TRUCK COMPANY OPERATIONS
TRAINING GUIDE

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CHAPTER 1 - APPARATUS SPOTTING

- Department strategic priorities for structure fires are: (3)
  1) protection of life
  2) fire control
  3) conservation of property.

- It has been estimated that only ___ percent of the work done at a structure fire is directly related to the "suppression mission". The remaining ___ percent of functions support the suppression mission but do not focus directly on the application of water.

  20, 80

STRATEGIC PRIORITIES

- The responsibility for assigning the truck company during the initial stages of the incident rests on the shoulders of the ________; the final placement of the apparatus for performing that function effectively is ultimately the responsibility of the _________.

  incident commander
  truck company captain

TACTICAL CONSIDERATIONS

- During a residential structure fire it is usually best to first drive past the incident, then spot at least one residence away. There are a number of reasons for this. (2)
  1) company members are able to view three aspects of the building
  2) ground ladders are removed from the rear of the apparatus and are already facing toward the scene

  Whenever possible, all units should be parked on the same side of the street so as to leave street access open around them.

- In general, when providing access for ventilation, ground ladders-if they can reach the intended objective-are a better choice than the aerial for several reasons. (2)
  1) Using the aerial on roofs can expose firefighters to unsafe climbing angles
  2) The aerial locks the apparatus into a location that may not be advantageous for defensive water tower operation.

- When the aerial is not needed for upper level access or rescue, the apparatus should be placed in a _______ position that provides a base for water tower operations.

  defensive
GUIDELINES

- Guidelines for Truck Company Placement
  - **Outside Storage**: Protect immediate exposures from radiated heat, with wind direction as a prime consideration. Spot in front of the leeward edge and to the side of the fire, not the front.
  - **Hazardous Materials**: Set up uphill.
  - **Multi-story Habitational**: The first consideration should always be rescue. In buildings without standpipes, the aerial can serve as a waterway enabling lines to be deployed to attack the fire.
  - **Concrete Tilt-up**: If roof access is needed and it can be accomplished using ground ladders, spot the apparatus in a defensive position for a possible water tower operation.
  - **Strip Mall/Light Commercial**: Usually it is best to spot for a water tower operation to cut off the fire and spare the largest portion of the building from fire spread.

- When the aerial is needed for roof access, spot the aerial in such a position that firefighters can approach the fire from the uninvolved area toward the involved area.

- When a water tower operation is obviously needed, the corner of the building is usually the best location for the truck. (2)
  1) The corner covers the largest area with the least amount of ladder movement.
  2) Corners are structurally stronger than its sides, reducing the probability of wall collapse.

- When choosing a corner for a water tower operation, it is important to consider stream direction. The stream should be directed from the unburned area toward the burned so as not to spread the fire to uninvolved areas.

CONSIDERATIONS

- A rear-mount aerial should never be spotted with its head toward the intended objective, as this reduces the overall reach of the aerial by the length of the apparatus.

- 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 extended over the rear at an angle of approximately ___ degrees from the center line of the truck chassis. The ladder should be pointing uphill when it is extended to the required position. This will reduce sideways tilt of the ladder

- When operating on a steep incline, avoid spotting uphill from the intended objective in order to reduce the working angle of the ladder.

- When responding to incidents on the freeway, if your apparatus is first on scene, it is a good idea to park it behind the incident. Then the truck will shield personnel and victims from oncoming traffic.

- Jackknifing tiller apparatus around the incident is usually not a good idea because the trailer section on most tiller trucks doesn't have adequate sidelighting, making it vulnerable to oncoming motorists, especially at night.

CHAPTER 2 - FORCIBLE ENTRY

STRATEGIC PRIORITIES

- The forcible entry team should consider the location and removal of victims its top priority. Choose an opening that can put a handline between the victims and the fire.

- Most victims will be found behind locked, inward swinging doors.
• Most often, doors are a better point of entry than windows. (2)
  1) Doors allow firefighters to enter at the lowest possible level, where heat, smoke and gases are above them.
  2) Doors are bigger than windows, usually, making entry, rapid exit and victim removal easier.

TACTICAL CONSIDERATIONS

➢ The weakest part of a security gate is the perforated metal sheeting that makes up the "screen" pan of the door. If it
  is spot-welded to the door it can be knocked loose, and a firefighter can reach and unlock the door.

• When attacking the lock side of a security gate, consider using a _____ cut over a vee cut.
  plunge

• The _____ cut will catch both the deadbolt and the latch with one cut, and do a cleaner job than a vee cut.
  plunge

• When cutting the hinges, remember to cut the _____ hinge first.
  bottom

• Externally mounted security gates and window bars can often be removed with sledge hammer blows to their
  ________.
  mounting screws

➢ Commercial glass and steel doors that do not have a tight fit can be pried, if care is taken to direct the force in the
direction the door(s) swing, and not inward, which will bend the frame and break the glass.

➢ Pulling the cylinder and picking the lock (through-the-lock) is extremely effective on glass and steel doors. No
  glass is broken and the damage done to the door is restricted to one missing lock cylinder.

➢ The usual problem with scissor gate forcible entry is a hasty attack that leads to a twisted or derailed gate. Make
  sure the gate has been secured in the open position to avoid accidental entrapment of personnel.

• Recessed doors, e.g., doors in alcoves, limit the prying options of the forcible entry team. Consider the ______
technique for this problem.
  adz end

• Cutting the lock with the rotary saw can be difficult, when the lock and jam are nearly flush with the alcove wall.
  An _____ mounted blade will get the blade closer to the jam, and make cutting easier.
  outboard

• The best option for rolldown doors is to cut the door with an _____ cut.
  inverted vee

➢ All L.A.U.S.D. grounds are secured with case-hardened padlocks and casehardened chains.
The case-hardened hidden single shackle padlock can be dealt with several ways. (3)

1) The shackle can be severed by cutting through the face of the lock two-thirds of the way up from the keyway.
2) If the lock is mounted on a substantial staple, a large pipe wrench can be used to rotate the lock and thus shear the pin.
3) The lock can be cut out of the problem.

CHAPTER 3 - WATER DELIVERY

STRATEGIC PRIORITIES FOR EXPOSURE PROTECTION

- The decision to use an elevated stream to "wash" or protect exposures is very much a ______ posture
defensive

- All fires have six sides: a top, a bottom, and four sides. Fire behavior dictates that the ________ side and the downwind side are at the greatest risk and should be considered first.
top or vertical

STRATEGIC PRIORITIES FOR CONFINEMENT

- Situations that lend themselves to an offensive aerial water delivery include
  a. Rapid vertical fire spread that is within reach of the on-scene aerial.
  b. Large open storage areas, lumber, baled goods, etc.
  c. Structure fires that have vertical potential with poor or blocked access available to firefighters with handlines.
  d. Fires in pressurized gas containers, flammable liquid tanks, tank cars, or other mobile containers
  e. Any fire where massive cooling is necessary to avert further complications (explosions, bleve, heavy fire spread, etc.)

STRATEGIC PRIORITIES FOR AERIAL STANDPIPE

- The County of Los Angeles has hundreds of buildings less than four stories in height without standpipes, and the aerial can be strategically placed at an upper floor or roof to deliver water to hose packs.

TACTICAL CONSIDERATIONS

- For a 1,000 gpm stream through a straight bore tip at 60 feet of elevation to be effective, the turntable must be within _____feet of the target, or projected target. This distance is a maximum.
  125

- Straight bore tips normally provide maximum reach and penetration at lower pressures. _____ nozzles have a very limited horizontal range of effectiveness, and normally are not suitable for exposures, reach, or penetration.
  Fog

- The normal procedure for deployment of an aerial ladder is _____, ____, and extend.
  Raise, rotate

- During water tower operations the normal sequence of raise, rotate, and extend is amended to _____, ____, and ___ only after water reaches the appliance and the operator is secure.
  Raise, extend, rotate
WATER TOWER ASSIGNMENTS

The following tasks are categorized by the post position most likely to handle them.

**CAPTAIN**
- Determine apparatus placement to meet objectives.
- Determine nozzle size, type, volume, and pattern.
- Supervise evolution.
- Verify Water supply and assign pumper.
- Assume or reassign hose clamp responsibility.
- Direct and supervise operation to meet strategic goals.

**APPARATUS ENGINEER**
- Spot or position apparatus as directed.
- Secure vehicle and engage hydraulic power.
- Place chock blocks and jack pads on Engineer's side.
- Deploy outriggers or stabilizing system.
- Verify apparatus as stable.
- Assist the topside FF position supply hose.
- Operate controls as needed for pipe installation.
- Raise ladder (correct angle 70 degrees).
- Extend ladder and set extension lock to meet needs.
- Coordinate supply line installation with the inside FF
- Signal "ready for water" after all is secure (allow the inside FF to ascend)
- Establish communications with stream operator.
- Monitor tactical radio frequency; transmit "water flowing".
- Rotate ladder to a safe operating area; flow water.

CHAPTER 4 - SEARCH AND RESCUE

**TACTICAL CONSIDERATION**

- A _____ area is the closest location that removes victims from hazards, and is a point where victims are transferred from search teams to treatment teams.

  safe refuge

**SEARCH**

- Initial on scene companies should always initiate the "_____". This is a rapid search of all involved and exposed areas affected by the incident. The emphasis should be on a rapid scan of the area to be searched.

  Primary Search.

- A ________ focuses on a thorough and complete inspection of the area searched during the Primary Search. The emphasis in this search phase is to guarantee that no victims are left in the building.

  Secondary Search
Search Markings

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<tr>
<th>Entrance &amp; Search Markings</th>
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<tbody>
<tr>
<td>↑ Entrance to structure</td>
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<tr>
<td>↑ Not Entrance to Structure or room</td>
</tr>
<tr>
<td>/ Single Slash when ENTERING structure, room, or area</td>
</tr>
<tr>
<td>× Second Slash when EXITING structure, room, or area</td>
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</tbody>
</table>

Victim Status Example

- 3 dead
- 3 alive
- 0

Ladder Rescue

- For rescue the first ladders should be raised to the victims closest to the fire.

- As a ground ladder is being raised it should be kept from the victims reach, so they will not be tempted to reach for it while the ladder is being raised.

- When a ground ladder is placed at a window for rescue, the tip should be at or just _____ the level of the sill below

- In placing a ground ladder at the front railing of a balcony or fire escape, two to ___ rungs should extend above the railing to provide a good handhold for victims or firefighters climbing onto the ladder.

  - four

- If floors being searched for victims by firefighters who entered through interior stairways can be reached with ground ladders, they should be raised, so they can be used as emergency exits for firefighters and victims.

AERIAL LADDER RESCUE

- When victims to be rescued are located some distance from each other, the Aerial Unit should be spotted ___. This will save you time in respotting the Aerial Unit for each victim.

  - between them

- When extending aerial ladder or platform always raise unit above victims, then lower down to them, this will reduce the chances of the occupants reaching or jumping for the ladder or platform while it is being raised.

- With respect to the window, balcony or fire escapes the aerial platform top rail should be placed even or slightly below window, fire escape and balcony railing. This will allow easier and safer access to victims and firefighters
Confined Space Rescue

- A confined space rescue is defined as an area that (3)
  1) Is large enough for an employee to bodily enter and perform work
  2) Has limited or restricted means of entry or exit
  3) Is not designed for continuous human occupancy

- Two Classes of Confined Spaces (2)
  1) A permit-required confined space is one that is immediately dangerous to life or health (IDLH) or may become IDLH.
  2) A non-permit confined space is a space which does not contain or, with respect to atmospheric hazards, have the potential to contain any hazard capable of causing death or serious physical harm.

➢ NOTE: All confined spaces must be considered IDLH until positively identified as otherwise.

- Hazardous atmospheres (3)
  1) Oxygen deficient atmosphere
  2) Flammable/Combustible gases or vapors
  3) Toxic gases or vapors

➢ NOTE: Monitoring of the atmosphere in a confined space must be done prior to entry and during the entire rescue operation.

- Scene preparation: Exclusionary Zone, Preferred ___ foot perimeter.

50

- The primary hazard to consider in a confined space is the potential for hazardous or ______ atmosphere.
  oxygen deficient

- Standard Collapse Rescue Plan
  1) Survey the site of collapse; determine potential dangers to rescue personnel. Request additional resources:
  2) Shut off all utilities which could injure trapped victims and rescuers.
  3) Search for and remove _____ victims first.
  4) Search all voids and spaces created by the collapse structure.
  5) Start selected debris removal digging to areas where victims could he trapped.
  6) Starr general debris removal to clear the entire collapse rubble

 CHAPTER 5 - LADDERS

STRATEGIC PRIORITIES

- Basic information in choosing ladder length:
  Residential occupancies are approximately ____ feet from floor to floor.
  Commercial occupancies are approximately 10 to 12 feet from floor to floor.
  The average windowsill height is approximately _____ feet above the floor.
  Windows are normally ______ feet high.

  Nine, three, four
• The base of the ladder should be placed one-fourth of the desired height of the raise. This ensures that the ladder will be at the proper climbing angle of ____ degrees.

70

TYPES OF LADDERS

➢ The 16-foot Straight Ladder will usually reach the roofs of most one-story residential buildings with a hip or gable roof.

➢ The 20-foot straight ladder will reach the roofs of most one-story residential buildings with flat roofs and parapets, most second-floor windows, and most of the lowest fire escape balconies.

➢ The 24-foot Straight Ladder will reach the roofs of most one-story residential buildings, some roofs of one-story commercial buildings, some roofs on two-story residential buildings with a hip or gable roof, second and third-floor windows, and most of the lowest fire escape balconies.

➢ The 35-foot Extension Ladder will reach the top of most two-story residential buildings, second-and third-floor windows and two-and some three-story fire escape balconies.

Aerial Ladders

• The main advantage of a ground ladder is its _______.

  portability

• The main disadvantages of ground ladders are their limited reach and the number of personnel required to raise them. Because of this, ground ladder operations become inefficient and time consuming when they are used for distances over _____ stories.

  three

STRATEGIC CONSIDERATIONS

Building Construction

• One of the best areas to place a ladder is as close to the _____ of the building as possible.

  corner

• Corners are considered an optimum placement area for ladder placement for the following reasons: (3)
  
  Horizontal openings - Windows, doors and vents are not usually found in corners.
  Strength - The strongest areas of a building are adjoining walls, hips and valleys.
  Location - When ventilation operations are complete, it is easy to find the ladder by looking at the corners.

• Exceptions to the advice on laddering corners: _____ building corners tend to be one of the weakest areas of the roof, due to lack of beams, purlins, and occasionally, even ledger plates.

  Tilt-ups
The four factors should be considered when a fascia is involved (4):

1) Overhang: Consider the distance a fascia extends from the building
2) Facial Height:
3) Supported or Unsupported
4) Height from Roof: How far does the fascia rise above the roof

TACTICAL CONSIDERATIONS

- When a ladder is placed at a window for rescue, the tip should be at or just below the level of the sill.

- If a ground ladder must be used on sloped footing, place it just above the level of the sill on the ______ side of the window.

- When an aerial ladder is placed at a window for rescue, the turntable should line up with the window and the ladder should be ________ to the building.

- The recommended distance of the aerial ladder from its objective is ____ to ____ inches.

- If a rescue is being performed, use the ____ -inch figure so that the ladder will rest against the windowsill after weight is placed on it.

> However, there is an exception to this recommended minimum distance: at very high angles, allow the ladder to just barely touch the building. This will prevent excessive movement when a crew member climbs to the higher elevations.

- When placing a ground ladder at the front or side railing of a balcony or fire escape, the top of the ladder should extend a maximum of ___ rung above the railing.

Ventilation

- The first ladder for ventilation should be placed on the same side of the building you plan to ventilate and at a corner away from the fire so crews can traverse the roof from the uninvolved portion to the involved portion of the building.

- When ladders are raised to the roof, they should extend a minimum of ____ to _____ rungs above the roofline or parapet.

- When requesting a second ladder, consider marking the location with a _____ to help ground crews find it. Each company should have its own ladder for access and emergency egress.
**Tilt-ups**
- Tilt ups: Consider placing the ladder to one side of a pilaster or cold joint. This results in a ___ percent chance of stepping on a beam or purlin, depending on the direction they run across the building.

  50

**Strip malls**
- Since most strip malls have fascias, place ladders to the sides or rear of the building, avoiding the fascias.

**Fascias**
- If you must ladder a building with a fascia, ladder the sides or rear of the building.

**Pitched or sloped roofs**
- Place ground or aerial ladders near or next to the section of roof to be ventilated

**Parapets**
- The base of roof ladders should be the first end carried up the ladder. This puts the ladder in position to be placed down the backside of the parapet.

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**CHAPTER 6 - VENTILATION**

- Studies have shown that only ___% of annual fire fatalities are actually burned. The remaining ___% mortality are victims of smoke inhalation.

  20, 80

- When analyzing the nation's fire loss, we find that less than ___ the loss is caused by the fire; the rest is a result of heat and smoke.

  one-half

- Ventilation is the planned and systemic direction and removal of smoke, heat, and fire gases from a structure

---

**PHYSICS OF FIRE**

- Building fires progress through three basic stages: (3)
  1) The incipient or beginning phase
  2) The steady state or free-burning phase
  3) The hot smoldering phase.

---

**THE INCIPIENT (BEGINNING) PHASE**

- In the incipient phase, the oxygen content in the air has not been depleted and remains about ___%.

  21
Some heat is being generated and the actual fire flame temperature can be above ____ degrees F. Yet the actual room temperature may be only slightly elevated based on the length of time the fire has been burning.

1,000

**STEADY STATE (OR FREE-BURNING) PHASE**

- This is the phase where there is adequate oxygen and fuel to sustain free-burning and fire growth to the point of full involvement. Oxygen-rich air is drawn into the fire. Heat rises to the uppermost reaches of the confined area and spreads out laterally from the top and then down. At this point the temperatures in the upper regions can exceed ____ degrees F

  1,300

- The following effects may be observed in Steady State:
  - High Oxygen
  - Full fire involvement
  - Thermally balanced

**MUSHROOMING**

- As smoke and gases are heated, they become lighter in weight and tend to rise. Cooler air is displaced down towards the fire, providing oxygen and sustaining combustion. As this process of circulation takes place, the heated gases and smoke build internal pressure that continues to rise to the highest point available and to spread laterally. This phenomenon is called "________." mushrooming

- A phenomenon called "rollover" takes place during the early stages of the free-burning phase.

- ________ occurs when super-heated gases pushed toward and along the ceiling mix with available oxygen and ignite, creating a fire front that rolls across the ceiling.

  Rollover

- The most direct way to stop the gases from feeding rollover is to extinguish the fire. However, in the interim, ____ ventilation in the proper location will reduce the chances of rollover

  vertical

- ________: Flame front rolls across ceiling and superheated vapors ignite

  Rollover

- Sometimes confused with rollover is the term "______" which is a simultaneous ignition over the surface of the entire room.

  Flashover

- Flashover occurs when the heat from the fire raises the temperature of the room and its contents to their ____ temperatures.

  ignition
• A flashover can usually be avoided by releasing heat with early and aggressive _____ ventilation and hose streams directed at both ceiling and contents.
  
  vertical

**HOT SMOLDERING PHASE**

• If the free-burning state remains unvented, the fire progresses to the hot smoldering phase with low oxygen levels, little to no flame production and temperatures in excess of _____ degrees F.
  
  1,000

• The room now begins to fill with dense black smoke to the extent that the area becomes pressurized and smoke is forced from all cracks. The intense heat continues to vaporize lighter fuels, and these gases greatly increase the chance of a ________.
  
  backdraft

  ➢ Prebackdraft
    - Low oxygen
    - High fuel
    - Smoldering fire
    - High fuel vapor concentrations

**BACKDRAFT**

➢ Firefighters responding to a fire that has progressed to the hot smoldering phase must consider the confined area is teeming with pressurized, heated, flammable gases; the introduction of oxygen to this fuel rich environment will result in an explosion of significant intensity.

• Proper _____ ventilation will release the heat and smoke and neutralize the hazard. Inappropriate _____ ventilation, such as through doors or windows, will supply the necessary oxygen for the backdraft explosion to occur with devastating speed.
  
  Vertical, horizontal

• ______ Signals: Dense black smoke becoming gray yellow smoke under pressure exiting from small openings. Little or no visible flame. Smoke appears to be breathing in and out of openings. Smoke stained, rattling windows muffled sounds.
  
  Backdraft

**CONVENTIONAL CONSTRUCTION**

➢ Conventional construction gets its strength from actual size or mass.

• Ridge beams are single members with conventional rafters running from ridge to top plate. Spacing is usually 16” to _____".
  
  24

  ➢ Conventional sheathing material is most commonly 1’ x 6’ laid at 90 degrees to support members and spaced for shingles, or laid at a 45 degree angle for support with no spacing.
Conventionally constructed commercial buildings built during the 1930's and 1940's commonly used truss construction. This type of construction used 2' x 12' lumber for the top and bottom chord with rafters 2' x 10'. This type of construction is very strong, and early structural collapse is not an immediate concern.

**LIGHTWEIGHT CONSTRUCTION**

- The four major types of lightweight roof construction(4)
  1. Panelized
  2. Open web truss
  3. Metal gusset plate truss
  4. Wooden "I" beam.

**METAL GUSSET PLATE TRUSSES**

- Metal Gusset Plate Trusses are commonly found in residential and commercial buildings. Usually 2" x 4" lumber butt jointed and held together by metal gusset plates, commonly known as a gang nail. The gang nail commonly penetrates ___ ".
  
  3/8

- Trusses are characterized by a top and bottom chord in tension and compression.

- The most common spacing for trusses is ___ ' on center and the point where the truss crosses the bearing wall is the strongest location.
  
  2

**WOODEN "I" BEAM**

- The ______ type of roof and sometimes floor system has a top and bottom chord of 2" x 3" or 2" x 4" lumber. The stem is normally 3/8" plywood or particleboard glued in place. Common spacing is 2' on center, and the area where the roof meets the exterior wall is the strongest location.
  
  Wooden "I" Beam

**OPEN WEB TRUSSES**

- Open Web Trusses have a wooden top and bottom chord that are cross-connected by ________ members. **The top chord is in compression and the bottom in tension.**
  
  steel tube web

- The steel tubes have the ends pressed flat in a semicircular shape with a hole punched through them. The top chord usually rests on the bearing wall and the bottom chord is unsupported. Spans of up to 70' are possible, normal spacing is 2' on center, and the area where the roof meets the ______ is the strongest point.
  
  exterior wall

- Direct flame exposure to Open Web Trusses chars to a depth of 1 inch in 45 minutes. Gang nails and stems are normally 3/8", it takes ___ minutes to Char to this depth. Roof failure will occur much sooner.
PANELIZED ROOFS

- The panelized roof normally consists of large laminated beams spaced every 12” to 40” spanning the length or width of the building. They are supported by pilasters or steel post on the ends.

- Panelized Roof Beams can span well over 100' and are often bolted together. Normally ____ are installed with metal hangers on 8’ centers perpendicular and between the beams.

  purlins

- Wooden 2" x 4" rafters are installed with metal hangers on 2' centers, perpendicular to and between the purlins. Decking is usually ___" plywood.

  1/2

- The safest and strongest locations are the beams, ____ and perimeter of the building. The inherent weakness is the lightweight construction between the major framing members.

  purlins

ROOF STYLES:

- There are three basic categories of roof design(3)

  pitched roofs, arched roofs and flat roofs.

PITCHED ROOF STYLES

- Pitched Roof Styles: Gable, hip, shed, bridge truss, mansard, lantern, sawtooth, gambrel and butterfly.

- ______: Basic A-frame design with the roof pitched in two opposing planes. If constructed in a conventional manner, the continuous ridge, exterior and bearing walls are normally safest locations.

  Gable

- ______: Two sets of opposing pitches where the roof slopes down to meet every outside wall. Strengths lie at the ridges, valley rafters and at the point where the rafters cross the outside walls. Weaknesses are the same as a gable when in the lightweight version.

  Hip

- ______: Basically this style is half a gable. The weakness here is the mono-pitched truss with a single web member subject to early collapse.

  Shed

- _____: This is heavy duty trussing with sloping ends. The two parallel chords are in constant tension and compression and can fail during heavy fire exposure. This roof usually fails in sections and may have a large open attic space.

  Bridge Truss
• ____: This roof has a double slope on each of its four sides. The lower slope is steeper than the upper slope. The four sides meet in the middle in a hipped peak/ridge. If it is a more modern version, the sides form a central flat area. This type of roof is usually bridge truss construction and creates large dead spaces and a potential for early collapse.

_Mansard_

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<th>ARCHED ROOF STYLES:</th>
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<td>Arched Roof Styles: Ribbed truss, bowstring truss and lamella styles.</td>
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• ____: The arched chords are usually 2"x 12" lumber with 2" x 10" rafters. Tie rods with turnbuckles are used for lateral support and to regulate tension. The roof is quite strong but sudden collapse can occur if the tie rods are heated to failure.

_Bowstring_

• ____: Construction is similar to the bridge truss except that the top chord is arched. The heavy timber is very fire resistant but is open with no attic to protect the framing.

_Ribbed Arch_

• ____: A geometric egg crate or diamond pattern frame with sheathing laid over it. The 2" x 12" members are bolted together with gusset plates. The roof is supported by exterior buttresses or internal tie rods.

_Lamella Roof_

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<th>THE FLAT ROOF:</th>
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<td>Conventional flat roofs are constructed with rafters 2&quot; x 6&quot; or larger depending upon the span. Rafters are covered with 1&quot; x 6&quot; sheathing often laid at 45 degrees to the outside walls. The perimeter of the building where the rafters rest on the exterior wall is considered a strength. Due to mass, rafters are also considered safe locations.</td>
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<tr>
<th>STRATEGIC CONSIDERATIONS</th>
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<tr>
<td>Normally the most effective vertical ventilation is a ____ hole cut directly over the area of fire involvement. heat</td>
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<td>When the fire is contained within the room or area of origin and has not yet spread to the overhead or attic spaces, use of ____ ventilation causes needless damage. vertical</td>
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<td>Normal pitched residential roof work can easily be accomplished using two men, freeing the other truck company members for other tasks.</td>
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</table>

2008 © TIM FORDHAM
When dealing with high-rise ventilation, be prepared to allocate four to six times the manpower normally assigned to ventilation work.

**DIAGNOSTIC METHODS: INDICATOR HOLE**

- One of the first diagnostic methods is the indicator hole. This can be a saw's kerf cut, the hole from the blade or pickhead of the axe, or a small triangular hole made with an axe or saw to provide a first look at fire intensity and construction.

**THE INSPECTION CUT**

- In the approximate area being considered for ventilation, the ventilation group should initiate an inspection cut. Even when you are positive of rafter direction, you still have to determine the type of construction and have a firm understanding of the fire's intensity in the rafter or truss area.

- The inspection Cut is made at 45 degrees to the outside walls, continuing until the cut intersects a framing member and then continues at least one more foot.

- The optimum size inspection hole would have cuts about two feet long.

- The normal progression for cutting the roof starts with an indicator hole. Next comes the inspection cut optimally in a location suitable for the final hole. The procedure is completed by expanding the inspection cut to create the hole and safely ventilate the structure.

**CUTTING METHODS: THE HEAT HOLE**

**NOTE: SEE TRUCK MANUAL FOR A DETAILED DISCRIPTION OF EACH CUTTING METHOD IF INTERESTED**

- Generally speaking, the heat hole would optimally be placed as close to the seat of the fire as possible.

- There are several ways to approach cutting the heat hole. One of the fastest ways is the DICING technique. Dicing is recommended for use on conventional pitched roofs with 1" x 6" sheathing.

- Another commonly used method of quickly executing a heat hole is the use of the LOUVERING technique. Louvering is effectively used on sheathing and is virtually mandatory on plywood decking when the decision has been made to use vertical ventilation.

- Another quick method of ventilating a pitched roof with sheathing commonly found on dwellings is the PULL-BACK METHOD. This method is limited to sheathing.
When dealing with a panelized roof consider the use of the DROP PANEL METHOD. The concept is to make three cuts creating a rectangular hole with the cut piece breaking or falling into the building.

There are times when the risk of placing a heat hole directly over the fire is too great and the fire's progress horizontally needs to be controlled. In this situation, the use of the _______ or __________ is recommended.

STRIP OR TRENCH VENTILATION METHOD

The fastest STRIP CUT utilizes the _______ TECHNIQUE when operating with the construction.

BETWEEN THE RAFTERS

Another method of producing a STRIP CUT when operating with the construction is by the use of the CENTER RAFTER TECHNIQUE.

The size of the hole. The rough rule of thumb is: In square feet, make the hole no less than ____ percent of the building area involved.

ten

After cutting the desired hole, you should evaluate effectiveness. If after fifteen to thirty seconds the intensity and pressure do not subside, consideration should be given to enlarging the hole or strategically cutting another.

Selection of the vent site has a specific relationship to the fire and none to the pitch of the roof

TACTICAL CONSIDERATIONS AND METHODS-POSITIVE PRESSURE VENTILATION

Probably the most effective method of forced ventilation is now most often called _______ or PPV.

positive pressure ventilation,

Positive pressure ventilation is basically the introduction of fresh air into a building at a rate faster than it can exit. This creates a higher pressure within the confined area overcoming the pressures created by the fire.

With few exceptions, the PPV process can be started as soon as attack lines are charged and ready to advance.

When setting up for PPV, the exhaust openings are most efficient when they are ___ to ___ percent of the entrance openings for standard three to five horsepower blowers.

75, 150

As the blower horsepower increases, or you are using multiple blowers in line, the exit openings increase to a range of ____to ____ percent of the entrance opening.

100, 175

When positioning blowers, the cone of pressurized air should be placed so the cone just covers the entrance opening. The blower will normally be tilted ____ to ____ degrees with smaller blowers necessarily closer to the opening.

20, 30
• When using multiple blowers, place the ______ capacity unit closest to the opening, about two feet away. The smaller capacity blower is placed behind the larger unit and is positioned so that its cone of air will seal the opening. This will increase the effectiveness about ____ percent.

largest, ten

• Multiple-story ventilation problems are normally solved by starting at the ____ level and ventilating towards the top.

lowest

• When using the horizontal approach on a high rise fire, windows should be opened on the ____ of the high-rise structure. There is a slight reduction of air pressure on the lee side caused by the prevailing wind.

lee side

➢ When ventilating vertically, the ventilation group will generally be more efficient when channeling smoke by beginning the routing process at the top, working down to provide a clear path for heat and smoke to exit when the fire floor is finally opened and either natural air flow or pressure is applied.

CONSIDERATIONS

• The single most dangerous task the average firefighter performs on a routine basis is that of ______

topside ventilation.

• When considering operating on the roof, the ventilation group commander’s first question will be the elapsed ______

Burn time

• Ventilation groups should vigorously sound the roof using a wide pattern that will provide for a ___’ to ___’ path of safe travel area.

2’ to 3’

➢ If the fire has vented itself prior to our arrival, the deployment of a topside ventilation group for heat hole purposes would be an inappropriate risk of personnel.

• Saw operation teams on the roof always require a minimum of ___ men.

two

➢ Again, considering time as the priority factor, the vent group should not be required to take a hose line. If the need presents itself, an additional company should be assigned the task of supplying one to the vent group.

CHAPTER 7 - UTILITIES

ELECTRICAL UTILITIES: STRATEGIC PRIORITIES

➢ Amperage measures the quantity of electrons that are moving through a conductor in one second. The flow of electrons (amps) is comparable to the flow of water (gpm)
Voltage refers to the property of electricity that is responsible for moving electrons through a conductor. Voltage can be compared to pressure used to move water.

**Transmission of Electricity**

- Transmission lines carry ______ to 1 million volts to receiving stations
  
  115,000

- Sub-transmission lines travel from a receiving station to consumers or a distribution station at ____ volts.
  
  34,500

- Primary distribution lines send ____ volts to consumers or are stepped down in voltage for other use
  
  48,000

- Secondary distribution lines carry 480/240/120 volts to consumers

**TACTICAL CONSIDERATIONS**

**Determining the voltage**

- The best method to determine the voltage of a conductor is to consider the ____ of insulators and the distance between them
  
  size

- Sub-transformers are not mounted on a single pole. They have _____ volts on the primary side and secondary voltages of 4,800, 480, or 240 volts.

  34,500

- Primary Distribution Transformers are mounted on a single pole, With _____ volts on the primary side and secondary voltages of 480, 240, or 120 volts

  4,800

- Shutoffs: If a panel is easily accessible, shut off the branch, Circuits first, then the main Circuit breaker.

- When cutting drip loops make cuts toward the source of power by cutting the _____ wire first, then stagger cuts farthest

- Small Commercial Occupancies Overhead Service -Two-wire, open configuration, normally 20 volts -Three-wire, open or triplex configuration, normally ____ volts

  240

- Commercial/Industrial Occupancies voltages can vary from 110 to 34,500 (Triplex or Quadraflex)

- During Emergency Operations - Service over ____ volts should be shut off by utility company

  750
- Emergency Operations – Do not enter high voltage electrical rooms

- Transmission Towers carry between 138,000 and 1,000,000 volts. Each tower has an identification number

• Emergency Operations - Transformers can explode and burn PCBs may be present. - If necessary, use water in a ____ pattern
  spray

• Street Electrical Vaults may carry between 4,800 and 34,500 volts. An electrical vault can be identified by its ______ manhole cover.
  square

- Emergency Operations Electrical Vaults
  - Establish a safe perimeter.
  - Do not attempt to remove the cover if smoke is showing.
  - Do not put water in a manhole or enter until safety is confirmed

- Street lights may be high or low voltage

• Traffic Lights normally operate on ____ volts
  240

- Telephone Lines: Voltage vary from 45 to 90 volts. Consider wires to be no less than 110 volts

• Hose Stream on Energized Vehicle: Water in a ____ pattern provides resistance to the flow of electricity
  fog

**NATURAL GAS UTILITIES: STRATEGIC PRIORITIES**

- Pure natural gas is odorless. Manufacturers add thiophene to aid in leak detection. Natural gas is non-toxic, lighter than air, and colorless.

• Natural gas has an ignition temperature of ____ degrees F. and a flammable range of between four and ____ percent.
  100, 14

• Natural gas is distributed by transmission lines, under pressures of up to ____ pounds.
  1,000

• Natural gas is distributed by transmission lines and distribution mains. Transmission lines vary in size between 12 and ____ inches, with pressures up to 1,000 psi.
  36

• The distribution mains that distribute gas to customers do not maintain pressures over ____ psi.
  60
• Natural gas is delivered to appliances by a low pressure (about ___ psi) customer line inside the structure.

1/3

• Gas companies refer to gas meters as "_______ (MSAs)"

meter set assemblies

• A basic MSA consists of piping, shutoff valve (or ____), regulator, and gas meter.

Stopcock

• The pipe rising vertically from the ground close to the exterior wall of the structure is called a "____"

riser

➢ Residential MSA Components
  Shut –off
  Flat washer
  Riser
  Regulator
  Gas Metter

• Tracking the riser up from the ground, the first fitting is the shutoff valve/stopcock/service cock. It has the following characteristics:
  A ______ indicates a plastic line in metal pipe
  A ____ indicates branch service
  A band indicates, a ____ service line

  flat washer
  ring
  plastic

• Regulators reduce gas pressure to _____ PSI

  one-third

• Branch Service: In some commercial areas, multiple structures may be served by a single service pipe called a "_______ ". It is supplied by a gas main

  standard service

➢ The occupancy that is farther from the supply main is a standard service; the other occupancies are branch services.

• A ____ or _____ ring around a shutoff valve indicates that the building is a branch service

  Metal
  plastic
TACTICAL CONSIDERATIONS: TURNING OFF THE GAS

- The most direct method of shutting off gas to a structure is to turn off the flow of gas at a shutoff valve. A basic shutoff valve consists of (4):
  1) a casing
  2) internal core
  3) tang
  4) backing nut

RESIDENTIAL

- Residential Shut off - Turn the tang crosswise toward the pipe a quarter turn

- Gas shut off
  ______ Valve: This valve will only turn one eighth turn in either direction
  ______ Valve – Turn handle clockwise several revolutions to shut off the flow of gas
  ______ Valve – Lift the lid and turn the handle clockwise to stop the flow of gas

  Nordstrom
  Gate
  Curb

- Leaks Inside avoid using electrical switches

OUTSIDE LEAKS (no fire)

- Bright _____ or ____ pipes can be pinched off
  Orange, pink

- Do not bend back plastic pipes

- Redwood plugs can be used on ____ pipes
  steel

- When a meter has been damaged, check the riser for a bright yellow pipe. Some of these pipes may contain ____.
  PCBs

- Gas traveling through a pipe can create static electricity. Use a ____ pattern on pipes to reduce this hazard
  fog

LEAKS WITH FIRE

- Generally, let the fire burn. Small fires may be extinguished with ____ or ____ extinguishers
  CO, dry chemical
WATER SERVICE STRATEGIC PRIORITIES

- A combination of supply and distribution systems provide water for domestic use and fire protection devices
  - **Supply Systems**
    - Gravity (from lakes and reservoirs)
    - Pump
  - **Distribution Systems**
    - A combination of gravity and pumps
    - Pipes within this distribution system can be classified as Trunk Lines

- Truck Lines—carry water from a primary source to distribution systems. Mains vary in size between two and ___ inches
  
  72

- A typical **domestic water service** consists of piping, water meter, shutoff valve(s), and pressure reducing valve.

- A typical **fire protection system** consists of piping, detector check valves, and shutoff valves

- Types of Shutoff valves (4)
  1) Non-indicating
  2) Ball or cone
  3) Gate type
  4) Indicating-type valve

SINGLE FAMILY DWELLING

- Single family Dwelling Water service will normally consist of
  - One-half to two-inch water meter
  - Shutoffs on one or both sides of the meter
  - Pressure-reducing valve

COMMERCIAL INDUSTRIAL

- Commercial Industrial
  - One-to two-inch water meter for domestic water, and two-to four-inch detector check valve for fire protection
  - Shutoffs are normally adjacent to meters and detector check valves

HIGHRISES

- Highrisers
  - Four to 10 inch meters
  - Four to 12 inch detector check valves
  - Shutoffs adjacent to meters and detector check valves
  - Shutoffs adjacent to meters and detector check valves
  - PIV’s are almost always present

TACTICAL CONSIDERATIONS

- Three-quarters to One-inch Service: Shutoffs are usually adjacent to a water meter. Turn shutoffs ___ degrees to stop the flow of water.
  
  90
• To stop the flow of water four-inch lines and larger, gate valves should be turned ____; OS&Y valves should be turned ________

Clockwise, counterclockwise

• Fire Protection Services: Closing the following outside valves will eliminate the flow of water past that point, and to the fire protection system inside: (3)

1) - PIVs
2) - Gate valves
3) - OS&Y valves (After closing, open the drain valve.)

• A color code has been adopted nationally to aid in identifying utilities:

- ____ power
- ____ telecommunications
- ____ sewers and drains
- ____ water
- ____ gas

Red, Orange, Green, Blue, Yellow

CHAPTER 8 - SALVAGE

• It is estimated that ______ percent of total fire loss is created during extinguishing operations and other events occurring after the fire, (Indirect damage). ___ percent represents the loss actually caused by the fire, (Direct damage).

75, 25

➢ Effective salvage = good public relations

STRATEGIC PRIORITIES

➢ Occupancy

Residential -- Start with irreplaceable personal belongings such as family photographs and other sentimental items
Commercial -- Give priority to any bookkeeping materials and other records including computers, then merchandise
Industrial -- Consider records first. Then pay attention to any valuable machinery and raw materials.

TACTICAL CONSIDERATIONS

➢ Controlled damage at the scene of an incident is the goal of salvage.

➢ Although traditional salvage covers continue to prove invaluable in fire, heat or other specialty situations, plastic should be given **strong** consideration in the following situations:

- As an additional vapor barrier under a salvage cover.
- If the area to be covered is in excess of a standard 12 x 18 foot salvage cover.
- Valuables will require covering for an extended period of time.
- If covers were used initially they can be replaced with plastic prior to leaving the scene.
- If covering for water protection on 1-100r(s) below an incident.
- Limited manpower.
SUMMARY

- ____ percent of fire loss is indirect, and salvage is a vary important fire department operation. Salvage should be a concern during every phase of the incident, from forcible entry to overhaul.

75

CHAPTER 9 - OVERHAUL

- Overhaul involves searching for and extinguishing any hidden, remaining fire and making sure that the building, its contents and the fire area are in safe condition. It also encompasses fire cause determination and recognizing and preserving any evidence of arson.

- Overhaul shall involve the implementation of a plan that will evaluate the following:
  - Structural integrity
  - Firefighter safety
  - Proper levels of protective equipment
  - Hazardous areas
  - Timely rotation and relief of crews
  - Company unity

TACTICAL CONSIDERATIONS

- Levels of carbon monoxide can be monitored by utilizing the carbon monoxide field monitors carried on all battalion vehicles. Exposure to levels of carbon monoxide above ____ppm can be hazardous.

100

- The determination to remove self contained breathing apparatus shall be the decision of the Incident Commander

EXTINGUISHMENT

- The overhaul operation should be conducted systematically, working away from the point of origin.

- Any area that has been exposed to fire or that shows possible signs of heat transfer i.e, blistering, discoloration, surfaces that are hot to touch or that have vertical streaks near baseboards or door casings should be exposed.

- Areas directly above the main portion of a fire should be thoroughly inspected for fire extension. Focus on the walls-especially if you are dealing with balloon construction--the plate, bottom portions of walls and floors, as they provide excellent avenues for extension

- ____ saws are more efficient for opening lath and plaster materials, as they do less physical damage

Power

- Plaster walls are cut with the blade of the axe on top of the studs vs. inside the studs. This eliminates further damage to the plaster.

- The ______ is recommended for pulling drywall ceilings. It is more effective and requires less effort than a pike pole.

rubbish hook
Ares involving doorways, windows and baseboards should have their casings and moldings pried away exposing the area directly behind, especially when indications warrant it.

CHAPTER 10 - EXTRICATION

- The patient has the most optimal chance for survival and recovery if he or she is delivered to a trauma facility within an hour of injury,—the so-called "_______"

    Golden Hour

STRATEGIC PRIORITIES

Size-Up: The following is a chronological list of extrication activities:
- First-in company establishes command of the scene.
- Hazard control and scene stabilization
- Gain access. Get to the victims
- Perform patient assessment and care
- Disentanglement. Either take the victim from the wreck or the wreck from the victim
- Patient handling and transportation. Do what is best for the victim
- Equipment replacement
- Critique

TACTICAL CONSIDERATIONS

- During extrication, if possible, all personnel at the scene should be in full protective gear before beginning extrication. A 1-3/4-inch charged hoseline should be manned with a _______ extinguisher on hand.

    dry chemical

TACTICAL CONSIDERATION

- The pin and locking mechanisms are the targets when opening a car door. Once the door starts to separate from the frame, concentrate the pressure of the tool between the two: "Go for the pin." The tool will force the locking mechanism away from the pin and the door will pop open.

Pulling a Steering Column

- Of all the basic tool operations discussed in this section of the manual, pulling a steering column is by far the most dangerous.

- The “Traditional” method of placing the power tool on top of the hood and using the chains to pull the steering column has been used for many years. When performing this method of extrication, a minimum safety zone of ___to ___feet around the vehicle should be maintained at all times.

    20 to 25

- When pulling a steering column during auto extrication the _____ method involves pulling the steering column up and away from the patient instead of through the dash.

    Dade County
- Rescuers are beginning to experience problems when moving the steering columns in front-wheel drive vehicles. While being pulled, these columns can snap in two, injuring both victim and rescuers. The ______ technique was developed to deal with this hazard. It attempts to open up the vehicle like a clam between the A and B posts, thereby moving the steering column and dashboard off the victim(s).

  clamshell

- The clamshell technique works best with smaller, late-model cars and trucks that are made of lightweight metals and plastics. Older, larger "Sherman Tank" type vehicles make it nearly impossible to perform this technique.

- When access to the victim(s) is limited due to damage to the vehicle, removing the roof can be a quick, relatively simple way to provide access. In fact, removing the roof of a damaged car with multiple victims should be a normal practice for all rescue companies.