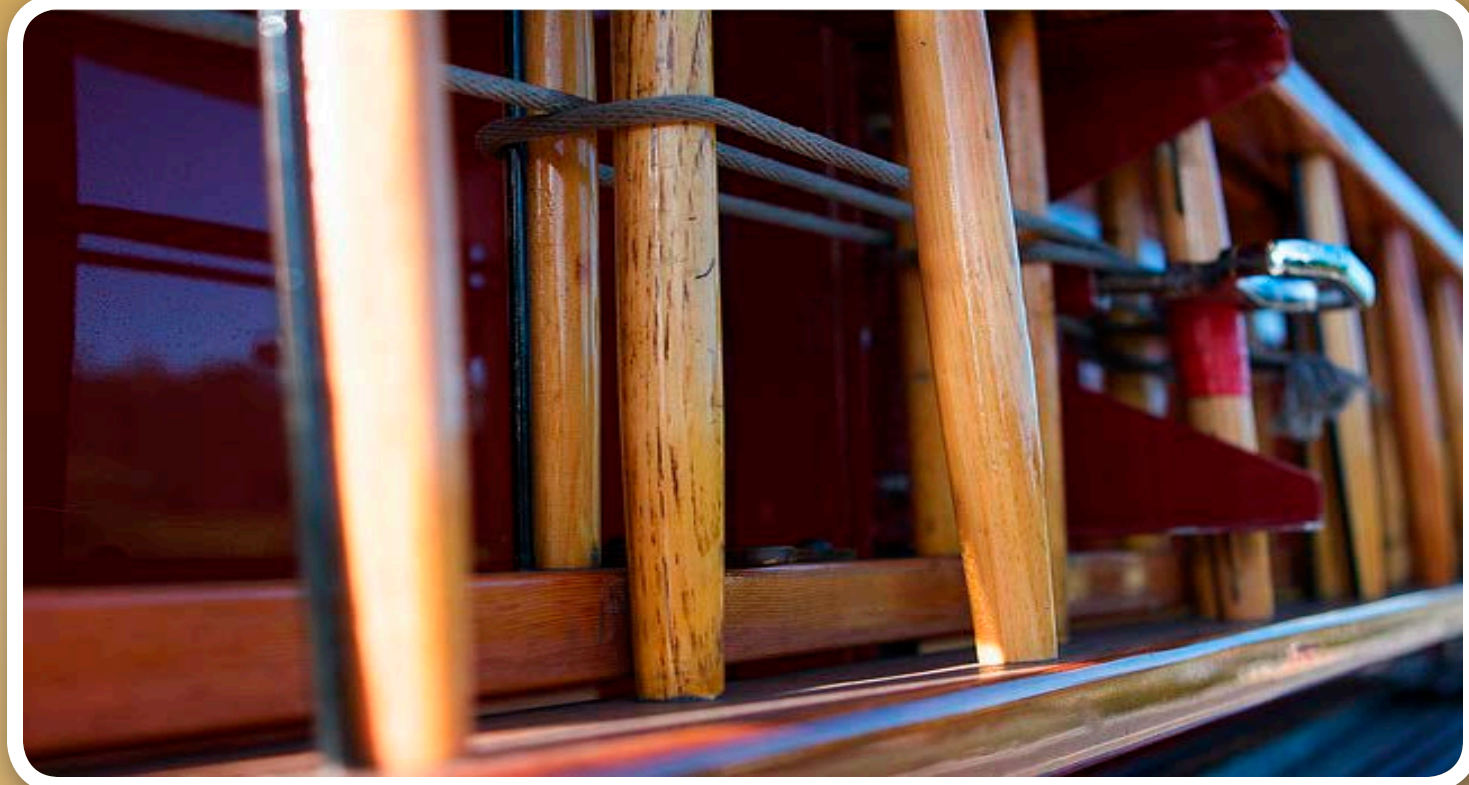
Ladders

19

Section III - Truck Company Operations



Ladder Parts

Ladder Types, Lengths, & Construction

Ladder Capacities & Maintenance

Ladder Safety

Ladder Raises

Ladder Rescues

Revised - June 2020

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Objectives

- Describe the parts of a typical fire service ladder.
- Describe the various types, sizes, and load capacities of ladders utilized by the SDFD.
- Describe and demonstrate the inspection and maintenance procedures of ladders used by the SDFD.
- Correctly utilize all safety precautions when working with ladders.
- Demonstrate the different ladder carries and evolutions used by the SDFD.
- Describe the meanings of various ladder commands.
- Demonstrate how to obtain proper climbing angle.
- Demonstrate proper techniques for climbing, locking into, and footing ladders.
- Demonstrate proper ladder selection and placement for different structures.
- Demonstrate how to assist victims down a ladder.

Introduction

Ladders are one of the most important and diverse tools used in the fire service. It is imperative that firefighters be proficient in all aspects of utilizing ladders, being especially cognizant of safety and proper body mechanics. Proper ladder selection and placement will support many strategic and tactical objectives, such as rescue, ventilation, access above and below ground, and emergency egress. In addition, ladders have other uses that may not be employed as frequently. Examples include a high point anchor, catch basin, bridging and other specialized applications.

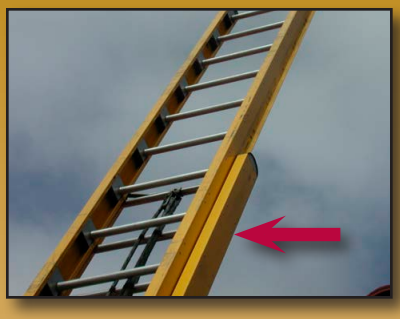
Safety precautions shall always be used by firefighters working with ladders. Ladder evolutions are safe and effective when the proper amount of people wearing the appropriate PPE are present and correct techniques are in place. The potential for firefighter injury, victim injury and property damage is high if safety is not considered. Safety shall be the highest priority when using ladders.

Ladder Parts and Definitions

- **Climbing Angle-** The angle of a positioned ladder in relation to horizontal. Also referred to as Angle of Inclination.
- **Bed–** The base section of an extension ladder.
- **Butt–** The bottom or base of the ladder identified by butt spurs. Wood ladders are painted black on the bottom 20 inches.
- **Beam-** The side rail of the ladder that supports the rungs and is the principal structural member of the ladder.
- **Fly Section–** The upper section(s) of an extension ladder.
- **Guides–** Slots or channels on the insides of extension ladder beams that guide the fly section when it is extended and retracted.
- **Halyard–** A rope or cable used to extend the fly section(s).
- **Hooks–** A pair of curved grapples attached to the tops of roof ladders. These fold outward from the roof ladder and secure it to the roof or parapet.
- **Locks–** Devices that hold the fly section in place once it has been extended. Also called dogs or pawls.
- **Pike Poles–** These poles are permanently fixed to larger extension ladders. They are attached the top of the bed section and help to guide and stabilize large extension ladders.
- **Pulley–** Grooved wheel over which the halyard is drawn when extending the fly section.
- **Rails–** The two support members of a trussed ladder beam that are separated by truss blocks.
- **Rungs–** Cross members that provide foothold for climbing. They span from one beam to the other.
- **Spurs–** Metal plates, spikes or cleats attached to the butt of ladder to prevent sliding away from structure.
- **Stops–** Blocks that prevent the fly section from being extended too far. They are located in the upper part of the guides.
- **Tie Rods and Tie Bolts–** Rods and bolts that run between the beam and support. They hold the ladder assembly together. Rods will be inside or underneath the rungs. Primarily present on wood ladders.
- **Top–** The upper end of a ladder. Top 20 inches painted white for visibility on wood ladders.
- **Truss–** The beam constructed with two rails separated at intervals by truss blocks.
- **Truss blocks–** Separation pieces between the rails of a trussed beam. The rungs are usually attached to the truss blocks.

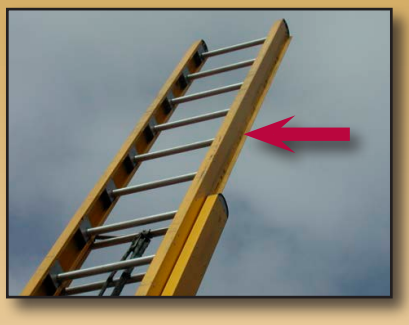
Ladder Parts

Beam



Bed

Butt



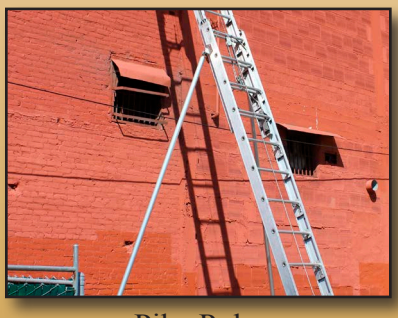
Fly

Guides

Halyard

Hooks
(Roof Ladder)

Locks



Pike Poles
(40’ & Larger Ladders)

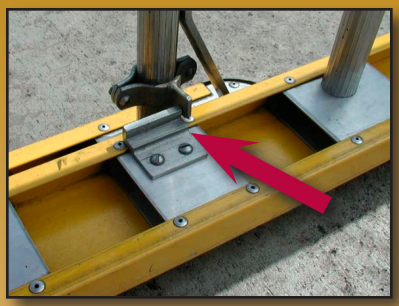
Pulley

Rails

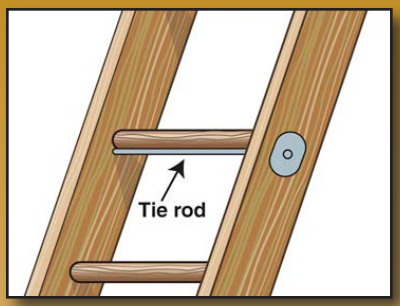
Rungs

Ladder Parts (Cont.)

Spurs



Stops



Tie Rods & Tie Bolts
(Wood Ladders)

Truss

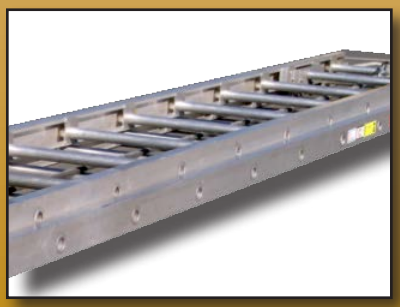
Truss Blocks

Top

Ladder Construction

Wood

Fiberglass



Metal

Types and Lengths of Ladders

There are several types and lengths of ladders utilized by the SDFD. Firefighters should be familiar with each ladder type so that the correct ladder is selected for the operation at hand.

Ground Extension Ladders

These ladders are constructed in two or more sections, a bed section and one or more fly sections. Extension ladder sizes are designated by the full length to which they can be extended. Extension ladders utilized by the SDFD are 24', 28', 35', and 40' lengths. Engine companies carry a 24' ground extension ladder. Truck companies carry 28', 35' and 40' ground extension ladders. 40' ground extension ladders have pike poles attached to facilitate evolutions. Larger ladders are heavy and should not be operated unless there are sufficient firefighters to safely do so.

Wall Ladders

Also referred to as straight or single ladders, these ladders have one section and are non- extending. Wall ladders are used for quick access to windows and roofs in two and three story buildings. SDFD carries 20' wall ladders on truck companies.

Roof Ladders

Roof ladders are non- extending and have hooks attached to the top end. These ladders are normally used on the roof of a building to give firefighters support when executing roof operations on a steep pitch. Typically roof ladders are laid flat on the roof with hooks secured over the ridgepole or another roof feature such as a parapet to anchor the ladder. When in operation, a firefighter's weight will be distributed over the ladder and more secure footing will be obtained. Engine companies carry 14' roof ladders, while truck companies carry various sizes ranging from 12' to 16', depending on the apparatus.

Pole Ladders (Attic Ladder)

Pole ladders are non- extending ladders having hinged rungs allowing the ladder to be folded up into a pole. These ladders may also be called attic ladders or folding ladders. In the folded position, one beam will rest against the other. The pole ladder is useful when attempting to gain access to narrow passageways or when working in confined areas (e.g. closets, attic entrances, etc.). Pole ladders are 10' in length and are found on engine and truck companies.

Step Ladders

Step, or "A"- frame ladders, come in 6' lengths and are located on truck companies. Some older trucks may carry 2' or 10' stepladders, however most have been phased out. These ladders would be used anywhere a free-standing ladder is required, such as in the middle of a room.

Roof Ladder

Wall Ladder

Ground Extension Ladder

Pole (Attic) Ladder

Step Ladder

Ladder Construction Materials

Wood Ladders

Most wood ladders are made of Coast Douglas Fir beams, hickory rungs, and red oak wear parts. The beams are truss type; rungs are solid, smooth, round with swelled centers. The hardware is zinc- gold plated steel for corrosion protection. Wood ladders are the highest cost of all material types, and heaviest per unit of length, however they are very durable and retain strength when exposed to heat and flame.

Fiberglass Ladders

Fiberglass ladders are made of fiberglass beams and aluminum alloy rungs. The beams are a composite material consisting of glass fibers running the length of the beam, wrapped in woven glass matting and pulled through a forming die in a vat of thermosetting resin. The result is a closely controlled shape with a very hard, smooth, glossy surface. The rungs are hollow aluminum, welded or pressed into mounting plates that are then riveted to the beams. The hardware is generally the same as in all metal ladders. Fiberglass ladders are a poor conductor of electricity and beams will not anneal when exposed to low levels of heat. These ladders are brittle, however, and will chip and crack if abused. Fiberglass ladders will burn aggressively when exposed to flame or temperatures above 650 degrees F. They are also heavy compared to aluminum ladders. They are mostly found on older apparatus and are being replaced by aluminum.

Metal Ladders

The majority of fire service ladders are made of 6061- T6 aluminum alloy that has been heat- treated to equal the strength of mild steel. The round, hollow rungs are usually pressed or welded into the beam assemblies. The ladders are assembled with rivets and bolts using steel hardware. The spurs are metal castings and the aluminum is a bare mill finish. Metal ladders are conductive. Contact with an electrical source can result in electrocution. They can also lose up to 50% of their strength when exposed to heat or flame leading to failure.

Advantages of metal ladders are their weight; they are about 30% lighter than fiberglass counterparts, they require less maintenance and are easy to repair. They will not splinter, they have a longer service life and they cost less than wood or fiberglass ladders.

Heat Sensors

All metal and fiberglass ladders constructed since January 1984 are required to have heat sensor labels. These labels will turn black if the ladder (or the portion of the ladder with the heat sensor) is subjected to a temperature greater than 300 degrees Fahrenheit. If subjected to this heat, even for a moment, the ladder can lose at least 25% of its load capacity. The NFPA now requires four heat sensors per ladder section. If any heat sensor turns black the ladder should be removed from service and tested to determine it is safe before returning to service.

Ladder Capacities & Maintenance

In accordance with NFPA 1932, the following figures are maximum ladder loads. This load is the total weight capability of the ladder including personnel, equipment, and other weight such as charged hose lines. Do not exceed the safe loading capacity of the ladder. These figures are for ladders that have been raised at the proper climbing angle.

Ladder Weight Capacities

- Attic/ Pole - 300 lbs
- Wall and Roof - 750 lbs
- Extension - 750 lbs

Fire service ladders are constructed to carry a 750-pound load with a 4:1 safety factor. As a comparison, industrial ladders are designed to support a 300-pound load with a 4:1 safety factor.

Ladder Personnel Capacities

- 0- 19 feet - 1 person
- 20-27 feet - 2 people
- 28- 39 feet - 3 people
- 40-49 feet - 4 people

Ladder Inspection and Maintenance

Ladders shall be inspected and cleaned weekly on Saturday as well as after each use. Constant and well-regulated inspection and maintenance will prevent dirt buildup that can harden in heated conditions and render the ladder inoperable. Ladders should be cleaned with clear water and a clean brush or chamois. They should be thoroughly dried after cleaning and inspection.

Inspections should attempt to identify the following:

- A kinked or frayed halyard
- Bent, cracked or broken beams
- Bent, cracked, or broken rungs
- Loose or worn rivets and bolts
- Broken welds
- Cracks, slivers, or dry rot on wooden ladders
- Excessively worn parts

- Proper operating hook assemblies on roof ladders
- Free -turning pulleys
- Guides in good condition and free movement of fly sections
- Dark streaks in wooden ladders (indicates deterioration).

Ladders should be lubricated occasionally. Proper lubrication includes a few drops of lightweight oil to the pulley, locks, pike pole pivot points and hooks of roof ladders. Wood ladders shall have their guides lubricated with paraffin wax, while fiberglass ladders should have automotive wax applied to protect them from ultraviolet deterioration.

Ladder Testing

Because fire service ladders are subject to abuse and overloading it cannot be guaranteed that ladders will not fail at any given time, but the chances of a failure can be minimized by testing them in accordance with NFPA Standard 1932.

This standard requires that ladders be service tested

- Annually
- Anytime a ladder is suspected of being unsafe
- After a ladder has been overloaded or subjected to impact loading
- After direct heat exposure
- After repair unless the repair was limited to halyard replacement.

The ladders are service tested in several ways, depending on the type of ladder. All ladders are subjected to a horizontal bending test to determine the overall strength of the ladder and its ability to recover from a load. In addition, extension ladders will undergo a hardware test to determine the integrity of metal components. Roof ladders are given a roof hook test to check for excess hook deflection. Station 40 crews are responsible for inspecting, testing, and repairing all SDFD ladders. All ladders will be cleaned and properly maintained by station crews prior to testing: wooden ladders shall be varnished and the beams of fiberglass ladders shall be coated with automotive wax.

Ladder Safety

Figure 19-1 Tie-off excess halyard with serveral wraps around the rungs and secure with a half hitch.

- Always choose the appropriate ladder for the job. Never attempt to accomplish a task from a ladder that is too short or misplaced. Secure a larger ladder or relocate the ladder to the correct position.
- Use the correct number of firefighters for the size of the ladder. Reduced crews may be adequate under certain conditions, however it is always preferred to utilize more personnel than less.
- Always lift with your legs, not your back or arms.
- Use extreme caution when raising ladders around electrical wires. Never allow the ladder to contact wires. Always check for overhead obstructions.
- Ladders should be placed at the correct angle so that climbing is made as safe as possible.
- Make sure the ladder is properly footed before climbing.
- Tie off the excess halyard by wrapping the halyard around 2 to 3 rungs and secure with a half-hitch, Figure 19-1.
- When possible secure the ladder at the upper contact point with a webbing or strap. This is traditionally done with a large clove hitch and over-hand safety around the beam of the ladder and another solid feature on the structure itself.
- Inspect the locks before climbing to ensure they are seated on a rung.
- Ensure the ground is firm and can support the weight of the ladder and firefighters. Ladders placed on soft ground or grass may cause one spur & beam to sink into the ground. This causes the ladder to slide against the building, become unstable, and potentially fall
- When working from a ladder, always lock in using the leg lock, or ladder belt if on an aerial ladder.
- A ladder should be raised to a minimum of two rungs above a roofline or parapet, three to five preferred. This makes the ladder more visible during operations and will provide better stability for firefighters getting on and off the ladder.
- Always keep ladders clean and inspect ladders for damage after every use.
- Climbing ladders must be done in a smooth, controlled fashion. Climbing with haste, lack of attention or making sudden and abrupt movements may result in a fall leading to significant injury or death.
- Proper PPE for climbing ladders shall include, at minimum, helmet and steel toe boots. Boots shall be in good condition and have enough tread on the sole as to not create a slip hazard.
- Prior to raising or climbing a ladder, the user shall ensure they are physically able to perform the task. Pre-existing injuries or poor physical condition can result in a fall from the ladder.

Ladder Commands

Verbal commands are essential to coordinating ladder carries and evolutions. Each firefighter involved in an evolution must understand what the command means and what is required of him or her when the command is given. Verbal commands must be loud and clear.

"Bring the ___foot ladder" (specified by officer)
Secure specified ladder, prepare to carry it to designated location for raise.

"Prepare to pick up ladder"
Firefighters are at designated positions to secure ladder off ground.

"Pick up ladder"
Firefighters uniformly pick up ladder and are ready to proceed with carry.

"Stand Clear! Ladder coming through"
During the carry of a ladder either by one or multiple firefighters, the path of carry shall be made known by shouting this command.

"Lower the butt"
Persons on the butt of the ladder, proceeding first, will determine where the butt will contact ground and the ladder will be raised.

"Foot my ladder"
Partner places weight on the spurs or rungs of the ladder to prevent the butt from sliding out.

"Prepare to raise ladder"

"My ladder"
The person calling this is now in control of the ladder.

"Prepare to shoulder/forward carry ladder"

"No overhead obstructions"
Person at the tip of the ladder will look overhead for wires, objects or any other overhead hazards the ladder may contact before raising.

"Raise the ladder"
Persons at tip of ladder will raise ladder hand over hand along beams. If one person is raising ladder, hand over hand on the rungs is preferred.

"Up the fly"
Fly is extended once the ladder is vertical.

"Locks locked"
Once the fly is extended to desired height, visual confirmation that the fly section is locked shall be called out.

"Lower into building"
Gently lower ladder to building, maintaining footing of ladder

"Sliding out on the butt"
Butt should be adjusted to obtain proper climbing angle.

"Rotate ladder"
If ladder was lowered in with fly section inside, ladder should be flipped so fly section faces out (towards climber).

"Proper climbing angle, four points of contact"
See the climbing angle formula later in the chapter. Four points of contact means that both spurs and both beams are resting securely against solid surfaces and the ladder will not rock.

"Secure the halyard"
Halyard shall be secured around rungs and tied off if necessary.

When the ladder is to be lowered, these commands may be used in reverse order. "Rotate ladder," "Slide in on butt," "Away from building," etc. Once again, overhead obstructions and hazards behind the firefighter while lowering a ladder should be verbalized.

Ladder Selection

When selecting the proper ladder for the job at hand, several things need to be considered. Is the ladder going to be used for ventilation or rescue? Is there a second ladder in place for roof operations? Is the structure a residential or commercial type? What is the distance between floors? Are there enough personnel immediately available to raise the selected ladder?

Figure 19-2 The ladder on the left is to short for this roof

Some general guidelines when selecting ladders:

24’ Extension Ladder

- One or two story residential roofs
- Single story commercial roofs
- Second story residential windows and fire escapes

28’ Extension Ladder

- Second story residential roofs and windows
- Third story residential windows
- First and second story commercial roofs and fire escapes

35’ Extension Ladder

- Second and some third story commercial roofs
- Third story residential roofs, windows and fire escapes

40’ Extension Ladder

- Third story commercial roofs
- Warehouses and other industrial structures where required.
- It should be noted that the 40’ ladder is a minimum four-person evolution. It is a heavy ladder that requires regular training to maintain proficient operation by a truck company.

20’ Wall Ladder

- Second story residential windows
- Some higher single story roofs
- Second level fire escapes and balconies
- If possible, this ladder should be avoided on most typical single story residential roofs, due to the ladder having its center point at or near the eaves of the house. This causes a pivot point that could lead to the ladder losing its footing while firefighters climb near the top or use the upper part of the beams for hand holds when getting on the ladder.
- A 24’ extension ladder not extended, or extended a few rungs, is a better

Figure 19-3 20’ Wall Ladders are not appropriate for single story roof lines.

choice for a primary ladder on a single story house. Do not use a 20' wall ladder on a single story house. Too much ladder above the roof line can make the ladder unstable and top heavy.

14' Roof Ladder

- Used when the pitch of a roof is too steep for safe operations without a secure foothold. Can also be used as a straight ladder with hooks folded in.

Ladder Placement

Ladder placement is very specific to the intended use of the ladder. Always place the ladder in a safe position. Never jeopardize safety by hasty positioning. The ladder should be positioned before extending it. It is difficult to relocate the ladder after it has been extended if the desired placement was not attained. If possible, a ladder should be placed to the windward side of the objective. This will keep personnel on the upwind side of any smoke and contaminants.

Laddering Roofs

Ladders raised to roofs should be high enough to clear the roofline or parapet by a minimum of 2 rungs, 3 - 5 preferred. There are two reasons for this: it facilitates getting on and off the ladder and it makes the ladder easier to find when a quick escape becomes necessary. Always attempt to place the ladder near a corner of the building because there will be more strength at these points.

There should always be a minimum of two ladders to a building so that there is more than one way off the roof. On large structures all four corners should be laddered. Ladder the strong areas of the roof so that personnel can start and return to the safest part of the roof.

The corners of buildings are always considered prime locations for ladders for the following reasons:

- **No Horizontal Openings -** Windows, doors, and vents are not usually found in corners. Placing a ladder over a horizontal opening presents the possibility of a burned ladder if interior fire conditions worsen.
- **Strength -** Structural stability is increased where two walls are tied together.
- **Location -** Corners are easy places to identify means of egress when visibility is limited.
- **Access -** By laddering corners of the building the structure's main entrance is rarely obstructed.
- **Hips -** Hips converge at the corners, so when personnel step off the ladder they are already at a structurally sound point on the roof.

Laddering Windows

When placing ladders in or around windows several considerations should be taken into account depending upon the type of operation. If the ladder is to be placed at or near a window for ventilation, it should be placed to one side (the upwind side) with two to three rungs above the window sill.

When laddering a window for rescue or entry, always place the ladder just below or even with the window sill. If the sill projects from the wall, it may be beneficial to wedge the ladder up under the sill for added support. Placing a ladder 2 to 3 rungs into a large window that allows room for the firefighter to safely dismount may be appropriate for FF entry and exit but may not work for rescue situations.

Other influencing factors that may be encountered when placing ladders include the following:

- Overhead obstructions
- Uneven terrain where the butt of the ladder is to be placed
- Obstructions on the ground (foliage, cars, etc.)
- The ladder itself is an obstruction to firefighters working the fire below it.

Laddering Parapets and Fire Escapes

Some structures have tall parapets. If a parapet is over 5 feet and it is necessary to place a ladder to access the roof, a roof ladder should be placed for access on and off the roof. If possible, hooks should be opened and placed over the parapet to assist footing for personnel using the ladder.

When laddering fire escapes, the top of the ladder should extend a maximum of one-foot above railings. Ladders should be spotted adjacent to fire escape ladder handrails and tied off to minimize side loads while personnel are climbing the ladder. Avoid laddering areas that may interfere with the use of fire escape drop ladders. Consider releasing drop ladders for use by occupants and to keep them from prematurely releasing during an incident.

Placing Ladders on a Slope

Ladders placed for climbing should be positioned with the base of the ladder resting evenly on both spurs and both beams at the top. When deploying ground ladders on uneven terrain it can be challenging to achieve four points of contact. Therefore, all Truck Companies will be outfitted with two sets of Ladder Chocks designed to shim the spurs as needed in order to achieve maximum stability when working on uneven terrain. Each set of Ladder Chocks is constructed of a 4”x4”x18” piece of cribbing and a 2”x4”x18” piece of cribbing lashed together with a piece of sash cord.

When laddering on a slope and unable to obtain four points of contact simply use the appropriate Ladder Chock(s) to shim the spur that does not have contact with the ground in order to make the ladder safe to work from. Ideally place the chock(s) perpendicular to the beam as pictured below in order to achieve full contact between the spur and the Ladder Chock(s).

Chocks should be stored in the ladder compartment in an obvious place so we remember to use them when appropriate. Maintenance includes visual inspection for damage/cracks to chocks or sash cord. Do not paint Ladder Chocks.

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Ladder Fundamentals

Raising Ladders

When raising the ladder, make sure the ground is firm and even where the butt spurs will rest. The ground should be as level as possible. If necessary, dig or scrape some of the soil away to even the footing before raising the ladder. As a safety measure, always attempt to set up an alternate means of escape when using ladders to gain access to a roof. This includes raising at least one additional ladder to the roof, usually opposite from the primary ladder. Ladders should be raised as far as possible away from the fire to avoid subjecting them to heat and fire exposure.

If the ladder is being placed next to a fire escape, it should be placed on the side opposite the drop ladder of the fire escape and secured to the railing. Fire escapes have the potential of becoming overcrowded, and if this occurs, firefighters should raise ladders at opposite ends of the escape and firmly secure them.

Footing Ladders

When raising and climbing ladders the butt must be "footed" to stabilize the ladder and prevent it from kicking out or falling. There are several methods for "footing" a ladder.

Ride The Rung

Riding the rung of the ladder requires the firefighter on the "butt" end of the ladder to step onto the lowest rung, squat, grab the next up rung and remain in position until the ladder is vertical. Do not step off the ladder until the ladder is vertical. This is the safest and preferred method for footing the ladder when it is being raised.

Foot The Spurs

An alternative method for footing the ladder when raising it into the air is to foot both spurs. Place the toes of your boots over both the spurs and remain standing. As the ladder approaches, you may grab the rungs of the ladder to help stabilize yourself. You must keep both feet on the spurs until the ladder is completely vertical. The drawback to this method is that it is easy for your foot to slip off as the ladder is being raised. If this occurs it will cause the beam of the ladder to lift and become off balance. Again, it is imperative that both feet remaining on the spurs until the ladder is fully vertical.

Media 19-1 Never Leave A Ladder Un-footed

Foot The Ladder For Climbing

In addition to footing the ladder while it is being raised, the ladder must at all times be footed while it is being climbed unless it has been properly tied off to a structural member. At no time should a firefighter be on a ladder that is not footed, Media 19-1. Below are the two methods that may be used to "foot" the ladder while it is being climbed.

Angle of Inclination (Climbing Angle)

The desired climbing angle for ladders is 75 degrees from horizontal. This will provide a comfortable climbing angle and give the stability needed for safe climbing. If the ladder angle is steeper than 80 degrees the ladder could pull away from the building when climbing. If the climbing angle is less than 70 degrees, it may slide out on the butt under the weight of a firefighter.

Figure 19-4 Proper Climbing Angle

Climbing Angle Formula

The butt of the ladder should be out from the building a distance equal to one-fifth of the used portion of the ladder plus 2-3 feet. The added 2-3 feet gives you the flexibility to place the spurs of the ladder into a crack to add stability to the ladder.

If the building has an overhang, take this distance from the wall at ground level as the reference point for using this formula. A method of checking the desired climbing angle is to stand on a rung and grasp the rung closest to shoulder level with both hands. With arms extended straight, the body will be perpendicular if the proper angle has been achieved.

Flipping / Rotating The Extension Ladder

Once the extension ladder has been set to the proper climbing, it should be flipped/rotated so that the fly side is facing out. The reason for flipping the ladder is so that the locks will be in a position that prevents them from slipping off of the rung when weighted, Figure 19-6. If the fly is facing toward the building the locks will be in a position to possibly slip off the rung when a dynamic load is placed on it, Figure 19-7.

Figure 19-6 Lock position with the fly facing away from the building

Working Height

The required working height of a ladder can be estimated as follows:

- Residential occupancies are approximately 9 feet from floor to floor.
- Commercial occupancies are approximately 10 feet from floor to floor.
- The average height of a windowsill is 3 feet above a floor.

Although these numbers may vary slightly from area to area, they are good indicators for the length of ladder needed to access any part of a building.

Figure 19-7 Lock position with the fly facing toward the building

Climbing

Prior to climbing a ladder, it must always be footed or tied off, Figure 19-8. When ascending a ladder, look toward the rungs just above your head. Climb with hands grasping the center of rungs, body erect, shoulders at an arm length from the ladder, knees in-line with the body. The legs carry the weight and the arms maintain balance and stability. Do not reach up and pull with the arms. Ascend briskly but smoothly, feet and hands working together, taking every rung with the feet and every other run with the hands. Your feet should contact

the rung at the base of the arch, using the heel of the boot to lock into the ladder and maintain footing.

Figure 19-8 Ladders must be footed or tied off prior to climbing

When climbing a ladder at least one hand should grasp the ladder at all times to ensure stability. Tools can be carried by straps or webbing to help keep your hands free. If necessary, a hand carrying a tool can provide security and balance by positioning the tool behind a ladder beam with the wrist cocked against the beam.

Working Off The Ladder / Leg Lock

When performing work from a ladder, such as breaking a window, the use of a leg lock is required to help stabilize yourself. To perform the leg lock:

- Step up one rung and slide a leg (use the leg opposite to the side you are working off) through a rung spacing.
- Slide your foot back through the space one rung down so that the rung is positioned behind your knee.
- Hook your foot to the outside of the beam or to the next rung down.
- All of your weight should be on the one leg not locked in and you can now lean out to work off to the side of the ladder safely.

Carrying Equipment Up A Ladder

Due to the nature of fire fighting, seldom are firefighters required to climb ladders empty handed or without equipment. Carrying equipment and tools up ladders brings an added degree of risk, however, when using the proper techniques it can be done safely.

Axe

Axes should always be carried up a ladder secured in a scabbard/axe belt. This allows the firefighter to keep both hands available for additional equipment or safe climbing. It is common for the handle of the axe to fall between the rungs of the ladder when climbing down a ladder. To avoid this, attempt to keep the axe on the outside of the beam of the ladder or flip the handle of the axe up to your shoulder and let it skip down the rungs as you climb down.

Roof Hook/Pike Pole

The roof hook and pike poles should be carried up a ladder with the hook and pike pointing toward the sky. As you climb, you can hook the roof hook and pike pole on the rungs above you as you climb upward. An alternative is to hold the pike pole or roof hook in your hand and slide it up the beam of the ladder as you climb.

Chain saw

The chain saw can be carried up the ladder with the saw running or stopped. If the saw is running, the chain brake must be set prior to climbing the ladder. There are several methods that may be used to carry the chain saw up the ladder:

- By the stabilizing handle with the chain bar facing backward.
- With one hand hooked through the throttle handle of the chain saw and spanning the beam of the ladder.
- Sling using the utility strap (never use this method with a running saw).

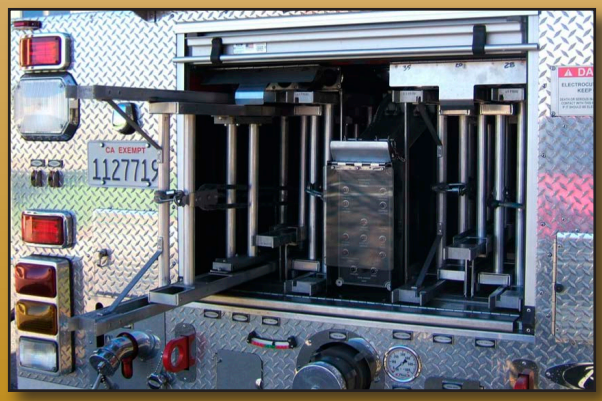
Ladder Apparatus Mounting

Ladders mounted on top of the apparatus are lowered via a control switch (Inset)

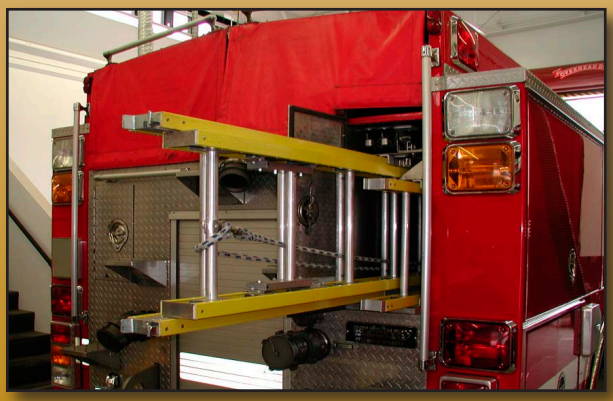
Ladder Rack in the lowered position

Flat Racked, Rear Mounted Ladders (Truck Company)

Flat Racked, Rear Mounted Ladders (Engine Company)



Vertical Racked, Rear Mounted Ladders (Truck Company)



Vertical Racked, Rear Mounted Ladders (Engine Company)

Carry A Roof Ladder Up A Ladder

Prior to taking a roof ladder aloft, you need to determine what your objective is. If you will be using the roof ladder to hook the pitch of a roof to provide added stability for roof operations you should deploy the hooks and prepare to take the ladder up hooks first. If your objective is to ladder the back side of a parapet wall then the butt of the roof ladder should be carried up first.

The following are the proper steps to take a roof ladder aloft:

- Open the roof hooks
- Place the roof ladder off to either the right or left side of the extension ladder, hooking one of the roof hooks to one of the extension ladder rungs.
- Climb the extension ladder until you are near the top of the roof ladder
- Hook your arm through the rungs of the roof ladder, 2 to 4 rungs from the top of the ladder.
- Begin climbing with the weight of the roof ladder resting on your shoulder.
- Once at the top, slide the roof ladder onto the roof and hook the ladder over the peak or ridgepole.






Ladder Carries

Removing Ladders From Apparatus

Before we can talk about the different type of ladder carries, we must first understand the different ways that ladders are stored and mounted on the apparatus. The reason this is important is because the method in which the ladder is mounted or stored on the apparatus may determine which type of ladder carry you will chose to use.

Ladder Rack

The 24' extension ladder and 14' roof ladder are most commonly loaded on to engine companies using a pivoting ladder rack. A control switch activates an electric motor that in turn lowers the rack to shoulder level. This method of ladder storage makes it very easy to perform a one person high shoulder carry or two person low shoulder carry.

Rear Load on the Beam

This ladder load is most commonly found on SDFD Truck Companies. The ladders are stored inside of an enclosed compartment, on their beam, with the butt of the ladder coming out of the apparatus first. When removing the ladder from this type of load, always pull out on the fly section of the ladder and push in on the bed section when returning it to the apparatus to prevent the ladder locks from unlocking. This ladder load is in the ideal position for firefighters to use the low shoulder carry method.

Rear Load on the Bed

This ladder load is found on a select few truck and engine companies. The ladders are stored inside of an enclosed compartment on their bed with the butt of the ladder coming out of the apparatus first.

Full Crew vs Short Crew

The term "full crew" is used to refer to the recommended number of firefighters required to safely raise a given size ladder. Under ideal conditions, the full crew is the preferred method to use when raising a ladder. Due to the nature of fire fighting and rescue, firefighters are placed in situations that are not ideal and may not have all the personnel required to perform a "full crew" ladder raise. For this reason, alternative methods and techniques have been devised to safely carry and raise a given size ladder with one less firefighter assisting, called a "short crew." In a "short crew" raise, typically the firefighter used to foot the ladder is removed from the evolution and replaced by a fixed object such as a curb or building, Figure 19-9.

Figure 19-9 A "short crew" requires the use of a building or curb to foot the ladder when raising

One Person Ladder Carries

Roof ladders, wall ladders, and the 24' extension ladder can all be carried safely by one firefighter using one of the following methods described below.

High Shoulder Carry

Figure 19-10 High Shoulder Carry

The high shoulder carry is performed by balancing the beam of the ladder on your shoulder at the center point, Figure 19-10. This method is fast, safe, and allows for a quick transition to raising the ladder. This ladder carry should always be lead by the butt of the ladder and when possible with the bed side of the ladder facing your head

Forward Carry

The forward carry is an effective one person ladder carry for short distances and for relocating a ladder that is already in a vertical position, Figure 19-11. The down side to this ladder carry is that you must ensure there are no overhead obstructions in your path of travel, such as trees or power lines. Extra care must also be taken when using this ladder carry to avoid trip hazards or large steps and curbs.

Figure 19-11 Forward Carry

To perform the Forward Carry:

- From the bed side of the ladder, grab the center point of the highest rung you can comfortably reach with your dominant hand.
- With your other hand, grab a rung about waist high, this will be your controlling hand.
- With your arm extended out overhead and your elbow firmly locked, slowly lean the ladder back as you squat with your legs.
- Slowly stand up and lift the load of the ladder.
- All lifting should be done with your legs and not your shoulders or arms. Your overhead arm should be locked out and only used as a balancing point for the ladder to rest on.
- Once balanced, begin to walk forward.

Forward Shoulder Carry

Similar to the forward carry, the forward shoulder carry is also used for short distance carries or relocating an already vertical ladder, Figure 19-12. In this carry the beam of the ladder is rest against your shoulder and carried in the vertical position. As with the forward carry, you must be aware of overhead obstruction in your path and trip hazards.

To perform the Forward Shoulder Carry:

- Approach the ladder with your face to the fly and the beam to your shoulder.
- Using the same hand as the shoulder against the beam, reach around the ladder to the bed section and grab a rung. This will be your lifting hand.
- With your opposite hand, grab hold of the top beam to stabilize the ladder.
- Lean the ladder back into you shoulder as you step backward and squat to transfer the load of ladder onto your shoulder.
- Slowly stand up and lift the load of the ladder with your lifting hand and begin to walk forward.
- All lifting should be done with your legs.

Figure 19-12 Forward Shoulder Carry

Two Person Carries

When personnel are available, the two person ladder carry is the preferred method for carrying ladders up to 28 feet. Using two firefighters to carry a ladder is safer, reduces injuries, and increases the maneuverability through tight spaces and obstructions. Good communication and coordination are essential to a two person ladder carry. As a general rule, the firefighter on the butt of the ladder should be leading the way and giving the verbal commands and instructions.

Low Shoulder Carry on the Beam

The low shoulder carry on the beam is the most common two person ladder carry. When using this carry, one firefighter is placed within one rung of the butt of the ladder in order to clear other personnel out of the way as the ladder comes through. The second firefighter is positioned at the top of the ladder and the ladder is carried slung low on the shoulder/arm with your hand passing through the rungs and grasping the lower beam. From this position the ladder can be quickly raised using a flat or beam raise.

Ladder Carries

Forward Carry - 1 FF

Ladders: 14’ roof and 24’ extension

Used for carrying or relocating the ladder short distances

Shoulder Carry - 1 FF

Ladders: 14’ roof and 24’ extension

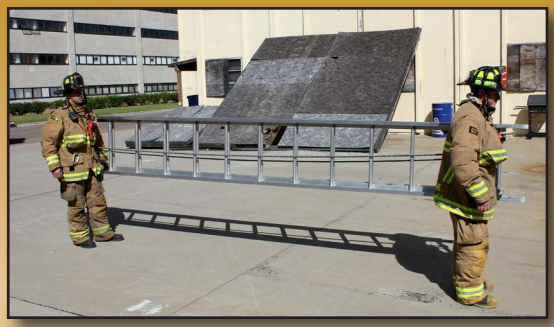
Used for carrying or relocating the ladder short distances

High Shoulder Carry - 1 FF

Ladders:

14’ roof, 16’ to 20’ wall, 24’ extension (Aluminum)

Low Shoulder Carry - 2 FF’s



Ladders:

14’ roof, 16’ to 20’ wall, 24’, 28’, 35’ extension

Ladder Carries (continued)

Straight Arm Carry - 3 or 4 FF's

Ladders:

35' ladders and larger

High Shoulder Carry - 3 or 4 FF's

Ladders:

35' ladders and larger

Low Shoulder Carry - 3 or 4 FF's

Ladders:

35' ladders and larger

Three & Four Person Ladder Carries

For ladders 35' and larger, three and four person ladder carries may be utilized. As with the two person ladder carry, strong leadership, communication and coordination are essential to a successful carry.

Straight Arm Carry on the Bed (Flat)

The straight arm carry on the bed requires the ladder to be carried flat with two firefighters at the foot of the ladder and two at the top. The ladder is carried bed side down at your hip level with your arms extended out straight to either a rung or beam (4 person). For a 3 person carry, the ladder is carried in the same manner only two firefighters are positioned at the ends of the ladder on the same side while the third firefighter is on the opposite side, mid ladder.

High Shoulder Carry on the Bed (Flat)

The high shoulder carry on the bed requires the ladder to be carried flat with two firefighters at the foot of the ladder and two at the top. The ladder is carried bed side down atop your shoulders. For a 3 person carry, the ladder is carried in same manner only two firefighters are positioned at the ends of the ladder on the same side while the third firefighter is on the opposite side, mid ladder.

Low Shoulder Carry on the Beam

The low shoulder carry on the beam is also an option for a 3 and 4 person ladder carry. This carry is ideal for situations where the ladders is stored on its beam in a rear loading ladder rack.

3 person low shoulder carry on the beam

One firefighter positions them self at the butt of the ladder and slowly removes the ladder from the rack. The second firefighter steps in on the opposite side of the ladder at the mid point and supports the ladder as it slides out. As the top of ladder exits the rack, the third firefighter steps in on the same side as the firefighter at the butt to carry the top. This carry is conducted the same as a two person low shoulder carry.

4 person low shoulder carry on the beam

Two firefighters position themselves at the butt of the ladder on opposites sides from each other and slowly remove the ladder from the rack. As the top of ladder exits the rack, the other two firefighters step in on opposites sides of the ladder from each other to carry the top. This carry is conducted the same as a two person low shoulder carry.

Flat Raise - 2 FF

Approach the building at a 90 degree angle and position the ladder with the bed section facing down

While one FF foots the ladder, the other FF raises the ladder to vertical by walking it up the rungs of the bed section

With both FF's stabilizing the ladder, the fly section can then be raised to the proper height and lowered into the building. Adjust ladder to the proper climbing angle.

If the bed side of the ladder is facing out it must be rotated 180 degrees. Foot the spur and put pressure on the beam as you rotate the ladder to avoid side to side movement.

Flat Raise From The High Shoulder Carry - 1 FF

Note - The ladder must be carried with the bed facing your head for the halyard to be on the correct side

Approach perpendicular (90 degrees) to the building using a high shoulder carry

Stick the spurs to your spot and in one smooth motion push up and forward

As you push forward on the beam, allow the ladder to pivot on the spur towards you

Continue to walk the ladder up and forward without losing your momentum

The bed of the ladder should now be facing you in a flat raise position

Once vertical, extend the fly and lower the ladder into the building.

Ladder Carries & Required Personnel

Ladder	*Carry*	*Raise*	*Full Crew*	*Short Crew*
14’ Roof	High Shoulder Low Shoulder	Flat or Beam	1	1
16’ to 20’ Wall	High Shoulder Low Shoulder	Flat or Beam	2	1
24’ Extension	High Shoulder Low Shoulder	Flat or Beam	2	1
28’ Extension	Low Shoulder	Flat or Beam	3	2
35’ Extension	Low Shoulder Flat Shoulder	Flat	3	2
40’ + Extension	Flat Shoulder Extended Arm	Flat	5	4

Beam Raise (Alley Raise) - 1 FF & 2 FF's

Approach parallel to the building, preferably with the fly facing towards the structure

FF on the butt of the ladder will select the proper spot and set the butt on the ground

For ladders 28' and larger, someone will need to foot your ladder as you raise it

Once raised the ladder is in the proper position to extend the fly

A single FF performing the high shoulder carry should follow the same steps

The only difference is that there is no need to foot the 14' roof and 24' extension ladders

Ladder Raises

Ladder raises refers to the process of taking the ladder from the horizontal position to vertical. There are two basic methods utilized for raising a ladder, the flat raise and the beam raise

Flat Raise

The flat raise is the most commonly used ladder raise. This raise typically requires the use of at least two firefighters; one to foot the ladder and the other to raise it, however can be performed with one firefighter using a 24' ladder from a high shoulder carry. Although the flat raise can be used in alleys and restricted areas, it is preferred to utilize this method when the ladder will be perpendicular to the building as you approach it.

The following is the proper procedures for performing the flat raise:

- A minimum of two firefighters shall carry the ladder in a low shoulder and approach the building at a 90 degree angle.
- Firefighter 1, at the butt of the ladder (leading the way) shall select the appropriate spot to place the ladder, then lower the butt end on the beam and then rotate the ladder so that the bed side is down.
- Firefighter 2 at the top of the ladder shall maintain the ladder off the ground and assist in rotating the ladder bed side down.
- FF #2 shall then check for and call out:
    - "Clear above, clear behind"
    - "No overhead obstructions"
    - "Prepare to raise ladder"
- FF#1 shall properly foot the ladder and call out "Ready"
- FF#2 - "Raising Ladder" - begin walking the ladder to the vertical position using the rungs, hand over hand.
- Once the ladder is vertical both firefighters shall stabilize the ladder by placing the inside of their right foot and knee against the outside beams of the ladder.
- The ladder is now in a position to "up the fly."

**NOTE - Using a flat raise in an alley or a situation where the ladder approaches parallel to the building is an option, however, it is not preferred because it requires an extra step and more time. When a ladder is flat raised parallel to a building, it is not in a position to be lowered to the building once vertical, it must be rotated 90 degrees. The most efficient method to use when the ladder must be raised parallel to a building, such as an alley, is the beam raise.*

Raising 40’ + Ladders

Carry the ladder to the target area using the high shoulder carry with the fly side down

Because the fly is facing down, there will be no need to flip the ladder once raised

Lower the butt of the ladder to the ground and properly “foot” it

The two firefighters at the top can then raise the ladder by walking it up on the beams

Remove the pin holding the “pike” while the other FF’s stabilize the vertical ladder

Walk the “pike” out to a 45 degree angle, one “pike” at a time

Raising 40’ + Ladders (continued)

Remove the pin and walk the second “pike”out to a 45 degree angle and prepare to “up” the fly sections

The FF on the halyard is facing away from the building so the other crew members must help spot the height & ensure the locks are locked

Once all locks are locked, slowly lower the ladder into the building with the “pikes”

Check for proper climbing angle and make adjustments as necessary

Reposition the pikes one at a time behind the ladder and set in place

Once both pikes have been set, tie of the excess halyard and the ladder is ready to climb

Beam Raise

Similar to the flat raise, the beam raise also requires at minimum two firefighters; one to foot the ladder and the other to raise it. The main difference between the flat raise and the beam raise is instead of walking the ladder to a vertical position with the bed of the ladder towards the ground, the ladder is raised to vertical by walking up the beam of the ladder. The beam raise is the preferred method to use in tight walkways or alleys and is often referred to as an "Alley Raise."

The following is the proper procedures for performing the beam raise:

- A minimum of two firefighters shall carry the ladder in a low shoulder carry and approach parallel to the building.
- Firefighter 1, at the butt of the ladder (leading the way), shall select the appropriate spot to place the ladder, then lower the butt end on the beam
- Firefighter 2, at the top of the ladder, shall maintain the ladder off the ground in their low shoulder carry.
- FF #2 shall then check for and call out:
    - "Clear above"
    - "Clear behind"
    - "No overhead obstructions"
    - "Prepare to raise ladder"
- FF#1 shall foot the ladder using the appropriate method, help stabilize the ladder on its beam, and call out "Ready"
- FF#2 - "Raising Ladder" - begin walking the ladder to the vertical position using the beam, hand over hand.
- Once the ladder is vertical both firefighters shall stabilize the ladder by placing the inside of their right foot and knee against the outside beams of the ladder.
- The ladder is now in a position to "up the fly."

**NOTE - As with the flat raise in an alley situation, the beam raise is not the method of choice when approaching perpendicular to a building because this requires the added step of rotating the ladder 90 degrees once in the vertical position.*

"Up The Fly" With Your Back Against The Building

Most evolutions result in the ladder ending up in a position with the bed facing out and the fly facing towards the building once raised to vertical. The benefit to this is that the halyard is on the bed side and allows for the firefighter to maintain good visual contact when "upping the fly" to the building. The drawback to this is that the ladder must be rotated 180 degrees before climbing.

Depending on the orientation of the ladder when carried and raised, for example when peforming a beam raise, there will be times when the ladder is vertical with the fly section facing away from the building and the halyard towards it. Instead of taking the time to rotate the ladder 180 degrees to position the halyard away from the building, the fly can simply be "upped" by the firefighter with their back to the building. This method must only be used when two or more firefighters are on the ladder to assist with stabilization and to act as a spotter.

Another added benefit of using this method is the fly will already be in a position facing away from the building. This means that once the ladder has been lowered into position and the proper climbing angle set, the ladder does not need to be rotated/flipped again. This method may save you valuable time by preventing you from making two extra steps of flipping the ladder 180 degrees.

NEVER RAISE THE FLY WITH YOUR BACK TO THE BUILDING WHEN PERFORMING A ONE PERSON LADDER EVOLUTION.

Figure 19-13 Short Crew evolution for a 20' wall ladders utilizing a building or curb to foot the ladder when raising

Short Crew Raise

The short crew raise is an evolution used in the event there are not enough firefighters to perform the standard ladder raise. The short crew raise allows for the elimination of one firefighter from the evolution by removing the person responsible for footing the ladder. Instead, the butt of the ladder is footed against the building, curb, or some other stationary object and then raised and maneuvered towards the building, Figure 19-13.

40' & Larger Ladder Raise

For 40 foot and larger ladders, poles, referred to as "pikes," are attached to the ladder to help stabilize it when raised. A minimum of four firefighters must be utilized when raising a ladder of this size. The method used to raise this type of ladder is basically a flat raise with assistance from the pikes. Never attempt a beam raise with this size ladder. Once the ladder has been raised and set in place, the pikes are set to assist in stabilization, Figure 19-14. Because of the pike configuration and the length of these ladders, they should not be rotated or flipped to place the fly side out as is required on smaller size ladders.

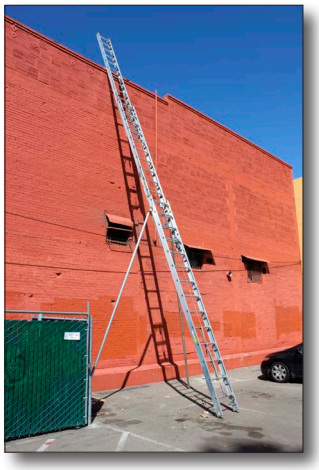


Figure 19-14 40' Ladder with pikes set in place

Ladder Rescues

Figure 19-15 Ladder placement for rescue

Firefighters may encounter victims during ladder operations. Victims may have various injuries and be in various states of consciousness. An approaching fire would dictate that the victim be rescued via the most available means. If conditions permit, victims, conscious or not, should be evacuated in a way other than the ladder (down an inside stairway, or to the roof if it connects to a safe exit). Ladder rescue should be used only as a last resort if no other escape routes exist. Helping victims or transporting them down a ladder is a very dangerous operation and should be conducted with extreme care and caution. Even fully conscious victims may have trouble descending ladders stemming from panic, unfamiliarity with the ladder, or a host of other reasons.

Known Rescues

If it is known in advance that a ladder will be used for a window rescue, it should be raised to the sill just below the window, especially if the window is narrow, Figure 19-15. This will permit easy access to the ladder from the window for both the firefighter and the victim. The ladder should be tied off at both the top and bottom and footed by firefighters.

Figure 19-16 Assisting a conscious victim down the ladder

Conscious Victims

If the victim is conscious, the rescuer will step onto the ladder first and assist the victim onto the ladder. Both individuals will then descend the ladder together. The rescuer keeps his/her arms around and under the victim's armpits, with hands on the rungs in front of the victim's face. One knee should be kept between the victim's legs to insure support in case the victim misses a rung or becomes unconscious, Figure 19-16. Attempt to continuously reassure the victim on the way down.

Figure 19-17 Assisting an unconscious victim down the ladder

Unconscious Victims

There are several methods for lowering victims who are unconscious. The victim may be lowered in a manner similar to a conscious victim except that he/she would rest completely on the rescuer's supporting knee. If this method is employed, the victim's feet should be placed on the outside of the rungs to prevent entanglement, Figure 19-17. Additional firefighters will probably be needed to assist in getting the victim onto the ladder.

An alternate method involves the same hold by the rescuer except that the victim is turned to face the rescuer. This method reduces the chances of the victim's limbs being caught in

the rungs, but again, the victim's arms and feet should be kept on the outside of the rungs to avoid entanglement. Children can be lowered by cradling them across the rescuer's arms. Do this only if the victim is light, Figure 19-18.

Similar to the cradling method is the sliding method. This method is very dangerous and should be used as a last resort only. The rescuer places his hands on the backside of the beams, locking them on. The victim is placed across the rescuer's arms, facing the ladder. One arm should be under the victim's armpit and the other should be between the victim's legs near his/her crotch, Figure 19-19. The rescuer's hands are slid down the backside of the beams as he/she descends.

Figure 19-18 Cradle Method

Figure 19-19 Sliding Method

Summary

Effective and efficient use of ladders is a core fire department skill that needs to be practiced often to maintain proficiency. When used properly they can and will save lives of both fire personnel and citizens by providing rapid means of egress from life-threatening situations. Properly judging ladder distances, placement locations and raising evolutions are critical skills that must be committed to memory through repetition. Most often ladder raises are done as a team. Be sure to communicate with your crew members to identify preferred raising methods then carry out the evolution together in training ensure fire ground success.

Media & Link Index

 SDFD Video - 24’ Extension Ladder - High Shoulder Carry (1 Person)

 Never Leave a Ground Ladder Un-Footed

 SDFD Ground Ladder Academy Spiel & SOG

 SDFD Ground Ladder Post Academy Drill Sheet

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Revisions/Updates

Date	*Revision/Update Description*
June 2020	All references to the number of rungs a ladder must be above the roofline have been changed to be more consistent with IFSTA. New language now states: "A ladder must be a minimum of 2 rungs above a roofline, 3 - 5 preferred."