NKCTC Firefighter Fundamentals

July 2020

North King County Training Consortium

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HAND TOOLS

Alan wrench set/Hex key/ Allen key: A tool with a hexagonal cross-section used to drive bolts and screws that have a hexagonal socket in the head (internal wrenching hexagon drive). They may be either American or Metric sizes.

AXES

Pick Head Axe: Comes with a 28-36" fiberglass handle with a 6-8 lb. axe head on one side and a pick head on the other. This is an excellent prying tool when the pick end is engaged. The blade side of the head is effective for cutting through wood, siding, and other natural lightweight materials.

Flat-Head Axe: The flat head axe also cuts through a variety of natural materials. When paired with a prying tool, the flat head axe becomes a vital addition to the forcible entry team because the flat head can be used as a striking tool.

Long arching swings should not be used with axes. This method increases the danger of hitting other members or overhead obstructions. Due to the grain of the wooden handle of an axe, the strongest axis when using the axe to pry is in line with the head or pick of the axe. Care must be used when prying in the direction of either side of the head of the axe.

Pry Axe: The pry axe has features not normally found on traditional rescue tools. The head of the tool has a shortened pick head axe with serrated teeth on the underside of the axe head. The handle has a slide feature that allows the user to extend the length of the tool to provide increased leverage. The slide handle can be completely removed from the tool and repositioned in the side of the axe head. This allows the tool to be leveraged from a different angle, much like the adz-type end of the Halligan tool. The end of the handle

also has a feature to allow the tool to cut through lightweight sheet metal.

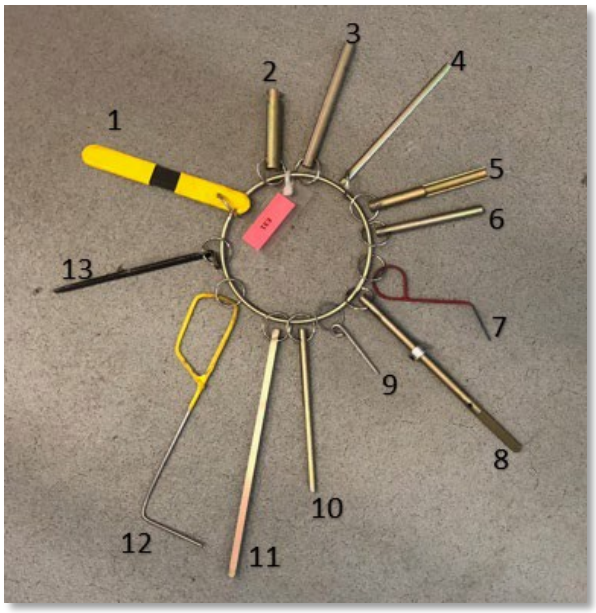
Pulaski: A special hand tool used in wildland firefighting. The tool combines an axe and an adz in one head, similar to that of the cutter mattock, with a rigid handle of wood, plastic, or fiberglass. The Pulaski is a versatile tool for constructing firebreaks.

Battery Cable Cutters: A type of plier used to cut copper battery and aluminum electrical cable. The tip of the cutters has a curved design to help pull the cable into the cutting blade as force is applied. This type of cutter cuts by creating a shearing force to cut multiple strands of cables.

Bolt Cutters: A tool used for cutting chains, padlocks (that are NOT case hardened), bolts, rebar, and wire mesh. It has long handles and short blades, with compound hinges to maximize leverage and cutting force.

Circuit Tester: The two-lead circuit tester is used to test for the presence of electrical current. When you touch a live hot wire with one lead and a neutral (white) or ground (green or bare copper) with the other, the neon test lamp should light. It confirms that the power is on and that you have a complete (good) circuit. If the light doesn't come on, either the power is off or you have a bad circuit.

Elevator Key (Drop Keys): All hoist-way door unlocking devices. These allow elevator personnel and emergency personnel to open elevator doors by hand.



1. Shove Knife
2. Side Exit Key
3. Half Moon Key (Large)
4. Fluted Knife Key
5. Half Moon Key (Small)
6. Swing Door Key
7. Volt Resistant Key (5000 Volt Resistance)
8. Adjustable Drop Key
9. Pin key
10. "T" Style Rib Key
11. Square Key
12. "Z" Key
13. Kerry Key

Fire Extinguishers

Dry Chemical: Used to extinguish class A, B, and C fires. Filled with Monoammonium Phosphate and Ammonium Sulfate (similar to baking soda).

Water Extinguisher: Filled with a mixture of water and surfactant (like dish soap or AFFF Foam).

CO2: Used to extinguish fires where Dry Chemical and Water may damage property (most suitable for Class C fires)

Hammer: A tool that used to strike an object. The most common uses for hammers are to drive nails. Hammers vary in shape, size, and structure, depending on their designed use. A hammer is composed of a head (most often made of steel) and a handle made of wood, fiberglass or steel.

Halligan Tool: A tool which has additional specialized features for forcible entry outside of simple pry or wrecking bars. The Halligan tool has an adz-type end for prying or gaining a purchase point, a fork end which is useful in prying nail, bolts, and lock hasps, a pike end which can be levered or twisted to break an objective, and a flat surface which can be hammered against.

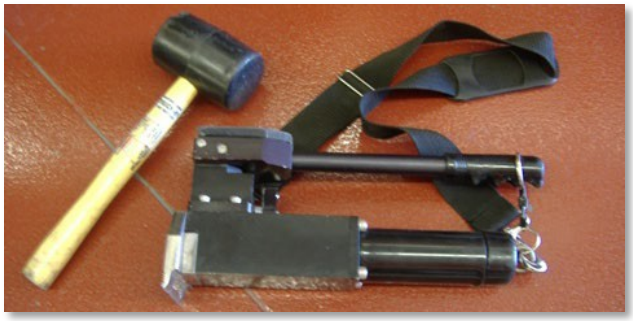
Hay Hook: A hand tool that is used for securing and moving loads. It is commonly used in the fire service for moving burning mattresses. It consists of a round wooden handle with a strong metal hook about 8" long projecting at a right angle from the center of the handle. The appliance is held in a closed fist.

High-Lift Jack: The high-lift Jack is designed for heavy lifting and winching. It has a rated lifting capacity of 4,660 lbs. and when used as a winch, the top clamp will support up to 5,000 lbs. As with the portable hydraulic jack, any kind of jack should have a flat, level footing and should be used in conjunction with cribbing. On a soft surface, a flat board or steel plate with wood on top should be placed under the jack to distribute the force placed on the jack.

Hammer Stapler or Hammer Tacker: A very simple device that has an approximately 12" handle and a head which, when it comes into contact at high speed with a hard material, inserts a staple. The hammer tacker is swung like a hammer to apply staples.

Homaltro: Primarily used for automobile extrication prior to ladder company arrival. Also a useful tool for spreading (11,690 lbs. max) or cutting (49,000 lbs. max) many items and materials.

Hydra Ram (Rabbit Tool): The Rabbit Tool is a handheld, manually operated hydraulic tool that exerts a tremendous amount of outward pressure that forces inward swinging doors. The tool consists of a set of



jaws with opposing tips that are beveled for ease in placing them between the door and frame. The wonder bar and mallet can be used to gain advantage point for the jaws. When the tool is pumped, the two interlocking jaws can exert a force of 10,000 lbs. per square inch, far greater than can be accomplished by muscle and leverage. Most units will feature one side of the tool moving while the base section serves as the anchor point. Pressure in the unit is relieved by means of a screw type relief valve on the hand pump. When unscrewed, the jaws return to the closed or neutral position. The stronger the door and frame, the better the tool works.

Irons: Irons are two very effective forcible entry tools which have been strapped together for ease of carrying and convenience. The Halligan tool can be wedged or purchased into an objective, then the flat head axe can be hammered against the flat surface of the Halligan to gain a better advantage in leveraging. A wood or aluminum wedge or tip of the axe can be used to keep a gap open as you adjust the location of the Halligan.

K-Tool: A tool designed for pulling lock cylinders limited to low profile mortise and rim locks.

Knox FDC Key: Used to lock and unlock a locking FDC plug or cap.

Lathe and Plastic (Visqueen): Forcible entry and ventilation operations can leave a building exposed to the weather. Six (6) mm plastic, 12 feet wide, folded into a 36" wide roll, 100 feet in length can be used in any situation where protection from smoke, water or air currents are needed.

Lathe is a wooden strip 48" x 1½" x ¼". Roll lathe into the ends of the plastic sheet and nail the rolled lathe (top piece first) to the outside of the building, if possible. A utility knife is usually located close to the rolled plastic for ease of cutting.

Mallet: A kind of hammer often made of rubber, plastic, or sometimes wood that is smaller than a maul. Rubber mallets are used when a softer blow is required. They are typically used to form sheet metal since they don't leave marks and are softer, as well as for forcing tight fitting parts together. (Note: Dead Blow Mallets contain sand in the mallet head to reduce recoil.)

Nut driver: A tool for tightening nuts and bolts. It essentially consists of a socket attached to a shaft and cylindrical handle and is similar in appearance and use to a

screwdriver. They are typically used for lower torque applications. A spinner handle is a shaft and handle with a drive fitting, most commonly ¼", at the end for attaching interchangeable sockets. This allows one to use a single handle with a number of different sizes.

McLeod: A rake with a two-sided blade on a long wooden-handle. It is a standard tool used for wildfire suppression. A combination tool with a large hoe-like blade on one side and a tined blade on the other, the McLeod was designed to rake fire lines with the teeth and cut branches and sod with the sharpened hoe edge.

New York/Roof Hook: This tool is also a product of Chief Halligan and was originally called the Halligan Hook. The "New York Hook" made of tubular steel construction is a force multiplier. Every pitch and facet of this tool has a purpose. It has a forged fulcrum designed to maximize the energy you deliver in your roof duties. This is not a pike pole; it is a pry tool. It can also be used with the Halligan bar for added leverage.

Officer Tool:

Pike Poles: Pike poles have a variety of uses on the emergency scene. Pike poles can be used to strip roofing in much the same way a pick head axe is used. The hook is inserted into the head cut and the roofing is pulled back. Pike poles have longer handles than axes, and their length allows firefighters to position themselves farther away from the point where heat, smoke, and perhaps fire may be issuing from. Also, if there is a ceiling below the roof, its removal will be necessary in order to release the products of combustion. The handle of the pike pole is an excellent tool for this purpose. Lengths of pike poles vary as well as the presence of a "D" handle.

Pliers: A hand tool used to hold objects firmly, and also useful for bending and compressing a wide range of materials.

Diagonal Pliers (or Wire Cutters, Diagonal Cutting Plier, Diagonal Cutters, or Dikes): Pliers intended for cutting wire (they are generally not used to grab or turn an object). The plane defined by the cutting edges of the jaws intersects the joint rivet at an angle or "on a diagonal," hence the

name. These cutters use a crushing force to cut the wire. Typically used for smaller wires.

Lineman's Pliers: Pliers used by electricians primarily for gripping, twisting, bending, and cutting wire and cable. Lineman's pliers have a gripping joint at the snub nose and cutting edge in the craw. Some versions include either an additional gripping or crimping device at the crux of the handle side of the pliers' joint.

Locking Pliers (Vise-Grips): Pliers that can be locked into position, using an over-center action. One side of the handle includes a bolt that is used to adjust the spacing of the jaws; the other side of the handle (especially in larger models) often includes a lever to push the two sides of the handles apart to unlock the pliers. Locking pliers are available in many different configurations and sizes, examples include: needle-nose locking pliers, locking wrenches, locking clamps, and various shapes to fix metal parts for welding.

Slip-Joint Pliers (Channel Locks): Water pump pliers (large pliers), tongue-and-groove pliers, also known as adjustable pliers, groove-joint pliers, arc-joint pliers, multi- grips, tap or pipe spanners and Channel locks, are a type of slip-joint pliers. They have serrated jaws generally set 45 to 60 degrees from the handles. The lower jaw can be moved to a number of positions by sliding along a tracking section under the upper jaw. An advantage of this design is that the pliers can adjust to a number of sizes without the distance in the handle growing wider. These pliers often have long handles, commonly 9½ to 12" long, for increased leverage.

Common Pliers: Commonly used for turning and holding nuts and bolts, gripping irregularly shaped objects, and clamping materials.

Portable Jack (Bottle Jack): The hydraulic jack is designed for heavy lifting applications. It is also an excellent compression device for shoring or stabilizing operations. Any kind of jack, hydraulic or otherwise, should have a flat, level footing and should be used in conjunction with cribbing. On a soft surface, a flat board or steel plate with wood on top should be placed under the jack to distribute the force placed on the jack. Lifting capacities vary depending on jack used.

Pry Bars: Pry bars come in various lengths and sizes. Generally used as levers for mechanical advantage. For example, one 6 foot pry bar can get you 5:1 mechanical advantage. If 100 lbs. were placed on the handle, you would get 500 lbs. of force on the other end, assuming the fulcrum point is 1 foot away from the load.

Push Broom and Broom: A cleaning tool consisting of usually stiff fibers (often made of materials such as plastic, hair, or corn husks) attached to a broomstick or handle.

Rabbit Tool: See Hydra Ram.

Rescue 42:

Rubbish Hook: The rubbish hook is an example of a tool in the push/pull category. The rubbish hook has limited use in forcible entry but in certain instances, such as breaking window glass, opening walls or ceilings, or louvering roof sheeting after a ventilation operation, they are the tool of choice. The rubbish hook has twin 6.5" long pins that are 6" apart. Tool length and "D" handle differ with different tools.

SAWS

Drywall Saw or Keyhole Saw: Also called a pad saw, alligator saw, or jab saw, this is a long, narrow saw used for cutting small, often awkward features in various building materials. There are typically two varieties of keyhole saw: the fixed blade type and retractable blade type.

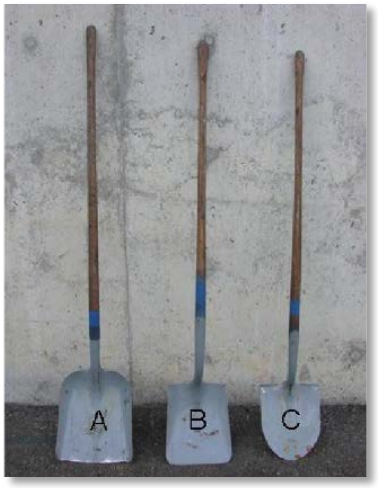
The cheaper fixed blade type is more commonly used in the modern construction trade. With the advance of certain building methods and materials, designs specific to these trades have been developed. One such modification being a sharpened point at the tip of the blade which can be pushed or jabbed through soft materials such as drywall without drilling a hole for the blade.

Hacksaw: A fine-toothed saw, originally and principally designed for cutting metal. Most hacksaws are hand saws with a C-shaped frame that holds a blade under tension. Such hacksaws have a handle, usually a pistol grip, with pins for attaching a narrow disposable blade. The frames may also be adjustable to accommodate blades of different sizes. A screw or other mechanism is used to put the thin blade under tension.

On hacksaws, as with most frame saws, the blade can be mounted with the teeth facing toward or away from the handle, resulting in cutting action on either the push or pull stroke.

Screwdrivers: Classified by the tip, which is shaped to fit the driving surface (slot, groove, or recess) of the corresponding screw head. Proper use requires the screwdriver's tip to engage the head of a screw with a snug fit. Screwdriver tips are available in a wide variety of types and sizes. The two most common types are the simple "blade" type (standard) for slotted screws, and the Phillips type for a screw head that has a crossing configuration.

Shovels: Hand tools consisting of a broad blade fixed to a medium length handle. Shovel blades are usually made of sheet steel or hard plastics and are very strong. Shovel handles are usually made of wood or fiberglass.



Scoop: Scoop shovels (A) are used for spreading and removing lightweight materials, carrying debris and digging in loose bulky material.

Square Point: Square Point shovels (B) are best used on flat surfaces during overhaul operations when moving loose debris.

Round Point: Round Point shovels (C) are designed for digging. They are considered to be an effective tool for use in fighting brush and grass fires.

Sledge Hammer: This is a very versatile tool on the fire ground and is primarily a striking tool. It comes with a 28-36" fiberglass handle with a 6-10 lb. head.

Squeegee: Squeegees are used during salvage operations to remove liquids. There are three types:

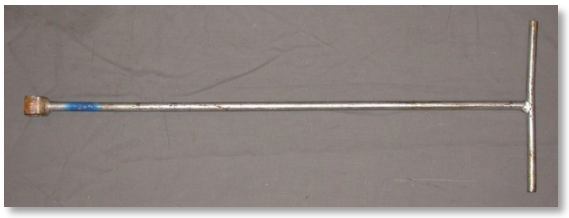
1. A 36" curved type is used only to push fluids.
2. A 24" straight type that can be used to push or pull water.
3. A 28" with curved edges that can be used primarily to push water.

Staple Gun: A hand-held tool used to drive heavy metal staples into wood, plastic, or masonry. Staple guns are used for many different applications to affix a variety of materials, such as Visqueen, to a surface.

Tool Box: Ordinary tool box with a variety of common hand tools which may include:

- Hammer
- Battery terminal puller
- Adjustable wrench
- Screwdrivers
- Pliers, wire cutters
- Strip caulk
- Gas locks and key
- Electrical tape
- Open end wrenches
- Center punch

Utility (Gas) Key: Specialized tool with one primary purpose - shutting off natural gas at the meter. The end of the tool is open to give the firefighter the ability of applying the tool in multiple angles to the shut-off. The flow of gas into a building may be stopped by turning the shut-off valve to the closed position, which is at a right angle to the pipe.



Utility Knife: One of the most popular types of workplace utility knives is the retractable or folding utility knife. Other utility knives are also known as a Stanley knife or box cutter. These types of utility knives are designed as multi-purpose cutting tools for use in a variety of trades and crafts. Designed to be lightweight and easy to carry and use, utility knives are commonly used where a tool is routinely needed to mark cut lines, trim plastic or wood materials, or to cut tape, cord, strapping, cardboard, or other packaging material.

Wildland Combi-Tool: The Combi-Tool is a combination shovel and pick all in one. This multipurpose tool is used to shovel, pick, scrape, and cut all in the convenience of a single tool.

WRENCHES

Box End Wrench: A tool used to provide grip and mechanical advantage in applying torque to turn objects, usually rotary fasteners, such as nuts and bolts, or keep them from turning. In North American English, wrench is the standard term. The most common shapes are called open-end wrench and box-end wrench.

Crescent Wrench: (adjustable wrench): A wrench with a "jaw" of adjustable width, allowing it to be used with different sizes of fastener head (nuts, bolts, etc.) rather than just one fastener, as with a conventional fixed spanner.
The movable jaw should be snugly adjusted to the nut or bolt head in order to prevent damage to the fastener's head, or rounding. In addition, it is important when applying significant force to ensure that the fixed jaw "leads" the rotation (it follows its tip) and the movable jaw "trails" the rotation, leaving its tip behind, so to speak. The area of contact for the fixed jaw should be farther from the body of the tool. That means the movable jaw's area of contact is relatively close to the body of the tool, which means less bending stress. The fixed jaw can withstand bending stress far better than can the movable jaw because the latter is supported only by the flat surfaces on either side of the guide slot, not the full thickness of the tool.

Pipe Wrench (Plumbers Wrench): An adjustable wrench used for turning soft iron pipes and fittings with a rounded surface. The design of the adjustable jaw allows it to lock in the frame, such that any forward pressure on the handle tends to pull the jaws tighter together. Teeth angled in the direction of turn dig into the soft pipe. They are not intended for use on hardened steel hex nuts or other fittings because damage will occur to the head, however, if a hex nut is soft enough that it becomes rounded beyond use with standard wrenches, a pipe wrench is sometimes used to break the bolt or nut free. Pipe wrenches are usually sold in the following sizes (by length of handle): 10, 12, 14, 18, 24, 36, and 48", although smaller and larger sizes are available as well. They are usually made of cast steel.

Socket Wrench: A type of wrench that has a socket attached at one end, usually used to turn a fastener. The most prevalent form is the ratcheting socket wrench, often called a ratchet. A ratchet is a hand tool in which a metal handle is attached to a ratcheting mechanism, which attaches to a socket, which in turn fits onto a type of bolt or nut.

Pulled or pushed in one direction, the ratchet loosens or tightens the bolt or nut attached to the socket. Turned the other direction, the ratchet does not turn the socket but allows the ratchet handle to be re-positioned for another turn while staying attached to the bolt or nut. This ratcheting action allows the fastener to be rapidly tightened or loosened in small increments without disconnecting the tool from the fastener. A switch is built into the ratchet

head that allows the user to apply the ratcheting action in either direction, as needed, to tighten or loosen a fastener.

Galvin Wrench: A tool that is designed to be used to open or close the main stem of a fire hydrant. The long handles provide leverage so that water may flow quickly. The five-sided hole in the middle of the wrench corresponds with the shape of the hydrant main stem nut. The box end of the wrench can be used to open and close the foot valve of a hydrant. It is often used with a Corey wrench.

Spanner Wrench: A straight, forged or folding-type wrench device used for tightening/loosening couplings, appliances or hydrant port caps. It can be used by itself or tandem in opposing movement.

Water Shut-Off Wrench: Is used to turn the quarter turn valve on the inlet side of a water meter. The end of a commercial meter key is a "U" shaped piece welded onto a long rod with a "T" handle. The quarter turn valve may be of different

widths depending on whether it's a residential or commercial application.

MAINTENANCE OF HAND TOOLS

It is critically important to maintain equipment in a ready state. Tools and equipment must be properly cleaned, inspected and maintained after each use to ensure they are ready for use when needed.

Fiberglass and Wooden Handles

- Check for cracks, blisters, or splinters. Splintered fiberglass needs to be replaced, it cannot be repaired.
- Sand wooden handles, if needed.
- Clean with soapy water, rinse and dry after use.
- Apply coat of boiled linseed oil after 2 days of air drying.
- Check to ensure head is on tight.

Cutting Edges

- Check to ensure the cutting edge is free of imperfections.
- File the edges by hand using a flat file to remove burs and gouges.

Unprotected metal surfaces

- Keep clean of rust.
- Keep oiled when not in use (WD40 or 30 weight motor oil).
- Surfaces should be free of burrs or sharp edges; file off if found.

Plated Surfaces

- Inspect for damage.

ROPE

Using rope and tying knots is considered a necessary skill to every firefighter. Ropes and knots can be used to rescue victims, stabilize vehicles and raise and lower tools and equipment. Although many other professions have the luxury of a stress free work environment, the fire service does not, therefore, firefighters must be able to tie knots quickly and proficiently. Being proficient with ropes and knots takes much practice to achieve mastery. It is important to note that safety is paramount when working with rope. Make sure you follow all safety guidelines for rescuing, rappelling and hoisting equipment.

ROPE DATA

Lifeline

- Rescue kernmantle
- ½" diameter
- 200- and 300-foot lengths
- 9,000-lb. breaking strength
- 600-lb. working load (15:1 safety factor)
- Melts at 480 degrees Fahrenheit
- 2% stretch under normal loads (200 lbs.)

Nylon Webbing

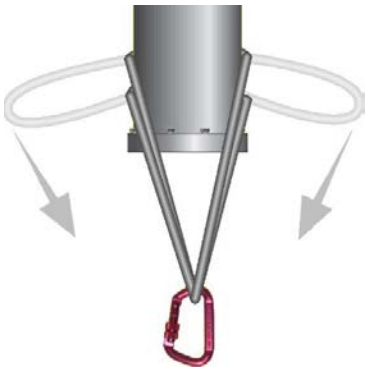
- Tubular (appears flat but is hollow)
- 4,000-lb. breaking strength

Prusik Cord

- Breaking strength of 2,800 lbs.
- 8-millimeter diameter
- Various colors and sizes

ANCHOR DEFINITIONS

Bight: A bight is a curved section or slack part between the two ends of a rope, string, or yarn. An open loop is a curve in a rope narrower than a **bight** but with separated ends.



Brake Bar Rack: A descending device that directs the rope straight through the device and allows the amount of friction to be adjusted when under tension.

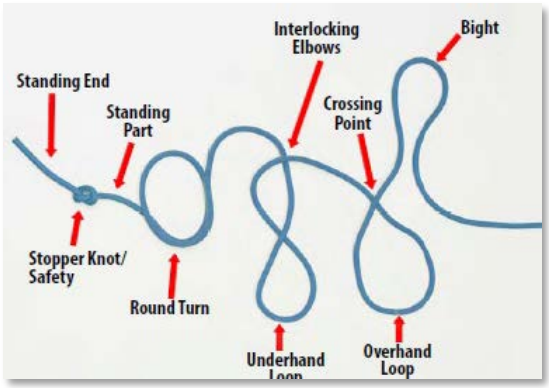
Figure 8 Plate: A type of single-person descent device, commonly referred to within the technical rescue industry as a figure eight descender, and is used for rappelling and descent/lowering maneuvers in the field in search and rescue.

Kernmantle Rope: Rope constructed with its interior core protected by a woven exterior sheath designed to optimize strength, durability, and flexibility.

Scarab: A small, simple device that could easily control heavy rescue loads, as well as excel at pick offs, twin rope systems and other general rescue techniques.

Wrap 3 Pull 2: Created by wrapping rope or webbing around an object multiple times and then connecting a carabiner to all but one of the strands of rope.

ROPE DEFINITIONS



Bend: A bend is a knot that is used to join to two ends of a rope.

Bight: A bight has two meanings in knotting. It can mean either any central part of a rope (between the standing end and the working end) or an arc in a rope that is at least as wide as a semicircle. In either case, a bight is a length of rope that does not cross itself. Knots that can be tied without use of the working end are called knots on the bight.

Binding Knot: Binding knots are knots that either constrict a single object or hold two objects snugly together. In binding knots, the ends of rope are either joined together or tucked under the turns of the knot.

Crossing Point: A crossing point is where the rope crosses itself. This will happen if we take a bight of rope and twist it to form a loop.

Dressing: Knot dressing is the process of arranging a knot in such a way as to improve its performance. Crossing or uncrossing the rope in a specific way, depending on the knot, can increase the knot's strength as well as reduce its jamming potential

Hitch: Any knot that is used to attach a rope or piece of webbing to a rail, post or similar anchorage point is called a hitch. Hitches can be fixed or running. A fixed hitch will secure itself to its anchorage when loaded while a running hitch allows a controlled release.

Interlocking Elbows: Interlocking elbows occur when a bight of rope is twisted twice to form two crossing points. Knots such as the "Butterfly" are tied by firstly forming interlocking elbows.

Loop: A loop is one of the fundamental structures used to tie knots. It is a full circle formed by passing the working end of a rope over itself. When the legs of a closed loop are crossed to form a loop, the rope has taken a turn.

Overhand Loop: Depending on which direction we twist a bight to form a loop; we will either end up with an overhand loop or an underhand loop. An overhand loop is created when the working end of the rope lies over the top of the standing part.

Underhand Loop: If the standing part of the rope lies over the top of the working end, then an underhand loop is formed. An underhand loop is the opposite of the overhand loop.

Open Loop: An open loop is a curve in a rope that resembles a semicircle in which the legs are not touching or crossed. The legs of an open loop are brought together.

Round Turn: Two passes of a rope around an object to completely encircle it.

Running End: The free end of the rope used for hoisting or pulling.

Setting: The process of tightening a knot. Improper setting can cause certain knots to underperform.

Standing End: The standing end (or standing part) of a rope is the part not active in knot tying. It is the part opposite of the working end.

Standing Part: The standing part is the length of rope that lies between the working end and the standing end.

Stopper Knot (Safety): A stopper knot is

the type of knot tied to prevent a rope slipping through a grommet. The overhand knot is the simplest single-strand stopper knot.

Working End: The working end of a rope is the part active in knot tying. It is the part opposite of the standing end.

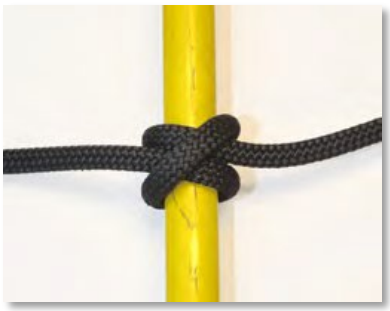
KNOTS

Becket Bend with a Safety Knot: Used for joining two unequal sized diameter materials together. It is easy to tie, inspect and untie after weighting with a load.

Bowline with a Safety Knot: The bowline is one of the most important knots in the fire service. It is easily tied and untied and is good for forming a single loop that will not constrict.

Butterfly Knot: Provides a secure loop in the middle of a piece of rope. Load can be safely applied from the loop to either end of the rope; between the two ends with the loop hanging free; or to the loop with the load spread between the two ends.

Clove Hitch: The clove hitch essentially consists of two half hitches. It is used to attach a rope to an object, such as a pole, post, or hose line. It can be dropped over an object or tied around an object.



Double Fisherman's Knot: Commonly used to create a prusik loop.

Double Loop Figure-Eight:

A type of knot that forms two parallel loops and resembles the **figure-eight** loop. It can be used as the start of an improvised rescue harness.

Figure-Eight: The figure-eight is the foundation knot for an entire family of figure-eight knots. It can be used as a stopper knot so that the rope will not pass through a rescue pulley or the grommet of a rope bag.

Figure-Eight Follow Through: The figure-eight follow through is used for securing objects. It is basically a figure-eight on a bight that is around the object.

Can also be used to marry two similar diameter ropes.

Figure-Eight on a Bight: The figure-eight on a bight is a good way to tie a closed loop.

Girth Hitch: A knot commonly tied with a sling of webbing, although rope can also be used. Other names for this knot are the Hose Knot, Cornice Hitch, and Running Knot. It is used to attach a sling or a loop made of webbing to a harness. It is also commonly used to connect two hose belts together or to affix a piece of webbing or rope to a solid object.

Half-Hitch: The half hitch is useful for stabilizing objects that are being hoisted. It is always combined with another knot or hitch.

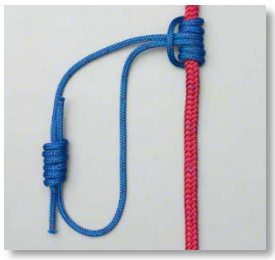
Handcuff: The handcuff knot consists of two adjustable loops formed from a bight. A handcuff knot is a knot tied in the bight having two adjustable loops in opposing directions, able to be tightened around hands or feet.

Inline Directional Figure-Eight: Creates a loop in the middle of a rope and is used as a load bearing knot to take strain in one direction only. In fact, a strain from the wrong end actually capsizes the knot into one that slides, i.e. it functions as a noose so that the loop tightens under load.

Overhand Safety: The overhand knot is one of the most fundamental knots and forms the basis of many others. As an added measure of safety, an overhand safety knot or "safety" can be used when tying any type of knot. The use of the overhand safety knot eliminates the danger of the running end the rope slipping back through the knot and causing the knot to fail.

Square Knot: A simple knot used for joining two ropes of equal diameter.

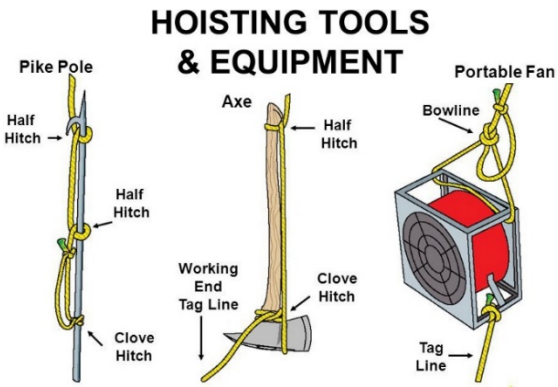
3 - Wrap Prusik Hitch: A friction hitch commonly used in rope rescue to capture a load. Typically used for connecting a load or a person to a rope. Commonly used in 3:1 raising systems, lowering systems and belay lines (always used in tandem).



Water Knot: A knot frequently used in the fire service for joining two ends of webbing together or when making a loop.

HOISTING TOOLS AND EQUIPMENT

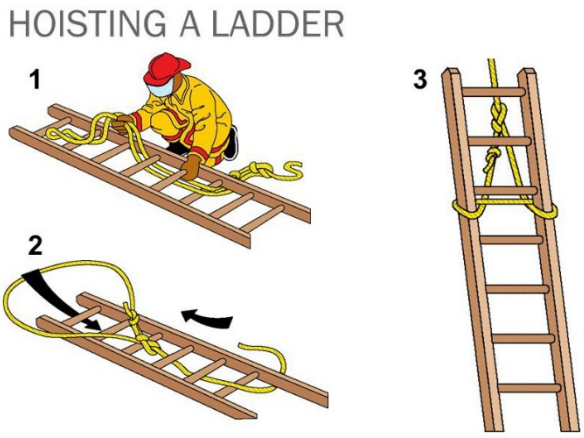
Rope and webbing are frequently used to raise or lower tools and equipment. Hosting pressurized cylinders (SCBA, fire extinguisher, etc.) is unsafe and must not be performed. Always attach to equipment securely and use the appropriate knot to prevent damage to equipment and/or injury to personnel. Tag lines can be used to control the ascent or descent of equipment and will typically make hoisting equipment over head safer.



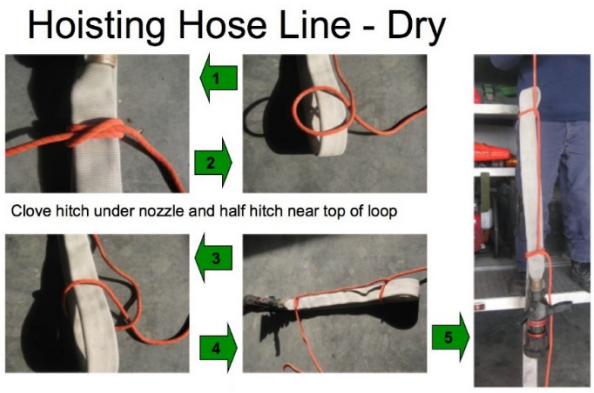
Hoisting an Axe: The procedure for hoisting a pick-head and flat axe is the same. First, tie a clove hitch and slide the hitch down the axe handle to the axe head. Loop the working end of the rope around the head of the axe and back up the handle (the excess running end of the rope becomes the tag line). Tie a half-hitch at the butt of the handle.

Hoisting a Pike Pole: Tie a clove hitch near the end of the handle. Using the running end, tie a half-hitch around the handle of the pike pole in the middle of the handle. Tie a second half-hitch around the handle of the pike pole under the pike hook. The remainder of the standing end becomes the tag line.

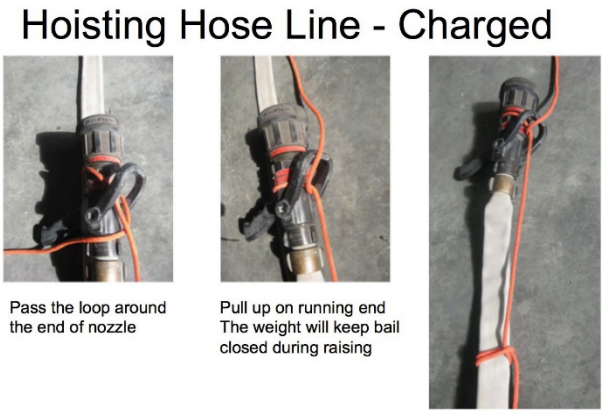
Hoisting a Ladder: Make a loop in the rope large enough to slip over the tip of the ladder using a Bowline or Figure-Eight on a Bight. Place the loop under the ladder and bring it up between rungs 3 and 4; approximately one-third the distance from the hoisting end. Open the loop and place it over the tip of the ladder. Arrange the standing part of the rope under the ladder rungs. Tighten the loop around the beams, pulling the standing part of the rope up behind the rungs toward the ladder tip. With the standing end of the rope, run it down towards the butt of the ladder and secure an appropriate knot to the beam of the ladder as a tag line.



Hoisting a dry hose line: Lower the proper length of rope from the intended destination of the hose line. Fold the nozzle or coupling end, if you have removed the nozzle, of the hose line back over the rest of the hose so that an overlap of 4 to 5 feet is formed. Tie a clove hitch, with an overhand safety knot, around the tip of the nozzle or coupling and the hose it is folded against so that they are lashed together. Place a half-hitch on the doubled hose about 12" from the loop end. Hoist the hose line



Hoisting a charged hose line: Charged hose line can be hoisted, but it is safer and easier to hoist a dry hose line. If it is necessary to hoist a charged line, lower the proper length of rope from the intended destination of the hose line. Tie a clove hitch, with an overhand safety knot, around the hose about 1 foot below the coupling and nozzle. Pass a bight through the nozzle so that the rope holds the nozzle shut while it is being hoisted. Tie a half-hitch around the nozzle to take the strain off the handle. Hoist the hose line.



Rigging a 3:1 System

Some rescuers find it challenging to remember how to rig a 3:1 system. The following process may make it easier to remember:

1. First rig a 1:1 system. The rope comes from the load and goes through one pulley.
2. Now add "capture" Prusiks that will hold the load if you let go of the rope. If you have enough rescuers at this point, you might try pulling on the rope to see if you can raise the load using this 1:1 system. Often times this is all the rigging that is required.
3. If you can't raise the load using the 1:1 system, add a "traveling" Prusik and Pulley. (These are called "traveling" because they travel at the same speed as the load.)
4. Pull on the rope that exits the traveling pulley.

POWER EQUIPMENT

NKCTC member departments use power tools to support fire and rescue operations. Typically, power tools save time and are critical to providing support that will have a direct impact on the incident's tactical objectives. Therefore, daily checks and other required maintenance for power equipment is critical to the proper function of the complex engines, electrical systems, and/or hydraulic plumbing.

Power tools operate using gas (unleaded or 2-cycle), electricity, air (pneumatic), or hydraulic power.

Members must have a working knowledge of each power tool they will be expected to use, to include general mechanics, maintenance and operation.

The power tools covered in this section are:

- Chain Saw
- Circular Saw
- PPV Fan (Positive Pressure Ventilation)
- Electric Exhaust Fan
- Reciprocating Saw
- Hydraulic Extrication Tools
- E-tool
- Lift Bags
- Small Gas-Powered Generator

General Overview

All power tools on each apparatus must be checked daily and after each use. Power tools and equipment must also receive a thorough weekly check to ensure proper operation.

There are two different types of gas engines used in power tools:

- 2 cycle engines
- 4 cycle engines

2-cycle engines, used in saws, require a pre-mixed fuel/oil blend to properly lubricate the combustion chamber of the engine. All Zone 1 2-cycle fuel should be pre-mixed in a labeled fuel can to ensure that it is not inappropriately used with the wrong equipment. ONLY use the fuel can labeled "50 to 1" to refuel saws.

All other front-line power tools, such as generators and powered fans, have 4-cycle engines that use high octane unleaded fuel (premium).

Due to the many different makes and models of power equipment used across Zone 1 agencies, it is beyond the scope of this Task Manual to provide detailed specifications for each piece of equipment. Please refer to manufacturer and internal

documentation for the most accurate specifications.

CHAINSAWS

SAFETY NOTICE

Proper Personal Protective Equipment (PPE) shall be worn while operating power equipment. At minimum, this includes eye protection, hearing protection, gloves, and helmet.

General Use Guidelines

Chain saws are a versatile tool. They can be used for Ventilation, Forcible Entry, and clearing downed trees. Chain saws are primarily used to cut through Class A roofing materials (wood and asphalt roof coverings) during vertical ventilation operations. Caution must be used when cutting through any material with a high revving chain saw; kickback from the saw can cause serious injury.

If kickback occurs, the violent reverse action of the kickback will actuate the inertia chain brake (same principle as a car seatbelt) or drive the chain brake handle back into the operator's hand, engaging the chain brake and stopping the movement of the chain. Therefore, it is imperative that the user properly hold and operate the saw.

Safety precautions must be taken with running saws so that no body parts are placed in the cutting path of the saw.

Avoid using the saw above your head. The most effective position to operate the saw is below the chest line where the operator has good visibility and can maintain control of the saw. Do not let the chain contact anything except the material you are cutting. A running chainsaw shall never be set down without the chain brake engaged.

DO NOT OPERATE CHAIN SAWS AT FULL THROTTLE WITH NO LOAD FOR MORE THAN 5-10 SECONDS.

Minimum Safety Precautions

Gloves, hearing protection, eye protection, helmet, and steeled toed boots are required, at minimum, to operate a saw. During all training evolutions and non-emergency responses, chaps will be worn at all times to protect the sawyer. The chain brake shall be engaged when moving (not operating) a running saw.

Chainsaw Chains

Chainsaws have two chain types available depending on the material that you are

cutting: carbide tip and wood cutting.

- **Carbide tip:** All chainsaws on suppression apparatus should have a carbide tip chain installed on them. This is the chain of choice for ventilation and forcible entry.
- **Woodcutting:** Most Zone 1 departments have regular, low kick back, wood cutting chains available. Wood cutting chains are for non-emergency calls for clearing downed trees or limbs. The use of department chainsaws to clear a downed tree will be used in accordance with your department policy. Wood cutting chains are NOT to be used for falling trees.

Starting Procedures

Zone 1 endorses two starting methods:

- On the ground
- On the groin

At no time will a saw be started using the drop method. In addition, all chain saws will be started with the chain brake engaged.

1. Squeeze the throttle trigger and set the run switch to the “choke” (cold start) position. If the saw is already warm, set to “warm start” position.
2. Confirm the chain brake is engaged.
3. If so equipped, press the decompression button.
4. Place saw on ground and while holding firmly, pull the starter rope until the saw begins to run. The master control switch will automatically move to the run position.
5. Release the chain brake and run the saw at a low throttle speed for 5-10 seconds.
6. Ensure the saw idles well. If not, continue to run at low speed until it will idle well.
7. Allow the saw to idle for 30-60 seconds until warm.
8. Run the saw at moderate to high speed and verify functionality.

After running the saw, ensure that it is secured with the chain brake forward and that all fuel levels and switches are placed back in the proper position.

Daily Check

Daily checks are performed at the start of each working shift to ensure saws are in good repair and ready for use.

1. Fuel (full).
2. Bar Oil (full).
3. Visually inspect the saw for cleanliness, clean or wipe off as necessary.
4. Extend the starter pull cord fully and inspect for damage or fraying.
5. Ensure the chain is rotating the correct direction.
6. Inspect each tooth on the chain, carbide teeth – replace if missing 3 in a row or a total of 6 teeth.
7. Check the chain tension and adjust if necessary (only adjust the tension on a cold chain).
8. Check all working positions of the chain brake.
9. Store with the master control lever in the stop position and the chain brake on.

Weekly Check

Weekly checks are performed to ensure saw functions properly and to address preventative maintenance measures.

1. In a well-ventilated area, perform the Starting Procedures for the specific make of the saw.
2. Let the saw warm up at an idle speed for 30 to 60 seconds.
3. The user can let the saw idle on a pad or soft ground while monitoring it, or the user can properly hold the saw in both hands during the warm up period.
4. Once the saw is warm, properly hold the saw and slowly rev up the saw to full RPM two to three times.
5. Check the proper operation of the chain brake.
6. Check to see if the chain and bar are being properly oiled by revving the saw's RPM up and pointing the tip of the bar approximately 4 to 6" from a light-colored surface. The user should see oil droplets appear on the surface.
7. At idle, shut off the saw by switching the master control switch to "stop."
8. Flip the master control lever up to the "stop" position. Move the master control lever to the "run" position. A hot engine usually can be restarted in the "run" position without choking.
9. Once off, place the saw on its right side and check the 2-cycle fuel tank and the chain oil reservoir.
10. Refill if necessary. Do NOT overfill.
11. Leave the master control switch in the "stop" position.
12. Engage the chain brake (chain brake on).

The Chain Brake

Push black hand-guard on top of saw towards nose of the bar to engage the chain brake. Do this before moving a running saw (Critical Safety Factor).

When ready to cut, pull the hand-guard towards the hand-grip to release the chain brake. The hand-guard will be in the off position when the chain is moving. The chain brake should always be engaged when the saw is stored.

Chain Tension

1. Slightly loosen the bar nuts.
2. Turn tension-adjusting screw clockwise to increase the chain tension.
3. Proper cold tension: Chain tie-straps should remain in contact with bar along bottom rails and move freely along bar.
4. Tighten the bar nuts.
5. Starting with "cold tension", chain will stretch as it heats up and/or wears in operation. It should be adjusted anytime chain tangs hang almost out or completely out of bar rails at point shown.

Adjustment of "warm chain": Warm chains will tighten upon cooling. To adjust while warm, tighten chain until tangs move halfway up into bar groove. Check tension after the chain has cooled as only a cool chain can be tensioned accurately.

Replacing a Chain

1. Loosen the bar retaining nuts with the appropriate tool, then back off the bar adjusting screw enough to remove the chain from the bar. Finish removing the retaining nuts and side cover and remove the chain entirely. When reinstalling, be sure the carbide cutting edge on top of bar points toward the bar tip, and the drive teeth engage drive

sprocket.

2. Be sure bar adjusting pin is engaging bar properly before installing side cover. Install the side cover and retaining nuts and hand tighten.
3. With a screwdriver or chain saw tool, turn the adjusting screw clockwise to take up slack in the chain. While turning the adjusting screw, always lift up on the bar tip with other hand.
4. Tighten the chain until slack is removed but not so tight that the chain cannot be rotated freely.
5. When correct tension is achieved, and while holding up on bar tip, tighten the retaining nuts securely.

More information on proper chain replacement and tensioning can be found on the Stihl website: https://www.stihl.com/chain-side-tensioning.aspx

Flooded Saw Procedure

If the saw won't start after attempting the normal start procedures and/or has obvious fuel/liquid coming out of the muffler, it is most likely flooded. The term "flooded" refers to the combustion chamber having excessive amounts of unburned fuel which diminishes the spark plug's ability to ignite. If this occurs, use the following 2-person routine:

1. Ensure the saw is set to the "run" position.
2. Secure saw to the ground and repeatedly pull the pull cord with the throttle wide open.
3. Pull on the starter repeatedly until saw fires (it may take upwards of 20 pulls).
4. Do not release the throttle/trigger during this operation - saw will usually attempt to start a couple times, keep pulling the starter rope, and keep holding the throttle open.
5. Once the saw fires and continues to run (probably poorly at first), release the chain brake and continue to hold the throttle wide open until the saw reaches maximum RPM.
6. Run the saw between idle and wide open for 1 to 2 minutes, or until all excess fuel is cleared. You should see the muffler dry out and burn off all excess fuel.
7. Ensure the saw idles well. If not, continue to run it at medium high speed until it will idle consistently.
8. Shut the saw off and re-start it a few times to ensure proper operation. If saw won't start after 30-40 pulls, let it sit for an hour or two and try to restart. If it still won't start, follow your department's procedure for saw repair.

CIRCULAR SAWS

There are two primary brands of circular saws in use by Zone 1 departments: Stihl and Husqvarna. Both are versatile tools that can be outfitted with many different

blade types that can cut almost any material that we encounter. With the right cutting blade installed, the saw can be used for:

- **Ventilation:** Commercial, industrial, peaked roofs, and flat roofs all covered with a variety of roofing materials.
- **Forcible Entry:** Security bars, roll up doors, fireproof doors, reinforced doors and windows, chains, and locks.
- **Heavy Rescue:** Building collapse, industrial accidents, natural disasters, recoveries, and more.
- **Vehicle Extrication:** Aircraft, buses, tractor- trailers, passenger cars, auto fires, farm and industrial accidents.
- Always use a high-speed blade.
- Always use the correct blade for the material you're cutting.
- When operating the saw, the operator must have one hand firmly placed around the front handle, with the other hand firmly holding the throttle assembly handle.

CAUTION

Kickback can occur when using a circular saw. To avoid kickback, and the potential for serious injury, use the following guidelines:

- Always have the blade guard in place and adjusted to the correct angle to assist you with your cut while providing maximum protection.
- Avoid using the saw above your head. The most effective position to operate the saw is below the chest line.
- Start your cut in such a way that you can predict what will happen after the cut is complete.
- Always cut at full throttle.
- Start your cut gently, do not force or squeeze the blade in.
- Move the blade slowly while controlling your throttle and blade RPM.
- Let the machine work without forcing or pressing the blade.
- Only use the blade's cutting edge when cutting.
- Never use the "Kickback Zone" of the blade for cutting.
- Always cut with the blade perpendicular to the surface being cut.
- Make your cuts using only the bottom half of the blade. This may require the user to "tilt" the saw down.

Safety Precautions

- Gloves, hearing protection, eye protection, helmet, structural coat or wildland coat, and steel toed boots.
- Be sure sparks from the cutting operation cannot reach flammable surroundings.
- Examine cutting wheel before each use. Wheels should have no cracks, nicks, or flaws.

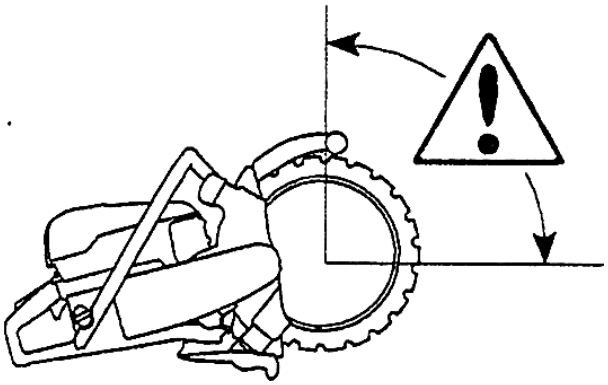
- NEVER operate unit without a safety guard.
- Moving the blade into a cut too quickly can cause the blade to shatter.
- If a wheel shatters, carefully examine the wheel guard for damage. A damaged wheel guard must be replaced before the saw's next operation.
- NEVER use saw to cut asbestos wrapped pipes.

Starting Procedures

King County Zone 1 endorses two starting methods:

- On the ground
- On the groin

Husqvarna K Series



1. Press the Decompression valve to reduce pressure in the cylinder.
2. Make sure the "STOP" switch is in the left position.
3. Cold Start: pull out the choke completely to engage the choke and start throttle.
   Warm Start: pull choke out and then push it back in to engage the start throttle without any choke.
4. Press the Air Purge at least six times until fuel fills the diaphragm.
5. With saw on ground, hold firmly and pull the starter rope until the saw starts. With a Cold Start the machine will stop when the engine fires because the choke is out.
   a. Press in the choke
   b. Press Decompression valve.
   c. Pull handle until engine starts.
6. When the engine starts, quickly apply full throttle to automatically disengage the fast idle.
7. Stop engine by moving "STOP" switch to the right.

The cutting blade will continue to rotate after the motor has stopped.
Make sure the blade can rotate freely until it is completely stopped.

Stihl TS Series

1. Press the throttle trigger interlock and throttle at the same time.
2. Holding both triggers down, move the control lever to "START" and hold it in position.
3. Release the throttle trigger, control lever, and throttle trigger interlock in succession – saw will be in starting throttle position.
4. Set the choke lever to the appropriate start position:
   a. Cold start
   b. Warm start
   c. Hot start
5. Press decompression valve button (this button must be pressed again before each fresh attempt to start the engine).
6. With saw on ground, hold firmly and pull the starter rope until the saw starts. With a Cold Start the machine will stop when the engine fires because the choke is out.
7. Move the choke lever to the warm start position, re-press the decompression valve, and pull starter rope.
8. When saw starts, quickly squeeze and release the throttle. This will set the control lever to the run position and the engine will idle.
9. To turn off the saw, move the control lever to the stop position.

Daily Check

1. Fuel (full).
2. Carbide tips should be inspected every shift for wear and the blade should be replaced and repaired if 6 or more tips (or 3 tips in a row) have 50% or more of the carbide missing, or the tips appear to be worn or rounded (refer to your department guidelines if different).
3. Most fibrous/composite saw blades can be installed and cut in either direction. A used blade with less than 80% of the blade remaining should be replaced.
4. Diamond tip blades should be free of hairline cracks.

Weekly Check

1. Place saw in a well ventilated area - outside if weather permits.
2. Visually inspect the saw for cleanliness - clean or wipe off as necessary.
3. Extend the starter pull cord fully and inspect for damage or fraying.
4. Fully inspect the blade.
5. Ensure the blade is installed in the correct direction.
6. Inspect each carbide tip on the wood cutting blade, replace if

necessary.

7. Replace any fibrous/composite metal and concrete blades with over 20% wear.
8. Start the saw (refer to correct make and model starting procedures).
9. Let the saw warm up at an idle speed for 30 to 60 seconds.
10. The user can let the saw idle on the ground while monitoring it; or the user can properly hold the saw in both hands during the warm up period.
11. Once the saw has warmed up, properly hold the saw and slowly rev up the saw to its full RPM two to three times.
12. At full RPM, ensure the blade is properly rotating and verify there is no unusual saw or blade vibration.
13. At idle, shut off the saw by moving the stop switch to the "STOP" position.
14. The blade will continue to spin once the saw is shut off. To stop the blade from spinning, gently make contact with an appropriate surface to stop the blade.
15. Once shut down, check the 2-cycle fuel tank. Refill if necessary. Do NOT overfill.
16. Once refueled, store the saw according to department policy.

Changing a Circular Saw Blade

Use the following procedure to change out a blade on the circular saw:

1. Adjust the blade guard in the best position to expose the flange nut.
2. Use the combination spanner to remove the flange hub nut.
3. Once the nut is removed, remove the flange hub.
4. Remove the blade you're replacing.
5. Install the new blade on the back of the other flange hub.
6. Ensure the blade is installed so it is rotating in the correct direction.
7. Replace the other flange hub properly over the blade.
8. Properly replace the flange hub nut and tighten firmly.
9. Start the saw after the blade has been installed to insure its smooth operation.

Saw Blade Types and Use

There a several different saw blade types. Most saw blades are designed for a specific material to cut. Here are the major material categories that saw blades are designed to cut:

Wood Cutting Carbide Tip Blades

Can have several carbide tips per inch of the saw blade. Carbide tips should be inspected every shift for wear and the blade should be replace and repaired if 6 or more tips (or 3 tips in a row) have 50% or more of the carbide missing, or the tips appear to be worn or

rounded. All wood blades rotate in one cutting direction and must be installed so the blade rotates the correct way. The rotation direction should be clearly marked on the blade.

Fibrous/Composite Metal and Concrete Blades

Can look very similar to each other and both should be marked appropriately once they are removed from their packaging. Avoid exposing composite blades to petroleum products. Petroleum will breakdown and erode the blade prematurely, making it unsafe to cut with. Most fibrous and composite saw blades can be installed and cut in either direction. As cuts are made, the blade will erode away at a rate that is based on the material being cut and its thickness. All blades start out as 14"; during the cut the blade will erode. When the blade has eroded to less than 6 to 8", it should be replaced. Crews should be prepared with the proper tools and plenty of blades to quickly turn the saw around if the situation calls for it. A used blade with less than 80% of the blade remaining should be replaced

Multi-purpose cutting blades

Generally, these are carbide tipped blades that can cut all major materials. While these blades will cut a variety of materials satisfactorily, they never cut as well as a blade that was designed for that specific material. They also tend to be heavier blades that steal horsepower away from the saw and their use should be avoided. Always use a blade specifically designed for the material you're cutting.

Diamond blades

The Vacuum Bonded Diamond Blade features diamond segments with specially designed grooves that allow the blade to better cut through harder materials like concrete, metal, reinforced concrete, and ductile iron. Vacuum bonded diamonds on the side of the blade help reduce binding

VENTILATION FANS

Gas Powered Fans

Most PPV fans use Honda 4-cycle gas powered engines with different horsepower depending on the fan size. Fans, unless otherwise specified by manufacturer

recommendations, typically use premium unleaded fuel.

The fuel tank, cap, and opening are located on the top of the fan. When refueling an adjustable fan, place the fan in its most extreme angle before refueling. This will prevent a full tank from overflowing when the fan is tilted during operation. Always avoid over filling any fuel tank.

Starting Procedures

1. Turn the kill switch to the "On" position.
2. Engage the choke knob.
3. Turn the fuel switch to its "On" position.
4. Place the throttle in its idle position.
5. Grasp the starter handle and pull sharply upward a few times until the engine catches.
6. Push the choke in.
7. Pull the starter handle again. The engine should start on the next full pulls.

Daily Check

1. Fuel (full).
2. Visually inspect the fan for cleanliness, clean or wipe off as necessary.
3. Extend the starter pull cord fully and inspect for damage or fraying.
4. Fully inspect the fan blades for any damage.
5. Inspect the shroud bolts to ensure they are tight and no bolts are missing.
6. Inspect the fan for missing or loose hardware.
7. Inspect the rubber feet to ensure they are stable and in good condition.

Weekly Check

1. Place it in a well-ventilated area - outside if weather permits.
2. Check the oil level.
3. Start the fan on a level surface with the wheels in the locked position.
4. Once the fan has started, adjust the throttle to a medium speed and let the fan warm up for 30 to 60 seconds.
5. Once the fan has warmed up, throttle the fan to its full RPM two to three times.
6. At full RPM, ensure there is no unusual fan vibration.
7. To shut off the fan:
    a. If equipped with a fuel shut off, move to the "OFF" position and allow the engine to run until the gas in the system is used and the engine stops.
    b. If there is no fuel shut off switch, turn the run switch to the "OFF" position.
8. Once off, check the fuel tank. Adjust the fan to the proper angle before checking. Properly refill if necessary. Do NOT overfill.
9. Once refueled, place the fan in a

ready state.

10. Place the throttle in the idle position.
11. Place the choke in the “On” position.
12. Leave fuel in the “OFF” position.

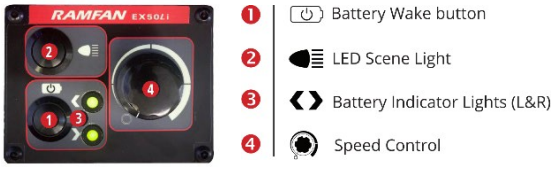
ELECTRIC FANS

Ramfan EX50

The Ramfan EX50 is an 18” diameter electric fan that can be powered by two 40 volt lithium ion battery packs, or by plugging in to a standard AC outlet. With fully charged batteries, the unit can operate for up to 45 minutes.

Battery Operation

1. Push and briefly hold the Battery Wake button. Indicator lights will show battery status.
2. Verify Speed Control is in the off position.
3. Increase Speed Control to desired rate.
4. When shutting down, reduce Speed Control to off position.



AC Operation

1. Set speed control to off position.
2. Connect fan to an AC power source. Indicator lights will display charge levels of batteries.
3. Power the fan by adjusting the Speed Control to the desired rate.
4. When the fan is powered off, the indicator lights will display battery charge level. The fan will begin charging the batteries after 15 minutes of idle time.

Note: Battery packs do not charge while the fan is being used in AC mode.

Daily Check

1. Visually inspect the fan for cleanliness - clean or wipe off as necessary.
2. Inspect unit for broken, worn, or loose parts.
3. Check battery levels:
   a. Press the battery wake button.
   b. Two LED lights will show green for full charge.

Supervac

The Supervac electric smoke ejectors operate using standard AC power. The units have a 16” blade that delivers a ventilation capacity of 5,200 cubic feet per minute.

Operation

1. Check ventilator inlet and outlet guards for obstructions. Check and remove from immediate surrounding area any objects that could be drawn into the ventilator intake.
2. Insert power cord plug into 120 AC power receptacle to begin ventilation.
3. To stop ventilation, remove power cord plug from AC power receptacle.

Daily Check

1. Visually inspect the fan for cleanliness - clean or wipe off as necessary.
2. Inspect fan housing for broken, worn, or loose parts.
3. Inspect fan shroud for loose or missing fasteners.
4. Inspect the power cord and electrical attachments for damage.

GENERATORS

Starting and Operating Procedures

1. Open fuel cap vent to "ON."
2. Control switch in "RUN" position, no load applied.
3. Choke fully "ON."
4. Pull the starter cord until engine starts.
5. As engine warms up, close choke.
6. After warming up for 1 to 2 minutes, connect AC loads.

Stopping Procedure

1. Disconnect all loads.
2. LET GENERATOR IDLE AT LEAST TWO (2) MINUTES WITHOUT LOAD TO COOL DOWN.
3. Close fuel valve.
4. Move Control switch to "STOP" position.

Daily Check

1. Fuel (full).
2. Oil (within operating range).

Weekly Run

1. Start the generator.
2. Plug in scene lights to ensure operation of both generator and lights.
3. Shut down the generator and return to pre-use settings.
4. Ensure fuel and oil levels are full.

EXTRICATION TOOLS

Gas Powered Hydraulic Extrication Tools

Hydraulic extrication systems are comprised or three primary components: the power unit, the hydraulic hose, and the hydraulic

tool. There are three primary types of hydraulic tools used in the fire service:

Cutters **-** Shears that are designed to cut through metal. Most commonly used to cut through a vehicle's structure in an extraction operation. Cutter blades are replaceable, however, they should not be used to cut case hardened steel.

Spreaders **-** A tool designed with two arms which come together in a narrow tip that can be inserted into small gaps between vehicle panels. When the tool is operated the arms are opened, pushing apart the metal panels.

Rams **-** Hydraulic cylinders used to force panels, structural members, or objects apart. These come in many different lengths and require more hydraulic fluid to operate that cutters or spreaders.

Zone 1 departments mainly utilize two brands of hydraulic systems for extrication: Holmatro and Hurst. Both units use Honda 4-cycle engines in their power units. Firefighters need to be familiar with each type of rescue tool used by their department. For units other than Holmatro or Hurst, refer to the owner's manual for operating procedures.

Starting Procedure

1. Open fuel valve.
2. Throttle control switch in "CHOKE" position.
3. Turn switch to the "ON" position.
4. Pull the starter cord until engine starts.

As engine warms up, move the throttle control to the "RUN" position

Stopping Procedure

1. Return tools to storage position: spreader open ½"; cutter closed to point where teeth cross; ram retracted.
2. Close manifold valves.
3. Disconnect hoses and replace dust covers.
4. LET POWER UNIT IDLE AT LEAST TWO (2) MINUTES AFTER OPERATING TO COOL DOWN.
5. Close the fuel valve and let engine run out of fuel - or- move run switch

to the “OFF” position.

6. Move the throttle control switch to the “OFF” position.
7. Refill fuel and top off hydraulic fluid level as needed.

Storage Control Positions

- Fuel shut-off in “OFF” position.
- Throttle control in “CHOKE” position.

Daily Check

1. Fuel (full).
2. Oil (check with dipstick not screwed in).
3. Visually inspect power unit for damage or worn/loose components.
4. Visually inspect the hoses for damage, cuts, or worn fittings.
5. Visually inspect the tools for damage or wear.

Weekly Run

1. Start the power unit.
2. Connect the hydraulic hoses to the power unit and to the tool.
3. Charge the appropriate manifold valve by moving the lever to the open position (lever inline with hose). Simultaneous tool operation is possible off one manifold or both by running the hoses in series creating a looped system. IMPORTANT: couplings WILL leak fluid under pressure to prevent lockup. DO NOT leave open butt hoses with the power unit running.
4. Connect hoses and operate cutting and spreading tools.
5. Cutting Unit: hold the blades perpendicular to material being cut to avoid twisting.

Electric Powered Extrication Tools

Electric powered rescue tools, such as the Hurst eDRAULIC, require no hoses or power unit. They operate at 24 volts when using an electrical power supply, or 25.2 volts with the high capacity lithium/ion battery. The advantage of the system is that it can be deployed quickly and is still powerful enough to perform most rescues. They are found on various units throughout Zone 1 and operated similar to the hydraulic powered extrication tools.

The eDRAULIC tools have a simple On/Off push button that is lit when power is on. Operation is controlled with a self-centering thumb lever, called a star grip, that immediately stops tool movement when

released - similar to a “dead-man” switch.

⚠ Electric powered extrication tools must not be used underwater.

Daily Check

1. Ensure batteries are fully charged.
2. Visually inspect the tools for damage or wear.

Weekly Run

1. Attach the power supply or battery.
2. Press power button and visualize that power light is on.
3. Open/spread tool half way using thumb switch (star grip), release switch and ensure unit stops operation.
4. Close tool to appropriate ready state.
5. Press power button and visualize that power light is off.

LIFT BAGS

Lift bags vary in size and lifting capacity. In Zone 1, you will find Paratech, Vetter, and Matt-Jack lift bag systems. For lifting capacities and ratings, refer to your agency’s documentation and manufacturer specifications.

Lift Bag Operation

The use of air/lift bags requires the correct sequencing of steps to perform a successful lift. Each member needs to be familiar with their department’s lift bag operations. The following list of instructions only includes the setup of the unit and does not include placement and lifting.

1. Obtain cribbing and all Lift Bag equipment.
2. Connect Regulator to SCBA bottle.
3. Open tank valve.
4. Set regulator at appropriate psi for your equipment, with the outlet valve closed.
5. Connect the supply hose to the controller and the regulator.
6. Lock all couplings and check for tightness.
7. Connect the supply hose between lift bags and controller.
8. Safety check all couplings prior to operation.
9. Open the regulator outlet valve. Caution: user needs to stay outside of 45 degree hazard zone during lift bag operations.
10. Operate controller as needed to reach the desired height, never stacking more than 2 bags.

When lifting sharp edged objects, it is acceptable to use plywood on the top and bottom of the lift bag.

Cribbing

Caution needs to be used when lifting. Cribbing must follow the load as elevation increases. The rule of thumb is "lift an inch, crib an inch." When a bag or combination of bags will not achieve the desired lift, cribbing can be used to make up the difference. It is important that the bag rests on a solid, flat surface. If the surface is not solid, the roundness of the bag can cause the weight of the item being lifted to shift, increasing the possibility of collapse.

Cribbing is also used for safety in case the lift system develops a problem. Once you achieve the required lift, the load can be set on the cribbing for better stability. Unless the load has a feature that requires cribbing with a solid surface, most cribbing can be accomplished with a couple of supports on top. The most important feature of a crib is that it will not move when under a load.

Sawzall

The Sawzall can use many different type of blades but typically only use a bi-metal or wood cutting blade. All Sawzalls in Zone 1 have a keyless quarter turn chuck to remove and install blades. There are two primary models being used by Zone 1 departments:

Corded Milwaukee

The corded Milwaukee reciprocating saw is equipped with 0-3000 stroke per minute, 1-1/8 stroke length, and a powerful 12-Amp motor. The gear protecting clutch extends gear and motor life by absorbing high impact forces and a QUIK-LOK blade clamp offers fast tool- free blade changes.

Battery Powered Hilti

Hilti WSR 36-A reciprocating saw is a very durable saw. It is equipped with a highly efficient motor that reduces the amount of energy required to operate the saw. Furthermore, as stated above, the saw has unlimited mobility because it is not limited by the power cord.

Material cutting to stroke rate:

- Wood: 5-6
- Drywall: 3-4
- Steel: 2-3
- Li-ion Battery charger status indicator
  - 75% -100% Charged: 4 LED lights
  - 50%-75% Charged: 3 LED lights
  - 25%-50% Charged: - 2 LED lights
  - 10%-25% Charged: 1 LED light
  - 10% Charged or <: 1 LED light blinking

Although very effective, there are a few limitations with these saws. The corded saw has a limited range depending on the length of the extension cord. In addition, setup is slightly longer because the cord reel must be deployed prior to using the saw, however, the saw has an unlimited power supply and can be operated for several hours. Conversely, the cordless units have unlimited mobility and a limited power supply. It is critical that the batteries for these units are maintained in a ready state and are replaced in accordance with the manufacture recommendations.

PERSONAL PROTECTIVE EQUIPMENT (PPE)

In today's fires the synthetic fuel loads off gas more prevalently and have a much higher heat release rate when compared to the legacy fuels of 30 years ago. Often, when a firefighter is exposed to high heat, sustaining thermal insult can be directly related to the level of protection provided by their personnel protective equipment (PPE). Therefore, it is critical that the wearer respect, care for, and maintain their PPE ensemble. The information contained in this section will provide firefighters with the minimum level of knowledge with regard to how gear is tested, inspected, cleaned, and cared for.

ALL DEPARTMENTS WILL REFERENCE:
NFPA 1851 and WAC 296-305-02001

PPE COMPONENTS

Helmet: Structural helmets are made of either thermoplastic or composite material. The brim at the rear of the helmet is longer than the front and a face shield(s) is usually attached to the front.

Hood: This garment protects all the skin above the coat collar that is not being covered by the SCBA face mask. Material per department specifications.

Jacket: A turnout jacket consists of three main layers: 1) an outer heat shell; 2) a moisture barrier layer; and 3) a thermal liner. The back of the jacket contains a fallen firefighter drag harness that can be deployed by raising the Velcro flap and pulling the drag strap.

Gloves: Structural firefighting gloves employ the same functional three-layer construction as the other turnout gear. There is a shell, which may be either leather or textile. Inside the shell is a moisture barrier, or barrier layer that may be separate or combined with a thermal lining.

Bunker pants: Are also constructed with the same materials as the jacket. Newer bunker gear also has waterproof knee pads integrated in their construction.

Boots: Newer bunker boots are constructed using insulated leather with oil resistant rubber soles. All structural firefighting boots have steel toes to prevent toe injuries and a steel insole to prevent puncture injuries to the bottom of the foot.

INSPECTION

Firefighters must become familiar with their clothing. This familiarity helps firefighters maintain a sense of awareness when changes have occurred that might affect the clothing's performance. NFPA 1851 indicates that gear should be inspected after each use and go through an advanced inspection at least once a year. While NFPA 1851 permits the department to determine what constitutes "use," it is important to carefully examine gear after the firefighter has been exposed to fire ground contaminants or encountered other hazardous substances. Damage that may be encountered is listed below.

Routine Inspection

Conduct a routine inspection of garments after each use. Look for:

- Soiling
- Contamination
- Physical damage
- Damaged trim
- Damaged closures and hardware

Advanced Inspection

At a minimum, conduct inspection every 12 months or whenever routine inspections indicate that a problem may exist. Advanced inspection areas include:

- Moisture barrier and seam sealing integrity
- Fit and coat/pants overlap
- Seam integrity including broken or missing stitches
- Material integrity for loss of strength due to UV or chemical exposure
- Loss or shifting of thermal liner material
- Wristlet integrity and functionality
- Reflective trim and Velcro integrity, attachment and functionality
- Label integrity and legibility
- Liner attachment systems
- Closure system functionality

Some damage will be obvious, such as discoloration of the outer shell - often caused by high heat exposure resulting in the loss of dye. Rips, punctures, opened seams, and loose trim are obvious signs of

wear and tear, but several types of damage may be less evident. For this reason, some departments will specify a means of inspecting inside the thermal liner/moisture barrier combination. However, even with the ability to examine the inner layers, not all failures are visual. The film of the moisture barrier can delaminate or develop pin holes with or without visual changes and seam tape can become loose. Similarly, damage can occur to some thermal barriers without any sign of missing quilt stitching. Other changes can take place that cannot be discerned without testing. The best practice for inspecting clothing is to look at its condition often and to make note of any changes. If you cannot determine where degradation or a harmful condition has taken place, it is best to show your clothing to your supervisor. NFPA 1851 does provide field tests to help ascertain the condition of the gear.

CLEANING

Firefighter protective clothing must be kept clean to ensure its proper performance. Dirty gear carries less insulation, is more likely to conduct heat and electricity, lacks liquid shedding properties, and can potentially become flammable. Moreover, many fire ground contaminants are carcinogens and skin toxic chemicals. Turnout clothing needs to be cleaned regularly to prevent these problems. Remember, improper cleaning can also destroy clothing or worsen its protective performance. There are three types of cleaning: routine or gross, advanced, and specialized. First and foremost, it must be noted that all cleaning starts on the fire ground with gross decontamination.

Gross decon or routine cleaning is done on the fire ground, in large part to prevent firefighter exposures to carcinogens. Routine or gross cleaning is performed after any fire ground use where soiling has occurred. It involves brushing debris from the clothing, rinsing with water, and applying spot cleaning as necessary. It is a good idea to inspect the condition of the clothing during routine cleaning.

Advanced cleaning is more thorough and must be done at least every six months, or more frequently, depending on the use and condition of the clothing. Advanced cleaning involves hand washing the clothing in a utility sink or machine washing. In either case, proper procedures must be followed. The basic procedures and conditions for cleaning turnout clothing is outlined below (see Cleaning Procedures). Machine washing is most effective in a frontloading washer/extractor to limit damage caused by top-loading machine agitators.

Proper drying is equally important. As turnout clothing is thick and bulky, drying is slow. Nevertheless, machine drying at high settings will quickly ruin this clothing (even though rated for high temperature use). If machine drying is selected, be sure to use a no heat setting. It is best to hang clothing

for air drying inside and away from direct light, especially sunlight. The UV radiation in sunlight breaks down some of the fibers in turnout clothing. Drying time can be reduced by using a fan with heated air over the clothing. In some cases, clothing can be contaminated by chemicals or blood-borne pathogens. When this occurs, the turnout clothing must go through a specialized cleaning. Many departments also use contract facilities for cleaning their clothing.

Cleaning Procedures
All cleaning will be done per department policy.

Routine/Gross Cleaning

Perform the following steps after each use:

- Brush off debris
- Rinse with water
- Lightly scrub item with soft bristle brush, if needed
- Spot clean, if needed
- Inspect item
- Clean again as necessary

Returning to Quarters

Contaminated Personal Protective Equipment (PPE) and other equipment should be transported in an open or exterior compartment to maximize firefighter safety. If PPE is carried in an occupant area, it should be bagged to prevent cross contamination of areas normally occupied by personnel. Additionally, PPE and other equipment that is presumed to have been exposed to hazardous substances should be appropriately decontaminated prior to returning to service.

Advanced Cleaning

- Examine manufacturer's label
- DO NOT USE Chlorine bleach or chlorinated solvents
- Use cleaning solutions with a pH range of not less than 6.0 and not greater than 10.5
- No high velocity water jets such as power washers
- Clean and decontaminate protective ensembles separately from non-protective items
- Where shells and liners are separable, clean and decontaminate those items with like items (i.e., shells with shells and liners with liners)

Procedures when cleaning in a utility sink

1. Do not overload the sink.
2. Pre-treat if necessary.
3. Water not to exceed 105 degrees.
4. Add cleaning solution or detergent.
5. Wear protective gloves & eye/face splash protection.
6. Scrub gently using a soft bristle brush. Use care with moisture barrier assemblies.
7. Drain water from sink.
8. Refill sink; agitate gently using gloved hand or stir stick.

9. Gently wring out garments and drain water.
10. Repeat (7) and (8) until garment is rinsed.
11. Dry the elements.
12. Inspect and rewash if necessary.
13. Rinse out the sink.

Procedures for machine washing

1. Do not overload the machine.
2. Pre-treat if necessary.
3. Separate outer shell from liner.
4. Fasten all closures, including pocket closures, hook and loop, snaps, zippers, hooks and dee's.
5. Turn garment inside out and place in a mesh laundry bag.
6. Wash temperature not to exceed 105 degrees.

REPAIR

Turnout clothing can only be repaired by a facility that is certified in repairing turnout clothing, in accordance with the manufacturer specifications. Improperly repaired clothing can be unsafe, potentially resulting in failure. Always check with the manufacturer before making any repair

STORAGE

Proper storage is a must for maintaining turnout gear. The space should be away from direct sunlight, fluorescent light, contaminants, and objects that can physically damage clothing. The space should also be well ventilated. Never store firefighter clothing in living quarters or at home.

RETIREMENT

Deciding when clothing must be removed from service is difficult and requires the judgment of a trained person. The general rule of thumb is that clothing should be retired when it's considered unsafe, cannot be effectively cleaned or decontaminated, or the cost of repairs is more than half of the original purchase price. The lifespan of protective clothing is entirely dependent upon the types of exposures, frequency of wear, and the care and maintenance that have been provided. However, the service life of turnout gear can be drastically cut short, as short as two to three years, if it is heavily used, worn or improperly maintained. All PPE will be retired per manufacturer specifications and/or department policy.

SUMMARY

Firefighter PPE is the first line of defense against thermal insult. Therefore, it is

critical the inspections, cleaning, and maintenance are consistently completed to ensure the reliability and performance of the ensemble. Firefighters must follow the prescribed procedures for care and maintenance based on the manufacturer recommendations. Not doing so can greatly reduce the level of protection provided by the ensemble.

SELF CONTAINED BREATHING APPARATUS (SCBA)

Firefighter survival in the hazard zone is dependent upon a functioning Self Contained Breathing Apparatus (SCBA) and an adequate air supply. All SCBA users must be thoroughly trained in the proper care, use and maintenance of their SCBA. In addition to caring for and using the SCBA during normal conditions all firefighters must be able to operate their SCBA during emergency situations as well. This section overviews the SCOTT X3 PRO SCBA's currently used by member organizations of the NKCTC and the recommended use, care, maintenance and emergency procedures.

DEFINITIONS

Buddy Breathing: The practice of sharing a common air supply among at least two firefighters.

Progress Report: Location - Condition - Actions – Air - Needs.

EBSS (Emergency Breathing Support System): An engineered system built into SCBA for the specific purpose of augmenting air supply.

Hazard Control Zones

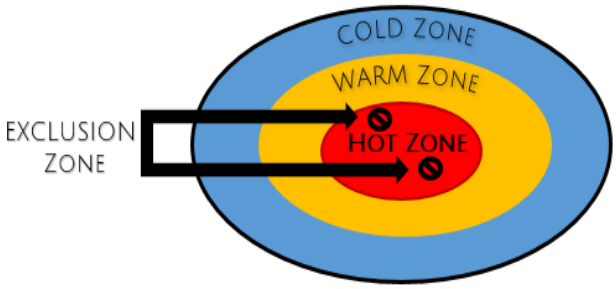
Cold Zone: The control zone of an incident that contains the command post and other support functions as deemed necessary to control the incident. The cold zone established the public exclusion or clean zone. There are minimal risks of human injury or exposure in this zone.

Exclusion Zone: The control zone designated to exclude all unauthorized personnel, responders and equipment. Examples of exclusion zones could be holes in the floors, explosive devices or collapse hazards.

Hot Zone: The control zone immediately surrounding the hazard area, which extends far enough to prevent adverse effects to personnel outside the zone. The hot zone is presenting the greatest risk to members and will often be classified as an IDLH atmosphere.

Warm Zone: The control zone outside the hot zone where personnel and equipment decontamination and the hot zone support takes place. The warm zone is a limited access area for members directly aiding or in support of operations in the hot zone. Significant risk

of human injury (respiratory, exposures, etc.) can still exist in the warm zone.



HUD: Heads-up Display

IDLH: Immediately Dangerous to Life or Health

RIC: Rapid Intervention Crew

SCBA: Self Contained Breathing Apparatus

UAC: Universal Air Connection

OPERATING PROCEDURE

Per WAC 296-305-04001, all members must have an annual fit test with their assigned mas. Checking for and achieving a proper seal every time the mask is donned is required for use. Facial hair shall not be allowed at points where the SCBA face piece is designed to seal with the skin on the face.

Members shall be allowed to use on the make, model and size respirator for which they have passed a fit test within the last 12 months.

In cases where there is a reported failure of the respirator, it shall be removed from service, tagged and recorded as such. It must be tested before being returned to service.

Premature removal of the SCBA must be avoided at all times. Especially during overhaul when smoldering materials may produce increased quantities of carbon monoxide and other toxic products.

SCBA shall be worn by all personnel working in areas where:

- The atmosphere is hazardous
- The atmosphere is suspected of being hazardous
- The atmosphere may rapidly become hazardous

Gross/field decontamination shall be performed on firefighters prior to removal of their respirator whenever firefighting activities resulted in exposure to a hazardous substance.

Each member of an Engine or Ladder Company or Aid Car shall be accountable for their own SCBA and shall check the condition of that SCBA at the beginning of each shift, after each use and at any other time it may be necessary to render the SCBA in a ready state of condition. If at

any time an SCBA is found to be functioning improperly, it shall be taken out of service per your departments SOP. Members operating in the Warm Zone of an incident (uncontaminated area just outside of the hazard zone), will operate wearing their SCBA in the standby position. Wearing the SCBA in these situation ensures that it will be immediately available for use if conditions change or if personnel are directed to enter an area where the use of the SCBA is required.

AIR MANAGEMENT

The goal of air management is to ultimately prevent firefighter fatalities while working in an IDLH atmosphere during fire ground operations. Air management for HazMat and confined space will be managed specifically within those disciplines. In the NKCTC, no one department has a policy of when to exit an IDLH. Typically it is an accepted practice to work until your low air alarm sounds. Being aware of your environment, depth into a building and the situation around you is an ongoing process. Exiting the ILDH prior to your low air alarm sounds is the culture we are striving for.

WORKING IN A HAZARD ZONE

Companies working on a task level objective at an incident in the hazard zone are at the greatest risk. No hazard zone management system can outperform unsafe behaviors at the task level. Task level responsibilities include:

- Wearing the proper PPE
- Being properly assigned into the hazard zone
- Properly using the passport accountability system
- Staying together as a company
- All members maintain orientation by use of hose line, rope or wall
- Always maintain an adequate air supply to safely exit the hazard zone
- No freelancing

The following rules will be adhered to at all times on the task level:

- The minimum number of personnel assigned to a crew or a team operating in a hazard zone shall be two firefighters with at least one portable radio. Crews or teams always go in and come out together. No member shall operate in the hazard zone alone.
- All personnel working in a hazard zone will either bring in their own hand line or work under the protection of a hand line located in their same geographic location
- All personnel shall be in contact with their Company Officer by either:
    - Voice (radio)
    - Vision (TIC)
    - Touch (hose line or rope)
- When Company Officers are reporting to command, it should be in the form of a Progress Report. This should be in the L.C.A.A.N

format (location, conditions, actions, air, needs).

- Company Officers shall also give an accountability report (PAR) upon exiting the hazard zone to either the IC or their assigned Division Supervisor.
- Any member whose job assignment is to operate outside of the hazard area is NOT to enter the hazard area without the express permission of the member's Company Officer.
- Members are totally dependent on the air that they bring with them into the hazard zone. We must base our operations around the realistic work times of our SCBAs. Company Officers must maintain awareness of their crew's air levels and the decision to exit the hazard zone must be governed by maintaining an adequate air reserve to deal with any sudden or unplanned events while exiting
- All members utilizing an SCBA in the hazard zone of an incident shall monitor the amount of the air in their SCBA cylinder as well as their rate of air consumption in order to exit the hazard prior to their low air alarm activation of the SCBA (33% of air left).
- It is critical that all three operational levels on the fire ground understand that the initial 67% of the crews air supply is to "enter the hazard area, work in the hazard zone and exit the hazard zone". The remaining 33% of the air supply is an emergency air reserve only to be used if an emergency occurs while exiting the hazard zone.
- Every member shall check their SCBA at the beginning of the shift to ensure that they have a full air cylinder. On the fire ground, every firefighter is responsible for managing their own air supply and frequently communicating the status of their air supply to their Company Officer.
- Prior to entry into the hazard zone, the company officer will brief his/her crew on the plan for achieving the tactical objectives, including a safe exit plan from the hazard zone with the crew intact. This ensures the crew has a "round trip ticket" into and out of the hazard zone.

PROGRESS REPORTS

As units operate on the fireground, periodic PROGRESS reports requested by the Incident Commander to help paint a picture for determining resource needs and assignments. A format for reporting is the **LCAAN** format:

- **L**ocation
- **C**onditions
- **A**ctions
- **A**ir (reported based on team member with lowest percentage)
- **N**eeds

BOTTLE AIR	AIR REPORT	SCOTT LIGHTS	4500 PSI BOTTLE	5500 PSI BOTTLE
100-75%	75+	2 green LED	4500-3375	5500-4125
70-50%	50+	1 green LED	3750-2250	4125-2750
50-33%	50-	1 yellow LED	2250-1485	2750-1815

Figure 1

To give a consistent air reading to the Command Officer during your progress report it should, regardless of the SCBA your department is currently using, we will no longer give air readings in PSI. We will use the 75+, 50+, 50- and 33 (format above) so the IC will have a better idea as to how long your work cycle in the IDLH can be. The goal is to exit the hazard zone during the active fire situation with 33% of your air remaining.

SCOTT AIR-PAK

The Consortium currently uses the SCOTT X3 Pro SCBA.

COMPONENTS

Face Piece: The AV-3000 face piece features include dual mechanical voice emitters and a nose cup which reduces fogging in the face piece.

First Stage Reducer: The pressure reduces cylinder pressure to 80-100 PSI.

E-Z Flow Regulator (M.M.R.): Second stage regulator contains several important functions:

- Donning/doffing switch
- Emergency bypass
- VIBRA ALERT alarm
- Regulator lock button
- Heads Up display

The EX Flow regulator will be referred to as the mas mounted regulator (M.M.R.) for the remainder of this document.

Audible/Sensor Module Assembly: This assembly serves two functions:

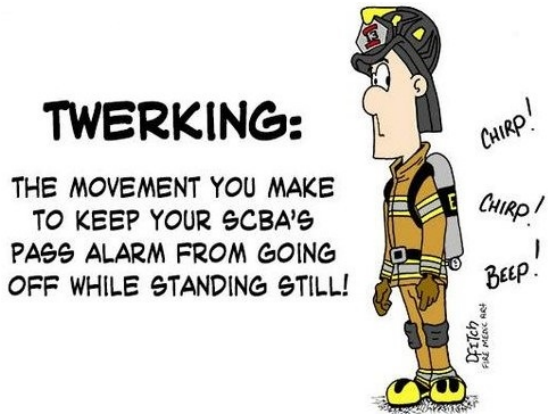
- Two speakers provide the audible tones for the PASS device.
- Houses the sensor module which is used to reset the pre-alarm for the PASS device.

PAK-ALERT: The PAK-ALERT (PASS) alarm is used to assist in locating a down firefighter. The PASS alarm system consists of a sensor module mounted to the bottom of the respirator pack frame, a pressure switch mounted between the cylinder and gauge line, and a chest mounted control console on the wearer's right shoulder strap.
The control console will be referred to as a PASS alarm for the remainder of this document.

Auto Activation: PASS alarm activates once the cylinder is turned on. This is indicated by 3 quick audible chirps followed by a flashing green light panel.

Pre Alert Alarm Tones: If the sensor module (located in the pack frame) remains

motionless for 20 seconds, pre-alarm ascending/descending tones will sound with alternating flashing (one per second) red panel lights. (See Fig. 5)
To reset the pre-alarm, movement must be generated in the pack frame (sway your hops). Moving the PASS alarm will not resent the alarm.



Full Alarm Tones: If the sensor module remains motionless through the 12 seconds of progressing pre-alarm cycle, the PASS alarm will go to full alarm. This is indicated by a continuous flashing red panel lights (See Fig. 6) and 3 tone chirps. Press the YELLOW reset button twice to restore to normal operation.

Manual Alarm: Press the RED button to manually activate the PASS alarm. Manual activation can be done when either pressurized or non-pressurized.

Vibralert: The Vibralert alarm device activates both during a low-cylinder condition and/or during failure of the primary pressure reducing valve. Vibralert's gentle vibration minimizes the chance the user's alarm will go unnoticed or be confused with another SCBA. A clicking vibrating alarm will begin to sound when the bottle pressure reaches 1815 PSI or 33T of its rated capacity.

Purge Valve: The purge valve is situated at the inlet of the breathing regulator and can be adjusted to provide a constant air flow of at least 125 liters per minute. The breathing regulator is arranged to direct the face piece's incoming air over the inner surface of the face piece lens for de-fogging purposes.

The airflow through the respirator when the bypass is in use can exceed 200 liters per minute. Partially closing the bypass can reduce air consumption.

Buddy Breathing System: EBSS (Emergency Breathing Support System). This feature combines a dual EBSS/Airline hose connection option. The buddy breathing system allows two users to share a common air supply and maneuver up to six feet apart while not exposing the recipient or donor to ambient air during connection.

Take note that the rescued firefighter will not have Heads Up display functions while connected through the EBSS to another firefighter's air pack. Once deployed DO NOT disconnect the EBSS hose.

Heads Up Display: The Heads Up Display provides a visual monitor of the air supply in the cylinder. The display is fitted to the

face piece mounted regulator and appears across the bottom of the firefighter's field of view through the face piece. The Heads Up Display consists of four rectangular lights to represent the cylinder pressure. The Heads Up Display (HUD) includes a photo sensing diode that adjusts the HUD in brightness depending on the ambient light source. The result is bright LED lights in full sunlight and batter saving dimmed LED in areas with no or little ambient light source.

Heads-Up Display Quick Guide	
Full Cylinder	2 green lights glowing
3/4 of a Cylinder	1 green light glowing
1/2 of a Cylinder	1 yellow light flashing SLOWLY
1/3 of a Cylinder	1 red light flashing RAPIDLY

Figure 2

Figure 3

Universal Air Connection (UAC): Per NFPA 1981 (edition 2018), all respirators are required to have UAC fitting mounted on the pack frame near the cylinder connection. This permits emergency air replenishment from another air supply source while in use.

There is NOT a UAC fitting located on the front of the air pack.

DO NOT confuse the UAC with the CGA bottle fill protective cap. The CGA is used ONLY for filling depleted SCBA cylinders.

The UAC manifold is fitted with a relief valve to bleed air if the rated pressure of the respirator is reached. UAC has one way check valve for receiving transfill air only. Not capable of providing air to other users.

Figure 4

Air Cylinders: SCOTT has created two types of 5.5 bottles for fire department use. A quick connector style and a threaded style. Each has a specific use. The quick connector cylinders are used for normal air pack use. The threaded 5.5 cylinders are for RIC use only and DO NOT have a quick connector fitting.

To replace the cylinder:

- Remove retention strap by lifting up on latch plate.
- Pull both SNAP-CHANGE locks horizontally away from the pressure reducer to release the cylinder connector.
- Remove the cylinder from the back frame.
- Inspect the high pressure seal in the inlet. If the high pressure seal is damaged or missing, remove the air pack from service.

High Pressure Seal

NOTE: A missing or damaged high pressure seal can result in air leakage.

To install the cylinder:

- Ensure the replacement cylinder has a protective cap installed on the Compressed Gas Assoc. (CGA) fitting.
- Ensure the new cylinder's connector is free of dirt and debris.
- Install new cylinder under cylinder retention strap.
- Orient the cylinder connector over the SNAP-CHANGE high pressure inlet.

- Engage the SNAP-CHANGE by pushing the cylinder connector firmly into the inlet until it clicks.
- Secure retention strap by pushing the latch plate downwards.

As mentioned above, each distinct type of SCBA bottles are for specific uses. Filling of each composite bottle is slightly different.

DONNING & DOFFING

NKCTC uses the 2 handed "over the head throwing method" or the "coat method" to don the SCBA while standing. Full PPE must be worn when donning from a standing position. Please refer to the check-off sheet.

Donning a SCOTT Air Pack:

- Open cylinder turning 2.5 turns.
- Listen for Vibralert activation.
- Check PASS alarm and chest gauge for activation.
- Don the air pack using either the coat or over the head method.
- Lean forward and pull the shoulder straps downward to tighten.
- Connect the bottom waist belt by attaching the main buckle to the V-Ring. The adjustment straps are located on both the left and right side of the body.
- Pull the waist adjustment strap forward to tighten.

Donning the Face Piece:

- Hold the face mask by the lens and strap at the base of head net.
- Place chin in first and pull net over your head.
- Tighten lower straps.
- Tighten upper straps by temple. If applicable, tighten the very top strap last.
- Check for negative pressure seal by covering the exhalation hole with your hand and breathe in sharply.

- Secure flash hood and helmet

Connecting the Regulator:

- Place 2nd stage regulator on face mask. NOTE: Red purge valve needs to point to the 12 o'clock position.
- Rotate regulator ¼ turn to the user's left until an audible click is heard.
- Breathe in. Inhalation will initiate the flow from the air pack.

All members should perform a buddy check to ensure all PPE is property in place before entering the hazard zone.

Disconnecting the Regulator:

- The stop flow of air, press Air Saver button located at the top of 2nd stage regulator.
- Push 2nd Stage locking tab outward.
- Rotate 2nd Stage regulator ¼ turn to the user's right until red purge valve is at 12 o'clock.
- Remove 2nd Stage regulator from face mask.
- Turn off air cylinder.
- NOTE: Air cylinder has an auto lock mechanism which requires user to push inward while rotating.
- Bleed air from system by opening purge valve.
- Once air is drained and with the purge valve open, press the yellow PASS alarm button twice to deactivate the pass alarm.
- Close the purge valve.

All members who deploy their SCBA during their shift must perform the SCBA ready state check off procedure before placing the unit back into service.

EMERGENCY PROCEDURES

Of a firefighter experiences the loss of supplied air, they must immediately notify their partner, if possible, to assist.
Either the firefighter or their partner calls "emergency traffic" to notify command of the emergency. The radio transmission should include:

- Unit identifier.
- What is the problem?
- Where are you located?
- What are your actions?
- What are your needs?

The distressed firefighter should also begin the following corrective steps to remedy the problem:

- If you are not getting any air, check your purge valve.
- If the purge valve does not work, check to ensure your bottle is turned on.
- If you are low on air but still getting air with a properly working SCBA, you should attempt to buddy breathe from a donor.
- If your mask has become damaged, you can breathe directly from the second stage regulator.
- If you still have air in the bottle, attempt to breathe directly from your bottle after disconnecting the 2nd Stage quick connect adapter.
    - If a first stage regulator failure occurs and air is remaining in your bottle, the bottle can be removed from your pack.
    - Disengage the 2nd stage quick disconnect as previously discussed.
    - Place the 2nd stage quick disconnect over the cylinder connector.
    - Slowly open and close the cylinder handle to allow air to enter the face mask.
      NOTE: This operation

requires two hands forcing the firefighter to remain in one place while rescuers attempt to locate them.

- The last option if you have depleted your supply is to attempt to filter breathe by pulling your flash hood over your face mask opening.

- Say as close to the floor as possible and control excessive breathing to delay possible CO poisoning. NOTE: The helmet strap must be disconnected prior to pulling up the flash hood.

Buddy Breather (aka Emergency Breathing Support System:

The EBSS can be used in three different operations:

- EBSS to another air pack (i.e. due to low air pressure).
- EBSS to SCBA mask (i.e. high pressure air leak).
- EBSS to supplied air (i.e. ladder truck air system).

Buddy to Buddy Breathing Operation:

1. Remove EBSS hoses from each SCBA pouch. NOTE: The rescuer firefighter may have to assist the injured/down firefighter.
2. Extend both 3-foot hoses and remove rubber protective covers.
3. Align female and male fittings. NOTE: Either fitting may be used to connect with.
4. Push the couplings together until they click. Exit the IDLH environment together.

EBSS to Regulator Disconnect Operation:

1. Remove EBSS hose from SCBA pouch.
2. Locate receiving firefighter's 2nd stage regulator connection adaptor.'
3. Use quick disconnect to remove 2nd stage airline from receiving firefighter's air pack.
4. Align female 2nd stage regulator fitting with EBSS male fitting.
5. Push fittings together until they click.
6. Both firefighters will not be using the same air pack.
7. Exit the IDLH environment together, if applicable.

Key Points to Remember:

- When using your buddy breather, remember that the system will work off the lowest pressure first to 100

PSI, then switches to the next highest pressure cylinder.
- When breathing from cylinder below 25% rated capacity all users Vibralert will activate.
- You can daisy chain multiple users to the EBSS system.
- The more users connected together, the shorter the duration of the air supply (more people breathing off one air source).

DAILY INSPECTIONS

The procedure for daily inspections are as follows:

- Visually inspect air cylinder for physical damage such as dents or gouges in composite wrapping.
- Check cylinder gauge. Cylinders shall be maintained with no less than 90% of the rated capacity, or 4,950 PSI for high-pressure cylinders. When practical, cylinders should be maintained full as possible.
- Check all hoses, buckles and cylinder restraint for wear and proper function.
- Check to ensure the Buddy Breather hose is in the pouch located on the waist belt.
- Check that the air saver button is pushed in and the purge valve is closed (rotate knob clockwise with the tab facing upwards).
- Slowly open cylinder valve fully. Listen for the Vibralert alarm to actuate then stop, the PASS to sound 3 quick audible chirps and ensure all five HUD lights initialize for 20 seconds followed by the cylinder level light. NOTE: Battery light will flash if replacement is needed.
- Compare cylinder valve and harness gauge. Readings must be within +/- 10% of each other. Also note green flashing light on PASS device indicating it is activated and operating.
- Inspect second stage regulator for damage and ensure that the regulator gasket is in place. NOTE: Cleaning of the regulator gasket with Fresh-Gear solution is recommended.
- Push in and rotate cylinder handle to close. Watch harness pressure gauge. Pressure must not drop more than 100 PSI in ten seconds.
- Open purge valve (counter clockwise with tab facing downward) and listen for air being released from the regulator.
- Observe the lights of the HUD and verify that they light properly in descending order. Close the purge valve when the gauge needle crosses the “1/3” mark but before the beginning of the red “EMPTY” band (see Fig. 9).
- The Vibralert end of service indicator alarm shall actuate (rapid clicking).

- The red light on the far left of the HUD shall flash rapidly at 10 times per second.
- After verifying that all alarms are functioning, open purge valve to remove air from the system. Turn off PASS alarm by pressing yellow reset button twice. The PASS alarm will sound a quick two tone chirp indicating the alarm is now inactive.
- Inspect the face piece seal and other rubber components for deformation, wear, deterioration, dirt, cracks, tears, holes or tackiness.
- Check the harness head straps for breaks, loss of elasticity, missing buckles and/or straps. Ensure the head harness straps are oriented correctly.
- Inspect the lens for cracks, crazing, bubbling, deformation, discoloring, gaps or holes. Any evidence of the damage mentioned to the face mask MUST be removed from service for further inspection by a Respiratory Specialist.

***Fresh-Gear disinfectant from Georgia Steel and Chemical Company is the recommended cleaner/disinfectant for all SCOTT products. If a recommended disinfectant is not available, you can disinfect the Mask Mounted Regulator (MMR) using the following solutions:*

- HypochloRICe solution (50 ppm of chlorine) made by adding approximately one millimeter (1 mL) of laundry bleach to one liter (1L) of water at 110°F/43°C.

AFTER USE INSPECTION

The "after use inspection" shall be performed each time an SCBA is used. Breathing apparatus must be thoroughly cleaned and disinfected prior to inspecting unit to avoid contact with hazardous contaminants.

1. Visually inspect air cylinder for physical damage. Check cylinder gauge ensuring proper pressure.

2. Check all hoses, buckles and cylinder restraint for wear and proper function.
3. Check that the air saver button is pushed in and the purge valve is closed (rotate knob clockwise with the tab facing upwards).
4. Test the battery level of the SCOTT air pack by manually pressing and holding the YELLOW reset button on the PASS alarm. The final light display will indicate the battery level. Green=good. Red=replace. NOTE: the pack frame lights will also display the above corresponding lights as well.

5. Disengage the quick disconnect fitting located on the second stage regulator airline. While pushing the plug "D" into the socket, pull the locking sleeve "E" back toward the guard. The plug "D" will separate.
6. Closely inspect the interior locking ridge for wear. If the coating is worn through and bare metal is showing, remove air pack for maintenance. Use of a worn quick disconnect may cause a loss of breathing air.
7. To reconnect, align the Heads-Up Display, plug with the mating connector and push plug "D" into socket until the locking sleeve "E" pops forward. Test for proper engagement by tugging on the coupling.
8. Slowly open cylinder handle fully. Listen for the Vibralert alarm to actuate, then stop and wait for the PASS to sound 3 quick audible chirps and ensure all five HUD lights initialize for 20 seconds followed by the cylinder level light. NOTE: Battery light will flash indicating replacement is needed.
9. Compare cylinder valve and harness gauge. Readings must be within +/- 10% of each other. Also note green flashing light on PASS device indicating it is activated and operating.
10. Remain motionless for approximately 20 seconds. Listen for PASS device pre-alarm to sound and for the green lights to change to a slow alternating flashing red light.
11. Reset PASS alarm by shaking the SCOTT pack frame.
12. Again, remain motionless until full alarm activates. Listen for distinctive increasing continuous 3 tone chirp to sound and the red light to flash rapidly.
13. Reset the PASS alarm by pushing YELLOW reset button twice.
14. Check the manual activation of the PASS device by pushing the RED manual button on the front of the unit.
15. Reset the PASS alarm.
16. Inspect second stage regulator for damage and ensure that the regulator gasket is in place. NOTE: Cleaning of the regulator gasket with Fresh-Gear is recommended.
17. Done face piece. Inhale sharply to automatically start the flow of air. Breathe normally from the face piece to ensure normal operation. Depress air saver button to stop the flow of air.
18. Push in and rotate cylinder valve to close. Watch harness pressure gauge. Pressure must not drop more than 100 PSI in 10 seconds.
19. Open purge valve (counter clockwise with tab facing downward) and listen for air released from the regulator.
20. Observe the lights of the HUD and verify that they light properly in descending order. Close the purge

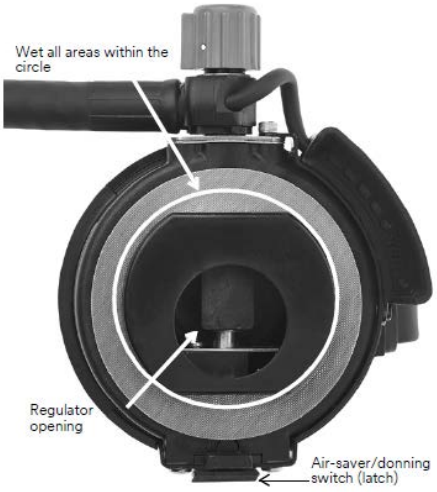
valve when the gauge needle crosses the “1/4” mark but before the beginning of the red “EMPTY” band.

21. The Vibralert end of service indicator alarm shall actuate (rapid clicking).
22. The red light on the far left of the HUD shall flash rapidly at 10 times per second.
23. After verifying that all alarms are functioning, open purge valve to remove air from the system. Turn off PASS alarm by pressing yellow reset button twice. The PASS alarm will sound a quick two tone chirp indicating that the alarm is now inactive.

CLEANING AND DISINFECTING

The face piece should be cleaned and disinfected after each use. To clean and disinfect the face piece:

1. Remove any obvious dirt from exterior of face mask. If the face mask is heavily soiled, it may be necessary to first wash the face mask with a solution of mild soap.
2. Remove nose cup from face mask. Spray nose cup with Fresh-Gear disinfectant/cleaning solution and rinse with clean water. ***Fresh-Gear disinfectant from Georgia Steel and Chemical Company is the recommended cleaner/disinfectant for all SCOTT products. If a recommended disinfectant is not available, you can disinfect the Mask Mounted Regulator (MMR) using a HypochloRICe solution (50 ppm of chlorine) made by adding approximately one millimeter (1 mL) of laundry bleach to one liter (1L) of water at 110°F/43°C.*
3. Thoroughly wash face mask with the Fresh Gear disinfectant/cleaning solution.
4. Rinse face mask thoroughly inside and out with clean water not exceeding 110 degrees Fahrenheit. NOTE: Hot water in excess of 110° can change the shape of some components.
5. Dry the face mask with a clean, link free cloth or allow the face mask to air-dry outside of the storage bags. Do not dry the parts by placing them near a heater or in direct sunlight. The rubber will deteriorate.
6. To clean the head harness, wipe off all surface dirt with a sponge dampened in cleaning solution. Wipe dry with a clean cloth.



If the air pack requires gross decontamination with hose:

1. With the second stage regulator docked, charge the air pack to prevent water or cleaning materials from entering the air system.
2. Sponge clean entire SCBA with mild soap and water.
3. Remove second stage regulator from belt docking bracket.
4. Inspect the inside of the regulator. NOTE: If excessive dirt or soil is present, remove the air pack from service for inspection by a Respiratory Technician.
5. For a quick cleaning/sanitizing the MMR, lightly spray the immediate surface area of the regulator opening with the Fresh-Gear cleaning/disinfecting solution.
6. NOTE: DO NOT immerse (submerge) the second stage regulator in water.
7. Dock the second stage regulator to prevent water from entering unit.
8. Rinse the entire SCBA with clean water.
9. Open the purge valve to clear any excess water from the second stage regulator.
10. Wipe down the components with a damp cloth and allow the SCBA to air dry.

SCBA FILLING

Before filling, visually inspect breathing air cylinder and valve assembly for physical damage such as dents or gouges in metal or in composite wrapping. Cylinders which show physical damage or exposure to high heat or flame, such as:

- Paint turned brown or black
- Decals charred or missing
- Pressure gauge lens melted
- Elastomeric bumper distorted
- Cylinders which show evidence of exposure to chemicals such as:
    - Discoloration
    - Cracks in the cylinder or the composite wrapping
    - Peeling of the outer layers of the composite wrapping
    - Bulging of the cylinder wall

Shall be removed from service and emptied of compressed air.
Check the latest cylinder hydrostatic test date to ensure it is current. The date of manufacture marked on the cylinder is also the date of the first hydrostatic test. Intervals for hydrostatic testing are established by the US Department of Transportation (DOT). Carbon fiber cylinders require visual and hydrostatic testing every 5 years with a service life of 15 years. Do not fill cylinders that have expired hydrostatic test date or exceeded the 15 year service life.

Filling a SCOTT Quick Connector Cylinder:

1. Remove the cylinder from the SCBA.
2. Check hydrostatic date and condition of the bottle.
3. Record the bottle number, date and condition in the cylinder log book at each filling station.

4. Place cylinder into the fill station containment chamber and remove CGA protective cover.
5. Connect filling station hose to CGA threaded fitting. NOTE: The CGA connection has a one way valve which makes it unnecessary to open the cylinder handle for filling.
6. Slowly fill the cylinder until it reaches 5500 PSI.
7. Remove fill hoses and replace cylinder into SCBA.

The pressure of a filled cylinde4r must not exceed the design filling pressure indicated on the cylinder label.

Composite material used in the manufacture of the cylinder is a good insulator so heat generated by the filling process takes longer to dissipate than with traditional metal cylinders. Consequently, a cylinder charged to normal filling pressure will reach temperatures in excess of 120° F (49° C) during filling. Particularly if filled quickly. Then, on returning to ambient temperature, the pressure inside the cylinder will drop slightly and the cylinder will not have a full charge. Topping up will be necessary to achieve a full charge; however, it is also possible to optimize filling procedures (e.g., by varying the speed of the filling) to achieve a full charge.
Slow Filling: Filling a cylinder slowly will significantly reduce the heat generated in the filling process. A maximum charging rate of 435 PSI/min (30 bar/min) or less is recommended.

Fast Filling: A Luxfer composite cylinder can be fast filled and reused if the cylinder is properly handled, well maintained and undamaged. However, the filler should take care not to exceed the maximum service pressure.

All in service SCBA cylinders shall be maintained with a minimum of 90% air fill capacity. (4950 PSI for 5500 rated cylinders and 4050 PSI for 4500 PSI rated cylinders).

RIC KITS

The NKCTC members use the SCOTT X3 Pro SCBA and the RIC PAK 3 RIC kits. This section is intended to provide users basic information regarding emergency procedures and compatibility to other SCBA manufacturers.
SCOTT X3 Pro Safety Features: SCOTT uses a buddy breathe system that allows more than one SCOTT user to breather from one SCOTT SCBA in the event of SCBA failure or loss of air. The safety system allows users to tap into another SCBA after the pressure reducer (second stage regulator). This system is not compatible with MSA users. See SCOTT X3 Pro section for more detail on the buddy breathe system.
All SCBA (regardless of manufacturer) have an NFPA required Universal Air Connection (UAC) located within 6” of the cylinder valve. The SCOTT X3 Pro UAC has a one way check valve that will allow the user to receive transfill air only. It will not allow a SCOTT user to give air (donor). SCOTT users do not carry a transfill hose and can only

receive transfill from an MSA user equipped with transfill hose or a RIC pack with transfill hose.

Figure 4

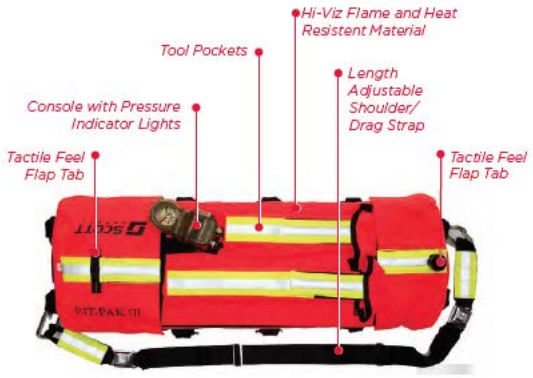


Figure 5

SCOTT RIC KITS

The SCOTT RIC Pak 3 is intended for use by Rapid Intervention Crew as an emergency source of breathing air to supply air for personnel as they are being evacuated from an IDLH environment. The SCOTT RIC pack 3 consists of a combination of LOW pressure and HIGH pressure supply assembly with a single 45-minute SCBA cylinder with an emergency regulator and face piece.

Figure 3

Exterior Remote Pressure Gauge:
The SCOTT RIC Pak 3 comes equipped with an external analog gauge showing the total available air pressure left in the breathing cylinder as well as an LED display with lights in the same format as the HUD display found on the air pack Second Stage regulators.

The gauge can be used to monitor air supply while dragging a victim to safety rather than forcing the user to open the RIC kit to visually examine the cylinder pressure.

Transfill Extension Hose:
The transfill extension hose is located in the front pouch of the RIC Pak 3 RIC Kit. This hose contains a male and female coupler

located on either end. The extension hose can be used to provide air supply by:

- Lowering to a disabled firefighter below grade (i.e. basement).
- Accessing a narrow void space (structural collapse).
- Locations where complete RIC team access may be limited.

In addition, the extension hose length can be extended with use of other extension hoses from other apparatus RIC kits. Once extended, the extension hose is connected to the female UAC coupler of the main RIC kit.

Low and High Pressure Air Supply:
The SCOTT RIC Pak 3 can be used to provide LOW and HIGH pressure air supply as well as a separate air system with an internal face mask. The determination of which supply type to use will depend on the compromised firefighter's status:

- An incapacitated firefighter low on air will most likely require an EBSS transfer since all available air supply will be used from both remaining bottles while the firefighter is sheltered in place.
- A mobile or lost firefighter low on air will most likely require a transfill hose operation who can then be assisted by rescuers on his own from the structure.
- A firefighter who has lost or damaged their face mask during operations will most likely require use of the complete air breathing system.

NOTE: These are only examples of operations. Ultimately the RIC team will need to determine the most beneficial choice for the distressed firefighter.

EBSS Hose Breathing Operation:

1. Turn on RIC pack air bottle.
2. Locate and disconnect the quick connect adapter on compromised firefighters SCBA.
3. Locate buddy breathing connection (dual EBSS) from RIC pack.
4. Connect to the RIC dual EBSS connection.
5. If firefighter is unconscious and immobile, remove out of service SCBA, leave connection in place and secure RIC pack for packaging and extrication.
6. If firefighter is unconscious and immobile, remove the out of service SCBA, leave connection in place and secure RIC pack for packaging and extrication.

EBSS to Regulator Disconnect Operation:

1. Turn on RIC pack air bottle.
2. Locate and disconnect the quick connect adapter on compromised firefighters SCBA.
3. Locate buddy breathing connection (dual EBSS) from RIC pack.
4. Connect to the RIC dual EBSS connection.

5. If firefighter is conscious and mobile, remove out of service SCBA, remove out of service SCBA from compromised firefighter and exit structure.
6. If firefighter is unconscious and immobile, remove the out of service SCBA, leave connection in place and secure RIC pack for packaging and extrication.

Safety Note!

Special attention should be given to the EBSS hoses during RIT operations. The EBSS operates at low air pressure which allows for greater hose flexibility but less protection makding the hoses more susceptible to easily beingy cut, damaged or kinked.

High Pressure Supply (Transfill):

The Transfill hose extends from the first stage reducer and is equipped with a coupling which fits all air packs that contain a UAC (Universal Air Connection) system.

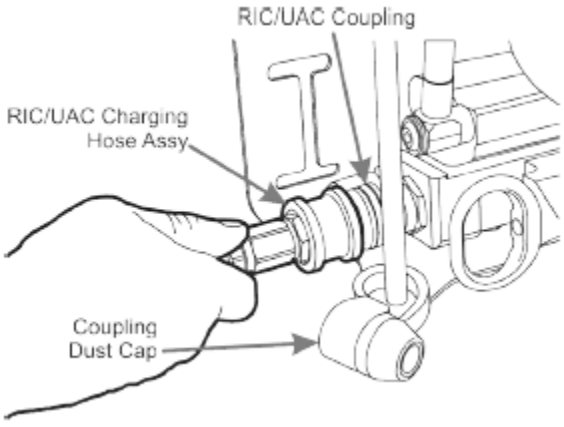


Figure 6

UAC Transfilling:

1. Turn on RIC pack air bottle.
2. Located transfill connection (UAC) on compromised firefighter's SCBA.
3. Locate transfill hose from RIC pack.
4. Connect transfill hose to firefighters SCBA transfill connection (UAC)
5. If firefighter is conscious and able to self-extricate, transfill for 30-60 seconds, disconnect hose and exit the structure.
6. If firefighter is unconscious and immobile, leave connection in place and secure RIC pack to firefighter for packaging and extrication.

Emergency Air System:

The SCOTT RIC Pak 3 can be used to provide air to a victim whose air pack has completely failed or has lost its air supply entirely. The SCOTT RIC pak 3 operates similar to the SCOTT air packs; however, it has significantly different safety features suited for rescue purposes only.

SCOTT Model AV 3000 Facemask:

The SCOTT RIC facemask does not contain a nose cup or voice emitters. It also has a specially designed head harness for easier installation

Second Stage Regulator:
The SCOTT Second Stage regulator does not contain an HUD display. The visual air level display is located on the remote pressure gauge as mentioned earlier.
NOTE: It is imperative that rescuers periodically monitor the victim's air supply through the remote pressure gauge or cylinder level.

Emergency Air System Operation:

1. Turn on RIC kit air cylinder and ensure proper startup operations.
2. Locate victim firefighter and determine emergency air supply needs (i.e. lost face mask).
3. Remove the facemask from RIC kit.
4. Place facemask chin cup against victim's chin, pulling head net over their head.
5. Pull bottom "O" rings to tighten face mask.
6. Open bypass to help with clearing mask.
7. Finish adjusting face mask straps as necessary.
8. Package victim for removal from IDLH environment.

NOTE: Ensure the RIC system is drained of air after operation and prior to storing. Otherwise the PASS alarm will continue to draw power from the batteries until depleted.

Safety Note!

Special attention should be given to the EBSS hoses during RIT operations. The EBSS operates at low air pressure which allows for greater hose flexibility but less protection makding the hoses more susceptible to easily beingy cut, damaged or kinked.

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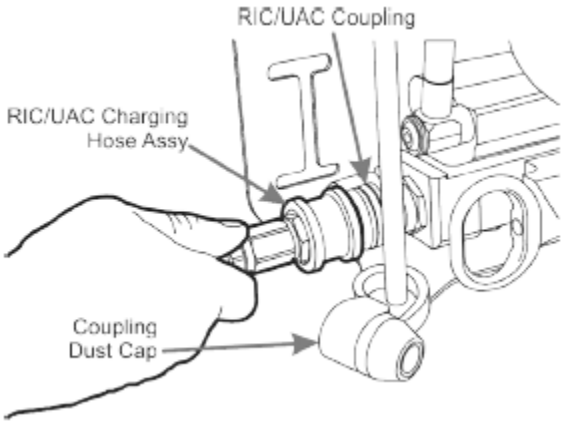

Figure 8

UAC Transfilling:

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6. If firefighter is unconscious and immobile, leave connection in place and secure RIC pack to firefighter for packaging and extrication.

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3. Remove the facemask from RIC kit.
4. Place facemask chin cup against victim's chin, pulling head net over their head.
5. Pull bottom "O" rings to tighten face mask.
6. Open bypass to help with clearing mask.
7. Finish adjusting face mask straps as necessary.
8. Package victim for removal from IDLH environment.

NOTE: Ensure the RIC system is drained of air after operation and prior to storing. Otherwise the PASS alarm will continue to draw power from the batteries until depleted.

FORCIBLE ENTRY

In emergency situations, where rescue or the prevention of fire spread is involved, little consideration should be given to property damage when gaining access. Other times, when gaining access for non-emergent issues, proper care should be given to the amount of damage caused from forcing entry. In addition, other factors, such as securing the building after the alarm is cleared, should also be considered prior to forcing openings. It is important to apply the correct level of force in each situation.

Forcible entry can be a very challenging and dynamic task on the fire ground. Forcible entry is defined as: the techniques used to get into or out of buildings or other areas of confinement when normal means of entry are locked or blocked. Forcible entry requires strength, knowledge, technique and skill. This chapter covers forcing entry through inward swinging, outward swinging, roll up doors and other types of entry hardware.

DEFINITIONS

Adz: The 2" flat blade located on the same end of the Halligan as the pike.

Adz, Fork, Adz: A mnemonic to assist in what first steps to take with the Halligan while attempting to force entry on an inward swinging door.

Arch: The inside curve on the fork end of the Halligan tool where the two blades of the fork are joined. Also called the "Crotch."

Bevel: The curved side of the fork end of the Halligan tool.

Bolt: The locking mechanism found on dead bolts. Usually square or round that slides into the strike approximately 1".

Crossing the Tools: A striking technique that gives the striking firefighter the greatest chance of hitting the prying tool and not the other firefighter.

Crotch: See "Arch."

Circular Saw: Also called rotary saw. A gas powered saw with blades that are matched to the material to be cut. They may be used to cut wood, metal, and/or concrete.

Door Stop: The portion of the door frame that prevents the door from swinging past the frame.

Drop Bar: A security device that can be mounted across the interior of the door at any point. The bars are held in place by brackets, which may be fastened to the door frame. These brackets may be indicated by exterior hex, elevator, or carriage bolts.

Flat Head Axe: The primary striking tool used in forcible entry. The blade of the axe can also be used as wedge to capture progress while prying.

Forcible Entry: The techniques used to get into or out of buildings or other areas of confinement when normal means of entry are locked or blocked.

Forks: A steel wedge on the opposite end of the adz. The wedge has a split in the middle that makes the fork.

Gap the Door: The initial opening made in between the door and the frame to create a purchase point.

Gap, Set, Force: Fundamental steps on how to force entry.

Halligan Bar: This multipurpose tool for prying, twisting, punching, or striking. It consists of a fork, adz, and pike.

Halligan Arch – The inside curve of the forks
Halligan Bevel – The outside curve of the forks
Halligan Crotch – Where the forks of the Halligan meet
Halligan FF – Firefighter operating the Halligan

Hydra Ram or Rabbit Tool: A hydraulic forcible entry tool.

Inward Swinging Door: A door that swings AWAY from you and into the compartment.

Irons: A set of forcible entry tools, usually

consisting of a flat-head axe and a Halligan tool.

Key-In-the-Knob Lock: As the name implies, the locking mechanism is part of the knob. These locks are found on both residential and commercial style doors.

Key Tool: A set of tools used in conjunction with K-Tool/Rex. The Key Tool is designed to manipulate internal lock mechanisms after the cylinder has been pulled.

K-Tool: A tool designed for pulling lock cylinders limited to low profile mortise and rim locks.

Life – Lift – Layout: This is the process of checking behind the door and sweeping for victims, assessing pressure and smoke behavior and lastly identifying the layout of the interior construction. This should be done every time you force a door.

Marrying Tools: A striking technique that gives the striking firefighter the greatest chance of hitting the prying tool and not the other firefighter.

Mortise Locks: Are designed and manufactured to fit into a cavity in the edge of either a metal or solid wood door. They have a solid, threaded key cylinder, which is secured in place by setscrews.

Mushrooming: This is common damage found on steel striking surfaces.

New York Hook: A steel shaft hook with a distinctly shaped head. May also be referred to as a Halligan Hook. It is available in 4', 6' and 10' lengths.

Outward Swinging Door: Door that swings TOWARD you and away from the compartment opening.

Pike: The Pike is a 4" metal spike orientated at 90 degrees to the adz on a Halligan.

Panic Hardware: An exit device which is tested for use on a door that is required to have panic hardware but cannot be used on a fire door. Panic hardware typically has the dogging feature, which allows the latches to be held retracted to create a push/pull function.

Rim Lock: A surface mounted cylindrical lock typically found on residential or exit device equipped doors on commercial buildings.

Setting the Tool: Driving the Halligan tool into the gap until the arch of the fork is

even with the inside edge of the door stop. The command would be “Drive.”

Shocking the Door: A method of striking the door to determine the location of locking devices.

Shoulder: (See Halligan) The topside of the fork end at the shaft on a Halligan. The joint where the forks attach to the shaft of the Halligan is ground down to form a 90 degree angle. This “modification” is an acceptable industry standard and can be used as an alternative striking surface.

Strike Plate or Keeper: Usually a brass plate attached to the inside of the jam where the latch/bolt throws into.

Striking FF: Firefighter operating the flat head axe.

Thru-the-Lock: Gaining entry by attacking the locking device and opening the door with little or no damage to the door and/or frame.

Wedge: A wedge (wood or aluminum) is used to capture progress while prying. They also can be used in conjunction with a Halligan to increase range.

COMMANDS

Hit – FF hits the Halligan once
Drive – FF hits the Halligan repeatedly until told to stop
Stop – Stop hitting
Wedge – Capture progress by placing axe head, wedge in-between door and jam
Help – Axe firefighter assists with pulling or pushing Halligan

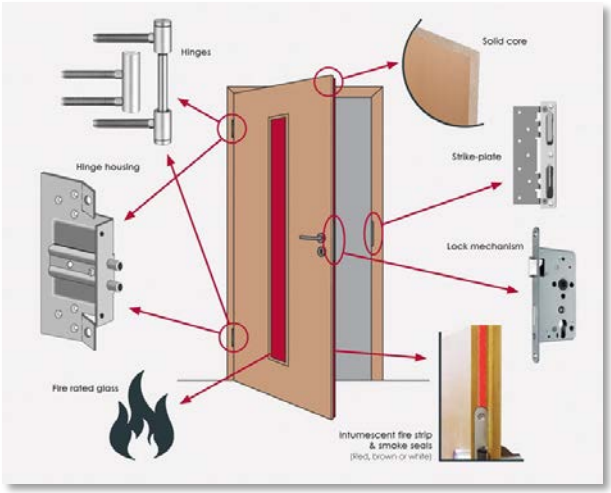
SIZING UP THE DOOR

The first step in sizing up a door is to determine the basic construction features and the direction the door opens. It should also be noted that during fire conditions we should always evaluate the conditions and check the door for heat prior to forcing entry. In addition, once the door is forced it should be controlled and the pressure in the space should be evaluated. At no time should a door be able to simply remain open contributing to the flow path.

Basic door construction features:

- Door – Wood, metal clad, solid, or hollow core
- Stop – Part of the jamb that stops the door
- Jamb - The frame
- Hardware - The handle, hinges and other components
- Locking mechanism - rim lock, knob-in-key, security chain, mortise lock and dead bolt

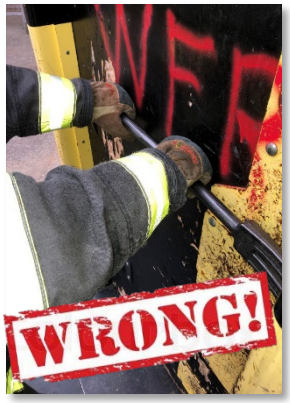
FORCING – INWARD SWINGING DOOR



(Adz – Fork – Adz)

<u>Always try before you pry</u>. If the door is locked, use the Gap-Set-Force method to force entry through an inward swinging door.

1. Size up the door and look for safety hazards. Inspect the door to identify locations of locks. Place your **<u>adz</u>** between the frame and the door, and pry away from the pike to "gap" the door.
2. "Set" your **<u>forks</u>** with the bevel towards the jamb. Work in conjunction with the striking FF to "set" the forks to the proper depth. The communication between the Halligan FF and the striking FF is, **HIT** (single double-tap hit), **Drive** (continuous hits), **Stop**, and **Wedge**. While working together to "set" the forks, be sure to cross the tools and hold the Halligan bar with your palms up. This keeps your elbows tucked next to your body. Always keep your hands away from the outside of the adz. To achieve a proper depth for the forks, the "crotch" must be even with the backside of the stop.
3. Once the Halligan is firmly in position, with open palms push the Halligan towards the door. Once you have reached your maximum throw, call for a wedge. This is where the striking FF captures your progress with either a wedge or the blade of the axe.



4. If the door does not open, place the bevel towards the jam and reset the forks into the crotch and push the Halligan towards the door. If the door does not open, capture your progress with a wedge.

5. Place the **adz** behind the door frame to gain the greatest leverage. Move the Halligan away from the pike.

Once the door is forced, control the door, check for pressure, and if safe allow it to swing open. By swinging the door fully open you can verify that a victim is not behind the door. While the door is open, check for **life – lift – layout**. This includes checking behind the door and sweeping for victims, assessing pressure and smoke behavior and lastly identifying the layout of the interior construction. Once you have that information, control the door by grabbing it with the adz on your Halligan. Again, open doors are ventilation points, and can contribute to the flow path, therefore, doors must be controlled until fire attack operations begin.

FORCING – OUTWARD SWINGING DOOR

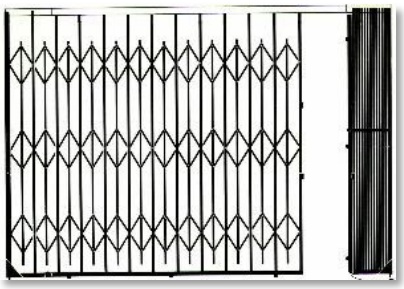
(Don't "fork" with an outward swinging door)

Outward swinging doors are typically found in commercial occupancies. Exits in most commercial occupancies require outward swing doors to meet the exiting requirements outlined in the Uniform Building Code. These doors typically have the hinges exposed which can be removed to make access.

1. Size up the door, looking for any safety hazards. Place the adz end of the Halligan between the door and the frame, either near the locking mechanism, or between the mechanism and any secondary lock. Have the forks of the Halligan pointing towards the hinge side of the door.
2. Once the Halligan is in position, using the flat head of the axe, drive the adz gap on the command "Hit." It will be necessary to pry the Halligan up and down to
3. "crush" the door inward, providing more space for the adz to get past the jamb and behind the interior surface of the door.
4. Once you have ensured the adz is set to the proper depth and is grabbing the backside of the door, clear any trip hazards behind you, and pull the Halligan toward you forcing open the door. As stated previously, maintain control of the door and don't create uncoordinated ventilation points.

ADDITIONAL SECURITY FEATURES

Some doors have security features that create additional challenges and may require other techniques to gain access.



Typically, before you can open doors with additional security features, such as an exterior gate, a padlock must be re- moved. Cutting the padlock with bolt cutters is not recommended as the padlock hasp is made of harden steel. Using the pike of the Halligan and striking downwards with a flat head axe will typically open a padlock.

DROP BAR HARDWARE

Four bolts on the outside of a metal door can indicate the presence of a drop bar. Using the same technique as explained for outward swinging doors, concentrate efforts in the area where the two bolts are located on the non-hinge side. Once drop bar confirmed, attack carriage bolts.

CYLINDER PULLING

Deciding to go thru-the-lock can be at times the fastest and best option with proper training and knowledge of the locking system. Below we will cover pulling the locking mechanism and manipulation of the lock with the key tool. There are many ways to pull cylinders and the tools share a synonymous purpose but some tools work better than others.

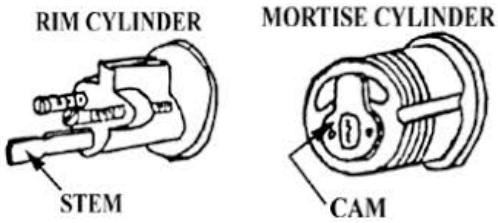
Certain locks in this section are more prevalent in certain occupancies than others. Look and examine while in your area to help recognize these locks. From the exterior, it's hard to tell what you have but most of the technique will be the same.

Mortise Lock: One way of gaining access to this lock starts with pulling the cylinder. The K-tool and the rex tool use similar techniques to pull the cylinder from the lock. There are several types of commercial mortise locks: sliding dead bolt, hook and latch, self-closing, and the swinging deadbolt. The objective is still the same -

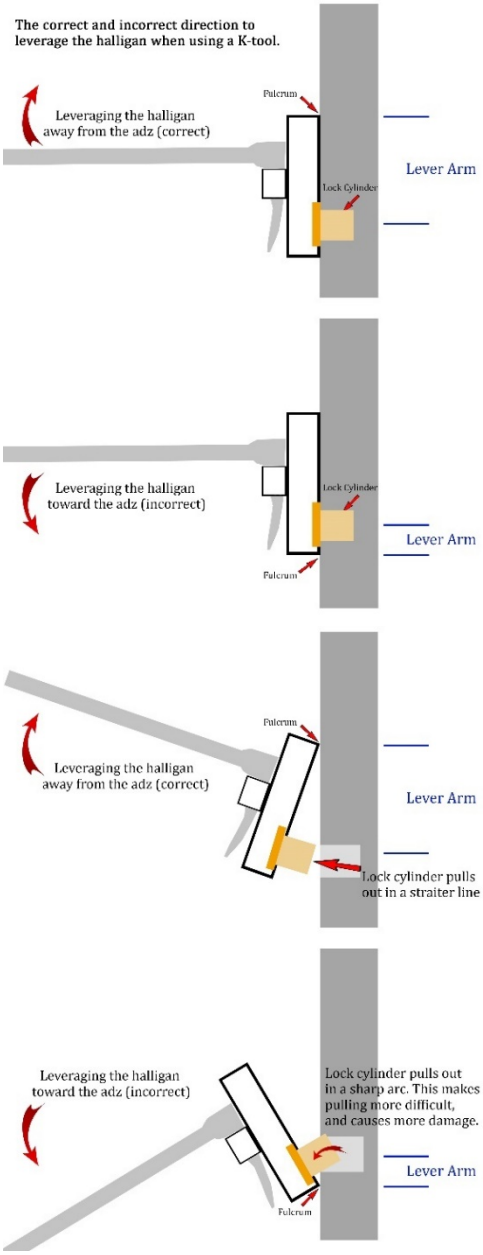
pull the cylinder and manipulate the locking mechanism.

Steps to force the Mortise locks:

- Set the K-tool/Officers tool firmly on the cylinder, tapping the tool into place just enough to bite into the lock.
- Remove the cylinder by pulling up first and then side to side.
- Insert the correct key tool. The back of the locking mechanism you pulled will give you the idea of
- what key tool to use and what lock your dealing with.



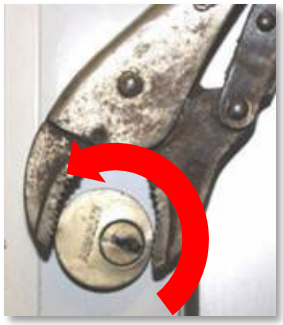
- Now rotate the key tool. If the mechanism is found at 5 o'clock, rotate toward 7 o'clock; if found at 7 o'clock, rotate toward 5 o'clock. Right to left or left to right
- If mounted with a doorknob, it may have a latch that may be connected to a second assembly.



Pulling the cylinder with Vise Grips

Another way to pull the cylinder is to use vise grips and simply rotate the cylinder counter clockwise to unthread the cylinder. Some locks have a free spinning collar that prevents the vise grips from grasping the cylinder, so you can either jam a flat head

screw driver between the collar and cylinder or dent the collar into the cylinder to acquire a strong bite. That will allow the cylinder and collar to move as one. Once pulled, manipulate the lock as you would normally.



TUBULAR DEAD BOLT

When forcing a deadbolt, you may find that it is too wide or too deep for a K-tool or a rex tool to bite into. Sometimes it's necessary to dig a little into the door to get behind the lock to defeat the two attaching bolts. On some softer doors, placing an axe behind the tool will prevent punching into the door while leveraging the lock out.

Steps to force the dead bolt:

- Remove the cylinder by pulling it out with either the Officer's tool or K-tool.
- Insert key tool.
- Rotate to open.

Pro tip: Place the Officer's tool at an angle to start the operation. Using the Officer's tool would be the preferred method on most of these locks due to its ability to get a better bite behind the cylinder. Mangling the lock will most likely result in having to use conventional forcible entry techniques.

RIM LOCK

These locks are usually installed as an add-on lock. They are installed on the inside surface of the door (with the cylinder extended through the door to the exterior). The back of the rim cylinder has a stem, which is inserted into the backside of the lock. As the key is rotated in the cylinder, **the stem** on the back end of the cylinder rotates the latch or bolt, which locks or unlocks the lock.

Too Deep

Too Wide

Using a Lock Puller (Officer's Tool / K-Tool)

- Set the lock puller behind the cylinder, getting a secure purchase.
- **Pry up** on the lock puller, pulling the cylinder from the door.
- The back plate is either pulled through the opening or the set screws are ripped from the back plate. (Sometimes a spring loaded shutter is installed so when the cylinder stem is pulled out the key opening closes and is inaccessible. At this point punching out the lock with the pike may be needed to gain access.) If not...
- Insert correct **key tool** and turn, unlocking the lock.

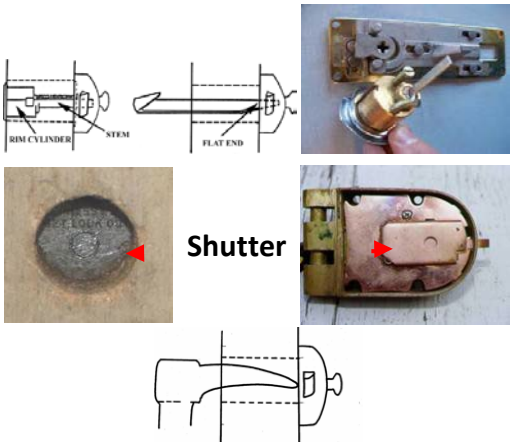
KEY-IN-THE-KNOB LOCK

As the name implies, the locking mechanism is part of the knob. These devices are found on both inward and outward swinging doors. The spring latch on the majority of these locks enters the striker approximately ½".

Forcing the key-in-the-knob lock - Using the Officer's Tool

The doorknob can be removed simply and quickly with the Officer's Tool, without damaging the stem assembly.

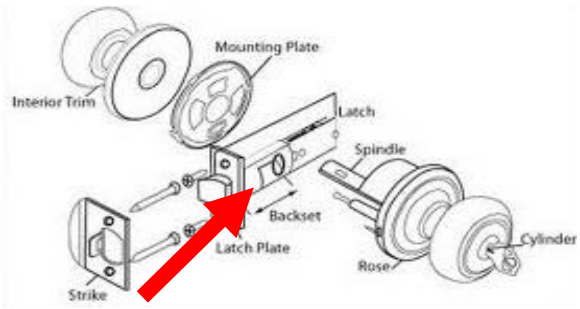
- If the **door is hollow,** an axe can be placed behind the tool to give the fulcrum a substantial base to pivot off.
- After the doorknob is removed, insert the stem of the Key Tool into the slot (if present) or into the back of the spring latch and pull or twist toward the hinge side of the door to activate the latch.
- If the lock has a shutter guarding the mechanism, drive the lock off the door with the Adz of the Halligan.



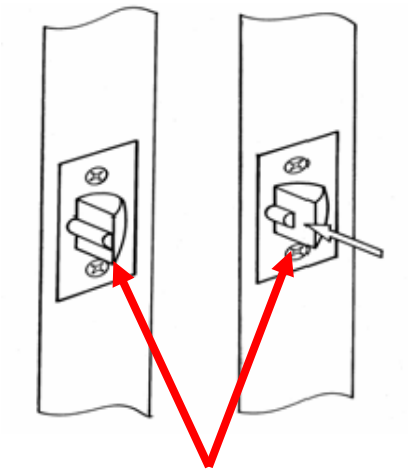
Forcing key-in-the-knob locks – Outward Swinging Doors

Key-in-the-knob locks on outward swinging doors have a simple spring latch which can be slipped back (opened) with a flat tool such as a **Shove Tool.**

At times there is a simple device known as **anti-loiding pin**, which may be added to the latch. This pin prevents the insertion of the shove tool without moving this pin first.



Insert key tool here and turn like a knob



Anti-loiding pin

Lastly, a flathead screw driver can be used to pry the center of the knob out in order to manipulate the lock.

OVERHEAD ROLL UP DOORS

Overhead roll up doors are commonly found on the exterior of both residential and commercial buildings. In most instances, they are the door that provides access to garages and loading areas. These doors can also be found inside the building to provide separation and/or security. They can also provide extra security when mounted over or behind other doors or even windows on the exterior. They come in four common types: Sheet Curtain, Rolling Steel, Sectional, and Slab/Tilt-Up. The three types that we most commonly encounter are Sheet Curtain, Rolling Steel, and Sectional. The primary cut sequence that we use in Zone 1 is commonly referred to as the "West Coast Cut." Some advantages of this cut are:

- This technique will work on all four common door types
- It creates a large, unobstructed opening with no hose obstructions or trip hazards
- You have control of the door and opening until you are ready to make access
- It is not necessary to alter or attempt to secure the track

- The overhead is not blocked by the door, so it is available for access by the hose lines
- There is no heavy door above the heads of firefighters making entry

The "West Coast Cut" Consists:

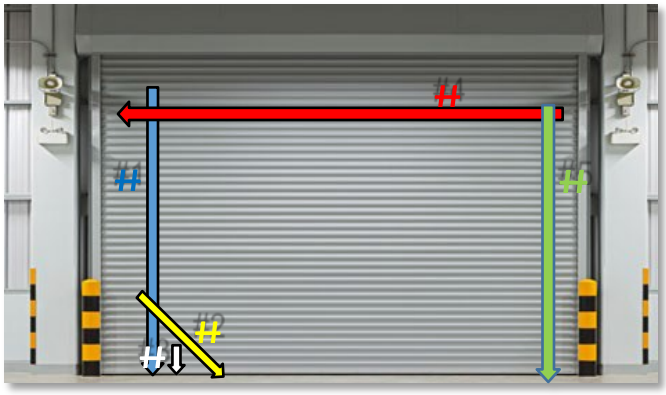
Cut 1 - Size up of the door. Understand what type of door it is and which direction you would prefer to do your cuts. Your first cut will be your vertical cut. Start about 1'-2' from the door jamb or edge. Start high (about head high) and cut to the ground. Keep your RPMs up and let the saw do the work. The saw shroud and power head will most likely prevent you from finishing your cut all the way through the bottom angle iron.

Cut 2 - To finish your vertical cut you will have to make a 45 degree angle cut from your vertical cut to the ground. This cut will make a triangle big enough to reach your saw through to finish your vertical cut. Again, your saw shroud will stop you before you reach the bottom. If possible, bend the triangle of material towards you so that you can visualize the bottom angle iron you are cutting. If not possible/practical, force the small triangular section of the cut sheeting to the ground away from you.

Cut 3 - Your third cut will be through the angle iron at the base of the door. Make sure it is completely cut through.

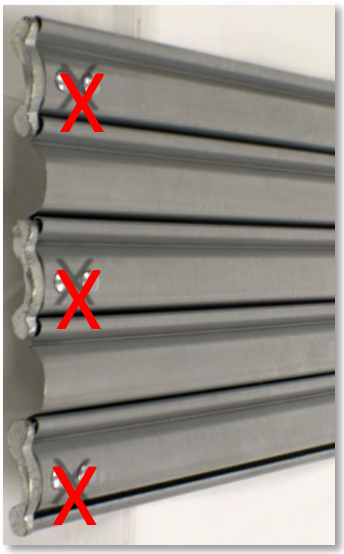
Cut 4 - Your fourth cut will be a horizontal cut. For best success, make your cut at shoulder height starting from the side of the door opposite of your vertical cut. Cut from one end of the door to the other, overlapping the vertical cut. Keep the saw at shoulder height and saw at full RPM.
Cut 5 – If a swing hinge is not needed, then vertically cut opposite cut 1 to complete the opening to allow the removal of the sections.

If, for various reasons, you find it necessary to start on the same side of your vertical cut and cut away from the vertical cut, leave a small (approximately 1') "tab" to hold the door in place. This will prevent the door from folding down on you and also leave the door intact until you are ready to make access. When ready, cut the "tab" away to complete the door. When complete you can simply swing the door open using the uncut side as a hinge. Make sure you keep the door between you and any potential fire.



SHEET CURTAIN

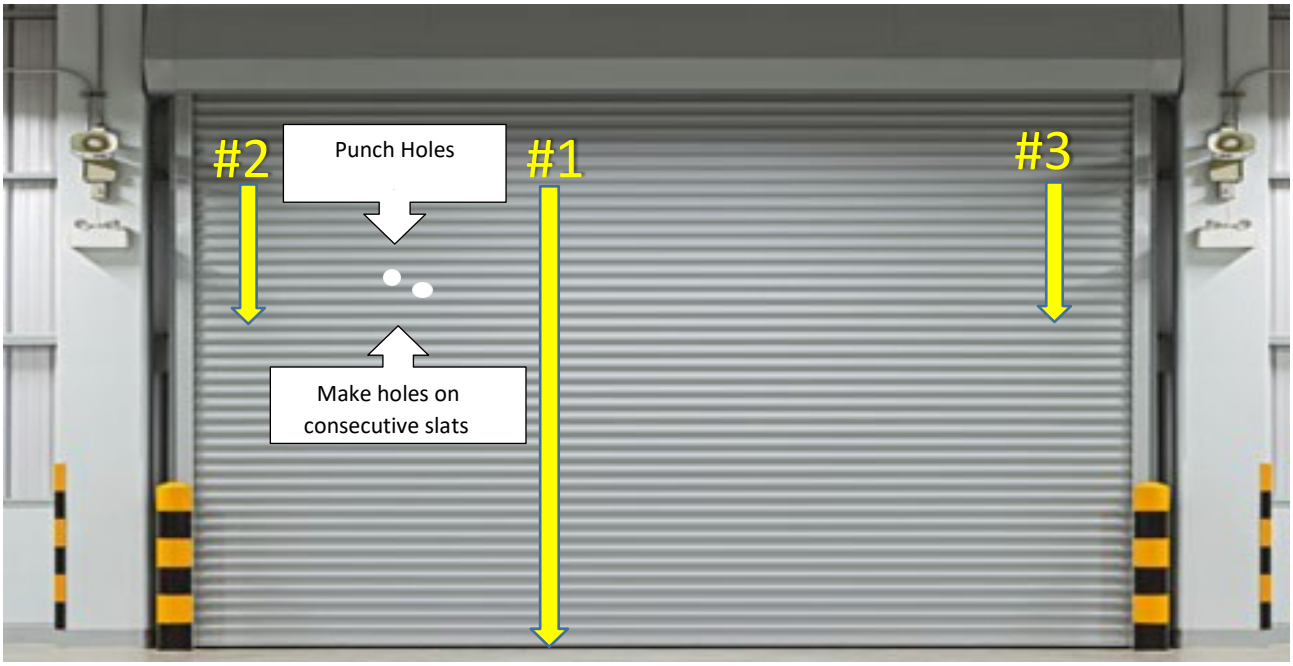
Sheet Curtain doors are one piece of material that rolls up around itself.



ROLLING STEEL

Slat removal method

Another cut option on rolling steel doors is to make one initial cut and attempt to remove one slat and, thus, allow all of the door below that point to fall to the ground. In most cases, the doors are constructed so that every other slat has a guide bar engaged in the track (see picture below left) so if the first attempt to pull a slat is unsuccessful, try to pull the one above or below before moving on. If it remains engaged it may be built like the picture below right, with every slat engaged in the track. If this is the case, then a second cut near the track will be necessary to bypass these guides.



- Start with cut #1 at the approximate ⅓ point
- Pull the short side first, then pull the long side (see slat pull picture below)
- Start about head high and cut as low as possible
- If unsuccessful, make cut #2 and try again to pull a slat
- If that is successful, make cut #3 and pull the long side

If still unsuccessful, you can always make the full "West Coast Cut" and open the door.

Punch Method

Prior to making cuts, identify two consecutive slats at head height, on the short side of cut #1. Punch the pike tip of your Halligan bar into the center of each slat with hits from an axe. Complete cut sequence with a saw.

Then insert your pike tip back into either hole and with an axe drive the Halligan towards your cut #1 with an axe. If slat does not move, repeat technique with the second hold.

SECTIONAL DOORS

Sectional doors may be cut utilizing the "West Coast Cut." When doing so, be sure

to make your horizontal cut mid panel so as to avoid the extra reinforcement and steel at the intersections for hinges, etc.

SLAB/TILT UP

Slab/tilt up doors can be metal, wood or combination materials. The "West Coast Cut" is effective on these doors. Consider the materials of the door and choose the appropriate saw.

SUMMARY

Forcible entry, like most firefighting skills, will perish without constant practice. Getting to know your first due and the locations of challenging buildings and doors will assist you in gaining access when forcible entry is necessary. Sometimes the fastest way in is the door next to you.

Performing a good size up and doing the appropriate amount of damage is paramount for good forcible entry.

SEARCH & RESCUE

Search and rescue operations are a primary function of the fire service. With such a high emphasis placed on saving lives, firefighters must learn how to safely and effectively search occupancies involved in fire. The following section will review some critical tactical issues that should be considered and overview basic search techniques that will help locate occupants.

DEFINITIONS

All Clear: A benchmark that is only reported by the Incident Commander (IC) over the tactical frequency that denotes no occupants are in the hot zone. This benchmark is announced after the completion of both primary and secondary searches.

Bump Up: This is the process of maintaining crew integrity while conducting an oriented search. A crew, while conducting search, may discover a door leading to another compartment. In this case, the "door person" may be required to move up and maintain orientation at the next opening. This action is referred to as "bumping up."

Control Zones: The incident commander shall provide for control of access to hazardous areas of the incident scene.

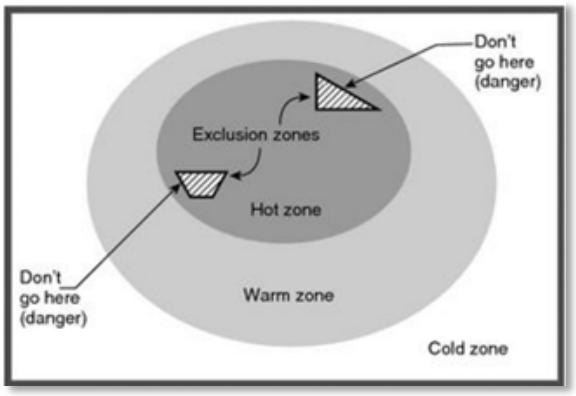
Procedures shall identify methods for identification of hazardous areas and communication of necessary protective equipment and other protective measures necessary to operate in the hazardous area. Hazard control zones shall be designated as hot, warm, cold and exclusion zones. (Ref. WAC 296-305-01005 and WAC 296-305-05000)

Cold zone: The control zone of an incident that contains the command post and such other support functions as are deemed necessary to control the incident. Note: The cold zone establishes the public exclusion or clean zone. There are minimal risks of human injury or exposure in this zone.

Exclusion zone: The control zone designated to exclude all unauthorized personnel, responders, and equipment. Note: Examples of exclusion zones could be holes in floors, explosive devices, or collapse hazards.

Hot zone: The control zone immediately surrounding the hazard area, which extends far enough to prevent adverse effects to personnel outside the zone. The hot zone is presenting the greatest risk to members and will often be classified as an IDLH atmosphere.

Warm zone: The control zone outside the hot zone where personnel and equipment decontamination and the hot zone support takes place. Note: The warm zone is a limited access area for members directly aiding or in support of operations in the hot zone. Significant risk of human injury (respiratory, exposures, etc.) can still exist in the warm zone.



IDLH: Immediately Dangerous to Life and Health

Incipient Stage: The beginning of a fire where oxygen content has not been significantly reduced and the fire is producing minimal amounts of water vapor, carbon dioxide, carbon monoxide and other gases. The room has a normal temperature and the fire can be controlled with a portable fire extinguisher, i.e. food burning on the stove, damper closed on fireplace, etc. (Ref. WAC 296-305-01005)

Initial Stage: The "initial stages" of an incident shall encompass the tasks undertaken by the first arriving company with only one crew assigned or operating in the hot zone. (Ref WAC 296-305-05002)

Inside Out: The process of rescuing firefighters using resources that have already been deployed and are currently working in the hazard zone.

Known Rescue: A situation in which someone can be seen, heard, or a reliable report indicates that someone is still in the structure and immediate actions are necessary to prevent loss of life or serious injury. (Ref WAC 296-305-05002)

MAYDAY: A single word distress call made three times ("Mayday, Mayday, Mayday") to indicate that a firefighter/unit is in immediate danger and requires immediate assistance. Example: "Mayday, Mayday, Mayday. Command from Engine 171." (Ref. King County Model Procedures, Section 16)

Nothing Found: Report to the IC from a crew indicating that no victims were found during a primary or secondary search.

Occupancy Type: Refers to the standard types of occupancies: residential, multi-family, strip mall, commercial, high rise, five over one, and big box (warehouse). This information will drive the incident's tactical priorities. Residential type occupancy must have a high life safety focus because these structures can be occupied 24/7/365.

Positive Communications: Contact must be maintained by visual, verbal, physical, or electronic means within the IDLH.

Primary Search: A quick search clearing all affected areas of the structure(s). Primary searches can be performed under low to zero visibility conditions with the possibility of high heat. They need to be performed quickly with a high degree of accuracy, safety, and accountability.

Rapid Intervention Crew (RIC): A crew designated by the IC that will be available for the immediate search and rescue of any missing, trapped, injured, or unaccounted for firefighter(s). This crew shall be fully equipped with the appropriate personal protective clothing, protective equipment, SCBA and specialized rescue equipment commensurate with the needs of the incident.

Rescue Mode: An operational mode which is focused on immediate actions meant to protect or rescue occupants to prevent serious injury or death. The initial company on-scene may utilize 2-in/1-out while performing imminent rescue. Rescue mode ends when the second company arrives on-scene or when the rescue situation is resolved, whichever occurs first.

Risk Management: The development of action plans that consider all present and potential risks.

Secondary Search: A thorough and systematic search of the fire building, conducted after the primary search by a different assigned crew.

Size-Up: The ongoing evaluation of problems. Size-up starts with the receipt of an alarm and continues until the fire is under control. This process is carried out many times and by many different individuals at each fire or emergency event.

Standby Firefighters/Team: On-scene members (minimum of two) designated to affect an immediate rescue of the initial team operating in the hot zone. When in rescue mode, a single standby firefighter is allowed per WAC 296-305-05002 and Best Practices. A standby crew is assigned as an interim step while waiting for RIC to arrive and/or assemble.

SEARCH AND RESCUE OPERATIONS

A major tactical priority to accomplish early in the incident is to locate and remove all occupants from the hot/warm zones. Risk/benefit analysis should be considered when determining how to accomplish search objectives. Additionally, any civilians exposed to the incident's hazards should be evacuated and delivered to immediate medical care.

For offensive structure fires, we achieve the life-safety incident priority by performing primary and secondary searches in the main fire occupancy and in any exposures threatened by the fire. The IC uses the

standard rescue order to prioritize and manage these searches. The Rescue Priority is the standard order that we use to search a hazard zone:

1. The most endangered
2. The largest group
3. The remainder of the fire area/structure
4. The exposures

We initiate the completion of the offensive tactical priorities by companies advancing attack lines to the interior of burning structures. This fulfills the Rescue Priority by:

1. Advancing initial lines directly to the most hazardous area of the building - the burning part - places crews in the same area as the most endangered group.
2. Initial interior crews will be searching and protecting the same exit routes that the occupants in the building would use to evacuate.
3. The hand line protects firefighters and begins the attempt to establish control of the fire. Also, this establishes an anchor point from which firefighters can work to search the remaining areas of the fire building.
4. All initial attack efforts must be directed toward supporting rescue efforts and hose lines must be strategically placed in a manner to control interior access, confine/control the fire, and protect avenues of escape.

The IC is responsible for assigning all incident resources in order to achieve quick and effective fire control and primary searches of the affected areas of the structure(s). The IC will assign companies to complete systematic searches in defined areas of the structure, eliminating any potential for a duplication of efforts.

When encountering large, high density residential structures (5 over 1, senior living, etc.) it is often more effective to implement a “shelter in place” rescue plan as opposed to removing occupants from the structure. Any occupants that are not directly exposed to the IDLH can potentially be left sheltered in the building.

When primary search companies encounter victims, Command may assign other companies to assist search crews; this will enable search teams to continue locating victims. Command will need to request and provide the necessary medical resources to treat any patients encountered on the

incident site.

Note: Strip malls, commercial buildings and big box fires have a reduced civilian life safety risk and all initial actions should be directed towards fire attack unless there is credible information of occupants inside of the hot zone.

Within the incident priorities, the key steps for command of Search and Rescue should be:

1. Secure and protect normal means of egress.
2. Search and clear the immediate areas of involvement.
3. Systematically clear the remainder of the fire area/exposures.
4. An All Clear must be obtained for all occupancies.

In addition to these key steps, firefighters assigned to search and rescue can consider the following:

5. Contain, control and eliminate the incident problem.
6. Remove the products of combustion in order to aid search.
7. The first hand line should go directly to the seat of the fire for efficient knockdown, firefighter safety, and to support primary and secondary searches.
8. Smaller sized occupancies will accommodate a much more rapid search than larger buildings.
9. A TIC's primary uses are for search and rescue and crew accountability; use it every time.
10. Once an All Clear has been achieved, the IC must continually consider that firefighters are the only remaining life safety threat in the hot zone.

ORIENTATION TECHNIQUES

Firefighters operating in a fire compartment will most certainly encounter reduced visibility environments. Therefore, it is imperative that firefighters become orientated to prevent becoming lost or trapped. Reducing our exposure time to IDLH environments should be a priority in our IAP/safety plan. Removing smoke increases our effectiveness and safety on the fire ground.

It is essential that all firefighters are able to operate in a confined, reduced visibility environment for extended periods of time while always maintaining orientation:

- Always know where you are.
- Always know how you got there.
- Always know how to exit the structure.
- Always know the location of your other crew members.

This orientation process starts with an effective size-up. Sizing up the incident and knowing the typical interior layouts of structures is paramount to effective and safe fire operations.

Example: In a two story single family residence the typical layout is:

- 1st floor - Kitchen, living room, dining room, and laundry.
- 2nd floor - Usually dedicated to bedrooms and center hallway.
- Garage - HVAC equipment, hot water heaters, utility connection.

Firefighters must use the information they obtain when they see various structures in non-fire situations, such as medical calls, pre-incident planning, or code inspections. Using this knowledge as a reference and familiarizing firefighters with building layouts during a routine walk through will help them operate in reduced visibility environments. Building knowledge as well as pinpointing the seat of the fire prior to entry will give firefighters a good idea of where they need to go.

Crews may need the protection of a hand line when operating in the hot zone, however, it is not always necessary to enter an IDLH atmosphere with a hose line. Maneuvering a hose line can reduce the mobility of a search team and can significantly slow search efforts. Staying orientated in reduced visibility environments can be done with a hose line, a rope, or by staying in contact with the wall. A charged hose line in a reduced visibility environment, or an environment that visibility may diminish, provides the following:

1. Fire extinguishment.
2. A life line to their exit point.
3. Hose couplings can be used to navigate out of the building.
4. Protection from thermal insult.

Fire hose will always be oriented in a manner that has the male coupling pointing to the fire and the female coupling pointing toward the exit. When coupled, the female coupling is always longer and the back half of the coupling is smooth with no spanner wrench ridges. Reading couplings with gloved hands is a skill every firefighter must master ("smooth-bump-bump leads to the pump").

Search Size up:

1. Fire location and severity.
2. Type of occupancy (layout/arrangement) and construction.
3. Exposures.
4. Time of day.
5. Are victims reported or confirmed to be trapped?
6. What is the IC's IAP? Where may other crews be working and what are they doing?

Target areas:

1. Paths of egress, to include doorways and windows.
2. Bedrooms - systematic searching on

top of beds and sweeping under beds.

Monitor the radio for information affecting the search and your SAFETY:

1. Status of the fire.
2. Status of the hose line.
3. Status of the vent.
4. Status of nearby crews.

Monitor and evaluate your surroundings and maintain a strong sense of situational awareness:

1. Heat levels.
2. Smoke conditions..
3. Air movement - making a ventilation opening will affect the flow path
4. Are conditions getting better or worse?

Orientation during the search:

1. Establish your location, direction of travel, and exit.
2. Oriented person (i.e. common hallway, center hallway).
3. Using the wall.
4. Using a hose line.
5. Using a rope.
6. "Bump Up" when encountering a room within a room (i.e. large walk-in closet in bedroom or additional office).
7. Crew's roles and positions.

Positive communication needs to be used throughout your search. This can be accomplished by one of the following: voice, sight, or touch. This is the safest and most effective way for the search team to maintain crew accountability. When speaking to crew members, ensure your voice amplifier is on and speak facing each other using a normal volume. With radio communications, it is very important to speak, not shout, into the radio and talk in a slow and controlled manner.

THERMAL IMAGING CAMERA (TIC) OVERVIEW

The TIC assists with firefighter accountability, search and rescue operations, and many other tasks in or out of the structure. A TIC can dramatically reduce the amount of exposure time for interior crews when used correctly.

Thermography is the use of an infrared imaging and measurement camera to "see" and "measure" thermal energy emitted from an object. Thermal, or infrared energy, is light that is undetectable by the human eye because its wavelength is too long; it's the part of the electromagnetic spectrum that we perceive as heat. Unlike visible light, in the infrared world everything with a temperature above absolute zero emits heat. Even very cold objects, like ice cubes, emit infrared. A TIC can measure a variance in the temperature of an object as low as ½ a degree that will show contrast on the screen. The camera sees through smoke and does not require any visible light, however, it cannot see

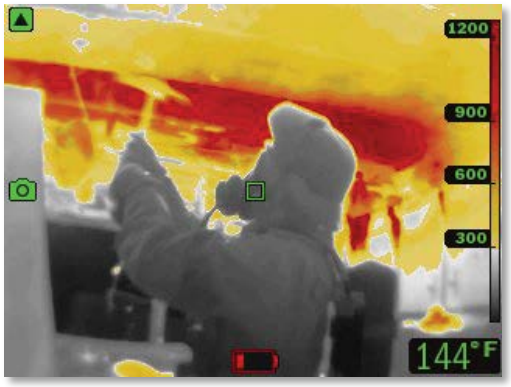
through objects and will reflect off water or glass. A thermal imaging camera should never replace the basic skills we learn and use as firefighters. It is designed to enhance our ability to function in reduced visibility but is not intended to replace other techniques. Using the TIC correctly is

very important to firefighter safety. Relying solely on the TIC can place firefighters in a situation where they become disoriented and are now a part of the problem.

WHERE DO WE FIND VICTIMS?

Victims are primarily found in bedrooms and paths of egress. Additional consideration should be given to searching areas of refuge, such as:

1. Bathrooms, tubs or shower stalls
2. Closets
3. Under beds
4. Behind furniture
5. Behind doors
6. Under stairs
7. Basements
8. Attic rooms
9. Cabinets



Often, victims will be found on the perimeter of the room trying to escape. All areas of residential structures must be thoroughly searched before an All Clear can be achieved.

Victims can also be found on upper areas of beds, sofas, etc. Be aware of the existing heat levels. Check under, behind, and on top of objects. Check locations such as closets, bathtubs, and under beds. Pause regularly to listen for any possible sounds being made by victims.

The fire safety industry works hard to improve its understanding of and to mitigate circumstances that prevent individuals from surviving home fires. Individual circumstances and characteristics of victims often play crucial roles in the outcome.

According to statistics, victims are found in the following manner:

Overall – (FF Rescue Survey 2018)

1. Bedroom (43.6%)
2. Family room/Living area (16.9%)
3. Hallway (10.2%)
4. Kitchen (9.3%)
5. Bathroom (7.5%)

What is their position?

1. On the floor (31.4%)
2. On the floor within 6’ of an interior door (14%)
3. On the bed (13.3%)
4. On the floor within 6’ of an exterior door (8.7%)
5. On the floor under a window (5.2%)
6. Bathtub/Shower Stall (1.4%)
7. Under bed (1.1%)

Fatalities vs. Injuries: (USFA 2013-2015)

Fatality Victim Location:

1. Bedroom (50.7%)
2. Common/Living area (11.1%)
3. Bathroom (8.2%)
4. Kitchen (6.7%)

Injury Victim location:

1. Bedroom (33.8%)
2. Common Room/Living area (10.3%)
3. Kitchen (9.8%)

Human factors contributing to fire fatality:

1. Sleeping (44%)
2. Physical Disability (26.7%)
3. Impaired by alcohol or drugs (26.4%)
4. Intellectual Disability (7.7%)
5. Unattended/unsupervised person (6.1%)

Human factors contributing to fire injury:

1. Asleep (52.2%)
2. Impaired by drugs or alcohol (26.5%)
3. Physical disability (11.3%)
4. Intellectual disability (7.7%)

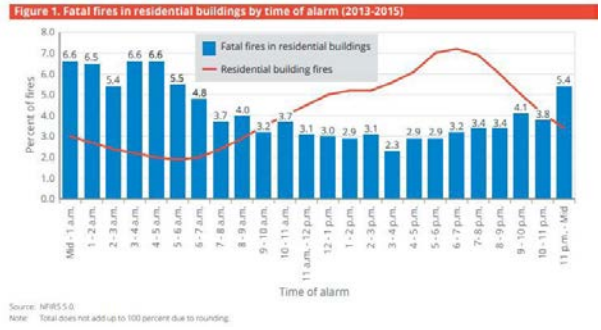
Activity prior to death:

1. Escaping (37.4%)
2. Sleeping (31.4%)
3. Unable to act (11.8%)
4. Irrational act (5.8%)

Activity prior to injury:

1. Fire control (34.7%)
2. Escaping (25.9%)
3. Sleeping (11.2%)
4. Rescue attempt (7%)
5. Returning to vicinity of fire before fire control (6.6%)

Fatality Fire Time of Day:



Injury Time of Day:

This data indicates that search should be heavily focused on bedrooms and paths of egress, followed by common/living rooms, and kitchens. Primary search must be conducted in systematic manner in order to be thorough, but the starting point of the search should be prioritized to areas where victims are most frequently found.

In addition:

1. Always remember to close doors to slow the spread of fire.
2. Perform local ventilation as needed to improve conditions for the victims and improve visibility for search teams. Try to stay in contact with a wall to keep from getting lost. If necessary, consider using a search rope to cover areas not covered in the wall-based search.
3. When searching non-standard rooms (irregular shapes or larger in area), consider search ropes to prevent loss of direction.
4. Remember that thermal cameras are a great tool for primary search, however, a team must be practiced in utilizing them to assist with search methods. The team must also carry a spare camera battery and be prepared to shift into standard search methods should the thermal camera fail.

DOOR MARKING

In some instances, it may be important to mark the entrance to a room you are initiating a search in (large compartmented buildings). You mark the door of a room to signify which part of the search is in progress or has been completed. Utilize a slash (/) upon entrance and make a second slash, creating an X, when the primary search is complete. That X tells any other firefighters that the room behind the door has been searched and there were no victims located. Typically, in short duration rapid searches, no marking is needed or a very basic X is the only marking required.

COMPARTMENT SEARCHES

Small Compartment Searches

Whether performing a right or left hand wall search, your actions will be the same:

1. Scan room with TIC to be aware of layout and potential victim(s).
2. Start search on the closest wall that leads to the seat of the fire, or to the last known location of the victim(s).
3. Work your way along the wall of the room, while searching for victims try to identify windows and doors for egress options.
4. The searching firefighter should always have a tool with them to assist with forcible entry/exiting and other functions.
5. While not necessary to maintain constant contact with wall, staying

orientated to a wall will help you systematically search and return to the area where you began your search.

6. The officer of the search team needs to maintain orientation to the building with team members searching forward. Finding a room off of a room will require the team, or the oriented person, to bump up to the new opening.
7. If a fire victim is located, "priority traffic" will be used to notify the IC or division officer. The search team needs to complete a 360 around the victim, position the victim's head first toward the exit and secure them with hose straps for ease of removal, if necessary.
8. The oriented person can reverse course and quickly lead the search team to the exit, bypassing previously searched areas.

Wide Area Search

Though fires in commercial occupancies generally require more resources to achieve early extinguishment, life safety is still the number one incident priority. Despite the fact that the civilian life hazard can be lower in commercial occupancies, the fire department still must conduct a thorough search to clear the building. Commercial occupancies that do have a high life hazard generally only do so during the day, or business hours. Overnight, the life hazard generally drops dramatically. Larger commercial occupancies are difficult and labor intensive to search. Availability of thermal imaging greatly assists search efforts in larger buildings, but traditional methods remain vital to ensure thoroughness and overcome deficiencies in thermal imaging technology. The techniques in this manual can be adapted to searches in everything from small commercial buildings, such as a strip mall or small office, to big box stores, large warehouses, or schools.

Rope Assisted Search Procedure (R.A.S.P.)

It is inherently difficult to maintain orientation in commercial buildings with reduced visibility. Most retail establishments are designed to keep customers in the space longer, so exit pathways can often be meandering, rather than straight lines. Maintaining orientation during search in a commercial building is vital, and due to size, the preferred method uses search ropes for orientation.

Equipment

- 200' or 300' search rope (not life safety).
- 2-3 20' tethers with marking knot at 10'.
- Distance markers (on search rope).
- F/E tools.
- Light.

Technique

- **ALWAYS** anchor the search rope outside the IDLH.

- **ALWAYS** anchor the rope anytime a change of direction is made. The rope's path is considered searched and safe area to facilitate rapid movement. The rope cannot be allowed to move into unsearched area because it is not properly anchored.
- Company Officer (C/O) carries the search rope and TIC to maintain orientation and accountability.
- Driver and Firefighter(s) follow on the rope (with tethers, if appropriate) ready to search.
- Depending on occupancy type, layout, and strategy, enter the building and move to area where search should begin.

Wide Area Search (minimal obstruction)

- C/O enters, picks trajectory to maximize coverage efficiency, then ties a loop in the search rope approximately 20' in to begin methodical search. C/O then continues to 50' mark to tie the next loop, anchor and watch progress. Driver and Firefighter(s) enter and follow on rope until encountering the first loop.
- Driver and Firefighter(s) attach tethers to loop and search their side of the rope using tether for orientation. Wrapping tether around the hand at all times to keep tight will manage line and ensure methodical coverage.
- C/O must be heads up with the TIC and radio communications at all times to maintain accountability.
- Once Driver and Firefighter(s) complete an arc, they move up to the next loop. Once at the next loop they clip their tether in and begin again.
- Anytime a change of direction is needed the main search rope must be anchored to something solid (object, tool, or person).
- Continue search in overlapping arcs until search is complete, or rope runs out. C/O must communicate completion of objective or need for additional crew to continue.

Wide Area Search (obstructions, divided occupancy)

- When conducting wide area search in a divided occupancy (warehouse, big box store, retail establishment, etc.) adaptation is necessary. Changes of direction will be more frequent, and search areas will be defined by aisles rather than tether length.
- C/O communicates search strategy to crew, then enters. Once trajectory is set, Driver and FF follow and execute search strategy until occupancy is search, or rope runs out.

Anchor-Point-Shoot

Anchor-point-shoot is a search procedure used when there is reliable intel about a

victim with approximate location. The scenario for this technique is poor or deteriorating conditions, where there is not time for a methodical search.

- C/O leads with the search rope, taking a direct path to where the victim is believed to be. As with any R.A.S.P., the search rope must be anchored initially outside the IDLH, and at every change of direction.
- Once in the vicinity where the victim is believed to be, the Driver and Firefighter will begin their arcing search with tethers.

Rope Assisted Minimum Manning (R.A.M.M.)

This technique is reserved specifically for a scenario where a crew is taking their 2-in-1 out rescue exemption. There is a credible report of a victim and location that is reasonably close to an access point.

- C/O anchors the rope at the edge of the IDLH, and scans the area with the TIC to show the Driver and Firefighter layout.
- The C/O lets out a bight of search rope, after anchoring both ends of the bight outside the IDLH. The Driver and Firefighter both attach tethers to the bight and make entry.
- Driver and Firefighter each search their side until tether length is exhausted.
- C/O monitors progress with the TIC and lets out rope on the bight as needed.
- Search continues until victim located, conditions force retreat, or more crews arrive allowing for a change to a different technique.

VENT ENTER SEARCH (VES)

An aggressive search technique used in a known imminent rescue situation where normal means of accessing and searching a room have been compromised by fire, heat, and smoke conditions.

Vent Enter Search is usually conducted in bedrooms or other small compartments with a single door. This allows firefighters to control the flow path by closing doors.

VES may also be used in larger spaces if conditions allow. To perform VES, the following steps should be followed:

1. **Observe Fire Conditions:** Evaluating conditions begins with the initial radio report. **Continuing to evaluate conditions while operating on the fire ground is critical.**

Evaluate the window you intend to ventilate. Is there active fire in the area that could lead to flash-over or rapid fire spread if you ventilate this space? Will fire conditions allow the firefighter to enter this space?

2. **Vent the Window:** Clear the entire window of glass and all obstructions that could hinder entrance/egress or victim removal.
3. **Entering the Room:** Let the room vent for a moment to release the buildup of gases and smoke prior to entering. Evaluate the conditions and make entry when safe. The TIC can be used to evaluate the room for safe entry and quick observation of the layout, and the potential location of a victim. Sweep the floor under the window to check for victim(s) and sound the floor to ensure structural integrity. Next, the firefighter will enter **and locate the door to the room to <u>isolate</u> the flow path**. Quickly search the hallway for any victim(s) and evaluate nearby fire conditions, then shut the door. Typically, the door will be found straight across the room from the window. Once the door is closed the firefighter will conduct an effective primary search of the room.

Oriented Member: Similar to conventional search techniques, a firefighter or company officer will remain at the window where entry was made on the ladder as the oriented member. This firefighter can use the TIC to observe the active search and monitor the conditions of the room. In addition, the oriented member will maintain radio communications with Command and can assist in removal of victim(s) from the room.

When locating a victim, it is critical to follow a very specific regimen of steps to ensure the victim and rescuers safely exit the structure. The most safe and effective removal of a victim is to quickly drag them from the structure. However, many things can impact a firefighter's ability to do so, such as distance to openings, conditions, obstacles, and manpower. Therefore, it is critical to complete a rapid evaluation of the situation and determine the best course of action.

1. When a victim is located, conduct a rapid 360 to determine the presence of other victims.
2. Communicate with Command, using "priority traffic," and let them know you have located a victim.
3. Rapidly assess the victim's condition and determine what resources will be needed, if any, to accomplish victim removal and communicate needs with Command or unit supervisor.
4. Prepare victim for removal with appropriate equipment or techniques.
5. Consider a closer exit point if available.

Below are a few examples of different packaging options. These are not the only methods that can be used to remove victims.

Quick Drag

1. Begin by standing behind the victim and placing them in the seated position.
2. While they are in a seated position, reach under the arms and clasp your arms across their chest or grab the victim's forearms.
3. Lift the victim so that you are standing upright and they are only making contact with the flooring surface on their heels.
4. Move backward utilizing small, compact steps and ensure that someone is guiding you out to prevent tripping and falling.

This method is very effective over short distances and friction is greatly reduced by getting much of the body off the floor surface.

1. Loop both arms and move the hose strap under the arm pits.

2. Cross the front loop over the back loop and place the front loop behind the head.

3. Take up the slack - this will allow you to stand and drag comfortably.

The "7" Victim Drag

Use either a 20' length of webbing, or two hose straps married together.

1. Loop on leg of the victim with the webbing/ hose strap.

2. Ensure that loop is snugged tightly into the crotch.
3. Pull a bight with both strands of webbing/hose strap across the chest through the armpit opposite the leg that is looped.

4. Cross the chest with the remainder of the webbing/hose strap and thread under the opposite armpit to form a “7” across the chest.

5. Put victim in the sitting position while maintaining the original bight on one side and tail on the opposite side.

6. Thread the tail end of the webbing/hose strap through the bight and tie into an overhand knot. (Create a bight near the end of the loose end of strap. Thread this bight through the bight of the strap coming from under the opposite arm. The loose end of the strap is then threaded through its bight to form a knot.)

7. Use remainder of tail to drag victim to safety or lower out a window

Unconscious Victim Down a Ladder
With one (or two) rescuers interior, and one at the tip of the ladder proceed as follows:

1. Move the victim to the base of the window (feet first).
2. Place the victim's feet against the wall and lock their knees.
3. Move the victim to the seated position and pass their hands/wrists to the rescuer on the ladder.
4. As a team, lift the victim head first over the sill.
5. Once the victim's head/shoulders are over the sill, the ladder rescuer should position their arm under the victim's head and above the shoulder.
6. As a team, move the victim slightly further down the ladder so weight is being borne at the crook of the neck.
7. Once the ladder rescuer is ready, the interior rescuer(s) should move the victim's legs/hips out the window.
8. The ladder rescuer should catch the victim between the legs, then rotate the victim's body weight to the leg arm by lowering it while maintaining position with the arm at the neck.
9. The victim's weight should now be born at the crotch, and the rescuer can proceed to climb to the ground.

Conscious Victim Down a Ladder
With one (or two) rescuers interior, and one at the tip of the ladder proceed as follows:

1. The interior rescuer(s) should help the victim over the sill onto the ladder where the ladder rescuer is waiting to encourage and stabilize them.
2. Once the victim is on the ladder, the ladder rescuer should keep close behind them for the climb down (head at victim's hip or thigh height).
3. If the victim begins to panic, or lose control, the ladder rescuer can quickly drive their shoulders forward into the victim's thighs, pinning the victim to the ladder until they can regain control.
4. The ladder rescuer should continue the climb down the remain of the way close behind the victim.

Two Person Carry

The two person carry can be utilized to quickly remove a victim from the hazard

area. Using a hose strap can make the carry more comfortable and effective for the rescuers. Firefighters walking upright in a reduced visibility environment should have someone leading them out to prevent falling.

Stairs

Stairs can be difficult to maneuver when carrying a victim. One method to assist in managing a victim up or down a flight of stairs is the use of a hose strap. Typically, the use of a hose strap by the rescuer positioned at the head of the victim can bear some of the weight and make the carry more comfortable.

1. Using the victim's torso, place a hose strap around the victim using an overhand knot; the use of a girth hitch can restrict breathing.
2. Attach the other end to your SCBA waist strap. Make sure you pull all of the slack out so you get good lift when standing up straight.
3. Secure the strap to your waist belt with an overhand knot. This will allow the firefighter at the head to have their hands free and using the stair railing and walls to stabilize their descent/ascent.

SUMMARY

It is imperative that we all have the knowledge, skills, and abilities to function safely on the fire ground. When responding to a report of an occupied building fire, firefighters must understand that the pace of these incidents can and will accelerate rapidly. Educating ourselves and regularly practicing search and rescue techniques will provide firefighters with the knowledge, skills, and abilities to safely and effectively locate and remove victims during the early stages of these very hectic incidents.

FIREFIGHTER SURVIVABILITY

Maydays and RIC

The individual firefighter's response to a Mayday situation should be focused on increasing the chances for survival. The development of these skills truly begins at the Recruit level and should continue throughout a firefighter's career on a daily basis.

DEFINITIONS

AWARE: An acronym utilized by RIC to remember what items need to be available for a rescue:

Air: Separate air supply for the down firefighter.
Water: Hose line to create a defendable position.
Access: Diagram building with access points.
Radio: Separate radio for the down firefighter, pre-set to the assigned tactical rescue frequency.
Extrication: Tools necessary to extricate the firefighter.

Emergency Traffic: Announced over the radio, indicating that a message involving firefighter safety is about to be communicated. "*Air Restricted to Emergency Traffic Only*": No radio communications, unless from the IC, are to be sent unless they meet the threshold of Emergency Traffic. Example: "*Command, E163 Emergency Traffic.*"

Mayday: A single word distress call, made three times ("Mayday, Mayday, Mayday") to indicate that a firefighter/unit is in immediate danger and requires immediate assistance. Example: "Command E171, Mayday, Mayday, Mayday."

Rapid Intervention Crew (RIC): A team consisting of a minimum of two (2) fully-equipped responders, preferred team of three (3), who are on-site and ready for deployment to the immediate rescue of responders.

Rapid Intervention Group (RIG): A group consisting of two (2) or more companies with an assigned leader that remains outside the hazard zone for firefighter rescue.

Roll Call: An accountability report from all crews assigned to the hazard zone, and Division/Group supervisors reporting on all assigned personnel.

Standby Firefighters/Team: On-scene members (minimum of two) designated to affect an immediate rescue of the initial team operating in the hot zone. When in

rescue mode, a single standby firefighter is allowed per WAC 296-305-05002 and Best Practices. A standby crew is assigned as an interim step while waiting for RIC to arrive and/or assemble.

Team Leader: Usually a Company Officer or member assigned or selected as the Team Leader.

Mayday

"Mayday" should be used when a firefighter or crew is presumed missing or when a firefighter or crew becomes trapped, lost or separated, or in serious trouble. The calling of "Mayday" should not be delayed; as soon as a firefighter THINKS that they are in serious trouble, "Mayday" should be announced. The rescue of a lost or trapped firefighter is very time sensitive and can be very complex. Waiting to announce "Mayday" increases the danger to the lost or trapped firefighter AND the rescuers.

The "Mayday" transmission may be given by the firefighter(s) themselves or by anyone that suspects there are missing, trapped or injured firefighter(s). Once acknowledged by Command, the "Mayday" shall be followed by a report to include who/what/where (crew or personnel identification, location, conditions, air, and needs). Additional information could include the number of firefighters missing or trapped, extent of help needed, and the quickest access to their location.

Example:

- Firefighter: *"MAYDAY, MAYDAY, MAYDAY, 151 Command from Firefighter Jones."*
- Incident Command: *"151 Command."*
- Firefighter: *"This is Firefighter Jones from Engine 151. I am on the second floor and separated from my company and unable to find my way out. I have 800 lbs. of air remaining and am requesting immediate assistance."*
- Incident Command: *"151 Command copy that Firefighter Jones is on floor 2, separated from Engine 151 crew, lost and is low on air and in need of assistance."*

During an emergency incident, the activation of an Emergency (EMER) Button which is not immediately confirmed false by the dispatch center will be considered a "Mayday" situation by the Incident Commander. The EMER button is the alternative for notification during times of distress if unable to radio a "Mayday" due to voice communication being impossible or ineffective.

NOTE: If the EMER button is activated, it will immediately take the user to the EMER talk-group and Dispatch will receive an audible alert. A dispatcher will immediately attempt to establish radio contact with the identified user of that radio. The dispatcher will also immediately notify the Incident Commander.

If the radio is out of range of the 800 MHz system, a firefighter will not be able to transmit a "Mayday" and the EMER button will not function. In that event, the firefighter must use voice communication on a simplex channel (State-Ops). (The EMER button will not function on a simplex channel.)

Firefighter Response to Mayday

The response to a "Mayday" begins with the individual firefighter and crew. Individual firefighter responsibilities for "Mayday" response include:

- Maintain composure
- Early communication of a "Mayday" situation, including who/what/where
- Actions to consider:
  - Check air
  - Radio for assistance
  - Activate PASS device
  - Control breathing, conserve air
  - Stay low
  - Illuminate, turn flashlight(s) on
  - Make loud noise
  - Find an exit
  - Shield your airway (last ditch effort)

Team/Crew Response to Mayday

If a team member is in trouble, the other member(s) of the team should take appropriate steps to help, which may include providing direct assistance, calling for help, and going to get help. All other crews in the area should maintain their tactical assignments to avoid placing other crews in danger.

IC Response to Mayday

Upon hearing a "Mayday," the Incident Commander shall restrict all radio traffic to "emergency traffic" only and immediately ascertain the **L**ocation/**U**nit/**N**ame/**A**ssignment-**A**ir/**R**esources needed (**LUNAR**) of the firefighter(s) needing assistance. The IC should then remind the firefighter in trouble to activate their PASS device and check for crews in proximity that can initiate search operations. Additionally, a determination should be made if deploying the RIC to initiate a rescue will be effective.

If the RIC or other crews in close proximity are not able to assist the firefighter(s) in trouble, a rescue plan should be implemented. The Incident Safety Officer will become the RIG (Rapid Intervention Group) Supervisor and utilize all levels of command to help assist in the rapid extrication of any firefighter(s) calling a "Mayday." The RIG should remain on the original radio tactical channel and all other fire-ground operations should move to another tactical channel.

A roll call should be completed when appropriate and the ongoing fire ground strategy confirmed and announced. An additional alarm should be called and the command structure expanded as necessary

to maintain organization of the incident. Incident Command should support RIG operations and announce when the "Mayday" is all clear.

Rapid Intervention Crew/Rapid Intervention Group

The Incident Commander should give early consideration to the establishment of a Rapid Intervention Crew (RIC) at an emergency incident where a danger to responders working in and about the incident is present. The size and number of Rapid Intervention Crew is dictated by the needs of the incident. All RIC members need to be fully equipped with protective equipment including protective clothing, SCBA, and any specialized rescue equipment that may be needed. The Incident Commander will announce the establishment and location of RIC over the radio to establish a time benchmark. When a single resource is assigned as the RIC, their unit identifier will be used (i.e. Engine 151, Engine 142, etc.).

When assigned, the RIC officer will obtain a briefing from the Incident Commander and/or the Safety Officer in addition to conducting a RIC specific size-up of the incident. The briefing will contain information regarding the current strategies and tactics, possible hazardous conditions, location of crews in the hazardous area, and factors that may affect firefighter rescue. The RIC specific size-up should include the fire location, type of construction and condition, as well as ingress/egress points in the structure. Radio communication on the primary and any secondary tactical channels should be monitored by the RIC.

Necessary rescue tools and equipment that the RIC may need should be brought to the area where the RIC is assigned. RIC should be ready for immediate assignment with crews wearing full PPE and a SCBA in standby. Consideration should be given to having a charged hose line and/or search rope available for use.

The Incident Commander shall alert the RIC/RIG upon learning that firefighters are trapped, missing, or in need of emergency assistance. The Incident Commander will determine the talk group that will be utilized to communicate with the RIC/RIG. The talk group in which the Mayday was declared will be used to communicate with the Mayday firefighter or crew.

The deployed RIC should attempt to communicate critical benchmarks to Incident Command. Those benchmarks include but are not limited to condition and remaining air of the compromised firefighter, resources required for extrication, obstacles that may hinder or delay extrication, and the estimated time required for extrication. Packaging a downed firefighter will include these five steps:

1. Loosen chest and waist straps of the down firefighter.

2. Disconnect waist belt and attach between the legs of the down firefighter.
3. Tighten shoulder straps and tie a half hitch in the ends of the straps.
4. Position RIC pack between down firefighter's legs and attach to the waist strap using the carabineer on RIC pack.
5. If the Scott RIC pack regulator was used, attach the small carabineer on the regulator hose to the down firefighter's shoulder strap.

Firefighter Drag with SCBA

This drag is very effective over long distances on surfaces like smooth concrete. This method should not be used in small tight spaces on flooring surface like carpet.

- Place downed firefighter in a seated position. From behind, reach under both arms with your right hand holding a bight of hose strap. Pass the bight of hose strap to your left hand and pull both ends of strap under victim's arms so each bight is equal.

Figure 1

- Hold both bights behind victim's back with one hand and pull one of the hose straps from the chest over the victim's head.

Figure 2

- Weave the hose strap from over the head through bight from the victim's right arm.

Figure 3

- Weave the hose strap from over the head through bight from the victim's left arm and pull tight.

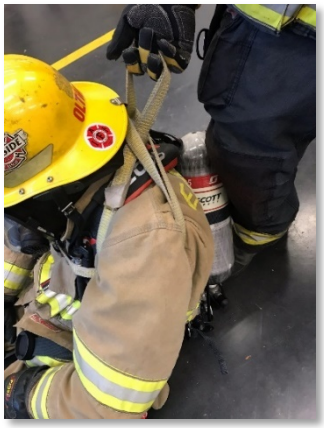


Figure 5

Stairs

Stairs can be difficult to maneuver when carrying an injured firefighter. One method to assist in managing a firefighter up or down a flight of stairs is the use of a hose strap. Typically, the use of a hose strap by the rescuer positioned at the head of the firefighter can bear some of the weight and make the carry more comfortable.

- Using a hose belt, place a girth hitch around the neck of the SCBA bottle and route the hose strap up the victim's back and between their shoulder straps

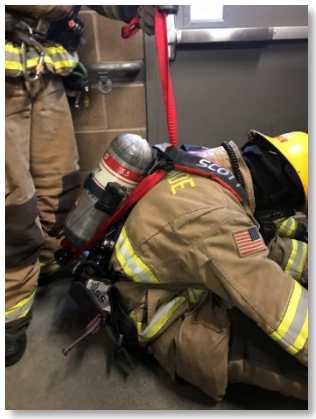


Figure 4

- Completely loosen victim's SCBA waist strap and reattach behind both legs of victim.
- Lifting in unison, the rescuer behind lifts with the hose strap while the rescuer in front reaches between victim's legs and lifts on victim's SCBA waist belt

Figure 6

Firefighter Bailout with Escape Rope

This technique utilizes a pre-rigged bailout system.

1. Call a Mayday when you determine you have an emergency.
2. Attempt to isolate yourself from the fire by closing doors or moving to an exterior wall away from fire.
3. Clear the window opening to bail out of.
4. Establish you anchor by using your hook or loop.
5. Attach the bail out system to your rated connection point.
6. Holding the rope from the anchor in one hand and the rope from the descender in the other, punch your hands out the window to clear your

descent control device over the window sill and weight the anchor by leaning out window towards the side of the window the anchor is on.

7. The hand holding the rope from the anchor releases the rope and grasps the window sill.
8. The hand holding the rope from the descender remains pointed down holding tension on the entire system.
9. Rotate your body out the window towards your anchor with your face to the wall and catch your weight with your heels on the window frame to control your exit from the window.
10. Once your weight is on the rope, orient your body to a vertical position and descend to the ground.
11. Upon reaching the ground, disconnect from the system and leave in place.

SURVIVABILITY TECHNIQUES

Wall Breaching

The firefighter equipped with full turnout gear, SCBA, and obscured face piece will use a hand tool to break open a large enough hole to quickly exit from a fire area to an area of safety. This operation entails both pulling and pushing the sheet rock from the wooden studs and then moving through the opening to safety.

APPLICATION:

- Firefighter should evaluate the area that will be breached for hazards or obstacles that may be contained within.
- The evolution and breaching should be quick. Clear enough room to exit but do not spend excess time "cleaning up" or creating a hole that is too large.
- A flat head ax or halligan tool should be used for this evolution. Feet can be used if no tool is available.
- The firefighter locates the wall and begins to breach a hole through it.
- The firefighter will use a push and pull action with the tool to clear the stud opening as quickly as possible.
- Once the hole is large enough, the firefighter immediately exists the room.
- Depending on physical size, the firefighter does not need to perform a "Low Profile" or "Full Escape" SCBA procedure. The intent is to exit the area as quickly as possible and if personnel are able to fit between studs without performing these evolutions, then it is acceptable.

Window Hang

The Window Hang technique is used when you need to get out of the heat and there's no ladder available. If you don't have a personal escape system, follow the steps below this may be your only option.

- Clear the window of the glass and sash
- Exit the structure through the opening headfirst while maintaining low profile
- Use your inside lower leg and forearm to support the rest of your body, which is hanging outside the rest of the building.

After bailing out the window, you may decide to swing completely out the window and drop to the ground. Or you may elect to remain in the hanging position until a ladder is positioned for your use. Which one you choose is going to depend on how much heat you are experiencing.

Firefighter CPR

There are occurrences that require crews to assist a firefighter on the scene of an emergency. Some may include; lost and separated from ones crew, collapse, fall through the floor to name a few. Other time may include cardiac arrest of a downed firefighter. Practice this 10-Step process to maximize your readiness to perform high quality CPR in full turnout gear with SCBA and be able to remove their PPE without CPR interruptions. This process works most efficient with four rescuers.

10-Step Process

Step 1

Rescuer 1; Position Firefighter's SCBA between legs. Drag the downed firefighter to a safe location by dragging from behind, and place the SCBA bottle between Rescuer 1 legs. This will serve to stabilize the SCBA so that it can be used as a CPR platform.

Step 2

Rescuer 2; Pop open chest clip of SCAB and begin high quality chest compressions. Once chest clip is removed (if applicable) initiate compressions through Bunker coat.

Step 3

Rescuer 1; Open SCBA bypass valve. If the SCBA facepiece is still in place, open the SCBA bypass. This will allow for passive ventilation with compressions, and allow rescuers to identify an etiology of cardiac arrest. We can identify if the downed

firefighter ran out of air and address aggressive oxygenation.

Steps 4-8 *should be performed in a coordinated method but simultaneously to the best of the ability of the rescuers.*
Do not interfere with or interrupt compressions.

Step 4
Rescuer 1; Remove helmet, mask, hood

Step 5
Rescuer 3; Begin unfastening the bunker coat from the bottom up.

Step 6
Rescuer 1; Loosen the shoulder straps and position arms above head.

Step 7
Rescuer 1 and Rescuer 3; Work zipper open, Do Not interfere with chest compressions.

Step 8
Hold coat and SCBA straps, and announce "prepare for pull down", the final command is "pull down".

Step 9
Rescuer 3 and Rescuer 4; Perform the "pull down" by grabbing one leg each and pulling the victim out of their gear. Rescuer 3 and Rescuer 4: Each Rescuer needs to firmly grab one of the down firefighter legs and coordinate the "pull down" method with Rescuer 1 at the head. Rescuer 1 will give the command to perform "pull down." Rescuer 3 and Rescuer 4 will pull the down firefighter toward his/her feet and out of the turnout gear jacket and SCBA.

Step 10
All Rescuers; Initiate comprehensive Resuscitation Bundle. Watch the following link to observe firefighter CPR in action: http://fd-cpr.com/index.html

Ladder Bailout

- Firefighter notifies Command of a MAYDAY following their own departments MAYDAY procedure.
- Crawling on hands and knees, approach the window with the ground ladder and use a tool to clear window of potential hazards and entanglements (frames, glass, drapes, etc.)
- Grasp Ladder beams for support
- Lower body still inside window
- Right arm between 1st and 2ndrungs positioned on far side of ladder (Note: Left arm can also lead out of window first)
- Right arm goes between 2nd rung and may grasp 3rd rung-Keep palm up
- Left arm down ladder beam-Grasp center of 4th rung with hand, palm down (If left arm leads out of window first, right arm follows down ladder beam)
- "Hook 2, Grab 4"
- Move to ladder-Keep head down-Bend knees-Slide right thigh along beam
- Rotate and swing body along the beam
- Position on Ladder-Position knees and boots on beams with body in a seated position
- Chest away from rungs-Grasp underside of beams and arms almost straight

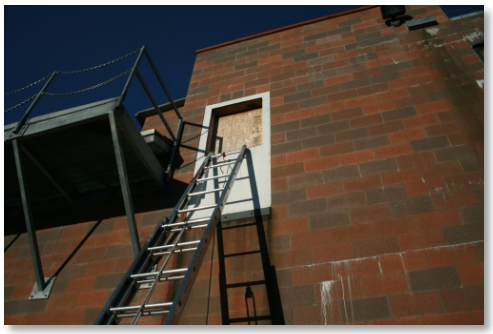
- Walk down or slide down ladder

Unconscious Firefighter Utilizing Aerial

High Pick Point

Secure rope to the top rung of the ladder and deploy the remainder of the rope down the outside of the ladder. This can be done prior to the raise, after the raise or by the interior crew.

Position ladder at window for Firefighter ingress.



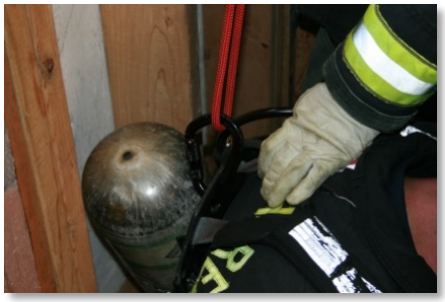
Vent (clear all glass and material out of window frame)
Enter (sweep floor, sound floor and enter room)
Isolate (close door to room isolating it from smoke and fire)
Search (locate firefighter to be rescued).

Outside member extends ladder above window.

Interior members move downed firefighter to window and packages them to be lowered (loosen SCBA shoulder and waist straps, unbuckle waist strap and pass between legs, buckle waist strap, tighten shoulder straps and connect carabineer to area that will capture the harness of the SCBA).

Interior member will reach through rungs, as high as possible, and pull rope into room creating a 2:1 mechanical advantage.

Attach 2:1 to carabineer on downed firefighters SCBA.



With the help of the outside member pulling on rope, lift downed firefighter up and over sill. Outside member will lower downed firefighter to ground.

If more friction is needed, the outside member can make a round turn on a rung.

Firefighter Entanglement

Members are encouraged always to be aware of the potential for entanglement hazards while inside of a structure performing fire-fighting activities. This suspicion of entanglement hazards is greatly heightened when there has been a collapse of any part of the structure. In the event that you are presented with an entanglement situation, a member should do the following:

- If you feel a tugging on your SCBA, STOP IMMEDIATELY and back up one step!!!
- Place your tool on the ground with the handle pointing in the direction you were traveling.
- DO NOT TRY to "*bull dog*" or force your way out of this. This will make your entanglement worse.
- If you are with a partner, let them know what your situation is and then you can ask them to try and free you if they can **see** the entanglement.
- While on our hands and knees attempt to snag the wires by taking your right arm and moving it in a sweeping motion backwards along the outside of the leg at the knee-up past the waist and directly overhead to the front of the firefighter in a swimming motion. If you do not snag the wire with this method, repeat the above motion with the arm on the other side.
- Upon snagging the wire, place the wire(s) in both hands and raise them high above your head sitting upright if possible.
- Take all the slack out of the wire by gathering it into your hand.
- Turn ¼ turn in either direction and hand the wire back to your partner, or let the wire loose once turned if not working with a partner.
- If after doing the swim motion you were unable to snag the wire, rotate body 90 degrees to either the right or left and attempt the swim motion once again.
- If this does not work, turn back to the center and then rotate 90 degrees the opposite direction and attempt the swim technique again.
- If none of the above techniques enable you to grab the wire and free yourself, then a Mayday situation

exists. You are entangled which is the same as an entrapment and you must put out a mayday.

- Declare a "MAYDAY" situation on the fire-ground channel.
- When giving the mayday, give a LUNAR report with includes the following information:
    - *LOCATION*
    - *UNIT*
    - *NAME*
    - *AIR SUPPLY Remaining*
    - *RESOURCES needed*
- At this point you will need to remove the SCBA from your back.

Doffing the SCBA

- Unbuckle the waist strap and extend it all the way.
- Fully extend both left and right shoulder straps.
- Take both hands and grasp the chest strap at its connection in the center and release it.
- Now place your left hand on the high-pressure hoses and left shoulder strap, bring the SCBA harness assembly around and tuck it into your crotch.
- Rest the SCBA on its bottle; frame up with the top of the SCBA against your body.

Note: If the SCBA assembly does not come around, do not force it, and move your body around to meet the assembly.

- **DO NOT LET GO** of the high-pressure line. Take your right hand and feel the floor around you
- Ensure there are no holes, stairs or drop offs in the floor.
- Switch hands, and check the floor on the other side and all around you.
- **MAKE SURE** there isn't a drop off. If your SCBA falls into a drop off, it can pull your face piece off resulting in firefighter injury or death. There have been documented firefighter fatalities as a result of this type of incident.
- Once freed, take the wires in your hand and push them away from your position, ensuring that the wires do not come back to you.
- When completely clear and no longer entangled in the obstruction, it is time to put the SCBA harness back on.

Re-Donning the SCBA

- Prior to putting the harness back on, check for any entanglement hazards over your head by performing an exaggerated swim maneuver
- If there are overhead obstructions, you must move to a safe spot prior to putting on the SCBA.
- To move with the SCBA not on your back, you must ensure that while you are moving, the SCBA cannot fall and pull our face piece off. To do this you must wrap your SCBA shoulder straps around your forearm.

- Take the SCBA and lay it on its bottle, frame up.
- Take the SCBA straps and pull them to the side.
- Now take your hands, place them on the bottom of the frame and slide your hands down to the ground.
- At this point with your hands flat on the ground, move them out away from the SCBA and catch the bottom of the shoulder straps.

Note: If you attempt this at the top or middle of the shoulder straps, there will be too much material to complete the wrap. The wrap should be completed at the bottom where the straps are thinner

- With the shoulder straps captured by your forearm, wrap the strap one time around your forearm and place your hands back on the bottle.
- Grab your tool and move out of the hazard area
- Once clear of the hazard area, you can begin to put the SCBA back on.
- Keeping one hand on the SCAB harness to ensure it does not fall, if there are holes in the floor. Use your other hand to check the area over your head once again for obstructions.
- If there are obstructions, move again to a safe spot.
- If there are no obstructions re-don the SCBA.
- When donning the SCBA, you may use the “Coat” method or the “Over the Head” method. Utilizing either one of these methods, place the SCBA on your back centered high. Lean forward with the SCBA on your back and allow the shoulder straps to hang loose.
- Take both hands and locate the chest strap. It is located just above the shoulder strap buckles on both sides and is quite a bit smaller than the shoulder straps. Follow those straps along to the plastic clasp for the chest straps. Align them, and push the ends together to connect them.
- Once the sternum strap is on, then tighten the shoulder straps. Then reach down and secure the waist strap.

At this point, you may take your tool and continue with your task or exit the building. Check your air supply as in may necessitate an immediate retreat from the building. Ensure that command is notified that you are free and disregard your mayday so the RIC can exit the building as well.

SCBA Emergency Ops

Refer to the SCBA Chapter, “Emergency Procedures”

LADDERS

BASIC GROUND LADDERS

Overview

Ladders have a major role in the fire service. A member must be able to ascend and descend from one level to another when performing emergency operations. Stairways are ordinarily accessible, but sometimes they may be involved in fire or other hazards. Members must therefore need to provide their own means of ascent or descent to upper floors. , roof top operations, ventilation, and fire stream operation may also require the extension and proper placement of fire service ladders. Fire service ladders demand close and coordinated teamwork. The safety of citizens and members depends on the member's ability to perform all operations quickly, using established and proper techniques.

GENERAL LADDER INFORMATION

Ladder Uses

Rescue: The principle use of fire service ladders is for rescue work.

Access: Fire service ladders are used to gain access to attics, upper floors, or to the roof of a structure as well as spaces that may be difficult to access otherwise.

Ventilation: Windows may be vented from the exterior using ground ladders.

Fire Streams: Ladders provide a means of access for hose lines from the ground level. Fire streams can be operated directly off of properly supported ladders.

Bracing: Ladders can be used as braces and as shoring in many applications.

Salvage: Ladders can be used to effect efficient salvage operations; forming catch-all basins, providing a means of attaching tarps, etc.

Ladder Nomenclature and Definitions

Anchoring: A method of securing the ladder to prevent slippage or other unwanted movement (see also Heeling, Footing, Ladder Anchors).

Attic Ladder: A 10’ folding or collapsible ladder designed to access interior crawl spaces or scuttle openings to attics.

Balance Point: Point of the ladder where its weight is distributed evenly.

Bangor Ladder: Also called a Pole Ladder, an extension ladder over 40' in length that uses stay poles for raising and stability.

Beam: The longitudinal structural sides of a ladder. The Beams can be solid, as in I-Beams, C- Channel or enclosed. Beams can also be of trussed construction utilizing two longitudinal structural members connected by gusset plates or truss blocks.

Beam Carry: A method of carrying a ladder on edge with one arm positioned through the rungs, over the top of the halyard, and supporting the lower beam.

Beam Position: The ladder is on the ground on one beam with the rungs vertical. Used in preparing to lift and carry 20' range extension ladders.

Beam Raise: Raising a ladder on edge.

Bed Position: When the ladder is laid on the ground flat, with the rungs in a horizontal position bed side down.

Bed Section (base section): Lowest and widest section of extension ladder. While the ladder is being extended or retracted, this section always maintains contact with the ground or other supporting surface.

Bed Member(s): The Member(s) that stand on the bed side of the ladder when raised.

Butt: The bottom end of the ladder that contacts the ground.

Butt Member: The member positioned at the "butt" of the ladder during carries and raises.

Climbing Angle: The proper angle for climbing a ground ladder.

Combination Ladder: A small ladder that can be used as a 6 foot A-Frame ladder or a 12 foot extension ladder.

Dogs: Locking devices on an extension ladder that prevent the fly sections form retracting when extending the ladder.

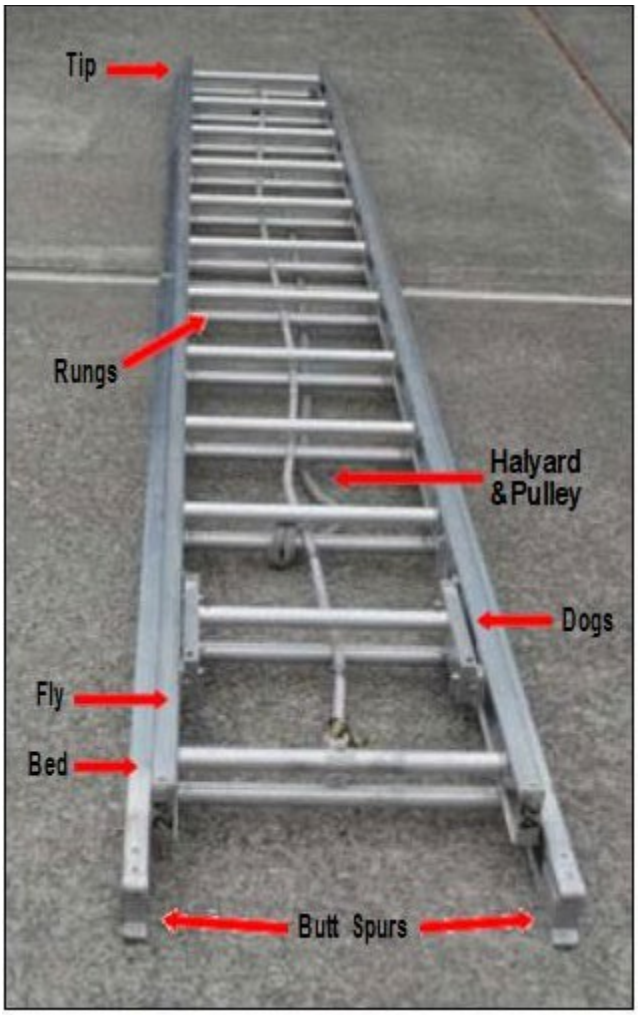
Extension Ladder: A ladder that has one or more sections that extends out from a bed section.

Flat Raise: A method of raising a ladder flat where both spurs are in contact with the ground as the ladder is raised.

Flat Shoulder Carry: Carrying the ladder in a flat orientation rested on the shoulders of the members performing the carry.

Fly Member: The member that stands on the fly side of the ladder when raised. This member is nearest the objective or building.

Fly Section: Upper sections(s) of extension of some combination ladders; the section that moves.



Footing: Securing the base of the ladder to prevent unwanted movement or slippage. The instep of a foot is placed on the outside of a beam and captures it securely as the ladder is being raised.

Grounding: Used to gain control of a ladder after it is pivoted, or during any unwanted movement, by stepping on the lowest rung of a ladder.

Guides: The channels or blocks that provide a track for the fly section(s) to extend out from the next lower section on an extension ladder.

Halyard: The rope and cable used to extend the fly section(s) from the bed of a ladder.

Halyard Anchor: A device used to secure the halyard to the bottom rung of a fly section.

Heat Sensors: Located on the inside of each beam of each section immediately below the second rung from the tip of each section. They are preset to change color at 300° F. (Heat sensors are not required on wood ladders.)

Heeling: Securing the ladder and preventing unwanted movement by standing on the rear side of the ladder (building side), grasping both beams, and pulling the ladder down and in toward the building.

High: The term announced when an extension ladder has reached the height of the objective. When announced, the ladder is extended next rung and secured.

Knee/Foot Lock: A method of footing the butt of a raised ladder by securing both sides of a beam with the knee and foot. The knee is lodged against the front side of the beam and the instep of the foot is hooked around the rear of the same beam.

Ladder Anchor: A metal hook on a rope or strap used to secure the ladder tip to the building or objective to prevent unwanted movement.

Ladder Chocks: Wedges used to level a ground ladder placed on uneven ground. Recommended they are painted a highly visible color and placed at an angle pointed away from the foot path of climbing members.

Left Beam: The beam on the left, as facing the ladder in a climbing position.

Locks: The positive locking devices on an extension ladder that prevent the fly sections from retracting when the ladder is extended. Also referred to as dogs or pawls.

Moving Pivot: A method of orienting a ladder to the building or objective during a raise. As the ladder is raised nearing the vertical position, it is swung into place to square it to the building or objective.

Pawls: The positive locking devices on an extension ladder that prevent the fly sections from retracting when the ladder is extended. Also referred to as dogs or locks.

Pivot: Slightly tilting the ladder on one spur in order to re-orient the ladder to the objective, typically in ¼ turns, either "in" (toward the building), or "out" (away from the building).

Position of Entry: The base should be out from the objective approximately ¼ of the distance of the height of the ladder raise. Approximately 70-degree angle.

Position of Rescue: A shallow climbing angle used to assist a victim, or perform a rescue. Approximately 60-degree angle.

Pulley: A grooved wheel over which the halyard is drawn.

Rescue Set: Two ladders, parallel at base of window for rescue with matching climbing angles.

Right Beam: The beam on the right, as facing the ladder in a climbing position.

Roof Hooks: The spring loaded hook devices on the tip of the roof ladder that allow the ladder to securely 'hang' from the peak of a pitched roof.

Roof Ladder: A single section, or straight ladder, with spring loaded hooks at the tip used for support on peaked roofs while working from them.

Rungs: Cross members used for climbing a ladder. Aluminum ladders will have rungs spaced 14" and made of corrugated design to prevent slipping. Wood ladders will have rungs made of hickory spaced 12" apart.

Rung Plates: The metal plate in which rungs are set between beam and truss. Also called gusset plates.

Rung Side: On wood ladders, the main beam side to which the rungs are attached. The rung side of wood ladders is also the carrying and climbing side.

Securing the Halyard: A safety measure to take up loose halyard rope and provide a backup if the locks should fail or were not properly engaged prior to climbing. The knot for securing a halyard to a rung should be of approved method.

Shift: Moving the ladder in the indicated direction while in the raised position.

Shoes: The bottom pivoting pads found on collapsible attic ladders.

Soft Lock: Method for a member to secure themselves to a ladder by reaching through the rungs with one arm while passing the other arm around the beam and then grasping a tool with both hands.

Spotting: Placing the butt of the ladder in the correct location prior to raising. Usually, in the line with and out from the building ¼ the height of the objective.

Spurs: The protective ends of ladder beams that help stabilize the ladder and prevent slippage.

Squaring the Ladder: Adjusting a raised ladder to straighten it in relation to the objective, for proper placement (i.e. left side of window), proper climbing angle.

Stops: The blocks or devices used to prevent a ladder's fly section(s) from extending out of the bed section or lower fly section.

Straight Arm Carry: A low arm beam carry where the upper beam of the ladder is carried with a straight arm. Typically used as the tip member during a "high / low" carry.

Straight Ladder: A single section ladder having no fly sections, such as a roof ladder, typically carried and raised by one member.

Tip: The top or upper most part of the ladder.

Tip Member: The member positioned at the ladder's tip during carries.

VEIS: The use of ladder(s) for accessing a single room for a targeted search for verified victims.

TYPES OF LADDERS

Baby Ladder

The baby ladder is a small extension ladder carried on both ladder trucks and engine companies. They vary in length when extended from 10' to 14'. Baby ladders are primarily used in gaining access to lower elevations on the exterior of buildings, salvage work, and gaining access to scuttles inside buildings.

Roof Ladder

The **primary purpose** of the roof ladder **is to establish secure footing on a pitched roof** (Fig. 5.3). The hooks provide a means of anchoring the ladder over the roof ridge or some other roof part and a working member can then use the ladder for support while removing shingles, cutting holes, and performing other ventilation and firefighting operations.

Additionally, a roof ladder can allow easier access to the bottom of a fire escape by using the hooks over the rungs and the spurs on the ground.

Roof ladders vary in length from ten to twenty feet. Twelve to fourteen being the most common size carried.

Folding / Attic Ladder

Folding or Attic Ladder

This ladder is constructed so that when folded, it measures approximately 4 inches in width. It is usually 10 feet in length and cannot be extended. Since it can be difficult to maneuver an extension or straight ladder around corners, in hallways, and in stairwells, this ladder proves itself very useful. It is also commonly called an “attic” ladder.

Extension Ladder

Extension ladders have two or more sections and are extended with a halyard. The only exception to this is a baby ladder, which does not have a halyard due to its height. In Seattle, extension ladders vary in measured length from 10 to 45 feet. A Bangor ladder is pictured in Fig. 5.6 next page

They are adjustable in height and their size is designated by the length of the ladder measured when the ladder is fully extended. Ladders 40 feet or longer are equipped with poles to assist in handling and placement. These poles are called "tormentor" poles. The following table of weight comparison is a source of Duo-Safety ladder company manufacturer.

SAFETY & LIFTING PROCEDURES

Safety Precautions

- Use extreme caution when reaching arms through the rungs of extended ladders, making sure that all dogs are locked and that the halyard is secured.
- Do not adjust the butt of an extended ladder until the tip is against the building and the fly is properly secured with the halyard or body loop.
- Keep hands, fingers, and feet clear of the fly sections and rungs of extension ladders when extending or retracting the fly.
- Use approved safety gear while manipulating ladders. At a minimum, wear gloves, helmets, and steel toed shoes.
- Avoid walking backward while carrying ladders.
- Attempt to maintain as many points of contact with the ladder to safely complete the required task, unless you are locked in on the ladder.
- **Never** lock in on an unsecured ladder.
- **Never** lock in on an aerial ladder.
- Check overhead for wires or obstructions prior to raising and lowering ladders.
- Always watch the tip of the ladder whenever it is in the vertical position, when lowering the ladder into the building, and when pivoting.
- Do not walk backwards when maneuvering tormentor poles.
- Do not step over ladders lying on the ground, walk around instead.

Lifting Ladders

Lifting should be done with the knees bent in a squatting position, with the back straight. This places the load on the heavy muscles in the thighs and not on the back. Lift with the legs and keep the load close into the body.

Do not lift by stooping over with the legs straight. This places the load on the sensitive back and abdominal muscles.

Keeping the toes pointed slightly inward rather than spread out lessens the chance of abdominal injury.

Ensure good footing before lifting and that the hand grip is firm and substantial. When two or more members lift together, their actions should be in unison.
The use of preparatory commands, such as "Prepare to lift, ---Lift," will ensure that all members are in unison.
If in doubt or a member is not ready, early communication from members is vital to preventing unnecessary injuries.

LADDER OPERATION

Members must know what action to take when the ladder command is given to ensure a smooth, coordinated movement in lifting, carrying, spotting, raising, pivoting, extending, retracting and lowering a ladder.

Commands shall be given by the member in charge in a loud, clear, and concise voice: prompt and exact response is required.

Members will be able to take charge of a ladder and issue all the commands and directions necessary to accomplish needed movements of a ladder.

When using tormentor poles, the member in charge will be on the right pole.

When two or more members are carrying a ladder, the member in charge shall be in the position noted below for correct spotting of the ladder:

1. On the right beam, at the center, for a cradle carry.
2. On the right beam, at the center or butt, for a 3 member flat carry.
3. At the right butt on a 4 or 5 member flat carry.
4. At the butt for all beam carries.

NOTE: If a sufficient number of members are available to carry the ladder, the officer may opt to stand out and give commands.

Working Load Limits

For safety, there are a maximum number of people permitted on a ground ladder at one time. These recommendations are from the ladder manufacturer.

Length or Type of Ladder	Maximum Load
Less than 30 feet	2
30 feet or longer	3

The maximum number of people listed above includes anyone being rescued or carried down the ladder and should not be exceeded. Loads exerted on these ladders

for drill purposes or normal fire ground operations should not exceed 750lbs.

NOTE: NFPA requires that ALL fire service ground extension and roof ladders have a 4:1 safety factor designed into the working load limits.

When a member is working on a ladder, the fly section(s) shall be properly secured using the halyard or a body loop, so that the fly(s) cannot retract.

Refer to the manufacturer's manual for the maximum load specifications for aerial ladder apparatus.

GROUND LADDER INSPECTIONS, TESTING AND MAINTENANCE

All ground ladders shall be inspected and maintained to ensure compliance with WAC, NFPA 1932, and manufacturer's instructions.

Ground ladders should be visually inspected after each use and monthly per state law.

Visual inspection shall include, but not be limited to:

- Heat sensor labels for change indicating heat exposure (if equipped).
- If there is visible charring.
- All rungs for snugness and tightness.
- All bolts and rivets for tightness.
- Welds for any cracks or apparent defects.
- Beams and rungs for cracks, splintering, breaks, gouges, checks, wavy conditions or deformation.
- Butt spurs for excessive wear or other defects.
- Halyards for fraying or kinking.
- Roof hooks for sharpness.
- Rungs for punctures, wavy conditions, worn serrations or deformation.
- Surface corrosion.
- Ladder slide areas for galling or absence of wax, if required by manufacturer.

Note: Any signs of failure during visual inspection shall be sufficient cause to remove from service until maintenance or repairs are complete and testing is complete.

Ground Ladders shall be tested:

- Annually and in accordance with NFPA 1932.
- At any time a ladder is suspected of being unsafe (obvious strain, metal fatigue or deformity).
- After the ladder has been subject to overloading, after heat exposure or heat sensor damage.
- After any deficiencies have been repaired, unless the only repair was the halyard.

Ground Ladder Maintenance:

1. Use a mild soap and water to clean ground ladders, non-abrasive scrub brushes may also be used.
2. Never use steel wool, wire brushes or caustic degreasers on aluminum ladders.
3. Be sure to flush inside the rails and rungs to clear debris.
4. Wet ladders should be wiped dry and checked for defects.
5. Ladder slides
   - Check for areas of old or excess buildup of wax - If present carefully scrape off
   - Preserve the finish by applying wax or automotive paste
6. Lubrication with a high quality silicone spray
   - Pulley bearings
   - Roof hooks
   - Dogs

BEST PRACTICES

It is imperative for the company officer to conduct frequent drills, including scenarios which could reasonably be expected to take place during any given emergency response. Drills should be designed to give all company members an opportunity to adapt to changing circumstances.

Orders must be given in a clear and concise manner so that all members of the company are aware of the evolution to be performed.

Role Responsibilities

Butt Member: The butt member is responsible to safely navigate the ground ladder to the objective. This member shall position himself/herself between the 2nd and 3rd rung in order to protect the beam spurs from contacting obstacles while being carried to the raise location. As the butt member approaches the location of the raise, he/she will visualize the area for overhead hazards, tripping hazards, unstable surfaces and overhead obstructions. The command "overhead clear" is important. Once at the objective, the butt-member shall verbalize "ground the butt" and set the ladder butt for the ladder raise.

Tip Member: The beam member(s) is/are responsible to safely carry the ground ladder to the raise destination and then, making sure there are no overhead obstacles, maintain control during the raise to the target objective. Lower the ladder into the building and maintain control while halyard is secured and safety checks performed.

Commands

"Prepare to": Command used to prepare other members of a lift, carry or movement of the ladder, prompting them to take their positions at the ladder.

"Lift": Members lift the ladder for the intended use.

"Carry": Indicates that the members shall carry the ladder to the designated location.

"Ground the Butt": Indicates the butt of the ladder shall be placed for the raise by the butt member.

"Beam or Flat Raise": Indicates the beam person(s) shall raise the ladder to the vertical position.

"Extend the Fly": Indicates the beam member(s) shall extend the fly section(s) of the ladder to the desired height.

"High, Dogs Locked": Indicates the fly is at the desired height. Adjust the final height to positively engage dogs.

"High Shoulder Carry": Type of carry used by one member, or used by the tip member when performing the "high/low" carry. (On its beam, the bottom beam is placed on the shoulder and one arm extended up to support the top beam.)

"Into the Building": The member(s) shall lower the raised ladder in to the building.

"Secure the Halyard": Beam member shall tie the halyard with an approved method, then ensure halyard is centered between the rung.

"Release the Halyard": Beam member shall untie the halyard and clear the halyard rope from the ladder rungs and from underfoot.

"Out from the Building": The member(s) shall push and pull the ladder to the vertical position away from the building.

"Lower the Fly": The beam member shall lower the fly section(s) to their nested position.

"Beam or Flat Lower": The butt member shall foot the ladder, and the beam member shall lower the ladder from the vertical position.

"On the Right / Left Beam, Quarter Turn In / Out": Indicates a repositioning of the ladder while in a vertical position WITHOUT the fly section(s) extended.

"Overhead Clear / No Obstructions": The butt member verbalizes that the work area is clear by verbalizing "overhead clear" during approach to set up a ladder, and verbalizes "No Obstructions" behind the ladder when taking the ladder down after use.

GROUND LADDER PRINCIPLES

Extension ladders shall be placed with the fly in (towards the building), unless otherwise directed by the team leader for a special circumstance.

Ladders are raised two ways, either flat, or on their beam. Ground ladders are generally raised the same way they are carried. As an example, if you carry the ladder flat, a flat raise would be used. An "Alley Raise" is a beam raise conducted parallel to the building instead of perpendicular to the building.

Ladder commands are normally given by the c Butt Person or Officer.

Ladder chocks should be used to level a ladder placed on uneven ground, to aid on slippery surfaces, or whenever their use will add safety to ground ladder operations.

Shifting the ladder may be required to achieve proper climbing angle or position. A couple of examples:

- Climbing angle incorrect: "Shift the butt of the ladder out from the building one foot, ready, shift and set."
- Tip not square: "Shift the tip of the ladder two feet to the right, ready, shift and set."

Prior to climbing a ground ladder, the member shall check 6 items:

1. Tip is square
2. Dogs are locked
3. Halyard is secure
4. Spurs are set
5. Climbing angle is good
6. Ladder is heeled or footed unless a ladder anchor is properly in place

GROUND LADDER CARRIES

One Member Carries

Shoulder Carry:

- Roll the ladder onto beam.
- Facing the butt end, kneel next to the ladder.
- Identify the balance point and place arm between rungs, placing the bed section beam on shoulder.
- Lift with your legs to stand up, grabbing the lower beam or forward rung.
- One Member Carries can be modified to accommodate dominate hand.

High Shoulder Carry:

- Roll the ladder onto beam.
- Facing the butt end, kneel next to the ladder.
- Identify the balance point and lift ladder up resting the butt end on the spurs.
- Place the bottom beam on the right shoulder while stabilizing the ladder with the right hand by grasping either the top beam, or by grasping a rung.
- Grasp a forward rung with the left hand for additional balancing.
- One Member Carries can be modified to accommodate dominate hand.

Suitcase Carry:

- Kneel beside the ladder facing the butt.
- Grab the middle of the ladder with closest hand and find the balance point.
- Lift the ladder.
- This carry allows the one free hand of the member to carry tools.

Removal from exterior mounted (Engine) ladder rack:

- Release locking devices, make sure the halyard is free from the rack and locks.
- Remove the unneeded ladder(s) and place them out of the way in a safe location.
- Face the butt end of the ladder and grasp the ladder at the balance point.
- Place right hand under the lower beam or through rungs and rest ladder on shoulder at balance point.
- When ladder is balanced on your shoulder, slightly lift up to release ladder from rack and step out away from the apparatus.

Removal from interior mounted bed shoulder carry:

- Unlatch the locking mechanism or compartment door that secures the ladders in the bed.
- Grasp the first rung of the ladder with the left hand, step backward and pull the ladder a few feet out of the bed.
- Continue pulling the ladder out of the apparatus bed until just the tip of the ladder is still supported by the bed; rest the butt end on the ground.

- Place inside arm though rungs at the balance point, stand up with ladder resting on shoulder.
- One Member Carries can be modified to accommodate dominate hand.

Two Member Carries

Shoulder carry from the ground:

- Position yourself between the second and third rungs from each end.
- At the command “PREPARE TO LIFT,” assume a squatting position, grasp the inside beam, and roll the ladder onto beam so bed section is facing you.

- At command “LIFT,” both members lift the ladder in unison using their legs to a standing position and rest the ladder on their shoulder.

- Use inside arm to reach through rungs and grab the lower beam or forward rung.

The suitcase carry:

- At the command “PREPARE TO LIFT,” kneel beside the ladder facing the butt end and roll the ladder to the outside beam.
- Grab the ladder with the closest hand.
- At the command “LIFT,” both members lift in unison to a standing position holding the ladder with the bed section against your legs.

Flat carry from the ground:

- At the command “PREPARE TO LIFT,” members position

themselves between the 2nd and 3rd rung from each end and assume a squatting position on opposite sides of the ladder.
- On the command "LIFT," lift the ladder to a standing position in unison placing the ladder on the shoulder using the inside hand to reach the opposite beam and balance the ladder.

Shoulder carry from ladder rack:

- At the command "PREPARE TO LIFT," members release ladder locks, making sure halyard is clear of rack and locks and position themselves between the 2nd and 3rd rungs from each end.
- At the command "LIFT," support the ladder with both hands on the rungs, remove the ladder from the rack and support the ladder on the shoulder with the upper beam on the shoulder.
- Place the arm through the rungs and grasp a forward rung for added support.

High / Low carry from ladder rack:

- At the command "PREPARE TO LIFT." members position themselves near the ends of the racked ladder, remove locks and make sure halyard is clear of rack and locking devices.
- At the command "LIFT," the members remove the ladder from the rack and perform the following carry:
    - o Tip member – high shoulder carry
    - o Butt member – suitcase carry

High / Low carry from ground:

- At the command "PREPARE TO LIFT," members position themselves between the 2nd and 3rd rungs from each end, and assume a squatting position on opposite sides of the ladder.
- At the command "LIFT," members lift the ladder and perform the following carry:
    - o Tip member – high shoulder flat carry with arm stretched out supporting the beam opposite the shoulder.
    - o Butt member – suitcase carry grasping the middle of the rung.

Cradle carry:

The cradle carry is a good option when a tool package is needed. The ground ladder is the "carry all" used to move multiple tools of choice to the scene. To perform the cradle carry, both members position themselves across from each other at the balance point of the ladder.

- Carrying the ladder package is accomplished by walking toward the objective area at the balance point of the ladder, maintaining grip on the beam of the ladder.
- By placing the spurs of the ladder against the structure, and resting the ladder on the thigh of each member, tools can easily be taken
- Once tools are removed from the ladder, it can then be efficiently raised from the rested position on the thighs of the fighters.

Three Member Carries

Adding a third member to a ladder carry can add complexity and reduce efficiency. Only consider adding a third member to a ladder raise if using a 35' or greater ladder, or deemed necessary for the special task assigned. Consider using a high / low carry for all three member carries due to the angle of the ladder during the carry which allows for differing crew member height to be easily adapted.

Positioning a third member:

- Flat carry - Two members on the same side of the ladder near the ends, one member on opposite side in the middle.
- Beam carry - Three members evenly positioned along the beam of the ladder.

GROUND LADDER RAISES

There are two main types of ladder raises: **beam** and **flat**. The cradle lift is another alternative, as shown prior.

Within those two types of raises, we have the option of deploying the ladder parallel or perpendicular to the building. This is based on how we approach our objective and any overhead wires or obstructions in our way.

Typically during raises, the fly section shall be facing towards the objective, thus the member raising the halyard will be facing the objective.

One member beam raise:

A one member beam raise can be utilized to quickly deploy a single ladder, such as a roof ladder or a 24' extension ladder.

Using a high shoulder carry in preparation for a one member beam raise offers the greatest efficiency of deployment and flexibility of placement because a building or structure is not needed to brace the ladder against.

From either a ladder rack or from the ground, lift the ladder at the balance point on to your shoulder facing the butt end and perform the following:

- Balance the ladder by grasping alternate rungs with the left and right hand.
- Visualize your objective area and verbalize "OVERHEAD CLEAR."
- Place the spur into the ground swiftly and simultaneously push the beam up raising the ladder.

- Capture and control the ladder once vertical by footing the ladder with the instep and shin while grasping both beams

One member flat raise:

The one member flat raise is additional movement added to a one member beam carry when utilizing a building or structure to raise the ladder against.

Follow all steps for a one member beam raise and add a moving pivot to achieve a flat orientation, and drive the ladder spurs against a building or structure and raise the ladder against it.

Two member beam raise:

From a two member beam carry, or a two person high / low beam carry, perform the following when the objective area is reached:

- Butt member – call "OVERHEAD CLEAR" and place the butt to ground positively footing the spur in anticipation for the ladder to be initially pivoted against that spur during the raise.
- Tip member – Orient the ladder to a high shoulder position (if utilizing a high / low carry, the tip member is already in this position), and drive forward down the beam toward the butt end lifting the ladder to a raised position using the legs as the primary lifting mechanism

If the approach for a beam raise is perpendicular to the building or objective, a smooth moving pivot can be used during the raise to orient the ladder correctly to the building. If a moving pivot is not used, a 90 degree pivot will be needed after the ladder is raised and controlled.

Once in a vertical position, both members capture the ladder using both grasping the beams/rungs, and using a knee foot lock on opposite beams to stabilize the ladder.

Two member flat raise:

From a two member flat carry, or a two member high / low beam carry, perform the following when the objective area is reached:

- Butt member – call "OVERHEAD CLEAR" and place the butt to ground positively footing the spur in anticipation for the ladder to be initially pivoted against the spurs during the raise.
- The butt member will anchor the butt end of the ladder. If necessary, grasp the rung or halyard and lean back to provide counterbalance.
- Tip member – Orient the ladder to a high shoulder position (if utilizing a high / low carry, the tip member is already in this position), and drive forward down the beam toward the butt end while balancing the ladder with the outside arm on the opposite beam lifting the ladder to a raised position using the legs as the primary lifting mechanism.

Once in a vertical position, both members capture the ladder using both grasping the beams/rungs, and using a knee foot lock on opposite beams to stabilize the ladder.

Three member beam raise:

From a three member beam carry, or a three member high / low beam carry, perform the following when the objective area is reached:

- Butt member – call "OVERHEAD CLEAR" and place the butt to ground positively footing the spur in anticipation for the ladder to be initially pivoted against that spur during the raise.
- Tip members – Orient the ladder to a high shoulder position (if utilizing a high / low carry, the tip members are already in this position), and drive forward down the beam toward the butt end lifting the ladder to a raised position using the legs as the primary lifting mechanism.
- At the point where the member forward of the other reaches the butt end, the member toward the tip can swing out and reposition at the opposite beam and assist with controlling the ladder once raised.

If the approach for a beam raise is perpendicular to the building or objective, a smooth moving pivot can be used during the raise to orient the ladder correctly to the building. If a moving pivot is not used, a 90 degree pivot will be needed after the ladder is raised and controlled.

Once in a vertical position, both tip members capture the ladder using both grasping the beams/rungs, and using a leg clamp on opposite beams to stabilize the ladder. The butt member grasps both beams for added support.

Three member flat raise:

From a three member flat carry, or a three fire-fighter high / low flat carry, perform the following when the objective area is reached:

- As the ladder is carried toward the objective, the tip member moves up quickly and smoothly to a point even with the center member (there is no command for this action)
- Butt member – call "OVERHEAD CLEAR" and place the butt to ground positively footing the spur in anticipation for the ladder to be initially pivoted against the spurs during the raise.
- The butt member will anchor the butt end of the ladder. If necessary, grasp the rung or halyard and lean back to provide counterbalance.
- Tip members – Orient the ladder to a high shoulder position and drive forward down opposite beams toward the butt end lifting the ladder to a raised position using the legs as the primary lifting mechanism.

Once in a vertical position, both tip members capture the ladder using by grasping the beams/rungs, and using a knee foot lock on opposite beams to stabilize the ladder, the butt member adding support by grasping both beams.

EXTENDING / LOWERING THE FLY

One Member Fly Extension

Place the inside of the right foot to the back of the right spur of the ladder. (Fig. 5.51) Be sure the toe is not in a position where the fly section could drop. Position the knee of the same leg on the bed side of the right beam. The opposite foot should be a comfortable distance in back to help keep the balance of the ladder. Reach up using a hand-over-hand motion to extend the halyard. (Fig. 5.49 & Fig. 5.50)

NOTE: While extending the fly section keep the ladder balanced by using your right shin to "push" against the right beam. That will assist in keeping the ladder away from you. If the ladder begins to lean away from you too far, pull back on the halyard until you regain control. Again, the shin and halyard should be used to control the "too close and too far away".

When the command "HIGH" is given the fly is locked at the next highest rung. Ensure that the dogs are locked. Do not put hands or feet in position where they can be injured by the movement of the fly section(s).

NOTE: At no time shall any member reach through a rung space or touch a rung with the hands or feet until all dogs are locked.

Using the inside of the right foot around the right spur

Member using the right shin to "push" the ladder away

Member using the halyard to "pull" the ladder back

Two Member Fly Extension

One member is on the fly side and one on the bed. The member on the bed side will place their right toe against the right spur of the ladder, extends the flies to the desired height. The opposite foot should be a comfortable distance in back to help keep the balance of the ladder. Reach up using a hand-over-hand motion to extend the halyard. While extending the fly section keep the ladder balanced by pulling straight down and in line with the center of the ladder as much as possible.

The member on the fly side will place both hands on the beams of the bed section and maintain the balance of the ladder with the ladder slightly tilted toward the objective.

When the command "**HIGH**" is given the fly(s) is/are locked at the next highest rung. Ensure that the dogs are locked. Do not put hands or feet in position where they can

be injured by the movement of the fly section(s).
NOTE: At no time shall any member reach through a rung space or touch a rung with the hands or feet until all dogs are locked.

Two member "extend the fly"

Three Member Fly Extension

There are two members on the bed side, and one on the fly side.

Command "**EXTEND THE FLY**"

The two members on the bed side both reach for the halyard with their **inside** hand. The taller member (or member on the right beam, if the members are the same height) calls "**HIGH**" and takes the higher hand position on the halyard, during extension, until the fly is extended to the proper height. The second member will take hold of the halyard with their inside hand just below the other member's hand during extension. Both members on the bed side will have their outside toe in front and against their respective bed side spurs.

Care must be taken to maintain the proper hand placement for both members and to establish a smooth rhythm while extending the fly. When the ladder is extended to the desired height the command "**HIGH**" is given. This is the signal to lock the dogs on the next highest rung.

The member on the fly side will place both hands on the beams of the bed section, at shoulder height and maintain the balance of the ladder with the ladder titled slightly in to the objective. The feet are placed shoulder width apart, one foot ahead of the other. The foot closest to the ladder will be about one to one and a half feet away from the butt of the ladder, hands at shoulder level. The fly-side member should be using body weight to manipulate the ladder in or out. This is accomplished by locking the back leg, getting a good stance, and locking the arms.

Three member "extend the fly"

Command "**LOWER THE FLY**"

When lowering the flies on any ladder only the member on the right beam manipulates

the halyard. If the member on the right beam is having difficulty getting the fly(s) in motion, the other member may assist in that process then turn the halyard over to the member at the right beam.

NOTE: It is important to lower the flies of the ladder using a hand-over-hand method. Do not let the halyard slide through your hands.

SECURING THE HALYARD / ANCHOR

Securing the Halyard

Round Turn method:
The halyard is secured by placing it through the second and third rungs of the ladder.

The bight is then wrapped around the rung and the slack taken up. Standing on the bottom rung and pulling upward works well. The rung is wrapped one round-turn making sure the remaining halyard is captured in the center of the rung.

Two half-hitches are tied on the line below the round-turn.

The hitches are adjusted so the remainder of the halyard is positioned behind the ladder and centered on the rungs to facilitate climbing ease.

Clove Hitch method:

- Take excess halyard into a bight, and place a clove hitch on the 3rd or 4th rung of the bed section.
- Place two half hitches around the standing end of the halyard below the clove hitch.
- Ensure excess halyard is placed toward the back of the ladder out of the climbing area of the rungs.

Securing the Ladder Anchor

Ladder anchors are used to secure the tip of the ground ladder. The ladder anchor is hooked to the structure. The webbing/rope is secured with a round-turn over the top of the first rung below the sill/roof-line.

The webbing/rope is then secured to the next rung below with a round-turn in the opposite direction…

….followed by tying two half-hitches and tucking the tail behind the ladder.

Make sure the ladder anchor is centered on the rung to facilitate ease of climbing.

LADDER PLACEMENT

Safety considerations for ladder placement should include the following:

- Overhead obstructions such as power lines and building overhang obstructions.
- Uneven terrain or wet / icy conditions on concrete or asphalt surfaces.
- Main paths of travel for firefighters or occupants.

Unless necessary, do not place ladders:

- In front of main entrances and exits.
- Into windows with heavy turbulent smoke or imminent fire conditions.
- Where the beams of the ladder will straddle hose lines.

Ladder placement should take into account efficiency and operating positions of interior crews. Ground ladders should be placed on and above the fire floor, areas adjacent to fire involved areas, and placed on at least two sides of the fire building.

Consider building construction and occupancy type for ladder placement also, and ask yourself where firefighters may seek refuge and rescue from a fire area if conditions rapidly deteriorate while operating on upper floors.

Rescue Set

When placing a ladder for rescue, either firefighter or civilian rescue, center the tip of the ladder at or just below the sill of the window to not obstruct the opening of the window. Consider a shallow climbing angle for rescue of an unconscious person(s).

Consider placing an additional ladder immediately adjacent to the first ladder placed during a rescue for an additional member to assist in the rescue.

Roof operations

During roof operations, extend the tip of the ladder at least 3-5 rungs above the roof line for ease of access and egress, and to improve the visual reference for the exit in smoky conditions.

Horizontal ventilation

Place the ladder on the upwind side, placing the tip even with the top of the window.

Vent Enter Isolate Search

For accessing a single room for a targeted search for verified victims, place the tip of the ladder at or just below the window sill for rescue.

ADJUSTING THE BUTT

This operation is performed while the ladder is in the vertical position and against the objective with the halyard secured. Use good lifting technique to avoid injuring the back.

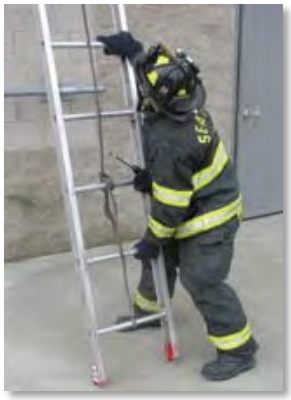
One Member on the bed side

Reach down with either hand and grasp the 1st or 2nd rung from the spur, and with the other hand grasp the 4th or 5th rung, and lift the butt of the ladder up off the ground and while looking up adjust the ladder as needed.

Two Members on the bed side

The member on the right beam will reach down with the left hand and grasp the 1st or 2nd rung from the spur, and with the right hand grasp the 4th or 5th rung. The

member on the left beam will reach down with the right hand and grasp the 1st or 2nd rung from the spur, and with the left hand grasp the 4th or 5th rung. Together both members will lift the butt of the ladder up off the ground and adjust the ladder as needed.



One member "adjust the butt" for climbing or lowering

Two member "adjust the butt" for climbing or lowering

SHIFTING LADDERS

One Member

26' or Less Ground Extension Ladder

This operation is performed so that a ladder can be moved parallel to a building or object while in the vertical position, and can be accomplished by a command or on an individual basis.

If the member is given the command to shift, they will be first given a preparatory command of "prepare to shift" and then the direction in which the ladder is to be shifted.

Example: Command - "**Prepare to shift right**"

The member will be on the bed side of the ladder when the command is given and move to the opposite beam called for. Example: "Prepare to shift right," the member will move to the left beam. The member will at the same time reach down and grasp the 2nd rung of the bed section with the right hand and reach around to the fly of the ladder with the left hand and grasp the right beam. When shifting to the left reverse the procedure. If you are shifting right, your right hand will be lifting the ladder on the bed section. If you are shifting left, your left hand will be lifting the ladder on the bed section.

Ready position waiting for commands

The next action is to state "OVERHEAD CLEAR"; the path that the ladder will take is checked to assure that there are no overhead obstructions.

The next command will be "**LIFT**", the member will lift the ladder off the ground using the leg muscles (not the back) and allow the ladder to balance on the shoulder and slightly across the front of the body.

The next command is "**SHIFT**"; the ladder will be moved in the direction ordered. Move forward in the direction of travel and monitor the position of the ladder being

carried. Also watch for overhead obstructions.
The next command is "**HALT - LOWER**", the member will take one additional step forward then bring the feet together and come to a stop, set the ladder to the ground, and then foot the ladder.

Ready position waiting for commands

"Prepare to shift left" position

"Lift" position, awaiting the "shift" command

"Prepare to shift right" position

Two Members

35' or Less Ground Extension Ladder

Example: Command - "**PREPARE TO SHIFT-RIGHT**"

The member on the bed side of the ladder will slap the right beam when the command is given. The member on the fly side faces the right beam, reaches through the fly sections between the 2nd and 3rd rungs with the right hand and grasps the 2nd rung of the bed section near the right beam. Their left hand grasps the fly section(s) of the right beam about shoulder height. The member on the bed side faces the right beam and grasps the 2nd rung of the bed section near the left beam with their left hand. The right hand grasps the right beam of the bed section. Both members should be squatting so the lifting will be done with the legs.

The next action is to state **"OVERHEAD CLEAR"**; the path that the ladder will take is checked to assure that there are no overhead obstructions.

The next command will be "**LIFT**", the members will lift the ladder off the ground in unison using the leg muscles (not the back) and balance the ladder tilting the tip slightly back.

The next command is "**SHIFT**"; the ladder will be moved in the direction ordered. Move forward in the direction of travel and monitor the position of the ladder being carried. The bed side member watches the ground and the fly side member watches the tip for obstructions.

The next command is "**HALT - LOWER**", the members will take one additional step forward then bring the feet together and

come to a stop, set the ladder to the ground, and then foot the ladder.

"Lift" position

UNEVEN TERRAIN

Wedging is a technique used to stabilize the butt of a ladder when the terrain at the spurs is uneven.

All ladder companies carry wooden wedges. A member can use these wedges one at a time or two wedges opposing each other. Other materials that are available at the scene may also be used to even up the base of the ladder, such as tarps.

If a spur is not touching the ground after the ladder is placed into the climbing position, it is steadied by placing the wedge or tarp between the spur and the ground making positive contact with both.

CLIMBING

Footing the Ladder

This is the preferred method of securing a ladder. A member footing a ladder places one foot against the base of the ladder at the spurs. The hands grasp the beams and the ladder is pressed against the building. This method allows for the member to remain in a safer position looking up the ladder and maintaining situational awareness.

Heeling the ladder

In this method of securing a ladder, the member is positioned beneath the ladder with the back toward the building, grasps the beams of the ladder with both hands and pulls the ladder toward the building.

Soft lock

While standing on a rung, reach through the rungs with one arm and grasp the tool with both hands.

Climbing the ladder

Climbing ground ladders should always be smooth and controlled. Climb with straight arms, bent knees and a heads up orientation. Ascending and descending a ground ladder with tools or equipment should be done while maintaining a firm grip, often sliding the tool up the right or left beam while ascending the ladder. Proper climbing methods should always be employed in ascending and descending ladders. The following safety items are to be checked before climbing:

1. Ladder spurs are secure and will not slip.
2. Wedge the ladder on uneven ground.
3. The ladder is resting firmly on the objective.
4. Ladder locks are secured on all flies and the bed section.
5. The tip is properly secured with a ladder anchor or the ladder is footed at the butt. Members facing the objective will look up when heeling a ladder.
6. The fly has been properly secured with the halyard or body loop.
7. Verify proper climbing angle (approximately 70 degrees).
8. If the ladder is equipped with tormentor poles, ensure that they are properly set. The poles should be parallel to the building whenever possible.
9. When climbing a ground extension ladder place your hands on the rungs **or slide them up the beams**. On an aerial ladder, use the trussed hand rail. When on a straight ladder fire escape, always climb with your hands on the beams, not on the rungs.

Ladder climbing should be done smoothly and rhythmically in order to minimize bouncing and swaying. In ascending or descending a ladder, climb near the center of the rungs on the arch of the foot.

While climbing, the back should be near perpendicular with the ground and the climber's arms almost fully extended. The hands should be grasping the rungs palms down and one hand should be grasping a rung at all times while climbing (or sliding up/down a beam). It is also acceptable to

use the beams to climb. The hands should run behind the beams for increased safety to the climber.

DEPLOYING THE ROOF LADDER

The use of a roof ladder is for steep pitched roofs, or slippery roof conditions.

Deploying the Roof Ladder:

- Approach at a 45 degree angle to either beam of the secured ground ladder if possible

- Place bottom rung of roof ladder against beam of ground ladder.
- Deploy roof hooks at the tip of the roof ladder so they are facing up.

- Walk the roof ladder into vertical position using the beam of the ground ladder as a pivot point.
- Climb the ground ladder until you reach a point at the upper ⅓ of the roof ladder.

- Shoulder the roof ladder by inserting one arm through the rungs.
- Grasp the ground ladder through the rungs of the roof ladder and continue climbing.
- Climb to the roof line.
- Using a hand over hand technique, slide the roof ladder on to the roof, securing the hooks over the ridge.

VENTILATION

All firefighters must have a good understanding of how to perform ventilation and be prepared when responding to do so.

TACTICAL VENTILATION OVERVIEW

Tactical Ventilation is the systematic removal of heated air, smoke and other contaminants from a structure with the replacement, or replenishment of cooler air. When done correctly, ventilation removes the productions of combustion and heat that contribute to civilian fire fatality. Ventilation also improves conditions and visibly for firefighters entering the building, helping speed up fire attack and improving firefighter safety. It is the most complex tactic to perform on the fire ground because proper ventilation requires:

- Planning
- Knowledge of building construction
- Knowledge of how and when to ventilate
- All companies working on scene coordinating their efforts
- Controlling the air flow

When done incorrectly or inappropriately, ventilation may endanger the lives of firefighters and civilians. Ventilation must be planned and coordinated with fire attack. Thus, a "ventilation plan" should be established and continually evaluated at both the task and strategic levels. The ventilation plan encompasses all units on the fire ground and should not be specific to truck work. Effective ventilation is a fluid operation based on fire conditions, rescue profiles, construction characteristics, building size, weather conditions and available personnel and equipment. An understanding of the theory and practice of ventilation and how it impacts fire behavior is essential to the enhancement of fire attack and search operations. The method of ventilation must be dynamic and adjust as conditions change. For example, one method may be initiated for the initial attack and a second method may be implemented as additional personnel and equipment arrive. Alternatively, one method may be discontinued and replaced by another as fire conditions change or as the incident evolves. It is also possible to have simultaneous methods incorporated into certain incidents. This makes it critically important that ventilation is established and continually evaluated by interior crews, the crews assigned to perform ventilation, and command.

Fires that are reported early and are in the initial stages of development are typically tapped quickly by the first arriving

company. However, fires that have developed past the initial stage, reaching the growth or fully developed stage, that have a large volume of smoke exiting under pressure when the initial company arrives, require a different approach. Fires with these characteristics require coordinated ventilation and should be given a higher priority in the initial operation rather than as a secondary task.

PRINCIPLES OF MODERN FIRE ATTACK

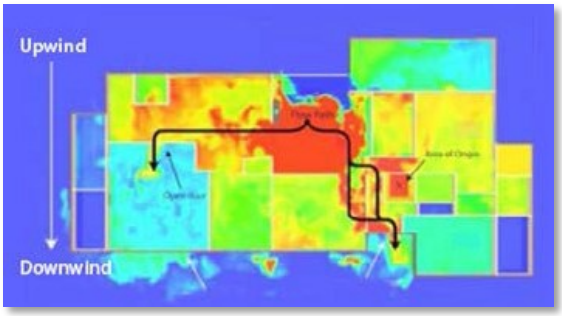
As stated earlier, fuels used in today's homes are much more dangerous than fuels from previous decades. Therefore, it is critical that as research uncovers more information about fire dynamics, we evolve our tactics to the changing conditions. The acronym SLICERS provides a process for first arriving companies to evaluate fire conditions in a compartment and employ tactics to mitigate the incident hazards and avoid placing firefighters in harm's way.

- Size up
- Locate the fire
- Isolate flow path
- Cool compartment
- Extinguish
- Rescue
- Salvage

This process, when used by first arriving companies, quickly brings the fire under control. It allows a single engine company to be proactive while waiting for other supporting resources to arrive.

FLOW PATH

The flow path is the volume between an inlet and an outlet that allows the movement of heat and smoke from the higher pressure within the fire area towards the lower pressure areas accessible via doors and window openings. The stage of the fire (i.e. ventilation or fuel limited), the distance from the inlet, cool air in (door or window), the distance from the fire to the outlet (door, window, roof vent), the shape and size of the inlet and outlet, and the type and shape of items (furniture or walls) or openings (interior doors) in the flow path all play key roles in the availability of oxygen to the fire, and ultimately firefighter safety. Based on varying building configurations, there may be several flow paths within a structure. Operations conducted in the flow path between the fire and where the fire wants to go, will place firefighters at significant risk due to the increased flow of thermal energy toward their position.



Fire behavior and flow path

Note: A single opening can be a sufficient flow path by creating bi-directional air movement (heat and energy released from the top of the opening and cool air entering the bottom).

DOOR CONTROL

Tactically there are several considerations for door control. Most importantly, it is a temporary action. Eventually, the door must be opened to gain access into the fire compartment, however, if you limit the air inlet you limit the fire's ability to grow. Fire dynamics, as it relates to door control, is fairly simple - if you have a ventilation-limited fire and you limit the amount of air at the inlet, you limit the fire's ability to grow. While this may not completely cut off the oxygen supply, it slows it, retarding fire growth. In the recent UL experiments, flashover was delayed for several minutes by limiting air through the inlet. The door should be controlled until water is ready to be applied to the fire and it is under control. Water application will create an endothermic reaction absorbing more energy than is being released.

TIMING

Well-timed and coordinated ventilation combined with water application improves conditions. Effective ventilation requires coordination and timing. The same ventilation action 30 seconds earlier, or later, could have a dramatically different outcome. This is especially true for vertical ventilation. Vertical ventilation is efficient in venting heat and smoke, but may cause rapid changes in the conditions within the compartment. Additional considerations about timing may include, but not always, are:

- The fire may not react to additional oxygen instantaneously.
- The higher the interior temperatures the faster the fire reacts.
- The closer the inlet (air) is to the fire the faster it reacts.
- The more air entering the faster the fire reacts.
- The larger the ventilation opening the more air the fire will pull into its base causing more rapid fire growth.

READING SMOKE

Evaluating smoke conditions is a very important component of size-up. Smoke conditions may change as the fire becomes ventilation-limited and the pressure within the compartment decreases. Firefighter safety can be improved if we consider all compartment fires to be ventilation-limited until proven otherwise.

When reading smoke, it is important to consider its volume, velocity, density and color:

Volume: The volume of smoke establishes the relativity to the "box." Large amounts of smoke from multiple openings are a significant finding.

Velocity: The velocity indicates the amount of heat being generated. The higher the velocity, the closer it is to the fire location (more heat). Velocity also indicates the rate of growth, as speed increases, so grows the fire. Turbulence equals heat; turbulent smoke means the "box" is done absorbing heat.

Density: The density of the smoke demonstrates the continuity of the fuel. The denser it is, the higher the concentration of fuel present in the column. The more fuel it contains, the more severe and more complete the reaction will be when it ignites.

Color: The color can indicate the type of material burning (brown smoke usually indicates unfinished lumber). It can also demonstrate the stage of heating (lighter colored smoke is generated in early stages of fire) or the distance the smoke has traveled (big box with fire located deep inside may present light colored smoke to the outside) the building can act as a filter.

Note: As volume, velocity, density and color increase, an extreme fire behavior event is pending.

VENTILATION SIZE-UP

The size up process begins even before the alarm goes off. Preparation of the firefighters during training, company inspections, and pre-fire plans assist with knowing what to expect before arriving at the incident. This section will discuss some size-up considerations from the dispatch to the actual act of ventilation, as well as during the evolution and the effectiveness of our methods.

From the Dispatch

- The type of occupancy will give you clues as to what you might be facing (commercial, residential, multi-family). Will there be fire protection systems in place that aid or hinder operations?

What area of the city?

- This clue will help you determine potentially what types of homes are associated with the area. Is this an

area common for Post WW2 construction, commercial with daylight basements, large luxury homes, near the water with potentially high winds?

Where is the fire located?

- Are calling parties or units arriving giving clues as to whether this is a top-floor or below-top floor fire? This observation may clue you in on what types of ventilation may be necessary, and help you and your crew devise a plan while enroute.

Approach from opposite direction if possible.

- This will potentially help you with ladder truck placement and getting familiar with your apparatus more effectively, as well as potentially avoiding laid supply lines or multiple apparatus. Take time to make time.

Get close, address if possible.

- Know how to deal with not being at the address and any obstacles that may be in your way (engines, other vehicles, vegetation).

- As we know, first arriving units need to leave room for the ladder company in case vertical ventilation or roof access is necessary. It is also very important to stay out of the "ladder bay" (area behind the ladder), not parking closer than 30' from the rear of the apparatus. This picture demonstrates how an engine company can prevent ladders from being pulled from the back of the ladder truck when parked too close.

Anticipate the area around the structure.

- Will there be flat level ground around the building? What method will be more expeditious or safer, aerial ladder or ground ladders? If locating on a hill, understand that being on the uphill side affords a higher reach, but being on the downhill side may maximize the angle of the ladder.

APPROACH AND ARRIVAL

Residential

View at least three sides if possible.
What's the smoke doing?

- The smoke characteristics will tell you where the fire is, how involved it is, and what to anticipate in the coming minutes. Look for the darkest, fastest moving smoke, from the smallest opening - this is where the fire is. This crucial information will help you to prioritize tactics as it gives you some awareness of the time you have for critical fire ground functions to be performed (i.e. entry for fire attack, rescue).

Is there any wind?

- Knowing the direction of the wind will help you determine where you will set up the aerial or ground ladders.

Is the fire self-vented?

- If the fire has self-ventilated from the roof, the need to make a vertical ventilation cut is potentially not needed. If there is still a need to access the roof and make another ventilation opening (such as a strip cut), be sure to look for fire wall locations to use as a barrier or use smoke indicators to identify a safer area away from fire location to access and work.

Look for the power drop.

- Identify where the power lines are and where they go into the building. This will help with utilities control as well as identify the location to avoid for access or work areas.

Look at the soffits, enclosed or bird blocking?

- The eves will tell you the direction of rafters, their location, and their spacing. Enclosed soffits pose a challenge to identify rafter direction.

Type of roof?

- Identifying the roof type will indicate the potential strength of the roof under fire conditions and potential hazards. It will also potentially tell you the type of cut that will have to be made based on the construction of the roof.

What era is the building?

- Will tell you strength or weakness concerns of the roof and what to expect under the sheathing. May also help identify whether or not to anticipate hidden areas or void spaces.
- Conventional vs. lightweight construction may also tell you the type of roof sheathing.

What are the conditions of the gable vent or any other vents?

- A good way to identify the level of involvement, if any, of the roof is to view the vents of the building. What kind of smoke conditions are visible?

View the roof line. Is there a ridge vent or is there a sag?

- If you visualize a sag in the roof, a high index of suspicion must be used that the roof is potentially unsafe for rooftop operations. Investigate the sag further before committing firefighters to ladder the roof.

Commercial/Multi-Family

All previous considerations and...

- PRE-FIRE! Tells fire loading, what's potentially on fire, and any protection systems.
- Attempt a 360 or a modified version. Sometimes these buildings are too big or have access issues.
- Top floor fire = VERTICAL VENT
- Mansard and/or parapet? Be aware of fire travel in hidden areas. Expose these areas.

360 SIZE-UP

What's the view from the front yard? (obstacles, check access)

- Where is the fire now and where will it be in the coming minutes? After completing your 360, turn back around and see how the fire traveled in that amount of time.

Envision the building layout.

- This will help in vertical hole placements and for positive pressure efforts.
- Determine location of the bedrooms and paths of egress to identify likely victim locations.

Look in windows for conditions, fire location, window staining

- Knowing the level of involvement will assist in making a determination on the type of ventilation needed, if it hasn't already been requested. Will also give you a basis to determine the effectiveness of your ventilation tactic.

Look up at the eves (rafter tails and smoke)

- Reading smoke will tell you the level of involvement in the attic space and rafter tails will also help you understand spacing and direction.

Means of egress (try to establish two)

- When passing by the fire room, if not self-vented, consider making an opening <u>after</u> coordinating with attack crews and the rest of your vent crew.

INTERIOR SIZE-UP

Where are the means of egress, and what are the conditions in those areas?

- How can you improve them or keep them clear?

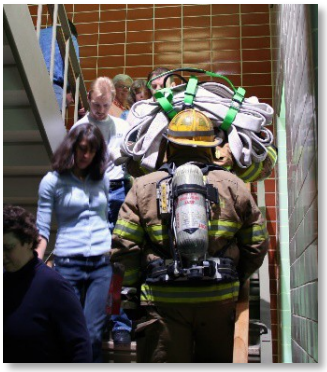
Conditions in the hallway of fire floor.

- Is ventilation needed in the hallway to assist with operations?

First-in officers should be considering vent needs when determining fire attack route, method and travel. Below top floor fire, find flow path for positive pressure.

STAIRWELL COORDINATION

Consideration should be given to designating stairwells for egress versus suppression operations.



TO THE ROOF

- No ladders over windows. Lessens likelihood of fire exposure or

blocking problems.

- Ladder to corners/outside walls/valleys AND access at the uninvolved walking to the involved (walk the strong parts to fire location).
- Check the roof vents. They are good indicators of the conditions under you in the area of the building.
- Check for skylights. Sound the roof.
- Inspection and indicator holes (size of building may dictate).
- Look for building features that indicate roof construction and rafter spacing.
- Environmental clues (dry spots on a wet roof).

BUILDING CONSTRUCTION

In order to fully be competent in ventilation operations, firefighters should first have an understanding of building characteristics. Possibly the most important task all firefighters should perform is conducting their own size-up on arrival of a structure fire incident. In addition to fire behavior conditions, firefighters should also take note of key building features to assist them with performing their tasks effectively, efficiently, and most of all safely. This section will discuss several building construction features that will assist crews in ventilation tactics. It is important to know this section is not all encompassing and knowing buildings in your first due area is the best way to ensure familiarization with construction types you'll face.

CONSTRUCTION TYPES

Type 1 Fire Resistive

Most commonly, these buildings are found as high rise structures and are constructed of concrete and protected steel. They are designed to withstand the effects of fire so as to confine it to the room/area of origin. These buildings are typically easily identifiable because of their height. Ventilation tactics in these buildings are usually limited to horizontal, and/or through the use of mechanical systems. These buildings have HVAC systems that assist with air movement, and sometimes mechanically pressurize stairwells.

Typically, priority should be given to locating the building systems and/or a site

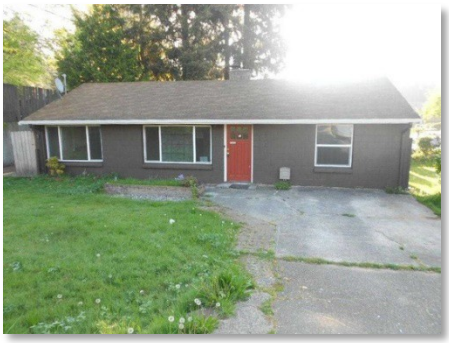
maintenance worker to help control the systems.

Type 2 Non-Combustible

This type is typically found in newer buildings and remodels of commercial structures. The walls are typically reinforced masonry or a concrete tilt-up, and the roofs have metal structural members and decking. The roofs are often covered with lightweight concrete, foam, an insulated membrane or a combination of these materials. These buildings are typically big box buildings and strip malls.

If you're unable to tell visually, sounding the walls is a good technique to find out the construction type. Crews on the roof should first cut an inspection hole to identify the roof construction type. Once it is discovered that the roof is metal, crews should consider other vertical openings such as sky lights or other natural ventilation openings as the time it takes to cut vertical ventilation openings would be lengthy and not effective. There are many of these buildings in our area.

Type 3 Ordinary



This type can be either new or old construction, non-combustible walls with wood interior structural members and wood framed roofs. Older buildings may have unreinforced masonry with conventional roofs, while newer homes may have lightweight trussed roof systems with reinforced masonry or tilt-up. Common roof systems in commercial buildings are parallel chord trusses and panelized roofing. To aid in identifying the era of these types of buildings, firefighters should look for clues such as collar ties, king's rows, and arched lintels. If an older building is discovered, firefighters should keep in mind the possibility of roof-on-top-of-roof systems. Coordinated vertical ventilation is effective on these buildings. There are many of these buildings in our area.

Type 4 Heavy Timber

There are not very many of these types of structures prevalent in our area. They are typically found in older buildings and use large dimensional lumber for structural materials. They often hold up well to fire conditions: however, often times are not maintained, or have significant weathering, termite issues, etc. that contribute to potential structural instability. They are noticeable by their large lumber dimensions spanning great distances. They were commonly built prior to 1960 and used bolts and metal plates for connections. Vertical ventilation is possible on these buildings but may require more time for cutting.

Type 5 Wood Frame

Our most common construction type, these account for most of the single family residences in our area. They are found in more modern homes, having both conventional and lightweight trussed roofs.

The roofs usually have asphalt shingle coverings, tile, or even metal. These buildings come in many different designs and configurations, as well as sometimes have garages attached. Interior coverings in these buildings include lath and plaster, gypsum board, wood paneling, and other combustible material.

CONSTRUCTION TYPE VARIABLES

Another common construction type you will see is a combination of the previously mentioned construction types. For instance, quite common now are new commercial and multi-family buildings which you may have heard referred to as "5 over 1" or "5 over 2" buildings. This means that there is Type 5 (Wood Frame) construction built over the top of Type 1 (Fire Resistive) or Type 2 (Non-Combustible). It is important to know that this phrase is referring to the construction types and there may be more than one floor of Type 1 or Type 2 (often used with parking garages) with multiple floors above it of Type 5 used for living space and/or business.

CONSTRUCTION ERA

A very important feature you should identify is the era of the building to help guide you with what you're up against. During the ventilation size-up, the first arriving officer or the IC must also consider age and the type of the building. The age of a building affects the ability of fire to spread, the stability of the building under fire, and the integrity of the utilities. Older buildings (Pre-33 & post World War II) constructed of unreinforced masonry (URM) can contain heat for a long time. Though the masonry exterior (often brick or cinder blocks) may slow the fire spread, there is a greater risk of backdraft conditions developing. URM buildings may also be prone to collapse. Pre-33 buildings used unreinforced masonry, no steel or cement, and have 13" thick walls. These buildings were very prone to early collapse. They are identifiable by the "king row" every sixth row, and the mortar was made of sand and lime.

The building's era should also clue you in to the potential layout of the inside of the building. For instance, a popular home style created by Jim Lovell in the 50's and 60's was to renovate these small post World War II homes into slightly larger homes taking advantage of the attic space. These homes dot Seattle and the surrounding area. It is important to note during your 360 that on the gable end there is a window typically to indicate a livable space. This will also clue you in to the fact that there are rafters above for a vaulted ceiling, as well as potential void spaces from the knee walls built within to create the livable space.

Another building type to be aware of with regard to era is "balloon construction." This building type started in the early to mid-1800s and lasted until the 1950s. Commonly identifiable by the windows lining up in a straight line, this method sped up construction time and reduced costs by having the studs extend from the sill plate to the top plate (eave). It is important to recognize these buildings as fires that originate in a basement may be in the roof already, or at least very soon, because of the lack of fire-blocking in the walls and the clear path of travel it has. Additionally, as with any other scenarios, uncoordinated ventilation techniques on these types of buildings can have devastating effects. **USE OF PPV** may accelerate the spread of fire through the walls, floor structures, and attic. Still, **ventilation remains a top**

priority. Keeping the atmosphere clear and cool increases firefighter safety and efficiency inside a structure. If vertical ventilation produces satisfactory results, then reducing or eliminating PPV will help control the spread of the fire.

Another important observation with regard to the building's era is recognizing whether the building is of "conventional construction" or of "lightweight construction." Conventional construction was used up until the 1950's until the wide-spread use of lightweight materials.

Conventional Construction

Conventional construction gets its strength from actual size or mass. There is less surface area exposed to air or fire. There is more mass or fuel to consume, creating a longer burn time and greater window of safety for the firefighter with respect to time.

Roof framing components are continuous lengths of full-sized lumber. Ridge beams are single members with conventional rafters running from ridge to top plate. Rafter size will vary depending on span, pitch and load. Spacing is usually 16" to 24". Additional members usually can be found in the form of collar ties and knee braces.

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. You will also find plywood used as sheathing in varying thicknesses.

Conventionally constructed commercial buildings built during the 1930's and 1940's commonly used truss construction. Although the conventional truss's members have the same strength interrelationship, it is much stronger than its lightweight counterpart. 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.

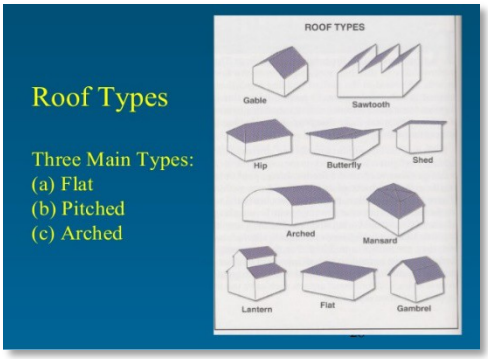
Lightweight Construction

In today's world, lightweight construction is predominantly used in the building industry. With high labor and material costs, lightweight

construction uses less lumber and smaller, low cost members. In modern construction, laminated beams, heavy timbers, and 1" x 6" sheathing have given way to 2" x 3" and 2" x 4" lumber and ½" plywood, regardless of building size.

From a firefighting perspective, the use of less fire resistive materials translates to less time available to ventilate before the roof becomes unstable. Discussed below are different types of roof construction.

ROOF TYPES

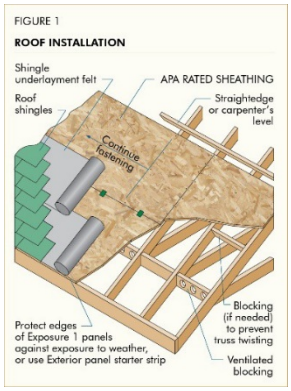


IFSTA states there are three common roof types that we will encounter: pitched, flat and arched. Pitched roof construction can further be broken down into gable, mansard, gambrel, hip, saw tooth, shed, lantern, and butterfly. Arched roofs can be broken down into bowstring, ribbed, barrel, and lamella.

Pitched Roof

While pitched roofs can be made using a variety of means, most commonly they are found with either trusses or rafters constructed in a way that creates one or more pitches with which to contend.

Roof coverings range from skip sheathing to plywood, an underlayment, and from shingles to metal. Be aware that many roofs can have multiple layers of material from years of re-roofing or remodels. Most, if not all, roof coverings can be ventilated using a power saw.



Another item to consider when ventilating is "over-framing." This is when you have framing over the top of existing roofs. Consider what is below you when sizing up where to place your ventilation opening.

Additionally, remodeled buildings can have pitched roofs built on top of shallow pitch

or flat roofs. Be aware when ventilating these buildings that you may have another roof below you that was never removed in the remodel process that will prohibit your vertical ventilation operation from being worthwhile. The best chance of knowing this information is during pre- incident surveys.

Flat Roof

Flat roof construction can be found in nearly any occupancy type. There are several designs that are possible for the construction of these roofs such as conventional framing, wooden I-beams, open web, open web bar joists, or panelized. They are also covered with a variety of roof coverings such as tar paper, hot mop, vinyl, car decking, pea gravel, and metal. Determining the type of construction used will have to be done during walk-throughs prior to the incident or by conducting a good size-up and getting up on the roof and exposing the materials ("skinning the roof").

Roof construction that contains a metal roof deck can prove to be an arduous task to access and cut. A good knowledge of the building ahead of time during pre-fire can help with understanding what you're up against.

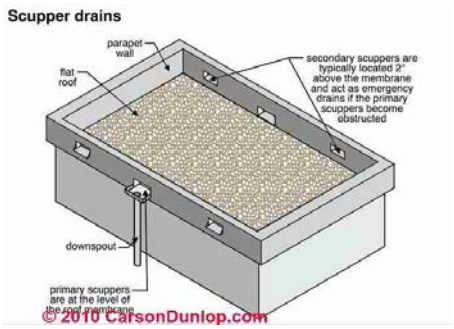
I-beams for floor joists or flat roofs may be present. Manufactured I-beams are used commonly today due to their lightweight design and ease of use, and their ability to span longer distances than dimensional lumber. These I-beams usually have pre-cut knockouts for plumbing and electrical runs and are made using glues. It is important to note that manufactured I-beams are susceptible to failure quicker than dimensional lumber.

Panelized roofs are present in any of the three types of roofs. They became popular because of their cost effectiveness on large commercial and industrial buildings. As you see in the picture to the left, they are noticeable by their use of beams, purlins, and rafters. They are often noticeable on top of the roof as well with their definitive lines and the spans.

Open web bar joists are another flat roof construction method. They are common to most new commercial buildings and use exposed steel that may not be fireproofed. Structural members and connection points are subject to weakening and failure when exposed to heat/fire. It is important to note

that they are susceptible to collapse after 5-10 minutes of exposure.

Additionally, flat roofs can be the most deceiving. Parapet walls can conceal live roof loads as well such as HVAC units and other utilities. Identify roof scuppers to get a good judge of the location of the roof line.



Common attic spaces are also typical of flat roofs with strip malls. Building codes require there to be fire wall partitions between occupancies: however, sometimes they are not present or are not installed correctly. Think ahead!

False mansards are also common on flat roof designs. Sometimes they are built into the roof framing, but often they are simply fastened to the parapet wall. These are great areas for fire spread and need to be checked.

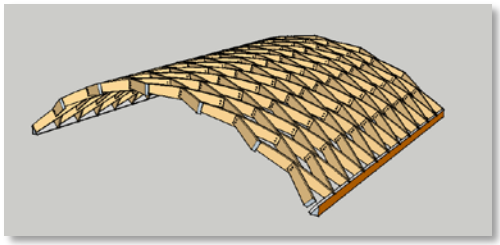
Car decking is another feature commonly found on either flat or pitched roofs. They can be present in either residential or commercial buildings. The size of the car decking varies from 3” x 5” to 2” x 6”. You will notice the notches on the sides and beads, or on the newer 2” x 6” version you will notice the “tongue and groove” appearance. It is important to note that car decking is fastened down not only to the rafter but also may have large nails or spikes that connect the two runs together. Be aware when cutting with a saw it is very important to find the direction of the runs and identify the spike or nail location. Additionally, it is

important to note it will be very difficult to feel the location of rafters with the saw.

Arched Roofs

There are several types of arched roofs in our area. The four construction types we will discuss are: lamella, tied trusses, bowstring, and arched trusses.

They can be constructed of wood, iron, metal, or a combination of wood and metal and span great distances. The structural members connecting the trusses together can also be either wood or metal purlins. Arched roofs are very frequently mislabeled and it is important to recognize the characteristics of each and the potential hazards that exist from each of them.



Lamella arched roofs are noticeable by their egg crate design and the lack of any apparent truss. They are common in gymnasiums, recreational buildings, large supermarkets, and some other medium sized buildings. They are a strong roof however when exposed to fire, total roof collapse can occur in a domino effect. There are very few of this design in our area.

The tied arch roof is often mistaken for a bowstring roof. Though very similar, there are distinct differences in their design. Bowstring roofs will utilize diagonal bracing to the bottom and top cords for webbing. The tied arch does not and, therefore, is not a true truss. The tie rod uses turnbuckles to counteract the lateral force the arch places on the walls. The biggest hazard is the catastrophic failure of the metal tie rod when exposed to heat conditions. These roofs should be considered very dangerous.

Often times, these tie rods are also concealed from view. To the right, you will notice the tie rod and turnbuckle have been wrapped in wood to make it more aesthetically pleasing and match the car decking roof and beams from the rest of the truss. Also pictured, you will notice the other tie rod being concealed by hanging lights.

Bowstring truss roofs originally were tied arch trusses with diagonal tension rods added to form a web. All the diagonal web members are in tension whereas vertical web members are in compression. Likewise, an arch truss that has had a tie rod added later on as a repair or for strength would also be considered a bowstring truss. Bowstrings can be constructed of all-wood, all-iron, wood and iron, and in later years, all-steel. One identifier to look for while sizing up an arched roof is that the smaller dimension bowstrings typically require buttresses or exterior walls to help absorb lateral forces.

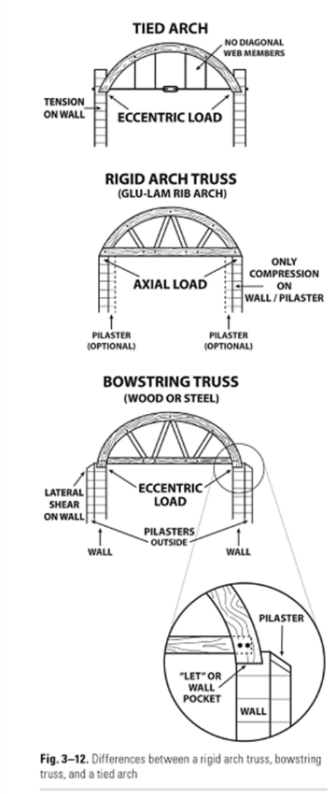


Fig. 3–12. Differences between a rigid arch truss, bowstring truss, and a tied arch

It is important to note that it will be highly unlikely you will be able to recognize the construction type of an arched roof when arriving at a fire incident, unless you've already familiarized yourself with the building. If crews are able to enter and identify the roof construction type, this will help incident commanders and ladder companies for identifying potential collapse hazards and ventilation techniques. It is a safe bet to say that roof failure will be directly related to the level of fire involvement. Roof structures exposed to high heat will be susceptible to failure. The rate of the failure will be correlated to the type of construction (metal or wood) and the length of exposure time at high heat. Knowing this time frame from time of dispatch and what interior attack crews are dealing with will be paramount in ventilation tactics.

FEATURES THAT HELP OPERATIONS

There are features of new construction that help operations and ventilation. Lightweight steel framing materials protected by sheetrock or sprinklers, protected heavy gauge steel supports, and self-closing doors are examples of building features that may help control fire spread and assist our operations. There are also sprinklers, suppression systems, and automatic smoke vents that help. The IC must know if they are present and use them effectively.

FEATURES THAT HINDER OPERATIONS

Construction features that hinder firefighting operations are those that promote fire spread, increase the likelihood of partial or complete structural collapse (such as unprotected steel components), or create obstacles to our entry and accessibility of the building.

As mentioned earlier on a building's era, fire spread in older buildings is aided by balloon construction, aged lumber and remodels. In all construction, it is the synthetic materials, alone and in combination, that increase fire spread and the toxicity of the products of combustion faced by firefighters.

There are construction features that greatly add to the likelihood of partial or complete collapse of a structure. Tanks and HVAC compressors placed on the roof or in the attic during remodels, in buildings not designed to carry their dead load. Automatic sprinklers, that release hundreds of gallons of water onto a floor to hold a fire, but add a new live load to a structure. Heavy construction features such as cornices and parapet walls that can collapse and fall from the building under fire.

Engineered construction (such as lightweight trusses, wooden I-beams, heavy timber trusses) are the newest and most dangerous threat to firefighter lives and safety. Developed to cut construction costs of buildings desiring large expanses of space, the buildings are to be approached from a ventilation standpoint with caution. Each member is part of a "system" of construction. If one member fails the entire system can fail. Nominal lumber size, gusset plates, and open spaces create a system that promotes fire spread and failure.

Consideration should be given to environmental impacts on buildings and the fire itself. For example, snow and ice on a roof, warm dry periods in the summer, and the wind direction (windward vs. leeward) and speed. Each of these things should be a consideration for supervisors and crews when making decisions on how and where to ventilate.

HORIZONTAL VENTILATION

Horizontal ventilation is put into play, in one way or another, on every fire incident

we respond to. While it is important to dedicate skilled crews (typically from the truck company) to this task much like vertical ventilation, it is also initiated often times by bystanders, occupants, police, and by our own first arriving crews. Engine drivers make it part of their tasks within the first few minutes of being on a scene to bring a gas fan to the front door at idle, turned at 90 degrees. The most important part to remember, regardless of who performs horizontal ventilation, is that it MUST still be coordinated with fire attack crews, and that it MUST be monitored for effectiveness.

The number of personnel needed to perform horizontal ventilation will depend on the size and complexity of the building or buildings involved. While small to medium single family residences may be ventilated with only one crew, large homes, multi-family occupancies, and commercial buildings must require multiple crews involved to be successful.

TOOLS

Fans

We carry a multitude of fans on our apparatus. They range from older model "box fans" that are powered by an electric motor and produce approximately 6000 cfm, and "gas fans" that are powered by 4-stroke gasoline engines and produce anywhere from 8000 to over 25,000 cfm. Also becoming even more prevalent are electric fans that produce similar cfm to their gasoline powered counterparts and have the ability to regulate their fan speed to produce variable cfm amounts. The benefit to using electric fans over gasoline is that electric do not produce carbon monoxide, making them useful in multiple applications.

Forcible Entry Tools

It may be necessary to force access into locations of a building and to also assist with establishing the flow path for your ventilation tactic.

Powers Saws

Power saws can be used to create or even enlarge openings. They are also useful for access into certain areas of the building.

Hooks

Hooks are useful tools when trying to break windows, or use as a prying tool and assist you with creating your desired flow path.

Ladders

It may be necessary to use a ladder to reach upper floor windows if they're not accessible from the inside.

Rope Bag/Drop Bag

Ropes are sometimes helpful when needed to hoist equipment to other floors. They can also be used as an escape tool should it be necessary.

Lighting

Carry personal lights at all times. Often times you will be operating in dark, smoky environments in order to complete your objective.

Radio

It is imperative that the ventilation crew, attack crews, and IC communicate to complete Coordinated Fire Attack.

CONSIDERATIONS

Number of Crews

The complexity of the assignment of ventilation will relate to the size or layout of the building and the level of fire involvement. While small to medium size residences may only require one crew to complete the objective, large residences, multi-family buildings, and commercial buildings may require several crews to complete the task. When this is the case, consider using multiple crews in a fashion that will accomplish the most work in the shortest amount of time. Create a Ventilation Group and assign a "lead" to orchestrate the tasks to be performed and be the point of contact for the Vent Group Supervisor. Have the ventilation plan communicated to ALL members of the Vent Group so everyone is on the same page. Through multiple complex incidents, we have discovered that dedicating multiple crews early on in the incident will provide a better chance for success.

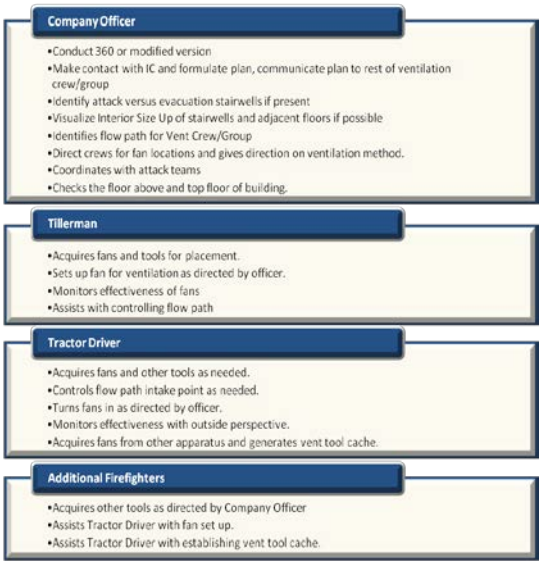
Location of Fire and Crews Inside

Prior to conducting horizontal ventilation operations, ensure that the vent crew knows the location of interior fire attack crews. Creating a flow path that places attack teams between the fire and the exit point of the flow path will unnecessarily place firefighters in danger.

Flow Path

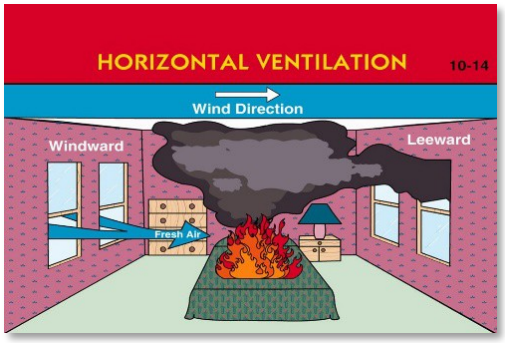
Inevitably there will be a flow path already established at the scene on your arrival. The emphasis should be on trying to control the flow path to make it work for you and the operations. Isolate any unwanted openings and control the intake and exhaust openings as needed. Besides doors and windows, think also of HVAC systems and pre-existing ventilation devices installed in multi-family and commercial occupancies. These can hinder your operation, but also help if you're able to control them. Some HVAC units have the ability to be controlled to exhaust products as well. Make contact with maintenance workers in these locations to see if they're able to assist you.

AN EXAMPLE OF ROLES AND RESPONSIBILITIES OF TRUCK COMPANY ASSIGNED TO VENTILATION:



TECHNIQUES

Natural Ventilation Methods



A simple method to ventilate the products of combustion is to use natural convective currents. This is easily done by opening doors, windows, and other such portals. Although this method may perform satisfactorily, it can depend on the proximity of the opening to the contaminants to be removed, the ability of the contaminants to travel unobstructed to the opening, the number and size of the openings, wind, humidity, and the temperature differential between the interior and exterior of the building. (Truck Company Operations - John Mittendorf)

Mechanical Ventilation Methods

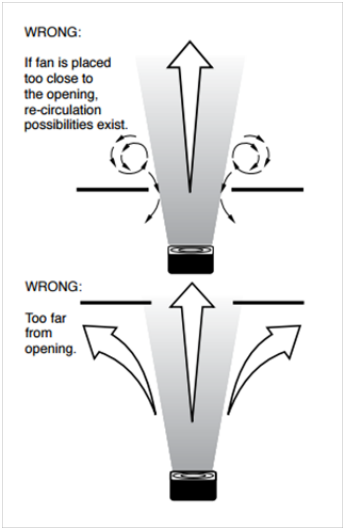
Negative Pressure Ventilation:

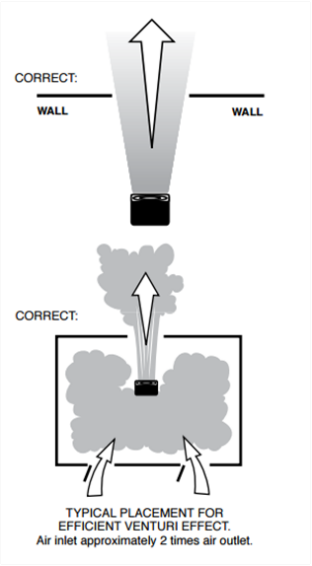
The two methods for performing mechanical ventilation are positive and negative pressure. Negative pressure involves placing a fan inside the structure and blowing out the exit opening to draw the contaminants to the outside of the building by creating a negative pressure inside the structure. When opening a window opposite the fan, the contaminants will be replaced by fresh air. This method is especially useful in large occupancies when used in conjunction with positive pressure to exhaust a large amount of product.

Negative pressure does have its drawbacks as well:

- Firefighters are exposed to hazardous contaminants to position the fan.
- Contaminants are drawn through the fan, creating additional equipment maintenance.
- Fans placed in doorways or hallways can potentially block paths of travel or ingress/egress areas.

- Fans that are hung in windows or doorways must use additional equipment.
- Fans placed inside are not efficient by themselves in removing contaminants at the top of the room or building. Air will flow the path of least resistance, which is normally a straight line from fresh air inlet to the fan. This limits the flow of air at the top of the area to be ventilated.





The placement of the fan for negative pressure is critical to its success. With the fan on the smoke side of the doorway, place a fan or fans far enough away from the doorway so as to cover the doorway with a cone of air coming from the fans. This will create a Venturi effect with the air going out the door, increasing the fans effectiveness by as much as 100%. Stacking fans will increase volume greatly, reducing ventilation time and increasing ventilation effectiveness. For oversized doors, place fans side by side to overlap their cones of air. An alternate method of using two fans in a doorway is to place one fan on the door, and a second fan away on the floor. The following guidelines should be used only as an aid in determining the correct placement of the fan based on its size and the size of the door, for example:

- 16” fans exhausting through a 36” door should be positioned 6-8’ from the opening.
- 20” fans exhausting through a 48” door should be positioned 8-10’ from the opening.

In large door openings, place fan slightly farther back or use multiple fans.

Positioned in this manner, the fan not only moves the air passing through the fan blades, but also draws air into the air stream on the discharge side. Efficiency increases by 20 to 100% of rated capacity. Actual increase varies according to the size of the fan, the size of the door opening through which it is exhausting, and the size of the opening providing fresh air.

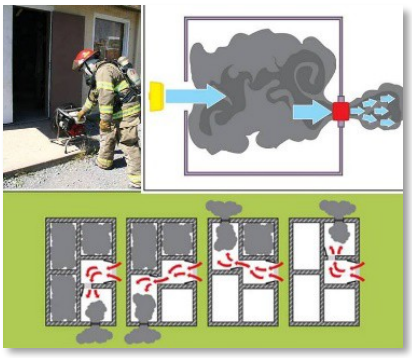
The smaller the fan, the lower the increase in capacity and vice versa. This is mainly because of the difference in velocity and the concentrated reach of the air stream.

*MOST IMPORTANTLY - CONTINUE TO MONITOR YOUR VENTILATION OPENINGS FOR EFFICIENCY!

Positive Pressure Ventilation (Post Fire Control)

This method is employed for smoke and gas removal after water has been applied to the fire. Utilizing a fan placed on the exterior of the building, the fan blows fresh air into the compartment and creates a pressure within. The pressure is equal at the top, bottom, and corners of the room. When an exhaust opening is created, the contaminants from all parts of the pressurized room leave through the opening. Compared to Negative Pressure Ventilation, this method has a number of advantages.

- Personnel aren't normally exposed to hazardous interior contaminants while positioning exterior fans.
- The contaminants aren't being drawn through the fan (reduces maintenance).
- Doors, windows, and hallways don't need to be blocked nor do they need to be hung in openings, thus reducing the personnel needed to set them up.
- Minimal impact on interior noise.
- Approximately twice as efficient at removing contaminants from the building.



To perform PPV, you must control the intake and exhaust openings of the building. Exhaust openings should be opened first, then pressurize the structure or area to be ventilated. The exhaust opening for PPV can be effective with a 1:1 ratio and up to a 5:1 ratio, dependent on the size and CFM rating of your fan. To remove contaminants effectively with a lower CFM fan, we employ a compartmentalization technique with which we systematically remove smoke and gases from the building one room at a time. If the fan is larger with a higher CFM rating, multiple rooms can be cleared at once.

Just like vertical ventilation, PPV must be coordinated with fire attack. As soon as water has been applied, PPV can start and assist with pushing products out of the exit opening. This will aid in the survivability of possible victims as well as the search effort of firefighters, and will help reduce smoke and heat damage to other areas of the building. The exit opening must be located in an area close to the fire. This means that if the fire has not yet self-vented out of a window, door, or the roof, that the vent crew must create the exit opening. Understanding that fire behavior will

increase without the application of water is crucial if the exit opening is created ahead of the fire attack crews and they are not prepared, the fire will grow exponentially. This can be especially important if there are victims in the building, or if crews will have an extended ETA to get to the seat of the fire. With this in mind, there are several instances where PPV may not be recommended. Every situation is different and company officers and incident commanders should evaluate the situation prior to implementation.

Critical Communications

Unit to unit communication must take place when coordinating ventilation openings. Roof companies need to confirm with the interior attack crew the location of and need for ventilation prior to creating any vertical openings. I.E.: "E13 from L11…. "E13…" "Confirming that you will need vertical ventilation over the Bravo-Charlie corner? Advise us when you are ready for ventilation."

PPV Contra-indications & Considerations

As with any fire ground technique, PPV has limitations and situations that need careful analysis as follows:

PPV is implemented to move air from high pressure to low pressure. Trapped occupants who have opened windows or are awaiting rescue have essentially made an exit opening or an area of low pressure. If the door to the room that "has the open window" is NOT closed, PPV will increase energy in that flow path. The possibility of that opening becoming active in ventilating heat and smoke has to be evaluated. In some cases, interior doors have been closed by occupants to provide more refuge. In these cases, a ladder rescue will take priority and forced ventilation needs to be delayed. Furthermore, PPV should not be used when the location of victims is un-known.

Firefighter positioning also has to be considered when using PPV. Firefighters may be operating in areas that have openings that might become exhaust points. This is especially true if the incident requires a technique called vent-enter-search (VEIS). In VEIS, firefighters essentially search targeted areas by entering from exterior openings. A known victim in a known location with heavy conditions might require this tactic and simultaneous PPV should not be used.

Unvented Basement Fires pose many challenges to firefighters. The lack of access and difficulty with adequate ventilation are two major concerns. The tactical situation will be driven by the layout of the basement and floors above, fire and smoke conditions and available exit openings. Many homes in the greater Seattle area have basements with a possible combination of an entry door on the exterior (typically side "C") or small perimeter windows around the foundation line of the home. A critical

tactical element in a basement fire is protecting the vertical ex- tension up the interior stairways. A hose team will typically make access for initial fire attack through the side "C" basement door but if the home has no exterior basement access, crews may have to advance the first line through the front door and face the decision to protect or advance down the basement stairs based on fire conditions.

Basements with an exterior entry – Fire attack should be initiated either by means of a quick hit from the exterior through basement windows or from the basement exterior entry. Any advance down the interior stairs should be preceded by fire attack established exit openings opposite the attack if possible or utilizing available windows or doors at the basement level. A quick hit from exterior basement windows to cool the interior conditions is also imperative. A hose team can request positive pressure ventilation prior to advancing down the stairs to assist with tenability. If conditions prevent a hose team from advancing down the stairs or it is decided to protect the stairwell, critical communication is necessary in re-directing incoming hose teams from a backup position to a primary attack line from the exterior entry. The venting of basement level windows is still necessary; however, PPV from the exterior entry should be significantly more passive and used only post-knock-down when a hose team is in a defensive position at the interior stairway above. In this situation, door control needs to be confirmed by the company protecting the stairwell. Fires with these construction characteristics require the main level and floors above (bedrooms) to be rapidly searched. With confirmed door control, the main level and the floor above can be adequately pressurized to assist in the search of these critical areas.

Basements without an exterior access - If, upon arrival, a basement has no exterior access and has self-vented out multiple windows, teams should consider initially knocking the fire down through the perimeter windows. This will cool the fire and allow time to pressurize the basement from the main floor assisting a hose team in utilizing the stairs for final extinguishment.

Over Pressurized Structures – These are fires that have developed a significant amount of smoke and heat throughout the structure and are exhibiting heavy dense smoke at the floor level. The augmented use of plastics in modern structures and furniture has increased the density, development and volume of smoke in the single family residence. Combustible smoke can rapidly over-pressurize a house and pose a backdraft or smoke ignition hazard in addition to contributing to vertical fire extension. PPV should not be initially used in these situations where a hos- tile event may occur. Hose teams may have to use discipline and delay advancing on a fire until vertical ventilation can be completed. It is also important to assess the occupant survivability of such fires and recognize it is

very low. Vertical ventilation at this point may be for firefighter safety and the mitigation of a hostile event rather than for life safety.

Exhaust point safety With selecting, providing and communicating the exhaust point in a PPV operation, firefighters also need to pre- vent any flames from the ventilated window/ windows from lapping and extending the fire to the attic, floors above or possible neighboring structures/exposures.

Positive Pressure Ventilation, as with many fire ground techniques, needs to be applied only when appropriate and continually evaluated for effectiveness. The ventilation plan needs to be clear and understood by all members at the incident. Additionally, any changes, adjustments or fire conditions that may affect the plan need to be communicated to command.

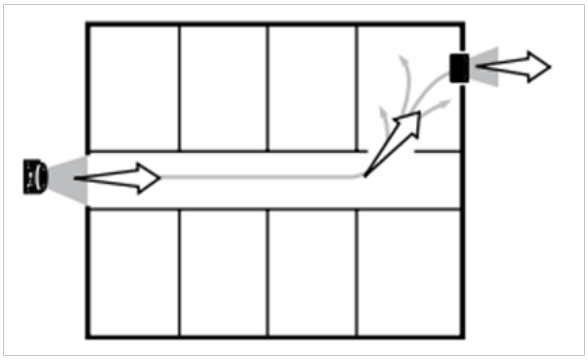
Additional Contraindications

Balloon Construction: PPV could accelerate the fire in balloon construction. Its unique construction type allows for unimpeded fire travel in the stud spaces between floors.

Fan Placement and Setup

Single Family

The exit opening should be as close to the fire as possible. Open prior to the fan being turned in and after coordination with fire attack crews. Initial fan shall be placed at the front door. The "Cone of Influence" shall cover the opening. If it is not possible to cover the opening, orient the fan so as to cover as much of the opening as possible, with the fan angled up to cover the top of the doorway. Note: Depending on the fan manufacturer, it may not be necessary to utilize a "Cone of Influence" at the intake opening. Also, if the occupancy is bigger in size and a larger volume of air is needed to employ PPV into the space to speed up the pressurization, multiple fans can be placed. The fans should be placed side by side with each cone covering the doorway, overlapping. This method has been found to be more successful than placing the fans in series. This concept is similar to fire engine pumps that pump in series or parallel. This method is also useful when the opening is large and one fan's cone will not cover the opening.



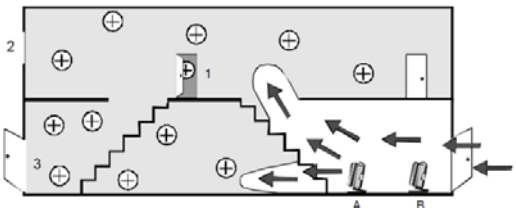
Multi-Family

Garden Style Apartments: Fans are set up the same as single family residences since there are typically no hallways to contend with. Pay particular attention to exposure units and be prepared to apply PPV for

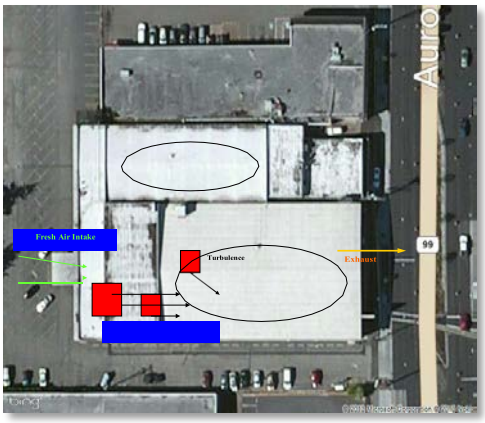
reduced risk of contamination to reduce property damage.

Townhomes: Fans are setup the same as single family residences since there are typically no hallways to contend with. Pay particular attention to exposure units and be prepared to apply PPV for reduced risk of contamination, reducing property damage.

Center Hallway Apartments: The first fan to be put into place should address the need of PPV on the fire floor. Depending on the location of the fire and the orientation of the building, it may be necessary to locate the fan closer to the fire apartment. Some apartments have fire doors in the middle of hallway that would block PPV efforts when they close.



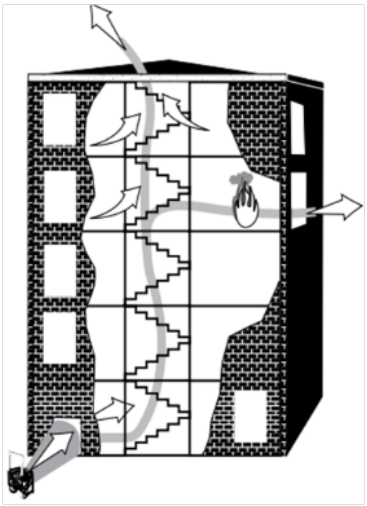
The second location to set up fans are at the stairwells. Pressurizing the stairwells is key to helping provide safe egress areas and also keeping smoke confined to the floor(s) involved. Identify which stairwell will be the attack stairwell and which will be egress stairwells. Position the fan to pressurize the entire stairwell of each. Keep the stairwell pressurized so that when the door to a floor is opened, the exhaust opening is the hallway. Contaminants will be forced back down the hallway this way and not come out to the stairwell. When pressurizing the attack stairwell, the door to the fire floor will be opened. When this is designated as the attack stairwell, the flow path will be directed down the hallway of the fire floor and then out the fire apartment.



The third and fourth location of fans should be at the floor above the fire and the top floor of the apartment building. The floor above is the exposure apartments and may have smoke coming through their units. The top floor will be the location where the CO and other products that have made their way to the stairwell and up will accumulate. The top of the stairwell will have a very hazardous amount of CO and should be considered part of the IDLH.

Additional considerations should be the use of electric fans or other gas fans and their use to help direct PPV air currents. Often times there are dead zones created and not enough turbulence from the PPV to help

direct the flow. Additional fans can be used to move the contaminants that have been trapped.



Commercial

Commercial occupancies range in many different sizes and configurations and can be quite difficult. It is important to remember that large commercial buildings will need lots of volume to help move the contaminants out of the building. Multiple fans should be placed in parallel at the inlet opening, and additional fans to help clear dead zones as well. A combination of negative and positive pressure is useful for speeding up the process in large buildings.

Mid-Rise

These buildings can offer us some of the biggest challenges. Due to the fact that the windows on these buildings generally do not open, options for ventilation are limited. Also, the configuration of these buildings allows for smoke to travel laterally great distances from the location of the fire. Stairwells and elevator shafts become natural locations for smoke travel as well and rise to upper floors, causing problems for those seeking refuge or egress. The other problem is that in taller buildings, smoke will travel upwards until it has reached the point where the gases have cooled to be the same temperature as the ambient air and it will then stop its ascent and begin to stratify, then spreading to other parts of the building. The goal when ventilating these buildings is to channel the smoke to the stairwells, then using the natural upward air currents in shafts (created when there is a vertical opening and an inlet at the bottom of the shaft), direct the smoke out of the scuttle at the top of the stairwell or elevator shaft.

If windows will open in the units of these taller buildings, then a similar tactic to multi-family buildings can be employed.

High-Rise

Ventilation of Smoke and Fire Gases
Incident Commander will consult emergency plans, building engineers and building fire safety directors for information regarding smoke removal methods.

High-rise buildings built under the most recent codes are equipped with stairwell pressurization systems in order to minimize the amount of smoke entering these vertical shafts. Every effort should be made to maintain the integrity of these systems. Keep unnecessary stairway and elevator

doors closed in order to maintain pressurization of these shafts.

Some buildings will be equipped with tempered glass windows for smoke control. At least 20 square feet of opening is required for each 50 linear feet of wall. The openings will be in line vertically one floor above the other.

- These windows are identified with a 3" orange dot on the glass. When ventilation requirements will be satisfied by removal of a limited number of windows, the tempered windows shall be removed first. Tempered glass removal is less hazardous than plate glass removal.

- Serious fires in most buildings will require rapid horizontal ventilation by window removal. This operation shall by coordinated by the Incident Commander as follows:
    - If time permits, the removal of a plate glass window will be preceded by covering the window with tape to reduce the amount of glass that falls.
    - Hose lines shall be placed on the floors above the fire floor for exposure protection before window removal commences.
    - Street level areas shall be cleared.
    - Fire floor extinguishment efforts shall be adjusted so that the hose teams will be protected from possible backdraft or flash over due to the sudden introduction oxygen onto the fire floor.
    - Rescue and evacuation plans shall remain flexible in anticipation of probable smoke travel changes caused by window removal.
    - Every attempt should be made to remove windows on the leeward side of buildings first. This tactic reduces the possibility of spreading smoke and fire in the structure.

- Mechanical smoke removal: Newer buildings have mechanical smoke removal systems. There are many variations of arrangements and functions and each building should be individually preplanned. The system will generally have a "Fire Mode" and a "Purge Mode."
    - In "Fire Mode," the main building exhaust fan is running and the air handler for the fire floor is off. This is an automatic function activated by the alarm system.
    - In "Purge Mode," the main building exhaust and supply fans and the floor air handlers are all running. This is a manual function which must be activated from the fire control room.
    - NOTE: Purging provides fresh air to the fire area and can accelerate fire growth. For this reason, it should only be accomplished after the fire is controlled or with ample charged hose lines in place. Good communication should be established between the control room and the fire floor so that

purging can be curtailed if adverse conditions develop.
    - Purging rate can be increased by opening doors from pressurized stairways and removal of ceiling tiles.

Evacuation Guidelines

- Consider evacuation plans in the building's emergency operation manual when making evacuation decisions. Do not override predetermined movement of building occupants unless necessary.

- Utilize public address systems in order to keep tenants informed.

- Realize that evacuation operations may extend well past fire extinguishment due to continued presence of smoke.

- Incident Commander may wish to assign a Group Supervisor or Branch Director to rescue and evacuation responsibilities.

- Evacuees will require close supervision as they leave the building so they:
    - Will not be injured by falling glass.
    - Will not disrupt ground level fire department operations.

- If possible, confine firefighting activity to one stairway, leaving the other one(s) relatively smoke-free and therefore more effective for evacuation.

- Utilize building floor wardens as much as possible for assistance in evacuation and to account for building occupants.

- Evacuate the fire floor, floor above and two floors below the fire to facilitate fire department operations.

- If you find stairways clogged with occupants, they may be detoured to safe refuge (floor area) to clear the stairway for firefighting activity.

- The number of fire department personnel required for partial evacuation will be much less than for total evacuation which will leave more personnel for fire extinguishment, etc.

- Occupants more than two floors below the fire should be safe; they will need to be reassured, but attention should be directed to those above this floor.

- Mark floors searched by placing a 12" strip of tape on the stairway side of the stairway door adjacent to the doorknob. However, be aware that tenants may move back into searched areas.

- When an evacuation stairwell has been identified, and if resources are available, a fire company should be assigned to monitor the evacuation stairwell.

Safety Precautions at High-Rise Buildings

Glass falling from upper floors of a high-rise building can cause serious injury to personnel and damage to equipment. In order to minimize the effects of this problem, the following precautions will be taken:

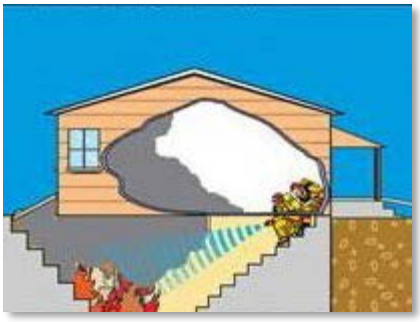
- Clear the area around the building a minimum of 200 feet in all directions.

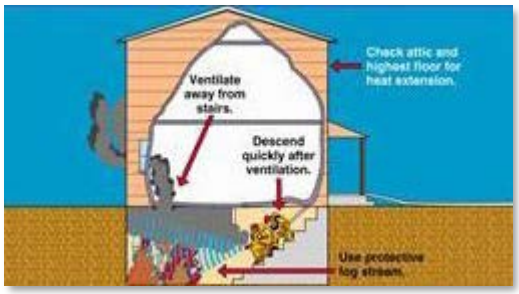
- All personnel required to enter the 200 foot zone will be wearing full protective clothing.

- Ventilation of upper floors by breaking glass will be coordinated with the Incident Commander to assure that ground level areas have been cleared. If possible, break glass on the leeward side of building before taking out windows on the windward side.

Basement Fires

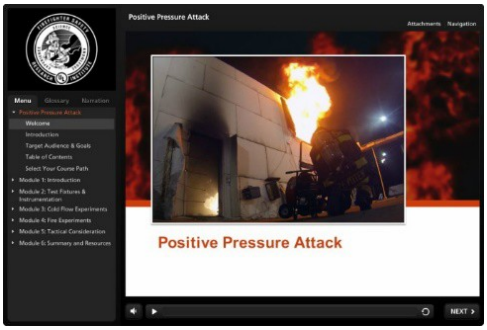
Ventilating basements can be challenging due to the number and/or size of potential exhaust openings. Often times the windows are smaller and do not afford a large enough opening to let PPV exhaust out at a normal rate. Directing the fan's cone at the door and exhausting out the nearest openings is still preferred; however special attention should be paid to over pressurization. If this begins to happen, attempt to find more exhaust openings within proximity of the fire area, or reduce CFM output by throttling down the fan and monitor the effects. If the basement has no windows available, then there are a couple options to use. You may make a cut to the outside of the building, exposing either the floor joist space above the basement, or in the exterior wall of the basement through the studs, thus creating an opening for the exhaust. You may also pressurize the floor above the fire, then use a fan to pressurize the bottom of the inlet opening and allow for the exhaust to come out of the top of the inlet. This turns our one opening into a bidirectional flow path.





Positive Pressure Attack (Pre Fire Control)

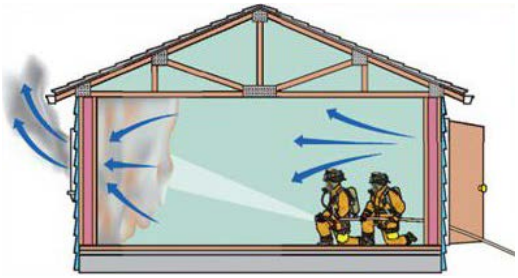
DISCLAIMER: While an effective tactic when performed correctly with the proper



conditions met, Positive Pressure Attack must be carefully coordinated with fire attack and only be implemented if the tactic is understood by all firefighters operating within the hot zone.

Similar to PPV, Positive Pressure Attack (PPA), if chosen as a fire control method, is used prior to water application. It uses positive pressure to push contaminants out of the exhaust opening, improving conditions inside for fire attack, search, and for survivability for victims. PPA must still be coordinated and is reliant upon the exhaust opening more than it is the inlet.

The exhaust opening must be close to the fire and must be a minimum size of a 1:1 inlet to exhaust ratio. This means that if the exterior door where the fan is approximately 20 square feet, then the exhaust opening must also be equal or larger than that, with the optimum size being a 2:1 ratio. The average bedroom window is approximately 15 square feet. With this problem, in order to achieve the minimum 1:1 or optimum 2:1, we must create more exhaust openings, or apply water to reduce the pressure created by the fire. Conversely, if the fire is in a bedroom, bedroom doors are often times smaller than main exterior doors. The inlet size only refers to the inlet opening to the fire area. This makes our 1:1 ratio more attainable due to the fact that this reduces our needed square feet. In an attempt to open other exhaust points, we must still make sure that we are not opening windows that are either in different rooms or in other areas other than the fire compartment. This will establish undesired flow paths that will make the fire extend.



If we do not establish the minimum 1:1 ratio needed, the positive pressure created will simply add to the pressure created in the fire compartment and instead of exiting the exhaust point, will work back again the fan currents.

This further establishes that any ventilation tactic must be monitored for effectiveness, and altered as needed to suit the needs of the incident.

Hydraulic Ventilation

Hydraulic ventilation is the engine company's tactic for employing immediate ventilation on a fire that has had initial

knockdown. After quick hit and darkening of the fire by the hose line, the attack crew will open up a horizontal ventilation opening (i.e. a window), if not already open. The farther a hose stream travels before the exit opening, the more it is moved, and/or the wider a fog pattern, all increase the effectiveness of hydraulic ventilation. This quick action after the initial knockdown allows for the attack crew to conduct a quick search of the fire compartment and introduce cooler cleaner air into the environment. As a consideration, however, just as with a fan, while the fire is not completely extinguished the entrainment of air that is occurring with hydraulic ventilation will help the fire grow. It then becomes important for the nozzleman to be paying attention to what the fire is doing as well so as to combat any flare ups.

Vertical Ventilation

Upon recognizing that vertical ventilation is necessary for the incident, the assignment of this function should occur early on in the incident. The ventilation component is usually completed by the truck company due to the crew's familiarity with the task and also because the truck company typically carries all of the necessary tools and equipment. Typically, a residential vertical ventilation operation can be completed with a minimum of two firefighters, however, a third person (usually an officer) should be utilized to observe the roof and fire conditions for safety and coordinate with fire attack while the crews are working above the fire. This becomes especially important when the building is a large residence, a multi-family or commercial building, or even an older building, and/or there will be multiple crews working as part of the "Ventilation Group."

The access method of ground ladders versus aerial ladder for accessing the roof shall be made by the company officer, however, a secondary means of egress should be addressed regardless of the method. Ladder placement will also be determined by the company officer or crew member in charge. When laddering the building, access will be made away from the fire in a safe location so that crews may make access by walking "good to bad." When laddering a steep pitch roof, effort will be given to laddering close to the fire location but not in a position that will expose the crew or ladders to fire from windows below. Crews have the latitude to decipher if roof pitches are too steep for walking and need to be accessed via a roof ladder.

After laddering the building, crews will access the roof, bringing all necessary tools with them. Considerations should be made as to whether crews should be on air immediately after accessing the roof or if it can be delayed. This could depend on smoke conditions, distance to the fire, etc. After cutting the vertical vent hole, crews should determine the effectiveness of the opening and determine if expanding the

hole, or secondary holes will be needed. After the crew has completed all needed ventilation openings, they will report the completion of their task and exit the roof expeditiously using the same route, sounding the roof along the way.

TOOLS

The type of occupancy and roof type will often dictate the types of tools taken to the roof. Knowing your buildings and a good size-up will assist you in choosing the right tools for the job at hand.

An example of equipment taken to the roof includes:

- All members carrying a scabbard axe
- Ground ladder
- Roof ladder as needed
- Chain saw
- Roof hook
- TIC

Forcible Entry Tools

A flat head axe with a Halligan tool provides the best means for forcing penthouse doors. Additionally, the point of the Halligan tool can carry out many functions that a pick-head axe would.

Power Saws

A chainsaw is our primary method and most efficient way to open up a roof. Often times we operate with two saws running simultaneously. Remember to bring an additional saw to the roof in case of mechanical problems. Start the saw on the ground prior to ascending the ladder.

Circular saws should mainly be used on commercial roofs, where we need to cut materials with more mass. Be careful using these types of saws for ventilation with typical roof material because the added torque makes control more difficult and it's really hard to feel when you're on a rafter. However, circular saws work well for cutting metal, cutting through foam to expose roof decking, forcing skylights and forcing entry on rooftop doors or hatches.

Hooks

One of the most important tasks to complete on the roof is "sounding". Firefighters use this technique to determine where structural members are located and the overall tenability of the roof. Rubbish hooks offer a few options in their use. First for "sounding" the roof, for use as a foothold, for removing roofing materials to view the roof construction, for louvering, and for prying either roof materials or skylights, and scuttle covers.

Other Cutting Tools

The axe is one of the most iconic tools in the fire service. When brought to the roof, the pick portion of the axe can be utilized to create smoke indication holes, while the flat-head's extra mass (usually 8 lbs.) offers a little more power for chopping through the roof. These tools can be used for footing on pitched roofs and to force entry on objects such as skylights.

Ladders
Ground and/or aerial ladders will be needed to access the roof for affecting vertical ventilation. Always place an additional ladder as a secondary means of egress for crews operating on the roof. Additionally, roof ladders may be needed if the roof surface is steep, slippery, or otherwise unwalkable.

Rope Bag/Drop Bag
Rope can be used to haul up tools and equipment if needed to the roof without having to descend the ladder. It can also be used as an escape tool should it be needed.

Lights
Lighting is helpful for visualizing the roof at night and for identifying hazards along your route of travel. Carry personal lighting at all times, even if you have the roof lit up by mounted lights.

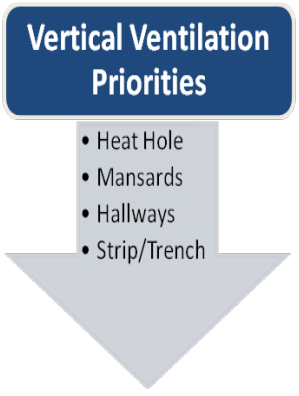
Radio
It is imperative that the ventilation crew, attack crews, and IC communicate to complete Coordinated Fire Attack and give "CAN" reports.

CONSIDERATIONS

Number of crew members and/or teams
The complexity of the assignment of ventilation will relate to the size of the building and the level of fire involvement occurring. While small occupancies may require only one crew operating on the roof to complete the assignment, a large occupancy may require several. When this is the case, consider utilizing multiple crews in a fashion that will accomplish the most work in the shortest amount of time. Create a Ventilation Group and assign a supervisor to orchestrate the tasks to be performed on the roof and be the point of contact for the Vent Group Supervisor.

The order of priority for vertical ventilation should be:

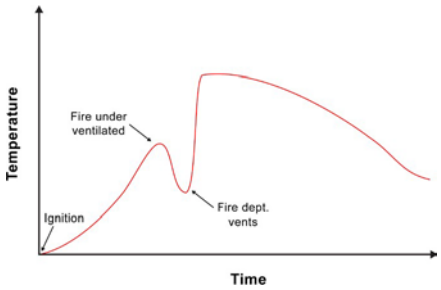
1. Create a Heat Hole over the fire area for immediate relief to the attack crews and potential trapped occupants.
2. Open up any mansards or exposure areas that could be involved and block egress or allow fire extension.
3. Consider performing a center hallway cut to relieve conditions in the hallway and allow for faster access to interior crews for suppression and/or search.
4. If needed to prevent further fire spread into adjacent areas of the building, consider performing a defensive strip cut.



SAFETY

Burn Time

It is imperative that crews observe the fire on arrival and watch for changes in conditions as the incident progresses.



Know the level of involvement and where the fire is. Consider the time of burn, and if there is fire involvement in the attic space.

Roof Ladders

Use of roof ladders should be considered whenever the roof appears too steep and/or when you can anticipate your footing on the roof will be challenging. Remember also that the sawdust you leave behind after cutting will cause the roof to be slippery.

Roof Construction

Understand the roof construction type and what is supporting you. Remember that the burn time on lightweight roofs is considerably different than large dimensional lumber, however, failures in roof systems with large dimensional lumber lead to more catastrophic events due to their increased span. Ensure that crews walk on strong points in the roof (peaks, valleys, exterior walls, beams, purlins) and sound vigorously as they proceed. Crews should also exit the roof walking identified routes of travel and sound again on their way off.

Coordinated Fire Attack with Ventilation

Ventilation will have an immediate impact on fire growth. Ensure that crews are ready for the ventilation tactic to be employed. Cuts can be initiated, but prior to opening the roof up, ensure you know that interior crews are prepared.

Saw Work

Understand and practice good saw technique. The depth of your saw needs to only be deep enough so as to cut through the roof covering and have enough surface area to make contact with rafters or truss top chords. Understand also that crews may be working directly beneath you and in low ceiling areas placing them at risk if a saw bar plunges too deeply.

HAND AND SAW TECHNIQUES

Hands and Feet

To ensure safe operation of the chainsaw, always ensure that you are using proper hand and foot positioning. You should be in an athletic stance and keep your weight on your hips, not on the saw. The hand on the bar should usually be the same as the foot you have set forward in your stance. Position your feet so that your legs are

open toward and you are facing towards the direction that you are cutting. Move your feet with your cut to maintain balance and proper position, and always be mindful not to cut towards your legs.

Passing Tools

When operating off a ladder for vertical ventilation it may be necessary to pass tools from the sawyer to the back-up firefighter. To safely accomplish this task, the sawyer receives his or her tool on the inside of the working area and passes the non-working tool to the outside of the working area regardless of the orientation of the ladder to the cut. In other words, the working tool is passed on the inside, and the non-working tool is passed on the outside of the cut. Any chainsaws that are passed should have the chain break set.

Plunging the Saw

When initiating the cut, never try to plunge the saw into the roofing material with the tip pointed straight down. The saw will have a tendency to walk around on the roof and can be uncontrollable. Instead, keep the saw at a 45 degree angle to the roof deck and plunge the tip into the roofing material. This allows more surface area of the cutting blade and allows you to be in a better position to control the saw.

After plunging the saw into the roofing material, bring the saw to a 90 degree angle to the deck and penetrate the roof no more than is needed to get through the roof deck, but deep enough to provide ample surface area of the bar to make contact with the rafter or truss top chord. A good rule of thumb is to use no more than 1/3 of the bar's length. Having enough bar into the deck will ensure that when you are progressing through your cut sequence, when you come to a rafter or top chord you will feel the resistance and not cut through the structural member. Having the saw anything less than perpendicular to the roof deck will lessen the chance of feeling resistance because of the reduced surface area. Push the saw with the hand on the bar through the decking as the material allows, so that when you contact a structural member you will feel the impact more suddenly and prompt you to start rolling your rafter.

Rolling Rafters

Once you identify a rafter, roll the saw over the rafter by bringing the saw upward and rotating the saw down towards the deck. Skim through the decking material the width of your rafter or truss top chord then plunge back down into the decking.

DIAGNOSTIC METHODS

Indicator Holes

A smoke indicator hole is a small, usually triangular, hole made with an axe or saw through the decking and insulation to indicate smoke and fire conditions in the structure below you. The holes are just big enough to fit the handle of your hook through. Generally speaking, indicator holes are placed as soon as you access the roof and roughly every ten feet of travel, every change of direction, and on either side of a firewall.

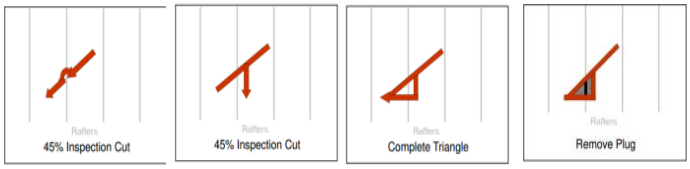
Another type of indicator hole is referred to as a "Kerf" cut. This is made with either an axe or saw by cutting into the decking and insulation with only one blade width. These holes however are not as good at indicating conditions beneath you as a triangular hole. If smoke is present, consider the volume, velocity, density, and color of the smoke to give you an indication of what type of conditions are beneath you.

Inspection Holes

An inspection hole is a cut through the roof decking to expose the construction of the roof underneath. Since construction is either parallel or 90 degrees to exterior walls, the hole is started making a 45 degree cut to any exterior wall.

This cut will ensure that the saw or axe will intersect a structural member. When the saw or axe contacts a structural member, roll it and continue about one foot past. To complete the triangular hole, make two additional cuts perpendicular to each of the exterior walls and then remove the triangle. The hole should be cut away from the path of travel and may be cut smaller than your foot but larger than your hand. This allows structural members to be felt with the hand but minimizes the danger of someone

stepping into the hole. The hole may be made larger if necessary. The hole will help you determine rafter direction, spacing, and the type of roof decking and the depth of your cut.

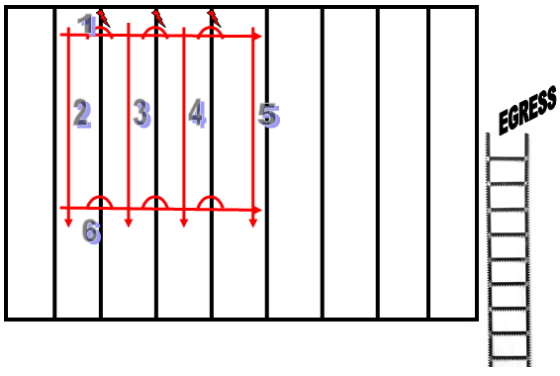


CUTTING METHODS: OFFENSIVE TECHNIQUES (creating the "Heat Hole")

Shallow Pitch or Flat Roof with Rafters/Trusses

The "Heat Hole" is the vertical ventilation opening that we cut to support fire attack by releasing the hot gases and smoke. Our minimum hole size when NOT operating off of a roof ladder is a 4' x 8' opening. Quite often the ventilation cuts are performed with one saw in operation. However, most can be performed in a two-saw sequence.

Dicing



One of the fastest ways to cut a heat hole is the dicing technique. Dicing is recommended for use on conventional pitched roofs with 1"x6" sheathing. The normal procedure would be to determine the location of the hole, make a head cut (roll rafters) and scoremark the rafter location. Next, make a number of cuts parallel to the rafters. After making the cuts the approximate size of the planned opening (one cut between each rafter), we can use an appropriate tool in a "J" hooking motion to pull and rake the roof and sheathing from the opening. Remember to never dice or make cuts any longer than you can reach with the tool available.

Dicing is very effective on plywood-type or corrugated decking materials as well. This is our most common technique when dealing with conventional and lightweight trussed roofs. (Truck Company Operations - John Mittendorf)

Step 1: Head Cut

Attempt to place yourself upwind, working from bad to good and towards your ladder or egress. Plunge the saw into the roof decking and start your head cut by finding the outside rafter. Then roll four or more rafters until you span the desired width of your hole (a typical vertical ventilation opening spans approximately 8 feet in width). After rolling each rafter, use the saw to score the roof decking, indicating the location of the rafter.

Step 2: Down Cuts

Plunge the saw into the decking and make your vertical cuts in between the rafters

(using your score marks on the decking as your indicators), perpendicular to the head cut. The vertical cuts should be approximately three feet so as to keep your cuts manageable and not place your feet in the vent opening area while cutting.

Step 3: Bottom Cut
Plunge your saw into the roof decking and start your bottom cut by intersecting your first vertical cuts. Be sure to exaggerate your cuts by a minimum of a hand width. This will ensure that the roof decking is still not attached when you open your louvers.

Step 4: Louver
Utilizing the trash hook or a pike pole, stand on the windward side and strike the louver panel on the side closest to you. Open each louver the same direction. After the louvers are open, if you do not have flames or heavy smoke production from your opening, you may need to puncture the sheetrock below the attic space.

When **utilizing two sawyers** on the roof, the first sawyer cuts the Head Cut. After rolling the second rafter, the second sawyer follows by cutting the Down Cuts. When the first sawyer finishes the Head Cut to the desired length as determined by the officer, they come back behind sawyer 2 and complete the cut sequence by performing the bottom cut.

Eight Cut

Step 1: ndicator Cut
This cut is made to locate the outside structural member.

Step 2: Head Cut
This cut is a full louver span along the top of the heat hole, rolling the center rafter.

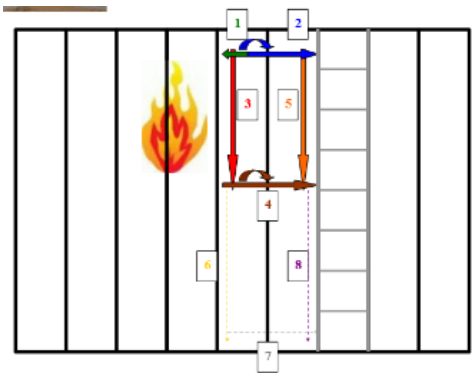
Step 3: Vertical Cut
This cut is along the inside of the outside rafter.

Step 4: Vertical Cut
This cut is a vertical cut along the other side of the rafter from cut 3 and is the beginning of the second louver.

Step 5: Bottom Cut
This is a duplicate of cut 2, but spanning the next bay of rafters.

Step 6: Vertical Cut
This cut is a duplicate of cut 3, but completing the second louver.

Step 7: Vertical Cut
This is a vertical cut and is the far-most fire-side cut.



Step 8: Bottom Cut
This cut is a horizontal cut made at the bottom of the desired louvers, spanning the entire louver bank. Note that you are not rolling rafters here because this is a skim cut.

Steep Pitch with Rafters/Trusses

If possible, take note of rafter tails to identify truss/rafter location prior to ascending the ladder. Position the roof ladder as to give yourself the best location to perform your cuts and span two rafter bays. Depending on how steep the roof is, use a rubbish hook or other tool to give you a foot-hold to step out to on the roof. In this evolution, the Vent Crew will need to pass the tools to each other. Tools get passed up on the inside and passed down on the outside.

Step 1: Head Cut
Reach out as safely as possible with your saw and plunge the saw into the roof at approximately the middle of the rafter bay, then find the outside rafter. Make your head cut back towards you rolling one rafter and stopping at the next.

Step 2: Outside Down Cut
This cut is made along the outside rafter and intersects the head cut by approximately a hand's width and extend down approximately 3-4 feet (depending on foot position of the sawyer). Cut to the inside of the rafter by a few inches so as to avoid running into the rafter during your cut.

Step 3: Bottom Cut
This cut intersects your down cuts by a minimum of a hand's width and mimics the head cut.

Step 4: Inside Down Cut
After making the bottom cut, the sawyer steps back completely on the roof ladder to make the final cut. The backup person then removes the foothold (i.e. axe or trash hook). The sawyer cuts along the inside rafter and intersects the head cut by approximately a hand width and extends down to intersect the bottom cut.

After all cuts have been made, the sawyer changes tools and "hinges" the sheeting at each of the cuts in order to provide the appropriate sized opening. Then, if needed, use a tool to punch through each louvered section to clear the opening to allow for smoke/heat removal.

Extending - Cuts 5, 6, and 7
These cuts are used on an "as-needed" basis and used to extend your existing hole. They mimic steps 2-4.

Pull Back
This method is limited to sheathing and is accomplished by making three cuts – the first, a head cut perpendicular to the rafters, rolling three or more. Next, two cuts parallel with the rafters are made to the approximate size of the hole. The top

board is loosened and the hole is opened top to bottom with a "J" hooking motion.

SUMMARY

As discussed in this section, it is important to understand the impacts of ventilation on fire growth. Equally as important, using modern fire tactics to safely extinguish fire and coordinating all fire ground activities is vital to safe and effective fire ground operations. All firefighters must have a good understanding of how to perform ventilation and be prepared when responding to do so. Primarily, firefighters will be responsible for residential ventilation and should not be called on to apply their skills to a commercial structure. Commercial ventilation is more complex and should be reserved for truck companies. Therefore, commercial ventilation operations are not incorporated in the Zone 1 Task Manual.

VENTILATION TERMINOLOGY

Center hallway cut: A cut placed in the center hallway area of an apartment building to remove smoke from the common egress areas. This may be required regardless of what floor the fire is located on depending stairwell configurations. It will provide ventilation for egress of occupants as well as access for firefighters.

Center rafter louver: The center rafter louver can be used on most decking materials. It consists of making two parallel, longitudinal cuts on either side of a single rafter as close to the adjacent rafters as possible, then two additional parallel cuts that intersect them (cuts are not completed in this order). The cut section of decking can then easily be louvered by pushing down on the near side of the panel, using the rafter as a fulcrum.

Clear the ceiling: After a ventilation cut is made, push a portion of the ceiling material down. This will allow for the heat, smoke and products of combustion to escape the interior portion of the structure through the ventilation opening.

Conventional roof construction: Utilizes structural members that depend on size for strength. The greater the span for a structural member, the larger it the member has to be to support a given load. This type of construction performs well in fire conditions.

Dicing: Dicing consists of making a head cut and multiple cuts between joists on roofs that have been skip sheeted with either 1X straight or diagonal sheeting.

Head cut: The lead cut through roof decking that is made perpendicular to rafters.

Heat hole: A ventilation hole that is placed as near to the seat of the fire as possible.

Designed to remove the heat from the structure in a vertical fashion.

Inspection hole: An inspection hole is made through the roof decking only and at an angle of 45 degrees to any exterior wall. Since roof structural members are either parallel or perpendicular to exterior walls, a 45-degree cut will ensure that the saw intercepts a structural member.

Lightweight roof construction: Strength is not derived from size of members. It is obtained from multiple members that are in compression and tension acting together. The sizes of the individual members are relatively small, requiring less time for structural collapse when exposed to heat and fire.

Louver-in-lieu: An offensive ventilation opening that is used in place of a pullback operation. Often time pullbacks cannot be accomplished and the louver-in-lieu is substituted in its place.

Louver against construction: Trench cut operations that are cut against the construction can be completed as follows: after the initial head/skim cut is accomplished, the outside rafter is identified. The sequence of cuts is to roll the first rafter contacted and stop at the second completing the louver. The second and subsequent series continues by moving over 4" and starting the cut again.

Louver with construction: Trench cut operations that are cut with the construction can be completed as follows: make the initial head/skim cut, then make outside parallel cut followed by bottom cut, and finishing with non-fire side parallel cut. This operation results in a 4'x 8' louver.

Panelized roof construction: A type of lightweight roof construction where the roof structure is divided into sections or panels. The smallest of these structural members (rafters) are typically 2' x 4' x 8' material connected to purlins, commonly 4 x 12 material, which are connected to beams (laminated wood or metal). These panels are sheeted by ½" plywood or OSB and covered with a composition product.

PPV: Positive pressure ventilation.

Pullback method: The pull-back method is used on decking comprised of wood sheeting and composition. Use two parallel cuts on either side of a single rafter to prepare the decking for pullback.

Rolling rafters: When you encounter a rafter while cutting through roof decking with a saw, lift the saw over the rafter and resume the cut. This method can be used to determine the location of a structural member or to ensure that the structural member is not severed in the cutting process.

Smoke indicator hole: A small opening made with an axe or power saw in roof decking that is used as a porthole to determine conditions within the attic space. Should be large enough to fit the D-handle of a rubbish hook through.

Sounding: Done with an axe, rubbish hook or other suitable tool in front of the path of travel to verify the roofs integrity. The sounding tool must be kept in front of the body to provide maximum stability for personnel if a weak portion of a roof is encountered.

Trench cut: A long, narrow section of roof that is removed ahead of a horizontally traveling fire to minimize extension. Trench cut operations are normally performed across the width of a roof (wall to wall). To be affective, a trench cut should be approximately three feet wide.

HOSE & APPLIANCES

The fire service has many ways to load and deploy fire hose. These loading and deploying practices are mostly based on culture and tradition, however, the need to improve interoperability has forced many agencies to look at hose loads and deployment practices. Many other factors, including getting water on the fire quickly, impact these deployment decisions. All hose loads and deployment techniques that have been adopted by the Zone 1 Training Advisory Committee are considered to be our "best practices."

The main emphasis of the hose section is to provide firefighters with information, common terminology and best practices to positively impact the deployment of hose lines and water delivery. It is intended to be a reference for recruits, apprentices and veteran firefighters.

DEFINITIONS

Adapters: Device for connecting hose couplings of dissimilar threads.

Advancing: Moving an attack line forward toward the objective (i.e., "advancing the line in the front door.")

Anchoring: Physically holding a hose line while it is being deployed or laid by the

Appliances: Hose adaptors, nozzles, wyes, gate valves, manifolds, and other portable channeling or controlling devices used on hose lines.

Attack Hose: Hose that is used by firefighters to combat fires.

Attack 50: The bundled top 50 foot section of hose in a bulk load. It is secured with a single rope tie and pull strap.

Bail: The controlling handle on a nozzle.

Bight: The fold in a hose where it bends back on itself for loading or when constructing hose bundles.

Bleed: The term used for relieving the air/water pressure out of a hose line by opening a controlling device (valve, nozzle, wye, etc.)

Blind Alley: A method of securing a water supply when accessing long driveways, dead-end streets with no hydrants, or lays into large residential or commercial properties. Typically, the first engine drops their supply hose in the street or entry and lays to the fire while a second engine connects to the first engine's supply hose and lays to the nearest hydrant.

Booster Line: Non-collapsible rubber-covered, rubber-lined hose wound on a reel and mounted on apparatus, and used for extinguishment of incipient and smoldering fires.

Brass: A reference to hose couplings. When loading hose or making up a bundle, the term "brass" is called out to indicate that a coupling is being passed into the hose load.

Break: A term used when loading hose that indicates that the flake of hose being loaded has reached the end of the hose bed and is ready to load back the opposite way.

Break a Coupling: Unthread or disconnect a coupling.

Bumper Load: A pre-connect stored in the front bumper of suppression apparatus.

Bundles: The tied sections or "bundles" of hose:

- ***Wyed Bundle*** – 150 feet 1¾" dual stack preferred, but single stack is also acceptable with marker bight (pull tab) on bottom of each stack and gated wye. Strapped or tied to maintain integrity.
- ***1¾" Bundle*** – 150 feet 1¾" dual stack with marker bight (pull tab) on bottom of each stack and no gated wye. Strapped or tied to maintain integrity.
- ***2½" Bundle*** – 150 feet 2½" dual stack with marker bight (pull tab) on bottom of each stack and no gated wye. Strapped or tied to maintain integrity (some departments had previously called this the 'Skidload').
- ***Hi-Rise Bundle*** – One 50 foot bundle of 2½" with smooth bore nozzle and one 50' bundle of 2½" with in-line pressure gauge. Strapped or tied to maintain integrity and stored flat or as horseshoe. Intended to be draped over the SCBA bottle for transportation and use with standpipe systems.
- ***Coil*** – 100 feet of 1¾" with a nozzle inside. Approximately 6 feet long when finished. Strapped or tied to maintain integrity. Can be loaded with or without gated wye.

Burst Section: A section of hose that fails, interrupting water flow.

Coupling: The threaded or ¼ turn ends of a section of hose that allow the hose to be connected together to form longer lengths.

Cross-Lay Bulk Load: Minimum of 300 feet of 2½" or 1¾" hose loaded flat and deployed from the side of the apparatus with an Attack 50.

Cross-Lot: The term for deploying a supply or attack line by grabbing the nozzle or coupling and pulling the hose straight out of the bed and to the objective (some departments had previously called this 'Overhaul').**Deck Gun:** A master stream device affixed to the topside of the engine and directly plumbed to provide large water flow.

Double Male/Female: Adaptors with male threads or female threads on both sides that allow connecting two male or two female hose ends together.

Dutchman/Dogleg: A term for the fold used to take up extra hose when loading a bulk or supply bed.

Dry Stretch: Laying dry hose to an objective.

Elevated Lines: Lines deployed to upper floors or roofs other than by conventional access. There are 3 identified methods of deployment:

- ***Dry-line up a ladder*** – A firefighter carries a hose line up a ladder dry and calls for water once the hose is deployed.
- ***Drop line*** – A firefighter uses their rope bag to hoist the hose line to an upper elevation.
- ***Bundle drop*** – A firefighter carries a bundle of hose to an upper elevation and lowers the female or wyed end of the hose for connection to a water supply.

Evolution: The term used for the prescribed methods of deploying hose lines from the apparatus.

Extended (Attack, Backup, Standby, Exposure): Deploying 2½" hose from the apparatus and extending the line with 1¾" hose bundle.

Extending: Adding to the length of a hose line with the same size or smaller hose.

Fire Department Connection (FDC): Used to supply standpipe systems, sprinkler systems, or combination systems (high pressure FDC is 250 psi or above).

Flat Load: Arrangement of fire hose in a hose bed in which the hose lies flat with successive layers one upon the other.

Foam: Class A foams break down the surface tension of water, allowing penetration. Class B foams act as a surfactant to seal a flammable liquid and prevent a flammable air/vapor mixture. Some foams are effective for both types of applications.

Foam Eductor: A unit for extracting foam concentrate from a bucket and mixing it with water flow from a hose line.

Forward Lay: A method of securing a water supply by laying supply line from a hydrant or other water source to the fire.

Gate Valve: A control valve with solid plate operated by a handle and screw mechanism; rotating the handle moves the plate into or out of the waterway.

Gated Wye: Hose appliance with one female inlet and two male outlets, each controlled by a ball valve.

Hand Lines: Refers to the hose lines that are managed and maneuvered by firefighters.

Heel: Synonymous with the term Back-Up Firefighter, but not to be confused with a Back-Up Team. There are many responsibilities of the Hell, the primary duty is assisting with the advancement of the hoseline.

Heeling: The term used for manually securing a hose to prevent its movement.

Hose Strap: A loop of webbing that can be used to help pull, adjust, or anchor hose lines.

LDH: Large diameter hose (4" or larger supply hose).

Marker Bight: A bight, typically 8", in the hose used to identify the location of a coupling.

Master Stream: Large caliber water stream that delivers 350 GPM or more.

Manifold: A controlling device that receives water through a supply hose and distributes water out three or more gated ports.

Monitor: A portable master stream appliance.

Nozzles: Nozzles are appliances used for creating and controlling water streams. Common nozzles are:

- Combination Fog Nozzle
- Break Away Nozzle
- Smooth Bore Nozzle

Pre-connect: Hose line connected to a discharge when loaded.

Quarter-Turn/Storz Coupling: Non-threaded (sexless) coupling with two hook-like lugs that slip over a ring on the opposite coupling and then rotate 90 degrees clockwise to lock.

Quick Hit: To attack the fire from the exterior to slow progression of the fire, making interior more tenable for firefighters and possible victims.

Rear Bulk Load: A minimum of 300 feet of 2½" or 1¾" hose loaded flat and deployed from the rear of the apparatus with an Attack 50 on top.

Reducer: Fitting used to attach a smaller hose to a larger hose.

Reverse Lay: A method of securing a water supply by laying supply hose from the fire location to the water supply.

Rolling Hose: Rolling the hose for storage or to relieve the hose of air and water for loading.

Shoulder Load: Hose that is loaded on the shoulder of a firefighter.

Siamese: Hose appliance used to combine two or more hose lines into one. The Siamese has multiple female inlets and a single male outlet.

Spanner Wrench: Small tool used to tighten or loosen hose couplings.

Stack 50: A section of the bulk bed with a pull bight which can be deployed as an additional 50 feet of hose to the objective.

Steamer Port: The large port on a hydrant.

Strip Bight: An 8" bight denoting the middle of an Attack 50.

Supply Hose: Hose that is designed for the purpose of moving water between a water source and a pump that is supplying attack hose lines or fire suppression systems.

Take the Hydrant: A command used to assign connecting the supply line to a hydrant.

Tied Tight to a Hydrant: An engine is positioned next to, or near enough to, a hydrant that they connect directly without using a forward or reverse lay.

Village Hydrant: A two-port hydrant with only 2½" ports.

Wet Stretch: Advancing a charged hose line to an objective.

Wrap the Hydrant: A command used on a forward lay to place the hose and adaptors around a hydrant without connecting to it.

CONSORTIUM HOSE LOAD OVERVIEW

For consistency, the following hose loads will be the standard for the consortium engine companies:

- Minimum of 800 feet of supply hose
- Pre-connects (1¾" @ 150 feet or 200 feet, 2½" @ 150 feet or 200 feet)
- High-Rise bundles 2½" @ 50 feet each, one 50 feet section with a smooth bore nozzle (optional)
- Two 2½" bundles @ 100 feet each, one bundle with a breakaway nozzle (optional)
- Two 1¾" apartment bundles @ 150 feet each with gated wye on one bundle minimum
- One 2½" bulk bed @ 600 feet flat loaded and flagged @ 150 feet, with the last 50

feet to 100 feet bundled with breakaway fog nozzle or smooth bore nozzle

HOSE APPLIANCES, NOZZLES, AND TOOLS

Adapters

Adapters are used for making hose connections of different sizes and thread types. There is a wide variety of available hose adapters and many departments carry specific adapters for their given response area. Mutual aid responses should determine the need for additional adapters and personnel assigned to an engine or ladder should understand the use of each adapter carried on their apparatus.

Bumper Lines / Booster Reels

Bumper and booster lines are used on some apparatus in Zone 1. The use of these hose lines is limited by the available volume of water and restrictions for use on certain fires. Bumper and booster lines are not to be deployed into structure fires, on well involved vehicle fires, or any situation where the protection of a water stream is necessary for the safety of personnel. Bumper and booster lines are for the quick extinguishment of small fires typically involving dumpsters, vehicles, grass and low brush, and other small exterior fires.

Hydrant Kit

Different departments use and carry a variety of hydrant kits. The specific inventory of hydrant kits will vary depending on the individual department requirements; a basic inventory may include:

- Hydrant Wrench
- Spanner Wrench
- Hydrant Gate Valve
- Marker Device
- Various Adapters
- Knox box FDC Keys

Manifold

Manifolds are appliances used to distribute water supplied from an LDH to multiple hand lines. Manifolds can be used on reverse hose lay evolutions to allow the supplying engine to leave the immediate scene and locate a remote water source.

Nozzles

Nozzles are appliances used for creating and controlling water streams. Common nozzles in Zone 1 are:

- Combination Fog Nozzle - 100 or 75 psi operating pressure
- Break Away Nozzle – 100 or 75 psi operating pressure
- Smooth Bore Nozzle – 50 psi operating pressure
- Master Stream Nozzle – apparatus mounted / ground monitors / elevated master streams 80 or 100 psi operating pressure, depending on mounted or portable, and smooth bore or combination

Spanner Wrenches
Spanner wrenches are used for making and breaking hose coupling connections. Spanner wrenches are designed for specific hose couplings with common sizes and types being 1¾" lug, 2½" lug, 4" lug, 4" and 5" Storz.

SUPPLY HOSE
The supply beds on Zone 1 engine companies vary slightly based on hose bed manufacturer design/size. Typical Zone 1 engine companies will carry a minimum of Large Diameter Hose (LDH) ranging from 4" to 5" diameter.

¼ turn Storz couplings have locking devices to maintain a positive lock when coupled. When making Storz couplings, align the locks. Doing so will make it easier to break the couplings prior to rolling and reloading the hose.

Care must be exercised while handling LDH. When laying dry supply hose from a moving engine, the firefighter heeling the hose must not step on any part of the hose or allow the supply line to move behind them. Doing so will prevent injury in the event the hose gets caught in the hose bed.

Handling supply hose filled with water under pressure creates another hazard. A hose strap or tool may be used to prevent the hose from kinking on your hand.

LOADING THE SUPPLY BED
The LDH bed is started with the first coupling laid at the front, cab side, left corner of the hose bed.

LDH is loaded in a flat orientation, laid in progressive rows, from one side of the bed to the other. Repeating this process produces stacks and rows.

Couplings are to be loaded toward the front of the hose bed and oriented so they will not flip when deploying. As progressive rows are made, cross overs must be created. Make the cross over from row to row and diagonally lay it from the cab to tailboard. Additionally, at each side of the hose bed, double stack prior to starting the next row to maintain a level load.

Place alternating bights at the rear of the hose bed. Every other bight should be placed approximately 8" in from the tailboard edge to prevent the bights from stacking higher than the hose.

Alternatively, LDH may be loaded as "Stack 50" with marker bights every 50 feet.

1. Place the female coupling in the left front corner (closed end) of the bed.
2. Form a marker bight even with the rear of the bed and lay the hose back onto itself toward the female coupling. Make a bight behind the female coupling (all subsequent bights will be made even with the front of the bed).
3. Create a Stack 50, maintaining

even, straight bights 6” from the rear of the bed.

4. Position the next coupling, to avoid turnover, at the front end of the bed and to the right of the first Stack 50.
5. As the new section reaches the rear of the bed, form a marker bight that is even with the first. Stack each subsequent section in the same manner as the first.
6. When the first row of hose is complete, the next coupling is loaded to the left front corner of the bed to begin another row of hose. Continue loading hose in the same manner until the final coupling.

Both loads are finished by wrapping the final coupling with the last 4’-5’ of hose and secure with a hose strap.

DEPLOYING SUPPLY HOSE

Deploying supply lines involves a couple techniques, depending on the intended application. Supply lines laid from moving engines should be heeled in a safe manner to prevent any injury to firefighters. No portion of the supply line should be positioned behind the heeling firefighter, and only a hand hold of supply lines should be used.

Overhauling supply lines involves deploying a supply line from a parked apparatus to a water source, or second apparatus by means of pulling and dragging the LDH from the supply bed and advancing it to the objective.

TAKING A HYDRANT

Taking a hydrant may vary based on hydrant type, hose, and fittings. The following should be used as a basic outline for taking a hydrant.

1. Stand behind the hydrant using the hydrant wrench to confirm the operating nut is in the closed position, keeping away from discharge ports until one cap is loosened. When complete place the hydrant wrench on the operating nut.
2. Connect supply hose to the steamer port (largest port) and 2½” gate valve, confirm that the gate valve is in the closed position. Adapters may be needed. Check for gaskets prior to connecting.
3. After confirming the driver is ready for water, fully open the hydrant in a controlled manner to safely send water. Follow the supply line to engine, removing any kinks. Report to driver upon completion.

FORWARD LAY

A forward lay refers to an engine stopping at the water source, the hydrant, on their approach and dropping a supply line prior to proceeding to the location of the fire. The forward lay works best when a water source is in the approach path of the attack engine.

REVERSE LAY

A reverse lay involves dropping the supply line at the fire location and driving to the water source. Typically, the first arriving engine is used as the attack engine, providing a fire attack off tank water to slow progression of the fire and provide for a more tenable environment. The second arriving engine becomes the supply engine, laying a reverse from the attack engine to the water source. Steps for making a hydrant are the same. A reverse lay is preferred for supplying large volumes of water via a ground monitor or manifold.

SUPPLYING A FIRE DEPARTMENT CONNECTION

Fire department connections should be supplied by matching the hose diameter to the connection: i.e. 2½" Siamese connection should be supplied with two 2½" hose lines; 5" Storz connections should be supplied with 5" diameter hose.

NOTE: Many FDCs require a fire department key to remove connection caps.

HANDLINES

PRE-CONNECTS

Zone 1 engine companies have several different types of apparatus and hose bed configurations. Regardless of apparatus configuration or design, each pre-connect is loaded with a total of 150 feet or 200 feet of hose.

Pre-Connect Loading

Connect the female end, or if using trays, leave sufficient hose to make the connection later.

1. Lay the first flake of hose and extend an 8" marker bight on the connected side.
2. Lay subsequent flakes to the width of the hose bed or tray until reaching coupling.
3. If agency uses 50 feet down for pre-connect loads, leave male coupling for later connection and go to step 8 below.
4. If agency uses 100 feet down for pre-connect loads, connect the next section of hose and lay the next flake, with an 8" marker bight on the connected side.

5. Lay subsequent flakes to the width of the hose bed or tray.
6. Leave the male coupling for later connection.

7. Connect the nozzle to a new section of hose and confirm the bail is closed.
8. Place the nozzle flush with the end of the hose bed or tray and lay flakes flush with the end of the hose bed or tray until reaching coupling.
9. Connect next section of hose and place an 8” marker bight on the connected side.
10. Lay subsequent flakes to the width of the hose bed or tray.
11. If agency uses 150 feet up for pre-connect loads, connect the next section of hose and lay the next flake, with an 8” marker bight on the connected side.
12. Connect male coupling from bottom section to the female coupling of the upper to complete the load.

Shouldering Pre-Connect

1. Grasp the nozzle and securely shoulder the middle third of the upper flakes on the right shoulder.

2. Step away from the apparatus until all the upper flakes are clear.

3. Turn left and reach back to grab the marker bight(s).
   A. Advance toward the objective, release the marker bight(s) as the line goes tight. Complete deployment using nozzle forward techniques.

BUNDLES

Zone 1 engines carry 150 feet of 1¾” or 2½” formed with a nozzle at the bottom and built upward in accordion fashion. The finished unit is approximately 6 feet long and secured with straps or ties to maintain integrity. Attachment of a gated wye is optional.

Loading 2½” bundles

The slot loaded bundles are made starting with the nozzle (or no nozzle if not required) and are approximately 6 -7 feet in overall length.

1. Start with the nozzle (or male coupling) and load each bight even with either the tip of the nozzle, or tip of the male coupling.
2. Continue flaking the hose making the bundle approximately 6 -7 feet in overall length until 100 feet of hose is used.
3. Place two bundle straps, one at the midpoint of the bundle and one near the nozzle (or male coupling).
4. In each of the hose trays holding slot loads, there will be two separate bundles stacked on top of each other; the bottom bundle will be 100 feet of bundled hose without a nozzle, the top stack will be 100 feet of bundled hose with a nozzle.

Loading Double Stack Bundles

The double stack apartment bundle is carried on Zone 1 engines that cannot accommodate the height of a single stack. They're also made with 150 feet of 1¾" hose, simply made in two 75 foot stacks side by side.

1. Start by making the double stack apartment bundle in the same way as a single stack, then at the 75 foot mark; fold the hose over the back of the bundle starting a second stack adjacent to the first.
2. When making the second stack, create the same pocket for the wye as made in the single stack as described as above.

Note: The first stack is started with the nozzle and is carried on the shoulder closest to the head of the firefighter, the second stack is made away from the first, ending up with the gated wye on the outside of the double stack.

Deploying Bundles from Standpipe Connection

1. With the standpipe charged, the officer enters the stairwell and confirms water is not discharging from the standpipe. The firefighter shoulder loads the apartment bundle with SCBA mask donned and follows officer to floor below fire floor.
2. The firefighter unstraps the bundle as the officer or other firefighter connects the gated wye to the standpipe.
3. The firefighter deploys the hose to the outside of the stairwell (to minimize kinks and keep the stairway clear) to the fire floor. If fire floor hallway is tenable, hose may be stretched dry to the desired location. If the hallway is not tenable, hose may be stretched to floor above and back down to be charged prior to hallway entry. Option: hose

may be deployed with a coil method from the fire floor.
4. Charge the line, bleed the air, and select the desired pattern.

High-Rise Bundle

The horseshoe shape of the high-rise bundle allows it to be easily placed over the firefighters SCBA cylinder, freeing the hands to carry additional equipment.

Building the High-Rise Bundle

1. Place a 4" contrasting stripe around the circumference of the hose 32" from the female coupling and at the center of the 50 foot section of hose.
2. Create a bight at the 32" mark and fold the hose back and forth in a horseshoe pattern with the female coupling extending past the bights.
3. Finish the bundle with the male coupling at opposite side of horseshoe from female coupling. Loosely attach coupling and fold excess hose back to female side tucking into first flake.
4. Secure bundle with two straps on the female side of the bundle and one strap just behind the male coupling.

For the nozzle section

Finish the bundle by positioning the tip of the nozzle even with the bottom flakes on the opposite side of the female end. Fold excess hose back towards the female side of the bundle tucking into first flake. The bundle is bound with three Velcro straps. A single strap will capture the male side of the bundle and two straps are used on the female side of the bundle. This is to allow precise placement of the bundles at the point of deployment.

BULK LOAD

The bulk load can be deployed in areas where water needs to be applied in a compartment that is a considerable distance from the location of the attack engine. The bulk load hose bed has a minimum of 300 feet.

The bulk load hose bed is "finished" with an Attack 50. The Attack 50 is the last section of a bulk load that has a nozzle attached and is tied into 6 foot lengths for rapid deployment.

Loading the Bulk Load

1. Place the female coupling in the left front corner (closed end) of the bed.
2. Form a marker bight even with the rear of the bed and lay the hose back onto itself toward the female coupling. Make a bight behind the female coupling (all subsequent bights will be made even with the front of the bed).
3. Create a Stack 50, maintaining even straight bights 6" from the rear of the bed.
4. Position the next coupling, to

avoid turnover, at the front end of the bed and to the right of the first Stack 50.

5. As the new section reaches the rear of the bed, form a marker bight that is even with the first. Stack each subsequent section in the same manner as the first.
6. When the first row of hose is complete, the next coupling is loaded to the left front corner of the bed to begin another row of hose. Continue loading hose in the same manner until the Attack 50.
7. The Attack 50 is created on the ground starting with the nozzle, bail down. Use a double-arm span to establish the length (approximately 6 feet). Form bights even with the nozzle and continue stacking flakes at the double-arm length size. Using a slip knot, place a single tie with a pull strap between the coupling and the bail.
8. Pass the Attack 50 into the hose bed ensuring the nozzle is on top and to the left of the open end of the bed.
9. Connect the Attack 50 to the bulk loaded hose.

Loading the Bulk Crosslay

1. The first section is loaded with the female coupling placed on the forward side of the bed on the driver's side, even with the edge of the bed.
2. The hose is folded back and forth in a crisscross pattern keeping the bights even with the edge of the bed.
3. After 200 feet are loaded, the next section is loaded as a Stack 50 closest to the cab of the apparatus. This Stack 50 requires a marker bight on each side of the apparatus.
4. The coupling leading to the Attack 50 should be positioned toward the rear of the apparatus and in a location that will result in an Attack 50 with a full top flake (1 to 2 feet from the officer's side of the apparatus).
5. The Attack 50 requires a 12" exaggerated bight on the driver's side, then a marker bight on the officer's side.
6. Continue flaking back and forth keeping the bights even with the edge of the bed.
7. Place a rope tie between the nozzle and coupling securing with a slip knot.

Flat load 2½"

Loading the Flat Load bed is similar to loading the supply bed of LDH.

1. Start with the female coupling at the front left corner of the hose bed, and lay progressive rows from one divider toward the other divider. Continue making

progressive rows and stacks on top of, and across, until all but 150 feet of the bed is loaded.
2. Mark the final 150 feet by extending a bight approximately 12" – 16" past the edge of the hose bed, and continue loading additional 50 feet after the extended bight is made.
3. Leave the male end of the hose uncoupled to accept the finished bundle.
4. Make a 75 foot or 100 foot (based on department specifications) bundle on the ground as described above for bundle make up, leaving the end uncoupled.
5. Load the bundle into the hose bed and attach the female end of the bundle to the exposed mail coupling.
6. Lay the bundled section on its side on top of the flat load in the hose bed.

Deploying Flat Load

1. Shoulder load the 75 foot or 100 foot bundle.
2. Reach back with your free hand and grasp the extended flake, marking 150 feet.
3. Make the hose stretch with driver assisting with hose bed deployment.
4. As the stretch approaches the desired target, drop the extended flake providing 150 feet of hose to make final stretch to target.
5. When the required hose is deployed, the driver will break the appropriate coupling from the hose bed and connect it to the discharge port.

Removing hose from Bulk Bed

1. Stand on the ground, face the bulk bed, grasp the strap or pull bight of the Attack 50 with the left hand, and pull it one-third out of the bed.
2. Grasp the hose of the Attack 50, pivot counter-clockwise, and remove the hose from the bed until the right shoulder can be positioned under the center of the Attack 50. Remove the hose completely from the bed.
3. Rotate counter-clockwise and grasp the next marker bight with the left hand. Hook the marker bight into the crook of the left elbow and proceed toward the objective.

Removing hose from the Bulk Crosslay – Driver's Side

1. Stand on the ground, face the Crosslay on the driver's side of the engine, grasp the exaggerated pull bight of the Attack 50 and pull it one-third out of the bed.
2. With the right arm, reach through the exaggerated pull

bight of the Attack 50 and position so you can pull the Attack 50 onto your right shoulder.

3. With both hands, remove the Attack 50 from the bed until the right shoulder can be positioned under the center of the bundle. Remove the Attack 50 completely from the bed.
4. Fully rotate counter-clockwise and grasp the pull bight of the Stack 50 with the left hand, partially removing the hose. Hook the pull bight of the Stack 50 into the crook of the left elbow and proceed toward the objective.

MOVING HANDLINES, THE BASICS

Moving handlines in Zone 1 is broken into two different segments: deploying dry fire hose from the fire apparatus to the entry point, and advancing a charged fire hose from the entry point to the final objective, or fire area.

The goal of hose deployment is to accurately estimate the distance from the apparatus to the fire and achieve a clean and efficient stretch while minimizing friction and kinks.

Making the Stretch from the Apparatus to Entry Point

Accordion Forward

The accordion forward stretch is the most efficient means to deploy a dry hose line from the fire apparatus to the objective. With the bundle on the firefighter's right shoulder, grasp the nozzle with the right hand and roughly the middle bight(s) with the left hand. At approximately 15 feet to 20 feet from the objective, drop the right shoulder dumping the bundle to the ground, maintaining your grip on the nozzle and the bight(s). Advance the nozzle and bight to the objective.

Accordion Reverse

Used when the nozzle person fins themselves without enough room to stretch an accordion forward. This stretch is done using the basic hand switch as the accordion forward stretch. The right hand takes roughly the middle bight of the shouldered bundle. In cases with less room up at the deployment area, the nozzle person can take more than one bight. While maintaining a grip on the bight or bights, the nozzle person will drop the hose bundle, and run the bight away from the objective. The bight or bights can be left towards the rear, or brought back to the objective.

"V" Split

While the hose is on the right shoulder, split the remaining bights in half gripping the nozzle half with the right hand and the remaining hose with the left. Drop the bundle holding onto both halves and take a few steps toward the objective, opening the

bundle up and exposing the middle bight. Grab the middle bight and stretch the hose. Alternatively, grasp the middle of each section and stretch the hose.

The Coil

Fire hose may be deployed in a coil where space is too confined for either accordion deployment or "V" Split to be successful (i.e. a stairwell, landing, porch, or balcony).

1. Place the hose bundle on the ground while maintaining the integrity of the bundle.
2. Place the nozzle against your knee.
3. Grab the "top" section (the section away from the nozzle) of each subsequent bight and place it over your left hand.
4. Once all the bights are accounted for, place your right hand inside the loops next to your left hand. Stand up and spread your arms as wide as possible. Step through the loops of hose with your right foot and place your left foot on the nozzle.
5. Make a fist with each hand against the wall, look away from the hose and call for water.
6. Adjust the completed coil with your right foot to keep the coil propped against the wall.

AVPP: Air Volume Pattern Pressure

Prior to entering the IDLH, it is important to ensure that the line is fully and appropriately charged, free of kinks, and that your nozzle is in good working order. This will be accomplished by performing an AVPP or Air, Volume, Pattern, and Pressure check.

- Once the attack line is charged, fully open the bail for approximately one to two seconds and then abruptly close the bail (this may need to be performed more than once). At the appropriate pump discharge pressure, this will assist in chasing kinks out of the hose.
- After hammering the kinks out of the line, open the bail and flow for 10-15 seconds to: bleed any air out of the handline, feel if you are receiving appropriate nozzle reaction, and to make sure you have a good stream. Flowing before entry also allows the driver time to set the pump to the needed pump discharge pressure.
- For combination fog nozzles: While checking AVP, after hammering the line change the pattern to flush and then back to the appropriate nozzle pattern.

Door Check

This is to be performed, on air, prior to advancing hose inside a structure.

- Size up your entry point.
- The Three L's: Lift, Life, Location.
- Check for Lift: With the

firefighter on the nozzle ready to fight fire, open the door fractionally to assess the fire conditions.

- Check for Life: Hook the doorframe with your feet, stay low and enter on your belly should conditions warrant. Call out and sweep with your arms, and/or a tool, looking for victims.
- Attempt to Locate: Try to locate the seat of the fire.
- Check for Lift once more: Assess fire conditions; have they improved or worsened since opening up the flow path?
- Relay your findings with the Heel.

HOSE HANDLING TECHNIQUES

Hip Grip (Standing)

1. Stand with feet parallel to the hose, lean forward to absorb the nozzle reaction. The handline should be straight into the hip of the nozzle person from the ground.
2. Create a "corner" or "shelf" between the hip and the top of the thigh. With the back hand slightly forward of the hip bone, press in and down on the hose through the hips to alleviate the nozzle reaction.
3. The forward hand will open the bail and take a position just behind the coupling.

Hip Grip (Kneeling)

1. Sit on the rear ankle with the rear knee nearly perpendicular to the hose. Place the forward leg parallel to the hose, bent at the knee, forward foot flat on the ground. The handline should be straight into the hip of the nozzle position from the ground.
2. With the shoulders nearly parallel to the hose and the back straight, assume an upright position. Lean away from the nozzle reaction.
3. Create a "corner" or "shelf" between the hip and the top of the thigh. With the back hand slightly forward of the hip bone, press in and down on the hose through the hips to alleviate the nozzle reaction.
4. The forward hand will open the bail and take a position just behind the coupling.

The Clamp

1. Place the rear leg over the handline and create as much surface area as possible with the foot, ankle, and lower leg to push the line into the ground.
2. The handline should be straight for at least 10 feet behind the nozzle.
3. The back leg should remain down and the front leg should

stay up. Lean away from the nozzle reaction.

The Heel

1. The Heel's forward knee will be down and the rear leg flexed and in line with the hose.
2. The forward hand is flat on the ground with the hose between the hand and the forward knee. The forward arm is kept straight.
3. The rear hand holds the line just above the rear ankle with the hand under the hose. The hose should not be above the rear knee.

The Crooked Lean

1. The nozzle position, starting in a hip grip (kneeling) position, will sit up onto their rear knee.
2. The Heel will maintain contact with the hose and move forward to the nozzle position.
3. The Heel will place their forward shoulder into the nozzle position's scapula allowing the nozzle position to lean back onto the Heel.
4. The Heel will take the weight of the nozzle position and control the nozzle reaction of the hose.

MOVING CHARGED HOSE INTO A STRUCTURE

After advancing the correct size and length of hose to the entrance, a careful evaluation of the conditions is required prior to entering any structure. With the line charged, the firefighter opens the nozzle to bleed off air and select proper nozzle pattern. Staying low and to the side of the doorway the firefighter opens the door, maintaining control, and then moves the line forward. The attack crew should place themselves on the attack line for mid span hose advancement and corners as these will create friction points that will hinder hose advancement and delay fire attack. Consideration should be given to utilizing additional personnel to support the attack hose line. The goal should always be to advance the attack line to the fire as quickly as possible.

Advancing the Line to the Fire

When advancing a handline, the Heel should allow the nozzle to have ample space to maneuver. Allowing for 8-10 feet of separation between the nozzle and the Heel is a good starting point. Adjust your spacing based on the conditions at hand.

In the Heel position, grab the same piece of hose 8-10 feet behind the nozzle person. With your other hand, grab a bight at or near the first coupling.

To increase the likelihood that the first 50 feet of hose makes it into the structure, the Heel drops the bight approximately 15-20 feet after making entry. Drop the bight prior to making your first corner if one is present within the first 15-20 feet.

It is the job of the nozzle to identify any obstacles or turns and to relay that information to the Heel. The Heel should acknowledge and confirm the information. For example: Nozzle- "left turn!" Backup- "copy, left turn". To avoid pinch points and reduce friction, the Heel should position his or herself on the opposite side of the turn. For example, in a left turn the Heel would move to the right side of the hose, jam their SCBA into a corner, and continue to feed hose.

When able, create a surplus of hose on the floor or up the walls by creating "S's" and/or loops. Try to always pre-load the available space in preparation for the next movement.

As more personnel are added to advance the line further, Heel should advance to key positions such as corners and doorways to limit friction and to keep the line moving smoothly.

HIGH-RISE/STANDPIPE HOSE DEPLOYMENT

High-rise/standpipe operations can be very challenging and require a steady supply of personnel. Typically, when using a standpipe to deploy handlines, whether you are going vertical or horizontal, often means the fire compartment is remote with regard to access or distance. It is important to note that if water application can be achieved from an exterior position prior to interior firefighting operations, this should be completed prior to an interior attack. If this is not achievable, due to the remote location of the fire compartment, all first arriving companies should support getting a handline in place as soon as possible. The following information is recommended as a best practice when utilizing a standpipe for fire suppression.

Equipment

The minimum required equipment for standpipe operations for a 3-person crew:

- One 50 foot 2½" high-rise bundle with a smooth bore nozzle
- One 50 foot 2½" high-rise bundle without nozzle
- Standpipe tool kit
- Set of irons
- Long handled tool (NY Hook)

Standpipe Tool Kit

The standpipe tool kit contains tools and appliances that are necessary for standpipe operations. Kits may include:

- Canvas tool bag
- 2½" x 2½" x 2½" gated wye
- 2½" inline pressure gauge
- Two 2½" 30 degree elbow fittings
- Two spanner wrenches
- 18" aluminum pipe wrench
- Wire brush
- 2½" nozzle with smooth bore tip
- 1½" x 2½" increaser
- Wood door wedges

Pressure Gauge

The inline pressure gauge is necessary to

ensure that a proper fire flow is being delivered for fire attack. One firefighter is designated to make all the connections to the standpipe and delivers water when called by the Nozzle firefighter. Standpipe outlet pressure is controlled by adjusting the standpipe valve wheel. This firefighter may assist in advancing the attack line but must be available to make pressure adjustments as needed.

Outlet pressure is adjusted by the standpipe valve wheel. A good place to start is to open the valve wheel completely then close it halfway.

The Nozzle must be flowing water long enough for the firefighter at the standpipe to dial in the correct pressure.

STANDPIPE OPERATIONS

Several factors need to be considered before you decide on which stretch to initiate. There are two basic types of standpipe hose deployments.

- Wet Stretch: Used when the fire floor or hallway is untenable.
- Dry Stretch: Used when the fire floor is tenable where there are conditions that don't warrant the use of SCBA masks. Two requirements to initiate this stretch must be met:
  - Positive door control
  - Tenable hallway

Dry Stretch

A hallway stretch is used in situations where the public hallway leading to the apartment or occupancy is tenable and the door to this apartment or occupancy is intact and controlled.

There are three drop points in a dry stretch. These drop points are:

1. On the floor below the fire.
2. Past the hallway door on the fire floor.
3. At the apartment or occupancy door.

Tasks

- *Drop Point 1*: Hose bundles are placed on the floor below the fire floor with the nozzle section closest to the stairwell door. Place hose bundles with male fittings towards the same direction. The desired number of hose lengths will be determined by the fire location. Remove Velcro straps and connect couplings.
- The Standpipe firefighter will connect the last female coupling to the standpipe outlet one floor below the fire floor. Before connecting the hose do the following:
  - Ensure that valve is closed. Remove cap.
  - Check for debris inside

standpipe valve. Use a spanner wrench to remove any debris that is lodged in a valve.
    - Clean the threads as needed. Watertight connections are necessary for accurate GPM delivery.
    - Attach elbow fitting to prevent hose kinking at the standpipe outlet.
    - Flush standpipe into the stairwell to clear any debris that may have accumulated.
    - Attach inline pressure gauge and hose. Stand by to charge the line and dial in the proper pressure using the standpipe outlet wheel. Water must be flowing from the nozzle to dial in correct pressure.
- The Nozzle and Heel will each pick up the first two sections of hose line and ascend to the fire floor drop point 2.
- *Drop Point 2*: The Heel will lay down a practical amount of hose on the fire floor, just past the stairwell door.
- The Nozzle will advance to the apartment or occupancy door while the Heel stretches the hose straight from the stairwell door.
- *Drop Point 3*: This is the apartment or occupancy door. Nozzle will place the working section of hose line at the door and backstretch the hose in the appropriate direction. Hinge side for inward swinging doors.
- The hose on the floor below will be stretched back straight in a single flake.
- The Nozzle will:
    - Call for water.
    - Bleed the hose line of air.
    - Communicate with the Standpipe Wheel to dial in proper pressure while flowing water from the nozzle, check pressure and adjust if necessary.
    - Begin the fire attack from this position.

Wet Stretch

A stairwell stretch is used to deploy hose lines when the fire floor has an untenable hallway. Un tenable (dirty) is defined as needing to mask up. There may be cold smoke conditions or active fire burning on the other side of the stairwell door.

There are two drop points on a stairwell stretch:

1. On the floor below the fire.
2. Stairwell landing of fire floor.

Tasks

- *Drop Point 1*: Hose bundles are placed on the floor below the fire floor with the nozzle section

closest to the stairwell door. Place hose bundles with male fittings towards the same direction.

- The desired number of hose lengths will be determined by the fire location. Remove Velcro straps and connect couplings.
- The standpipe wheel will connect the last female coupling to the standpipe outlet one floor below the fire floor. Before connecting the hose:
  - Ensure that valve is closed. Remove cap.
  - Determine if there is a pressure reducing valve (PRV). Either remove or disable PRVs.
  - Check for debris inside standpipe valve. Use a spanner wrench to remove any de- bris that is lodged in a valve.
  - Clean the threads as needed. Watertight connections are necessary for accurate GPM delivery.
  - Attach elbow fitting to prevent hose kinking at the standpipe outlet.
  - Flush standpipe into the stairwell to clear any debris that may have accumulated.
  - Attach inline pressure gauge and hose. Stand by to charge the line and dial in the proper pressure using the standpipe outlet wheel. Water must be flowing from the nozzle to dial in correct pressure.
- *Drop Point 2*: Nozzle will ascend with the nozzle section of hose to the stair landing of the fire floor. The Heel will assist with stretching and back stretching up the stairs and back to the floor below.
- The hose on the floor below will be stretched back straight in a single flake.
- The Nozzle will:
  - Call for water.
  - Bleed the hose line of air.
  - Communicate with the Standpipe Wheel to dial in proper pressure while flowing water, check pressure and adjust if necessary.
  - Begin the fire attack from the fire floor stairwell landing.

SUMMARY

Loading and deploying fire hose is a critical skill in the fire service. Applying water into the fire compartment as quickly as possible from a safe position is often a necessity to successful fire suppression. Consequently, hose must be loaded correctly so that it deploys as efficiently as possible supporting rapid water delivery. Once deployed, firefighters need to possess the knowledge and skill to lay, maneuver, and manipulate

hose effectively. Like all other skills in the fire service these, too, are perishable and require constant attention, therefore, constant practice is essential.