must be followed in ventilating a room, a floor, a cockloft, an attic or basement. The procedure to be followed will be influenced by location and extent of the fire. Some of the ways by which horizontal extension occurs are as follows:

a. Through the wall openings by direct flame contact or by convected air;

b. Through corridors, halls, or passageways by convected air currents, radiation, and flame contact;

c. Through open space by radiated heat or by convected air current;

d. Through all directions by explosion or flash burning of fire gases, flammable vapors or dust;

e. Through walls and interior partisans by direct flame contact;

f. Through walls by conduction of heat through beams, pipes or other objects.

Factors that influence the choice of vertical or horizontal ventilation, or both, include the size and location of the fire, the construction of the building, and the effects of weather, particularly wind. Horizontal ventilation is often preferred in minor to moderate scaled fires. Horizontal venting is also usually less costly to repair than vertical venting, unless there is also a man-made opening at the roof level.

Vertical ventilation is often important in determining whether the fire is stopped or continues to spread. When a sufficiently sized, properly placed, opening is made at the roof level, under certain circumstances, relief is dramatic. Horizontal fire extension is slowed dramatically, and visibility and heat conditions improve rapidly, as fresh air is drawn in at lower levels to replace the hot gas that is exiting out the top. Not every fire demands or allows for roof or vertical venting. Relatively minor fires with little heat build-up, as well as fires in the lower portions of a structure removed from vertical openings, probably will not benefit by opening the roof. Those fires with little heat built up, as well as fires in the lower ports of the structure removed from vertical openings, probably will not benefit by opening the roof.

8. Methods of Ventilation

Ventilation may be accomplished by opening doors and windows found within the structure itself. Under certain conditions, when there is no wind, cross-ventilation is less effective since force to remove the smoke is absent. In other instances, cross-ventilation cannot be accomplished due to the danger of wind blowing toward an exposure or feeding oxygen to the fire. The wind plays an

important role in ventilation. Its direction may be designated as windward or leeward. The side of the building where the wind is striking is windward, the opposite side is leeward.

Since horizontal ventilation does not normally release heat and smoke directly above the fire, some routing is necessary. Firefighters should be aware of internal exposures as well as external exposures. The routes by which the smoke and heated gases will travel to the exit may be the same corridors or passageways which occupants will be using for ventilation. Therefore, the practice of horizontal ventilation without first considering occupants and rescue procedures may block the escape of occupants.

Since horizontal ventilation is accomplished at a point other than at the highest point of a building, there is a constant danger that the rising heat and gases will ignite that portion of the structure which the heat and gas contact when released. The heat and gases may ignite eaves of adjacent structures, or be drawn into windows above their liberation point. Unless for the specific purpose of aiding a rescue, the building should not be opened until charged lines are in place at the windward attack entrance point, at the immediate point where the fire might be expected to spread, and positions to protect other exposures. The opening of a door or opening on the wrong side of a building may reverse air currents and drive heat and smoke back upon firefighters. Opening doors and windows between the advancing firefighting crews and the established ventilation exit point will reduce the intake of fresh air from the opening behind the firefighters.

In the event that the natural movement of the heated gas is insufficient to remove the products of combustion rapidly enough to allow firefighters to finish their tasks without difficulty, mechanical ventilation may be needed. Mechanical ventilation can involve hose lines, portable fans, or building ventilation systems, depending on the resources available and the fire situation. Venting can be done either by sucking contaminated air out or by blowing fresh air in. Both methods accomplish the same objective: To remove all of the contaminated air, and replace it with fresh air. Certain pros and cons apply to each method.

Venting using a fog or spray stream is one of the earliest and simplest means of mechanical ventilation. The higher the nozzle the pressure, the more air moved. By standing back six to eight feet from the window or door opening, and adjusting the pattern to just cover the opening, a venturi will be set up adding to the efficiency of the stream itself. At times, the six to eight foot positioning will not be possible or practical. The use of this type of ventilation will also permit the firefighter located within the interior of the structure to monitor the extinguished fire for signs of rekindle as a result of the fresh air being introduced into the structure by the ventilation efforts. The use of a hose stream for ventilation does have drawbacks, however. It cannot be used at minor fires where water damage is a concern, in areas where poor water supply exists, or where freezing temperatures will result in ice formation creating fall hazards.

The use of smoke injectors, blowers, or exhaust fans and other portable devices suffer none of the drawbacks of the hose line except for the same problem with the force draft over smoldering members. Problems can result, however, with power availability, manpower requirements, storage space, and explosive gases; but, with proper planning by company officers, these can be overcome.

a. Negative vs. Positive Pressure - Mechanical Ventilation

Mechanical ventilation offers a great opportunity to channel products of combustion where designed. The decision will have to be made, however, as to whether or not products of combustion will be sucked out of the structure or whether fresh air will be blown in. The Fire District prefers that positive pressure ventilation (PPV) be used whenever possible. PPV has many advantages over negative (sucking) ventilation, the first of which is efficiency. PPV moves almost twice as much fresh air through the structure than negative pressure ventilation can remove. PPV will also eliminate interior debris and obstacles, such as curtains, being drawn into the fan and blocking air intake. PPV will also reduce the introduction of combustible gas from the fan motor into the interior of the structure, and from impeding firefighter ingress and egress from the structure.

However, firefighters must always remember that in a building where there is a suspected life hazard, the principle of venting for life will demand that windows be taken out, which will eliminate the use of PPV. A desire to keep glass intact will have a negative impact on any victims inside who need fresh air to survive. A basic guideline for interior firefighter search for a life hazard is to "vent as you move, provided the fire will not be extended by the venting". This is the opposite pattern desired to make PPV work effectively. Thus, the decision to use PPV should be made only after considering all of the factors that can affect the situation, including:

1. Life hazard;

2. Extent of fire;

3. Hose line availability;

4. Degree of confinement;

5. Environmental factors in the vicinity of the fan (i.e., dust, powders, weeds, etc., that might be drawn into the fan, impeding operations or damaging the unit);

6. Available equipment and/or power supply.

If the situation seems to lend itself to PPV, PPV can make the job much simpler. But remain aware of the conditions in the building to be ready to order PPV halted if it appears to be having a negative impact on operations.

b. Vertical Ventilation

Once the fire has achieved a substantial headway, it is building up pressure of its own within the structure. The natural tendency is for heated gas to rise. When restrained from rising, it spreads out horizontally. By providing an opening of sufficient size at the top, the fire can continue skyward without extending horizontally. District firefighters should recognize the buildings where this is possible, and, in the event of a serious fire, make all efforts to open this area as soon as possible. In many multiple story buildings, a skylight is provided over a staircase to take advantage of natural

lighting. By removing the skylight, or breaking the individual panes, rapid ventilation is provided over this critical vertical artery.

In addition to interior staircases, the second most common vertical artery is the pipe chase or soil pipe. By feeling soil pipes for heat, a member can estimate whether or not fire is about to enter the cockloft or attic area. Even if a fire appears to be confined to a lower floor, if the soil pipe at the roof level is hot to the touch, immediate steps should be taken for fighting the fire on the top floor or attic. The top floor ceiling must be pulled, hose lines stretched, and, if fire is in fact present, the roof must be opened.

A serious fire within the building's voids is a severe threat to the very existence of the structure due to the numerous interconnections with other blind spaces, both vertical and horizontal. Fire within these spaces are extremely smokey fires due to the limited oxygen available to the fire. Firefighters will have great difficulty locating, opening up, and attacking the fires because of poor visibility. The answer: Total ventilation. This includes all windows and other horizontal openings as well as roof ventilation, particularly over the tops of the vertical voids. With anything less, it is unlikely firefighters will be able to remain in positions to cut off further fire spread, and will ultimately be driven out of the structure.

District firefighters should be familiar with various roof designs, and the hazards associated with each. These designs include peaked roofs, flat roofs, inverted roofs, truss roofs (including light-weight, bow string, and metal truss roofs), metal deck roofs, and light weight roofs.

District firefighters should be familiar with the procedures for making vertical ventilation openings, or cuts, in each of these types of roofs, including the procedure for the trench cut.

In ventilating roofs, District firefighters must not ventilate where additional exposure problems will be created. Serious fires that are threatening the very existence of a structure demand total ventilation if interior forces are to be able to do their jobs. Any desire not to do any damage may result in the total loss of the structure.

9. Precautions/Hazards

When laddering a roof, the ladder selected should be one which will extend two to three feet above the roof line. This will be done in an effort to provide personnel operating on the roof line with a visible means of egress.

If possible, when laddering buildings under fire conditions, place ladders near building corners or fire walls as these areas are generally more stable in the event of structural failure.

When operating either above or below ground level, establish at least two separate escape routes, or means of egress, where possible, preferably at opposite ends of the diagonal corners of the building that are separated by considerable distance.

Be aware of fellow firefighters engaged in roof ventilation who may be carrying hazards such as power saws, axes, hooks, or other moving objects, especially in poor visibility conditions.

A firefighter using a power saw blade or chain should not permit the blade or chain to spin more than six inches above the roof. Do not begin to gun the engine until the roof is about to be penetrated. If it is necessary to gun a saw to keep the saw running, all personnel must be cleared out of the area, the entire hole cut, and then shut the saw down as soon as the last cut is made.

When visibility is completely obscured, movement should be completely stopped. It is better to take some punishment moving cautiously than it is to walk into a hole or off the roof.

Members operating on a roof should make sure that the roof is secure before placing their full weight onto any portion of the roof. Tools or other objects should be used to check the integrity of the roof before proceeding.

Members should be cautious when there are accumulations of snow or rain water on a roof. The depth of the rain water or snow may not be apparent by visual observation, and like the roof itself, the depth should be checked to determine the added weight load to the roof.

When operating on peaked or flat roofs, whenever possible, a roof ladder should be utilized. A second means of egress should also be available in case of an emergency. Where possible, the use of an aerial platform or ladder is also preferable where the possibility of collapse or a severe is present.

When walking on a peaked roof, a firefighter should straddle or stay near the ridge rafter. If a firefighter slips or loses his or her balance, he or she can grad the roof peak. Chimneys, television antennas, and soil pipes are not designed to support the weight of a falling firefighter and may break.

To maintain footing when walking on a peaked roof surface, firefighters should bend their legs at the knees and walk flat footed. This method is called the "roofers' walk". It will reduce the chance of sliding down a peaked roof.

When there is a danger of a peak roof deck burning through or a collapse due to an attic fire, place a roof ladder on the sloping side of the roof form which you are operating and walk on the rungs of the ladder. The ladder should be supported by the roof ridge and the bearing walls of the house.

Roof operations should be conducted from an aerial ladder or an aerial platform when peaked roof beams are in danger of collapse due to fire destruction of the attic. The firefighters should, therefore, be independently supported.

Firefighters should not walk on a peaked roof with a slope of more than a 30☜ angle from the horizontal.

Roof operations hold many dangers for firefighters. This, combined with the importance of the task, demands that the members assigned to this crucial task be efficiently capable for the job. Failure to complete the assigned tasks can result in the destruction of the building, or even loss of life. As the

firefighters performing the ventilation are often not operating under direct supervision of Chief Officers, they therefore become the eyes and ears of the Incident Commander at roof level. These members must recognize dangerous conditions and report them immediately. Failure to do so may result in the injury or death to civilians and fellow firefighters alike.

J. FIRE GROUND PERIMETER

In Subpart E(6) of this section, the establishment of a collapse zone was reviewed. However, in every emergency incident, it is important that "standard fire ground perimeter" be established. For safety purposes, the fire ground is defined by an imaginary line which encloses a space where the fire situation creates a potential hazard to personnel. This definition avoids any confusion or conflict over where the specific requirements are in effect and where they are not. Nobody should be inside the perimeter unless they have a specific assignment or function to perform, are wearing full protective clothing, have their SCBA, are functioning with their assigned company or crew, or are assigned to a sector. All others must remain outside the perimeter area. The rigid enforcement of this rule virtually eliminates freelancers and wanderers in the area where they are exposed to danger.

The absolute consideration for the perimeter should be how far the potential danger extends from the fire. The factors consider when setting the perimeter must include the area subject to structure collapse, areas of potential explosions, areas of smoke drift, areas of falling debris, and the location of the fire in relation to the center of the street and clear areas available around the building.

The majority of structure fires do not create any major challenge in identifying the fire ground perimeter, even with imaginary lines. Where the hazards are not clearly evident, such as hazardous materials incidents or areas where weakened parts of the structure may be expected to fall, the Incident Commander should use a rope or tape stretched to define a visible boundary line. This boundary line defines a special hazard area and a perimeter which may only be entered through an access control point. The definition of the special hazards zone should be the standard function of the safety sector.

The command post should be outside the fire ground perimeter and sufficiently removed from the hazards so that the Incident Commander can operate without his SCBA and gloves. Sector or officers operating inside the perimeter must be fully protected. Only the minimum number of personnel should be inside the perimeter exposed to hazards - particularly in high-risk situations, and any crews which are not being used should be sent to rest or to standby outside the perimeter. Basic safety requirements are still in effect outside of the perimeter, but the stringent requirements for operating within a fire area may be relaxed.

Beyond the fire ground perimeter is an additional area, generally controlled by the police and defined by a Afire line@. This area is reserved for the fire department to operate without having to deal with spectators, traffic and other problems. Within this immediate area, personnel should be expected to operate routinely with a normal approach to safety, sharing the space with the reporters, photographers, EMS personnel, police officers, trustees, and owners of the burning building(s), all of whom may be officially authorized to be there. The limits of the fire line shall be established through an arrangement with the police department.

While the hazard created by the fire should be limited to the fire ground perimeter, personnel operating within this outerzone, particularly apparatus drivers, need to be aware of the movements and actions of people who may be preoccupied with their activities or simply distracted by the spectacle. Visitors not well versed in fire ground activities must always be escorted.

K. SALVAGE AND OVERHAUL

1. Salvage

a. Introduction

Salvage work consists of those methods and operating procedures allied to firefighting which aid in reducing fire, water and smoke damage during and after fires. A portion of these damages can be attributed to the necessary operations of applying water, ventilating a building, and searching for fires throughout a structure. These procedures cannot be entirely eliminated, but improved techniques and fire extinguishment plus prompt and effective use of good salvage procedures result in a more systematic approach to minimize these losses.

b. Planning for Salvage Operations

Efficient salvage operations are dependent upon planning and training. Each station should review their inventory to make sure tarps are available on their apparatus. Each firefighter should also be familiar with salvage operations and the use of salvage equipment. Chief Officers must give salvage operations a high priority and do not hesitate to call additional help to perform savage work.

c. Arranging Contents to be Covered

The actual arranging of contents to be covered may be limited when large stocks and display features are involved. Display shelves are frequently built to the ceiling and directly against the wall. This construction feature makes it difficult to cover shelving. When water flows down a wall it will naturally come into contact with each shelf and wet the contents.

One common obstacle to efficient salvage work is the lack of skids under all stock that is susceptible to water damage. Examples of contents that have perishable characteristics are flour, material in cardboard boxes, feed, paper and other dry goods. When salvage covers are limited, it is good practice to use available covers for water shoots and catchalls, even though the water must be routed to the floor and cleaned up afterward.

Arranging household furnishings presents a different type of situation. If a reasonable degree of care is taken, one average-sized cover will usually protect the contents of one room. A suggested procedures for arranging furniture in a room is to group the furniture in the center of the room, if possible not under a light fixture which might leak. If the floor covering is a removable rug, slip the rug from under the furniture as each piece is removed and roll for convenience. A dress, chest or high object may be placed at the end of the bed, if there is a roll of rug, place it on top to serve as a

ridge pole. Other furniture can be grouped close by and pictures, curtains, lamps, and clothing can be placed upon the bed. It may sometimes be necessary to place the cover into position before some articles are placed on the bed. In this event, bed and furniture can be protected while other items are placed under the cover.

d. Salvage Cover Maintenance

Each station within the District carriers salvage covers on its apparatus. Proper cleaning, drying and repairing of these salvage covers will increase their span of service. Ordinarily, the only cleaning that is required for salvage covers is showering with a hose stream and scrubbing with a broom after use. Covers that are extremely dirty and stained may be scrubbed with a detergent solution and then thoroughly rinsed. Permitting salvage covers to dry while in a dirty condition is not a good practice, because after carbon and ash stains have dried, a chemical reaction takes place which rots covers. When dried, foreign materials are difficult to remove even with a detergent. Canvas salvage covers should be perfectly dried before they are folded and placed in service. This practice will prevent mildew and rot. Conditions permitting, salvage covers may be dried outdoors. After covers are dried, they should be examined for damage. If a hole is discovered, if possible, the hole must be patched. If mending is not possible, the salvage cover should be taken out of service.

e. Other Salvage Equipment

For conducting salvage work at fires, each apparatus may also carry additional equipment depending upon the space available on the engine, ladder, or squad. When possible, the tools and equipment should be located in one area on the apparatus and should be kept in tool boxes or other containers to make them easier to carry. Additional salvage equipment will include pliers, chisels, tinsnips, wrenches, hammers and nails, hack saws, heavy-duty stapler and staples, linoleum knife, screwdrivers, roofing paper, tarp paper, plastic sheeting, mops, squeegees, scoop shoves, brooms, water vacuums, sponges, rags, and floor runners.

2. Overhaul

a. Introduction

Overhaul is the practice of searching a fire scene to detect for hidden fires which may rekindle and to detect and safeguard signs of arson. Afterwards, the building is to be left in as safe and habitable condition as possible. Salvage operations performed during firefighting will directly effect any overhaul work that may be needed later.

Salvage and overhaul may sometimes be performed simultaneously, but overhaul generally follows salvage operations. When effective salvage procedures proceed a thorough and systematic overhaul, the result will have a significant effect upon reducing the extent of the loss and facilitate prompt restoration of the property to full productive use.

Many of the tools and equipment used for overhaul are the same as those used for other firefighting operations. These tools would include pike poles, plaster hooks, axes, buckets, shovels, hooks and forks.

b. Searching for Hidden Fires

Since overhaul procedures may not necessarily follow a pattern or plan, one of the first routine operations should probably be to search for hidden fires. A search must be continued at the fire area to be certain that the fire has been completely extinguished. Before starting a search for hidden fires, it is important to determine the condition of the building in the area to be searched. The intensity of the fire and the amount of water used for its control are two important factors that effect the condition of the building. The first determines the extent to which the structural members have been weakened, and the second determines the additional weight placed on floors and walls due to the absorbent qualities of the building contents. Consideration should be given to the two factors for the protection of personnel during overhaul.

The firefighter should be aware of other dangerous building conditions, such as:

- weakened floors due to floor joists being burned away;
- spalled concrete from the heat;
- weakened steel roof members;
- walls offset due to elongation of steel roof supports;
- mortar in wall joints open due to excessive heat;
- Wall ties holding veneer walls melted from heat.

The firefighter can often detect hidden fires by sight, touch or sound. An important objective in searching for hidden fires should be to make a systematic and careful check to determine whether the fire extended to other areas of the building or other buildings. If it is found that the fire did extend to other areas, it is necessary to determine through what medium it traveled. When the floor beams are burned at their ends where they enter a party wall, the voids in the wall must be flushed with water. The far side of the wall should also be checked to see whether fire or water has come through.

Insulation material, in the form of bats or spray, will often harbor hidden fires for a prolonged period and these bats must be removed in order to locate the hidden fire.

If fire has burned around windows or doors, there is a possibility that there is fire within the casings. These areas should be opened to assure complete extinguishment. Another point of possible trouble is behind a cornice. When fire has burned around a combustible roof or cornice, the cornice should be opened and inspected for hidden fires.

When concealed spaces below floors, above ceilings, within walls and petitions, must be opened during the search for hidden fires, the furnishings of the room should be moved to locations where they will not be damaged. Only enough wall, ceiling or floor coverings should be removed to assure complete extinguishment. Weight bearing members should not be disturbed.

Each apparatus carriers various tools for opening a ceiling from below. These tools would include a pike pole, plaster hook, dragon slayer, or halogen hook or tool. Again, all firefighters operating within the interior of a structure fire should be in full protective clothing.

c. Extinguishing Hidden Fires

A charged hose line should also be available for the extinguishment of hidden fires, although the same caliber of lines as were used to bring the fire under control is not always necessary. District pumpers can, upon instructions from the Incident Commander or other officer, be disconnected from the hydrant, but a minimum of a 2-1/2 inch supply line, where possible, should be left for standby. Large 2-1/2 inch attack lines do not necessarily need to be used by an overhaul crew during their search for hidden fires, but a line should be kept ready to extinguish any fire outbreak. A smaller hose line will often provide better maneuverability through the building for overhaul purposes. Nozzles should be placed so if it is accidentally opened it will not cause additional water damage. A garden hose connected directly to a domestic water supply can also be used to extinguish small fires. When garden hoses and other limited extinguishing devices are used during overhaul, provision should be made to maintain large hose lines within close proximity. Water pumps, cans and portable fire extinguishers provide limited extinguishing facilities, and are not as reliable as lines for overhaul purposes.

Small burning objects are often uncovered during overhaul. Because of their size and condition, it is better to dunk the entire object in a container of water than to try drenching it with a stream of water. Bathtubs, sinks, laboratories, and wash tubs are all useful for this purpose. Larger furnishings, such as mattresses, stuffed furniture, and bed linens should be removed to the outside where they can be easily and thoroughly extinguished. It is important for all firefighters to remember that all scorched or partially burned articles may prove helpful to an investigator in preparing an inventory to determine the cause of the fire. The use of wetting agents is of considerable value when extinguishing hidden fires. The penetrating qualities of wetting agents usually permit complete extinguishment of hidden fires in cotton, upholstery, bailed goods, and a large number of other materials. Special care should be taken to eliminate indiscriminate use of and direction hose streams.

d. Protecting and Preserving Evidence

Two things should be kept clearly in mind by firefighters regarding the protection and preservation of material evidence:

- Keep the evidence where it is found, untouched and undisturbed if at all possible;

- Properly identify, remove and safeguard evidence that cannot be left at the scene of the fire.

No changes of any kind should be made to the evidence other than what is absolutely necessary in the extinguishment of the fire. Firefighters should avoid trampling over possible arson evidence and obliterating it so that it becomes useless. The same precaution applies to the excessive use of water. Human footprints, when discovered, should also be protected. Boxes placed over prints will prevent dust from blowing over otherwise clear prints and keep them in good condition for further investigation.

When evidence must be collected by firefighters it must be properly marked, tagged, identified, and preserved in clean containers. Careful notation must be made of the date, time, and place where found. Additionally, identifying marks on lamps, bottles, and other articles must also be noted. The firefighter collecting the evidence must also record his name.

The firefighter who detects arson and finds the evidence should be able to identify it later. When such material has been tagged, labeled, and properly marked, it is ready to be turned over to investigators or other proper authorities.

Only after evidence has been properly preserved may all debris be cleaned up. Charred material should be removed to prevent the possibility of rekindle and to help reduce the loss from smoke damage. Any unburned materials should be separated from the debris and cleaned. Shoveled debris collected in large containers such as buckets and tubs reduce a number of trips back and forth to the fire area. Where possible, the firefighter should avoid dumping debris into streets or on sidewalks where it will impede traffic, and should likewise make every attempt to avoid damaging costly shrubbery or other private property.

Finally, salvage and overhaul operation should continue even after the fire is completely extinguished, otherwise merchandise or furnishings previously protected could become damaged by weather. Firefighters on the scene should cover broken windows or open roofs when and where possible, whether the fire itself or the fire suppression activities made such measures necessary.

L. LADDERS/AERIAL DEVICES

1. Ground Ladders

The Fire District carries various types of ladders on its apparatus, including single ladders, roof ladders, folding ladders and extension ladders. All District members must be able to identify the various types of ladders, remove those ladders from their place of storage on the apparatus, and demonstrate the proper carry of each type of ladder.

The process of raising a ladder when it is needed will not in itself extinguish a fire, but a well-positioned ladder becomes a means by which other operations can be performed. Teamwork, smoothness and rhythm are very necessary when arising and lowering fire department ladders, and

speed and accuracy are to be developed. However, firefighters must be aware of certain general principles that affect the raising of ladders.

a. Basic Ladder Position

The assignment to be accomplished determines where the top of the ladder should be located. When the ladder is placed for rescue from a window, the top of the ladder must be even with the window sill or slightly below. A ladder protruding into the window opening will impede the removal of occupants.

A ladder placed for a firefighter to enter a window can be along side the window and about three rungs above the window sill, allowing easy access for the firefighter to climb into the sill and enter the room. If the window is wide enough, the ladder can protrude into the window opening. In either case, the opening must be cleared with a tool to allow safe entry and exit.

A ladder placed to play a stream of water from a hose line into a window should have the top of the ladder resting on the wall above the opening. A firefighter can then position the ladder slightly below the center of the window while playing the stream into the building.

When placing a ladder to ventilate a window, it should be placed on the windward side of the opening, slightly above the top of the window.

b. Raising a Ground Ladder

A major concern when raising metal ladders is contact with live electric wires or equipment, either by the ladder or the person climbing it. The same hazards exist with respect to wet wooden or fiberglass ladders. Care must be taken before beginning a raise to be sure that this hazard is avoided.

When raising a fly section on an extension ladder, the fly extension may be in (next to the building) or out (away from the building). The recommended practice is that the fly section be OUT (away from the building). This recommendation is based on information received from ground ladder manufacturers, NFPA Standard 1931, strength tests conducted on ground ladders by the National Bureau of Standards, and the International Fire Service Training Association=s Essentials= Manual which all indicate that extension ladders are stronger with the fly section outward. In either case, the firefighting team raising the ladder should agree on the position of the fly section prior to initiating the raise.

Once the decision has been made as to the position of a ladder, the team may initiate the raise. It may be possible for a firefighter to raise a ladder him or herself and each department firefighter should be familiar with the procedure. Firefighters should also be familiar with procedure for pivoting and rolling a ladder. Once a ladder has been raised, the ladder should be kept from slipping whenever firefighters climb it, especially if the ladder is at a lower-than-desirable angle, if there are strong winds, or if the ground is icy or unstable. Added stability might also be necessary when operating hose lines from the ladder or when using the ladder for rescue. A firefighter may secure a ladder by heeling. While heeling may be accomplished by positioning the firefighter on the ground

below or behind the ladder, the District prefers that a firefighter remain behind the ladder, which minimizes the possibility of being struck by falling objects. The ladder may also be secured by tying the ladder to a fixed object. If the ladder is tied, it is preferable to be tied at both the top and bottom. Additionally, before an extension ladder is climbed, the excess halyard should be tied to the ladder to prevent the fly from slipping and to keep anyone from tripping over it. Once a ladder has been placed, under no circumstance should it be removed while somebody is operating on the roof or within the building at the upper end of the ladder.

c. Climbing a Ground Ladder

Climbing should be started after the climbing angle has been checked and the ladder is properly heeled. The District expects that all firefighters are familiar with the proper procedures for climbing a ladder. In the event that a firefighter is required to carry equipment up and down a ladder, it is preferred that the item be place don a sling or other object in order to leave the hands free for climbing. In the event that the item must be carried by hand, it is preferred to slide the free hand under the beam while making the climb. This method permits constant contact with the ladder.

In the event that a roof ladder must be raised to a upper level via a straight or extension ladder, the roof ladder can be carried by one firefighter using the shoulder method, or it can be passed up the ladder by a firefighter positioned below. In the one person raise, the roof hooks should remain closed until the firefighter has reached the desired position on the ladder, and is locked in by a safety belt, life belt, or leg lock.

d. Working on a Ground or Aerial Ladder

Firefighters must sometimes work while standing on a ladder and must have both hands free. In this case, a safety belt or leg lock must be used to safely secure the firefighter to the ladder while working from it. Safety belts are located on various department apparatus.

e. Assisting a Victim Down a Ladder

When it is known in advance that the ladder will be used for window rescue, the ladder tip should be raised only to the sill. This gives the victim easier access to a ladder. All other loads and activities should be removed from the ladder, which should be securely anchored at both the top and bottom, if possible. Three or four firefighters should be used for a ladder rescue. For ground ladder rescues, when possible, at least two firefighters should be in the building and one on the ladder. If the victim is conscious, the firefighters in the building should lower the victim feet first from the building to the ladder. The rescuer on the ladder should support the victim and descend the ladder. The rescuer descends first, keeping both arms around the victim under the armpits, with hands on the rungs in front of the victim for support in case the victim slips or passes out. When descending aerial ladders it may not be possible to place arms around the victim as the side rails may be in the way. Reassure the victim constantly while descending because the victim probably will be nervous and panicky.

An unconscious victim is held on the ladder in the same way as a conscious victim except the body rests on the rescuer's supporting knee. Place the victim's feet outside the rail to prevent

entanglement. A second way to lower an unconscious victim involves the same hold by the rescuer, except that the victim is turned around to face the rescuer. This position lessens the chance the victim's limbs will attach between the rungs. A third alternative method is to lift the victim out the window to the rescuer on the ladder. The victim is then support at the crotch by one of the rescuer's arms and at the chest by the other arm. If the victim is heavy or if several rescuers must help, two ground ladders can be placed side by side. One firefighter descends first and supports the victim. A second firefighter on the other ladder descends slightly above the victim supporting the upper torso. Smaller size adults and children can be brought down a ladder by cradling them across the arms.

f. Operating From a Ladder

When dismounting a ladder onto a roof and carrying a tool, the tool should be used to locate and feel out the roof before dismounting the ladder. The tools should then be placed on the roof to allow both hands the freedom of safely climbing onto the roof. Likewise, when mounting the ladder from the roof, place the tool where it can be retrieved after mounting the ladder to descend.

When breaking window glass, break the top panel first, and then lower panels to prevent being exposed to the heat of the fire. The tools should be at such an angle that broken glass cannot slide down the handle.

Care should be taken when ventilating lower floor windows that firefighters operating on ladders above are not endangered by the escaping gas and fire.

Firefighters operating in a fire building should look for secondary means of egress. This can be fire escape, an adjoining roof, or a main or ground ladder.

g. Innovative Ladder Usage

Firefighters generally use a ground ladder to reach upper elevations or search and rescue, ventilation, and suppression. However, firefighters should not let the traditional uses of the ladder limit other functions for which the ladder can be utilized, such as to bridge openings between buildings, or propping open overhead doors to fire buildings (ensuring a ready exit for firefighters), as a battering ram to open doors or break out plate glass windows, as a stretcher to remove someone injured from upper floors or below grade locations by securing them to the ladder, replacing over floor areas that have been weakened or burned through to allow firefighters to operate in a safer manner, or for placing over roof openings during overhaul to identify their location.

h. Ground Ladder Maintenance

To ensure their liability, the District prefers that all ladders receive regular maintenance and testing. Maintenance should include the thorough cleaning and inspection for wear and damage at regular intervals, and after major incidents. Should any problem be discovered, or if the ladder fails the testing, the ladder should either be repaired or destroyed.

i. Basic Guidelines for Safe Use of Ground Ladders

- Use a proper length and kind of ladder;
- Never attempt to "make due", except to save a life;
- Use the ladder at the proper angle;
- Position the ladder with the objective in mind;
- Keep all ladders away from all electrical lines;
- Do not position ladders directly in front of paths of entrance or egress where fire is likely to vent;
- Do not overload the ladder;
- When climbing, always have one hand on the ladder;
- When working off the ladder, always use the ladder locks or a ladder belt;
- Do not over extend yourself;
- Tie the base of the ladder off;
- Never leave a ladder unattended;
- Before stopping off any ladder, be sure of the stability of the area you are about to enter.

2. **Aerial Devices** (For more specific information, see the "Ladder Company Operations" S.O.P.s)

a. Introduction

Aerial devices are commonly used to perform the following tasks: to provide roof access, rescue or removal of victims, access for members to enter and search upper floors, window ventilation, heavy stream application, and as a platform for overhauling or inspecting an area.

Certain tasks lend themselves to be performed by specific kinds of devices; for example, ventilating windows on the front of the building is accomplished rapidly by using an aerial ladder, or removing an unconscious victim is far easier with an elevating platform. The Western Reserve Joint Fire District utilizes an aerial ladder with water pipe capabilities, while other nearby departments, such as Beaver, Boardman, Canfield, and Campbell, operate ladder towers. Both have advantages and disadvantages when operating on the fire ground. However, because of the possibility that both will

be operating at any large commercial, industrial, or institutional fire within the District, the operations of both will be discussed.

b. Placement of Aerial Devices

A "scrub area" is the amount of surface area that physically may be contacted by an aerial device. Generally, the greater the working height of a device, the more scrub area it can cover. Scrub area determines how wide and high apparatus may be expected to cover for access, egress, platform and stream application.

Positioning of the apparatus has a direct bearing on the scrub area. The farther the apparatus is from the building, the less area the end of "the stick" will reach. At the same time, position too close may reduce useful scrub area since the apparatus may be too close to swing the ladder or boom to the lower floors, which may be where it is needed.

The particular "perfect distance" for an aerial device to obtain its maximum scrub area will vary, depending on the length of the device and the number of telescoping sections.

The ladder operators (chauffeurs) must be trained to judge this distance from a building to get the most out of the apparatus. That involves setting the apparatus up at actual structures and comparing the effects of various distances. Additionally, Incident Commanders must be aware of the capabilities and limitations of the District's device as well as other devices available to them.

When placing an apparatus for operation on the lower three floors of a building the driver must be cognizant of the vehicle's "profile" and how it affects the movement of the aerial device. Rear mounted devices, such as the District's, suffer from pulling nose-in as do the mid-ship trucks, but often not as severely since they are built with a lower profile cab to allow for street clearance. The best scrub area for rear mounted devices is obtained by backing into position, but this can be impracticable due to time constraints, as well as the need to keep the street clear for other apparatus. To obtain the best scrub area for mid-ship mounted devices, such as Boardman's, the best scrub area is obtained by placing the apparatus just off parallel to the objective. The cab should be angled approximately 15 to 20 degrees away from the fire building. This would get the cab out of the way for the lower angles without swinging the back into the way.

Some guidelines for apparatus positioning apply to all kinds of aerial devices. The first is that they should be positioned for maximum benefit of their device. On the fire ground, it is fairly common to see aerial devices blocked out of the proper position by engine companies. A pumper should be spotted 25 feet in one direction or another of the fire building to allow the aerial access to the building.

The second guide is to position the apparatus with the fire's anticipated progress in mind. Generally, as the aerial driver approaches a building, he should slow down and observe conditions. If obvious conditions demand locating at a specific position, such as a victim at a window, go ahead and spot as described above. In the absence of any specific requirements, however, position the apparatus just past the corner of the building you approach first. This allows the apparatus to be driven forward if

the need to reposition suddenly occurs. This is must simpler than trying to back up into position. To position for access over the fire, try to position to the upwind side of the fire so that the heat, smoke and flame are carried away from anyone operating above. (See Subpart C of this section for more information regarding apparatus and vehicle placement at structural fire scenes.)

All aerial devices must be kept 10 feet or more away from overhead power lines. The metallic frame of aerial devices, coupled with a direct contact between the stabilizers and the ground, produces an excellent path for electric current. The premise must not be broken unless under extreme conditions.

c. Raising and Placing an Aerial Device

When raising the District's aerial to the roof, the ladder should be extended so that at least three to five rungs project above roof level, allowing for greater visibility of the "escape route" when conditions on a roof start to deteriorate. Additionally, the extra projection allows the firefighter to maintain a firm handhold at normal standing position while mounting or dismounting the ladder. The ladder itself should remain an inch or two out from the building, which eliminates placing a strain on any parapet walls and allows the truss construction of the ladder to perform its design. When the weight of firefighters is applied to a ladder, the beams will just rest on the roof edge.

A critical factor to remember when positioning an aerial is that the ladder must be placed as square to the building as possible. If a ladder is placed at an angle to the building, one beam of the ladder will contact the building first. As the climbing firefighter's weight approaches the tip, the ladder will twist until the other beam also rests on the roof's edge. This is dangerous for two reasons: First, the twisting is a severe torsional load on the ladder, which can lead to ladder failure. Second, placing the ladder at an angle can permit the ladder to slide along the upper wall of the building, causing a twisting motion, which can lead to a severe shock load on the ladder if it leaves the wall of the building. A way to avoid these hazards is by positioning the apparatus so that the turn table is in line with the objective, and rotating the ladder until it is perpendicular to the building.

The positioning of the District's aerial ladder to a window should be similar to positioning to the roof, in that the turn table should line up with the window and the ladder should be perpendicular to the building. The aerial should be just below the window sill if possible. That leaves most of the window free for entry/exit. Remember, the average residential window is only 30 inches wide, while the tip of the District's aerial is 32 inches wide. There is not enough room for a firefighter to squeeze by if a ladder projects too far into the window.

When placing a mutual aid department's platform to the roof, a firefighter in the basket can place it at the best location. If the roof has no parapet wall, it is best to place the basket over the building, just resting on the roof, allowing firefighters to step directly through the platform onto the roof. If the building has a moderate height parapet (3 to 6 feet), place the top rail of the platform basket just slightly above the top of the parapet. This facilitates member climbing in or out of the basket. For unusually high parapet walls (more than 6 feet), it is best to locate another spot from which to enter, or if not possible, ascent/descend from the bucket to the roof by the use of an "attic ladder" secured to the top section of the boom.

A primary function of all aerial devices is to allow firefighters access to upper floors of a structure via the exterior. When fire on a lower floor is blocking access to escape from upper floors, the aerial device is necessary. It allows firefighters to get above the fire, to search for and to cut off any vertical extension and to search for and remove any victims.

If a victim is found, especially an unconscious or disabled victim, it is much safer, faster and efficient to place him or her into the basket of a tower ladder, if available. Finally, the basket of a tower ladder is a better area of refuge if conditions worsen inside the building suddenly, as firefighters working on the interior of a structure can bail out into the basket much more easily than clambering out onto an aerial ladder.

Positioning a basket of a tower ladder requires a technique apart from placing it on the roof. First, most platforms have a master stream nozzle mounted on the front center of the basket which impedes access to the basket at the center. On the other hand, the front corners of the basket are relatively unobstructed. For these purposes, the best position for the basket is as close to the building as possible, with the basket in line with the window. This assures the shortest travel distance and places the front corner of the basket at the window. The basket should be placed so that the top rail is level with the window sill, making entering the basket easier and keeping people in the basket out of most of the smoke/heat coming from the window.

Unless the line up is perfect, the firefighter should forget about the gates of the basket. They are too narrow and trying to align them with the window opening takes too much valuable time. Additionally, most tower ladder baskets only open inward (i.e., Boardman's), reducing the space available inside the basket.

d. Aerial Operations

The use of aerial devices to apply heavy streams of water goes back more than 100 years to the days of hydraulically raised water towers. However, aerial devices utilizing water pipes are often misused. Just as at ground level, there is more to proper stream application 50 feet in the air than just squirting water. Water functions primarily as a cooling agent. Therefore, to do its job, it must end up on the fuel, cooling it until it ceases to give off flammable vapors. That means the water must hit the seat of the fire, not merely the flame that results form the burning process. At ground level, when a fire exceeds the capabilities of a hand-line, a master stream is often brought into play. One of the most common reasons for doing this is that the fire has extended into the cockloft, allowing a rapidly spreading fire that extends to several areas simultaneously. In rather short order, the roof decking burns through and the Incident Commander now is faced with a lot of visible fire blowing through the roof. A much more satisfactory approach is to put a lot of water on the fire form underneath, where it will cool off the fuel, thus stopping the gas (flame) production.

A mistake at this point is to think that by putting the stream through a hole in the roof, the fire will be stopped. This is almost never the case. This action just drives flame, heat and smoke back under the roof where they spread out. Remember, the basic purpose of a roof is to keep water out. The roof does not discriminate between an elevated master stream and a torrential downpour. As long as part

of the roof is intact, the fire will burn beneath that section, unimpeded by the stream coming through the hole.

A much more successful approach is to get a stream up under the roof from below. The District Incident Commander should consider this maneuver in the event of heavy fire. Remember, height is not a requirement for the use of a master stream. Many rapidly spreading taxpayer or plaza fires have been stopped in their tracks by the quick application of 800 to 1000 GPM of water being applied from the sidewalk level.

The telescoping device of the aerial device must never be extended or retracted while a person is climbing on the ladder. Shifting rungs of the ladder can cause severe crushing injuries to a firefighter's legs and feet. If conditions are such that people on the device are exposed to severe conditions, rotating the turn table, raising or lowering it should provide relief. Extending or retracting, however, invites injury.

Finally, when members are operating from aerial devices, they shall be secured to an aerial device by an approved safety harness that complies with the requirement set forth in NPFA 1500.

M. REHABILITATION DURING EMERGENCY OPERATIONS

All supervisors shall maintain an awareness of the condition of fire department members operating within their span of control and shall ensure that adequate steps are taken to provide for their safety and health. The command structure shall be utilized to request relief and reassignment of fatigued crews.

The Incident Commander shall consider the circumstances of each incident and make suitable provision for rest and rehabilitation for members operating at the scene.

Weather factors during emergency incidents can impact severely on the safety and health of members, particularly during extremes of heat or cold. Where these factors combine with long duration incidents or situations that require heavy exertion, the risk to members increases rapidly.

To that end, when such conditions are expected, the Incident Commander should make arrangements for additional companies or multiple alarms to provide adequate relief on the fireground. Additionally, additional EMS units should be summoned to the scene as needed to provide relief. The District should enforce the rule that no one firefighter operate on the interior of a structure or utilize more than two air bottles (one in extreme conditions) at a time, without being sent to rehab to be checked out. In the event that a firefighter is showing signs of suffering form exhaustion, typical rehabilitation considerations for operations during hot weather extremes are:

1. Moving fatigued or unassigned personnel away from the hazardous area of the incident;

2. Removal of personal protective equipment;

3. Ensuring that personnel are out of direct sunlight;

4. Ensuring that there is adequate air movement over personnel, either naturally or mechanically;

5. Providing personnel with fluid replenishment, especially water; and

6. Providing medical evaluation for personnel showing signs or symptoms of heat exhaustion or heat stroke.

Typical rehabilitation considerations for operations during cold weather extremes are:

1. Moving fatigued or unassigned personnel away from the hazardous area of the incident;

2. Providing shelter from the wind and temperature extreme;

3. Providing personnel with fluid replenishment, especially water; and

4. Providing medical evaluation for personnel showing signs or symptoms of frost bite, hypothermia, or other cold-related injury.

The Incident Commander shall make all arrangements necessary for the on-scene rehabilitation to include at least basic life-support care.

N. INCIDENT CRITIQUE

In every emergency incident, the fire department shall make arrangements at its next immediately scheduled drill to review the incident in its entirety, and to discuss any improvements which might be made to these Standard Operating Procedures.

Additionally, at any incident involving firefighter's serious injury or death, a formal post incident critique shall be made of the incident. Critiques of such an incident shall be made by both the entire department and the Fire Department Occupational Safety and Health Committee (Safety Committee). (The Safety Committee shall meet after the entire department to define all further reporting as set forth below.) The critiques shall include a basic review of the conditions present, the actions taken, and the effect of the conditions and actions on the safety and health of the department members. The critiques shall identify any action necessary to change or update any safety and health program elements to improve the welfare of members. The critique shall include a standardized action plan for such necessary changes. That action plan shall include the change needed, responsibilities, dates, and details of such action.

The Incident Commander must automatically integrate firefighters' safety and survival into the regular command functions. When this integration occurs, the Incident Commander promotes firefighter welfare by performing the standard job of command. Under fire conditions, the Incident

Commander is at an extreme disadvantage to perform many additional tasks. The safety plan for the Incident Commander has to be the regular command plan.