



# **TRUCK & LADDER MANUAL**

SAN FRANCISCO FIRE DEPARTMENT

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TRUCK & LADDER MANUAL  
Revised January 2008

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## **FOREWORD**

The goal of this manual is to establish standard operating practices as authorized by the Chief of Department and implemented by the Division of Training.

The purpose of this manual is to provide all members with the essential information necessary to fulfill the duties of their positions, and to provide a standard text whereby company officers can:

- Enforce standard drill guidelines authorized as a basis of operation for all companies.
- Align company drills to standards as adopted by the Division of Training.
- Maintain a high degree of proficiency, both personally and among their subordinates.

All manuals shall be kept up to date so that all officers may use the material contained in the various manuals to meet the requirements of their responsibility.

Conditions will develop in fire fighting situations where standard methods of operation will not be applicable. Therefore, nothing contained in these manuals shall be interpreted as an obstacle to the experience, initiative, and ingenuity of officers in overcoming the complexities that exist under actual fire ground conditions.

To maintain the intent of standard guidelines and practices, no correction, modification, expansion, or other revision of this manual shall be made unless authorized by the Chief of Department. Suggestions for correction, modification or expansion of this manual shall be submitted to the Division of Training. Suggestions will be given due consideration, and if adopted, notice of their adoption and copies of the changes made will be made available to all members by the Division of Training.

Joanne Hayes-White  
Chief of Department



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## SECTION 1. SFFD LADDERS

San Francisco Fire Department ladders are classified as to use and construction. The various classifications are:

- Straight ladders
- Extension ladders
- Roofing and ridge ladders
- Boarding ladders
- Aerial ladders

All ladders are constructed of either wood or metal. A brief description of each type follows.

### STRAIGHT WOOD LADDERS

#### 12-Foot Straight Ladder

Construction	Wood. Straight ladder with solid beams.
Reach	11 feet
Applications	Used for several purposes; e.g., in narrow or confined places (closets, light wells) where body maneuverability is hampered. May also be used inside a building in order to gain access to attic spaces and to ceilings.
Firefighters	Carried and placed in position by one firefighter.
Apparatus	Carried on most engines

#### 14-Foot Roofing Ladder

Construction	Wood. Straight ladder with solid beams. Two large rounded steel hooks attached to the top of beams.
Reach	13 feet
Applications	Primary uses: to reach a higher story from another ladder; to gain access to light wells; holds of ships; or over sides of waterfront docks or piers; on peaked roofs.
Firefighters	Carried and placed in position by one firefighter.
Apparatus	Carried on trucks.

### **14-Foot Ridge Ladder**

Construction	Wood. Straight ladder with solid beams. Two short, slightly curved metal hooks attached to top of beams.
Reach	13 feet
Applications	May be used as a 14-foot straight ladder, but especially used on peaked roofs.
Firefighters	Carried and placed in position by one firefighter.
Apparatus	Carried on trucks.

### **16-Foot Fire Escape Ladder**

Construction	Straight ladder with trussed beams. Leather strap provided at top of ladder to secure ladder to fire escape balconies.
Reach	15 feet
Applications	Used primarily for fire escape work, but may also be used to gain access to basements through sidewalk trap doors. Also 1st story windows and roofs of small buildings
Firefighters	Carried and placed in position by one firefighter.
Apparatus	Carried on some trucks.

### **22-Foot Boarding Ladder**

Construction	Wood. Straight ladder with trussed beams and 4" hooks. Two large rounded hooks attached to top of beams. Hooks are considerably larger than those on roofing ladder.
Reach	21 feet
Applications	Used to scale sides of ships and for other fireboat work.
Firefighters	Normally two firefighters are required to place this ladder.
Apparatus	Carried on the fireboat.

### **22-Foot Fire Escape Ladder**

Construction	Straight ladder with trussed beams. Leather strap provided at top of ladder to secure ladder to fire escape balconies.
Reach	21 feet
Applications	Used primarily for fire escape work, but may also be used to gain access to basements through sidewalk trap doors. Also 2nd story windows and roofs of small buildings.
Firefighters	Normally two firefighters are required to raise this ladder.
Apparatus	Carried on trucks.

### **24-Foot Straight Ladder**

Construction	Straight ladder with trussed beams. Top of ladder has wooden crosspiece (on truss side) and a leather strap.
Reach	23 feet
Applications	Used as a brace for the 50-foot extension ladder. Also used to gain access to 2nd story windows; to roofs of small buildings; to basements through sidewalk trap doors or similar openings; and as a fire escape ladder.
Firefighters	Normally two firefighters are required to raise this ladder.
Apparatus	Carried on trucks.

## **WOOD EXTENSION LADDERS**

### **12 Foot Extension Ladder - Attic Extension Ladder**

Construction	Solid beam, constructed in two sections.
Unextended Length	Approximately 7 feet.
Extended Reach	11 feet
Applications	Carried normally with ceiling hook & extension attached.
Firefighters	Carried and placed in position by one firefighter.
Apparatus	Carried on trucks

### **18 Foot Extension Ladder - Baby Extension**

Construction	Solid beam; constructed in two sections.
Unextended Length	Approximately 10.5 feet.
Extended Reach	17 feet
Applications	Normally used inside buildings where 12-foot extension ladder is inadequate.
Firefighters	Carried and placed in position by one firefighter.
Apparatus	Carried on trucks.

### **22-Foot Extension Ladder**

Construction	Solid beam; constructed in two sections.
Unextended length	Approximately 13 feet long while not extended.
Extended Reach	21 feet
Applications	Used to gain access to first and second story windows and roofs of small buildings.
Firefighters	Normally two firefighters are required to raise this ladder.
Apparatus	Carried on some engines and reserve salvage.

### **35-Foot Extension Ladder**

Construction	Trussed beams constructed in two sections.
Unextended length	Approximately 20 feet long when not extended.
Extended Reach	33 feet 8 inches
Applications	Normally used to gain access to third story windows and to roofs of two story buildings.
Firefighters	Normally four firefighters are required to raise this ladder; however, it may be carried, raised and lowered safely using three firefighters.
Apparatus	Carried on trucks.

### **50-Foot Extension Ladder (Bangor)**

Construction	Trussed beams, constructed in two sections.
Unextended length	Approximately 28 feet long when not extended.
Extended Reach	48 feet
Applications	Ladder poles used when raising and lowering the ladder. Length of ladder poles is 21 feet approximately. Used to gain access to third and fourth story windows or roofs of three-story buildings. When required, braced by the 24-foot straight ladder.
Firefighters	Six firefighters are required to raise and place and lower this ladder.
Apparatus	Carried on trucks.

## METAL LADDERS

### 10-Foot Metal Folding Ladder (Straight Ladder)

Construction	Aluminum. Folding beams.
Unextended length	Closed length is approximately 11 feet;
Extended Reach	Open reach is approximately 9 feet; open width is approximately 12 inches
Applications	Used in narrow or confined places where body maneuverability is hampered or where height is limited as when laddering a ceiling or attic space.
Firefighters	Carried and placed in position by one firefighter.
Apparatus	Carried on some engines.

### 14-Foot Utility Ladder (Straight Ladder)

Construction	Solid beam construction. Equipped with folding hooks on inner side of beams near top.
Reach	13 feet
Applications	Used for several purposes: in narrow or confined places; to gain access to attic spaces and to ceilings; to holds of ships; and may be also used as a ridge ladder.
Firefighters	Carried and placed in position by one firefighter.
Apparatus	Carried on some engines.

### 24 Foot Extension Ladder

Construction	Solid beam constructed in two sections.
Unextended length	14 feet.
Extended Reach	23 feet
Applications	Used to gain access to first and second story windows and roofs of small buildings. May be used on fire escape balconies.
Firefighters	Normally two firefighters are required to raise this ladder.
Apparatus	Carried on some engines.

## AERIAL LADDERS

### Lti 100-Foot Extension Ladder (Spartan)

- Four section all metal truss ladders
- Fully hydraulic operation
- Powered by tractor driven propulsion motor





## **SECTION 2. LADDER HANDLING AND SAFETY PRACTICES**

### **REMOVING LADDERS**

If proper care is not exercised, serious ladder damage may occur when removing them from the apparatus. This type of damage occurs most frequently when one ladder is removed from the apparatus in order to get to another ladder. If the ladder is dropped to the ground against curbing, serious damage may occur. Always use care when removing ladders. Place un-needed ladders where they cannot be damaged or cause injury to personnel. Standard safe practices for removal of ladders from apparatus are as follows:

#### **Ladders Carried On Top Of Apparatus**

When removing ladders from the top of apparatus, the firefighter must take the necessary time to climb to a safe working position on the apparatus before attempting to free the particular ladder required.

Generally, ladders carried on top of apparatus are in "nests" of two or more, which often necessitates removing the top ladder in order to obtain the ladder below. Injuries to firefighters and damage to ladders have occurred when the ladder was carelessly tossed to the ground, allowed to rest vertically against the apparatus, or placed improperly.

Any ladder removed from the top of apparatus and not needed at the moment should be returned to its position on the apparatus or placed in a safe position against the apparatus wheels with the hooks, if any, turned towards the apparatus. When practical, assistance of another firefighter should be provided to receive the ladders from the member on top of the apparatus.

#### **Ladders Carried On The Side Of Apparatus**

Ladders carried on apparatus sides may also be in a "nest" of two or more. Ladders carried on the side of engines are normally held in place by a cable and clamp device. Trucks normally have a double yoke and pin arrangement to secure ladders to the sides. In every case, when a ladder is removed in order to obtain a desired ladder, the extra ladder shall be placed in a position of safety.

#### **Fifty-Foot Ladder**

When removing the fifty-foot extension ladder, the firefighters at the foot will grasp the beam with one hand and the lower rung with the other hand. Together they will slowly and smoothly pull the ladder out from the ladder bed.

As the midpoint of the ladder clears the chassis of the truck, the two beam firefighters, facing each other on opposite sides of the ladder, take firm hold of the ladder beam, assume their share of the weight, and move outward with the ladder.

As the beam firefighters move out, the two pole firefighters move into position opposite each other. When the third rung from the top of the ladder reaches the rear of apparatus they take firm hold of the ladder beam.

When the ladder is clear of the truck it should be raised to the shoulders of the firefighters and carried to the location as ordered using the flat carry.

### **Ladder Placement**

Proper placement of ladders at a fire can be a difficult problem. The fire officer, however, is expected to direct the proper raising of a ladder under adverse emergency conditions. The officer must, through constant practice, learn to place ladders properly in the shortest period of time possible. The following suggestions are offered for guidance.

### **Estimating Heights**

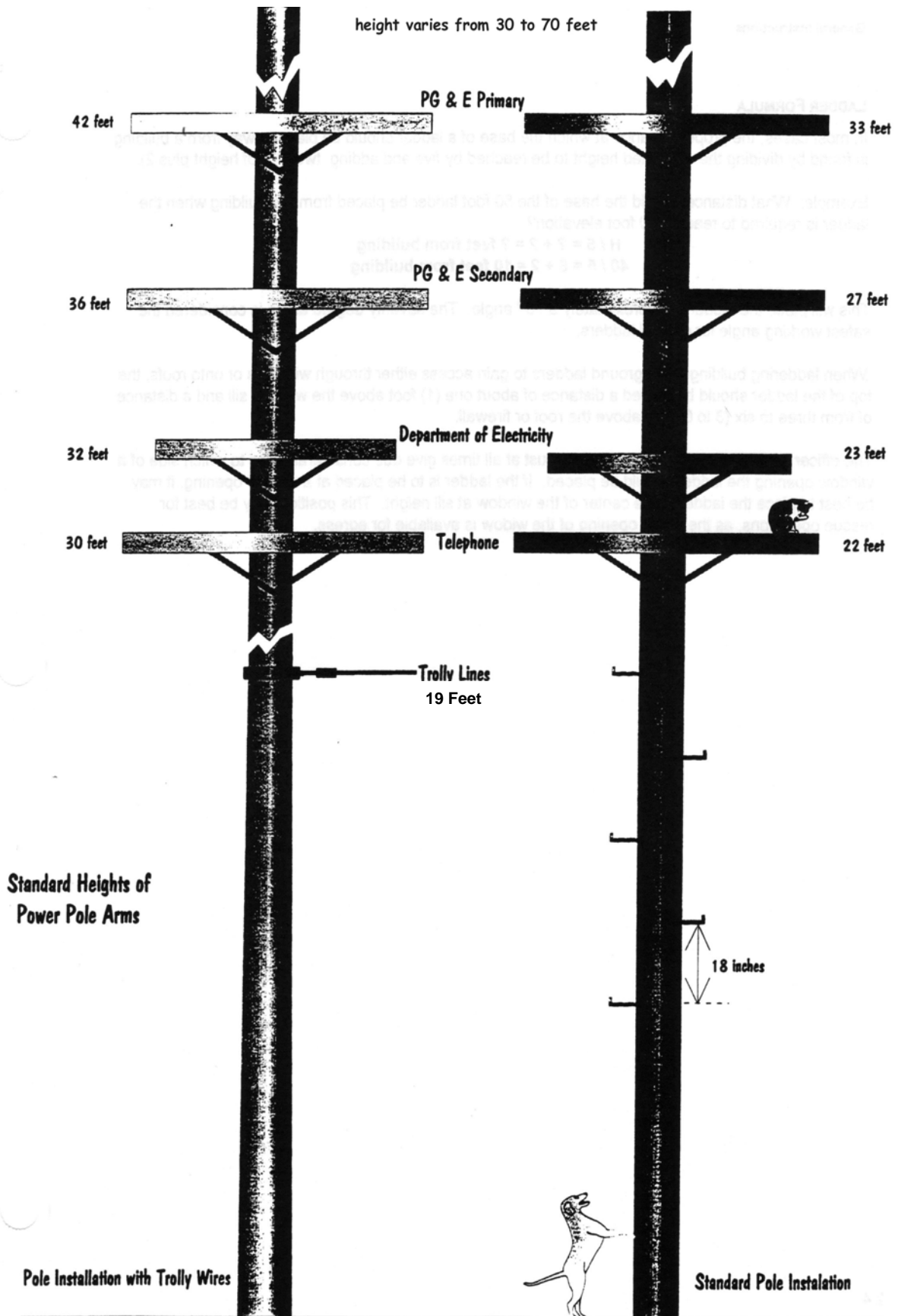
When computing ladder and hose factors, the normal story of a building is assumed to be 12 feet. However, the officer must evaluate the first story height as to whether it is a basement, cellar, or full story. If a window is to be laddered, the windowsill heights (about 3 to 4 feet) must be considered. Roof and fire wall heights will have to be considered, and all of these factors must be totaled when ordering ladder for a particular job.

One of the most accurate means of judging ladder heights is to take advantage of climbing spikes on power poles. The first spike starts at a height of approximately 7 feet above the ground, and each spike on the same side of the pole will denote an additional 3-foot elevation. A quick count of the spikes on one side of the pole will give an accurate means of measurement.

If the officer must assist in raising extension ladders, the Officer will normally take position at the foot of the ladder. The officer may temporarily leave this position to stand off to the side and check the proper extension height of the ladder.

When raising an extension ladder, the best position for an officer to take when sighting for ladder reach and placement is to stand well off to the side and parallel with the building. As the ladder is being extended, the proper height may be observed and the ladder pawls locked at this position.

After the pawls are locked, it is recommended practice to take a turn around the rungs with the halyard until the ladder is against the objective. Should readjustment of the ladder be necessary, no time is lost untying the halyard.



Muni overhead electrical wires are about 19 feet high, and are good for estimating heights for the 16' or 22' fire escape ladder.

Light poles for streetlights are generally of two types: metal and masonry (granite/gray). If the light globe is even with the roof or window, a 35' extension ladder will reach.

Overhead electrical service wires come into residential units at the weather head at about 18 feet.

### **Ladder Formula**

In most cases, the proper distance at which the base of a ladder should be placed away from a building is found by dividing the estimated height to be reached by five and adding two (1/5 of height plus 2).

Example: What distance should the base of the 50-foot ladder be placed from the building when the ladder is required to reach a 40-foot elevation?

$$\begin{aligned} H / 5 &= ? + 2 = ? \text{ feet from building} \\ 40 / 5 &= 8 + 2 = 10 \text{ feet from building} \end{aligned}$$

This will place the ladder at approximately a 70° angle. The seventy-degree angle is considered the safest working angle for ground ladders.

When laddering buildings with ground ladders to gain access either through windows or onto roofs, the top of the ladder should be placed a distance of about one (1) foot above the window sill and a distance of from three to six (3 to 6) feet above the roof or firewall.

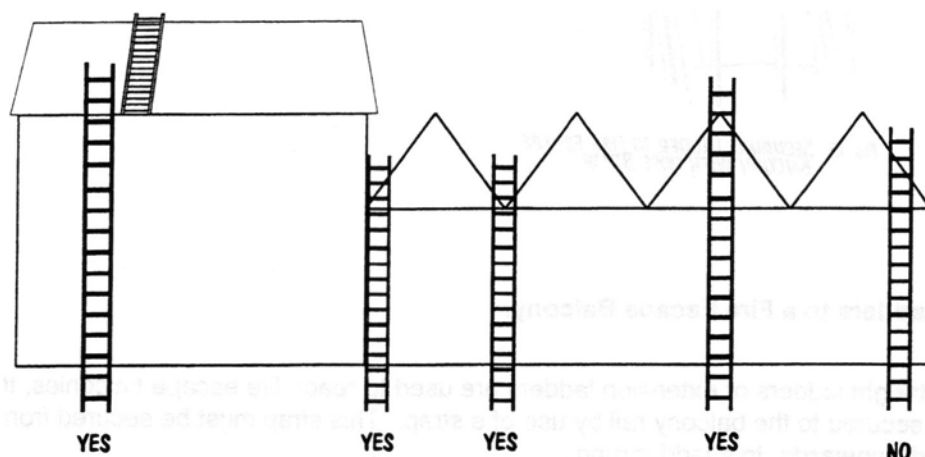
The officer in charge of a ladder operation must at all times give due consideration as to which side of a window opening the ladder should be placed. If the ladder is to be placed at a narrow opening, it may be best to place the ladder in the center of the window at sill height. This position may be best for rescue operations, as the entire opening of the window is available for egress.

## **HOSE LINES AND LADDERS**

When hose lines are to be taken over ladders, the ladders should be so placed as to allow the firefighters carrying the hose lines to climb the ladders safely and step into the window opening without having to step over the hose. Most firefighters are right handed, therefore it would be best to place the ladder on the left side of the window and then direct all firefighters carrying hose upon approaching the ladder to place the hose or hose straps on their right shoulder if they are not already so doing. Where circumstances dictate that the ladder be placed against the right side of the window, the firefighters carrying the hose would be directed to carry the hose or hose straps on the left shoulder.

## **Gable or Pitched Roofs**

When placing a ladder to a gable or pitched roof, it is extremely important that the top of the ladder be placed so as to rest on parallel points of the beams or truss. Otherwise the weight of a person on the ladder will create an imbalance of stress at the point of ladder rest and cause the ladder to fall toward the lower point of rest.



Whenever adequate clearance is available, the ladder should be placed to the base of the roof slope. If it is not possible to place the ladder to the base of the roof slope, the ladder may be placed to the valley of adjoining roof slopes or placed so as to rest securely against an adjoining building. The ladder may be placed to the peak of the gable, provided that the ladder rungs are not permitted to rest against a roof ornament common to this type of roof construction or to rest against the peak of the roof.

The ladder should never be placed to the slope of the roof unless absolutely unavoidable. It is obvious that a ladder placed in this position is extremely unstable and would tend to fall toward the down slope whenever any stress is placed against the unequal points of rest at the top of the ladder.

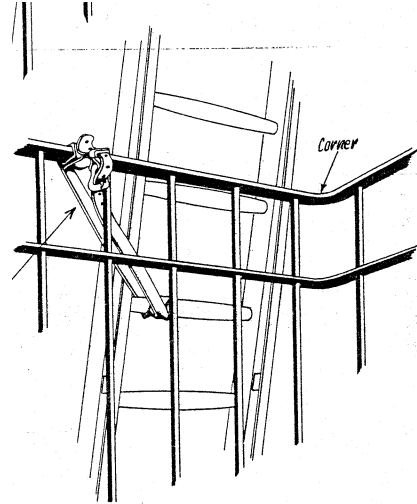
Firefighters working on pitched roofs should make the maximum use of the roofing and ridge ladders and should never rely on a roof gutter for use as a footing. Roof gutters are not designed to sustain the weight of a person and may be in a badly deteriorated condition.

## **FIRE ESCAPES**

When ladders are used in conjunction with fire escapes and balconies, consideration must be given to two-way traffic ingress of firefighters and egress of building occupants. Height of ladders above balcony rails is a determining factor in facilitating traffic to and from upper floors. Ladders should be placed to allow persons to step easily from ladder to rail and steps of fire escape, and vice versa. In some cases it may be easier to step directly on and off to the side of a ladder, and in other cases easier to step around the top of the ladder.

## Securing Ladders to a Fire Escape Balcony

- Where straight ladders or extension ladders are used to reach fire escape balconies, the ladders must be secured to the balcony rail by use of a strap. This strap must be secured from rail of balcony **downwards** to a ladder rung.
- The 22-foot Fire Escape Ladder, the 16-foot Fire Escape Ladder, and the 24-foot, Straight Ladders are normally equipped with a leather ladder strap secured to the top rungs of the ladder. When ladders are used which are not equipped with ladder straps the hose strap may be used.
- A simple hose strap may be utilized by first placing the strap with keeper around a rung and placing keeper in position on strap. The hook end is then passed over rail of balcony with open side of hook facing downward. Ladder base should then be moved outward slightly to take up any slack. This **strap** must be secured from rail of balcony **downwards** to a ladder rung.



Truck officers are not limited to placing fire escape ladders in one standard position, nor are they limited to the use of any specific ladder for fire escapes. Conditions may warrant placing ladders at the ends of balconies, to upper balconies, or the use of ladders shorter or longer than the 22-foot fire escape ladder.

**Safety Note:** Where small wood extension ladders such as the 22-foot extension ladder are used to reach the fire escape balconies, strapping and placement of the halyard must be altered. It is possible that the foot of the extension ladder might be pulled outward by dragging hose, etc. and cause the bed ladder to extend from the fly. For this reason, it is necessary to take the halyard up the ladder to where the two ladder sections meet and there tie both sections together securely, using the regular halyard tie.

When the 24-foot metal extension ladder is used to reach fire escape and is attached thereto with a strap, the halyard must be passed through the rungs to the rear of the ladder at pulley level. The tie will then be made as outlined in the preceding paragraph.

## **SAFETY PRACTICES**

**Unless absolutely necessary, ladders should not be placed:**

- In front of entrances and exits where ingress and egress might be obstructed.
- Into or against burning windows or other burning surfaces.
- Against rounded overhanging roof surfaces, or against the slope of a pitched roof where the stability of the ladder might be endangered.

- Over sidewalk elevator trap doors.
- Over sidewalk deadlights.
- In such a manner that ladder spurs straddle hose lines.

**At all times when climbing or coming down ground ladders there shall be members footing or supporting the ladder at the top to provide stability and safety for those using the ladder.**

The top of a ladder should not be scraped along a wall or window ledge when it is being shifted to a new position.

When lowering a ladder into a window, be alert for falling glass. When extension ladders are in position for climbing, the first firefighter up the ladder shall check the correct position of ladder pawls. This applies to all extension ladders.

When a ladder is placed in an unusual or abnormal position, there should be enough firefighters on the scene to assure stability before the ladder is climbed.

When additional stability may be secured by moving the spurs a matter of a few inches or so into a crevice or crack in the sidewalk, it is advisable to do so.

Place all hand raised wood truss ladders with the truss side facing toward the building, except the 24-foot ladder when used as a brace for the 50-foot ladder.

Many times difficulty is encountered in placing the 50-foot extension ladder to a particular location and in removing it from its position of rest against the building. Set backs in building levels, bulkheads, ground depressions or variance in ground elevations, vehicles parked at curbs, obstructions and shortage of personnel are common causes of this type of difficulty, and often require the beam and ladder pole firefighters to assume awkward positions.

Considerable assistance can be provided in instances of this type by use of the halyard as a guy line. The halyard is made to take up part of the strain in lowering the ladder to, or removing it from the building. An important precaution to observe in the use of the halyard for this purpose is to secure the halyard firmly on the truss side of the ladder to the fourth or fifth rung above the ground. This will prevent accidental tripping of the pawls, which might release the fly and permit it to fall with possible damage to the ladder and injury to firefighters.

## **LADDER CLIMBING**

When climbing ladders with the proper rhythm, it is necessary to step with the ball of the foot on the rung, to grasp each rung using the hands alternately, and to climb near the center of the ladder. Keep shoulders about arm's length from the ladder, climb steadily

and smoothly, and do not look downward. Normally the firefighters should not attempt to run up or down ladders. If carrying an item in one hand, slide the other hand on the beam or truss to maintain a grip on the ladder.

When it is necessary for firefighters to pass on a ladder, the member going up should be responsible for procedure. That member should notify the firefighter coming down, then move to the right-hand side of the ladder, with the inside hand on the rung and the outside hand on the beam. The firefighter coming down moves to the left-hand side and proceeds downward. As soon as they have passed, each moves back to the center of the ladder.

## **LADDER LEG LOCK (LOCKING IN)**

When working from ladders, it is frequently necessary to have both hands free to do such work as handling hose lines, ladders, etc. Firefighters working on ladders should not let go of the ladder with both hands unless properly secured to the ladder by the ladder leg lock. To lock in, the firefighter places one leg through the ladder over the second rung above the one upon which the lower foot is placed. Then brings the foot back through the ladder between the first and second rungs and braces the toe over the rung above the lower foot. Then lowers the lower foot to one rung below original position.

NOTE: Do not hook the foot and ankle around the ladder beam.

The leg lock is made on the side of the ladder opposite the side on which work is to be done. The lower foot, on which the weight is carried, should be on the rung near the beam in a position from which it will not slide.

<b>NOTE: Do not lock in on aerial ladders.</b>
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## **LADDER CAPACITIES**

A general safe rule for ladder loading is: One person for each 10 feet of ladder length up to 30 feet. SFFD ladder practice requires that not more than three (3) firefighters shall be on any hand-raised ladder at any time.

### **Wood Ladders**

The following table of recommended safe loads is based upon the average weight of a firefighter being 175 lb., and upon the ladder being properly raised and placed at an angle of 70 degrees. The table also applies only to the hand-operated wooden ladders in service in the Department, but does allow for added loads such as when emergency rescue is necessary:



Straight Ladders		Extension Ladders	
Ladder	No. of Persons	Ladder	No. of Persons
12 foot	1	12 foot	1
14 foot roof	1	18 foot	2
14 foot ridge	1	22 foot	2
16 foot	1	35 foot	3
22 foot	2	50 foot	3
24 foot	2		

### **Aerial Ladders**

The following table provides a guide for recommended safe loading of aerial ladders at several angles of inclination. It is based upon the proper placement of the apparatus and assumes the load to be evenly distributed on the ladder: Refer also to manufacturers' specifications.

Fully extended and unsupported at top			
Angle of Inclination	45°	60°	70°
Number of Firefighters	1	1	3
Limit on Fly			1

(Note: Refer to manufacturers' specifications for each type of aerial and the recommended ladder loading).



## SECTION 3. SFFD GROUND LADDERS

### PROPER LIFTING POSTURE

A note of caution should be given relative to the proper method of lifting or lowering ladders from or to the ground. Serious back injury has been sustained by firefighters using their back muscles to lift a heavy ladder by bending their body from the waist and then straightening up to lift. The heavy muscles of the thigh and the muscles of the arm are the ones that should be used in lifting, NOT THE MUSCLES OF THE BACK. The correct body position for lifting is to bend the knees, keeping the back straight and lift by using the muscles of the legs and arms as the legs are straightened. Firefighters on the beam must always have their palms up when lifting ladders.

### INSPECTION AND CARE OF LADDERS

Inspection of ladders requires careful attention to details and common sense. Failure to detect a flaw in a ladder may cost the life of a firefighter or of those they serve. A rigid inspection should be made of all ladders used at a fire immediately on their return to stations and at regular weekly intervals, even through the ladders are not used. Defects observed shall be reported to the Bureau of Equipment. (refer to Appendix A - Inspection of Wooden Ladders)

#### Ladder Inspection

PART	INSPECTION
Varnish Finish	Inspect for damage, defects, and worn varnish finish on wooden ladders. Maintaining the seal provided by this varnish finish cannot be over emphasized. The original strength and characteristics of the wood are preserved and protected by the varnish seal. The varnish prevents entrance of moisture and retains the oils and resins in the cell structure of the wood. Ladders that have been used at a fire should be cleaned and wiped as soon as possible to prevent moisture from penetrating the finish through damage or defect in the varnish.
Rungs	Inspect for looseness, wear, splinters, gouges and cracks. These indicate a need for varnish. Pay particular attention to the rungs on which the fly ladder has been locked.
Beams	Inspect for wear, splinters, gouges, and cracks.
Spurs	Inspect for wear and defects.
Halyards	Inspect for frays, improper splices, wear, cuts
Locks, Pulleys, Rollers	Inspect for breakage, wear, lubrication, and springs.
Tie rods and Bolts	Inspect for tightness, burrs, and sharp edges.

Stops	Inspect for wear and proper operation
Guides, Braces, and other Wood Members	Inspect for looseness, wear, slivers, gouges, cracks, or need for varnish.

## BRACING LARGE EXTENSION LADDERS

(See SFFD Drill Manual for detailed instructions)

Frequently, the 50-foot ladder must be braced by use of a shorter ladder of straight-trussed design placed against the main ladder truss. Normal procedure is to place the brace ladder with the truss side toward the main ladder truss.

As the 24 foot straight ladder is approximately the same width as the 50 foot extension ladder, a wooden cleat is placed on the truss side at the top of the 24 foot ladders to prevent slipping when used as a brace. To achieve firm bracing, a leather ladder strap, normally secured to the brace ladder, is used.

The method of strapping a brace ladder cannot be varied. The strap must come downward from the brace ladder to the bed ladder and, where practicable, both the fly and bed ladder rungs should be secured by the strap. When this is not practicable, the strap must be secured downward from the brace ladder to the bed ladder, not to the fly.

The brace ladder butt is normally placed about one foot from the base of the building. However, proper ladder angle is critical, so the brace ladder may be placed closer to the building if necessary. In the absence of regularly attached ladder strap, the shoulder portion of the combination hose and shoulder strap may be used.

The 50-foot extension ladder should be braced whenever possible. Additional stability and strength of the brace ladder is an important safety feature. It is mandatory that the 50-foot ladder should be braced when hose lines are led over the ladder, when it is to be used for extensive climbing operations, when it is fully extended, and when used on hills.

## SLIDING LADDERS

The firefighters on the foot place their hands on the first and fourth rungs and move that position **without allowing the base of the ladder to rise off the ground.**

The beam firefighters place the ladder on their shoulder, with one hand going under rungs and grasping the third rung from their shoulder. The other hand grasps the beam of the ladder.

When sliding the ladder, the foot is slid along the ground. It is very important that the foot does not come off the ground when sliding, as this will place the entire weight of the ladder on the shoulders of the beam firefighters.

After the ladder is slid to its new position, the firefighters resume their normal position and raise the ladder.

When sliding the 35 or 50-foot extension ladders, the ladder-raising device is of great assistance and is recommended when a firefighter is available. When conditions indicate that the ladder will have to be slid, the ladder-raising device should be removed and placed in the bed of the ladder prior to removing the ladder from the truck.



## LADDER RAISING DEVICE



The ladder-raising device is very useful in raising ladders where wires or other obstacles interfere with the raise. Use of the ladder-raising device normally calls for a crew of five firefighters to raise the 35-foot ladder.

Upon command, the beam firefighters pick up and raise the ladder; the foot firefighters ground the foot of the ladder and slide it forward toward the objective.

When the top of the ladder has been raised sufficiently high, the firefighter operating the ladder-raising device faces the foot of the ladder and positions the yokes on the highest rung possible. Place the long tines of the yoke above the short tines.

When required, the firefighters hold the ladder momentarily to allow the device to be shifted to a lower rung, repeating a second or third time to raise the ladder to a vertical position.

Note, when in tight quarters, a ceiling hook can be used in place of the ladder-raising device, and is more maneuverable.

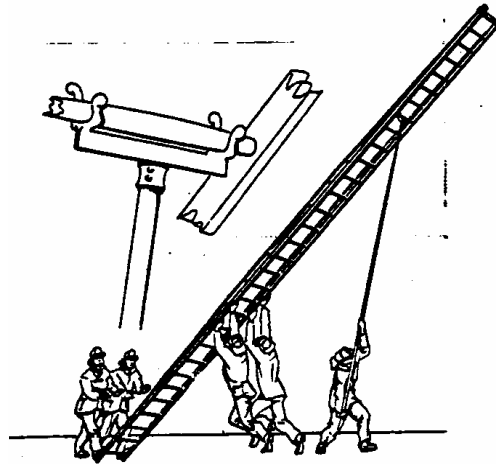
Another use for the ladder-raising device is the placement of the wrecking hook and chain. The foot end of the device is squared. The end fits into a yoke that is part of the wrecking hook. In this manner the wrecking hook can be placed at the desired point for use.

## THE CHUTE RAISE

Occasionally situations are encountered where it is impossible or impracticable to raise a ladder in the normal manner, such as in lightwells, shafts, inner courts, etc. Ladders may have to be carried through windows, doors, basements, or alleyways and may be obstructed by limited areas and low overheads. The "Chute Raise" may be employed. The chute raise usually requires the top of the ladder to enter the area first. As the top of the ladder is raised, the foot is held down firmly (grounded) and slid along the ground toward the objective.

The following instructions are designed for five (5) firefighters operation (including one firefighter on the ladder raising device or ceiling hook) with the 35-foot ladder. The chute raise may be used with other ladders as well; the number of firefighters required varies with the size of the ladders used.

1. Carry ladder to point of raise, top of ladder to front. Provide ladder-raising device if needed.
2. Consider the ladder position for climbing, as it may necessitate the turning of the ladder so as to place the truss toward the wall when raised.
3. Beam firefighters face beams near top of ladder; with both hands lift the ladder, swing under beams or truss and raise ladder by moving hand under hand on beams or truss. Foot firefighters hold foot of ladder to ground and slide ladder toward objective. Unlike the normal flat raise of the ladder, the beam firefighters cannot move rapidly toward the foot as the ladder is being slid in their direction. It may even be necessary in some instances to adjust their steps backward to clear low overhead obstructions.
4. Where the ladder-raising device is used, it is placed in position when the top of the ladder has been raised sufficiently high for the firefighter using it to step under the ladder. However, a force should not be exerted with the device until it is at an angle above horizontal sufficient to permit a more upward thrust. The yoke should be placed on the highest rung possible. When necessary the other four firefighters should hold the ladder momentarily to allow the device to be shifted to a lower rung.



## THE AUDITORIUM OR CHURCH RAISE

The Auditorium or Church Raise is used where it is impracticable or impossible to rest the top of a ladder against a support. As the name implies, some of the common uses of this raise are found in auditoriums and churches where it is necessary to work in the center of an open area with no top support for the ladder. It also has outdoor uses,

such as re-weaving flag staff halyard, and cutting high wires. This raise is particularly applicable with the 50-foot extension ladder, but may be used with shorter ladders as well.

### Instructions

1. Obtain the required extension ladder and place the butt at point of raise. Obtain ropes for use as guy lines. Stretch ropes to full length. Bring both ends of each rope together; take bight at middle of each rope and adjust until ropes are evenly doubled.
2. Pull out fly ladder to place top rung of fly clear of bed ladder. Position each bight of rope between first and second rungs at top of fly ladder and tie as follows: Make one turn around fly beam just under top rung, passing bight between outer edge of beam and doubled rope. Carry bight to top of fly ladder and place over top of beam. With doubled rope, work the slack out of bight and hitch the bight to bind the bight and prevent the rope from slipping. Lay all ropes on the ground in such position so as not to interfere with ladder raise.
3. Follow Standard Practice to raise the ladder. Particular emphasis is placed on maintaining the ladder vertical and on placement on secure footing. A 90-degree position of pole firefighters is mandatory.
4. A stationary object should be used to anchor the four guy ropes. Columns may be available indoors. Outdoor use may provide such objects as poles, trees, car bumpers, etc. If a car bumper is used as an anchor make certain the car will not move during the operation. Where no other means are available, firefighters may be used to do the anchoring; each firefighter will take a position at about 45 degrees from the plane of the ladder to form a square. Each firefighter faces toward the ladder, takes one turn of guy rope around his/her waist, forms a bight in the rope, and takes one turn of the doubled rope around the guy rope to snub the rope. Under no circumstances should a knot be used to anchor the guy rope to a firefighter, as it may be necessary to release the rope immediately.



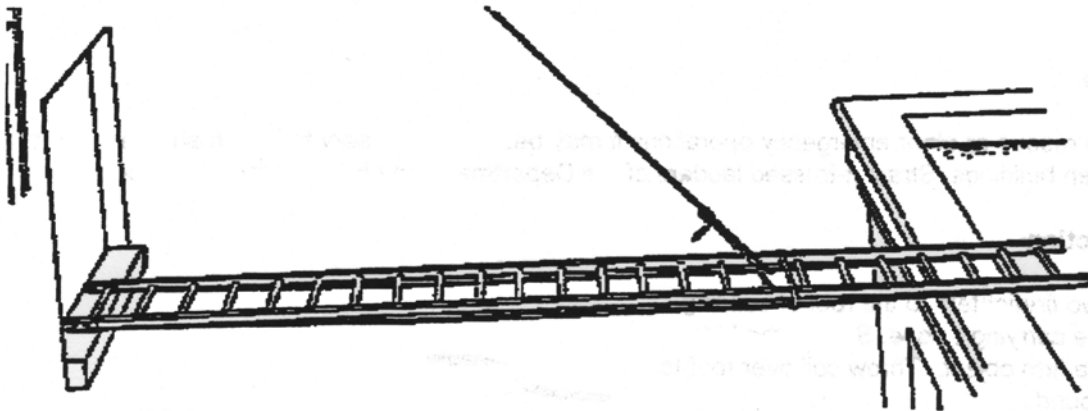
Guy ropes **should not** be used to assist in the lowering or the raising of ladders during a church raise.

### WRECKING HOOK

The wrecking hook and chain consists of 130 feet of 3/4-inch rope, 15 feet of chain and a wrecking hook. This is used together with the snatch block and rope sling to pull down walls, chimneys, or other hazardous parts of buildings. The sling is used to attach the snatch block to a substantial anchor.

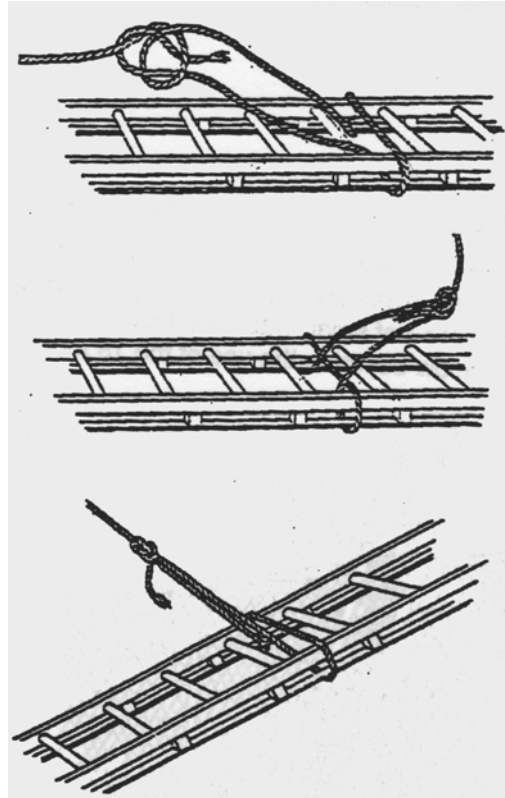
## BRIDGING AN OPEN AREA

During rescue or other emergency operations it may become necessary to bridge an open space between buildings. Straight-trussed ladders of the Department may be used for this purpose.



### Instructions

1. Two firefighters to the roof of building, one carrying a rope. Secure the bitter end to a firm object. Throw coil over roof to ground.
2. Place the ladder on ground at point of raise, truss down. One firefighter makes the bridging tie on the ladder at a point measured from top by the formula: Length divided by 5 + 2.
3. Measure two fathoms for tie; at the measured point of the rope pass the end over the rung and around beam; continue around the beam and parallel with the rung to top of opposite beam.
4. Continue around the opposite beam, passing end of the rope between parallel line and rung so that both sides are identical. Form an equalizing bowline to complete knot.
5. On hoisting the ladder, one firefighter remains on the ground to guide the ladder until vertical, beam is toward building. Other firefighter then proceeds to the floor from which bridge is to be made.
6. As the firefighter on the roof pulls the ladder to the desired height, the firefighters at window grasp the butt of the ladder and guide it into the window. They then signal to the firefighter on roof to lower the top of ladder until the objective is reached: adjustment is then made by the firefighter in the window either pulling or pushing the ladder. The firefighter on roof guides the ladder to horizontal. Rope is then made slack

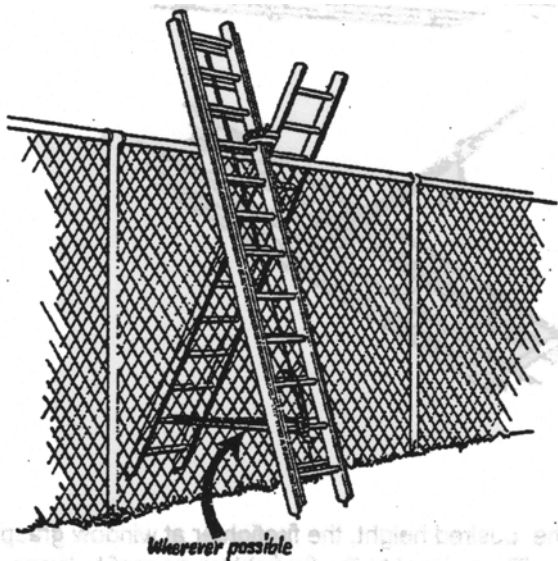




and placed to the side of ladder but left in attached position for removal of ladder. (Rope must not interfere with use of ladder).

## BRIDGING WALLS, FENCES, & OTHER OBSTACLES

Bridging a fence or wall is frequently a problem for the firefighter, especially when it is crowned with sharp wire ends. The various small straight ladders may be used in combination for this purpose; the bed and fly section of small extension ladders may be parted and used as separate ladders. The instructions below describe the use of the 18-foot extension ladder for bridging a fence.



1. Place the ladder on the ground parallel to the fence, bed ladder up, top near point of raise. Untie the halyard and pull it clear of the ladder.
2. Firefighter at top of the ladder, grasp the metal tie rod of bed ladder, lift slightly and pull bed ladder clear of the fly ladder toward the top of extension. Place bed ladder in climbing position against fence. One firefighter climbs to position on bed ladder (shoulder even with top of fence) to receive fly ladder.
3. Firefighter on ground picks up the fly ladder and raise it (foot first) to firefighter on bed ladder.
4. Firefighter on bed ladder, raises fly

ladder to balance point, tips same over fence (foot first), and lowers or slides ladder foot to ground,

5. By using simple leverage, the proper distance of the fly ladder from fence to the base of the ladder can be achieved. Use the hose and shoulder strap or truck belt to secure ladders together at top. Include fence top in tie if practicable. If possible, secure base of ladder bridge.

## VERTICAL LADDER HOIST

How to use the Eye Splice (bowline) in rope to Hoist a Ladder (Vertically)

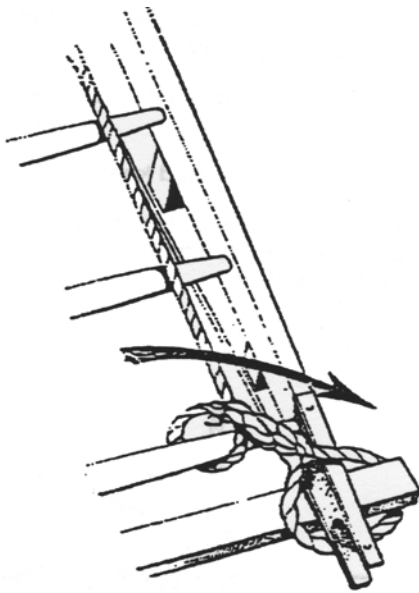
### Instructions (24-foot ladder)

1. Position ladder on ground parallel with building, truss down, butt at point from which ladder will be raised. (if necessary, to raise at right angle to building, place butt toward building.)

*To determine rung on which to start the tie, use this formula:*

*$1/5$  length of ladder times 2 equals the starting rung.*

*Example: 24-foot ladder*



continue hauling on rope. Ladder will break over fire wall without removing the rope.

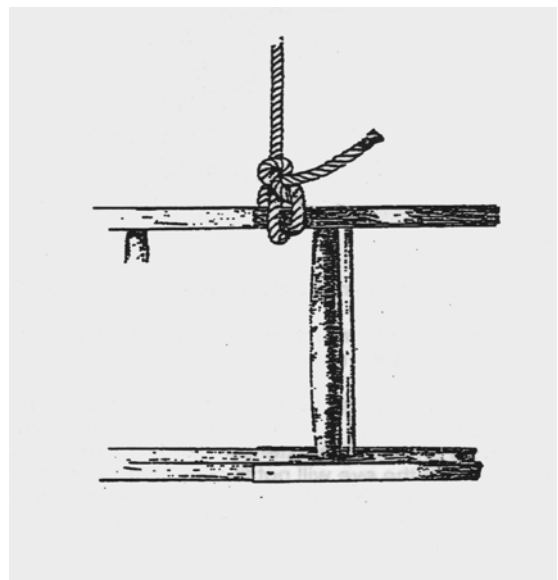
$$1/5 \text{ of } 24 = 5 \times 2 = 10$$

2. Start at butt of ladder; count ten rungs toward top of ladder. Tie an eye splice from a bowline.
3. Pass eye under tenth rung from butt; bring up and make one round turn with eye of rope around to rung, binding hauling line against beam.
4. Place eye over end of beam and cross-piece. (Caution: Be sure eye is pulled tight against the rung or cross- piece.
5. Turn ladder over before hoisting in order to place the rope between building and ladder. Guide ladder until it rests flat against building and is suspended clear of ground.
6. When ladder reaches fire wall,

NOTE: In most cases, it is better to hoist the butt of the ladder first, since this will facilitate the raising of the ladder on the roof, or the placing of the ladder in a lightwell. This method can be used on all straight ladders and also on extension ladders if the eye will fit over the beam ends of both the fly and bed ladders. if the eye will not fit over beam end, make an eye loop and fit it securely to the ladder beam ends as instructed above. Some extension ladders have a tie rod that will prevent safe placement of the eye over the top beam end. In this case, reverse placement of the ladder and place the eye over the beam end.

## HOW TO TIE A LADDER FOR HOISTING IN A HORIZONTAL POSITION

Where wires or any other obstruction prevent hoisting a ladder and breaking it over the fire wall in the normal (vertical) manner, this alternate method may be used. Use of two ropes from the roof and one rope as a guide line will be required.



## **Instructions**

1. Place ladder on the ground at a point from which the ladder is to be hoisted. Rest ladder on one beam as for the beam raise; beam side toward and parallel to the building.
2. Tie a clove hitch with keeper around top beam between first and second rungs at each end of the ladder. Use one rope at each end of the ladder.
3. Tie guy line around bottom beam at center of the ladder. Use clove hitch and keeper.

NOTE: The officer should anticipate the situation that will exist on the roof for proper placement of the ladder butt before it is tied for hoisting. This will facilitate maneuvering the ladder on the roof since the space available may prevent turning the ladder end for end.

## **LADDERS AS BATTERING RAMS**

The battering ram is the recommended tool to use in these situations. However, it may be necessary to use a ladder as a battering ram in certain situations. If so, the best ladders for this purpose would be straight trussed ladders as their inherent strength makes them the most rugged. Extension ladders should be used only where straight trussed ladders are not available. The bed or fly sections of extension ladders will, under impact against a solid object have a tendency to move with possible damage to ladder and injury to firefighters. Position ladder, foot first, at a 90-degree angle to the object to be breached. If the object is wide, a flat position of the ladder may be best. If the object is narrow, such as a door, a vertical beam above beam position may be desired.

### **Flat Use**

1. Position ladder flat on ground, truss down. Two firefighters face each other opposite the third rung from the top. Each firefighter grasps the rungs of the ladder, hand in the direction of thrust on third rung, other hand on rung two rungs away from third rung and from direction of thrust, palms down. Raise ladder to position for breaching.
2. Upon preparatory command "ready," the ladder is drawn back between the firefighters, the arm nearest ladder foot at a position across body.
3. Upon the command "strike," all firefighters drive ladder forward in a flat plane against the object.
4. To prevent injury, the officer shall avoid placing firefighters behind the top of the ladder.



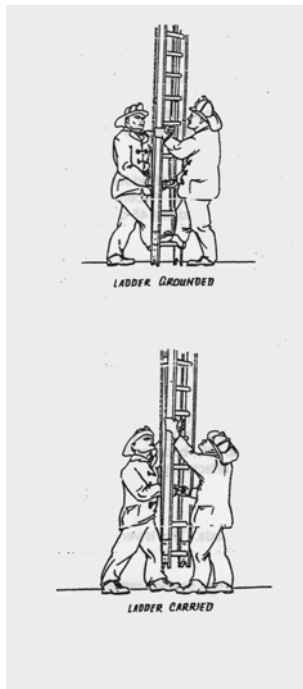
## **Vertical Use - Beam Over Beam**

1. Place ladder on ground with one beam above the other.
2. Place two fire fighters facing each other at third rung from foot on opposite sides of ladder. Place two firefighters facing each other at third rung from top of and on opposite sides of ladder. Each firefighter grasps center of third rung with hand nearest direction of thrust, other hand grasps center of rungs away from third rung and from direction of thrust. Face palms toward each other. Raise ladder to position for breaching.
3. Upon preparatory command "ready," the ladder is drawn back between the firefighters, the arm nearest ladder foot at a position across body.
4. Upon the command "strike," all firefighters drive ladder forward in a flat plane against the object.
5. To prevent injury, the officer shall avoid placing firefighters behind the top of the ladder.



## **VERTICAL LADDER CARRY - UP OR DOWN STEPS**

### **Two of Four Firefighters**



1. Carry ladder as instructed.
2. The preparatory command "prepare to ground ladder" will be given prior to firefighters reaching the steps. The command "ground" will be given about one full step from the bottom or top step of the stairway in order to give the firefighters room in which to readjust hand positions on the ladder.
3. The firefighters last to go up or down the steps will hold the ladder in position while the firefighters first up or down the stairs move to the first step and readjust the position of the hands on the ladder. Move the hand parallel with the ground to a position on the next higher or lower rung and readjust the hand on the beam or truss for reach
4. Upon the command "prepare to carry", assume proper position and upon the command "carry", resume the vertical lift and carry off the steps: ground the ladder, resume normal positions and carry the ladder to the terminal point.
5. When carrying ladders up of down stairs in the vertical position, the ladder-raising device can often be used to good advantage.

## **HOW TO RAISE LADDERS ON HILLS**

The raising of ladders on a hill presents many problems. The difficulties multiply as obstructions, steep grades, or longer ladders are encountered. The size-up on the part of the truck officer is of utmost importance as time consuming delays occur when ladders are not placed properly or when means of leveling the ladder are not readily available. Ladders are raised on a hill with the top of the ladder placed uphill. From this position, less lifting will be required to reach a vertical position.

A ladder raised on hills will require leveling of the downhill spur by use of a wedge block, ladder block, or ladder heeler. The necessary leveling equipment must be available for immediate use to prevent holding excessive ladder weight or controlling instability of the ladder when in a vertical position and resting on one spur. Therefore, when it is apparent that any leveling device is needed, the officer should insure that the correct device is at the point of the ladder raise.

Wedge blocks are most commonly used to make minor adjustments in the leveling of ladders raised on hills. The placement of the wedge block is normally toward the building at the butt. Placement of the wedge block should be with the heavy edge of the wedge toward the building and at a 45-degree angle outward from the leveled spur.

The ladder heeler is an all-metal device, which may also be used to level ladders raised on hills. The ladder heeler is clamped to the downhill beam of the ladder by two wing nuts, which are tightened against the ladder beam or truss and is also held in place by two large cotter pins. Extension to the ground to level the ladder is accomplished by means of a metal leveling rod. The leveling rod is adjusted by means of a metal handle attached to the rod. The butt or spur of the downhill ladder beam rests on a horizontal flange at the low end of the heeler. The metal leveling rod is housed in a notched metal tube, which permits setting the extension of the leveling rod in graduations of 1-1/2 inches. Maximum extension is approximately 12 inches.

When using a ladder heeler, it is attached and secured to the down hill beam of the ladder after the ladder has been raised. When placing ladders on hills for raising, place the spurs about one or two inches from a crack in the sidewalk. This is particularly important on steep hills, because if the ladder moves the spurs will catch in the crack. If ladder angles are not seriously affected, place the spur initially in the crack in the sidewalk. Refer also to the Drill Manual.

### **Recommendations For The 50-Foot Ladder**

The pole firefighters do not push until the top of the ladder is above their heads. This is very important because if they push too soon, they will push the ladder down the hill.

When the ladder is in a vertical position, the pole firefighters take a 45-degrees position rather than the 90-degrees position. The downhill pole firefighter has control of the ladder on the pivot.

After the pivot, a block or ladder heeler is placed under the downhill spur. Generally the officer will place the device.

The outside pole firefighter then proceeds toward the building and sets in position while the fly is raised and the ladder is lowered into the building.

It may be necessary to use one or both of the ladder pole extension on the downhill pole in order to set the pole properly. This device is approximately 36-inches long and is held in place on the bottom of the pole by a set screw.

When used on a hill, the 50-foot ladder should always be braced regardless of the ladder elevation. This is necessary for additional stability and safety. The bracing ladder should also be properly leveled with wedge blocks.

On very steep hills, two additional firefighters may be required to back up the butt firefighters on the 50-foot ladder. Each additional firefighter places one foot directly behind the butt firefighter's foot that is on the ladder spur. This prevents the butt firefighters from being pushed down the hill by the base of the ladder.

NOTE: Where ladders are raised on hills or uneven ground and immediate rescue of victims must be performed, an alternate method of leveling the downhill beam may be performed in the following manner (assuming blocks or leveling devices are not at hand):

1. A member or members of the ladder crew may step behind the ladder at the downhill beam.
2. Place their shoulder against the downhill beam with one foot behind the other to afford stability.
3. The person climbing or descending the ladder must be cautioned to use the uphill side of the ladder for ascent or descent.

### **Placing Ladder On Beam**

An excellent alternative when raising a ladder on a hill is to lower the ladder into the building or window on the inside beam. After the ladder is placed, roll and level it.

## **SECTION 4. AERIAL LADDERS**

The aerial ladders in service in the Department are all metal construction. The wide range of use of each aerial truck and the variance of each manufacturer's design make it impracticable to set down exact standards of operation in this manual. Reference is given to the instruction manual supplied with each individual apparatus for those officers and members assigned to truck companies. The intent of the following information is to establish general standard practice well within the safety limits of all aerials.

### **CONSTRUCTION**

The construction of aerial ladder trucks varies with the manufacturer's design to the extent that each truck should be carefully studied in order to learn the peculiarities of such items as ladder release locks and other operating equipment. Practically all ground ladders of trucks are carried on rollers or trays in the ladder bed of the truck, and may be easily removed and carried to the point of operation by firefighters using the flat carry.

The aerial ladder consists of four sections constructed entirely of rust resistant steel alloy. Main beams of all sections on aerials are trussed to support the designed load. Under normal use, trussing is designed to carry the greatest load in a direction vertical to the ground, hence, side stress on the ladder must be avoided as much as possible.

The aerial ladder operates on a shaft, which permits vertical movement. Horizontal movement, or rotation, is provided by a turntable at the lower end of the ladder. When the aerial ladder is raised, the entire weight of the ladder is transferred to the turntable. Therefore, it is mandatory that the ground jacks be placed prior to raising the aerial ladder for any purpose, so that this weight is not transferred to the springs and tires. The jacks also provide stability for the apparatus when the ladder is rotated from the in-line position.

### **TRUCK POSITIONING**

The **FIRST** truck to arrive should be positioned at the **FRONT** of the fire building if possible. This will depend on a variety of elements: the height of the building, the type of the building, laddering requirements, the width of the street, overhead wires, etc.

The **SECOND** truck to arrive should take the other street front of the building. If the building is in the middle of the block, the second truck should be positioned back from the building so as not to block other apparatus, and still be in a position to use the aerial if necessary.

When trucks are positioned in front of buildings and the aerial is not required to be immediately raised, the driver and tiller operator should set the ground jacks and engage the aerial transmission so that the immediate use of the aerial ladder may be affected. Aerial ladders generally should not be used on one or two story buildings. At these heights, low ladder angles provide poor climbing conditions and fire fighters can fall through the rungs.

If a fire building is less than 3 stories or it is obvious the aerial cannot be used due to other conditions, park the apparatus across the street and beyond or forward of the fire building so ladders, tools, and equipment are readily accessible.

When obstructions or wires restrict the use of the aerial, then hand raised ladders should be raised first to the building. The truck can be repositioned after this has been done. Truck officers should be cognizant of situations that indicate the possible use of ladder nozzles. In such situations, hand raised ladders should be used to ladder buildings.

When placing the truck for operation of the aerial ladder, it is desirable that it be placed on the most level and solid footing available, consistent with the immediate requirements. If the emergency indicates the aerial ladder will be an important factor in rescue and fire fighting operations, other units responding should avoid blocking the area. No apparatus should be positioned directly behind any truck. Doing so will block the removal of ground ladders.

The proper distance out from a building will vary and will depend upon the height of extension required and upon conditions at the emergency. Obtaining proper distance out from a building for preferred climbing angles is a matter of experience and good judgment. As a general rule, where the aerial ladder will be raised to several different elevations, or the ladder nozzle is to be used, the truck should be so located that the ladder will reach the building horizontally without being extended. It will then be safe to extend to any length to reach upper floors, provided that the upper floors are not set back. The best climbing angles are from 70 to 80 degrees from the horizontal. At these angles, the ladder will carry its maximum load.

Ideal field conditions for spotting aerial ladders are seldom found. Narrow streets, alleys, overhead obstructions, and heavy traffic are some of the factors, which may require variations from standard practices. Only good judgment by members and a complete understanding of the equipment and of its limitations will indicate the safe extent of deviation from standard practice.

## **AERIAL LADDER OPERATION**

Aerial ladders are not indestructible. They have limitations that all members, especially officers, must be aware of and understand.



The primary purpose of an aerial ladder is to expedite rescue, and to provide a means of access to and egress from the upper stories or roofs of buildings. Always secure two means of egress from a roof.

Aerial ladder failures are not as uncommon as one would like to believe. There have been many ladder failures throughout the country. Some of these resulted in loss of life or debilitating injuries. Thanks to Underwriters Laboratories (UL) and the National Fire Protection Association (NFPA) committees 1400 and 1500, the fire service has become more aware of aerial ladder limitations and safety.

It is the responsibility of all officers to know the limitations of equipment under their control. The Bureau of Equipment has a video and other documents available to emphasize the above-mentioned limitations. Address questions to Bureau of Equipment, extension 3514, or the Division of Training, extension 2000.

### **Aerial to Windows and Fire escapes**

The top of the aerial should be approximately 2 to 6 inches off the sill and the aerial ladder extended into the window one-foot. It may be impossible to place an aerial ladder into a window due to the lights on the end of the aerial ladder on some models. If this is the case, try to position the ladder as close as possible to the window sill. Get off and on the aerial over the top of the ladder and not to the side.

When laddering a fire escape with an aerial ladder the same procedures as placing an aerial to a window apply: the ladder should be 2 to 6 inches off the fire escape railing and extended to one-foot over the railing.

Placement of the aerial ladder should involve:

1. Raising the ladder from the apparatus bed
2. Rotating the ladder into position
3. Extending the ladder fly to the target
4. Lowering the ladder into position.

Members become proficient in the operation of the aerial ladder by constant drills and practice. At all drills, all safety precautions should be observed and stressed. The truck officer should take the time to teach, and try all evolutions.

## **Aerial to the Roof**

There are situations where the aerial is the best way to get to the roof. Do not hesitate to use it in the following cases.

1. There is no adjoining building of the same height.
2. The stairs are burned away or weakened.
3. The stairs are being used to evacuate people.
4. To advance hose lines to the roof.
5. The stair shaft is untenable because of smoke and heat.

On peaked roof operations: The ridge and roof ladders can be placed in the bed of the fly section of the aerial ladder. The hooks of both ladders must be over the top rung. On some aerial ladders, the ladder must be raised out of the bed so the hooks of the roof ladder will clear the tiller cab. Never send the ridge ladder on the aerial alone. Always send it with the roofing ladder nested on top of it because the roofing ladder locks the ridge ladder in place at the top of the aerial. This operation eliminates two firefighters from carrying these ladders up the aerial ladder. One firefighter should be on the roof to accept the ladders while another passes the ladders from the aerial.

To avoid overhead obstructions such as electric wires, cables, etc., it may be necessary to reposition the truck to raise the aerial. **Do not attempt to move the truck with the aerial ladder raised!** If it becomes necessary to move the truck, the aerial ladder must be lowered. Maneuver the truck in a slow, smooth manner and adjust ground jacks after truck is in position.

With firefighters on the unsupported aerial ladder, it is of utmost importance that ground jacks be placed on solid footing. If the aerial is to be raised to a roof, extend it 3 to 6 feet over the top of the wall keeping the aerial ladder 2 to 6 inches above the roof or wall.

If you are the driver of an aerial truck that has been used to get firefighters to the roof or upper floors of a building, make sure that those firefighters are down before moving the ladder. If ordered to move the aerial, inform that officer that there are firefighters on the roof or above the fire and that this aerial provides their means of egress. Always secure two means of access or egress from a roof or floor.

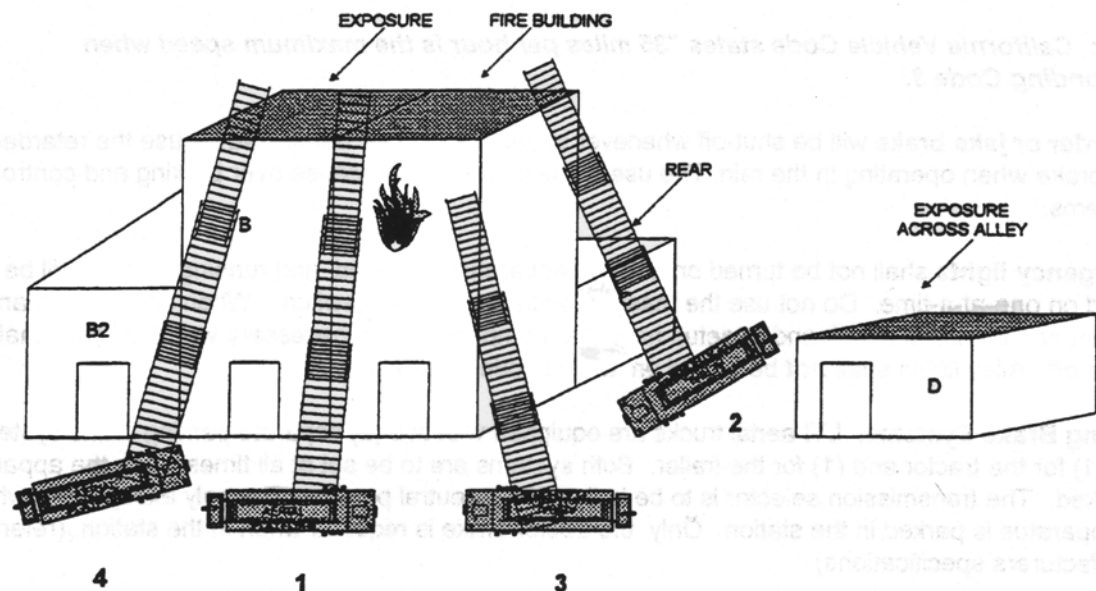
While the beams of aerials are by no means fragile, ordinary care should be exercised in handling. A blow on the bottom of the beam, which might occur if the ladder were dropped violently against an object, may dent the beam and affect its smooth action over the roller or actually weaken it structurally. Always lower the ladder gently into position.

Once again, do not support the end of an aerial on a building or other object. The aerial ladder is designed to be operated in the cantilever position (unsupported). Always leave 2 to 6 inches off of sill or roof, and extend the aerial 3 to 6 feet over a roof. An aerial ladder of truss construction placed on an object will reverse the design criteria of the truss configuration and weaken the ladder.

## Aerial Ladder Rescue Operations

When needed to rescue people from roofs or upper floors, the aerial ladder is truly a life saver. However, if it is possible to get people down the stairway or to the roof, and from there to an adjoining building and down the stairway, do not use the aerial ladder. Its use for rescue is difficult and dangerous. Here are some reasons why a stairway rescue is preferable:

1. If the structure is fire resistant, it is generally only necessary to move people to the floor below or to an adjoining area.
2. Stairs have banisters and are wider than ladders.
3. People on ladders are exposed to falling objects.
4. There is less danger of falls.
5. Old or sick people can be helped down a stairway, but they must be carried down the ladder.
6. One adult can guide a dozen children down a stairway, but not on ladders.
7. Many people will resist getting out of a high window and onto a ladder
8. Civilians may stop and rest or shift their grip. This would be dangerous on a ladder.
9. One stairway serves all floors at one time, but you would need a different height of ladder for each floor.
10. Many people can be taken down a stairway at one time.



When rescuing trapped persons from upper floors, it is imperative that the truck be placed in the most stable position possible. This type of rescue problem may require considerable maneuvering and extra long reaches at low angles of inclination.

The aerial ladder may be used in an unsupported position for a rescue attempt. Past experience has shown that even though trapped persons are desperate, they will not always descend the ladder of their own accord. It may be necessary to have firefighters on the ladder assisting them to safety.

## **Tactical Positions for Aerial Ladders**

Tactical positions for aerial ladders depend largely upon the strategy used by the Incident commander.

- Aerial ladder to roof of the fire building at the front for hose lines, ventilation, or ladder pipe operations.
- Aerial assigned to cover rear of fire. Aerial will operate either to fire floor or roof as directed. In case the truck cannot get to the rear, manual ladders will be used and the aerial used in front as needed.
- Aerial to fire floor for direct attack on fire and also to provide access to the fire floor. Aerial ladders may also be used to reach floors above the fire.
- Aerial ladder to cover exposures
- Aerial for rescue company building location

## **VENTILATION WITH AERIAL LADDERS**

Upper story window ventilation may be accomplished with the aerial. The preferred method to break a window is by dropping or lowering the ladder against the window panes (not extending the aerial fly into the window). Beware of glass trailing down the ladder. This procedure is not to be used unless an emergency occurs. When an aerial ladder is used for ventilation through a window, BOE should be notified in writing of the circumstances.

Lower aerial into window if aerial is to be used for ventilation. **Never** extend into window. To do so will cause damage to hydraulic cylinders and/or extension cables.

## **STANDARD OPERATING GUIDELINES**

The following are considered standing operating procedures for aerial ladder apparatus operations and shall be followed at all times.

**Retarder or jake brake** will be shut-off whenever streets are wet or damp. Never use the retarder or jake brake when operating in the rain. The use of these devices will cause over braking and control problems.

**Emergency lights** shall not be turned on until the apparatus is started and running. Lights will be turned on one-at-a-time. Do not use the master switch as a primary switch. When operating at an incident and the initial attack and/or setup has been completed, all unnecessary warning lights shall be turned off. Alley lights shall not be turned on during code 3 response.

**Parking Brake Systems.** LTI aerial trucks are equipped with two (2) separate parking brake systems; one (1) for the tractor and one for the trailer. Both systems are to be set at all times when the apparatus is parked. The transmission selector is to be in the "N"

or neutral position. The only exception is when the apparatus is parked in the station where only the tractor brake is required.

**Aerial Ladder Capacities:** Aerial operating capacities are governed by the load capacity chart installed at the aerial control console. Any deviation from these rated capacities could cause serious injury to personnel and/or structural failure of the aerial ladder. Load capacities are established at maximum permissible extension and operation throughout 360 degrees, with outriggers fully extended and set, turntable level (within 6 percent/3.5 degrees), waterway drained, and with aerial unsupported. Full, rated capacities are allowable on grades up to, but not including, 6 percent/3.5 degrees. On grades between 6 and 14 percent/3.5 and 8.0 degrees, capacities are reduced in half.

### **Environmental Hazards**

**Always** keep an aerial at least 10 feet away from all overhead wires. If the aerial should contact power lines, all personnel should remain on the apparatus until power is shut-off or the aerial is freed. Always assume that power lines and electrical devices are energized.

Death or serious injury will result from contact with, or inadequate clearance from, energized conductors. Maintain safe clearances from power lines and electrical devices.

Allow for ladder sway, rock, and sag when operating near power lines and cables. The apparatus is not insulated. Contact between the apparatus and ground, should the unit become energized, will result in death or serious injury.

Use extreme caution when operating in windy conditions. Careful consideration must be given to the following: apparatus supporting surface, aerial profile (elevation, extension, and position relative to the wind), and the intensity of wind gusts. All of these elements combined affect operating limits.

### **Operating With Personnel On The Aerial Ladder**

Position the aerial, and then climb. **Never** allow climbing operations during any aerial functions (extension, rotation, etc.). Do not permit personnel to mount the ladder until the rungs of all sections are aligned for climbing and the rung alignment indicator light is illuminated.

**Never** initiate the extend or retract function with personnel on the ladder. The power available to extend and retract the ladder is more than enough to mangle or sever a limb, which may have slipped between ladder rungs.

**Never** get off or on the apparatus while in motion.

Only qualified personnel shall operate vehicle and aerial ladder. The operator must read and understand all DANGER and WARNING placards affixed to the apparatus, be aware of, understand, and can apply the working rules and regulations of the SFFD.

**Never** attempt to operate an aerial while mentally or physically impaired.

**Never** rest aerial ladders on one beam only. The ladder will twist when loaded. The ladder is not designed to withstand this stress. The operator shall **never** leave the apparatus with the aerial ladder elevated and extended. Do not use the aerial ladder as a ram. Do not push or pull sideways

Note: Any time an aerial ladder is subjected to any stress not approved by the manufacturer or the Bureau of Equipment, it shall be reported to the Incident Commander, who shall, with the assistance of the Bureau of Equipment, determine if the ladder should be put out of service until a certified inspection can be performed. This shall automatically be done any time an aerial is used to ventilate or if subject to heat and fire in excess of five (5) minutes.

**Never** use aerial ladder as a crane.

**Never** use the ladder to overhaul utilizing the pulley system and carry-all for lowering overhaul debris. This type of operation can cause shock loading and failure of the ladder. Shock loading is the sudden stopping of a heavy, moving object.

**Communications Headsets and Hearing Protection:** Headsets and hearing protectors are to be removed from the apparatus when the apparatus goes to Central Shops for more than same-day repairs

**Bureau of Equipment Support:** Officers are encouraged to contact the Bureau of Equipment with questions regarding maintenance and operation of aerial ladder apparatus.

**Training and Drills:** It is the truck company commanders responsibility to ensure his/her officers understand the capacities and limitations of the apparatus assigned. It is each officer's responsibility to be prepared to deploy aerial ladder apparatus in the most safe and efficient manner. The way to ensure safe, efficient operations is by creative, innovative drills using the ladder in all modes of operations. Chief and/or company officers are encouraged to contact the Division of Training or Bureau of Equipment for assistance.

## **AERIAL LADDER NOZZLE OPERATION**

Water Tower Operations: Aerial ladders are commonly used as water towers. When used as a water tower, proper aerial ladder angle and weight loading are critical. Note: Aerials, when used as a water tower, should never be supplied by more than one source, high pressure or pumper. If using a pumper as a supply source, no other lines

should be taken off the pumper for hand held lines etc. Quick opening and closing of hose lines can cause a ladder to flex and put excessive stress on the aerial ladder far beyond the design limit and cause the possibility of ladder failure.



Many of the basic water tower operating rules are based upon reactive force, i.e., the force created at the nozzle (in relation to pressure, flow, and the size and type of nozzle opening), which is transmitted to the aerial structure. This is the same as the force transmitted to the operator when using a hand-held line. When operating the aerial as a ladder nozzle, the nozzle reaction should be taken into consideration. The larger the nozzle, the greater the reaction. Likewise, the greater the nozzle pressure, the greater the reaction. This reaction force tends to push the ladder toward vertical.

When placing the aerial ladder for nozzle operations at a fire, the truck should be so located that the ladder will reach the building horizontally without being extended. If the tip of the ladder is kept out of the building 20 to 30 feet, it will be possible to direct the stream into various windows at the same elevation by rotating the turntable without adjusting the angle of the ladder. If the ladder is brought close to the building, maneuverability will be sacrificed for reach.

LTI Aerials may be extended to 100 feet for ladder pipe operations. At this elevation the angle of inclination should be from 70 to 80 degrees from horizontal. On aerials equipped with inclinometers, the reading should be adhered to for lower angles of inclination. The readings are conservative and provide for safe operations under the conditions indicated.

One firefighter and a line in operation is the limit on the fly section. The hose line on a ladder should be laid on the ladder rungs, preferably near the middle between the ladder beams. It should never be hung over the side of the ladder. The line should be secured with hose straps in the standard manner.

The nozzle operator should be equipped with an SCBA and a life belt and secured to the ladder for safe operation. The water should be turned on and off gradually to avoid any possible whipping action that might impose an unnecessary strain upon the ladder supports at the turntable. A bale type nozzle should never be used on any line supply to a ladder pipe. Avoid directing a stream sideways from the aerial ladder, as side stress may be dangerous. The nozzle should be moved slowly when changing directions. If more than a 10-degree horizontal sweep is required, rotate the turntable slowly. The ladder nozzle may be used with guy ropes or cables to control vertical movement of the nozzle, eliminating the firefighter at the top of the ladder.

An operator must be at the controls whenever the aerial is being used with the ladder nozzle. Under no circumstance should the apparatus be moved while a line is in operation on the aerial.

There are times when the fire ground Incident Commander must make the decision to change strategy from the offensive to the defensive mode and place into operation master streams such as monitors and ladder pipes. There are a number of factors to be considered when setting up and putting a ladder pipe into operation:

What are the strategic objectives?

- Fire attack
- Exposure protection
- A combination of the two

Is there adequate water supply and pressure? (if a pumper is supplying a ladder pipe, it cannot supply additional handheld streams)

What nozzle should be selected?

- Smooth bore
- Fog

Where is the location of the fire?

- Upper floors
- Attic or cock loft area

What type of building construction?

- Masonry and unreinforced masonry
- Truss construction
- Parapet walls
- Cornices

Is building collapse a possibility?

- Building construction
- Fire duration
- Building contents (fire load)
- Water load

What are the weather conditions?

- Wind speed and direction

What are the tactical considerations?

- Positioning of apparatus
- Stream placement
- Operated from the ladder



- Operated from the platform

When used for fire attack, ladder pipes are most effective when placed close to and low in the window to allow for maximum penetration, good deflection off ceilings and walls and operation into the attic or cock loft. Solid streams provide better reach and can penetrate further into a building. When adequate water supply and pressure is a concern, reducing the size of a smooth bore nozzle increases velocity providing better reach. While this will reduce output, under these circumstances it is better to have a stream with reduced flow that is hitting the target than a poor stream from a larger tip that is not effective.

SFFD procedures recommend aerial trucks run with 1-3/4 inch straight tip pre - connected for use. Initial supply to the ladder pipe Siamese is 160 psi with minimum of 2 large lines for supply.

For exposure protection, using a stream in such a way that it washes down the sides of the exposure is very effective. The theory of providing a protective water curtain between the fire and exposure accomplishes little. Since water is transparent, radiant energy will pass through the surface to exposures. When operating in windy conditions, due consideration must be given to the exposure on the leeward side. Adverse conditions such as high winds, inadequate water supply or reach may affect the stream.

Generally, elevated streams are used because they provide reach into upper floors that ground based master streams cannot. When upper floors are involved, the streams should first be directed into the lowest floor involved working upward as extinguishment takes place. When an attic or cock loft is involved a well directed closely placed solid stream with good pressure may breach the top floor ceilings providing penetration into these spaces. One of the most common mistakes made in the deployment of ladder pipes is to direct streams through roof openings whether they are self-vented or a product of fire fighting operations. This defeats the natural ventilation process and spreads fire throughout uninvolved areas of the building. If the roof has collapsed and ventilation is no longer a factor it may be acceptable to direct streams from above provided it reaches the seat of the fire. The most common type of roof in San Francisco is the tar and gravel. With this type of roof a self-venting fire can melt the material in such a way that it leaves the attic unvented.

The construction type of the involved building plays a major role not only in ladder placement but also in the actual operation of the ladder pipe. When moving the stream from window to window in a masonry building for example, the impact of the stream may dislodge bricks or cause a partial wall collapse. The same holds true when streams strike parapet walls or cornices. A conscious effort must be made to assess the structural integrity of the building involved. Prepare for a building collapse if the situation warrants. If a collapse is anticipated keep personnel and apparatus at a safe distance. Be aware of the collapse zones when positioning any apparatus. The Collapse Zone is defined as the area a wall will cover if it falls - usually the height of the

wall plus an additional 1/3 of the height. This may present a less desirable position but master streams can still be applied.

Buildings with arched truss roofs present a unique hazard. The end trusses are tied into the front and rear walls with rafters. The front wall is generally the weakest because of the number of openings it contains (i.e., windows and doors). When end trusses collapse the levering action caused by the attached rafters push the walls outward. The weakened front cannot resist these forces and collapses into the street. At fires involving a building with an arched truss roof a truck company may be placed in front of the building out of the collapse zone with the stream directed through the front windows in an effort to protect the truss. The resulting action can prevent a possible collapse of the front wall.

When using ladder pipes or any master stream, remember water weighs 8.35 lbs. per gallon. One ladder pipe with a 1-3/4 inch tip nozzle can deliver over 700 gallons per minute or 5,845 lbs. per minute. That is almost 3 tons of undesigned load being added every minute! How much has the fire itself affected the structural integrity of the building and how the weight of the water will affect the building's structural integrity?

Safety is the primary consideration when operating ladder pipes. The operator should be wearing full protective equipment, a safety belt and have an SCBA. All members should have a thorough understanding of the capabilities and limitations of the equipment. A high nozzle pressure equates to high nozzle reaction. This can impose a stress on the ladder or vehicle that is beyond the manufacturers design limits. Spray tips produce less nozzle reaction than streams from smooth bore nozzles. The sudden shutting down of a ladder pipe or loss of pressure from a burst hose can cause a whipping effect that will affect the stability of the ladder and the vehicle. It is mandatory to maintain a clearance of at least 10 feet from power lines. If safety of the ladder pipe operator is ever at question, it may be necessary to operate the pipe from the platform. Use of guide cables will be required.

Safe and effective use of a ladder pipe requires knowledge, common sense, and good judgment. This is based on an understanding of fire behavior, building construction, hydraulics and the limits and capabilities of the apparatus. Maintaining a high level of proficiency will require constant training.

### **Rule-Of-Thumb Flow Chart For Ladder Pipes**

Nozzle tip pressures for straight tip ladder pipe nozzles is 80 psi. (Initial pressure to ladder pipe Siamese should be 160 psi with pressure adjusted for ladder elevation; 1 psi per foot of elevation).

Nozzle Tip Size	Gallons Per Minute
1 1/4 inch	400
1 3/8 inch	500
1 1/2 inch	600

1 5/8 inch	700
1 3/4 inch	800
1 7/8 inch	950
2 inch	1100

## **AERIAL LADDERS AS EMERGENCY STANDPIPES**

Aerial ladders are primarily designed for laddering practices and for use as ladder nozzles. The hose and nozzle provided on all aerial ladders for ladder nozzle operation may also be used as an emergency standpipe. All ladder nozzles have either a 2-1/2 inch or a 3-inch male thread to which the spray nozzle or tip is connected. With the nozzle or tip removed, a small line way may be connected to the ladder nozzle (using a 3-inch x 2-1/2 inch reducer on the 3-inch thread) from which two 1-3/4 inch lines may be extended. In lieu of this practice, a large hose line may be connected to the ladder nozzle (using a 2-1/2 x 3 inch increaser on the 2-1/2 inch thread) and led to a distribution point where a 3 x 2-1/2 inch reducer, a small line wye, and two 1-3/4 inch hose lines may be connected.

## **RAISING AERIALS ON STEEP INCLINES**

If the aerial ladder must be operated on a steep incline it is best to place the truck in such a position that the ladder may be rotated at an angle of approximately 45 degrees from the center line of truck chassis and pointing up hill when extended to the required position. This will cause the ladder to be at an angle with a window ledge or fire wall, but it will reduce the side wall tilt of the ladder and will be safer under heavy loads.

## **AERIAL LADDER LOAD DISTRIBUTION**

Aerials in the Department are designed to support heavy loads safely. All new aerial ladders are given an acceptance test by Central Shops personnel and the Bureau of Equipment jointly.

It is desirable that the load on a ladder be distributed evenly. Concentrating the load in the middle of the ladder span when supported at the top approximately doubles the stress over that imposed if the load is distributed evenly. When an aerial is being used in an unsupported position and the load is concentrated at the top, the leverage on the turntable is much greater than if the load is distributed over the entire length.

If the aerial ladder is to be used unsupported, the preferred angle is 70 to 80 degrees. At these angles, the ladder will safely support three evenly spaced persons. Not more than one person should be on a fly section.

Due to differing specifications, the safe loading of aerial ladders varies with each make of apparatus. Officers and members must be thoroughly familiar with the particular

model ladder that they are operating, and must refer to the manufacturer's specifications to determine the safe loading and operation of their ladder.

## **AERIAL LADDERS IN HIGH WINDS - 35 MPH AND HIGHER**

Extreme caution must be used when operating the aerial ladder during high winds. It may be advisable to attach guy ropes to the top of the fly if it is to be extended above 75 feet. Tension should be maintained on the guy rope in the direction from which the wind is blowing, specially if the wind is blowing from the side of the ladder.

## **ELECTRICAL HAZARDS**

The operating, erecting or handling of tools, machinery equipment, or apparatus over energized high voltage lines is prohibited. For voltages of 750 or more, CAL/OSHA standards require that aerial ladders be operated at a minimum clearance of 10 feet. Make sure no part of your equipment can come within ten (10) feet of high voltage lines, and firefighters shall not work in violation of the 10-foot rule unless participating in a rescue attempt. In such instances firefighters should be extremely alert to the risk and be aware that one-third of all those shocked by high voltage die.

All wires should be considered charged even though they are not electrical. Fallen electric wires in the vicinity may have charged them. Any overhead conductor shall be considered energized unless and until PG&E personnel verify that the line is not energized, and the line is visibly grounded at the work site.

For other than emergency situations, alternate methods, other than aerials for reaching upper stories and roofs must be considered rather than raising aerial ladders near high voltage lines. Such methods, in addition to wooden ladders, may call for using fire escapes, interior staircases, or adjacent roofs of buildings.

Any metal part of an aerial ladder, Attack Hose Tender that touches high voltage lines energizes the entire apparatus, and the apparatus is then a potential killer. The essential point is to never provide a ground for an electrical contact, the safest course for the operator is to touch nothing until the power is off. The operator is usually safe remaining at the controls. If the operator decides to jump clear, be sure not to touch any part of the equipment when or after reaching the ground. If it becomes necessary for a person to get off the truck when it is electrically charged, this should be done in such a manner that contact is not made between the truck and the ground at the same time.

If necessary, request radio to contact PG&E to de-energize or re-route the lines. Don't attempt under any circumstances to raise or move high voltage lines. If necessary, the PG&E crew will do it. Don't take any chances! When in doubt call PG&E. If your apparatus touches a high-voltage line, the operator should back the equipment away or lower the aerial to break contact with the power line. When requested by the SFFD

Communications Center, PG&E personnel will be dispatched as quickly as possible. Keep away from equipment cables, or any metal that is touching or in danger of touching high voltage lines, and report it to the nearest officer at once.

## **AERIAL LADDER INTERCOM SYSTEMS**

Intercom systems permit voice communication (transmission and reception) between the aerial ladder operator on the turntable and the firefighter positioned on the upper end of the ladder.

The installation includes a master control operating head on a pedestal attached to the turntable, cable, take up reel or pulley, conduit through which the cable extends, and a speaker (transmitter and receiver) installed between the beam and rail of the fly section.

Power supply for the system is provided by the apparatus. The intercom system is energized by turning on the ignition switch or the aerial switch, depending upon the year and model.

### **Master Control Operating Head**

Two volume control switches are installed on the master control operating head. They are in the "off" position when turned completely counter clockwise. Facing the unit, the right control knob establishes the volume control for voice transmission through either speaker when used as a microphone. The left control knob permits volume adjustment for voice clarity and noise background control when the speakers are used for reception. This left knob also establishes a proportion between the sensitivities of both speakers when employed as microphones.

For practical purposes, the right control knob may be considered as the transmitting (talking) volume control properly set to insure adequate volume for voice transmission. The left control knob may be considered as the reception (listening) volume control, properly set to insure adequate volume for voice reception.

The transmitting switch permits voice transmission from the master control operating head to the speaker on the fly section.

### **Operating Instructions**

For normal outdoor operation, turn the volume control switches to an initial setting at an approximate 1030 hours position, and adjust as required. To transmit, firmly hold down the transmitting switch. Direct your voice into the speaker at arms length, as it is unnecessary to lean into the speaker. Release the switch upon completion of transmission and the speaker automatically becomes a receiver.

The speaker on the fly section has no operating controls. It is open at all times, permitting continuous transmission and reception. To transmit to the turntable, direct

your voice in the general direction of the speaker. Maintain a voice level sufficiently strong to override surrounding background noise. It is unnecessary to bend down or lean into the speaker. Keep the turntable operator informed of volume control adjustments to insure adequate reception.

### **System Testing**

The intercom system shall be tested daily, at 0800 hours. When testing the system inside stations, set the volume control knobs at approximate 0700 hours position. This should afford sufficient testing power and eliminate objectionable feedback.

### **Maintenance**

During ladder extension and retraction, observe the cable, pulley, and reel movement to insure free movement and to avoid damage.

LTI Aerial Servicing: Servicing of the aerial ladder intercom system is the responsibility of the Department of Electricity Radio Shop.

## SECTION 5. TRUCK COMPANY OPERATIONS

There are seven (7) cardinal points of truck company operations. They are not necessarily given in order of importance because each fire establishes its own priorities. The seven cardinal points are:

- Search & Rescue
- Laddering the Building
- Ventilation
- Forcible Entry where needed
- Overhauling
- Salvage operations
- Controlling Utilities

### SEARCH & RESCUE

- For those overcome or otherwise unable to move. At the same time, examine for extension of fire. Provide any type of rescue that may be necessary.
- Saving of life, saving of those in actual peril first.

There are definite techniques to use in searching a building, particularly in residential structures. Look for unconscious victims at the point of egress from a room or area. As you progress into the room or area and visibility is nil, stay along the wall until you come to a bed. Look on and under the bed; feel with your axe, your hands or your legs for a victim. Look in closets and bathroom areas. When you come to a window, open it and then proceed with your search, feeling for hot spots on floors and walls, always looking for possible fire extension points. Don't panic if you get mixed up in your search. Stay along the wall and it will eventually bring you to the door through which you entered or a door to another area which may be a point of refuge. Make occasional forays from your side wall position to see whether anyone is lying on the floor.

If you get lost and come across a hose line, drop down and crawl along the hose. It will bring you eventually to the nozzle team. If you go the other way, it will lead you to the fresh air outside. If you feel trapped, reach the nearest window, stick your head out, and yell for help, or throw items out the window to attract attention. You should also use your radio to report your location if you need rescue.

**If you are lost, running low on or out of air, under a collapsed part of the building, or other emergency situation an EMERGENCY TRAFFIC Transmission shall be initiated. (See Emergency Traffic Procedures, General Order 02 A-07)**

If you feel you are losing consciousness, and have a flashlight, turn it on. Set it on the floor with the light pointing toward the ceiling. The beam may make it easier to find you.

It is often desirable to learn the floor layout before moving in on the fire floor. This can be done by entering the floor below the fire and noting the layout. Armed with this information, you can proceed into the fire floor. Experienced firefighters are cautious in smoke filled areas where visibility is zero. They shuffle one foot ahead of the other or push an axe or ceiling hook ahead to insure that the floor is intact. When entering through a window, probe with a foot or an axe, or drop the nozzle down a bit to see if the floor is intact.

If there is any information or indication that victims may be trapped or overcome within the fire building a primary search should commence immediately. Search personnel must be equipped with SCBA'S. Searching for trapped victims requires coordination and communication between the search personnel and the Incident Commander.

Communications and coordination is also important between the truck and engine companies involved in the incident. As truck firefighters are searching around and above the fire they must know that the fire is under attack, and all out efforts are being made to stop the spread of the fire. Additionally, engine companies are much more effective in placement of hose lines when truck companies effect forcible entry, laddering, and ventilation operations.

Every firefighter on scene must be made aware when a victim search is in effect. All activity should be directed toward assisting the firefighters engaged in the search, providing protection for them and the victims.

### **Search Procedures**

- While searching a building for victims, always be alert to paths of fire spread.
- Look for victims at the point of egress from a building.
- When searching in an environment of zero or limited visibility, use the thermal imaging camera. Stay alongside the wall until you come to a bed or other furniture. Look for victims in beds, alongside beds, or under beds.
- Check closets, bathrooms, and utility areas for victims.
- When you come across a window, open it to aid in ventilation, if conditions permit.
- Check for "hot spots"; the fire may be spreading.
- If you are unfamiliar with the building, look at the floor layout below the fire floor. This floor may have somewhat identical features.
- Move slowly into a smoke filled area, use a tool to probe ahead, or extend one leg supporting your weight with your other leg.
- Exit elevators 2 floors below fire floor. Do not use elevator that penetrate the fire floor.



- Double your search area by holding one of your search partners hands, keeping your other hand against the wall, have your partner stretch out and probe with a tool or leg.
- Extend your search area by using a tied off safety line.

### **Search Techniques**

Search personnel must work quickly and efficiently. They must be careful to avoid injury to themselves and others. This is especially true when searching near or above the fire. The fire may be hidden by doors to rooms or sections of the building.

### **Thermal Imaging Camera (TIC)**

The Thermal Imaging Camera can greatly enhance search techniques. It allows firefighters to see a heat image in dark or smoky conditions. It allows us to see the white shapes of people and the temperature variations near heat sources or ceilings. In a heated smoky environment it lets you see in the dark. See Appendix C for more information on Thermal Imaging Cameras

### **Doors**

Before any door is opened it must be checked for heat. A very hot doorknob usually indicates that there is fire on the other side of the door. Some heat felt on the door or knob may indicate the presence of hot gases on the other side. These gases could ignite with explosive potential if the door is opened quickly. Determine which way the door opens. Most doors off hallways into apartments and offices open into the unit. Feel for the door hinges. If the hinges are on your side of the door, the door opens toward (to) you. Some modern doors have flush hinges giving no indication of which way the door swings. Check the doorjamb, if the jamb does not cover the edge of the door then the door opens to you.

Doors that open to you are the most dangerous to firefighters, but they must be opened to complete the search. If the door opens to you and shows signs of heat, get down low and place your body weight against the door. Release the latch slowly and allow the door to open slightly. You may feel a strong push against the door from the inside. This strong push may indicate that the room is filled with heated gases and possibly fire. Immediately close the door and call for an attack line. Wait until the attack line is positioned for fire suppression before opening the door again. If upon initial inspection a room is seen to be full of fire, again, close the door, call for an attack line, and wait for the attack line to be in position before re-opening the door.

If an inward opening door will open only partially, do not attempt to force the door farther. Get down and attempt to reach around the partial opening to feel if a victim is blocking the passage of the door. The victim must be removed to safety and receive medical treatment quickly.

## **Victims**

Occupants of a fire building will naturally try to escape through doors, windows, fire escapes, hallways, and stairways leading out of the building. Firefighters should look for victims overcome by smoke and heat near and in such places. In particular, firefighters must ascertain that the push against inward opening doors is due to smoke and gases and not a victim lying against the door.

Great physical effort is often required to move a victim away from a door. The firefighter is working from an awkward position, with a door between themselves and the victim. The unconscious victim is a dead weight. If needed, call for assistance at once.

If sufficient firefighters are available, victims should be removed from the building while the search continues; it may be better to get the victim into the hallway, vent the hallway, and if possible vent the room or unit and continue the search.

If a victim is found deep within an apartment or large room, an alternative action is to punch through a wall into an adjoining room or apartment. The victim can then be moved into a less charged area.

## **Visibility**

Smoke reduces visibility during search procedures; firefighters must stay low and move carefully on hands and knees. While crawling extend one leg or a tool in front of you in order to feel for obstructions, victims, or holes in the flooring. The TIC is also useful in low visibility.

In hallways and corridors, the walls can serve as directional guides. As search personnel feel along hallway walls, the location of doors will become apparent. Inside the rooms of apartment and office suites, the low crawling position will keep firefighters from tripping over furniture and other obstacles and aid in locating victims.

Windows should be opened as they are encountered. This helps to ventilate the area and makes it easier to search and locate victims. This also helps reduce the danger from trapped heat and gases.

## **Rescue Considerations**

Rescue means removing victims and potential victims from danger. The extent of the rescue problem is directly affected by:

- The number of people in the fire building
- The paths by which heat and smoke can reach the occupants
- The routes available to firefighters for getting to occupants and removing them from danger.

The above factors, in turn, depend upon the construction, size, and interior layout of the building.

All buildings involved in fire, and exposure buildings, must be searched during fire fighting operations. Reasons for conducting a search are:

- Children sometimes play in abandoned buildings
- Homeless sometimes occupy abandoned buildings
- Building security must be accounted for
- Attic and mezzanine apartments are sometimes overlooked
- Illegal sleeping rooms may be located in basement or cellar areas, garages, lofts, etc..

Firefighters who are directed to search a structure must report back to the officer who ordered the search. In ALL instances the firefighters must report:

- Whether or not the search was completed successfully
- If unable to complete the search state the reasons why
- If additional help is needed, or extenuating circumstances are encountered.

### **Hospitals, Schools, Institutions**

Fires in hospitals, schools, nursing homes, and similar education and care facilities are handled essentially the same as in multiple family dwellings. The search and rescue problem is compounded by the large number of potential victims, by their age, and by their physical condition. For example, at night a hospital will most likely have a smaller staff and therefore there will be fewer employees to assist in moving or complete removal of patients. Sleeping patients, sometimes sedated, will be without the benefit of a full staff to assist them to safety. If the fire starts in a vacant work area it may go undetected by the smaller night staff; this could delay the alarm and increase the severity of the rescue problem.

The same situation may be encountered in nursing homes due to the patient/staff ratio. Fire companies must know the location of such buildings within their first alarm response area because these buildings require extraordinary rescue procedures. Whether or not full evacuation of the building is required depends upon factors such as building construction and size, fire protective features of the building, and the location and severity of the fire. If it is clear that the fire will be controlled, it may be possible to move patients to areas more isolated from the fire, rather than evacuate them entirely from the building.

Patient room doors are usually wide enough to accommodate a hospital bed or mattress used as a stretcher. When smoke is the main concern it may only be necessary to lower the patients to the floor to get them below the level of the smoke. Either of these actions may be desirable in light of the physical condition of the patient. However, if there is any doubt regarding control of the fire, **THE BUILDING MUST BE EVACUATED COMPLETELY.**

Most schools present a rescue problem in the daytime when school is in session. But remember that often schools are used for nighttime activities such as adult education and other activities. It is the responsibility of every company to be aware of such uses of the schools within their first alarm response area.

Upon arriving at a working fire in a school, firefighters should expect to find panicky and/or overly excited children and adults. The school should be completely evacuated. Whenever there is concern that everyone has not left, the building areas above and around the fire should be searched immediately. Confirm through primary and secondary search that all civilians are removed from the building.

### **Summary of Rescue Operation**

Rescue is a prime objective at a fire. Firefighters must expect some personal risk during rescue operations. To minimize this danger, the operations required in search and rescue situations should be made a part of standard operating guidelines. Firefighters should receive continual training in these operations. These guidelines should include a standard search pattern that is simple to perform and thorough in its coverage of the fire building.

Primary search areas should include fire floor close to the source and the floor above the fire. Objectives should be victims and spread or extension of fire.

The following are paramount when performing rescue:

- Always wear an SCBA when conducting search and rescue operations. Work in pairs when wearing breathing equipment, this is MANDATORY.
- Equip yourself with a rope and the thermal imaging camera.
- By observing the exterior of the building before entering, locate, if possible, more than one means of egress.
- In a smoky atmosphere do not search standing; search on hands and knees below the smoke and heat.
- Completely search one room before moving to the next.
- Begin your search on an outside wall. This will permit you to ventilate by opening windows as you move along.
- In heavy smoke conditions, move up and down stairs on hands and knees. Keep your head up whether ascending or descending.
- Look for and report any extension of fire as you move along.
- If rooms or buildings are too hot to enter, reach in the doorway or a window. Use the handle of a tool and sweep around you. Victims may be found lying just inside a doorway or window.
- Once you have successfully rescued a victim, place him/her in someone's custody to deter the victim from re-entering the building.
- If you become trapped in a hallway or stairs, try to retreat down. Never go up. Conditions will be worse on upper floors. Look for an outside wall or window. Look for hose lines to follow out of the fire building or to a safe area.

## **LADDERING THE BUILDING**

### **When To Ladder A Building**

In firefighting a standard operational technique for all cases is impossible. A truck officer should be prepared for alternate ladder raises, especially with the problem of overhead wires, parked cars, and narrow alleys or streets, as well as the problem of hills. Ladders should be raised with a purpose in mind.

Raising ground ladders as indicated by need is a vital function of a truck company. While this is academic, in too many cases engine companies forget that they, too, carry ground ladders. Department practice requires that truck officers use their initiative in laddering buildings.

The following are several ways the ground ladders can be used to decided advantage at a fire:

- To ladder fire escape balconies. Fire escape should always be laddered.
- To bridge narrow alleyways.
- To use as stairs in case fire burned away the first or upper floor stairs.
- To ventilate windows by pulling the top out and allowing the ladder to fall against the glass. The ladder must be turned at a right angle to the building to prevent hand injury from glass sliding down the beam.
- To advance hose lines to upper floors because the regular stairs are being used to evacuate people.
- Where the stairs are inadequate to get all of the people down fast enough.
- To get down shafts, excavations, lightwells, etc.
- To get to the roof of the adjoining building.
- For forcible entry.
- To bridge a larger opening for the use of a cellar nozzle.

First alarm truck companies will ladder buildings upon arrival. Truck officer should call for the ladder that is required. Hand-raised ladders should be raised if and where needed. There should be a secondary means of egress provided for each floor involved above the fire floor. Also, do not ignore the rear of the fire building. Many times these present good laddering opportunities but are ignored because they sometimes can be difficult to access with ladders. The second truck company generally enters the building for immediate ventilation, forcible entry, or other duties.

Chief Officers should not be required to issue orders to first alarm truck companies to ladder buildings, nor call the ladder to be used. These are the truck officer's responsibilities. However, chief officers may order more than one ladder or building side to be laddered depending upon existing conditions.

When overhauling, small extension ladders are used inside buildings. Truck officers are to order such ladders brought into buildings whenever they think it is necessary.

### **Laddering Fire Escapes**

Laddering the fire escape normally completes the requirements of access to the roof, as fire escapes generally go over the roof.

When a building is equipped with a fire escape, the fire escape is always laddered, whether or not fire or smoke is showing. Laddering the fire escape normally completes the requirements of access to the roof, as fire escapes generally go over the roof. This normally is the duty of the first arriving truck company. In the event the first truck company was unable to complete this, then the second arriving truck company shall ladder the fire escape.

On buildings equipped with two fire escapes, primary consideration shall be given to laddering the fire escape that is equipped with standpipe outlets, UNLESS LIFE HAZARD DICTATES OTHERWISE.

### **Ladders To The Roof**

When buildings within the reach of hand-raised or aerial ladders are not equipped with a fire escape, then the necessary hand raised or aerial ladder shall be raised to the roof upon arrival unless laddering is required to windows for rescue or other vital operations.

Sooner or later the problem arises of getting firefighters to the roof to ventilate. Probably the quickest way to get to the roof is by aerial ladder (if the ladder is in position). Another method where the buildings are of equal height is to go up the inside stairway of the adjoining building to get to the roof. An advantage here is that the aerial ladder could be used for rescue purposes or advancing hose lines if needed. Another advantage of using the adjoining building is that it gives the firefighter a safe route to the roof and also a good line of retreat from the roof.

## **VENTILATION**

After the building is laddered, two firefighters are usually ordered to the roof, or above the fire to ventilate from the top down.

The truck officer should consider going to the roof to supervise ventilation. If necessary to split the truck crew, the officer can accompany the ventilation team to the roof and order his remaining firefighters inside to assist the companies with search, rescue, ventilation, and forcible entry. It is important to have an officer on the roof to supervise ventilation and give reports via portable radio to the Incident Commander.

Truck company officers should consider using power saws in performing roof ventilation. After venting the roof, the firefighters should go down the front or rear fire

escape, venting by windows and moving in on the floor above the fire to search for people overcome, vertical fire extension, or the presence of shafts that could allow fire to spread.

When going to the roof to ventilate, insure all necessary tools are brought to the roof with the ventilation team. It causes unnecessary delays if members are sent down from the roof to obtain essential tools. Bring all essential tools to the roof, including roofing and ridge ladders when working on peaked roofs. For more information refer to the Ventilation Manual.

## **FORCIBLE ENTRY**

Normally two firefighters, using the proper tools, can be effective in forcible entry. If the truck company was first to arrive, they should bring a water type extinguisher. The truck crew forces entrance for the engine crew, and opens ceilings and sidewalls to expose hidden fire. They may have to force entrance to the floor above for examination. Members should open windows as they proceed.

No one truck company could perform all the necessary tasks at a serious fire, particularly where people are trapped. In such cases, priorities are determined by the number of firefighters available and the importance of prevailing conditions. It may be possible for the first truck arriving to handle only roof ventilation and forcible entry. Incoming units would have to fill in for other jobs. For more information refer to the Forcible Entry Manual.

## **OVERHAULING**

The overhauling process may be defined as an orderly examination of a fire building and its contents to insure that the fire is completely out. It may require a good deal of opening up of partitions, ceilings and shifting of contents. Therefore, the job should be well thought out in advance; otherwise there will be duplication of effort.

Overhauling involves opening walls and ceilings where fire may have traveled, eliminating all means of rekindling, a close inspection of all fire arteries, and removal of heavy volumes of water.

The general procedure for hauling debris out of buildings to the street is by using carryalls. The tossing of debris from windows or any other elevated position requires the approval of the Incident Commander. Debris should not be placed into light wells, side alleys or against buildings. It should be placed in the street, at the curb, in front of the property involved. The snatch block with hauling rope is an effective means of removing debris from the upper stories of buildings. Do not use the aerial ladder in this evolution.

Be particularly careful in removing mattresses from the building. Roll the mattress and tie it with a hose strap or piece of rope or webbing. If you are close to a window and you will do no damage by throwing it out the window, do so. Do not attempt to drag a water-soaked mattress down hallways or stairs without using the carry-all provided on trucks or engines. Before attempting to take mattresses inside elevators, always make sure that the mattress fire is out, and also keep a portable water-type extinguisher in readiness. Truck officers should carry a short length of rope or webbing in their turnout coat pocket for use as a mattress tie or for other situations that may arise.

## **SALVAGE OPERATIONS**

In addition to standard operations, salvage may involve sprinkler systems and shut-offs, auxiliary appliances present in the fire building such as utility shut-offs (gas, water, etc.), and securing the building before leaving the premises. For more information refer to the Salvage Manual.

## **NATURAL GAS LEAKS**

When responding to a suspected natural gas leak in a multiple unit building you may be able to isolate the gas leak by locating the buildings bank of gas meters. Check the test gauges on each meter. The test gauge is the arrow indicator on the clock like gauge without numerals. These test gauges may be above or below the other gauges, which have numerals for billing purposes.

If the test gauges (i.e. a typical single family dwelling will have two test gauges marked 1/2 and 2 cubic foot pounds) are spinning, you are best advised to shut off the gas meter immediately and thoroughly investigate the specific dwelling the meter supplies. This isolation technique may be used for dwellings with individual gas services but would not be effective for large industrial gas meters.

### **Natural Gas Leaks And Ignition Sources**

Natural gas, when contained in an enclosed area in the correct volatile mixture (5-15% gas to air), have been ignited by the following items:

- Flashlight
- Electrical transformer
- Telephone
- Doorbell
- Light switch.
- Pilot light

Proceed with caution and avoid using the above and other ignition sources that exist on the premises.

Eliminate the volatile potential of a natural gas leak.



- Ventilation of a natural gas leak cannot be overemphasized. By venting the leak you eliminate the natural gas from achieving an explosive potential (5-15% gas to air).
- Remember that natural gas is lighter than air and you should investigate the leak thoroughly including the room or rooms above the leak.
- In addition to venting the gas leak, attempt to locate a shutoff close by the appliance (if applicable) to eliminate the fuel source.
- Notify PG&E.

Shut down the natural gas to the building either at the gas meter, if it's located on the exterior, or at the street shutoff (pilot lights = ignition sources) Use shut down lock down kit to insure it stays shut down.

It may be necessary to secure the electrical power to a structure in the event of a fire or other emergency, In this instance, the electrical power can be secured at the main switch or at the electrical panel for a specific apartment or unit, In an instance where there is a problem controlling utilities or it is suspected that the local utilities could present a fire hazard, notify PG&E.

## **GENERAL INFORMATION**

Take all tools you consider may be necessary when reporting for an assignment. If going into the building. Many times a truck company in their ventilation, search, or "opening-up" procedures find a hidden fire. They may have to use the "house" line, rather than waiting for an engine company to bring in their hose lines

An excellent item for truck officers to carry is a 1-inch piece of inner tubing to be used similar to a rubber band. In entering flats and apartment houses, where you are first to enter the building the front door usually will close behind you. Place the rubber band over each door knob at the lock and this will keep the door from locking fully. Other firefighters may enter the building with no difficulty, as the door will not lock. Rubber stoppers will perform the same function but are seldom available.

Truck officers should equip themselves with many similar devices that will aid them in the various situations that may develop. In areas where sprinklers are installed, it is advantageous to carry a sprinkler shutoff in the officer's belt. The key to good truck work at fires has always been initiative and ingenuity.

Truck officer duties and responsibilities include the officer being aware of the location of all members of the truck company. Many times truck crews become separated, by necessity, to perform vital operations, but it is the officer's job to "know where his/her members are and what they are doing."

It will usually be necessary to raise ladders to provide access to the building involved. Regardless of who performs them, or when they are done, truck company operations must be carried out. In contrast to engine companies, truck companies generally do not operate as a team. That is, their assignments take them to different parts of the building and at times are carried out simultaneously. Therefore, if a truck company operated as a team and did everything together, it would seriously delay vital operations at crucial stages of the fire. This does not deter from the fact that in all ladder operations, teamwork is the keynote to success.

In large municipalities such as San Francisco, a properly staffed and trained truck crew responding routinely with engine companies provides greater fire operation efficiency. A well trained truck company often insures the success or failure of the operation at a fire. It is part of their function to determine life hazards, and the possibility that a fire may extend in the rear or to adjacent buildings by way of shafts, cellars or attic spaces.

An alert truck company will know that the rear of a building is at times more important than the front. People in the rear may be trapped or may have jumped. Fire may be extending into other buildings or to other floors. At night, rescue and venting at the rear is more difficult because vision is limited. In some areas, windows may be barred. Hose operations are hampered because it is difficult to gain access to some rear areas. You may have to bring in hose lines and ladders through adjoining yards, courts, or by going through the building. At roll call, truck company members are told their functions and what tools to carry.

## **ROUTINE TRUCK COMPANY OPERATIONS**

### **Stuck Muni Wheelchair Lifts/Assist Muni**

With the weight of the truck crew on the lift, have the bus driver attempt to raise or lower the lift. If this does not work, use manpower to lift the wheelchair and occupant off the coach.

### **Person Stuck In Elevator**

Once on scene, determine if people are still in the elevator. Often, they are out upon arrival. Find out from responsible party if elevator repair has been called and if they have an ETA. If not, have a repair technician called. Locate the floor the elevator is stuck on. Communicate with the trapped people to determine their state of mind, health needs, anxiety level, need for bathroom; this will help you decide the degree of urgency or plan of action. Reassure the trapped people and wait a reasonable amount of time for an elevator service technician.

Attempt to shut down the power to the elevator and restart it. This often resets the relays and restarts the elevator. Keep in mind, with the power off the occupants are in the dark. Tell them what you are doing. Try to “jimmy” the door release mechanism with bent wire tools. With double or side by side elevators, use a ceiling hook or broom stick with a nail (configured like a ceiling hook) to release the stuck elevator from the adjacent elevator door.

In urgent situations, where immediate release is required, force the door with the Rabbit Tool, Porta-Power or pry bars with blocks. Before removing occupants, shut off the power and have a step ladder if they are stuck between floors and need to step up or down to the floor level. A large truck block in the door sill is an extra safety precaution against a runaway elevator car.

If a person in the elevator has mechanical skills, you can talk them through opening the door from the inside. Have them spread the inner or car door(s) by hand, and use a pen to reach up and trip the locking pawl.

### **Child Locked In Car**

Determine the degree of urgency by the appearance of the child. If they are in distress, break a window to gain entry. Find out if a locksmith or auto club is on the way. They have master keys for most cars and the practice to “jimmy” the door very quickly.

Work from an open window or spread car door from the frame. Use “jimmy” tools to work the door handles, lift the locks, retrieve the keys, or push the unlock button. The door unlock mechanism can be released by sliding a “jimmy” down along the window. Be careful of cars equipped with side airbags.

### **Auto Extrication**

Provide for scene safety by placing the apparatus between you and traffic. Place flares and/or safety cones to slow traffic and give early warning. Mitigate fuel spills with absorbent. Have a small line ready if fire potential exists. Stabilize the vehicle(s) with blocks, cables, ropes, or rigs. Disconnect the battery if possible. Check the opposite side door and rear doors for access. If necessary, use the “Jaws of Life”, Jacks, Porta-Power, power saws and bars to cut and pry trapped occupants free.

## **SPECIAL OPERATIONS**

Truck companies are equipped with a rescue box that contains a variety of tools to deal with a major disaster. High Angle Rescue gear includes ropes, harnesses and an assortment of hardware. Structure Collapse Situation; Pry bars, hammers and assorted hand tools to construct shoring in compromised structures

## **MUNI LRV Lifting**

Trucks are equipped with jacks for lifting Muni Light Rail Vehicles. Refer to the Transit Manual for lifting techniques.

## **Rapid Intervention Crews (RIC)**

The purpose of the Rapid Intervention Crew is to provide fire personnel for the rescue of firefighters in a building if the need arises. The rescue of firefighters in need is a time sensitive issue. It is important to have a company or companies standing by ready to effect rescue if it becomes necessary. It is too late if a company must return to the apparatus to don SCBA or to obtain necessary tools and equipment. The RIC should be standing by at the Command Post with full protective clothing and equipment in the event they are needed to assist fellow firefighters. The RIC should be a company specifically dedicated to assist firefighters who are in need of immediate assistance. They should not be assigned to normal firefighting operations, but should be kept specifically aside for the purpose of providing rescue and assistance for firefighters.

Duties and responsibilities of the RIC are:

- Reports to the IC at the Command Post and stands by for orders from IC
- RIC standby in full protective clothing with all necessary tools and equipment
- Provide immediate assistance for any firefighter in distress

One or more RIC teams will be assigned to the incident depending upon the size and nature of the incident. The Safety Officer should be advised when the RIC team is in place. If RIC operations are in place, a Chief Officer should be assigned as the RIC Group Supervisor and immediately call for back up RIC teams.

Anything that can be done to increase the chances of firefighter survival should be done. The RIC will be the IC's first offensive move to assist members in need of assistance. The importance of having a team at the ready is that the RIC is not involved in any fire suppression activities and therefore does not have to drop what they are doing to effect rescue attempt. Not all companies at the incident can stop their operations and attempt to provide aid to firefighters in jeopardy. Some companies are involved in critical fireground operations such as hose line operation, ventilation, etc. To stop these functions and divert these companies from their essential fireground operations may intensify the situation that required rescue of firefighters.

## **Procedure For Use Of Rapid Intervention Crew**

### **Location**

A company (preferably a Rescue Squad or Truck Company) with sufficient manpower and the essential tools and equipment is designated by the Incident Commander as the Rapid Intervention Crew, and reports directly to the IC, except when a fire or emergency is in a high rise building. In this case the RIC should be at the Operations post on the

floor below the emergency. The Officer of the RIC should immediately begin a size-up of the building, noting the location and number of entrances and exits, fire escapes, horizontal exits, access stairs, and any other information that may be useful during search and removal or recovery. If a problem should develop, the IC should provide the RIC with the last known location of the firefighters in need of assistance.

### **Equipment**

A RIC reporting to the IC should have full protective equipment, SCBA, an extra air bottle per firefighter, portable radios, PASS devices, door chocks, flashlights, rescue ropes, multi-purpose saw, chainsaw and forcible entry tools, (axes, halligan, chicago etc).

### **Search Techniques**

Companies designated as a RIC should be familiar with specialized group or team techniques. The method used will depend on the size and complexity of the building or area involved. For small areas, the general search method of Right In/Right Out, or Left In/Left Out can be used, with one firefighter always remaining in the door for safety. In larger areas, the team approach using a guide rope can be used. A pattern of sweeping the floor with an arm, leg or tool as the team moves forward is usually employed. Voice contact must be maintained to provide continuity of the team.

### **Before Entering**

It is important that the IC assign the task of keeping a time check on firefighters operating in the search area. Limitations of SCBA and stress on the firefighters should be considered and provisions made for manpower rotation and rest periods. The Incident Commander must remain in control of the fireground when an event warrants putting a RIC into action. The initial reaction of companies on the fireground will be to provide assistance to those in distress. This must be avoided. An orderly reaction will avoid putting other firefighters in danger or jeopardy. The IC must immediately perform a Personnel Accountability Report (PAR) or roll call with all committed Divisions, Groups and Single resources.

The RIC Officer may specify a tool assignment at roll call. During a search, communications between the RIC Officer and firefighters may be more efficient if firefighters are called by their assignment, such as "Saw person", or search position number. This method helps to maintain contact with each firefighter during the search and avoid confusion when firefighters have similar names.

Prior to entering the building, the RIC Officer should review the mission of the RIC and provide the following information:

- Number of firefighters missing
- Their unit number
- Last known location
- Entrance used by the firefighters
- Their path into the fire building

- Problems in the building or area
- Search technique to be used
- Communications plan

## **COMMUNICATIONS**

Before operating, RIC members must make sure their radios are on the proper frequency. The frequency to use is the fireground frequency and will be the rescue channel during the search, all other fireground personnel switch to A1 for fireground use. No other communication should be permitted on this frequency. In high-rise buildings, BART, MUNI, and other difficult locations, a relay communication system may have to be established.

### **Entering The Building/Area**

Before doing so, the RIC officer will perform a final check of the firefighters' protective equipment, tools, and radio frequency, and then don SCBA and enter the building with the team members.

When the team is in the building or area, team members should attempt to locate and identify a second exit as they begin a search of the fire area. Should conditions begin to change, they then would be able to withdraw from the area and not become part of the problem.

RIC members should examine the floor below the fire for the missing firefighters; in some recent cases, firefighters fell through the floor and became trapped below the fire. If the fire originated in the basement and floors collapsed, firefighters may be found trapped under debris and hose lines.

In the past few years, many firefighters have been seriously injured or killed fighting "routine" fires. Although a RIC may not have prevented all the injuries or deaths, the availability of a RIC may have been effective in some of these incidents. Some of the factors implicated in the incidents causing these firefighter injuries and deaths are given below:

- Conditions deteriorated rapidly
- Poor communications on the fireground
- Improper size-up
- Failure to follow basic safe firefighting principles
- Failure to listen carefully to other units on the scene
- Failure of officers and firefighters to use their Self Contained Breathing Apparatus
- Failure to identify possible problems during preplanning of familiarization visits
- Energy efficient windows
- Failure to detect secondary fires and firefighters going above fires without knowing it

- Failure to have a secondary means of egress on the fire floor or the floor above the fire
- Some firefighters do not activate their PASS devices when entering the fire area
- Freelancing
- Deviating from the IC's orders to a fire company's orders

The success of the RIC operation depends on many factors. One of the most important factors is training before the team is needed. Fire companies should avail themselves to training in vacant buildings, buildings with large floor areas, maze conditions, and unusual problems. There appears to be a need to familiarize firefighters with survival techniques, such as saving air in the SCBA by controlling the mind and slowing respiration rate. This procedure will extend the air supply, and buy more time. Experience has demonstrated that time availability and training are critical factors, and that quick deployment is essential.

If a Rapid Intervention Crew is put to work, another company must be called to the scene as its replacement. It may be in the best interest of the IC to rethink the duties of companies reporting to the Command Post while awaiting specific firefighting orders. Furthermore, it is incumbent on the IC to think ahead when calling a RIC to anticipate delays in response due to distance, location etc. Units at the scene and not working should realize they might be called upon to serve as the RIC at a moments notice. Bringing the proper tools and equipment to the Command Post for even the small routine fire may save a firefighter from injury and death.





## SECTION 6. SAFETY PRECAUTIONS

It is not possible to compile a list of precautionary items that would cover every situation encountered when operating an aerial ladder. Therefore, it is the prime responsibility of the officer in charge to oversee fire ground management and to ensure proper use of the aerial apparatus.

Avoiding known hazardous conditions and knowing what corrective action to initiate when unexpected circumstances occur is the result of proper training and experience. All personnel who work around and/or operate these units shall be trained and certified in all phases of aerial ladder safety, operating procedures, and fire ground management.

With those thoughts in mind, the following precautionary items have been established to assist operators in the proper use of the aerial ladder apparatus.

Your aerial ladder is only as reliable as those who operate and maintain it. A perfect safety record is **NO ACCIDENT**.

In addition to the precautionary items, **DANGER** and **WARNING** placards are installed at applicable locations on the apparatus to further illustrate its proper and intended use and to alert personnel of impending hazards.

### CAPACITIES

**Learn the load capacities of the aerial.** Even though the unit is equipped with a load chart installed at the operators station, it is the responsibility of the operator to study and learn the load limitations of the unit. However, do not rely on memory. Always refer to your load chart when operating the unit.

**Do not exceed rated load capabilities.** Regardless of built-in design factors, never exceed published load limitations.

**Evenly distribute weight on ladder.** Personnel on ladder should maintain a distance of 10 feet apart.

### SETTING UP THE LTI

**Always apply parking brakes.** Parking brakes must be applied before outrigger operation is initiated. In tiller models, trailer brakes must applied also.

**Always use wheel chocks.** Chocks must be placed ahead of and behind the front steering axle tires. Restraining the front axle provides additional friction to prevent

movement of the apparatus (walking) on its outrigger system. This is particularly important when operating on uneven terrain. When operating on hills, place the chocks on the downhill side of the front steering axle tires and the tiller tires.

**Keep away from dangerous banks and areas of uncertain footing.**

Avoid areas such as stream, canal, river banks, and sandy terrain. The auxiliary jack pads supplied with the unit are intended for use every time outriggers are deployed on a sidewalk. Sidewalks are not reinforced and are only approximately 3" thick. The pads distribute the weight over a larger area and prevent the sidewalk from collapsing.

Their use is not recommended if icy or slippery conditions exist. Do not use outrigger pads on hills. Their use on hills will increase the chance of the apparatus sliding down the hill.

Never set outrigger jacks over storm drain or on manhole cover.

**Always extend and set outriggers before attempting any aerial functions.**

Capacities are based on all weight being removed from the vehicle springs, with the load forces being absorbed by aerial torque box and chassis frame.

## **AERIAL OPERATION**

**Only qualified personnel are permitted to operate the aerial ladder.** Do not permit anyone to operate or even approach a unit on station unless they have been previously trained and certified in the proper operation and application of this apparatus.

**Danger:** You must not operate apparatus until you read, understand, and can follow all procedures contained in the handbook. Read and understand any danger and warning placards affixed to the apparatus, and you must be aware of, understand, and apply the working rules and regulations of your employer and any applicable regulations imposed by US Government Agencies.

**Never get on and off the apparatus while it is in motion.** When getting off or on, use both hands and ensure that your footing is solid.

**Do not initiate any aerial operation with tillerperson in cab.** Ensure that the tiller firefighter is out of tiller cab before initiating any ladder function. Extending a cradled ladder, or swinging an extended ladder without sufficient elevation will damage tiller cab and subject anyone inside to serious or fatal injury.

**Never reverse swing directions rapidly.** Feather the control lever movement in both directions. Suddenly reversing swing direction could dislodge personnel resulting in serious injury, and can cause damage to the swing system and/or ladder structure.

**Never leave the apparatus with the aerial elevated and extended.** Always retract, lower, and stow the aerial in the cradle, and shut off the power before leaving the apparatus.. The driver should remain with the apparatus when the aerial is in use.

**Keep constant eye contact with an aerial in motion.** Always keep your eye on a moving aerial. Watch for hazards in all directions. If you must look away, stop the operation immediately, but smoothly. **Never use any structure to support the aerial.** On LTI aerials, keeping the lights at the tip of the aerial directed at the beam of the fly ladder with the switches in the on position will aid the operator in positioning the ladder at night. These lights will not come on until the ladder power switch in the cab is turned on.

The preceding safety precautions and operating instructions pertain to all aerial apparatus, and LTI apparatus. For more safety precautions when operating LTI aerials see appendix B



## SECTION 7. GLOSSARY

**AERIAL LADDER:** A hydraulic aerial extension ladder permanently mounted on the turntable of an aerial truck.

**ANGLE BRACES:** Braces extending diagonally from a truss block and beam to adjacent truss block and truss. Their purpose is to provide further strength to the ladder.

**BANGOR LADDER:** An extension ladder of truss type and equipped with ladder poles.

**BEAM:** The main structural part of a ladder on which the rungs are supported.

**BEAM RAISE:** Raising the ladder on its side with the beams one above the other, rungs in a vertical position. (Rungs at right angle to the ground).

**BED LADDER:** The lower section of an extension ladder.

**BRIDGING:** Use of ladders above ground level to provide a walkway to cross lightwells, alleyways, roof to roof, or window to window of adjacent buildings, etc. Also, using ladders or the sections of an extension ladder for climbing over walls, fences, etc.

**FOOT:** The bottom of base (foot) of the ladder.

**CHURCH RAISE:** A method of raising a ladder in a vertical position without use of solid support against which to rest the ladder. Ropes are used to support the ladder in a vertical position.

**CHUTE RAISE:** A method of raising a ladder in a confined area where normal raising is impractical.

**CROSS PIECE:** A wooden cleat at the top of the 24-foot ladder which allows these ladders to be used as brace ladders.

**EXTENSION LADDER:** A ladder of two or more sections, which can be extended to increase its length.

**FLAT RAISE:** Raising a ladder with beams and rungs parallel to the ground on the same plane as the ground.

**FLY LADDER:** The upper section (or sections) of an extension ladder. Its purpose is to reach elevations beyond the height of the bed ladder.

**GUIDES:** Strips on the inner side of an extension ladder which guide the fly ladder while it is being raised and lowered.

**HALYARD:** Rope or cable used to raise or lower the fly of an extension ladder.

**LADDER BLOCKS:** Wooden blocks of various sizes and shapes. Their purpose is to afford a level surface for the base of the downhill spur of a ladder raised on sloping terrain.

**LADDER HEELER:** A metal clamp that fits on the foot end of a ladder beam. It is secured in place by a screw clamp and the cotter pins. It contains an adjustable sliding rod which is locked in place by a sliding sleeve lock. Its purpose is to stabilize a ladder by extending one spur to correspond with the other when the ladder is raised on a steep grade.

**LADDER POLES:** Poles equipped with sear pins that are attached to the upper end of the beams of a bed ladder by means of sear locks. Their purpose is to assist in raising, lowering, guiding, and steadying the 50-foot ladder.

**LADDER POLE EXTENSIONS:** A separate metal extension that is adjustable to the ladder end of ladder poles and is secured by a setscrew. Its purpose is to extend the length of the pole when used on an excessive grade.

**LADDER POLE SPIKES:** Metal spikes at the lower end of ladder poles. Their purpose is to prevent the poles from slipping from a set position.

**LADDER RAISING DEVICE:** A 15-foot pole equipped with a metal yoke that fits onto the rungs of a ladder and is used to assist in raising a ladder. It can be used where the foot of the ladder must be slid into position or where overhead obstructions interfere with raising of the ladder.

**LOCKING PAWLS:** Metal locking devices commonly attached to fly ladders. Their purpose is to lock the fly ladder in place when elevated. There are two types of locking pawls:

- Spring operated on the 24-foot metal, 35 and 50 foot wood extension ladders and aerial ladders.
- Pendant pawls on the 12, 18, and 22-foot wood extension ladders which swing into locking position when the ladders are in the off vertical position.

**POLE LADDERS:** Extension ladders with poles added for stability.

**PULLEY:** A grooved metal wheel attached to extension ladders over which the halyard is drawn when raising or lowering the fly ladder.

**ROLLERS:** Metal rollers on aerial ladders and Bangor extension ladders over which the fly ladders roll when extended or lowered.

**RUNGS:** Cross members between beams that provide footing for climbing the ladder.

**SEAR LOCKS:** The locking mechanism permanently attached to 50 foot wood extension ladders for engaging the sear pins.

**SEAR PIN:** The pin at the top end of ladder poles used to engage poles to sear locks.

**SINGLE LADDER:** A non-adjustable or straight ladder that is not trussed.

**SPURS:** Metal reinforcements attached to the ends of ladders. Their purpose is to preserve ends of ladders and to provide better footing.

**STOPS:** Blocks that prevent the fly ladder from being extended out of the bed ladder.

**STRAIGHT LADDER:** A ladder built in one section only.

**TIE BOLTS:** Metal bolts used to secure tie rods.

**TIE RODS:** Metal rods placed under rungs and through both beams. Their purpose is to tie one beam to the other beam.

**TOP:** The topmost point of the ladder.

**TRUSS:** The tension member parallel to the beam. It is separated from the beam by truss blocks and braces. The purpose of the truss is to add strength to the beam.

**TRUSS BLOCKS:** Spreaders set at a 90-degree angle to the beam and the truss. Their purpose is to separate truss from beam and to stiffen the ladder.

**TRUSS RAIL:** The longitudinal members of the ladder truss.





## SECTION 8. APPENDIX

### APPENDIX A

#### SAN FRANCISCO FIRE DEPARTMENT DIVISION OF TRAINING BULLETIN 95-5

Wood ground ladders should be inspected frequently to ensure they are in safe operating condition at all times. It is not recommended they be load tested, especially if the load test is a destructive or partially destructive procedure.

The inspection procedures as explained are simple, easy, and require no special devices or critical measurements. The inspection can be performed by firefighters at the station, or at the fire scene. Special technicians are not required.

It should be noted that load testing is not needed to determine the condition of wood ladders because they are not subject to concealed damage. When wood deteriorates or is damaged, the impairments show as visually observable changes in appearance. This is not true with aluminum and other metals.

These instructions also include a record-keeping system designed to track each formal ladder inspection and record all maintenance/repair actions taken.

#### CONDITIONS TO BE IDENTIFIED BY VISUAL INSPECTION

The following six conditions of wood may require maintenance/repair action. These conditions are identifiable by visual inspection.

1. Cracks (openings parallel to the grain).
  - A. Level of Acceptability: If 1/32" wide or less, and 1/8" deep or less, a crack is not severe enough to impair strength. If wider and/or deeper, the crack is above the level of acceptability.
  - B. Remedial Action: If a crack is above the level of acceptability, replace the cracked piece of wood. If below the level of acceptability, spot re-finish the wood piece and return to service.
2. Checks (same as cracks)
3. Splinters (small pieces of wood which have separated from a larger piece)
  - A. Level of Acceptability: If 1/8" x 1/8" in cross section, a splinter is not severe enough to impair strength. If larger then 1/8" x 1/8", the splinter is above the level of acceptability.
  - B. Remedial Action: If a splinter is above the level of acceptability, replace the splintered piece of wood. If below the level of acceptability, spot re-finish the wood piece and return to service.
4. Breaks. (openings, perpendicular to the grain)

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- A. Level of Acceptability: If 1/64' wide or less, and 1/8" x 1/8", a break is not severe enough to impair strength. If wider and/or deeper the crack is above the level of acceptability.
  - B. Remedial Action: If a break is above the level of acceptability, replace the broken piece of wood. If below the level of acceptability, spot re-finish the wood piece and return to service.
- 5. Gouges (areas of missing wood material)
  - A. Level of Acceptability: If 1/8" x 1/8" in cross section or less, a gouge is not severe enough to impair strength. If larger than 1/8" x 1/8", the gouge is above the level of acceptability.
  - B. Remedial Action: If a gouge is above the level of acceptability, spot re-finish the wood piece and return to service.
- 6. Dark Streaks: Areas of wood which are discolored with black or gray marks: Black adjacent to a steel fastener, Gray accompanied with softness; Black from exposure to extreme heat (charred).
  - A. Level of Acceptability:
    - I) If adjacent to steel fastener, the black mark is a stain and has no effect on the strength of the wood. Acceptable
    - II) If gray, and accompanied by softness in the wood, it may be an indication of fungus attack. If the softened wood when removed is 1/8" x 1/8" in cross section or less, it is not severe enough to impair strength. If larger than 1/8" x 1/8", the softened wood is above the level of acceptability.
    - III) If black, from exposure to extreme heat (charred), and the charred wood is 1/8" x 1/8" in cross section or less, it is not severe enough to impair strength. If larger than 1/8" x 1/8", the charred wood is above the level of acceptability.
  - B. Remedial Actions:
    - I) Black marks adjacent to fastener No action required
    - II) Gray, soft, above level of acceptability: Replace the damaged piece of wood.
    - III) Black, charred, above the level of acceptability: Replace the charred piece of wood.
- 7. Other Conditions: In addition, there are four non-wood conditions that may require remedial action. These conditions also are identifiable through visual inspection.
  - A. Tightness of connections and fasteners. All loose parts should re-glued or fasteners should be tightened. Bolts should not be over tightened to avoid crushing wood fibers.
  - B. Excessive wear of butt spurs. If dull, the spurs should be filed sharp If worn out, they should be replaced.
  - C. Proper operations of roof hooks. If damaged they should be repaired or replaced.
  - D. Fraying or deterioration of the halyard. If worn, it should be replaced.
  - E. Varnish finish. The varnish finish should be inspected. If damaged, or if gloss is dulled, repairs should be made in accordance with the

Bureau of Equipment and Ladder Shop's directions. Officers shall contact the Bureau of Equipment and schedule ladder refinish. A general form report shall also be submitted describing the ladder damage.

Note: Address questions regarding ladder maintenance and inspection procedures to the Bureau of Equipment.

#### INSPECTION PROCEDURES:

1. After each use, inspect the ladder for evidence of major damage. if no damage is readily observable, ladders should remain in service, and no record is necessary.
2. Four times a year, January, April, July and October, and immediately after any use where it is suspected that a ladder has been subjected to overloading or unusual abuse, conduct a detailed inspection of the following ladder parts, log the results, and take remedial action if required.
  - A. Beams - look for cracks, splinters, breaks, gouges, or dark streaks.
  - B. Rungs - look for cracks, splinters, breaks, or checks, and check for looseness.
  - C. Hardware - look for looseness, broken or missing parts.
  - D. Butt Spurs - look for excessive wear or dullness.
  - E. Roof hooks - check for damage.
  - F. Finish - look for scratches, loss of gloss or general deterioration of the varnish film.
3. Record the inspection on the LADDER LOG.. Place the LADDER LOG in the rear of the APPARATUS MAINTENANCE LOG.

## APPENDIX B

### **Safety Precautions When Operating Simon-Lti Aerial Ladders**

- When starting apparatus engine ensure the MASTER LIGHT SWITCH is turned off. Having the master switch on puts an excessive load on the alternator and batteries. Lights should be switched on individually.
- When operating aerial always set both parking brakes. Parking brakes must be applied before outrigger operation is initiated.
- Always use wheel chocks. Chocks must be placed ahead of and behind the front steering axle tires. Restraining the front axle provides additional friction to prevent movement (walking) of the apparatus on the outrigger system. This is particularly important when operating on uneven terrain.
- Always use stabilizing plates under outriggers, especially when used on sidewalks. Place handle of plate up and in towards the apparatus. Operators must use good judgment when operating on steep hills. Outriggers may slide on metal stabilizing plates. If the operator feels this may happen, it is permissible not to use the stabilizing plates. Never set outrigger jack over storm drain or manhole cover. Beams should not bridge street and curb, if possible.
- Always extend and set outriggers before attempting any aerial function. All outriggers must be fully deployed, all beams extended to full travel with jacks extended, as necessary, to contact solid, load-bearing surfaces, before aerial is rotated through 360 degrees. Extend outriggers separately from respective sides, unless the operator has a clear view of the other side of the apparatus, or someone is spotting for the operator.
- Keep apparatus leveling indicator in the "GREEN ZONE". Operation of aerial is reduced by 50% when operating in the "YELLOW ZONE". Operation is PROHIBITED when the indicator is in the "RED ZONE".
- Raise the outriggers until the balloon is taken out of the tire sidewall. Never raise tires off the street.
- Use outrigger pins at all times. Allow 1/4-inch minimum clearance above the locking pin inserted through the holes in the outrigger skirt.
- Always leave the floodlights on the tip of the fly section in the "ON" position in order to have immediate visibility at night.
- Do not support the end of an aerial on a building or other object. The aerial ladder is designed to be operated in the cantilever position (unsupported). Always leave 2 to 6 inches off of sill or roof, and 3 to 6 feet above a roof.
- Lower aerial into window if aerial is to be used for ventilation. Never extend into window. To do so will cause damage to hydraulic cylinders and/or extension cables.
- The aerial power foot switch (DEADMAN) is for the operator's safety when doing other operations in the area of the aerial ladder controls.
- Do not use the fast idle when operating in close quarters and extra safety is a factor. If it is not an emergency, do not use the fast idle. When bringing the

aerial down after use, do not use fast idle. The easier the operators are on the equipment, the longer the equipment will last and the fewer maintenance problems will arise.

- The fast idle switch at the outrigger controls will override the turntable control. The operator must ensure the outrigger control is turned off before starting operation of the aerial ladder.
- There are no mechanical locks on the LTI aerial. The ladder is held in position by hydraulic check valves.
- If the operator cannot see or judge distance between the roof and the ladder, gently rest the aerial on the roof and gently raise it off the roof approximately 2 to 6 inches using the slow idle.
- When bedding the ladder, make sure it is fully bedded. Hold down the control lever for approximately five (5) seconds after the ladder is bedded.
- Transmission oil level can only be checked when the transmission is hot. Drive the apparatus first using the retarder and all gears before checking the transmission oil. The apparatus must be on level ground when checking. Notify the Bureau of Equipment if the level is low.
- The automatic transmission will operate in "2" or "3" at all times. The only exception is operating on steep grades. "1" is to be used going up or down steep grades. "4" and/or "5" will be used for highway operations only.
- Do not operate the siren constantly. The siren draws excessive voltage and will damage the on-board computer, which will cause the siren and transmission to malfunction.
- Do not operate the air-horn excessively as it will draw down the on-board air tanks. State law requires safety check valves in the air system designed to turn air off to the horn if excessive air is used for the horn system.
- Do not drive with the alley lights in the "ON" position. They draw excessive current and may damage the on-board computer.
- If the aerial ladder will not operate, check outrigger for downward extension.
- Check outrigger micro switches if the aerial fails to operate and outriggers are extended down properly. Check for dirt, and if needed, clean and lubricate. This is part of the operator's daily inspection.
- Ensure rungs are aligned before climbing. Check rung alignment light.

## APPENDIX C

### Thermal Imaging Cameras

Thermal Imaging Cameras (TIC) have been purchased by the San Francisco Fire Department to assist with field operations.

Thermal Imaging Cameras help Firefighters see in a zero visibility environment. They can be used to help locate downed Firefighters, victims during search and rescue operations, hidden fire and other such uses. They can also be used to see damaged structural members and warn of potential collapse and have various uses during hazardous materials operations. The key issue with Thermal Imaging Cameras is that they are a “behavior-altering” device. Like few other new technologies to the fire service, the TIC changes the way we view a fire situation. The result is that we must understand how it changes a Firefighter’s behavior so as not to increase danger when used.

The responsibility for use and operation of the Bullard T3LT and T3MAX Thermal Imaging Cameras lies with the Company Officer. Responsibility for daily inspection and operational checks, as with any other apparatus equipment, lies with the apparatus operator (drivers), Incident Support Specialists, or Chief Officer.

The TIC shall be utilized at all box alarms. The TIC shall be used to assist in size-up, search and rescue efforts, fire attack, ventilation, overhaul, hazardous materials incidents, and any other incident the Company Officer identifies a need for its use. TIC’s are useful tools in Wildland firefighting incidents as well.

Firefighters must not become overconfident when using the cameras and remember the basic firefighting fundamentals such as staying low below superheated gases and smoke. Using the Thermal Imaging Camera may also tend to give Firefighters a false sense of security due to the TIC’s limited view area.

As soon as you know the camera is going to be used, it should be turned on. All units have a warm-up time of approximately five (5) seconds for the T3LT model and approximately eight (8) seconds for the T3MAX model. Always take the spare battery with you when using the camera. The batteries are the weakest link. There are no user serviceable parts on the camera. If the unit fails to operate, the only option the user has is to change the battery. Therefore, make sure you have a charged spare battery with you at all times when operating the camera at an incident.

There are two different ways you can use the camera. You can lead the search or you can direct the search. If you are leading the search with the TIC, there may be a tendency to get caught up in the technology and leave the search team. This can cause further Firefighter injuries and negate the team concept of the search operation. You may also choose to direct a search team by having the Firefighters out in front of the

member with the camera. Do not allow Firefighters conducting the search to get out of range or view of the camera. **While searching with the camera, the two personnel team concept must be adhered to.**

The user must allow the camera to work for them. The basic concept of the TIC is that there must be thermal contrast for it to properly function. If there is no contrast, the camera will not work. In areas where everything is the same temperature, the TIC will not work. Objects with different mass and density absorb and give off energy at different rates. This is what gives us contrast and allows the TIC to function properly.

The camera can also be used to search for hot spots at a fire during overhaul. The camera will detect the variation in heat and allow hot spots behind walls, etc. to be seen on the viewer. However, the TIC is not a substitute for normal overhaul procedures. It can **assist** with overhaul by detecting hot spots in a room or area.

It is essential that companies drill with the TIC to ensure proper, safe operation. If you do not know where you are and what you are looking at, it will be difficult to interpret the viewer. The TIC can give an individual a false sense of security and cause them to have tunnel vision with the camera. Sometimes during fireground operations, our lack of visibility has kept us safe. Firefighters may not have advanced quickly because of the lack of visibility. The TIC will assist to give you better vision in smoke-filled situations. The operator must be aware of their surroundings and proceed cautiously. Continue to scan the area and take reference points. In the past, the sofa or bed was not there until the Firefighters felt them. With the TIC, we will have visual indicators and it will be easy to get overconfident and develop tunnel vision. Continue to scan the areas and note visual and physical indicators.

## **Background Information**

The lack of visibility on the fireground is caused by products of combustion, primarily smoke and smoke particles. Smoke is composed of two elements: fire gases and soot. Heavy smoke causes all the light to be scattered or blocked since the light waves cannot penetrate the smoke and smoke particles. This zero visibility condition is what limits the effectiveness of lighting for interior firefighting operations. Thermal energy is not visible to the human eye, but Firefighters can feel the heat. The Thermal Imaging Camera allows Firefighters to see a thermal heat view of the surroundings. The TIC will take a thermal picture and translate this into an electrical picture and then into a visual image for the human eye. This is possible because the TIC relies on the thermal energy emitted by all objects and not on reflected visible light. The TIC provides vision capability with zero light present since thermal energy is characterized by its long wavelength which allows it to travel through smoke and mist. The TIC will then provide a visual view similar to a black and white television to the Firefighters through the smoke and darkness. When viewing an area through a TIC, hot objects appear white, hotter objects appear brighter white, and colder objects appear gray to black. The whiter the object, the more heat present in the object.

## **USES OF THE TIC**

- Provides safer navigation for Firefighters in zero visibility conditions
- Assists with overhaul and search operations
- Enables Firefighters to see obstacles in buildings which may interfere with firefighting operations
- May be used as a search tool to locate lost persons in an open wilderness area
- May be used to check for hot spots in a grass fire or dump fire situation
- May be used to determine fluid level in a container during hazardous materials incidents
- Can be used by Rapid Intervention Crew (RIC) companies during search and rescue of downed Firefighters

## **OPERATION OF THE TIC**

1. The TIC (including all accessories) must be completely dry when stored.
2. To turn on the T3LT, simply depress and release the large, dark gray power button under the LCD display. Upon pressing the power button the thermal imager will display the Bullard logo and initiate a calibration sequence. The thermal image will appear in approximately five (5) seconds for the T3LT and approximately eight (8) seconds for the T3MAX. To turn off power, depress and release the power button again.
3. Once the camera is operational, an image will be visible on the screen. Cool areas appear dark while sources of heat appear white.
4. T3LT and T3MAX models are equipped with temperature measurement capability. The right side of the display will show a bar graph or Relative Heat Indicator (RHI). The RHI will indicate the approximate temperature of the object viewed within the “crosshairs” shown in the middle of the screen. The accuracy of the indicators is dependent on numerous factors including the distance from the object being viewed and its emissivity, which is the object’s ability to radiate heat. Units are calibrated with a preset emissivity corresponding with normal construction materials. Objects with emissivities that vary greatly from this, such as metals and shiny objects, will reduce the accuracy of the temperature indication. Additionally, temperature measurement accuracy decreases as the distance from the object in the “crosshairs” increases.
5. You will periodically observe a momentary freeze in the image. This is normal and is a function of the self-calibration shutter. The shutter will activate every 30 seconds to three minutes, depending on the environment. The shutter will also activate each time the T3 goes into, and out of, Electronic Integration (EI) Mode. The Bullard T3 is equipped with an automatic gain control (AGC) that manages the sensitivity of the unit ensuring optimal image resolution in intense energy situations. When the AGC engages to accommodate high heat scenes, the letters EI appear on the screen indicating that the unit has shifted into Electronic Integration mode. This is an indication that the T3 has scanned an object that it has calculated to be at least 200° F (93° C).



6. **The TIC has NOT been determined to be intrinsically safe as an ignition source. Therefore the TIC should not be used in a potentially explosive atmosphere.**

## MAINTENANCE OF THE TIC

### Daily or After Each Use:

- Ensure unit is working properly
- Insert fully charged battery
- If necessary, recharge previous battery
- Verify all battery chargers and associated cables are functioning properly
- Using a damp cloth, clean off large pieces of debris

### Weekly:

- Clean lens with soft cloth and mild cleaner
- Clean LCD display cover with soft cloth and mild cleaner
- Verify all hand straps are in usable condition and properly secured
- Check for cracks, holes or other damage to the unit's outer shell
- Verify the batteries do not show physical signs of damage

### Monthly:

- Check tightness of all external screws, including those holding on straps, those connecting the LCD display cover and those connecting any bumpers. Do not over-tighten
- Cycle each battery fully. This is accomplished by using a conditioner or by fully charging and draining the battery. Ensure that one battery is always fully charged for use at an incident
- Using a damp cloth and mild cleaner, clean the outer shell of the unit. Do not immerse the unit under water for cleaning
- Verify that the battery contacts on the unit are corrosion-free
- Verify the battery chargers are corrosion-free on all primary contacts
- Users with a wireless receiver should verify that the transmitter and receiver are functioning properly and that all receiver cables are in good condition

### Variable:

The frequency of these maintenance steps will be determined by the amount of use the unit receives in the field. While this is a guideline, users should replace any part when they notice a decrease in product performance or usability, rather than waiting for a specific period of elapsed time.

- Every 8 to 24 months: replace the LCD display cover
- Every 18 to 36 months: replace the rechargeable batteries

Consult the user manual for additional maintenance and service information.

