



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

Truck Company
Book 3 – Ladders
First Edition

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PREFACE

Truck companies carry a myriad of tools and equipment to the fire scene. The most obvious, and arguably one of the most critical to firefighting operations, is the ladder in its many forms. Much like the hose team must master their trade in the deployment of hose lines, so too must the truck company members master their craft in the art of selecting and deploying the proper ladders for meeting operational objectives. It is imperative that truck company members are well-versed in all styles and types of ladders carried on their apparatus. Additionally, all members should be knowledgeable in the proper selection, deployment, maintenance, and care of ladders on their assigned apparatus.

The purpose of this manual is to establish standards and operational guidelines for the Northern Virginia region and to ensure all jurisdictions share a common language during emergency operations and training.

Definitions

The key definitions used in this manual are as follows.

Bridging – Using a ladder to span distances resembling a bridge. This can be used to span two buildings, trenches, etc.

Clamp-on Ladder Pipe (Portable Ladder Pipe) – Portable, elevated master stream device clamped to the top two rungs of the aerial ladder when needed and supplied by a 3-inch or 3½-inch fire hose. The nozzle is typically controlled with guide ropes.

Combination Ladders – Ladders with a locking hinge in the center of the main beam than can be used as a straight ladder or A-frame ladder. These ladders are typically telescoping giving them a great deal of versatility.

Extension Ladders – A non-self-supporting ground ladder that consists of two or more sections traveling in guides, brackets, or the equivalent arranged to allow for the link adjustment.

Folding Ladders (Attic Ladder) – Short, collapsible ladder easy to maneuver in tight places such as reaching through openings in attics and lofts.

Pre-piped Waterway – Fixed elevated piping that is secured to the bed of the hydraulic ladder and supplies a master stream nozzle delivering over 350 GPM. Controls for these waterways are typically controlled remotely with manual hand cranks or electronically.

Roof Ladders – Straight ladder with folding hooks at the tip. The hooks anchor the ladder over the roof ridge or other obstacle.

Rope Hose Tool – Piece of rope or webbing spliced to form a loop through the eye of a metal hook; used to secure hose to ladders or other objects and/or assist in the movement of the hoseline.

Straight Ladders – A non-self-supporting portable ladder that is fixed in length consisting of one section.

Turntable – Rotational structural component of the aerial device. Its primary function is to provide continuous rotation on a horizontal plane.

Special Note

Please be aware that while this manual may make recommendations on the use, testing, maintenance, and storage of ladders and equipment, personnel and departments must always consult the equipment manufacturer's recommendations and guidelines as the primary resource for use, testing, maintenance, and storage.

PORTABLE LADDERS

Portable ladders are first and foremost for the access and egress of firefighters, Figure 1. They can also be used to:

- Search for and remove victims,
- Provide access to areas below grade,
- Access and exit areas above ground level,
- Advance hose lines to upper floors,
- Deliver tools and equipment to areas above or below ground level, and
- Conduct ventilation operations.



Figure 1: Portable ladders should be placed for the access and egress of firefighters.

The main advantage of portable ladders is their versatility and mobility. They can be quickly placed in service by a crew of two or more, or, in some cases, by one well-trained individual.

NFPA 1901 recommends the standards for fire department apparatus and states that the minimum total ladder length to be carried on aerial apparatus as 115 feet. Typically, truck companies in the region will carry in excess of 115 feet, but the selection of ladders will vary throughout the region and in accordance with the type of truck style (aerial platform, aerial, and tiller). Truck companies carry a complement of ladders consisting of straight ladders, roof ladders, extension ladders, folding ladders, and combination ladders. All of these have different applications on the fire ground and require continual practice for their effective deployment. Personnel should be intimately familiar with the complement carried on their respective department apparatus as well as be well-versed in their maintenance and use.

The ladders should have the tip marked (i.e., fluorescent paint, tapes, etc.) to increase visibility of the ladder when inside a smoke-filled room or on a roof. However, the only NFPA requirement pertaining to marking portable ladders is that if marked they shall only be marked at the top 18 inches. The ladders should also be marked (tape or permanent marker) at the middle point to facilitate quick recognition so as to not unload the ladder from the bed unbalanced and

have to reposition it on the shoulder prior to deployment. Ladders should be tested annually and must be inspected and cleaned monthly and after every use. This can be accomplished with soap and water and, at times, steel wool may be required to remove burs along the beams.

Personnel should be familiar with any ladders that have heat sensor indicators on the ladder (required by NFPA if manufactured after 1984) and visually inspect them during the inspection. The labels should be located below the second rung and at the halfway point of the ladder. If the indicators have changed color or have reached their expiration date, the ladder should be removed from service and tested, Figure 2. These labels are rated to change color if the temperature on the ladder reaches 300° degrees Fahrenheit. This is important as the aluminum, even if only exposed for a moment, can lose as much as 25% of its load capacity and can continue to accumulate over its lifetime



Figure 2: Personnel should inspect heat sensor stickers, if present, on their ladders for change of color and expiration during their inspection.

The main disadvantage of portable ladders is their limited reach. Most of the portable ladder complements carried on truck companies have a maximum reach between 35 to 45 feet. This length can allow access from the ground level to fourth floor windows and/or a roof. Ultimately, the effective reach of the ladder will depend on the distance from the building and the terrain on which the ladder is placed.

When selecting a ladder for a task, choosing an extension ladder longer than needed is better than one that is too short to complete the task. This will allow the firefighter to overcome topography or grade issues that may be present around the structure or, due to obstructions, demand a steeper angle. However, training and knowing your first due response areas are paramount, as too much ladder may present problems as well. A ladder that is fully extended to its maximum reach and placed at a poor climbing angle may result in an accident or injury.

Truck companies, in particular driver/operators, should be prepared on all incidents to position the aerial device properly to any structure, but should also consider placement options for

making portable ladder deployment efficient. Ground ladders will provide a quick and efficient means of access and egress to most residential structures. However, if victim removal from a window or upper level is necessary and out of reach, the aerial device can provide a more efficient platform from which to work.

Portable Ladder Carries

Staffing, terrain, and other incident issues will dictate the specific manner a portable ladder should be carried to its intended target, however, some general tips and guidelines may be beneficial. Regardless of the carry used, firefighters must always be diligent of the surroundings by continuously checking for overhead power lines, obstacles, and bystanders.

Single, straight, or roof ladders, due to their limited overall size, are the easiest to carry to the objective. These ladders may be carried on a high shoulder carry, low shoulder carry, or even in a suitcase fashion, Figure 3. All of these methods will provide a free hand for another ladder, tool, or simply to stabilize the firefighter when traveling over rough terrain.

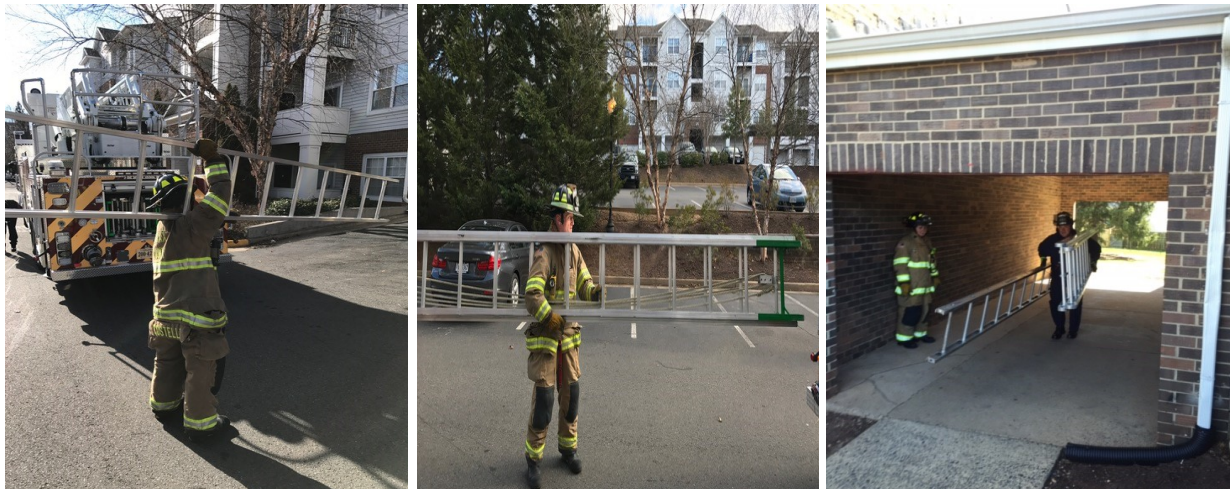


Figure 3: The high shoulder carry (left), low shoulder carry (center), and the suitcase carry (right).

Extension ladders are the most versatile ladders, but they are also the most cumbersome and heavy of the ladder complement, which means we need to use more personnel to carry and operate them or find creative techniques.

Extension ladders should be loaded in the ladder bed in an alternating fashion in order to facilitate the most advantageous carry to the objective, Figure 4. Having the tip out is advantageous for those instances when the objective is towards the front of the ladder truck negating the need to rotate the portable ladder and butt out. Ladders loaded in the opposite direction facilitate deployment to an objective to the rear of the ladder truck, Figure 5. Firefighters should remember to grab the fly section of an extension ladder if loaded heel out and grab the bed section if loaded tip out so as not to extend the ladder in the bed. If the firefighter is not paying attention and the ladder is extended in the bed, it may take several minutes to rectify the problem.

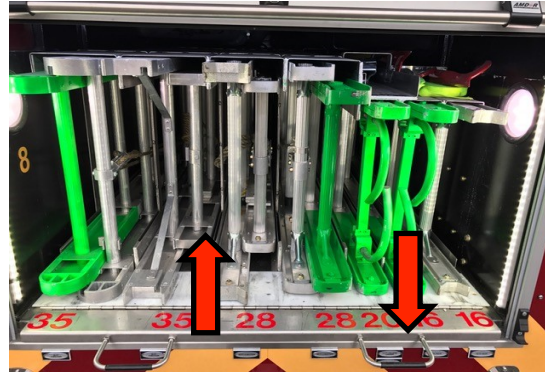


Figure 4: Ladders loaded in alternating positions.



Figure 5: Heel-out storage means the ladder is directed toward the objective (left) and tip out storage allows deployment to an objective in front of the apparatus without turning the entire ladder (right).

Firefighters should take note of whether or not the aerial ladder will be placed in service when deploying portable ladders; often, depending on grade, once the stabilizers are set the height of the truck, it will make portable ladder removal very difficult.

Once the extension ladder of choice is selected, the carries may be the same as the single, straight, or roof ladders with the exception of the potential need for more personnel. With staffing of four or more on a truck company, the need to single-handedly carry the larger extension ladders is outweighed by the efficiency of using more personnel. Two firefighters can effectively carry a 35-foot or greater extension ladder, hand tools, and a roof ladder to the objective, deploy the ladders, and not be fatigued for the next task.

Firefighters should practice their ladder carries and deployment on a regular basis to increase their muscle memory and confidence.

Portable Ladder Placement

Laddering of a building is dependent upon the type and occupancy of the building as well as the location and extent of fire. The primary reason for general laddering of a building is to provide avenues for firefighter access and egress. Other factors to consider for laddering a structure include:

- Victim removal,
- Access for vent, enter, isolate, and search (VEIS),
- Access for hose line advancement, and
- Ventilation operations.

Based upon these factors the priority order for placement of portable ladders on the fireground should be:

1. Fire floor.
2. Floor above the fire.
3. Adjacent compartments and roof if needed.

If the decision is made to access or operate on the roof, two ladders should be placed to the roof at different areas to provide a secondary means of egress. Roof operations are ultimately safer if performed from the aerial when possible.

In order to select the most appropriate portable ladder for the task to be accomplished, estimate 9 feet per floor in residential occupancies and 12 feet per floor in commercial occupancies. For basement fires, an attic ladder may be placed into the basement well window if the size of the opening permits egress. Additionally, consider prepositioning a ladder to quickly deploy into the structure to replace stairs that have deteriorated from the fire. The typical run of residential stairs is 13 feet; if feasible, the placement of a 14-foot straight ladder can provide access in place of the stairs. A folding attic ladder should also be anticipated for fires that originate in the attic. All too often are calls for attic ladder communicated late in the operation.

Placement of the correct ladder for the task and the location should be determined prior to deployment, Figure 6. Truck companies may have to use additional portable ladders from other truck companies or engine companies on scene to fulfill additional demand for appropriate portable ladders.



Figure 6: A 20-foot straight ladder versus a 24-foot extension ladder deployed to a second story window.

Some common applications for various ladders are shown in Table 1.

Table 1: Common applications for ground ladders on the fireground.

Appropriate Ladder	Intended Target
14'/16' Straight/Roof	2nd floor residential windows
16'/20' Straight/Roof	2nd floor commercial windows/1 story roof
20' Straight/Roof	2 story residential roof
24' Extension	2 story residential roof 3rd floor residential windows
28' Extension	2 story commercial roof 3rd floor residential windows
35' Extension	3rd floor commercial windows 3 story residential & commercial roof 4th floor residential windows
40' Extension	3rd or 4th floor commercial windows 3 story roofs
45' Extension with stay poles	3rd or 4th floor commercial windows 3 story roofs
Aerial	Below grade and any target higher than 4th floor windows depending upon access and obstructions.

Approximate bedded lengths and weights for various ladders are shown in Table 2.

Table 2: Approximate lengths and weights of portable ladders.

Ladder Type	Approximate Bedded Length	Approximate Weight in Pounds
14' roof	14	30 to 40
16' roof	16	35 to 50
20' roof	20	45 to 60
24' extension	14	70 to 80
28' extension, two section	16'6"	80 to 120
28' extension, three section	13'6"	100 to 150
35' extension, two section	20'	120 to 150
35' extension three section	16	125 to 180
40' extension, two section	22'6"	160 to 170

Some general rules for portable ladder usage and placement are:

- Position the ladder with the objective in mind (access, egress, or hose advancement.)
- When heeling a ladder, the heeling firefighter should position outside of the ladder (not under it) to monitor fire conditions, check for rescues, and to stay away from falling glass and dropped tools, Figure 7.
- Place the ladder with the fly out for all operations.
- If an assigned task demands a firefighter to work from a portable ladder, a leg lock or a ladder belt or Scott Multi-use strap should be used. If using a leg lock, the leg used to perform the lock shall be opposite of which the task will be performed,



Figure 7: Heeling ladder position on outside of the ladder.



Figure 8: Perform the leg lock with the leg opposite of which the task is performed.

- If a victim is present at the window, throw the ladder to the side of the window and once raised, roll it onto the sill. This may prevent the victim from either jumping or reaching out and trying to grab the ladder when it is not in position.
- Place the tip of the ladder next to and upwind of the opening if the ladder will be solely used for performing ventilation of that opening.
- Place the tip of the ladder at or slightly below the sill, and in the center of the opening for access or egress, Figure 9. The window can be ventilated and entered from this position when executing VEIS. This is the preferred position for the majority of fireground operations.
- If ascending to a roof, place at least 3-5 rungs above the roofline and make a general announcement on the fireground channel, Figure 10.
- Place the tip of the ladder a minimum of two rungs above and near the end of the railing on a balcony where the railing is flush with the exterior wall. This position will allow for the firefighter to climb onto the balcony as well as keep the ladder out of the way of operations, lessening the probability it could be dislodged from its position.



Figure 9: The preferred position for the portable ladder is at or slightly below the sill.



Figure 10: When laddering a roof, three to five rungs should be placed above the roofline.

- Place the tip of the ladder against the wall to the upwind side of a cantilevered balcony. The balcony will assist in keeping the ladder stabilized. The ladder tip should be a minimum of two rungs above the railing height, Figure 11.
- Portable ladders should not be placed directly in front of an entry or exit route.



Figure 11: If positioning a portable ladder to a cantilevered balcony, place against the wall to the upwind side. The ladder tip should be a minimum of two rungs above the railing height.

- Windows showing fire or those that are showing smoke should have a ladder placed at, or slightly below the sill. This is to ensure if a firefighter is in the room they can quickly exit onto the portable ladder.

Factors that may affect ground ladder placement include terrain and obstructions on the ground or overhead. When the ladder is being raised on soft ground or uneven terrain, a step chock or similar object can be placed under the bottom of the ladder to reduce the distance or prevent the beam from sinking in the ground, Figure 12. Situational awareness is critical to ensure sufficient clearance between any overhead lines and the ladder placement, also providing 10 feet of safe work area for fire service personnel to operate once in place. Always check overhead for obstructions and electrical wires when placing any ladders.

Once a portable ladder is in place, it should not be moved and the position voiced on the radio. However, if an emergency arises and requires a ladder to be moved, another ladder must be placed to the original location.



Figure 12: Use of step chock and cribbing to overcome uneven terrain for ground ladder placement.

Roof ladders should be used on pitched or sloped roofs, or where footing is questionable. The roof ladder offers some support by dispersing the firefighter's weight should the roof deck become compromised, Figure 13.



Figure 13: If operating on a peaked or pitched roof, personnel should operate off of a roof ladder placed on the roof to disperse their weight.

When a high parapet is encountered, an additional roof or straight ladder should be used to descend onto the flat roof. The second ladder should be carried up the first ladder, heel first,

when traversing a parapet. On some tower ladders in the NOVA region, a ground ladder can be attached to the basket of the ladder to allow for access over the parapet, Figure 14.



Figure 14: Ground ladder placement from aerial to access a roof with a high parapet wall. Some Tower Ladders have the factory installed option for this operation.

Crews operating on the roof should be advised of the location of all ladders that have been placed to the roof for egress. Roof operations require two ways off the roof (masonry firewalls that parapets through the roof may act as one way off).

Advanced Ladder Placement Techniques

Due to staffing, the need to carry and place portable ladders with only one member arises and there are times when the terrain will not allow for easy heel placement. These instances, while rare, will require unique tactics and practice to become proficient while operating alone. When the need arises to place a ladder with one member, and the environment doesn't support the proper heeling of the ladder (e.g., flat hard surface or overhangs), members must seek alternate methods of heeling. If a seam in the sidewalk or asphalt can be found and is in line with the objective, it can prove advantageous for ladder heeling, Figure 15. There may be times when there are over-hangs or shrubbery that complicates heeling the ladder alone. A New York roof hook, or other suitable hook, may be used to create distance from the building and provide sufficient footing for the ladder, Figure 16.



Figure 15: The use of a seam in the sidewalk or asphalt can be helpful in heeling the ladder to raise.



Figure 16: The use of a truck company hook to aid in heeling and placing it the correct distance from the building.

Another method is the single person beam raise when there is no other alternative, however this is typically only suitable for the straight or roof ladders due to the size and weight of the larger extension ladders. For the extension ladders the use of webbing may be used to step off the ladder when there is no suitable heeling surface. If asphalt is encountered a haligan may be driven into the surface to provide for a heeling surface. All of these methods should be carefully executed due to the instability of a single person raise without a solid heeling surface and tying them off, at either the bottom or top, after being deployed is encouraged.

Alternative Uses for Portable Ladders

Companies should be familiar with their response districts and be aware of areas where laddering may be a problem. Other uses for portable ladders include:

- Bridging between two structures or across a trench,
- Ice rescues,
- Creating makeshift drafting pits,
- Creating salvage chutes to divert water from damaging property (Figure 17), and
- Hanging exhaust fans during ventilation.

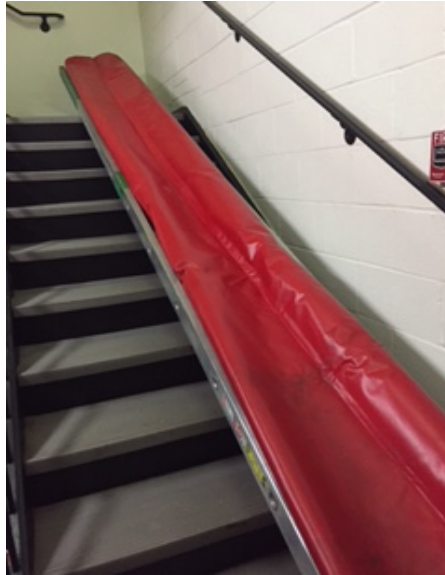


Figure 17: Using a ladder as a salvage chute.

Bridging is a method for using a ladder to move from one elevated or horizontal position to another, Figure 26. Ladders can be used to bridge a separation from one building to another, deck to a deck, or to access the roof of another building in a row where the roof is at a different elevation. Extension ladders should be used for bridging as the ladder is being used against its intended design and the extension ladder provides a more stable surface. Ladders can also be used to get over a fence, wall, or other barricade. When bridging over a fence or wall while climbing the first ladder, remember to carry the second ladder heel first, to place it to the ground without multiple movements of the ladder. If a fence is encountered on the Charlie side of a townhouse or other area that makes for tight quarters during firefighting operations, the fence should be removed as that will aid in ladder placement as well as assist the hose team.



Figure 18: Using a ladder to bridge between two areas.

Ladders can also be used in place of stairs in buildings under construction, or where stairs have been damaged by fire, by placing the ladder in the space from the upper landing to the lower floor. These ladders should be tied off or use the roof ladder and deploy the hooks for extra stability. They can also be used to block open elevator shafts or open floor areas as well as to create chutes or pits for water retention depending upon the size of the ladder.

During ice rescue operations, a portable ladder can be deployed on the ice as the firefighter moves toward the victim. The ladder will distribute the weight of a firefighter on the ice, or as a tool for the victim to grab.

AERIAL LADDERS

The aerial ladder can be very effective to rescue occupants trapped above the ground level. Removal and/or rescue via the interior stairs is the preferred path of removal due to the danger of a civilian descending an aerial ladder. If conditions do not allow for an interior removal to occur, using the aerial is acceptable. Any member operating on the aerial, in a bucket or on the aerial, shall wear a ladder belt or Scott Multi-use strap as the aerial often times will move abruptly. When performing a rescue via an aerial ladder, extra care must be taken to ensure that panicked occupants do not attempt to jump to the raising ladder. To prevent this, aerial operators must use the following aerial movements whenever a victim is present: raise, rotate, extend, and lower, Figure 19.

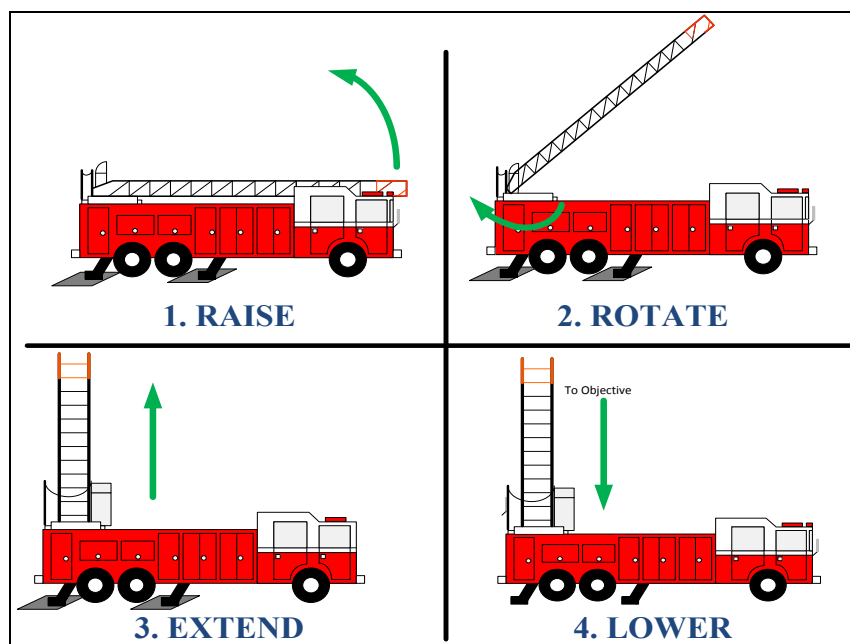


Figure 19: When using an aerial ladder for rescue, raise, rotate, extend, and lower into the objective is the preferred order to ensure the occupant does not jump onto the moving ladder.

If feasible, rescues made via an aerial ladder should be performed by a tower, as the bucket provides a more secure platform to operate from when attempting to remove occupants. Rescue via the tower can be completed in several ways. Entering and exiting from the platform shall be through the swinging gates and not over the railing if possible. Initially, the platform is elevated above the objective. The tower basket operator can communicate with the occupant and if calmed lower the platform to the point where the base of the platform is level with the window ledge. The occupant can then be moved in through the opened platform door. If the occupant is obese or incapacitated, the platform can be lowered to where the top rail is level with the ledge or sill. This is an occasion when entering over the railing may be prudent. A firefighter from the interior coordinating with the firefighter in the platform will need to occur for this operation to be successful.

Truck companies may have to make multiple rescues via the aerial ladder when they arrive at a fire and it is vital that an order of priority is clear based upon fire conditions. Occupants most threatened by the fire (in fire apartment, in apartment directly above fire apartment) will be the first priority for rescue. Performing constant size up of the fire and the expected travel is essential for the truck company. This knowledge will help the truck company personnel determine if multiple people need to be rescued via the aerial that are in the path of the fire and smoke. Additionally, if multiple rescues are to be made in a multi-story building, the tower can remove occupants to lower levels not affected by fire instead to the ground each time. This action will shorten the time between the aerial tower completing multiple rescues. This action shall be communicated to the incident commander to ensure companies can assist in the removal of the occupants via interior means.

When removing a victim down an aerial ladder, place the ambulatory victim between you and the ladder, then descend in unison with them (right foot down by the victim, right foot down by the firefighter) and maintain contact with the victim. If the victim panics, press them into the rungs with your body and attempt to calm the victim before you continue your descent. If the victim is removed to the ground they should never be left at the turntable. The victim will not be accustomed to the operations of the turntable and could fall from the apparatus causing injury.

During any rescue operation involving the aerial or when personnel ascend the aerial and enter an IDLH, the truck company operator should not leave the turntable. The truck company operator is most familiar with the operation of the apparatus and can quickly perform actions to remove personnel and citizens from an IDLH. The aerial ladder should not be retracted or extended with personnel on the rungs of the ladder.

Many times occupants will believe they are trapped by the fire and need immediate rescue, when in reality, they are not in harms way and will be able to shelter in place (e.g., an occupant on a balcony well below the fire and can protect in place by remaining on the porch and closing their balcony door.). At a minimum, truck company personnel must communicate with the occupants and provide them clear instructions to alleviate some of their fear and potentially stop the occupant from jumping.

Aerial Ladder Contacting Overhead Power Lines

If the aerial encounters an electrical power line, the operator should:

- Use the hydraulic controls to move the aerial ladder away from the wires. The electrical energy may damage the aerial's hydraulic system making this task impossible to perform.
- Stay on the turntable and warn all others to stay at least 30 feet away. The minimum safe distance will increase as the voltage increases. Safe distances can also be affected by weather and other factors.
- Notify the Incident Commander that the vehicle may be energized and make notification to the respective power company to de-energize the affected power lines.

- If collapse occurs or the vehicle catches fire, the operator must jump from the turntable onto the ground, never touching the vehicle and ground simultaneously. After jumping clear of an energized vehicle, the operator should bunny hop away from the vehicle for at least 30 feet to avoid any grounding potential (step potential).
- Isolate and deny entry to the area around the vehicle.

Elevated Master Stream Operations

The purpose of the master stream device is to apply a large volume of water, with the reach and penetration needed to extinguish the fire, Figure 20. This requires determining the location of the fire and having adequate water supply to reach it. Depending upon the volume of fire, obstacles hindering positioning and other issues, the master stream may be used for exposure protection or other tactical objectives, Figure 21. All of these tactics require personnel trained in the positioning, setup, and operation of the truck company and the elevated mater stream device.



Figure 20: The use of elevated master streams can be very effective in large uncontrolled fires.

Turntable placement is the responsibility of the truck driver, and shall be accomplished through communication and coordination between the officer and driver. Turntable placement is critical. The officer and driver must estimate the fire's growth and potential spread in order to have the stream operating at, or ahead of, the fire's forward progress. This requires knowledge of the time it takes the truck company to deploy its elevated stream and achieve a constant water supply, fire spread and growth, and the age and type of construction. An idea of the amount of time it takes for the stream to begin operating is gained from constant multi-company training. Knowledge of fire growth and spread is gained from experience and good judgment.

Depending on building construction type, condition of the structure, and the amount of fire, a potential exists for full or partial collapse of the structure. As a general rule, if the apparatus is to be used for its elevated stream and there is potential for collapse, it shall be parked away from the structure outside of the collapse zone, 1½ times the structure's height, and/or on an outside corner. If an effective stream and the penetration is sacrificed due to this distance, heavy consideration should be given to operating the stream from the turntable only. Coordination shall be maintained between two trucks operating on opposite sides of the structure to eliminate the

possibility of pushing building materials towards the other truck company. When no hazard exists for collapse, position the aerial device in front of the fire so that the elevated stream will be most effective. Ideally, the aerial master stream should be positioned for the best reach and penetration to the seat of the fire. Aerial master streams positioned too far from the involved structure do not deliver water effectively due to the stream breaking apart prior to reaching the seat of the fire.



Figure 21: Elevated master streams on an aerial tower provides an effective tool in offensive exterior attack or for exposure protection.

Truck drivers must be familiar with the characteristics of their unit in order to provide necessary information to pump operators for proper water supply. One option for truck drivers to consider, when being supplied for aerial master stream operations, is to call for water from the engine company while watching the flow meter. When the desired flow is achieved (and shown numerically on the flow meter at the turntable pedestal), tell the engine driver that their pump discharge pressure is adequate.

Some elevated devices come with a set of smooth bore stacked tips and a fog nozzle. While often debated which nozzle is best, the facts show that smooth bore nozzles with an appropriate solid stream has the best penetrating ability to reach the seat of the fire. Officers and Incident Commanders need to keep this in mind when selecting a master stream nozzle. Both nozzles present benefits on the fireground, and it is imperative that personnel be familiar with each.

The three main uses for elevated stream operations are:

1. Extinguishment,
2. Exposure protection, and
3. Flying standpipe.

Extinguishment

Large volumes of fire should be knocked down prior to reaching the firewalls. If the water supply is sufficient and there are multiple master streams available, the additional master streams should be placed to support the existing firewalls, Figure 22.

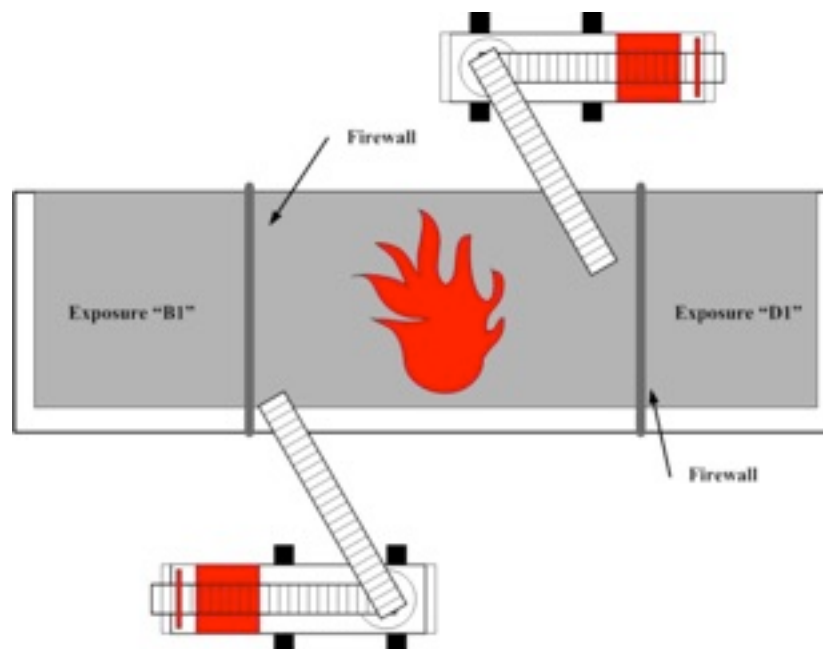


Figure 22: An example of two aerial devices working to defend the existing firewalls.

Depending upon the changing conditions of a large volume fire, the aerial device may need to be repositioned. The truck company must operate together and ensure all repositioning is coordinated between the truck company and engine company supplying the aerial.

Master streams can be used in various patterns for different purposes, as shown in Table 3: Potential uses for each pattern that may be present on a master stream..

Table 3: Potential uses for each pattern that may be present on a master stream.

Pattern	Use of Elevated Stream
Narrow Fog/ Straight Stream	Attic Fires
Fog Stream	Exposure Protection
Smoothbore Nozzle	Warehouse / Commercial Building

If the elevated stream is prepared to flow onto the fire but water is not yet at the nozzle, it shall NOT be rotated into attack position until water is flowing to prevent fire damage to the aerial. Operators MUST ensure that pinnable waterways are secured in the attack mode prior to charging the aerial waterway as serious damage, injury, or death may result from waterway failure. However, it is important to control where the stream is directed as the ladder is rotating into attack position. A protective stream from a hose line may be flowed onto the truck or the

aerial to protect it from exposure to heat and fire. This may be necessary when the water supply for the elevated stream is delayed, interrupted, or conditions have worsened.

All elevated streams using smooth bore tips should begin with the largest tip available within manufacturer's specifications unless directed otherwise, or if it is known that the municipal water supply will not support the flow.

As a general rule, to achieve the maximum benefit of any stream inside a structure, the stream should be directed upward at a 30-degree angle through a window or opening, Figure 23. An aerial ladder can be aimed upward with the addition of a 2½-inch, 45-degree elbow. Personnel should consult manufacturer recommendations for their respective apparatus.

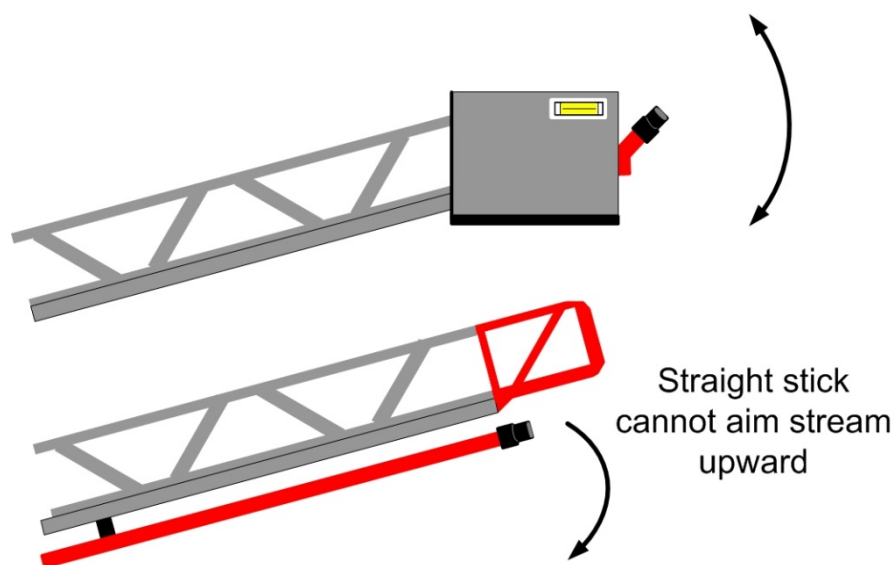


Figure 23: A 30-degree angle is best for fire knockdown from the platform.

If directing the stream into a window, the nozzle should be placed as close to the window as possible. If the nozzle cannot position through the window it should position at the level of the sill and flow at an upward angle. An aerial platform is equipped to handle this task, as its master stream has the ability to move upward, unlike the pre-piped waterway on rear mount ladder trucks. This action allows for a large volume of water to be bounced off the ceiling, floor members, or walls and create the maximum amount of droplets to absorb the massive amount of BTUs generated by the fire. The steam generated by the broken stream will follow the waves of convection generated by the fire and can extinguish fire in upper floors.

If a large volume of fire is on several floors, attack the fire on the lowest floor first, then move up, attacking each successive floor. If a large fire is spreading horizontally, stop its horizontal progress first and extinguish back towards its apparent origin. The nozzle should be at the level of the fire floor so that the stream can operate directly onto the seat of the fire. Personnel should remain cognizant that flowing thousands of gallons a minute into a building is creating a significant collapse potential.

The truck company's master stream can reach well above the noted length of the ladder and may be used to knock down a large fire from the exterior or flow down the face of the building to prevent auto-exposure/leap frogging.

A narrow fog is typically more effective than a smooth bore stream for sweeping the burning roof materials at the roof height. If operating upwards through lower windows into an attic fire, a smooth bore should be used to penetrate the ceiling, as the stream will bounce off the underside of the roof acting as a large sprinkler. The integrity of the roof assembly should be constantly monitored to evaluate the stream effectiveness.

When the stream is flowing at maximum rotation to one side, nozzle reaction will cause the ladder or platform to move in the opposite direction. Awareness is necessary to ensure the ladder or platform doesn't strike an object if this occurs. This is particularly important when working near wires, buildings, or other obstacles. The formula for calculating nozzle reaction (NR) is shown in Table 4.

Table 4: Nozzle reaction.

Nozzle Reaction	Nozzle Type	Formula
	Smooth Bore Nozzles	$1.5x D^2 x NP$
	Fog Nozzles	$.0505 x Q x \sqrt{NP}$

Exposure Protection

When an elevated master stream is being used for defensive operations, it is often to perform exposure protection. This tactic employs the use of a large volume of water to stop the spread of fire to both internal and external exposures of the fire. The most successful form of exposure protection is to slow or stop the ability of the exposure to continue to absorb heat from the fire. Ultimately, the most effective form of exposure protection is to put the fire out, and that should be consistently analyzed to ensure fire attack is being accomplished.

The elevated master stream should not be directed to break windows or create openings on the exposure building by dislodging siding or other exterior finishes. The stream should be directed to provide a constant film of water onto the exposed portion of the structure. The tactic of creating a water shower between the fire and the exposure has proven not to be as effective as saturating the exposure building.

Personnel should coordinate the placement of handlines to be deployed into the exposure building if the fire penetrates a window or other openings and begins to burn within the exposure. The nozzle operator of the elevated master stream must remain vigilant and constantly assess the effectiveness of the exposure protection provided by the elevated master stream.

Flying Standpipe

The primary function of the aerial apparatus is for placement to those upper floors beyond the reach of portable ladders for firefighter access/egress and victim rescue. There are times when we may elect to use the aerial device in order to get water to upper floors when stretching through the interior is either untenable or not possible. This tactic should always be carefully

weighed against the use of the aerial for firefighter safety and victim rescue, as connecting a hose line to the aerial apparatus will remove the aerial from service for other important tasks. There are several ways in which we may use an aerial device for a flying standpipe and most often we associate this with connecting the hose to the aerial. Most aerial towers will have a small 1½-inch threaded discharge connection located on the bucket for this tactic, as well as a small length of hose with a nozzle. The main purpose of the hose and associated connection on the bucket is for mop up or overhaul scenarios. A straight aerial ladder may be converted to a flying standpipe by removing the tips from the pre-piped water way, leaving the stream straightener and applying a reducer. The most advantageous method for using the aerial device to achieve a flying standpipe is to simply use the ladder for access stretching the hose up the ladder, securing the hose with a rope/hose tool, and thereby freeing up the aerial for other duties.

If placing an elevated stream into operation after a change in strategic modes (offensive to defensive), ensure through Command that a personnel accountability report (PAR) check is completed verifying all personnel are out of the area where the stream will operate and that it is safe to flow water.

Use extreme caution when operating elevated streams in the vicinity of overhead electric wires. Always assume wires are energized, and may arc to the aerial. When operating the stream, avoid striking wires or any electric equipment. (The 10-foot rule doesn't necessarily apply; the safe distance should be increased if at all possible.)

All personnel on the aerial operating any elevated stream shall be in full PPE and SCBA. A life belt shall be worn and fastened to a portion of the ladder rated for anchoring when operating the ladder pipe.

TOWER/LADDER TOWER OPERATIONS

Fire and rescue departments within Northern Virginia primarily operate tower ladders, as the ladder itself is a dominate part of the apparatus. A tower ladder will typically only have an escape ladder mounted to the boom of the platform. This book will be referring to ladder towers, or simply towers, as those that have the ladder built into the bucket.

The tower is one of the most versatile ladder trucks in the fleet due to the ability to operate independently from the bucket of the aerial, giving us a steady work platform from which to operate, Figure 24. Consider requesting these units in situations requiring an elevated stream, or those fires involving large square footage at street level, such as fires in strip shopping centers. When using the tower at street level, operators should be familiar with the required distance from the structure to get the bucket at street level. The various angles of the aerial and set-backs from buildings will change these distances, and are examples of why crews should train on positioning to ensure the proper position the first time.



Figure 24: The tower is one of the most versatile tools on the fireground if used correctly.

The placement for both life and fire travel will be determined by the type of occupancy and structure. Once positioned correctly, the tower provides the versatility to flow a master stream from ground level up multiple stories. It also provides scrub area to flow streams through multiple windows on two sides of the building. The platforms on towers automatically remain level with the turntable regardless of the angle of the aerial. However, the platform level can be changed while the aerial is in operation. This has the effect of increasing the range of the up and down nozzle movement, which allows the stream to cover a larger area. Most can be remote controlled from the ground as well.

The ability to cover a large scrub area with a tower is also beneficial with VEIS operations. It allows crews to quickly affect numerous rescue or searches on multiple sides of the building, and from different floors. For hasty egress or victim rescue, the top rail of the aerial tower bucket should be level to the window sill so a victim may be pulled into the bucket and not needing to use the doors.

If a tower is requested to the scene, specifically for elevated stream operations, consideration for the most effective position for the tower must be given. This may require the repositioning of other apparatus, which should be done quickly, efficiently, and must be practiced regularly by truck companies.

Some firefighting situations, such as a well-advanced fire in a strip shopping center or warehouse, may require a mobile master stream operated into the first or lower floor. The tower is best suited for this application because of its flow capabilities, ability to operate at ground level or below, and the ability for firefighters to position in the bucket behind the nozzle to view its effectiveness.

Most towers will have emergency shut-off switches in multiple locations, which will, at a minimum, be located in the bucket and on the turn-table to prevent accidental operation of the aerial while personnel are operating. The decision to engage the emergency shut-off should be carefully weighed against the task that personnel are performing and the ability for other members on the fire-ground to quickly deactivate the switch. While it may seem appropriate to engage the switch prior to climbing the aerial (at the turn-table) or upon exiting the bucket (at the bucket), this could prove fatal if while completing your task the need arises to reposition the aerial due to individuals being cut off by fire.

There are many other instances, not fire related, that may warrant engaging the emergency shut-off during aerial operations, but caution should be exercised during fire suppression.

Tower/Ladder Considerations at Highrises

In the event that master stream operations are needed in high-rise fire operations, initial placement of the truck company is vital and must not be placed too close to the fire building negating the reach and penetration of the master stream. The master stream should be positioned and worked in such a fashion that the application of the water can be applied in all directions: up, down, left, and right.

Elevated master stream operations can prevent auto exposure over 100 vertical feet depending on the wind conditions and placement of the truck company, Figure 25. Prior to any master stream operations taking place, all personnel should be withdrawn to staging, at least two

floors below the fire floor.

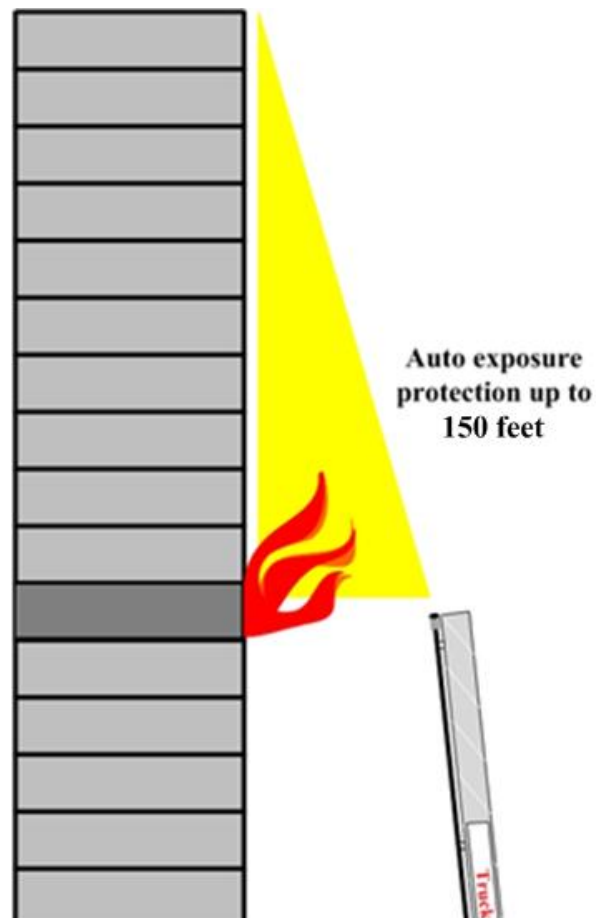


Figure 25: Master streams can provide auto exposure protection