SOUTH KING COUNTY FIRE TRAINING CONSORTIUM

FIREFIGHTER FUNDAMENTALS

SOUTH KING COUNTY
FIRE TRAINING
CONSORTIUM

Hand Tools
Power Equipment
PPE
SCBA
Forcible Entry
Search & Rescue
Ladders
Ventilation
Hose
BSC

FIRE TRAINING
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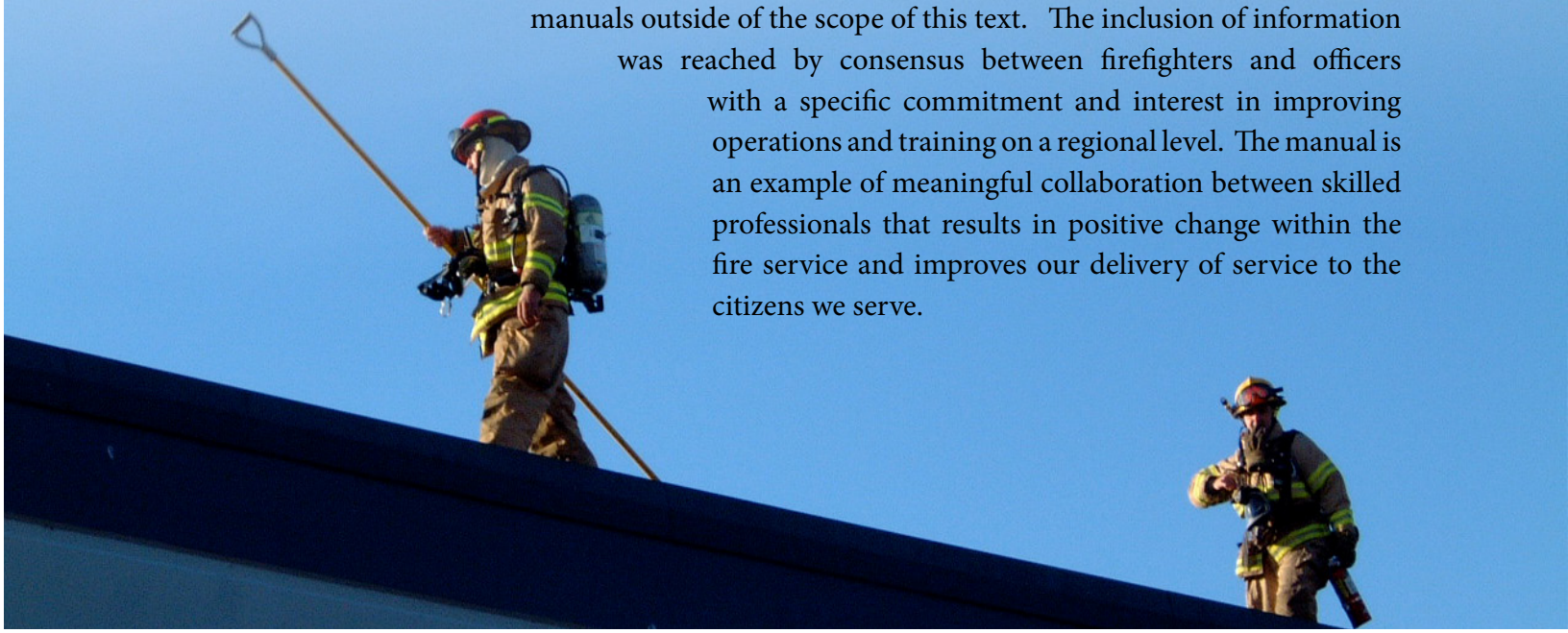
INTRODUCTION

The American Fire Service is built around the capabilities of the fire engine as the backbone of a successful fire response system. The engine company requires high quality equipment, personnel, leadership, and training to operate at a variety of incidents in a safe and effective manner.

The current regional response model relies heavily on automatic aid between neighboring departments to provide adequate numbers of personnel on scene to successfully fight fires and resolve other emergencies. A critical factor to safe and effective automatic aid operations is the extent and level of consistency between units from different departments at the task level. Differences in task level procedures, terminology, tactics, and practices can have a negative impact on the tempo of the incident and the safety of responders.

The member agencies of the South King County Fire Training Consortium are committed to improve emergency responses by delivering high quality, consistent training to fire fighters who respond to incidents together and to standardize operations at the task level wherever possible. The Firefighter Fundamentals captures the best practices of local fire departments as a foundation for consistency in training delivery and emergency response.

This manual covers the general categories of engine company operations and the basic tasks within each category. It is intended to provide a standard platform for recruit and apprentice training and to serve as a resource for tenured personnel. The Firefighter Fundamentals is not exhaustive in its content. Advanced concepts and methods are found in specialized manuals outside of the scope of this text. The inclusion of information was reached by consensus between firefighters and officers with a specific commitment and interest in improving operations and training on a regional level. The manual is an example of meaningful collaboration between skilled professionals that results in positive change within the fire service and improves our delivery of service to the citizens we serve.



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Hand Tools & Hoisting

Fire suppression task level activities usually start with basic hand tool operation and competent water delivery. While these tools, generally speaking, have primitive design features, it is very important that all firefighters use hand tools efficiently and effectively. The following section will outline the basic hand tools and the most common application for each tool.

FIRE FIGHTING TOOLS

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

Fire Extinguishers

Dry Chemical Fire Extinguisher: Is

10A:120BC rated extinguisher for ABC type fires. The cylinder is made of steel with a 20 lb. capacity. The extinguishing agent is a Mono-ammonium Phosphate agent with an operating pressure of 195 psi and a discharge time of 30 seconds and an initial range of 21 feet.

Pressurized Water Extinguisher: The "P-can" has a 2.5 gallon water capacity and is charged to 100psi. Discharge time is approximately 60 seconds and a reach of 30 feet to 40 feet.

Flat Head Axe: Comes with a 28 – 36 inch fiberglass handle and a 6- 8 pound Axe head on one side and a flat head on the other. The axe is used to cut through most natural material. The flat head side of the axe is used as a striking tool. Its most often paired with a prying tool to aid in forcible entry and when coupled with the Halligan tool, it is referred to as; "A Set of Irons".

Halligan Bar: Invented in 1940 by FDNY Deputy Chief Hugh Halligan, this forcible entry and extrication tool provides firefighters with the needed force or leverage to handle most forcible entry situations. It has a point, a fork and a leverage foot to aid the firefighter in forcing their way into buildings. It can also be used in vehicle extrication as a prying tool.

McLeod: Is 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 also a product of Chief Halligan 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.

Pick Head Axe: Comes with a 28 – 36 inch fiberglass handle with a 6- 8 pound 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.

Pike Poles: Are a penetrating and pulling tool with a primary use of breaking glass and opening up walls or ceilings. The standard 6 foot Pike Pole has a point and a hook at the end of the pole. It is the best tool to use when removing drywall from ceilings or walls. Pike poles come in varying lengths from 3 feet long (closet Pike) to 14 feet.

Prybar: Is a tool consisting of a long metal bar with a single curved end and flattened points. It is used as a lever to force apart two objects.

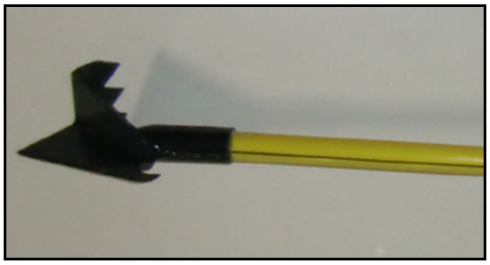
Pulaski: Is a special hand tool used in wildland firefighting. The tool combines an axe and an adz in one head, similar to that of the cutter mattock, with a rigid handle of wood, plastic, or fiberglass. The Pulaski is a versatile tool for constructing firebreaks.

Set of "Irons": Is a Flat Head Axe combined with the Halligan Bar. This tool set is primarily used for forcible entry.

Sledge Hammer: This is a very versatile tool on the fire ground and is primarily a striking tool. It comes with a 28 – 36 inch fiberglass handle with a 6 to 10 pound head.

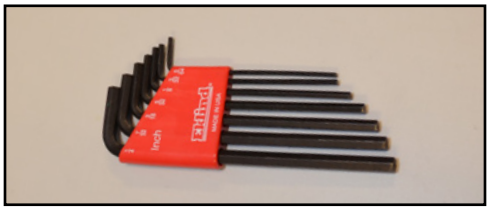
Trash Hook Plaster Hook: There are several different head types that can be used on the end of a pole. Each different attachment has a specific use that it was designed for. Primarily these tools are used for penetrating and removing dry wall.

TOOLS & HOISTING



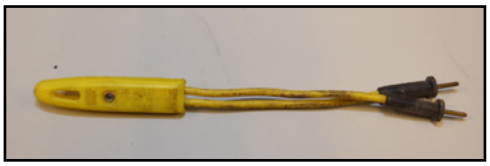
HAND TOOLS

Alan wrench set, hex key or Allen key: Is 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.



Battery Cable Cutters: Are 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.

Circuit Tester: The two-lead circuit tester is used to test for the presents 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.



Hacksaw: Is 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. In normal use, cutting vertically downwards hacksaw blades should be inserted with the cutting teeth facing downwards.

Hammer: Is 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.

Mallet: Is a kind of hammer often made of rubber, plastic or sometimes wood, that is smaller than

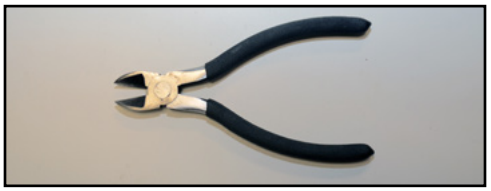
maul. Rubber mallets are used when a softer blow is required. They are typically used to form sheet metal, since they don't leave marks and are softer, as well as for forcing tight-fitting parts together.

Nut driver: Is 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.

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

Clamping pliers (Gas line pliers): are modified locking pliers that can be used to crimp small diameter gas or water line.

Diagonal pliers (or wire cutters, diagonal cutting plier, diagonal cutters or dikes): Are 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.



Lineman's pliers: Are pliers used by electricians primarily for gripping, twisting, bending and cutting wire and cable. Lineman's pliers have a gripping joint at their snub nose and cutting edge in their 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): Are 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.

TOOLS & HOISTING

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 9.5 to 12 inches long—for increased leverage.

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

Screwdrivers: They are 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.

Utility Knife: One of the most popular types of workplace utility knifes is the retractable or folding utility knife. Other utility knifes are also known as a Stanley knife, box cutter or X-Acto knife. 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.

Wrenches

Box end wrench: Is 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): Is 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): Is 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 inches, although smaller and larger sizes are available as well. They are usually made of cast steel.

Socket wrench: Is 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.

Sockets: Are attached to the ratchet through a square fitting (called the drive) that contains a spring-loaded ball detent mechanism to keep the sockets or extensions in place. The drive on the ratchet—which comes in standard sizes of 1/4", 3/8", 1/2", 3/4", and 1" allows a wide variety of socket types and sizes to attach to a given ratchet. Some ratchets have quick release buttons. The ratchet handle supplies the mechanical advantage to provide more torque to loosen or tighten the fastener. Sockets can be either standard or metric sizes.

TOOLS & HOISTING

HANDLED TOOLS

Floor squeegee: Has a long handle like a push broom and is used to remove water from flat surfaces. The blades can be straight or curved.

Push broom and broom: Are 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.

Shovels: Are 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.

Hand shovel blades usually have a folded seam or hem at the back to make a socket for the handle. This fold also commonly provides extra rigidity to the blade. The handles are usually riveted in place. A T-piece is commonly fitted to the end of the handle to aid grip and control where the shovel is designed for moving soil and heavy materials

Round point shovel: The blade is slightly curved for scooping, and the end is round, often curving to a point in the middle. The edges of the blade are beveled to allow the shovel to slice into dirt. Some shovel handles have a D-grip at the top, making them easier to maneuver.

Square nose shovel (Square Pointed Shovel): Are not very effective for digging undisturbed soil. The flat edge does not penetrate the ground as well as the pointed tip of the round-point shovel. The flat edge and shallow basin make the square-point shovel an effective tool to gather and lift loose soil, mulch or rock.

Scoop shovel: Generally has a dished or cupped shape, and typically a fairly square edge, tailored to scooping up dirt or other materials that are already fairly loose and has a much larger capacity than the square nose shovel.

MISCELLANEOUS TOOLS

Crowbar, wrecking bar, pry bar, pinch-bar or sometimes a prise bar, or Gooseneck: Is a tool consisting of a metal bar with a single curved end and flattened points, often with a small fissure on one or both ends for removing nails.

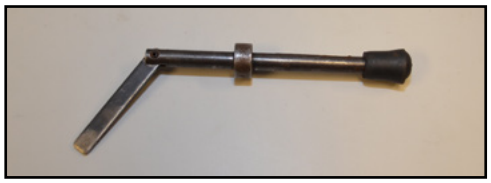
It is used as a lever either to force apart two objects or to remove nails. Crowbars are commonly used to open nailed wooden crates, remove nails, or pry apart boards. Crowbars can be used as any of the three lever classes but the curved end is usually used as a first-class lever, and the flat end as a second class lever.

Dry wall 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.

Elevator key (Drop Keys): Or hoist way door unlocking devices, allow elevator personnel and emergency personnel to open elevator doors by hand.

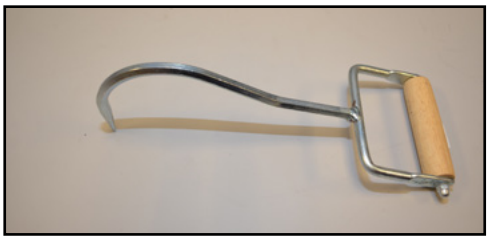


Galvin wrench: is a tool that is designed to be used to open or close the main stem of a fire hydrant. The long handles provide leverage so that water may flow quickly. The five-sided hole in the middle of the wrench corresponds with the shape of the hydrant main stem nut. The box end of the wrench can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

Hammer stapler or hammer tacker: Is a very simple device that has an approximately 12 inch 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.

Hay hook: Is a hand tool that is used for securing and moving loads. It is commonly used for moving burning mattresses in the fir service. 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 jacks: Can be used for extrication, heavy



rescue, forcible entry, and RIT/RIC procedures to lift stable loads, winch loads, clamping, spreading and raising vehicles or other loads when properly chocked and stabilized.

Knox FDC key: Is used to lock and unlock a locking FDC plug or cap.

TOOLS & HOISTING

Spanner wrenches: 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.

Staple gun: Is 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.

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 replaced, 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 30wt motor oil)
- Surfaces should be free of burrs or sharp edges; file off if found

Plated Surfaces

- Inspect for damage
- Wipe plated surface clean or wash with soap and water

BASIC KNOTS AND HOISTING:

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. And, 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, repelling and hoisting equipment.

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 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

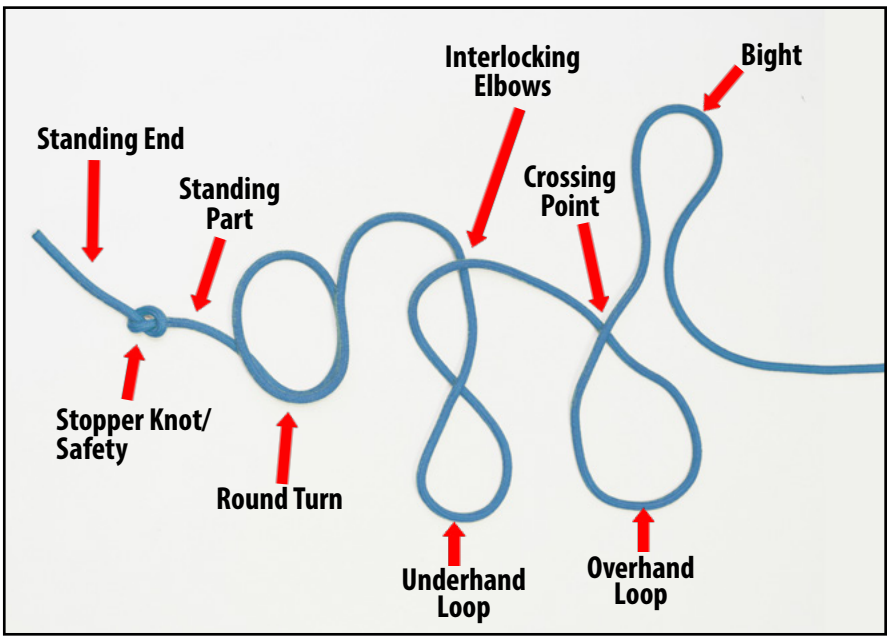
Hitch: Any knot that is used to attach a rope or piece of webbing to a rail, post or similar anchorage point is called a hitch. Hitches can be fixed or running. A fixed hitch will secure itself to its anchorage when loaded while a running hitch allows a controlled release.

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.

Knot: Knots are generally categorized into three different groups depending on their specific function or use. Any knot which does not fall into the category of bends or hitches is referred to as a knot.

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



TOOLS & HOISTING

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 narrower than they are in a bight.

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: Is the process of tightening a knot. Improper setting can cause certain knots to under-perform.

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.

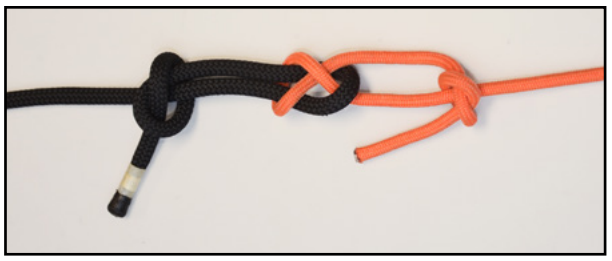
Standing Part: The standing part is the length of rope that lies between the working end and the standing end.

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.

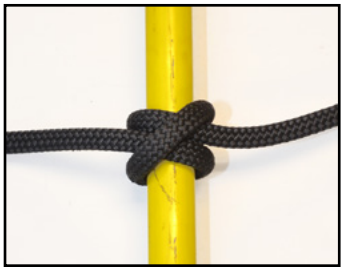
KNOTS

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: It 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.

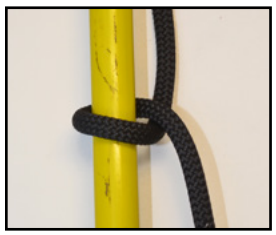


Clove Hitch: The clove hitch essentially consists of two half hitches. It is used to attach a rope to an object, such as a pole, post or hoseline.

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.

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



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: It 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.

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

TOOLS & HOISTING

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 on the handle a few inches above the clove hitch. Tie another 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.

SUMMARY

Like all other tools it is important to know the proper use, care and maintenance. Having equipment in a ready state and knowing how to use the tool effectively and in its proper application can save precious time on the fireground. All firefighters should strive to master the use of all tools carried on a fire apparatus.

POWER EQUIPMENT

Power Equipment

- Stihl Chainsaw
- Stihl Circular Saw
- Gas Blower
- Gas Generator
- Hydraulic Extrication Tools
- Lift Bags
- Reciprocating Saws

SKCFTC 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 tactical objectives. Therefore, the daily morning checks and other required maintenance for this equipment becomes critical because power tools rely on complex engines, electrical systems, and/or hydraulic plumbing to operate.

Power tools operate using gas (unleaded or 2-cycle), electricity, air (pneumatic) or by hydraulic power. Every member must have a working knowledge of each power tool and its general mechanics, maintenance and operation.

The power tools covered in this Section are:

- Chain saw
- Circular saw
- PPV fan (Positive power ventilation)
- Reciprocating Saws
- Hydraulic extrication tool
- E-tool
- Lift bags
- Small gas powered generator

GENERAL OVERVIEW

All power tools on each apparatus must be checked and placed in a ready state during the morning check on a daily basis. All power tools must also be inspected and placed in a ready state after each use.

There are two (2) different types of gas engines used in power tools:

- 2 cycle engine
- 4 cycle engine

Both saws have 2 cycle engines that require a specially blended 2 cycle fuel in order for the engine to properly lubricate itself. All SKCFTC 2 cycle fuel comes premixed from the apparatus shop. **ONLY use the fuel can labeled "50 to 1" to re-fuel saws. Never mix your own two cycle fuel blend.**

All other front line power tools are 4 cycle engines that use a high octane unleaded fuel (premium).

Safety Note!

Personal Protective Equipment (PPE) to be worn while operating power equipment consists of **Eye protection, Hearing Protection, Gloves, Helmet and Structural Fire fighting** coat at a minimum. (Generators excepted)

Stihl Chainsaw

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 on the fire ground to cut through Class A roofing materials (wood and asphalt roof coverings) in order to provide vertical ventilation. Great caution must be used when cutting through any material using a chain saw because a high revving chain can be completely exposed (top and bottom) and any kickback with the saw could cause serious injury.

If a kickback should occur, 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. It becomes imperative that the user properly hold and operate the saw.

When operating the saw, the user must have one hand firmly placed around the wrap around handle, with the other hand firmly holding the throttle assembly handle. When cutting a roof care needs to be taken not bury the entire bar into the roof but only use the top 1/3. Safety precautions must be taken with running saws so that no body parts are endangered.

Engine	2 Cycle
Power Head	044-066
Bar	20" (Roller or Sprocket Tip)
Chain	Carbide tip or wood
Oiler	Fully Automatic
Fuel	50:1 (Stihl 2 Cycle oil only)
Bar Oil	SAE 30 wt
Weight	25 lbs.

Avoid using the saw above your head. The most effective position to operate the saw is below the chest line where the user has good visibility of what they're cutting and they can maintain good control of the saw. Do not let the chain contact anything except the material to be cut. After finishing a cut, shut off the engine and wait for the chain to stop turning before setting the saw down

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

POWER EQUIPMENT

MINIMUM SAFETY PRECAUTIONS

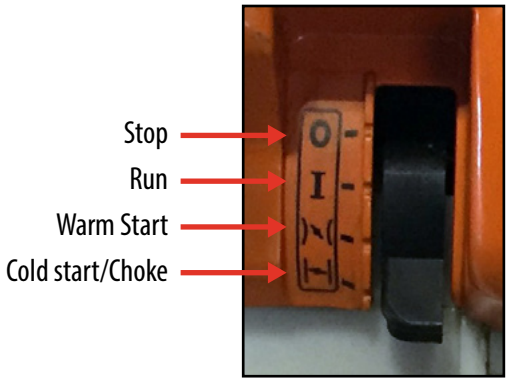
Gloves, Hearing protection, Safety goggles, Helmet, Structural Coat, Chain Brake engaged while moving (not operating) a running saw.

DAILY CHECK

- Fuel (fill at ¾)
- Bar Oil (full)
- Visually inspect the saw for cleanliness, clean or wipe off as necessary
- Extend the starter pull cord fully and inspect for damage or fraying
- Ensure the chain is rotating the correct direction
- Inspect each tooth on the chain, Carbide teeth – replace if missing 3 in a row or a total of 7 teeth
- Check the chain tension and adjust if necessary *only adjust the tension on a cold chain
- Check all working positions of the chain brake
- Store with the Master control lever in the stop position and the chain break off
- **Leaving the chain brake off when starting will allow the user to quickly engage the throttle to assit the motor in starting. The chain brake needs to be engaged anytime the saw is moved.**

WEEKLY RUN

- Retrieve the saw from its riding compartment and place it in a well-ventilated area
- Hold the saw firmly on the ground with the chain in the clear.
- Master Control lever in "cold start position" all the way down and the throttle in the locked on position.
- Make sure chain brake is off.
- Pull the starter cord and as soon as the engine fires move the master control to the "warm start position" one click up.
- Pull the starter cord again and engage the throttle.
- Let the saw run at fast idle for 5 to 10 seconds
- Squeeze and release the throttle trigger to set the saw to idle
- Let the saw warm up at an idle speed for 30 to 60 seconds
- 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
- Once the saw has warmed up, properly hold the saw and slowly rev up the saw to full RPM two to three times
- Check the proper operation of the chain brake



- Check to see if the chain and bar are being properly oiled by revving the saws RPM up and pointing the tip of the bar approximately 4 to 6 inches from a light colored surface. The user should see oil droplets appear on the surface
- At idle, shut off the saw by switching the master control switch to stop
- Flip the master control lever up to the "stop" position. Move master control lever to "Run" position. A hot engine usually can be restarted in run position without choking.
- Once off, place the saw on its right side and check the 2 cycle fuel tank and the chain oil reservoir.
- Refill if necessary. Do NOT overfill
- Once off and re-fueled, leave the master control switch in the stop position
- Dis-engage the chain brake (chain break off)
- Place the saw in its riding position in the proper compartment

STARTING PROCEDURES

- Ensure the saw is set to "choke" (cold start) position.
- Confirm the chain break is forward and engaged
- Place saw on ground and pull the starter rope until the saw begins to run (the master control switch will automatically move to the run position).
- Release the chain break and run the saw at medium/high throttle speed.
- Ensure saw idles well, if not, continue to run it at medium/high speed until it will idle well.
- After running the saw ensure that it is secured with the chain break forward.

THE CHAIN BREAK

Push black handguard on top of saw towards nose of bar to engage the Chain Brake. Do this before moving saw (Critical Safety Factor). When ready to cut, pull handguard towards handgrip to release chain brake. The handgaurd will be in the center position during normal operations.

Chain Brake On

Chain Brake Off

ADJUSTING CHAIN TENSION

- Turn tension-adjusting screw clockwise to increase the chain tension.
- Proper cold tension: As tight as possible without causing binding. Chain tie-straps should remain in contact with bar along bottom rails and move freely along bar.
- Starting with "cold tension", chain will stretch and droop as it heats up, limbers 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.

POWER EQUIPMENT

- Adjustment of "warm chain": tighten until tanks move halfway up into bar groove. Check tension after bar has cooled, because only a cool chain can be tensioned accurately.

REPLACING A CHAIN

- Loosen bar retaining nuts with appropriate tool, then back off bar adjusting screw enough to remove chain from bar. Finish removing nuts and side cover. Remove chain. When reinstalling, be sure carbide teeth on top of bar point towards bar tip, and drive teeth engage drive sprocket.
- Be sure bar adjusting pin is engaging bar properly before installing side cover. Install side cover and nuts, hand tighten.
- With screwdriver or chain saw tool, turn adjusting screw clockwise to take up slack in chain. While turning adjusting screw, always lift up on bar tip with other hand.
- Tighten chain until slack is removed but not so tight that chain cannot be moved back and forth on bar freely.
- When correct tension is achieved, and while holding up on bar tip, tighten nuts to secure bar.

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 amount of unburned fuel in it which will diminish the ability of the spark plug being able to ignite the plug is too "wet". The fuel air mixture will not burn properly. In order to have the best chance of starting a flooded saw, try the following 2-person routine:

- Ensure the saw is set to "run" position.
- Ensure it is not in the "choke" position.
- Place saw on ground and have one person secure it so the second person can pull on the starter rope and hold the saw throttle in the "full on/wide open" position.
- Pull on the starter repeatedly until saw fires (it may take upwards of 20 pulls).
- Do not release the throttle/trigger during this operation -saw will usually attempt to start a couple times, keep pulling starter, and keep holding throttle open.
- Once the saw fires and continues to run (probably poorly at first), continue to hold throttle wide open until saw clears out and runs well at wide open.
- Run saw between idle and wide open for a minute or two, long enough that saw runs well and is no longer spitting gas/oil mixture out of the exhaust. You should see the muffler dry out and burn off all the fuel that was on it.
- Ensure saw idles well, if not, continue to run it at medium high speed until it will idle well.
- Shut saw off and re-start it a few times without "choke" to ensure it is cleared up.
- If saw won't start after 30-40 pulls, let it sit for an hour or 2 and re-try to start.

If it still won't start, follow your Departments procedure for saw repair.

Stihl Circular Saw

Circular saws are a very versatile. They 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.

Kickback can also occur using the circular saw causing a very hazardous situation. To avoid kickback and serious injury, use the following guidelines when operating a circular saw:

- Always use a high speed blade.
- Always use the correct blade for the material you're cutting.
- When operating the saw, the user must have one hand firmly placed around the front handle, with the other hand firmly holding the throttle assembly handle.
- Always have the blade guard in place and adjusted to the correct angle to assist you with your cut.
- Always 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.
- Only use the blade's cutting edge when cutting.
- Always try to cut with the blade fully vertical.
- Make your cuts using only the bottom half of the blade.
- This may require the user to "tilt" the saw down so the bottom of the blade is available

Engine	2 Cycle
Horse Power	6.5
RPM	5,350
Cutting Disc	14" diameter • Aluminum Oxide • Metal • Silicon Carbide • Concrete
Fuel	50:1

POWER EQUIPMENT

to cut with.

SAFETY PRECAUTIONS

- Gloves, Hearing protection, Safety goggles, Helmet, Structural Coat
- 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 blade to shatter.
- If a wheel shatters, carefully examine the wheel guard for damage. A damaged wheel guard must be replaced to protect the operator.
- NEVER use saw to cut asbestos wrapped pipes.

DAILY CHECK

- Fuel (fill at ¾)
- 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 appeared to be worn or rounded.
- 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.

WEEKLY RUN

- Retrieve the saw from its riding compartment and place it in a well-ventilated area - outside if weather permits
- Visually inspect the saw for cleanliness, clean or wipe off as necessary
- Extend the starter pull cord fully and inspect for damage or fraying
- Fully inspect the blade
- Ensure the blade is rotating the correct direction
- Inspect each carbide tip on the wood cutting blade, replace if necessary
- Replace any Fibrous/composite metal and concrete blades with over 20% wear
- Start the saw with the saw placed flat on the ground
- Press the throttle trigger interlock and throttle trigger at the same time and hold. Move the slide control to the choke position and release Interlock and trigger.
- Set the choke lever on for a cold start
- Hold the saw firmly on the ground with the blade in the clear.
- Pull the starter cord until motor engages; do not pull the starter cord all the way to the end.
- When engine first turns over move the choke lever up and attempt to start again
- As soon as the engine is running briefly blip the throttle trigger once
- Do not let the wheel contact anything except

the material to be cut. After finishing a cut, shut off the engine.

- Let the saw run at fast idle for 5 to 10 seconds
- Let the saw warm up at an idle speed for 30 to 60 seconds
- 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
- Once the saw has warmed up, properly hold the saw and slowly rev up the saw to its full RPM two to three times
- At full RPM, ensure the blade is properly rotating and verify there is no unusual saw or blade vibration
- At idle, shut off the saw by moving the slide control to the Stop position
- The blade may continue to spin once the saw is shut off for a long time. To stop the blade from spinning, gently make contact with an appropriate surface to stop the blade
- Once off, check the 2 cycle fuel tank. Refill if necessary. Do NOT overfill
- Once refueled, leave all switches in the off position
- Place the saw in its riding position in the proper compartment

CONTROL POSITIONS

- Press the throttle trigger interlock and throttle trigger at the same time and hold. Move the slide control to the choke position and release Interlock and trigger.
- Set the choke lever on for a cold start

CHANGING A CIRCULAR SAW BLADE

- Use the following procedure to change out a blade on the circular saw:
- Adjust the blade guard in the best position to expose the flange nut
- Use the combination spanner to remove the flange hub nut
- Once the nut is removed, remove the flange hub
- Remove the blade you're replacing
- Install the new blade on the back of the other flange hub
- Ensure the blade is installed so it is rotating in the correct direction
- Replace the other flange hub properly over the blade
- Properly replace the flange hub nut and tighten firmly
- 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

POWER EQUIPMENT

Wood Cutting Carbide Tip Blades

Fibrous/Composite Metal and Concrete Blades

Multi-Purpose Blade

appeared 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 inches, during the cut the blade will erode, when the blade has eroded to less than 8 to 6 inches, 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 satisfactory, 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.

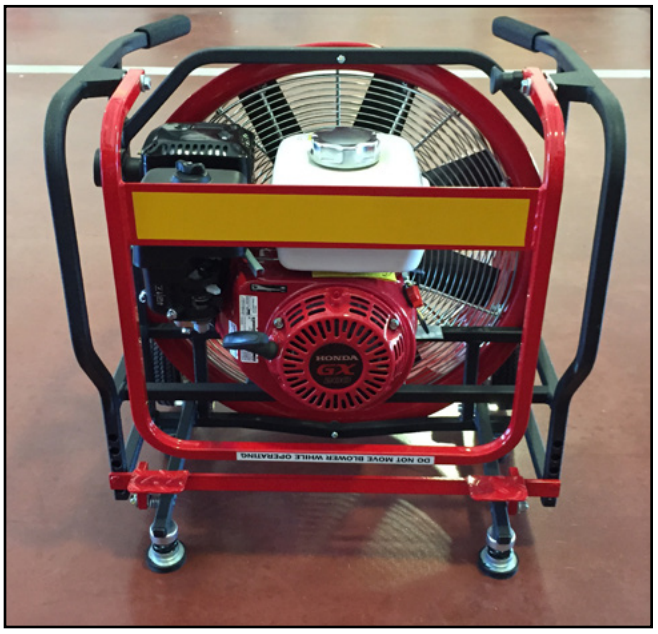
Gas Blower

Gas powered fans are primarily used on the fire ground to provide positive pressure ventilation (PPV). Like any form of ventilation performed on the fire ground, the placement and use of fans around the Incident site must be a highly coordinated activity based on the current critical factors of the event.

Again, do not start a fan unless it has been coordinated by the IC or the Division's Chief. Fans should not be used while the operation is trying to control any concealed space fires until the fire is controlled. Fans should also NOT be used in offensive situations where the location of the fire is unknown.

Fans are very loud and will drown out any nearby radio traffic. Avoid operating fans around areas that will generate any critical radio traffic.

Fans should be place 8 to 11 feet away from the opening you're ventilating and then the fans angle should be adjusted so the fans air pressure fully covers the horizontal opening.



Engine	4 Cycle
Horse Power	4.8-8.4
Fuel	Premium unleaded
Oil	SEA 30 Weight
Weight	85 pounds

Once the building has been pressurized, open or manipulate other horizontal openings throughout the structure to direct the smoke as necessary.

Most PPV fans use Honda 4 cycle gas powered engines with different horse power depending on the fan size. Only use premium unleaded fuel when refueling a fan.

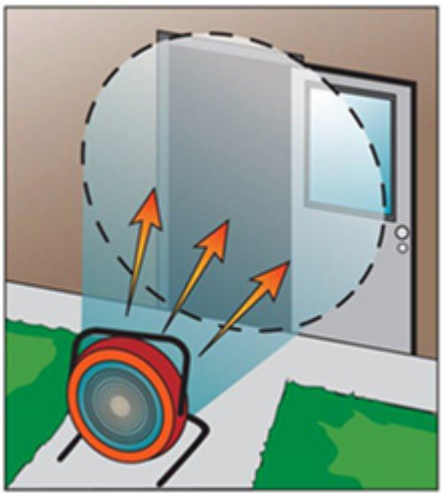
The fuel tank opening and cap are located on the top of the fan. When refueling an adjustable fan, place the fan in its most extreme angle before refueling. This will prevent a full tank from overflowing when the fan is tilted in the field. Always avoid over filling any fuel tank

DAILY CHECK

- Retrieve the fan from its riding compartment and place it in a well-ventilated area - outside if weather permits
- Visually inspect the fan for cleanliness, clean or wipe off as necessary

POWER EQUIPMENT

- Extend the starter pull cord fully and inspect for damage or fraying
- Fully inspect the fan blades for any damage
- Start the fan with the fan placed flat on the ground with its wheels in the locked position
- Turn the kill switch to the "On" position
- Engage the choke knob
- Turn the fuel switch to its "On" position
- Place the throttle in its idle position
- Grasp the starter handle and pull sharply upward a few times until the engine catches
- Push the choke in
- Pull the starter handle again, the engine should start on the next full pulls
- Once the fan has started, adjust the throttle to a medium speed and let the fan warm up for 30 to 60 seconds
- Once the fan has warmed up, rev up the fan to its full RPM two to three times
- At full RPM, ensure there is no unusual fan vibration
- At idle, shut off the fan by switching the contact switch to the "Off" position



- Once off, check the fuel tank. Adjust the fan to the proper angle before checking. Properly refill if necessary. Do NOT overfill
- Once refueled, place the fan in a ready state
- Place the throttle in the idle position
- Place the choke in the "On" position
- Shut "OFF" the fuel
- Place the fan in its riding position in the proper compartment
- Check the oil on a weekly bases

Gas Generator

DAILY CHECK

- Fuel (fill at ¾)
- Oil (within operating range)

WEEKLY RUN

- Plug in scene lights to ensure operation of both generator and lights

STARTING AND OPERATING PROCEDURES

- Open fuel valve, ON
- Control switch in RUN position, no load applied
- Choke fully ON
- Pull the starter cord until engine starts
- As engine warms up, close choke
- After warming up for 1 to 2 minutes, connect AC loads

Engine	4 Cycle
Horse Power	7.8
Fuel	Premium unleaded
Oil	SEA 30 Weight
Watts	4,000
Amps	33.3/16.7
AC Output at 60 Hertz	120 or 120/240 volts

STOPPING PROCEDURES

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

Hydraulic Extrication Tools

SKCFTC member departments mainly utilize two hydraulic tools for extrication, Holmatro and Hurst. Firefighters need to be familiar with each type of rescue tool used by their department. In very limited circumstance you may find a hydraulic rescue tool in your organization that is not covered in this manual, if this occurs please refer to the owner's manual for operating procedures. Below you will find a list of the capacities for each type of tool found in the consortium along with other general information.

DAILY CHECK

- Fuel (fill at ¾)
- Oil (check with dipstick not screwed in)

WEEKLY RUN

- Open fuel valve
- Throttle control switch in CHOKE position
- Pull the starter cord until engine starts

- As engine warms up, move Throttle control to RUN position
- Connect hydraulic hoses to power unit and to tool
- Charge appropriate Manifold valve by moving lever to open position (lever inline with hose) simultaneous tool operation possible, off one manifold or both.
- IMPORTANT: Couplings WILL leak fluid under pressure to prevent lockup. DO NOT leave open butt hoses with power unit running.
- Cutting Unit
- hold blades perpendicular to material being cut to avoid twisting of tool
- Capable of cutting: steering wheels, steering columns, brake pedals, door hinges, nader pins and roof posts.
- DO NOT use on case hardened steel, it damages the cutter blades
- Connect hoses and tools to ensure operational condition

STOPPING PROCEDURES

- Return tools to storage position: Spreader closed, Cutter ½ open, Ram retracted
- Close Manifold valves
- Disconnect hoses and replace dust covers
- LET POWER UNIT IDLE AT LEAST TWO (2) MINUTES AFTER OPERATING TO COOL DOWN.
- Close fuel valve
- Move Throttle control switch to OFF position
- Refill fuel and hydraulic fluid level and fill as needed

STORAGE CONTROL POSITIONS

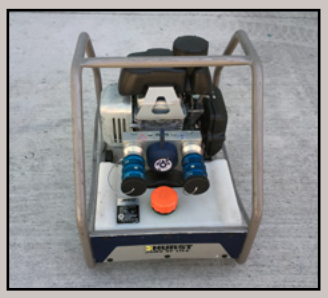
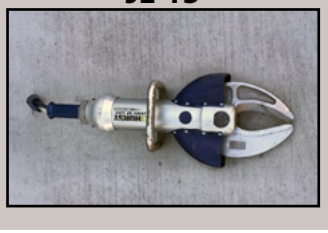
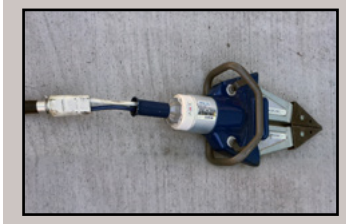
- Fuel shut-off in OFF position
- Throttle control in OFF position

HOLMATRO HYDRAULIC EXTRICATION TOOLS

Power Head 	**Engine**	4 Cycle
	Horse Power	5.5
	Simul-pump	10,500 psi working pressure
	Hydraulic Fluid	Amkus vegetable oil combustible. NOT compatible with Hurst fluid.
	Hydraulic Hoses	2 sections; 30' twinned steel-braided coating
	Hose Couplings Lock	Locking collars on female couplings. Twist left to couple, right to uncouple
	Fuel	Premium unleaded gas
	Oil	SEA 30
Cutting Unit 	**Max Force**	60,000 pounds
	Opening at Center	5 Inches
	Opening at tips	4.1 Inches
	Weight	30.1 pounds
	Control	Twist grip; right to close and left to open
Spreader Unit - Model 30 CX 	**Max Force**	16,950 pounds
	Max Opening	32 Inches
	Weight	47.5 pounds
	Chains	Quick adjust clevis pins, attach to spreader without removing tips
	Control	Twist grip; right to close and left to open
20" Ram with 10" Extension 	**Max Push Force**	30,650 pounds
	Max Pull Force	14,400 pounds
	Length Open	39.1 Inches
	Length Closed	19.3
	Weight	27 pounds

POWER EQUIPMENT

HURST HYDRAULIC EXTRICATION TOOLS

Power Head 	**Engine**	4 Cycle
	Horse Power	5.5
	Hydraulic Fluid	MCS-2361 9 (Phosphate Ester) - is corrosive. Wear eye protection and avoid vapors.
	Hydraulic Hoses	2 sections; 16' Kevlar
	Hose Couplings Lock	Quick couples. Align slot with pin to connect or disconnect. Twist to lock.
	Fuel	Unleaded gas
	Oil	SEA 30
Cutting Unit - JL-15 	**Force at Mptcj**	70,000 pounds
	Force at Tip	25,000 pounds
	Opening at Center	7.25 Inches
	Weight	36 pounds
	Control	Thumb control - right closes, left opens
Spreader Unit - JL -32B 	**Spreading Force**	18,000 pounds
	Pulling Force	18,800 pounds
	Max Opening	32 Inches
	Chains	Quick adjust clevis pins, attach to spreader without removing tips
	Weight	70 pounds
	Control	Twist grip; right to close and left to open
Ram Unit - R410 	**Max Push Force**	30,799 pounds
	Length Open	29.5 Inches
	Length Closed	17.7 Inches
	Weight	28.7
	Control	Twist grip; right to close and left to open

E-Tool Extrication Tool

This battery-powered rescue tool requires no hoses and no power unit. The advantage of the E-tool is that it can be deployed quickly and is still powerful enough to perform most rescues. They are found on various units throughout the consortium and operated similar to the hydraulic powered extrication tools

The E-tool has an easy push button On/Off that is lite when power is on.

Cutting Unit - S700E2 	**Cutting Force**	10,000 pounds
	Opening at Center	77.6 Inches
	Weight	50 pounds
	Control	Thumb control - right closes, left opens

Spreader Unit - SP300E2 	**Spreading Force**	32,000 pounds
	Max Opening	24 Inches
	Chains	Quick adjust clevis pins, attach to spreader without removing tips
	Weight	44 pounds
	Control	Twist grip; right to close and left to open

Lift Bags

Lift bags vary from department on size and amount they can lift. In the SKCTFC you will find Paratech, Vetter and Matt-Jack lift bag systems. As general rule, the adjacent table is what each size bag can lift.

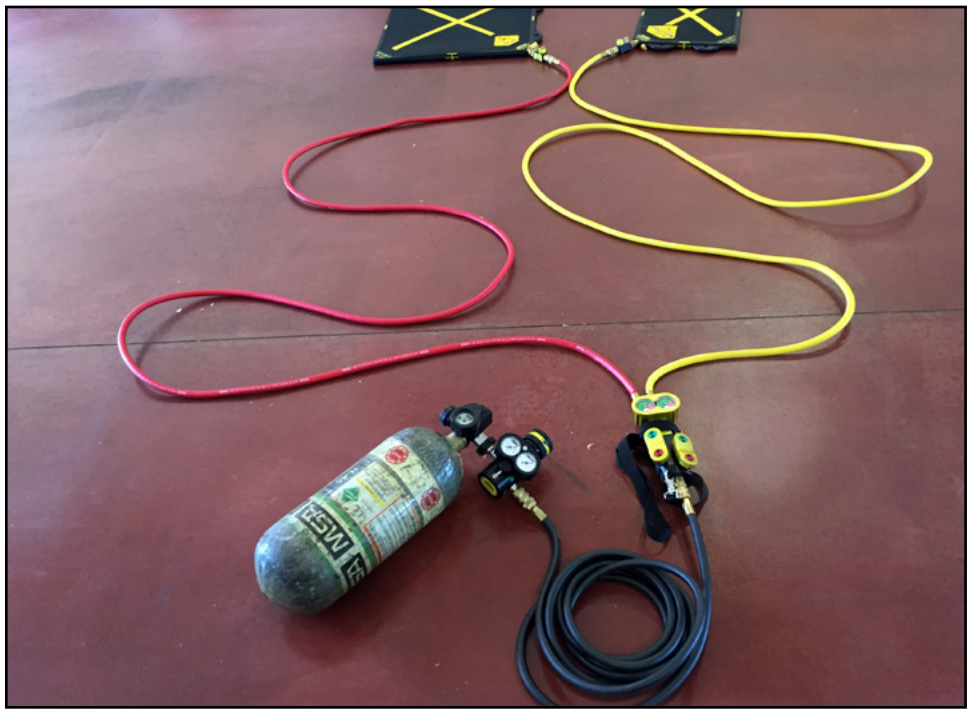
Size	Capacity	Lift Height
6″ x 6″	1.2 tons	3 inches
9″ x 9″	3.3 tons	5.1 inches
12″ x 12″	6.67 tons	5.9 inches
15″ X 15″	10.8 tons	8.2 inches
15″ x 21″	17 tons	9.2 inches
24″ x 24″	38 tons	13.1 inches
28″ x 28″	43.8 tons	15.5 inches

To put these lift ratings in perspective an ecology block of concrete weighs approximately 3,500 lbs. (1.75 tons) and a mid-size car ways just over 2,000 lbs. (1 ton). So you can see that these bags, even the smallest can lift a significant load. Typically, only a few inches of lift may be required to remove or free a victim that is trapped.

AIR 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 air bag operations. The following list of instructions only includes the setup of the unit and does not include placement and lifting.

1. Wears full Bunkers and eye protection.
2. Obtains cribbing and all Lift Bag equipment.
3. Connects Regulator to SCBA bottle.
4. Opens tank valve.
5. Sets regulator at 135 psi with outlet valve closed.
6. Connects supply hose between controller and regulator.
7. Locks all couplings and checks for tightness.

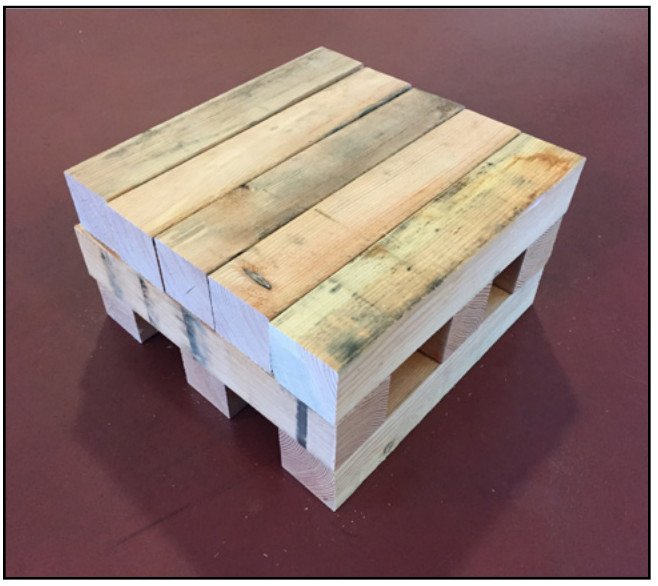


8. Connects supply hose between air bags (2) and controller.
9. Opens regulator outlet valve. Caution – user needs to stay outside of 45 degree hazard zone during Lift Bag operations.
10. Operates controller as needed to reach desired height never stacking more than 2 bags.
11. The pressure at which the relief valve operates is 118 psi.

When lifting sharp edge objects it is acceptable to use plywood on the top and bottom of the air bags.

CRIBBING

Caution needs to be used when lifting and 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 as illustrated below. When the surface is not solid the roundness of the bag can move, as friction is reduced, collapsing the built-up cribbing. Cribbing is also used for safety in case the lift system develops a problem. Building a framework of cribbing as you inflate the bag(s) will prevent the load from returning to its original position. 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.



Reciprocating Saws

Reciprocating saws or "Sawzall's" are found in the Consortium as corded or battery operated. There are a variety of manufactures but they all operate relatively the same. They are very effective for Auto-extrication and during the overhaul phase of a fire.

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 has to 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.

CORDED MILWAUKEE

Length	19'
Weight	7.1 pounds
Voltage	120V AC
Amps	12
Stroke Length	1-1/8"
SPM	3,000

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

Variable Speed	
Weight	9.63 pounds
Battery	Lithium Ion
Stroke Length	1.1"
SPM	2850
Stroke Rate Adjustment	1 (low) - 6 (high)

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.

The Sawzall can use many different type of blades but typically only use a Bi-metal of wood cutting

blade. All Sawzall in the consortium have a keyless quarter turn chuck to remove and install their blades.

Material cutting to stroke rate:

- Wood: 5-6
- Drywall: 3-4
- Steelz: 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 - 1 LED light blinking

Sawsall Blade Chuck

Personal Protective Equipment

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, if exposed to high heat, sustaining thermal insult can be directly related to the level of protection provided by a firefighter's personnel protective equipment (PPE). Therefore, it is critical for the wearer to 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.

DEFINITIONS

Routine cleaning: It involves brushing debris from the clothing, rinsing it 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: 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.

Specialized cleaning: Specialized cleaning occurs when gear is contaminated by chemicals or blood-borne pathogens. When this occurs, the turnouts must go through a specialized cleaning.

PPE Ensemble: A full Personal Protective Equipment (PPE) Ensemble as defined by NFPA consists of 7 separate items that are all worn in conjunction together, prior to entering an IDLH Hazard Zone:

1. Helmet
2. Nomex/PBI hood
3. Jacket
4. Gloves
5. Bunker pants
6. Boots
7. SCBA

THERMAL PROTECTIVE PERFORMANCE

A Thermal Protective Performance Test (TPP): Is a test rating that is required for all structure firefighting gear. The TPP test evaluates the garment material's thermal insulation in the presence of both direct flame and radiant heat. The purpose of the TPP is to measure the length of time that the person wearing the garment or related equipment can be exposed to a heat source before incurring a second degree burn, or skin blistering.

A TPP rating of 35 is required for structural firefighting protective clothing to meet the National Fire Protection Association (NFPA) standards. A 35 TPP rating will protect a firefighter from flashover temperatures (1,000 to 1,200 degrees F) for 12 to 15 seconds before resulting in a 2nd degree burn. All SKCFTCFD PPE meets or exceeds all NPFA standards. All undergarments must be 100% natural fibers.

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

PERSONAL PROTECTIVE EQUIPMENT

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.

Nomex/PBI hood: Made with either Nomex or PBI fibers. This garment protects all of the skin above the coat collar that is not being covered by the SCBA face mask.

Jacket: A turnout jacket consists of 3 main layers; 1) An outer heat shell constructed of a PBI/Kevlar weave 2) A moister 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. A good firefighter will always use red suspenders to hold up their bunker pants.

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.

PERSONAL PROTECTIVE EQUIPMENT

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 fireground contaminants or encountered other hazardous substances. Damage that may be encountered is listed in ***Table 1***.

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 come 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 take 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.

Table 1 - Inspection

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

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 fireground contaminants are carcinogens and skin toxic chemicals. Turnout clothing needs to be cleaned regularly to prevent these problems. Yet, improper cleaning can also destroy clothing or worsen its protective performance.

Table 2 - Cleaning Procedures

Routine 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

Advanced Cleaning

At least every six months, subject clothing to more thorough cleaning; general precautions include:

1. Examine manufacturer's label
2. DO NOT USE Chlorine bleach or chlorinated solvents
3. Use cleaning solutions with a pH range of not less than 6.0 and not greater than 10.5
4. No high velocity water jets such as power washers
5. Clean and decontaminate protective ensembles separately from non-protective items
6. 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 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 sink

Procedures for machine washing

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

PERSONAL PROTECTIVE EQUIPMENT

There are three types of cleaning — routine, advanced, and specialized cleaning defined in NFPA 1851. ***First and foremost, it must be noted that all cleaning starts on the fire ground with gross decontamination. Gross decon is done on the fire ground in large part to prevent firefighter exposures to carcinogens, however, it does, in addition to preventing exposures, reduce degradation and improve the performance of our PPE.*** Routine cleaning is performed after any fireground use where soiling has occurred. It involves brushing debris from the clothing, rinsing it 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 appear in ***Table 2***. Machine washing is best done in a front loading 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.

REPAIR

Turnout clothing can only be repaired by a facility that has experience in repairing turnout clothing or by consultation with the manufacturer. Here again, NFPA 1851 provides some guidelines for field repair and strongly suggests that any outside repair facility be recognized by the clothing manufacturer and uses the proper materials for any repairs. 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 light, especially sunlight, 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. Furthermore, 2013 edition of NFPA 1851 requires that fire departments remove any gear from service that has a manufacture date more than 10 years old. Gear subject to this requirement includes garments, hoods, gloves, boots and helmets.

SUMMARY

Firefighters PPE is the first line of defense against thermal insult. Therefore, it is critical that inspections, routine cleaning and maintenance is consistently completed to ensure the reliability and performance of the ensemble. Firefighters must follow the prescribed procedures for care and maintenance based on the manufacture recommendations. Not doing so can greatly reduce the level of protection.

SCBA

Self Contained Breathing Apparatus

- MSA Air packs
- Scott Air-Pak
- RIT Kits

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 two types (Scott/MSA) of SCBA's currently used by member organizations of the SKCFTC 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 Needs, Air

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

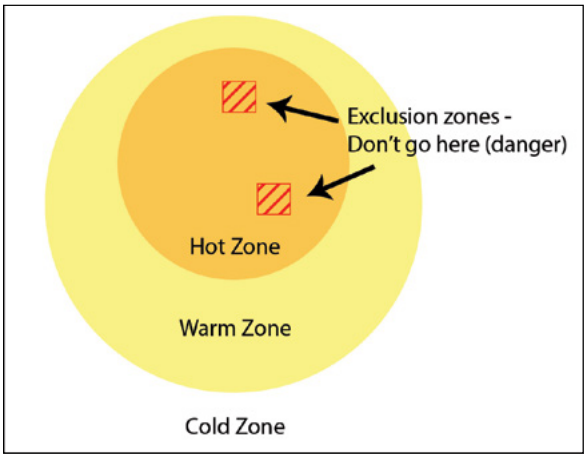
Hazard control zones:

> ***Cold zone:*** The control zone of an incident that contains the command post and such other support functions as are 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 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: Immediate death life hazard

RIT: Rapid Intervention team

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 mask. 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 of the face.

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

In cases where there is a reported failure of a respirator, it shall be removed from service, tagged and recorded as such, and 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 situations insures 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 Haz-Mat, Confined Space and Dive Rescue will be managed specifically within those disciplines. In the SKCFTC, no one De-

SCBA

partment 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 sounding is the culture we are striving for.

WORKING IN A HAZARD ZONE

Companies working on task level objectives 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 maintaining an adequate air supply to safely exit the hazard zone
- Maximum depth into a structure – 175 feet – based on air supply
- 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 a 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 includes location, conditions, actions, needs, air.

- Company Officers shall also give an accountability report (PAR) upon exiting the hazard zone to either the IC or their assigned Division Supervisors.

- 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 SCBA's. Company officers must maintain an 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 air in their SCBA cylinder as well as their rate of air consumption in order to exit the hazard zone prior to their low air alarm activation of the SCBA (25% air left).
- It is critical that all 3 (three) operational levels on the fire ground understand that the initial 75% of a crews air supply is to "enter the hazard area, work in the hazard zone and exit the hazard zone". The remaining 25% 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 insure that they have a full air cylinder. On the fireground, 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 insures the crew has a "round trip ticket" into and out of the hazard zone.
- The maximum depth into an IDHL structure is 175 feet. This is based on air supply times. All members shall maintain orientation and manage the hand lines so that excessive hose is not brought into the structure. This will assist in reducing travel time while following a hose line out of the building when air management is the most critical.

PROGRESS REPORTS

To give a consistent air reading to the Command Officer during your Progress Report, regardless the SCBA your department currently uses, we will no longer give air readings in PSI. We will use the 75+, 50+,50- and 35 format below so the IC will have better idea as to how long your work cycle in the IDLH can be. The goal is to exit the hazard zone during active fire situation with 35% of your air remaining.

Both	Air Report	MSA	Scott	4500 psi bottle	5500 psi bottle
100-75%	75+	4 green LED	2 Green LED	4500-3375	5500-4125
75-50%	50+	3 green LED	1 green LED	3375-2250	4125-2750
50-35%	50-	2 yellow LED	1 yellow LED	2250-1575	2750-1925
> 35%	<35, exiting	1 red flashing LED	1 red flashing LED	< 1575	<1925

MSA Air Packs

COMPONENTS

Carrier and Harness Assembly: Secures the SCBA bottle and evenly distributes the SCBA's weight over the hips for comfort and stability. The composite plastic back plate is reinforced with fibers and features spine strain reduction components. Shoulder straps with easy-release friction buckles and a center-pull waist belt system are designed to be quickly deployed without entanglements.

Air Cylinders are a MSA carbon wrapped, 45 minute rated, 4,500 psi carbon fiber air cylinder (bottle). Average working time is 25 to 30 minutes.

High Pressure Regulator: The first stage regulator reduces the high pressure from the air cylinder to between 85 to 100 psi before delivering the air pressure to the second stage regulator that mounts directly to the face piece.

Mask Mounted Regulator: The respirator is a mask-mounted pressure-demand regulator with a quick-disconnect assembly. The regulator is designed to maintain a slight positive pressure of air inside the face piece whether the wearer is inhaling or exhaling. This helps prevent contaminants from entering the face piece.

The second stage regulator: Features a slide to connect attachment system that allows firefighters to hang the regulator on the face piece in the "ready position", then simply push it into the face piece when SCBA air is needed. There is an emergency bypass (the red knob) located on the right side of the regulator when connected to the mask.

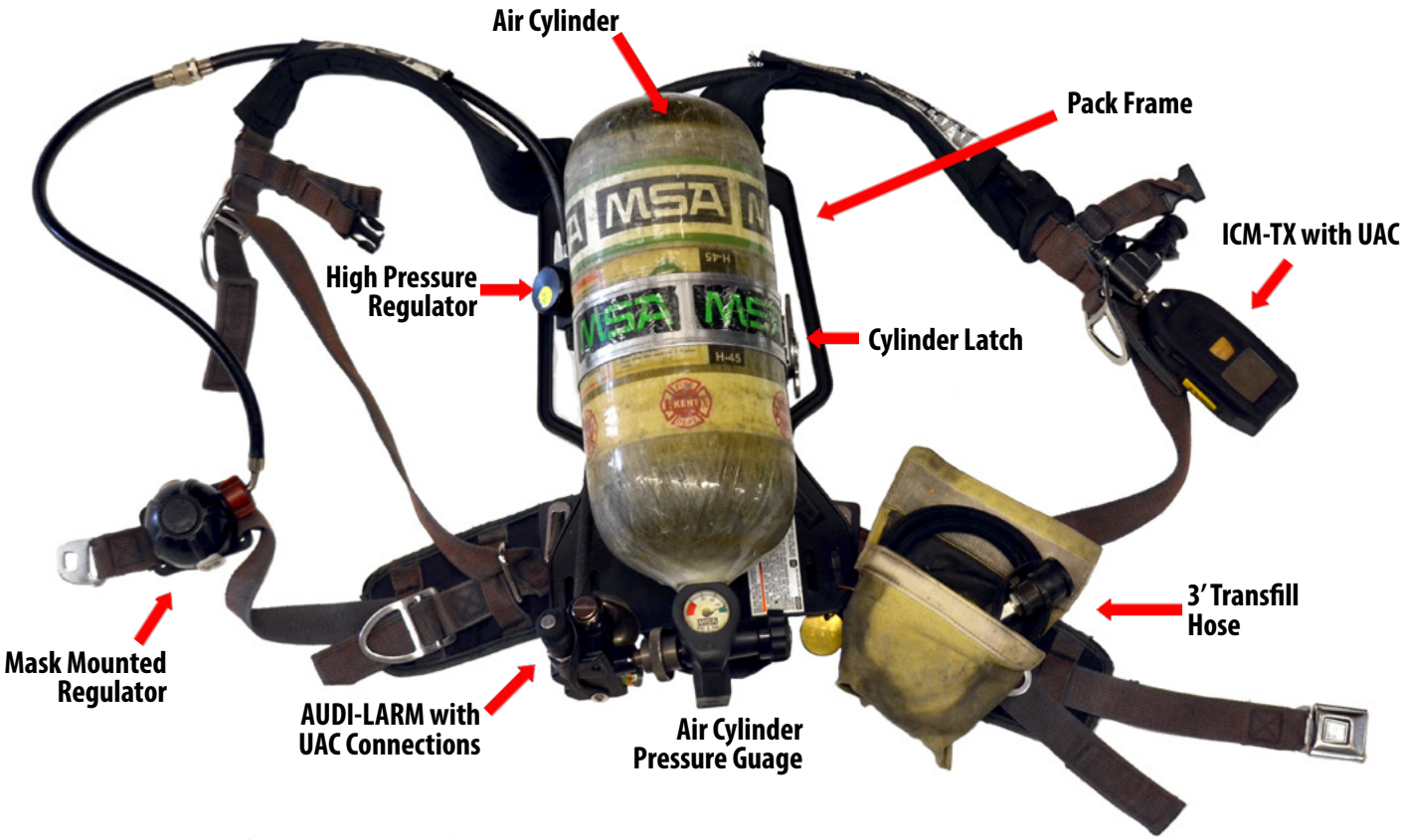
Removing the regulator while wearing gloves is very easy with the two large release buttons that automatically turn off the flow of air as the regulator is removed.

Clear Command Voice Amplifier: The Clear Command Module should be fastened on the "bus bar" located on the left side of the face piece by assuring the thumb screw on the inside of the bus bar is hand tight. To activate the amplifier, depress the On/Off button located on the outside of the Clear Command. A red light will indicate the unit is functioning properly.

Blinking red light indicates faulty battery. Replace batteries by loosening the battery cover thumbscrew. Use only Duracell MN 2400 or Energizer EN92 AAA Alkaline batteries. Replace the cover and hand tighten thumbscrew to prevent water damage. Remove Clear Command when cleaning face piece to avoid water damage.

Heads Up Display (HUD):The Face Piece HUD lights (located outside of the mask) correspond to the Pass Units air pressure display. 4 green lights indicate full to ¾ cylinder, 3 green lights indicate ¾ to ½ cylinder, 2 yellow lights indicate ½ to ⅓ cylinder. Continuous flashing red indicates ⅓ to empty cylinder. Orange light indicates PASS alarm is in pre-alert. Single flashing yellow indicates HUD low battery. Double flashing yellow indicates PASS unit low battery.

AUDI-LARM Alarm with UAC Assembly: The Audi-Larm Alarm rings when there is approximately 35% of the air mask's rated service time remaining and when the cylinder valve is first opened, providing an audible indication that the alarm is working properly. The Audi-Larm assembly includes a UAC Assembly (Universal Air


Air Cylinder
Pack Frame
ICM-TX with UAC
High Pressure Regulator
Cylinder Latch
3' Transfill Hose
Mask Mounted Regulator
AUDI-LARM with UAC Connections
Air Cylinder Pressure Guage


Release buttons
Emergency Bypass


HUD
Clear Command


Mode Button
Digital Display
PASS Reset
Manaual PASS
Heat Sensor
UAC Fitting

SCBA

Connection). The UAC Assembly is a male quickfill inlet for use by Rapid Intervention Crews for emergency filling of the SCBA or during transfill operations. The UAC is capable of giving or receiving transfill air. Also included with the UAC Assembly is a pressure relief valve for protection of the cylinder burst disc.

Universal Air Connection & Trans Fill Hose: MSA users have 2 UAC fittings. One required fitting is located near the cylinder valve as part of the alarm bell assembly. The other UAC is located on the chest mounted harness gauge/PASS device. Both UAC are capable of giving and receiving transfill air. All MSA users carry a 3' transfill hose located in a pouch on the waist belt.

ICM TX Integrated PASS Unit: Combines the features of an integrated PASS Unit, with the functionality of a Heads-Up-Display (HUD). The unit uses 4 AA batteries for power. The battery level of the unit must be verified whenever the unit is put into a ready state.

Manual PASS Activation Button: When the Unit is in the monitor mode, a bright green LED flashes behind the translucent manual PASS activation button. When the PASS goes into full alarm, the light turns red for quick recognition of a firefighter in distress.

The PASS alarm system will start to give the user warning tones that indicate the unit will go to into full alarm in 5 seconds when it remains motionless for over 20 seconds. Simply shake the PASS unit to disarm the pre-alert tones.

The PASS device is also activated into full alarm by holding down the manual PASS activation button for 3 seconds. To deactivate a full alarm, press the yellow reset button that is located on the side of the unit 2 times.

Digital Display: The Pass Unit will display to the user the cylinders current air pressure in 10 psi increments. This pressure should not differ from the bottle pressure gauge by more than + / – 10%. It also displays battery status icon, heat alarm and cylinder pressure icon.

Green Mode Button: When pressed once will activate backlight display and illuminate heads up display (HUD). Press twice to display air remaining in minutes based on current consumption rate calculated after three minutes of use. Press and hold for three seconds to provide continuous HUD display. Press and hold again for three seconds to turn off continuous display.

Heat sensor: The ICM TX has a thermal alarm. It will provide a beep every 3 seconds when activated based on a time temperature curve and the thermometer icon will appear in the display.

PASS Rest button: To turn off the PASS alarm, press this button twice. This button also turns off the pack. To do this, first ensure that the cylinder is closed and that the air is bled. Once this is done, press this button twice turn off.

DONNING & DOFFING

SKCFTC 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 MSA air pack:

- Ensure that the cylinder is fully pressurized.

- Fully open the cylinder valve.
- Listen for Audi Alarm to ring and PASS to activate.
- Don the air pack using either the coat or over the head method
- Bend forward slightly; resting the carrier on the back.
- Attach the chest strap buckle (optional).
- Fasten the waist belt and pull it tight for a snug fit.
- Most of the air mask weight should be carried on the hips.
- Stand up straight. Pull the shoulder strap pull tabs out to tighten the shoulder straps. Additional adjustments to the waist belt may be needed.
- The shoulder straps and waist strap ends must be tucked in and lay flat across the body

Donning the Face piece:

- Loosen all harness straps. Grip the bottom straps. Insert chin into the lower part of face piece, then pull the harness back over the head.
- Pull the back of harness downward until centered at the back of the head.
- Tighten the two lower straps first by pulling them straight back, not out. Tighten the face piece until the mask is snug against the face.
- Tighten the two side temple straps in the same manner.

Check face piece fit:

- Hold palm over face piece inlet.
- Take deep breath and hold for 10 seconds. Face piece should collapse against face. If it does not readjust and try again.
- Test exhalation valve.
- Take deep breath and hold it.
- Block the face piece inlet with palm of hand and exhale. A sharp exhalation of air may be needed to open the valve. If the valve does not release the valve, do not use the face piece.

Connecting the Regulator:

- Orient the regulator so that the bypass knob is pointing to the right and slide button is on top.
- Slide the regulator onto the rail of the face piece cover.
- Insert regulator into face piece inlet.
- Ensure proper engagement by pulling on the regulator.
- Inhale sharply to start airflow.

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

Disconnecting the Regulator:

- Grasp the top of the regulator.
- Push the side release buttons and pull down and out of the face piece.
- Slide regulator up and off the cover rail.

SCBA

- Close cylinder valve.
- Bleed system with bypass valve.
- Turn control module off by pressing the reset button two times.
- Stow the regulator in the belt mounted holder.

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

If a firefighter experiences the loss of supplied air, they must immediately notify their partner if possible to help 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 you are located?
- What are your actions?
- What are your needs?

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

- Open Bypass valve.
- Ensure cylinder is fully open
- If low on air attempt to transfill, following transfill procedures.
- If face piece has failed breathe directly from regulator
- If you have completely run out of air, attempt to filter breathe through your flash hood.
- Disconnect 2nd stage regulator from face piece.
- Pull flash hood upward covering face piece opening.
- Stay close as possible to the floor.

Transfill Procedures:

The air mask with the higher pressure reading is the donor. The air mask with the lower pressure is the receiver. Transfilling between users of air mask should be performed only during life-threatening emergencies or simulated training exercises. Both donor and receiver must return to fresh air immediately following the procedure.

If the donor's alarm is not ringing follow these steps.

1. Remove the 3 foot emergency transfill hose from protective pouch.
2. Remove the rubber dust cover from the female quick fill fittings.
3. Remove the rubber dust cover from the male quick fill fitting.
4. Push the female fitting on the male fitting until they click in place. Pull on the hose to be sure it snapped in place.

5. After 45-60 seconds, pressure between cylinders will be equal.
6. Disconnect quick fill hose by pulling the gray sleeve back on both ends.
7. Return to fresh air.

DAILY INSPECTIONS

The procedure for daily inspections is as follows:

1. Visually inspect air cylinder for physical damage such as dents or gouges in composite wrapping.
2. Check cylinder gauge. Cylinders shall be maintained with no less than 90% of the rated capacity, or 4,050 psi for high-pressure cylinders. When practical, cylinders should be maintained to be as full as possible.
3. Check all hoses, buckles and cylinder restraint for wear and proper function.
4. Check to ensure the Transfill hose is in the pouch located on waist belt.
5. Check that the release buttons are pushed in and the bypass valve is closed.
6. Slowly open cylinder valve fully. Listen for the Audi-larm to ring then stop, and the PASS device to activate.
7. 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.
8. Inspect second stage regulator for damage and ensuring that regulator gasket is in place.
9. Close the cylinder valve. Watch harness pressure gauge. Pressure must not drop more than 100psi in ten seconds.
10. Open Bypass valve and listen for air released from the regulator
11. Observe the lights of the HUD and verify that they light properly in descending order. Close the Bypass valve when the gauge needle crosses the "¼" mark but before the beginning of the red "EMPTY" band
12. Ensure the Audi-larm rings and the HUD displays one red continuously flashing LED.
13. After verifying that all alarms are functioning, open bypass valve to remove air from the system. Turn off PASS alarm, by pressing yellow reset button twice. The PASS alarm will sound indicating that the alarm is now inactive.

AFTER USE INSPECTION

The "after use inspection" shall be performed each time an SCBA is used.

1. Breathing apparatus must be thoroughly cleaned and disinfected prior to inspecting unit to avoid contact with hazardous contaminants.
2. A after use inspection is identical to a daily inspection however with the below additional (indicated by **) inspections included:
3. Visually inspect air cylinder for physical damage. Check cylinder gauge ensuring proper pressure.
4. Check all hoses, buckles and cylinder restraint for wear and proper function
5. Check that the release buttons are pushed in and the bypass valve is closed.
6. Pressurize the system by opening cylinder valve. Listen for the Pass Device to activate and Audi-larm ring briefly.
7. Compare cylinder valve and harness gauge. Readings must be within +/- 10% of each other.
8. 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.

SCBA

9. Reset PASS alarm by shaking the Pass device.
10. Again remain motionless until full alarm activates.
11. Reset the PASS alarm by pushing YELLOW reset button twice.
12. Check the manual activation of the PASS device by pushing the RED manual button on the front of the unit.
13. Reset the PASS alarm.
14. Inspect second stage regulator for damage and ensuring that regulator gasket is in place.
15. Don face piece. Inhale sharply to automatically start the flow of air. Breathe normally from face piece to ensure normal operation. Depress the release buttons to stop the flow of air.
16. Close the cylinder valve. Watch harness pressure gauge. Pressure must not drop more than 100psi in ten seconds.
17. Open bypass valve and listen for air released from the regulator.
18. Observe the lights of the HUD and verify that they light properly in descending order. Close the bypass valve when the gauge needle crosses the "¼" mark but before the beginning of the red "EMPTY" band.
19. Ensure the Audi-larm rings and the HUD displays one red continuously flashing LED.
20. 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:

21. Remove the mask mounted regulator from the face piece.
22. Unthread the thumb screw of the HUD and remove from the face piece bracket.
23. Remove the Clear Command Communication System.
24. Thoroughly wash the face piece (and nosecup) in the cleaning solution. A soft brush or sponge can be used to clean the soiled face piece.
25. Rinse the face piece and components in clean, warm (110°F) water (preferably running and draining).
26. Clean the pressure-demand exhalation valve by pressing in on the stem with a blunt object and flushing it with clean water.
27. Allow the face piece to air dry. Do not dry the parts by placing them near a heater or in direct sunlight. The rubber will deteriorate.
28. Operate the exhalation valve by hand to be sure it works properly.
29. Insepect and re-attach the HUD, tightening the thumbscrews finger-tight.
30. Re-attach Clear Command Communication System tightening the thumbscrews finger-tight.
31. Thoroughly dry the face piece and regulator after cleaning and disinfecting. The face piece can trap water, which could enter the regulator.

In general, only the face piece requires cleaning and disinfecting after each use. If the air pack is soiled (i.e. heavy smoke residue or dirt accumulation) use a sponge damp with mild soap solution or use a soft/medium bristle brush to thoroughly clean:

- Harness (straps and buckles)
- Cylinder Carrier (band and latch assembly)
- Cylinder (handwheel, gauge, outlet

connection)
- Audi-Larm Alarm (bell and coupling nut connection)
- ICM TX Pass Device.
- First Stage Regulator.
- Firehawk Second Stage Regulator. Cover the outlet of the Firehawk Regulator to prevent water, dirt, or debris from entering.

SCBA

Scott Air-Pak

The consortium currently uses too different models NxG7 Model 5.5 and the NxG2 4.5-

COMPONENTS

Face piece: The AV-3000 Facepiece 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 by pass
- VIBRA ALERT alarm
- Regulator lock button
- Heads Up display

The EZ Flow regulator will be referred to as the mask 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 SE 7: The PAK-ALERT (PASS) alarm is used to assist 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 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 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 pre-alarm, movement must be generated in the pack frame (sway your hips). Moving the PASS alarm will not reset the alarm.

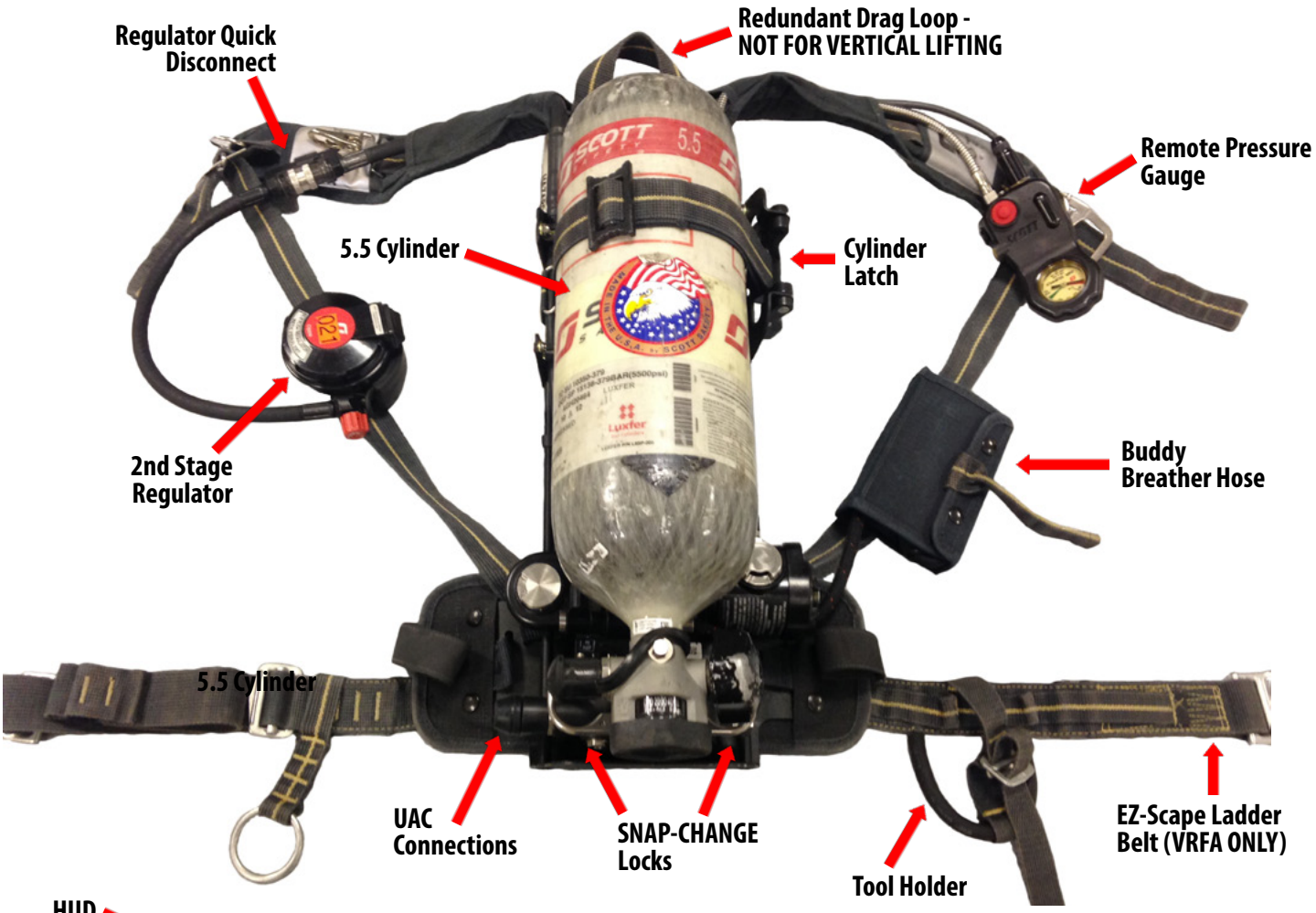
Full Alarm Tones: If the sensor module remains motionless through the 12 seconds of progressing pre-alarm cycle, the PASS alarm will go to full alarm. This is indicated by a continuous flashing red panel lights (See Fig. 6) and 3 tone chirps. Press the YELLOW reset button twice to restore to normal operation.

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

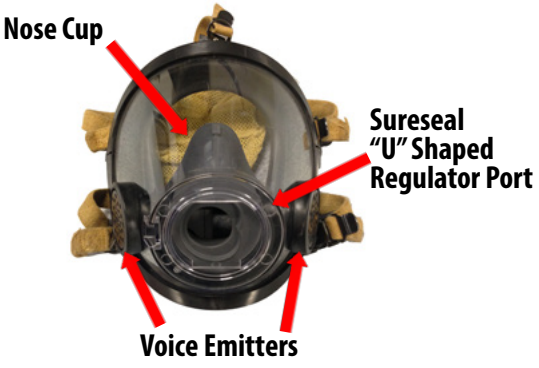
VIBRALERT: The Vibralert® alarm device activates both during a low-cylinder condition and/or during failure of the primary pressure reducing valve. Vibralert's gentle vibration minimizes the chance the user's alarm will go unnoticed or be confused with another SCBA. A clicking vibrating alarm will begin to sound when the bottle pressure reaches 1375 psi or 25% of its rated capacity.

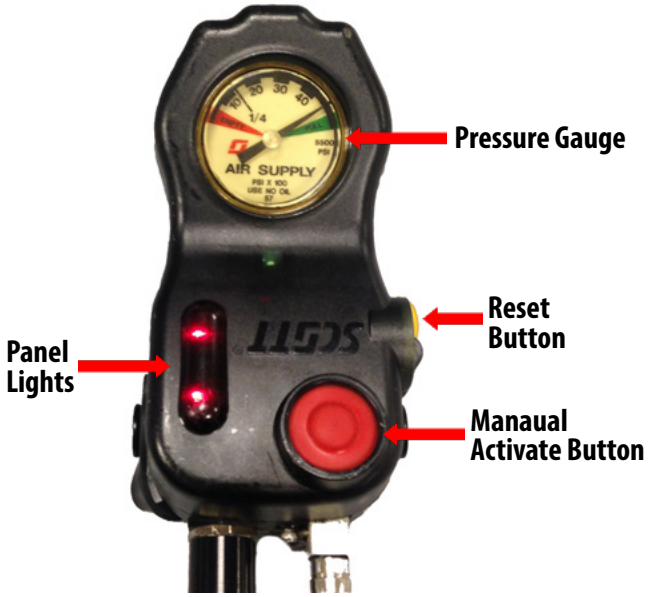
Purge Valve: The purge valve is situated at the inlet of the breathing regulator and can be ad-

SCBA


Regulator Quick Disconnect
Redundant Drag Loop - NOT FOR VERTICAL LIFTING
Remote Pressure Gauge
5.5 Cylinder
Cylinder Latch
2nd Stage Regulator
Buddy Breather Hose
5.5 Cylinder
UAC Connections
SNAP-CHANGE Locks
Tool Holder
EZ-Scape Ladder Belt (VRFA ONLY)


HUD
Air Saver Button
Lock Button
Purge Valve


Nose Cup
Sureseal "U" Shaped Regulator Port
Voice Emitters


Pressure Gauge
Reset Button
Panel Lights
Manaual Activate Button

SCBA

justed 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.

Users must immediately exit to fresh air.

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 sun light and battery saving dimmed LED in areas with no or little ambient light source.

Universal Air Connection (UAC): Per NFPA 1981 (edition 2007), 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 used for ONLY filling depleted SCBA cylinders.

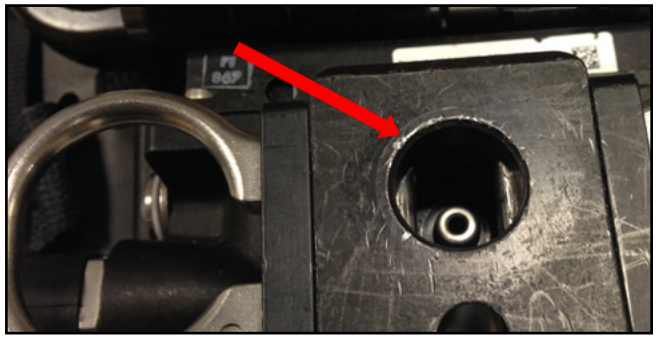
The UAC manifold is fitted with a relief valve to bleed air if the rated pressure of the respirator is reached. UAC has one way check valve for receiving transfill air only. Not capable of providing air to other users.

Air Cylinders: SCOTT has created two types of 5.5 bottles for fire department use: a quick connector style and 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 RIT 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

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

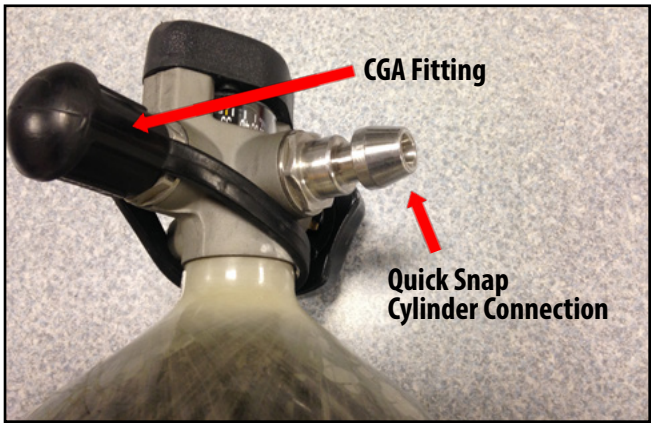
away from the pressure reducer to release the cylinder connector.
- Remove the cylinder from the back frame.
- Inspect the high pressure seal in the inlet. If the high pressure seal is damaged or missing, remove the air pack from service.



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 CGA (Compressed Gas Assoc.) 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 types of SCBA bottles are for specific uses. Filling of each composite bottle is slightly different.

DONNING & DOFFING

SKCFTC 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 ½ 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 strap is located on the left-hand side of the body.
- Pull the waist adjustment strap forward to tighten.

SCBA

Donning the Face piece:

- Hold the face mask by the lens and strap at base of head net.
- Place chin in first and pull net over your head.
- Tighten neck all straps.
- Tighten temple straps.
- Check for negative pressure seal by covering the exhalation hole with your hand and breathing 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 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 insure all PPE is properly in place before entering the hazard zone.

Disconnecting the Regulator:

- To stop flow of air, press Air Saver button located at 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

If a firefighter experiences the loss of supplied air, they must immediately notify their partner if possible to help 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 you are located?
- What are your actions?
- What are your needs?

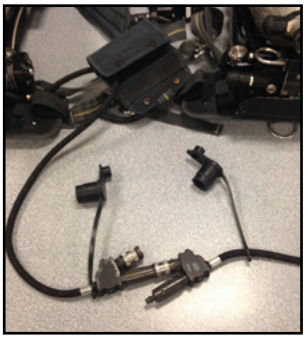
The distressed firefighter should also begin the following corrective steps to remedy the problem:

1. If you are not getting any air check your purge valve.
2. If the purge valve does not work check to ensure your bottle is turned on.
3. If you are low on air but still getting air with a properly working SCBA, you should attempt to buddy breath from a donor.
4. If your mask has become damaged you can breathe directly from the second stage regulator.
5. 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.

6. The last option if you have depleted your air supply, attempt to filter breath by pulling your flash hood over your face mask opening.



7. Stay 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.
8. Buddy breather (aka Emergency Breathing Support System)
9. The EBSS can be used in three different operations:
   - EBSS to another air pack (i.e. due to low air pressure).
   - EBSS to a SCBA mask (i.e. high pressure air leak).
   - EBSS to a 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:

SCBA

1. Remove EBSS hose from SCBA pouch.
2. Locate receiving firefighter's 2nd stage regulator connection adapter.
3. Use quick disconnect to remove 2nd stage air line 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 now 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 of the lowest pressure first to 100psi, 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 is 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 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 ensuring that regulator gasket is in place. NOTE: cleaning of the regulator gasket with Wesco dyne solution is recommended.
- Push in and rotate cylinder handle to close. Watch harness pressure gauge. Pressure must not drop more than 100psi in ten seconds.
- Open purge valve (counter clockwise with tab facing downward) and listen for air 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 "¼" 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 ten (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 that the alarm is now inactive.
- Inspect the face piece seal and other rubber components for deformation, wear,

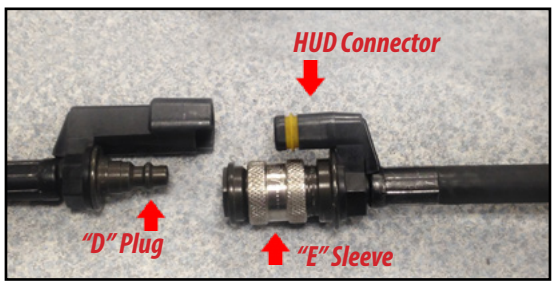
deterioration, dirt, cracks, tears, holes, or tackiness.
- Check the harness head straps for breaks, loss of elasticity, missing buckles and/or straps. Ensure the head harness straps are oriented correctly
- Inspect the lens for cracks, crazing, bubbling, deformation, discoloring, gaps or holes. Any evidence of the following damage the face mask MUST be removed from service for further inspection by a Respiratory Specialist.

NOTE: In December 2012 the NFPA released a safety alert regarding possible rapid failure of face masks which have been subjected to repeated exposure of heated conditions. (See photos below)

NOTE: SCOTT AV-3000 Face pieces are fitted with a Nose Cup which fits in front of the face seal. The Nose Cup must be fitted IN FRONT OF the Face Seal as shown in (See Fig.7)

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



- Check all hoses, buckles and cylinder restraint for wear and proper function
- Check that the air saver button is pushed in and the purge valve is closed (rotate knob clockwise with tab facing upwards).
- 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 displaythe above corresponding lights as well.
- Disengage the quick disconnect fitting located on the second stage regulator air line. While pushing the plug "D" into the socket, pull the locking sleeve "E" back toward the guard. The plug "D" will separate.
- 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.
- 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.
- Slowly open cylinder handle 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 indicting 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.
- Remain motionless for approximately 20

SCBA

seconds; listen for PASS device pre-alarm to sound and for the green lights to change to a slow alternating flashing red light.

- Reset PASS alarm by shaking the SCOTT pack frame.
- Again remain motionless until full alarm activates. Listen for distinctive increasing continuous 3 tone chirp to sound and the red light to flash rapidly.
- Reset the PASS alarm by pushing YELLOW reset button twice.
- Check the manual activation of the PASS device by pushing the RED manual button on the front of the unit.
- Reset the PASS alarm.
- Inspect second stage regulator for damage and ensuring that regulator gasket is in place. NOTE: cleaning of the regulator gasket with Wesco dyne is recommended.
- Don face piece. Inhale sharply to automatically start the flow of air. Breathe normally from face piece to ensure normal operation. Depress air saver button to stop the flow of air.
- Push in and rotate cylinder valve to close. Watch harness pressure gauge. Pressure must not drop more than 100psi in ten seconds.
- Open purge valve (counter clockwise with tab facing downward) and listen for air 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 "¼" mark but before the beginning of the red "EMPTY" band.
- 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 ten (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 that the alarm is now inactive.

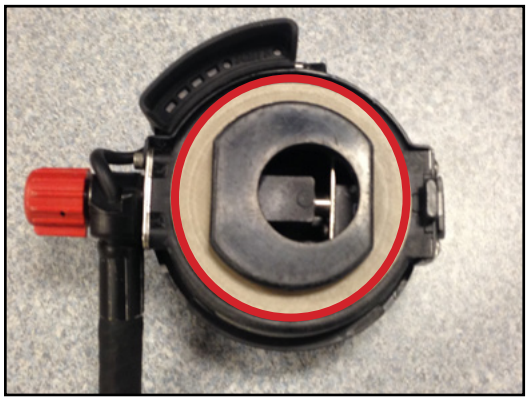
CLEANING AND DISINFECTING

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 Wescodyne disinfectant / cleaning solution and rinse with clean water.
3. Thoroughly wash face mask with the Wescodyne disinfectant / cleaning solution.
4. Rinse face mask thoroughly inside and out with clean water not exceeding 110 degrees Fahrenheit.
5. NOTE: Hot water in excess of 110° can change the shape of some components.
6. Dry the face mask with a clean lint 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.
7. 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 2nd 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.



Wet all areas within the red circle

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 of the MMR, lightly spray the immediate surface area of the regulator opening with the Wescodyne 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 or elastomeric bumper distorted, and 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 and/or 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:

- Remove the cylinder from the SCBA.
- Check hydrostatic date and condition of bottle.
- Record the bottle number, date and condition in cylinder log book at each filling station.
- Place cylinder into the fill station containment chamber and remove CGA rubber protective cover.
- 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.
- Slowly fill the cylinder until it reaches 5500 psi.
- Remove fill hoses and replace cylinder into SCBA.

The pressure of a filled cylinder 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, and so heat

SCBA

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 120oF (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 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.

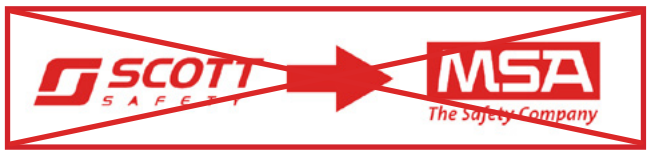
All in service SCBA cylinders shall be maintained with a minimum of 90% air fill capacity. (4950 psi for 5500 rated cylinders and 4050psi for 4500psi rated cylinders)

RIT Kits

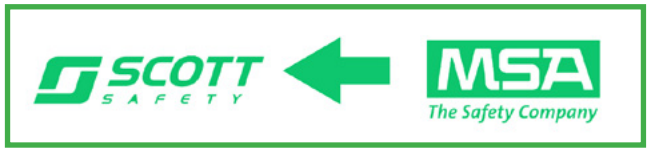
The SKCFTC members use two different manufacturers SCBA, Scott and MSA. This section is intended to provide users basic information on both makes of SCBA regarding emergency procedures and compatibility in order to provide assistance during mutual aid responses.

Scott NxG7 Safety Features: Scott uses a Buddy Breathe system that allows more than one Scott user to breathe from one Scott SCBA in the event of SCBA failure or loss of air. This 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 NxG7 section for more detail on buddy breathe system.

All SCBA (regardless of manufacturer) have a NFPA required Universal Air Connection (UAC) located within 6" of the cylinder valve. The Scott NxG7 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 a MSA user equipped with transfill hose or a RIT pack with transfill hose.



Scott Air Paks can never donate to MSA



An MSA pack can donate to a Scott Air Pak, but only with an MSA transfill hose.

MSA RIT KITS

MSA RIT Pack: Consists of complete air pack with mask , transfill hose and 45 minute rated 4500 psi cylinder. Transfill capability is compatible with Scott users.

Scott 5500 psi Transfill with MSA 4500 psi Safety Concerns: SKCFTC Scott users (exception of Maple Valley uses 4500 psi) use 5500 psi 45 minute rated cylinders. All MSA users have 4500 psi 45 minute rated cylinders. To avoid potential over pressurization of cylinders **do not attempt to transfill from cylinders pressurized greater than the receiving cylinders rated pressure.** If you are using a Scott 5500 psi bottle to transfill to a MSA 4500 psi bottle, bleed the Scott bottle down to 4500 before attempting to transfill.

SCBA

SCOTT RIT KITS

The SCOTT RIT PAK 3 is intended for use by a Rapid Intervention Team (RIT) as an emergency source of breathing air to supply air for personnel as they are being evacuated from an IDLH environment. The SCOTT RIT PAK 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.

Exterior Remote Pressure Gauge:

The SCOTT RIT 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 2nd Stage regulators.

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

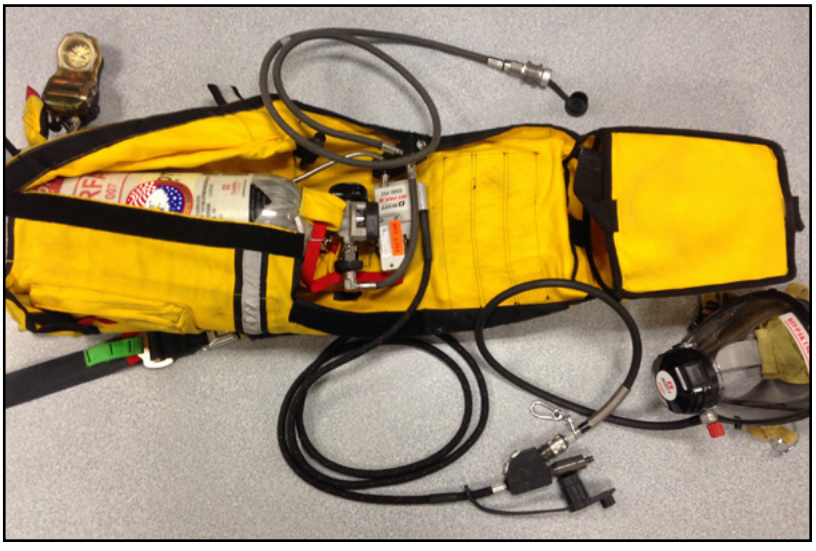
Transfill Extension Hose (length may vary by department): The transfill extension hose is located in the front pouch of the VRFA RIT kit. This hose contains a male and female coupler located on either end. The extension hose can be used to provide air supply by:

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

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

Low and High Pressure Air Supply: The SCOTT RIT 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 mostly 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 mostly 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 RIT team will need to determine the most beneficial choice for the distressed firefighter.

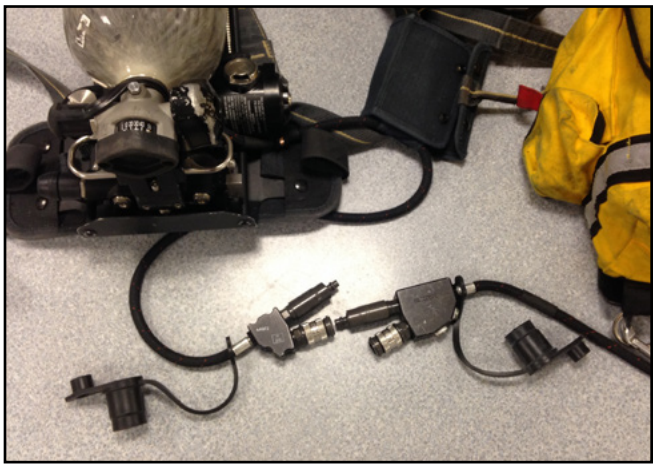
LOW PRESSURE SUPPLY (EBSS): The EBSS extends from the 1st Stage Reducer to a dual manifold with both male and female quick connect couplings. The RIT kit EBSS can be used in two emergency operations:

- EBSS to another air pack (i.e. due to low air pressure).
- EBSS to a victim firefighter's SCBA mask (i.e. high pressure air leak).

NOTE: The EBSS hose MUST be disconnected from quick connect adapter prior to either of the operations listed above.

EBSS hose Breathing Operation:

1. Turn on RIT Pack air bottle
2. Locate buddy breathing connection (dual EBBS) on compromised firefighters SCBA



Disconnect face mask prior to attaching EBSS hose

3. Locate buddy breathing connection (dual EBBS) from RIT Pack
4. Make connection (you will breath from low bottle first)

RIT kit EBSS to victim's EBSS

5. If firefighter is conscious and able to self-extricate leave structure
6. If the firefighter is unconscious and unable to self-extricate, leave connection in place and secure RIT pack to FF for packaging / extrication.

EBSS to Regulator Disconnect Operation:

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

SCBA

High Pressure Supply (Transfill): The Transfill hose extends from the 1st Stage reducer and is equipped with a coupling which fits all air packs that contain a UAC system (Universal Air Connection).

Connect ing to a UAC fitting

UAC transfilling:

1. Turn on RIT Pack air bottle.
2. Locate transfill connection (UAC) on compromised firefighter's SCBA.
3. Locate transfill hose from RIT 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 RIT pack to firefighter for packaging and extrication.

Emergency Air System: The SCOTT RIT PAK3 can be used to provide air to a victim whose air pack has completely failed or has lost its air supply entirely. The SCOTT RIT PAK3 operates similar to the SCOTT air packs however it has significantly different safety features suited for rescue purposes only. These features include:

SCOTT Model AV 3000 facemask: The SCOTT RIT facemask does not contain a nose cup or voice emitters. It also has a specially designed head harness for easier installation.

2nd Stage Regulator: The SCOTT 2nd Stage regulator does not contain a HUD display. The visual air level display is located on the remote pressure gauge as mentioned earlier.

The SCOTT RIT PAK3 Vibralert: Does not activate for low air warning, instead contains an audible bell alarm to indicate 10% bottle level remaining.

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 RIT 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 face mask from RIT kit.
4. Place face mask 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 RIT 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

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 entering for non-emergent issues, proper care should be given to the amount of damage caused from forcing entry and other factors, such as securing the building after the alarm is cleared. The correct level of force needs to be applied 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 inch flat blade located on the same side of the Halligan as the pike.

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 deadbolts. Usually square or round that slidesinto 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. 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 doorframe that prevents the door from winging 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 doorframe. 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 of adz. The wedge has a split in the middle that makes the fork.

Gap the Door: The initial opening made in the

door and or frame to create a purchase point.

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

Halligan Hook: Available in 4', 6' and 10' lengths, steel shaft hook, with a distinct shaped head and is commonly referred to as a "Halligan Hook" or "NEW YORK HOOK"

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

Inward Swinging Door: Door that swings AWAY from you.

Irons: Set of forcible entry tools, usually 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 doors.

Key Tool: A set of tools used in conjunction with K-Tool/Rex Tool for manipulating internal lock mechanism after the cylinder has been pulled.

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

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.

Outward Opening Door: Door that swings TOWARD you.

Pike: On the same end of the Halligan as the adz there is a 4 inch metal spike called a pike. The pike is at 90 degree angle to the adz.

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".

Shoulder: The topside of the fork end at the shaft. The joint where the forks attach to the shaft of the Halligan is ground down to make a 90 degree angle. This is an acceptable industry standard of tool modification. It 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.

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.

Wood Wedge: A simple wood wedge used to capture progress while prying. They also can be used in conjunction with a Halligan to increase the range.

SIZING UP THE DOOR

Determine basic construction and direction the door opens

Basic 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

FORCIBLE ENTRY

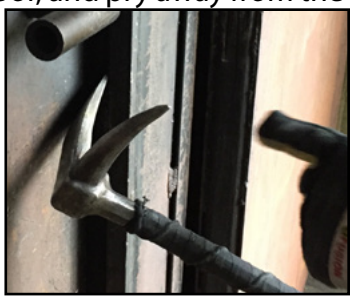
Inward Swinging Door

Outward Swinging Door

FORCING - INWARD SWINGING DOOR

Try before you pry. Use the Shock-Gap-Set-Force method forcing entry through an inward swinging door.

1. Size up the door, looking for a safety hazards. "Shock" the door to identify locations of locks, and initiate the "gap". Set your adz between the stop and the door, and pry away from the pike to "gap" the door.



2. "Set" your forks with the bevel towards the jamb. Work in conjunction with the striking FF to "set" your forks to the proper depth. The communication between the Halligan FF and the striking FF is; Strike (single hit), Drive (continuous hits), Stop, and Wedge. While working together to "set" the forks be sure to cross your tools and keep your hands off the outside of the Adz. The proper depth for the forks is when the "arch" is even with the backside of the stop.

3. Once the Halligan is in position, with open palms push the Halligan towards the door. Once you have reached your max throw call for a wedge. This is where the striking FF captures your progress with either a wooden wedge or the blade of the axe.

4. If the door does not open, place bevel towards the door and set the forks to the crotch. Push Halligan towards the door. If the door does not open, capture with a wedge.

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

Once the door is forced allow it to swing open to make sure there isn't a victim behind it. While the door is open get low and sweep the immediate area to check for victims, layout of the building,

and conditions. Once you have that information control the door by grabbing it with the adz on your Halligan. Open doors are ventilation points, and must be controlled until fire attack operations are ready.

OTHER METHODS

Another option for forcing an inward door is the sledge hammer. Using the sledgehammer as a battering ram or swinging it as you would an axe and striking the door on or near the locking mechanism maybe all that is required. Stouter doors may require more than one strike.

If you find yourself without a tool and opt to kick the door in, the mule kick is more effective and safer than kicking the door with a straight kick. Unlike the movies don't ram a locked door with your shoulder. This will most likely injure your shoulder or put you in the fire compartment.

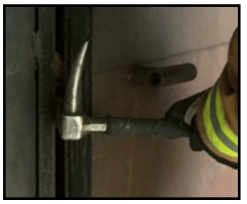
Some residential exterior doors have a window panel next to it. Taking the glass and reaching through can be a quicker option and cause less damage to the structure. Remember, removing glass increases the flow path and should be done in a coordinated manner.

FORCING - OUTWARD SWINGING DOOR

Outward swinging doors are used in commercial occupancies and for most exits to aid in allowing people to rapidly leave the building in an emergency. They typically have their hinges exposed which can be used in your size up and possibly removed to make your 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 have your partner drive the adz in on your command of "strike" with the back of the flat head axe further into the gap. It might be necessary to pry the Halligan up and down to "crush" the door inward to provide a bigger space for the adz to set in.
3. Once you have ensured the adz is set at the proper depth and is grabbing the backside of the door. Pull the Halligan towards you to force the door. Be aware of any trip hazards the might be behind you before you force the door. As stated above control the door and don't create uncoordinated ventilation points.



FORCIBLE ENTRY

PANIC HARDWARE/SECURITY

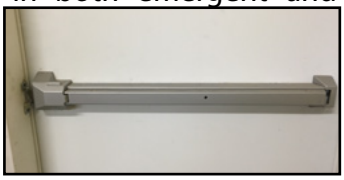
Some doors will have security measures that will be a challenge and require other techniques to open.

Before you can open this door the padlock on the gate will need to be removed. Cutting the padlock with bolt cutters is not recommended as the padlock hasp is made of harden steel. Using the pike of your Halligan and striking downwards with the flat head axe will typically pop open a padlock.

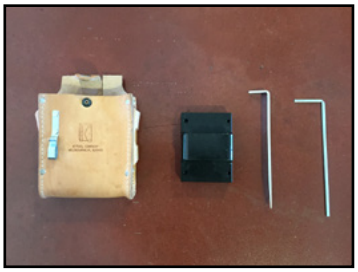
The four bolts on the outside of the door can indicate panic hardware. Using the same technique as stated for an outward swinging door, concentrating on the area where the 2 bolts are located on the non-hinge side. If the door proves to be too difficult to open, request Truck company assistance via the IC.

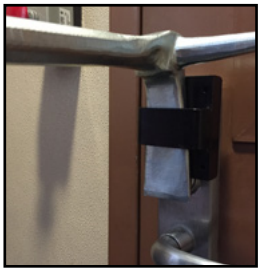
THE K-TOOL

The K-tool is used in conjunction with your irons to pull cylinders locks and utilize the "through the lock" technique. This method can be used in both emergent and non-emergency situations and allows you to secure the premises after you are complete.



Once the cylinder lock is out you can manipulate the internal components with the Key tools that come with the tool to open the door. Place the K-tool/Rextool over the cylinder lock - tap the tool into place until the tool bites the lock cylinder - place the Adze of the Halligan into the tool from the underneath - pry the tool away from the





door. The tool and lock cylinder will stay on the Adze, minimizing damage to the tool.

OVERHEAD ROLL UP DOOR

Overhead roll up doors can be found on exterior of commercial occupancies and residential garages. They come in three types; rolling steel, sheet curtain and panel. The cut sequence of attacking all types is the same. The cut sequence that we use is called the "west coast cut". This is different than the "triangle" cut that was taught in the past. This offers a larger opening for firefighters and equipment. If making this cut under IDLH conditions ensure personnel are wearing full PPE with mask.

1. Size up the door, looking for safety hazards. The first cut is vertical and should start on the left side of the door (facing the door) above your head. If the door is a rolling steel roll up door, you may be able to pull a slat after the first vertical cut. If it does not pull after two to three tries, continue the vertical cut to the

ground. Keep your saw at full RPM and allow gravity to guide your saw to the ground. Your saw shroud will stop before you reach the bottom.

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 should start about 3 feet off the ground and extend to the bottom of the door, again, your saw shroud will stop you before you reach the bottom; this is the "teepee" cut. Force the small triangular section of the cut sheeting to the ground away from you and cut through the angle iron at the base of the door, make sure it is completely cut through.

3. Your 3rd cut will be a horizontal cut. For best success make your cut at shoulder height from one end of the door to the other, overlapping the vertical cut. Keep the saw at shoulder height and saw at full RPM and cut as far to the right as possible.

4. You have two options at this point. You can either make an additional vertical cut on the right side, or if the door is light enough you can simply swing the door open from left to right, using the right side of the door as a hinge. Make sure you keep the door between you and any potential fire. Once the door is open fully you can cut the remaining 3" on the right side of the door and remove it completely.

SUMMARY

Forcible entry like most other fire-fighting 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. Always remember to try before you pry and make good decisions when gaining access into a structure; this will help safeguard the healthy re-lationship between the community and your fire organization.

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 reported by the I/C to dispatch that denotes no occupants are in the hot zone. This benchmark is announced after the completion of both primary and secondary searches.

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

Air: Separate air supply for the victim.

Water: Hoes line to create a defendable position.

A Radio: Separate radio for the victim, pre-set to the assigned emergency.

Extrication: Tools necessary to extricate the victim.

Bump Up: This is the process of maintaining crew integrity while conducting and oriented search. A crew while conducting search may discover a door leading to another compartment which would require the "door man" to move up and maintain orientation at the next opening.

Got One/Got a Victim: Simple verbal communication stating that during a search you found a victim.

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 minute 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. pan on the stove, damper closed on fireplace, etc.

Initial Stage: Shall encompass the control efforts taken by resources which are first to arrive at an incident requiring immediate action to prevent or mitigate the loss of life or serious injury to citizens and firefighters.

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

Known Life Hazard: 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 live or serious injury.

MAYDAY: A standard three-word distress call to indicate that a firefighter or company is in immediate danger and requires immediate assistance, i.e. "Mayday, Mayday, Mayday; Command from Engine 1".

Need Help?: This term goes hand in hand with Got One/Got a Victim. The oriented member will call out to the firefighter who has found a victim, need help? This allows the firefighter to relay pertinent information about the victim. Such as, victim consciousness, injuries, time to extract, additional resources needed, tools and

equipment and 360 of victim complete with no additional victims found. All this information can be relayed to Command by the oriented member.

Occupancy type: This will many times drive the incident's search priorities. Residential occupancy types 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.

Primary Search: A quick search and clearing of all affected areas of the structure(s). Primary searches are 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 safety and accountability.

Rapid Intervention Team (RIT/RIC): A designated crew that will serve as a stand-by rescue team for personnel and be available for the immediate search and rescue of any missing, trapped, injured or unaccounted for fire fighter(s). This team shall be fully equipped with the appropriate personal protective clothing, protective equipment, SCBA and specialized rescue equipment needed as based on the specifics of the operation that is underway. This includes the emergency breathing Support System (quick-fill hose device).

Risk Management: The development of action plans, which take present and potential risks into consideration.

Secondary Search: A more thorough, methodical search of the affected areas of the structure(s) once the conditions in the structure have been completely controlled. Command will request secondary searches of all affected areas once the first 3 tactical priorities have been achieved.

Size-up: The ongoing evaluation of problems confronted within a fire situation. 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. The responsibility of size-up initially lies with the first officer of the first unit or company that arrives on scene. This responsibility is passed up the chain of command as other units arrive with higher-ranking personnel.

Standby Firefighter: One (1) fire fighter in standby mode fully equipped with the appropriate protective clothing and equipment in order to provide rescue assistance of other firefighters.

Standby Mode: Full personal protective clothing including a SCBA donned with the face piece in standby mode.

Suppression Personnel: Personnel approved by the Fire District to make interior attacks at structure fires.

Standby Mode

SEARCH & RESCUE

OFFENSIVE INCIDENT ACTION PLANNING (IAP)
When an incident's critical factors and the risk assessment indicate an offensive strategy, firefighters will enter the IDLH (Immediately Dangerous to Life and Health) in an attempt to control the fire and search for occupants. An offensive IAP is based on the standard offensive tactical priorities.

Offensive Tactical Priorities and their corresponding completion benchmarks:

- Fire Control – Under Control
- Life Safety/Search and Rescue – Primary and Secondary All Clear(s)
- Property Conservation and Loss Stopped

The offensive tactical priorities establish the major operational activities required for a complete, integrated effort and they identify the three major functions we must complete to establish the overall incident response.

SEARCH AND RESCUE OPERATIONS

A major tactical priority to accomplish early in the incident is to locate and remove any savable, endangered occupants from within the hazard zone. In addition, any civilians exposed to the incident's hazards should be evacuated.

For offensive structural fires, we achieve the life-safety priority by performing primary and secondary searches in the main fire occupancy and in any exposures threatened by the fire. The Incident Commander (IC) uses the standard rescue order to prioritize and manage these searches. The Rescue Order 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 Order by:

- Advancing initial lines directly to the most hazardous area of the building—the burning part – places crews in the same area as to the most endangered group.
- Initial interior crews will be searching and protecting the same corridors that the occupants in the building would use to evacuate.
- The hand line protects FF's and begins the attempt to establish control of the fire. Also, this establishes and anchor point in which firefighters can work from to clear the remaining areas of the fire building.
- 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 all duplication of efforts.

When encountering large, high density, compartmented, multi-unit/room residential structures, it is often more effective to implement a shelter in place life safety operation as opposed to removing occupants from the structure who are not directly exposed to the incident hazards of the IDLH. These actions should include:

- Secure and protect normal means of egress
- Search and clear the immediate areas of involvement
- Contain, control and eliminate the incident problem
- Remove the products of combustion
- Systematically clear the remainder of the fire area/exposures

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.

Strip malls, commercial buildings and big box fires have a much lower life safety hazard and all initial actions should be directed towards putting water on the fire unless there is credible information of survivable occupants inside of the hazard zone.

Search and Rescue rules of thumb:

- The 1st hand line should go directly to the fire for firefighter safety and to support completing primary and secondary searches.
- All-clears must be obtained for all residential occupancies.
- Smaller sized occupancies will accommodate a much more rapid search.
- Larger sized commercial occupancies – all initial efforts directed towards fire control.
- A TIC's primary use is for S&R and crew accountability – use it every time.
- All personnel searching in an active fire area must either bring in their own hand line or work under the protection of a hand line located in their same geographic location while performing search operations.
- Once All-Clears have been gained in operational areas, the IC must constantly consider that firefighters are the only remaining life safety threat in the hazard zone.

ORIENTATION AND TECHNIQUES

The better our visibility the more rapid we can search. Therefore, removing smoke increases our effectiveness and enhances our safety on the fire ground. Reducing our exposure time to IDLH environments should be a priority in our IAP/safety plan. Smoke is a product of combustion and consists of unburned vapors and small particles that refract light, making it very difficult to see through, even in small amounts. Consequently, when firefighters operate in a fire compartment they will most certainly encounter reduced visibility environments. Therefore, it is imperative that firefighters become orientated to prevent becoming lost or trapped.

It is essential that all firefighters are able to operate in a confined, reduced visibility environment

SEARCH & RESCUE

for extended periods of time while always maintaining orientation:

- You always know where you are
- You always know how you got there
- You always know how to exit the structure
- You 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 the structures in your first due area is paramount to effective and safe fire operations. Example: Predominately single family residence in SKCFTC is a 2 story house. A typical layout is:

- 1st floor - Kitchen, living room, dining room, laundry and garage.
- 2nd floor - Usually all dedicated to bedrooms and center hallway.
- Basement (if equipped) - Living room, bedrooms, HVAC equipment, hot water heaters, utility connections

Firefighters must use the information they obtain when they see these 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. This knowledge, coupled with pinpointing the exact location of the fire prior to entry, accomplished while performing a full 360, will give firefighters a good idea of where they need to go, how they will get there, and how they will prioritize the search areas.

Crew's may need the protection of a hand line when operating in the hazard 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:

- Gives firefighters a life line to their exit point
- Hose couplings can be used to navigate out of the building
- It protects firefighters from thermal insult
- Gives you the ability to extinguish the fire. This always makes conditions better!
- Manages the depths you can attain a structure

Threaded attack hose will always be loaded in a manner that has the "Male" coupling pointing to the "Fire" and the "Female" coupling will always point toward the "Exit". When attached together, 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-lug-lug leads to the plug".

Male Coupling

Female Coupling

Search Size up:

- Time of day

- Type of occupancy (layout/arrangement) and construction
- Fire location and severity
- Where is the fire moving to?
- Are victims reported or confirmed to be trapped?
- What is the IC's IAP? Where other crews may be working and what are they doing?

Target areas:

- In direct proximity to the main door/front door to the occupancy
- The bedrooms – Systematic searching on top of beds, sweeping with foot under beds
- The bathrooms

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

- Status of the fire
- Status of the hose line
- Status of the vent
- Status of nearby crews

Monitor and evaluate your surroundings:
Heat levels

- Smoke conditions
- Air movement – If you make a ventilation opening, will this affect the ventilation plan?
- Are conditions getting better or worse?
- 2.8 - Orientation during the search:
- Establishes your location, direction of travel, and your exit
- Searching off the wall
- When do you "Bump Up" in commercial or office layouts.
- Searching off the hose line
- Searching off the rope
- What are the crew's roles and positions? What tools are assigned?

The bedroom areas of a house are also typically connected with a common hallway. When searching the bedroom areas of a home, the preferred search method is an oriented search under the protection of a charged hose line.

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, specifically without an ear piece, it is very important to speak into and not shout into the radio.

THERMAL IMAGING CAMERA OVERVIEW (TIC)

All personnel in the SKCFTC should be trained on the use of a TIC. 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"

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thermal energy emitted from an object. Thermal, or infrared energy, is light that is undetectable by the human eye because its wavelength is to 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 see's through smoke and does not require any visible light, however, it cannot see through objects such as water and 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 meant to replace

other techniques. Using the TIC correctly is very important to firefighter safety. Relying on the TIC can place you in a situation where you become disorientated and are now a part of the problem.

COMPARTMENT SEARCHES

Door openings: Whichever way the door opens into the room, start your search on the closest wall that leads to the seat of the fire or to the last known location of the victim(s).

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

- Place your right/left hand or shoulder on the room wall next to the door opening and conduct your search with continuous contact to the wall.
- Work your way along the wall of the room sweeping your hand up and down on the wall you are on to identify windows and doors.
- The searching firefighter should always have a tool with them. A tool can be used to sweep around the room or under objects, assist with forcible entry/exiting and many other functions. If you hit something with a tool, put your hands on the object and determine what it is.
- Staying orientated to a wall will help you get back at the same entry point where you can continue your search until all areas have been cleared.
- The officer of the search team needs to maintain orientation to the building with his/her members searching forward. Finding a room off a room will require the team, or the oriented man, to bump up to the new opening.
- If a fire victim is located priority radio traffic will be used to notify the I/C or division officer. The search team needs to complete a 360 around the victim, position the victim head first toward the exit and secure them with hose straps for ease of removal if necessary.
- Now the oriented man can reverse course

The Six Sided View

The six sided view is designed to ensure that firefighters get a good mental picture of the compartment, identify potential hazards and locate obstacles or possible victims.

The scan begins at the base of the left wall and moves up and across the ceiling (this scan must be done prior to the floor to eliminate the existence of overhead hazards), down the right wall, across the floor, level the camera and look straight ahead and then complete your scan of the room by looking behind you (this view is used to scan the floor from a different vantage point and is typically completed first, before entering the next room).

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and quickly lead the search team to the exit bypassing already searched rooms and areas.

VICTIM PACKAGING AND REMOVAL

When locating a victim or firefighter 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 or firefighter 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 man power. Therefore, it is critical to complete a rapid evaluation of the situation and determine the best course of action.

First, when a victim is located conduct a rapid 360 to determine the presence of other victims. Second, communicate with command, using "Priority Radio Traffic", and let them know you have located a victim. Rapidly assess the victim's condition and determine what resources will be needed, if any, to accomplish victim removal. If the victim is non ambulatory a number of drags can be used to expedite their removal from the hazard zone. Remember, if the victim is located near your egress point simply using the double under hook method and quickly drag them to safety.

When packaging a victim for removal it is important to evaluate the environment to determine the quickest and most efficient method for moving the victim or firefighter to safety. Many environmental and resource issues can and should factor into this decision making process; call for resources early if you think you will need assistance. Coordination and effective internal team communication will be critical to the success of the rescue, think, plan and act. Below are a few examples of different packaging options. By no means are these the only methods that can be used to remove victims or firefighters.

Victim or Firefighter (without SCBA) Drag

This method creates cornice knots on each shoulder and supports the head. It is most useful if the victim or firefighter needs to be moved over a great distance. This system is not recommended for tight areas and compartments that have a flooring material that creates a lot of friction.
Loop both arms and move the hose strap under the arm pits.
Cross the front loop over the back loop and plce the front loop behind the head.

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

Quick Drag

The quick drag can be used for victims or firefighters and can be accomplished by standing behind the victim, while they are in a seated position, and reaching under the arms, clasping your hands together. If rescuing a firefighter who is wearing an SCBA, simply grab each shoulder strap, lift and drag (note: make sure the shoulder straps on the SCBA are tight and the chest strap, if equipped, is disconnected before dragging). This method is very effective over short distances and friction is greatly reduced by getting much of the body off the floor surface.

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 floor-

ing surface like carpet.

Tighten all SCBA straps, place the loop of your hose strap over one leg and slide it high and tight into the crotch.

Place a round-turn around the waist strap (or an overhand knot), place a half hitch around the shoulder straps behind the neck (make sure you

capture everything, including the high pressure hose).

Use a carabineer to connect to the end of the first hose strap if needed. SCBA chest strap, if equipped, must be disconnected before dragging.

Two person carry

The two person carry can be utilized to quickly remove a firefighter or victim from the hazard area.

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Using the SCBA straps, hose strap or a combination of both 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 or injured firefighter. One method to assist in managing stairs is for the rescuer that is positioned at the head to use a hose strap to help carry some of the weight.

Using the victim's torso or the SCBA straps, place a hose strap around the victim using a girth hitch.

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. Secure the strap to your waist belt with an overhand knot. This will allow the firefighter at the head to have his/her hands free and using the stair railing and walls to stabilize their descent/ascent.

Vent, Enter Search

Vent the window

Sound the floor

Scan the area immediately outside the fire room

Secure the door

Search the room

Second firefighter stays at the window to keep orientation

VENT ENTER SEARCH OVERVIEW (VES)

Firefighters who are told that there is a confirmed victim(s) inside can use the VES technique to rapidly search an area that would otherwise not be searched until later in the incident.

Vent Enter Search Prompts:

- You are being told that there is a victim(s)
- You have identify exactly where they are believed to be and how old they are (knowing the victims' ages can help rescuers identify areas they may hide)

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- Young children have been found to hide under beds and in closets
- Teenagers have been found to hide in their parents' bedroom and seek refuge in bathroom tubs with the water running.

Vent Enter Search should be restricted to bedrooms only. Bedrooms will allow you to control your environment with the door. Firefighters will be able to control the flow path by closing the door. Once information is confirmed of a known victim(s) firefighters will gain ingress by laddering the window. The following steps shall be followed:

Observe Fire Conditions: Evaluating conditions begins with the initial radio report, when your company arrives on scene and continued monitoring of operations that are happening on the fire ground. Evaluate the window you intend to ventilate. Is there active fire conditions in the area that could lead to flashover or rapid fire spread if you ventilate this opening?

Vent the Window: 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.

Entering the Room: Sweep the floor under the window to check for victim(s) and sound the floor to insure structural integrity. Next, the firefighter will locate the door to the room to isolate the flow path. Quickly search the hallway for any victim(s) and evaluate nearby fire conditions, then shut the door. Typically the do or will be found straight across the room from the window. Once the door is closed the firefighter will conduct an effective search of the room.

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

FIREFIGHTER MAYDAYS

Firefighters who find themselves lost or trapped must immediately use "Mayday" to announce their situation while they continue to attempt to find their way out. Firefighters should not delay notification of distress. Notifications should occur as soon as the firefighter THINKS he or she is in trouble. The longer you wait to tell somebody you are in trouble the more you jeopardize yourself and the rescuers lives. The rescue of a lost or trapped firefighter is very time sensitive and can be very complex.

It can take a considerable amount of time to put a RIT/RIC team into place. Insuring that the RIT/RIC is at the best location of entry, search and begin rescue efforts. Command must consider updating their action plan to fit the priority of rescue efforts.

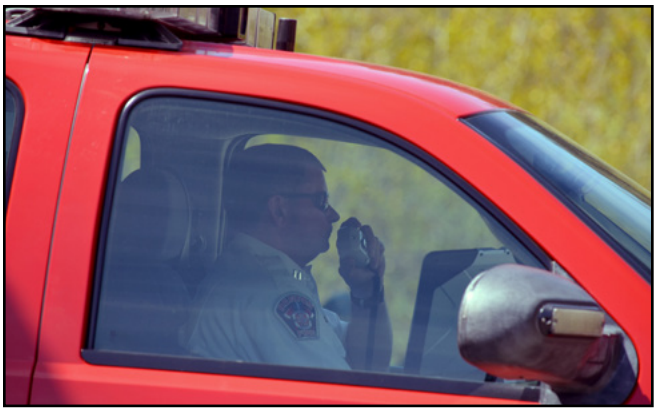
The radio message MAYDAY will be used for firefighters who are in a potentially life threatening situation. Any member with knowledge of such a situation may use MAYDAY to report the emergency.

The term MAYDAY will be used:

- By a member who is in a life threatening situation
- By a member who witnesses or has confirmed that a firefighter is in a life threatening situation
- By a company officer, division/group officer, or other member who cannot account for an assigned firefighter who is operating in the hazard zone. MAYDAT would generally occur following a PAR that fails to locate/account for the suspected lost member.

Commands Response to the MAYDAY:

- Confirm; Who, What (problem) and Where
- Work from the inside out (Can the firefighter self-rescue? Are crews working on the interior in close proximity to the firefighter that called the mayday?)
- Commit RIT/RIC; Deploy the RIT/RIC to the last known area of the lost firefighter(s), and/or to the area reported during the MAYDAY (Is the firefighter on a hoseline?)
- Change Rescue Effort; Develop a rescue plan and utilize all levels of command to help assist in the rapid extraction of any firefighter(s) calling a MAYDAY
- Request additional Alarm and Additional Medic
- Conduct a PAR; account for all other companies working on the scene
- Maintain Firefighting Positions and Provide Reinforcements; keep all efforts in place as long as they are in a safe environment.
- Withdrawing from Affected Area(s); collapse or structural integrity is in question.
- Assign a RIT/RIC Group Supervisor; This will aid in the communication during this complicated task
- Expand Command Organization; Consider expanding command to assist in the organization of the incident.



- Establishment of Treatment and Transport Group; Insure that treatment and transport are rapid once the firefighter(s) are removed from the structure
- Soften the Structure; Make sure that the RIT/RIC will be able to remove any firefighter(s) with ease and multiple means of egress.
- Vent, Maintain Tenability and Lighting; Attempt to make conditions inside the structure as clear as possible. This will help with extraction time of the firefighter(s).
- Monitor Appropriate Channels; Insure that the Emergency channel and Zone 3 Emer. channels are being monitored
- RIT/RIC Stand-by Teams; One RIT/RIC teams are deployed, insure that they are supplemented with additional crews for the likelihood of additional firefighters getting trapped, lost or injured.

RAPID INTERVENTION TEAMS/CREWS

Risk Analysis: - Risk management (risk vs. value analysis) shall be utilized by the Incident commander when formulating the incident action plan. The incident objectives should address life safety, property conservation and incident stabilization in as safe a manner as possible, as dictated by the incident. The practical application of risk management shall be as follows:

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- Within a structured plan, we may risk our lives to protect savable lives.
- Within a structured plan, we may risk our lives a LITTLE to protect savable property
- We will NOT risk our lives at all to save lives or property that are already lost

The acceptable level of risk is directly related to the potential to save lives or property. Where there is no potential to save lives, the risk to firefighters must be evaluated in proportion to the ability to save property of value. When there is no ability to save lives or property, there is no justification to expose FD members to any avoidable risk, and defensive suppression operations or other non-aggressive action is the appropriate strategy.

Once additional resources have arrived, the Incident Commander shall upgrade the initial 1-out component to a dedicated Rapid Intervention Crew to include back up teams and/or additional RIT teams, depending on the magnitude, configuration of the structure, or geographical layout of the incident. Separate Rapid Intervention Teams are not required for each interior team.

RIT is designated, announced via radio and assigned to a location by the Incident Commander. When assigned, the RIT Officer will obtain a briefing from the Incident Commander and conduct a specific size up that focuses on:

- Fire location
- Interior team(s) entry point and location
- Critical fire ground factors (scene conditions & hazards)
- Type of construction and condition
- Air management (elapsed time)
- Firefighter fatigue
- Radio communications
- Potential firefighter rescue operations

During size up, every RIT member will be assigned a primary function, if deployed and equipped for such function. Refer to the AWARE acronym in definitions; Air, Water, A Radio and Extrication. If a hydrant supply has not been established the RIT should pull a separate charged hose line off of another Engine Company if available. Necessary and appropriate rescue tools and equipment that the RIT may need shall be brought to the area where the RIT is assigned. RIT shall be immediately ready for assignment wearing full protective clothing and SCBA in standby with a minimum of one portable radio for the team and preferable one radio for each member. The RIT Officer must closely monitor the tactical radio channel at all times to maintain awareness of the activities and status of working companies.

RIT will maintain its company radio designation. Example – E1 you will be assigned RIT. If hailed on the radio RIT will answer as E1. The assigned RIT Company will report directly to the Incident Commander, unless assigned to a division, group or branch. If RIT is launched on a rescue, a new RIT will be assigned to take their place and will assume the "RIT" call sign.

Prior to deploying RIT/RIC the incident commander shall determine if he/she can utilize in-

terior crews working in close proximity to the mayday or report of missing personnel (inside out). This responsibility should be designated to the division or group supervisor if the mayday occurs in their defined area of responsibility. It is important to continue with fire suppression operations and other tactical objectives to keep the incident under control. RIT can be deployed simultaneously to the inside out process. As stated earlier, if RIC is deployed the incident commander should backfill with a second RIC and strongly consider requesting additional alarms.

Firefighter rescue steps: These steps are completed as a team and should happen simultaneously, do not get hung up on the order, AIR is important!

- Shut off the PASS device if activated
- Radio command and tell them you have located the firefighter and get additional resources
- Unclip the chest strap and perform a 360
- Determine if they are conscious and what their issue is
- Asses the condition of their SCBA, if compromised, get them on air
- Package the patient for removal
- Share the work load and manage your team's air!

WAC 296-305-05002 (2 IN 2 OUT):

In Washington State prior to engaging in structural firefighting operations, with the exception of an imminent rescue, firefighters must have a standby/RIT in place prior to entering the IDLH. Below is WAC 296-305-05002:

> (1) Before beginning interior structural firefighting operations, the incident commander must evaluate the situation and risks to operating teams.
>
> (2) 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.
>
> (3) In the initial stages of an incident where only one crew is operating in the hot zone at a working structural fire, a minimum of four individuals shall be required, consisting of two individuals working as a crew in the hot zone and two individuals present outside the hot zone available for assistance or rescue of firefighters during emergency operations where entry into the hot zone is required.
>
> (4) Initial attack operations shall be organized to ensure that if, on arrival at the emergency scene, responders find a known rescue situation where immediate action could prevent the loss of life or serious injury, such action shall only be permitted when no less than three personnel (2-in/1-out) are present and equipped to provide emergency assistance or rescue of the team entering the hot zone.
>
> No exception shall be allowed when there is

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no possibility to save lives or no "known" viable victims.

(5) Firefighters must not engage in interior structural firefighting in the absence of at least two standby firefighters (2-in/2-out) except as provided in WAC 296-305-05002(4).

(6) Standby team members shall comply with the following:

(a) Members shall remain aware of the status of firefighters in the hot zone.

(b) Members shall remain in positive communication (radio, visual, voice or signal line) with the entry team, in full protective clothing with respiratory protection donned while in standb mode.

(c) Only one standby team member may be permitted to perform other duties outside the hot zone, provided constant communication is maintained with the team in the hot zone, and provided that those duties will not interfere with his or her ability to initiate a rescue as appropriate.

(d) No standby team members shall be permitted to serve as a standby member of the firefighting crew when the other activities in which the firefighter is engaged inhibit the firefighter's ability to assist in or perform firefighter rescue or are of such importance that they cannot be abandoned without placing other firefighters in danger.

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 will accelerate rapidly. Educating ourselves and regularly practicing search and rescue techniques will provide firefighters with the KSA's to safely and effectively locate and remove victims during the early stages of these very hectic incidents.

LADDERS

Ground Ladders

Ground ladder tasks are assigned and coordinated to achieve incident objectives. They provide access to upper floors and roofs. In addition to access, ground ladders are also used as a secondary means of escape from upper floors. Like other fire ground functions, ground ladder deployment must support the tactical objectives of the incident action plan. Deploying ground ladders on the fireground is one of the most challenging fundamental fire-fighting skills to maintain. Deploying a ladder requires strength, balance and agility; it also requires communication, coordination and teamwork. Carrying, raising and climbing ladders are skills that must be practiced regularly to maintain an acceptable level of proficiency. The following section will provide firefighters with a road map to learn and practice these skills as a team to be effective in the deployment of ground ladders.

DEFINITIONS

Anchoring: A method of securing the ladder to prevent slippage or other unwanted movement.

Attic Ladder: An 8' - 14' 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: An extension ladder over 40' in length that uses stay poles (also called "tormentor" 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 Raise: Raising a ladder on edge.

Bed Section: The bottom section of an extension ladder that the fly sections extend from.

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

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

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

Climbing Angle: The optimum angle of a ladder in a raised position that is ready for climbing, typically 70 – 75 degrees.

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 from retracting when extending the ladder, also referred to as Pawls or Locks.

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 firefighters performing the carry.

Fly Section: The moving section(s) of an extension ladder that extend past the bed section.

Footing: Securing the base of the ladder to prevent unwanted movement or slippage. One foot steps up on the bottom rung, the other is placed on the beam, slides down the beam to the ground and holds it securely as the ladder is being raised.

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.

Heeling: Securing the ladder and preventing unwanted movement by standing on the rear side of the ladder (building side), gasping 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 to the next rung and secured.

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 firefighters.

Ladder Package: An assortment of tools and equipment including saws, hooks, irons, and ladders assembled as a package and brought forward to the fire scene. Creating a ladder package can prevent unnecessary trips back to the apparatus.

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

Leg Lock: A method of securing oneself while working on a ground ladder. A leg is stepped through the space between two rungs, and brought back to one side of a beam wrapping

LADDERS

the top of the foot around the beam opposite the side performing work if leaning off center from the ladder.

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 dawgs 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 fly sections), or "out" (toward the bed section).

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.

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

Securing the Halyard: A safety measure taken 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.

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

Shifting (the Tip or Butt): Moving the tip and/or butt of a secure raised ladder to ensure it is not leaning either right or left of plumb prior to climbing

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

Team Leader: Ensures the ladder is carried and raised safely and efficiently to meet the tactical objectives. Typically gives all commands/direction during the ladder carry and raise evolutions.

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

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

Working Set: Two ladders placed adjacent to one another at a window sill for civilian or firefighter rescue. This allows for an additional firefighter to assist in the rescue.

LADDER ANATOMY

LADDERS

GROUND LADDER INSPECTIONS, TESTING AND MAINTENANCE

All ground ladders shall be inspected and maintained to ensure compliance with WAC 296.305.06005.

Ground ladders should be visually inspected after each use and monthly per the WAC.

Visual inspection shall include, but not be limited to:

- Heat sensor labels for change indicating heat exposure.
- All rungs for snugness and tightness.
- All bolts and rivets for tightness.
- Welds for any cracks or apparent defects.
- Beams and rungs for punctures, wavy conditions, worn serrations or deformation.
- Butt spurs for excessive wear or other defects.
- Halyards for fraying, kinking, or breakage (unclip halyard to remove any twists as needed).
- Roof Hooks for proper operation.
- 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* (in accordance with the 2004 ed. of 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. Overloading any ladder with a 750 lb. in service duty rating and a 4:1 safety factor by NFPA 1932 is considered to be more than:
  - Three people at one time:
    - Three firefighters with full turnout gear and air packs
    - Two firefighters and an unconscious victim
    - Two firefighters and a charged hose
- 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, scrub brushes may also be used
2. Never use steel wool or wire brushes 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 flange and guides
   - Check for areas of old or excess buildup of wax - If present, carefully brush with soap and water (using a Scotch Brite pad may

help)
- Preserve the finish and lubricate by applying paraffin (or candle)wax on contact points

6. Lubrication with dry graphite should include:
   - Pulley bearings
   - Roof hooks
   - Dogs/locks/pawls (lubrication oil may also be used on the pivot points of the dogs)

GROUND LADDER PRINCIPLES

Extension ladders shall be placed with the fly in (towards the building), unless other- wise 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.

Ladder commands are given by the company officer, or team leader as task, location, objective (TLO). This person will designate the ladder to be used, the type of carry, the target for raise, the type of raise, and which tools/equipment are needed.

The person who is in charge of the ladder carry and raise from the beginning will remain in charge of the operation regardless of ladder position.

Unless otherwise directed ladders should be carried Butt first.

Ladder chocks should be used to level a ladder placed on uneven ground or whenever their use will add safety to ground ladder operations.

Shifting the ladder may be required to achieve proper climbing angle or position. Shifting the ladder is accomplished by using commands to coordinate the ladder shifting movements. The team leader shall verbalize the desired destination of the ladder. A couple of examples:

- Climbing angle incorrect: "Shift the butt out from the building one foot, ready, shift."
- Tip not square: "Shift the tip of the ladder two feet to the right, ready, shift."

Prior to Climbing a ground ladder, the firefighter shall perform the following six safety checks:

1. Tip is square
2. Dogs are locked (upper and lower if applicable)
3. Halyard is secure
4. Butt is square and set
5. Climbing angle is good
6. Ladder is heeled or footed unless a ladder anchor is properly in place

LIFTING LADDERS

Attention should be given to the proper method of lifting or lowering a ladder. The correct body position for lifting is to bend the knees, keeping the back straight, and lift by using the muscles of the legs and arms as the legs are straightened. Keep the ladder as close to the body as possible throughout the lift.

ROLE RESPONSIBILITIES

Butt Person: The butt-person is responsible to safely navigate the ground ladder to the raise destination. This member shall position himself/ herself between the 2nd and 3rd rung to protect the beam spurs from contacting obstacles while being carried to the raise location. As the butt-person approaches the location of the raise, he/she will visualize the area for overhead hazards, tripping hazards, unstable surfaces and overhead obstructions. Confirms and replies to team leader that overhead is clear.

Beam / Tip Person: The beam-member(s) is/are responsible to safely carry the ground ladder to

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the raise destination and then confirm and reply to the team leader that the overhead is clear. Further, the beam-member(s), will maintain control during the raise to the target objective, lower the ladder into the building, secure the halyard and perform safety checks.

Team Leader: The team leader gives commands for raising the ladder. The team leader is positioned in the middle of the ladder during a 3-person beam raise, at the butt of the ladder during a 2-person beam raise, or on the left beam (mid beam) during a flat raise. The team leader is responsible for calling **"Overhead Clear," "Ground the Butt," "High"** and making any adjustments to final placement.

The person who is in charge of the ladder carry and raise from the beginning will remain in charge of the operation regardless of ladder position.

COMMANDS

Commands begin with task, location, and objective (TLO) given to crew. For example: "3-person, flat-shoulder carry; ladder the third story window for firefighter access." All crew members will know which ladder is to be raised, the location of the raise and the goal of the raise.

"Prepare to Carry": Command used to prepare other members of a lift, carry or movement of the ladder, prompting them to take their positions at the ladder. When removing the ladder from the apparatus, this will include: removing the butt cover, unlocking and placing roofers out of the way, and unlocking and preparing the extension ladder to lift off the rack.

"Ready, Lift": Members lift the ladder for the intended use. From both apparatus and/or ground.

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

"Overhead Clear": The team lead indicates that the work area is clear by verbalizing "Overhead Clear" during approach to set up a ladder; this is confirmed and repeated by the crew.

"Ground the Butt": Indicates the butt-person has reached the appropriate location to raise the ladder and then is immediately moving to place the spurs on the ground and into a position to assist with the beam or flat raise.

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

"High": Indicates the fly is at the desired height. The fly will continue to be extended to the final height to positively engage both the top and bottom dogs.

> **NOTE:** Prior to the next step the team will visually confirm and verbally call out

"Top dogs locked, bottom dogs locked."

"Into the Building": The members shall lower the raised ladder in to the building

"Secure the Halyard": Beam member shall tie the halyard with a round turn and two half hitches, then ensure halyard is centered on the rung

"Shift the Tip or Shift the Butt": Small, controlled adjustment moves to set the ladder correctly

Once the ladder is placed against the structure PERFORM THE SIX SAFETY CHECKS:

1. Tip is square
2. Dogs are locked (upper and lower if applicable)
3. Halyard is secure
4. Butt is square and set
5. Climbing angle is good
6. Ladder is heeled or footed unless a ladder anchor is properly in place

"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 members(s) shall push and pull the ladder to the vertical position away from the building.

"Lower the Fly": The beam person(s) shall lower the fly section(s) to their nested position

> **NOTE:** To ensure all dogs are locked in the nested position for stowing, Prior to the next step the team will visually confirm and verbally call out
>
> **"Top dogs locked, bottom dogs locked."**

"Beam or Flat Lower (to ground or shoulder)": The butt person shall foot the ladder, and the beam person(s) shall lower the ladder from the vertical position (Example: "Flat Lower to the shoulder or Beam Lower to the shoulder).

"Overhead Clear / Behind Clear":

"Ready": Team members anticipate and get in proper position to lower.

"Lower": The ladder is lowered to a horizontal position.

"Carry": The ladder is carried to another location or back to the apparatus for stowing.

"Halt": Stops the carry of the ladder.

"Face the Butt": All members face the Butt. Unless otherwise directed ladders should be carried Butt first

"Face the Tip": All members face the Tip.

Pivoting the Ladder

"On this beam, (slap the intended beam with your hand) quarter turn in (toward the fly sections)/ out (toward the bed section)": (Indicates a repositioning of the ladder while in a vertical position WITHOUT the fly section(s) extended): ***"Ready"*** – Rock the ladder to get a spur off the ground, ***"Pivot"*** – Quarter turn max, **IN** toward the fly sections, **OUT** toward the bed. Foot the ladder due to spur leaving the ground.

REMOVING LADDERS FROM APPARATUS

LADDERS

Ground ladder carries are the general techniques used by companies to remove the ladder from the assigned apparatus and carry it to the tactical location using teamwork and efficiency. Carries can be performed by one, two, or three people depending on the size of the ladder and the distance the ladder must be carried to the objective (Bangor ladders will require four or more people).

Ladder 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 and balance the ladder on your shoulder. Slightly lift to release ladder from rack and step out away from the apparatus.

Removal from interior mounted bed (aerial apparatus) 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. Face the butt end of the ladder and grasp the ladder at the balance point and balance the ladder on your shoulder. Slightly lift to release ladder from rack and step out away from the apparatus.

GROUND LADDER CARRIES

One Person Carries

Extension Ladder – High Beam 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.

Roof Ladder and Wall Ladder – High Beam 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.

TWO PERSON CARRIES

Two Person Beam Shoulder Carry (from ladder rack):

- At the command "Prepare to Carry", firefighters 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 "Ready 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.
- Team lead will be in the butt position.

Two Person Beam Shoulder Carry (from the ground):

- Position yourself between the second and third rungs from each end
- At the command "Prepare to Carry" assume a squatting position, grasp the inside beam, and roll the ladder onto beam so bed section is facing you.
- At command "Ready 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.
- Team lead will be in the butt position.

Two Person High / Low Carry (from ladder rack):

- At the command "Prepare to Carry", firefighters 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 "Ready Lift", the firefighters remove the ladder from the rack and perform the following carry:
- Tip person – high shoulder beam carry.
- Butt person – suitcase carry grasping the beam.
- Team lead will be in the butt position.

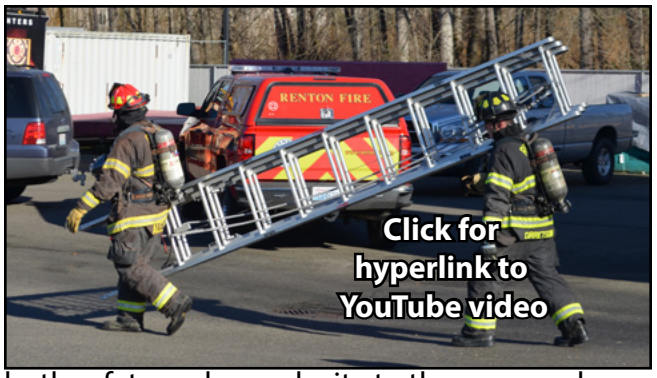
Two Person High / Low Carry (from the ground):

- At the command "Prepare to Carry", firefighters 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 "Ready Lift", firefighters lift the ladder and perform the following carry:
- Tip person – high shoulder beam carry.
- Butt person – suitcase carry grasping beam.
- Team lead will be in the butt position.

Positioning for Three Person Carries

Adding a third person to a ladder carry can add

LADDERS



both safety and complexity to the carry and raise (only consider adding a third person to a ladder raise if using a 35' or greater ladder). Position the third firefighter as follows:

- Three-person Flat Shoulder Carry: Two firefighters on the right beam of the ladder near the ends and one firefighter (Team lead) on left beam in the middle.
- Three-Person Beam Shoulder Carry: Three firefighters evenly positioned along the beam of the ladder.

GROUND LADDER RAISES

There are only two types of ladder raises: **beam** and **flat**.

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.

During all raises, the fly section shall be facing towards the objective, thus the firefighter raising the halyard will be facing the objective.

One firefighter beam raise:

A one firefighter 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 firefighter 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 butt 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 firefighter flat raise:

The one firefighter flat raise may be utilized when longer ladders or a smooth raising surface limits the ability to perform a one firefighter beam raise. This raise utilizes a building, curb, sidewalk or any other suitably stable object to raise the ladder against.

Two person beam raise:

From a two-firefighter beam carry, or a two person high / low beam carry, perform the following when the objective area is reached:

- Butt person – 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 person – Orient the ladder to a high shoulder position (if utilizing a high / low

carry, the tip firefighter is already in this position), and drive forward down the beam toward the butt 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, the firefighter on the bed section will foot by stepping up on the first rung and sliding the opposite foot down one of the beams.

Three person beam raise:

From a three-firefighter beam carry, perform the following when the objective area is reached:

- Team Lead – Calls **"Overhead Clear"** and then gives the command **"Ground the**

LADDERS

Butt". The team lead will finish the raise on the right beam.

- Butt person – Places the butt to ground positively footing the spur in anticipation for the ladder to be initially pivoted against that spur during the raise.
- Tip persons – Orient the ladder to a high shoulder 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.
- The firefighter on the tip will finish the raise in the butt position and the firefighter on the butt position will finish the raise on the left beam.

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 firefighters foot the ladder by grasping the beams / rungs and standing on the lowest rung with the inside foot, drives the butt into the ground and then slides the outside foot down the beam. Once the firefighters have slid the outside foot down the beams, they will keep the toes of their boots on the butt spur. The butt firefighter grasps both beams for added support.

Three person flat raise:

From a three-firefighter flat carry, perform the following when the objective area is reached:

- Team Lead – Calls **"Overhead Clear"** and then gives the command **"Ground the Butt"**. Once the butt is firmly on the ground, the team lead will slide down towards the butt end of the ladder on the left beam.
- Butt person – Places the butt to ground positively footing the spur in anticipation for the ladder to be initially pivoted against the spurs during the raise.
- Squat on the first rung and grasp either the third rung or halyard and lean back to assist in the initial lift
- Tip persons – Once the butt is firmly on the ground, the tip persons will slide down towards the butt end of the ladder along the beams.

Once in a vertical position, both firefighters foot the ladder by grasping the beams / rungs and standing on the lowest rung with the inside foot, drives the butt into the ground and then slides the outside foot down the beam. Once the firefighters have slid the outside foot down the beams, they will keep the toes of their boots on the butt spur. The butt firefighter grasps both beams for added support.

SECURING THE FLY SECTIONS AND LADDER ANCHORING

Securing the Fly Sections

When a fly section(s) is raised on any extension ladder, the halyard must be tied securely. The exception to this is when an immediate rescue is encountered. During an immediate ladder rescue, tying the halyard uses valuable time and often a victim or firefighter needing rescue will not wait. In this case, ENSURE THE DOGS ARE LOCKED prior to climbing.

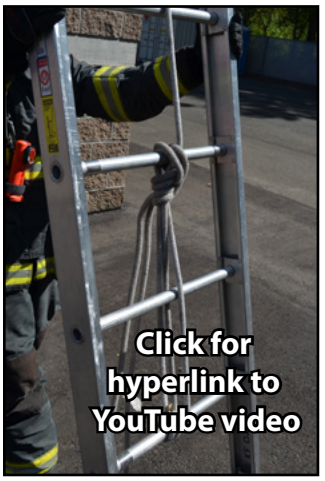
Tying the halyard is the final step in securing extended fly sections prior to climbing the ladder. The halyard will be tied using the round turn method.

Round Turn method:

- Take excess halyard into a bight and place a round turn on the 3rd or 4th rung of the bed section.
- Place two half hitches around the standing end of the halyard below the round turn.
- Ensure excess halyard is placed toward the back of the ladder out of the climbing area of the rungs.

Anchoring the Ladder

Ladder anchors are used to prevent the tip of the ladder from moving while climbing. To be effective, the rung, which the ladder anchor attaches to, must be below the level of the contact point of the ladder against the building or structure.



Ladder anchors are best used for ladders that will remain in place and not need to be moved during fire ground operations.

There are (2) approved methods for anchoring a ladder, each being dependent on the device being used.

- Ladder anchor strap
- Ladder anchor rope

Ladder Anchor Strap

Secure hook to building or window sill, bring strap over the top of the first rung at or below the sill, then connect the other side of the strap three rungs below anchoring location. Tighten the

LADDERS

strap and secure the strap with two half hitches at the tightening mechanism.

Ladder Anchor Rope

Secure hook to the building or window sill, bring the rope over the top of the first rung below the ladder anchoring point. Then go to the next rung below and use a round turn around the front of the rung. Proceed to the third rung below the anchoring location and place a round turn from the back side of the third rung. Secure with two half hitches.

CONSIDERATIONS IN LADDER PLACEMENT

Ladder placement should consider 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 and ask yourself where firefighters may seek refuge and rescue from a fire area if conditions rapidly deteriorate while operating on upper floors.

Safety considerations for ladder placement during fire incidents 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

Obstacles in Ladder Placement

The fire ground is exponentially more dynamic than the drill ground. Ideal ground ladder placement may be impeded by parked vehicles, rockeries, fences, and uneven terrain. If objects, terrain or building features create challenges to ladder placement, consider an alternative location for laddering the building or adapt to this less-than-ideal location and create the safest ladder placement possible. When placement and climbing angles may be less than ideal, consider driving the spurs into the soil, butting the ladder against a curb or other solid object or hard tying the butt of the ladder into the building or stationary object with either a hose strap or utility rope. Anchoring the tip using a ladder anchor should always be considered when the ladder is expected to remain in a static location during fireground operations.

Placement for Rescue/Working Set

When placing a ladder for rescue, either firefighter or civilian rescue, place the tip of the ladder at the sill of the window to not obstruct the opening

of the window. Orientation of the fly section(s) should be considered - a "flys out" orientation can make descending with an unconscious victim easier. Also, consider an advantageous climbing angle in ladder placement to aid firefighters in descending with an unconscious victim.

Place an additional ladder immediately adjacent to the first ladder at the sill during rescue operations. This technique of using a "working set" provides several advantages for both civilians and firefighters:

- Allows simultaneous firefighters easy access to upper floors for search, rescue and removal of victims.
- Allows for multiple firefighters to work off ladders and assist victims as they egress or are removed from the structure.
- Allows for both an ingress and egress ladder, that meets the tactical objectives of the operation.

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 from the roof, as well as increasing the visual reference for exiting the roof in smoky conditions.

Horizontal Ventilation

For horizontal ventilation place the ladder alongside the window on the windward side. Place the tip even with the top of the window.

Vent Enter Isolate Search

Accessing a single room for a targeted search of verified victims, place the tip of the ladder at the window sill.

CLIMBING AND WORKING FROM GROUND LADDERS

Footing the ladder

This is the preferred method of securing a ladder. A firefighter footing the ladder places the toes of one foot against the base of the ladder at the butt spurs. This method allows for the firefighter to remain in a safer position looking up the ladder and maintaining situational awareness.

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 beam while ascending the ladder.

Locking in

Firefighters must be secured to the ladder when working from it. Using a leg lock is one way to accomplish this:

- Climb to desired height and then ascend one rung higher.
- Extend the leg opposite the side that work will be performed.
- Bend the knee around the rung and secure the foot around the next lower rung and

LADDERS

beam.
- Move the other leg down one rung.

Arm lock

This can be accomplished by applying pressure from the knees outward to the beams and/or reaching through the rungs and around a beam on the side where work is being performed. This allows for work to be conducted while maintaining the required points of contact.

Rolling Ladders

Rolling ladders is a technique of moving an extended ladder with the halyard secured, to a desired location. Rolling the ladder across the exterior wall (or eve/fascia) of the building to the final location. One firefighter can easily and safely roll a ladder across a large exterior wall reaching multiple windows or balconies quickly.

DEPLOYING THE ROOF LADDER

The use of a roof ladder is for steep pitched roofs, or slippery roof conditions such as snow, wet moss or leaves, or frost. A roof ladder is not used to span the weight of the ventilation crew over a compromised roof structure. ***IF THE ROOF IS DEEMED UNSAFE, CREWS SHOULD NOT BE ON IT.***

Deploying the Roof Ladder:

- Approach at a 45-degree angle to either beam of the secured ground ladder
- Set butt end of roof ladder against butt of ground ladder
- Deploy roof hooks at the tip of the roof ladder so they are facing away from the ground ladder
- Walk the roof ladder into vertical position using the butt end of the ground ladder as a pivot point
- Ensure hooks are orientated away from the ground ladder prior to climbing
- Climb the ground ladder until you reach a point at the upper 1/3 of the roof ladder.
- Shoulder the roof ladder by inserting on arm through the rungs
- Grasp the ground ladder beams through the rungs of the roof ladder and continue climbing
- Climb to the roof line and perform a leg lock
- Using a hand over hand technique, in a controlled manner, slide the roof ladder on to the roof with the hooks down securing the hooks over the ridge.

GROUND LADDER SELECTION

There are many different styles and lengths of ladders within the SKCFTC and can include the following:

Extension Ladders

- 45' 3 section (Bangor)
- 35' 3 section
- 35' 2 section
- 30' 3 section
- 28' 2 section
- 24' 2 section

Roof/Wall Ladders

- 20'
- 18'
- 16'
- 14'

Attic Ladders

- 10'

Miscellaneous Ladders

- Various folding A-frame and combination ladders

Working Height of Ladders

Selection of the proper ladder depends on the desired use and function. Choosing the right roof ladder to bring forward will be dependent on the pitch of the roof and the span from the ridge to the eave. Determining the proper extension ladder to throw will depend on the type of occupancy, the height of the building if being used for roof access, the height of the desired window if being used for rescue or access and/or the desired climbing angle. Floor heights will differ from residential (rule of thumb 9-10') to commercial (10-12') and should be considered when selecting a ladder. A roof ladder may even be an appropriate selection for window or roof

access on a residential structure.

General Reach Guidelines

- 24'- 3 story window
- 28'- 3 story window
- 30'- 3 story window
- 35'- 4 story window

LADDER PACKAGES FOR VERTICAL VENTILATION

Tools and ladders used for vertical ventilation can vary due to the type of building construction and situational needs of the operation. These ladder packages are meant to serve as a foundation and can be expanded to meet the needs on the incident. The ladder package is used to efficiently move needed tools and equipment from apparatus that have been

LADDERS

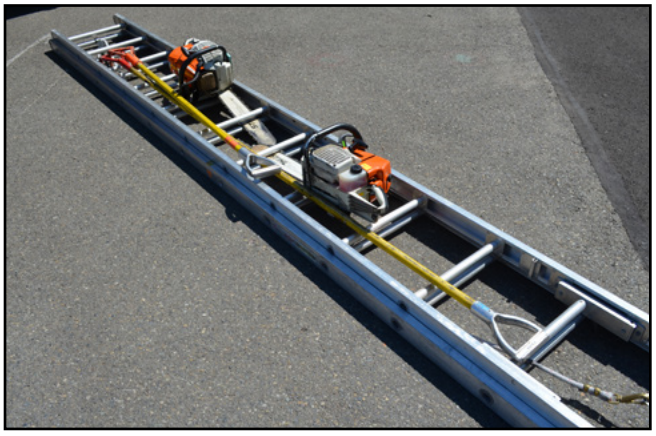
parked out of the way to the fire scene in a single trip.

Residential

Tools: 1 chainsaw, 1 rubbish hook (6' or 10'), 1 New York hook, and a set of irons.

Ladders: extension ladder and a roof ladder.

Commercial



Tools: 2 chainsaws, 2 rubbish hooks (6' or 10'), 1 New York hook, and a set of irons.

Ladders: extension ladder and roof ladder.

Additional Considerations

PPV fan, circular saws, TIC, and any additional tools that the incident may deem useful or necessary.

SUMMARY

The fire service has a myriad of fundamental skills that require constant attention to maintain proficiency, ladders being no exception. The deployment of ladders on the fire ground should be a very coordinated and fluid process.

As professionals we should all endeavor to maintain the highest level of skill with all firefighting fundamentals. Achieving this will provide a high level of service to the community and create value for our organization.

Video Links

Ladder Fundamentals	
Pivoting the Ladder	2 Person Shoulder Carry Beam Raise
Single FF 24' Carry and Raise	2 Person Suitcase Carry
Single FF Ladder Roll	3 Person Flat Carry Flat Raise
Single FF 24' High Carry Beam Raise	Shifting the Ladder
Securing the Halyard	3 Person Shoulder Carry Beam Raise
2 Person High/Low Carry Beam Raise	

Ventilation

The fire service's workplace has changed and one of several significant factors is home furnishings. As compared to legacy furnishings, the modern home furnishings are made of synthetic materials that have significantly higher heat release rates. This shift speeds up the stages of fire development creating an increased potential for ventilation-limited fire conditions prior to fire department arrival. Most importantly, the time between tactical ventilation and flashover are 2 minutes for the modern fire and over 8 minutes in the legacy fire. The legacy fire could be described as forgiving as it pertains to ventilation. The firefighter has time to recover after poorly timed ventilation or an uncoordinated attack as they have approximately 8 minutes to adapt prior to flashover. The time to recover in the modern fire is approximately 2 minutes or 25% of the legacy time.

TACTICAL VENTILATION OVERVIEW

Tactical Ventilation is the systematic removal of heated air, smoke, or other contaminants from a structure and their replacement with a supply of air. 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 and insufficiently, ventilation endangers firefighters, civilians and increases property loss. The operation must be planned and coordinated with fire attack. Thus, a "ventilation plan" should be established and continually evaluated by those at the task and strategic level. The ventilation plan encompasses all units on the fire ground and is not Ladder Company specific. 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 is essential for a coordinated effort to enhance fire attack and search operations. The ventilation methods of horizontal, PPV and vertical ventilation are the three essential means and must be dynamic as conditions change. For example, one method may be initiated for 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 the ventilation be 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 by the first-in hose line very quickly. Fires that have developed much further and are exhibiting heavy smoke under pressure on initial company arrival require a different approach. Fires with these characteristics require coordinated ventilation as a top priority in the initial operation rather than as a secondary task.

Under heavy smoke conditions, it is imperative that an effective ventilation plan is established

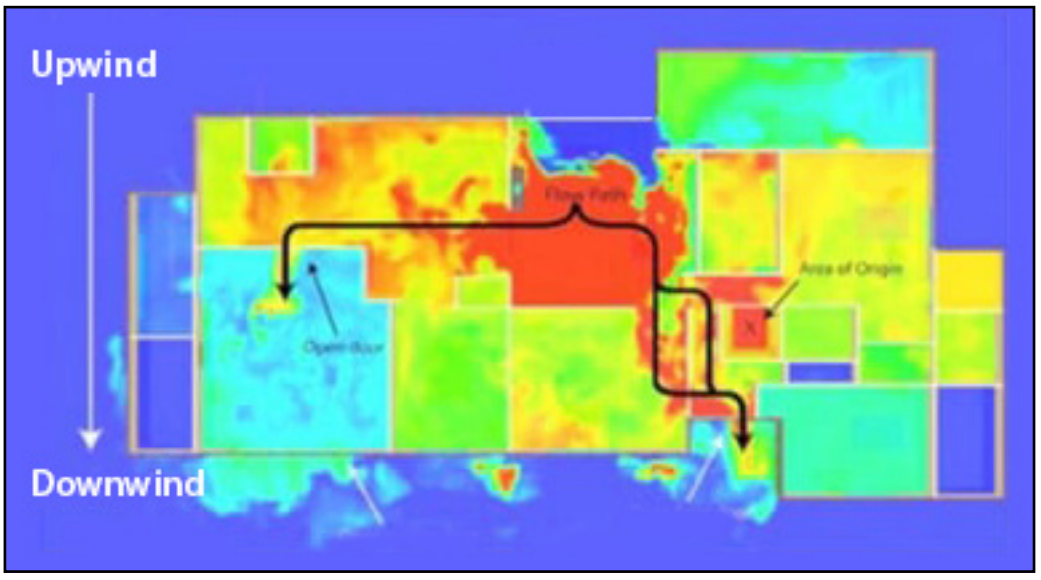
immediately by the IC or designated ventilation crew. Efficient ventilation under heavy conditions provides greater visibility and a much safer fire attack for hose crews where flashover is a possibility. However poorly timed ventilation or an uncoordinated attack can lead to flashover in 2 minutes.

STAGES OF FIRE GROWTH AND FLOW PATH

The stage of the fire (i.e., ventilation or fuel limited), the distance from the inlet (door or window) air to the fire, the distance from the fire to the outlet (door, window, roof vent), the shape of the inlet and outlet, and the type and shape of items (furniture or walls) or openings (interior doors) in the flow paths all play key roles in the availability of oxygen to the fire, and ultimately firefighter safety. 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. 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 members at significant risk due to the increased flow of fire, heat and smoke toward their position.

DOOR CONTROL

Tactically, there are several considerations for door control. Most importantly, it is a temporary action. You have to open a door to gain access into a burning home, but if you limit the air inlet you limit the fire's ability to grow. The fire dynamics of door control are fairly simple. If you have a ventilation-limited fire and you limit the air, then you limit the heat that is able to be released. While this does not completely cut off the oxygen supply, it slows it, which slows fire growth. In the UL experiments, flashover was delayed for minutes by limiting the air supply. The longer and further the door is closed, the slower the fire will grow. The door should be controlled until water is applied to the fire. Once water goes on the fire and the attack crew



Fire behavior and flow path

VENTILATION

has the upper hand, meaning more energy is being absorbed by the water than is being created by the fire, then the door may be fully opened by firefighters to ventilate.

TIMING IS EVERYTHING

The purpose of venting is to improve the conditions for firefighters to operate. Well-timed and coordinated ventilation upon application of water means better ventilation and improved conditions. Some of these improvements can be cooling, increased visibility, and useful flow paths opposite a hose line to release steam expansion. Chances of backdraft, flashover, smoke explosions and the effects of rollover are also reduced.

It is not possible to make statements about the effectiveness of ventilation unless one includes timing. That 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 also causes rapid changes in the conditions in the home. Additional considerations about timing include:

- The fire does not react to additional oxygen instantaneously
- The higher the interior temperatures the faster the fire react
- The closer the air is to the fire the faster it reacts
- The higher the ventilation the faster the fire reacts
- The more air the faster the fire reacts
- The more exhaust the more air that is able to be entrained

READING SMOKE

Looking at smoke conditions is a very important component of size-up, but firefighters should not get complacent if there is nothing showing on arrival. Smoke color may change from black to grey as the fire becomes ventilation-limited and the pressure within the house decreases. Seconds later there may be no visible smoke showing at all. No or little smoke showing could mean a fuel-limited fire that is producing little smoke or it could mean a ventilation-limited fire that is in the initial decay stage and starved for air. In order to increase firefighter safety, consider treating every fire like it is ventilation-limited until proven otherwise.

When reading smoke, 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 faster smoke is

closer to the fire location. Also indicates rate of growth…as speed increases, so grows the fire. Turbulence=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. 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).

BUILDING CONSTRUCTION

The firefighter's ability to safely and efficiently ventilate a building through its roof will depend to some degree on the firefighter's understanding of roof construction. Construction methods and materials have changed significantly over the last several decades. It is essential that firefighters become familiar with the existing and newly constructed buildings within their response district. The following descriptions of both conventional and lightweight construction are not to be construed as complete or absolute. Basic characteristics, strengths and weaknesses are given to provide a basic framework of knowledge from which to operate safely.

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 a greater window of safety for the firefighter with respect to time.

Roof framing components are continuous

VENTILATION

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 have 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 1/2" 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. This discussion will focus on the four major types of lightweight roof construction:

- Panelized
- Open web truss
- Metal gusset plate truss
- Wooden "I" beam

Metal Gusset Plate Trusses: This type of roof system commonly found in residential and commercial buildings is usually 2" x 4" lumber butt jointed and held together by metal gusset plates, commonly known as a gang nail. The gang nail commonly penetrates 3/8".

Trusses are characterized by a top and bottom chord in tension and compression. The strength of the truss lies in the geometric interrelationship. Failure occurs when one component of the truss is consumed by fire or the gang nail pulls loose due to charring. The most common spacing for trusses is 2' on center and the point where the truss crosses the bearing wall is the strongest location.

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

Open Web Trusses: This type of system has a wooden top and bottom chord that are cross-connect-

ed by steel tube web members. The top chord is in compression and the bottom in tension. The steel tubes have the ends pressed flat in a semicircular shape with a hole punched through them. The tubes are placed in slots in the chords with pins driven through them. The top chord usually rests on the bearing wall and the bottom chord is unsupported. Spans of up to 70' are possible, normal spacing is 2' on center, and the area where the roof meets the exterior wall is the strongest point.

Panelized Roofs

The panelized roof normally consists of large laminated beams spaced every 12" to 40" spanning the length or width of the building. They are supported by pilasters or steel posts on the ends. Along the span you will find either wooden or steel posts as supports. Beams can span well over 100' and are often bolted together. Normally purlins are installed with metal hangers on 8" centers perpendicular and between the beams.

Wooden 2" x 4" rafters are installed with metal hangers on 2' centers, perpendicular to and between the purlins. Decking is usually 1⁄2" plywood. The safest and strongest locations are the beams, purlins and perimeter of the building. The inherent weakness is the lightweight construction between the major framing members.

Roof Styles

There are three basic categories of roof design:

- Pitched roofs
- Arched roofs
- Flat roofs

The following discussion identifies them by category and evaluates some of the more common styles with respect to strengths and weaknesses.

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

Gable: Basic A-frame design with the roof pitched in two opposing planes. If constructed in a conventional manner, the continuous ridge, exterior and bearing walls are normally safest locations. In the lightweight version, the ceiling joists are the bottom chords of the truss, often not tied to the interior walls.

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

Hip Roof

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

Bridge Truss: This is heavy duty trussing with sloping ends. The two parallel chords are in constant tension and compression and can fail during heavy fire exposure. However, the

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likelihood of failure is dependent on the dimensions of the materials and the span of the trusses. This roof usually fails in sections and may have a large open attic space.

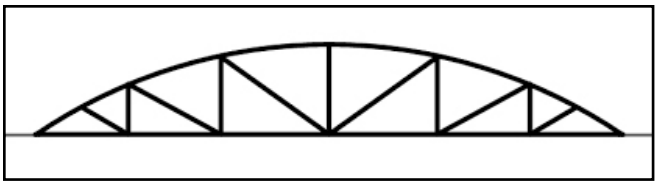
Bridge Truss

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

Mansard Roof

Arched Roof Styles: Ribbed truss, bowstring truss and lamella styles.

Bowstring: The arched chords are usually 2"x 12" lumber with 2" x 10" rafters. Tie rods with turnbuckles are used for lateral support and



Bowtring Truss

to regulate tension. The roof is quite strong but sudden collapse can occur if the tie rods are heated to failure.

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

Lamella Roof: A geometric egg crate or diamond pattern frame with sheathing laid over it. The 2" x 12" members are bolted together with gusset plates. The roof is supported by exterior buttresses or internal tie rods. The common hazard inherent in all arched roofs is their tendency towards sudden and complete collapse. Hazard should be estimated by the size of lumber and the span involved. If there is heavy fire involvement in the truss area, personnel should withdraw from the roof and the interior to avoid sudden collapse.

The Flat Roof: Conventional flat roofs are constructed with rafters 2" x 6" or larger depending upon the span. Rafters are covered with 1" x 6" sheathing often laid at 45 degrees to the

Flat Roof

outside walls. The perimeter of the building where the rafters rest on the exterior wall is considered a strength. Due to mass, rafters are also considered safe locations.

Several lightweight roof systems are used to produce flat roofs. The wooden "I" beam, metal gusset plate truss, and open web types are all previously mentioned possibilities. Identification of building construction type is most difficult in flat roof buildings. The single best way of being certain about building construction type is having previous knowledge of the building.

BUILDING SIZE-UP AND THE VENTILATION PLAN

All firefighters on the fire ground, but especially those tasked with developing the ventilation plan, need to consider the following Size-Up:

- Building type and age
  - Commercial, residential, hotel, etc.
- Location and extension of fire
  - Determines where to ventilate both offensively and defensively
- Location of doors and windows
- Type of roof and construction features
  - Determine your route of travel on the roof top.
- Ladders (Type and location)
  - Where is the roof line? Where is the roof line? Location of HVAC and scuppers help in determining this. Are you going to need a roof ladder to climb down a parapet wall? Do you need an aerial to get to the roof or will a 35' ladder be okay? Where is the secondary means of egress going to be located? The officer in charge of vent should radio the IC and state where the ladder should be located and what size needed.
- Hazards
  - Electrical wires, fascia, large roof top HVAC, roof or tilt-wall collapse potential
- The units assigned to interior fire attack, who will be in direct communication with the ventilation crew

In developing the plan, consider using natural construction openings versus vertical openings (heat holes, strip cuts, skylights). Also consider what equipment is needed and available to perform ventilation operations as well as any access issues (ground versus aerial ladders). Furthermore, the training and experience of the crew is crucial to a safe and successful outcome of the plan.

HORIZONTAL VENTILATION

Horizontal ventilation is defined as: "any technique by which heat, smoke, and other products of combustion are channeled horizontally out of a structure by way of existing or created openings". (IFSTA Fire Service Ventilation, Seventh Edition) It is important to note that horizontal ventilation is often the quickest means of beginning some level of ventilation and is the first step in a potential transition to hydraulic, PPV, or vertical ventilation.

In Horizontal Ventilation, problems have occurred when crews avoid taking out enough windows for their own safety even when the initial ventilation plan may be vertical.

Additional items to consider are the direction and speed of the wind and whether these will be a factor in ventilation. Also account for exposures near horizontal ventilation openings and whether these will be impinged upon.

VENTILATION

New buildings and older buildings retrofitted with new windows, typically double or triple pane, withstand much more heat from fire prior to self-ventilating. Multi-pane windows may not break out from heat as completely as single pane windows will, potentially causing the structure to build up much higher and more dangerous interior temperatures if firefighters enter without initiating a coordinated ventilation plan.

Window Venting

When conducting horizontal ventilation, we typically will use a window as an exhaust point. We must determine the location of the fire based off of the size up, 360 of structure, and verbal reports from witnesses. Based off of this information the horizontal opening should be as close to the seat of the fire as possible. As we prepare the ventilation opening, a charged hose line must be ready to make entry in conjunction with door control.

Venting of appropriate windows from an exterior position provides the necessary horizontal relief for advancement on a fire by interior attack lines. The optimal place to horizontally vent a fire is in the area of origin, on the side opposite the approach of the attack team. This provides the greatest effect for the amount of resources invested. However, the most important objective is that the ventilation opening draws the fire, heat and smoke away from any trapped occupants. The window opening or openings need to be large enough to vent the smoke and heat out of the building. Too small of an opening results in rapid fire development, not a lifting of heat and smoke from the floor. Openings that are adequate create a low-pressure environment, thereby drawing energy away from the hose team and out the window. This provides much-needed relief for crews approaching the fire area/room because, instead of the fire traveling out of the fire room toward the attack team, much of it will exhaust from the building to the outside, lifting the thermal layer.

The timing of ventilation is crucial. Window venting must be coordinated with the fire attack team. Disastrous results have been seen when venting takes place too early or is not coordinated. Most of the fires we arrive at are in a ventilation-controlled state, meaning the fire has the fuel it needs but has started to run out of available oxygen. These fires present themselves as heavy, dense smoke under pressure, pushing from openings in the building.

The unplanned venting of windows that have unobstructed pathways leading to the location of the fire will quickly give the fire the added oxygen it needs. If uncoordinated venting

occurs from the outside vent, the entry door is not controlled, and hose teams are not in place with charged lines to move in and extinguish, the fire will spread rapidly, enveloping interior crews and overwhelming on-scene resources. Coordination and communication between interior hose teams and outside support must be accomplished.

Window Selection

The darker the staining of a window, the nearer that window is likely to be in the area of origin. A black-stained, cracked window is closer to the area of origin than a window that simply has water droplets running down the glass. When viewed from the exterior, the conditions of windows can inform crews as to what conditions they should expect inside the building. For example, if one window is stained black and every other window in the house is clear, then there is a well-developed compartment fire with a closed door. When deciding which window to ventilate, normally the window closest to the area of origin should be vented first. Ventilation of windows other than those in the area of origin may place interior crews in jeopardy. Venting windows behind the attack team's advance toward the area of origin may cause a ventilation-controlled environment to change to a fuel-controlled environment. This new fuel-controlled environment causes gases that were once too rich to burn to ignite with the influx of fresh air. This will cause a rapid and unexpected increase in heat to an un-expecting hose team.

When we determine the ventilation opening location, we must size up the window. Is it plate glass or tempered glass? Plate glass will break into shards and tempered glass will be an explosion of small, pebble like pieces. Tempered glass will be found in doors, next to doors, in bathrooms, and windows that are close to the ground. These will take a strong strike with a pointed object to get them to break. A pick head axe, Halligan pick, or a center punch may be used. Plate glass windows will be found in bedrooms, living rooms, and areas that people cannot fall through them. These windows are much weaker and will not take much force. Use the side of a tool to break the window. Try to strike the window high, holding the tool high, so that glass does not guillotine you from above. The fire fighter should be upwind when breaking the window so that the smoke is moving away from them. As with both types of glass, clear the opening after the window is broken. This would include the glass, blinds, and curtains.

If the hose line advancement is still difficult due to high heat, removing more windows from the fire room until enough cooling is accomplished is preferred. Consideration must be given to preventing any flames from the ventilated window/windows from lapping and extending the fire.

POSITIVE PRESSURE VENTILATION

Positive pressure ventilation is a system of using powered fans and the control of entry and exit openings within a structure to provide the pressure necessary for directed air movement. The objective is to create and sustain a slightly higher internal pressure, forcing heat and fire gasses to an area of low pressure or resistance (selected or

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natural exit points). Studies have concluded that effective PPV raises the pressure of the interior atmosphere to just 0.1 to 0.2 pounds per square inch. A thorough understanding of this process allows firefighters to increase their safety and to improve the survivability of occupants inside a structure.

Effective PPV can channel heat and products of combustion out of a structure via the most efficient and least destructive path while reintroducing fresh air. A survivable atmosphere is created much faster than with natural or horizontal ventilation alone.

A PPV fan may be used to defend real estate, as in a strip mall. A positive pressure fan may be set in an adjacent space next to the fire room/occupancy to pressurize the area and keep fire from spreading into the unaffected space.

A PPV fan may also be used to evacuate smoke from a structure. This is typically applied immediately after a fire attack team has extinguished a fire and checked for extension. The starting and stopping of the fan is directed by the interior fire officer who is in the best position to determine visibility and fire extinguishment. Application of the fan should be short term and used only long enough to clear smoke conditions. Early termination of the fan restores fire ground communications.

What we know about PPV:

- Exhaust points should be about ¾ to 1-1/2 times the entry point. This may change based on the distance of the exit point from the entry opening or based on higher power fans.
- Should know location of fire and make exhaust opening as close to the seat of the fire as possible.
- Must be coordinated with fire attack.
- Must have an exit point prior to putting fan into place.
- Must have attack corridor integrity. Too many openings make PPV ineffective and dangerous.
- The cone of air should cover the entry point.
- The fan creates a jet stream that moves through the structure.
- The jet stream will move along the path of least resistance.
- Too many openings will reduce the flow of air through the structure.

PPV works best if we keep a big flow of air moving that will overpower the pressure that is generated by the fire. A small flow of air will only feed the fire and not remove the heat, smoke and steam. PPV may also be used with both horizontal and/or vertical openings.

As stated in the horizontal ventilation section of this document, exit openings may be made either by the fire or by firefighters carefully selecting them. It is important to remember that horizontal ventilation initiated by first-in companies is typically the first step to a possible transition to PPV. The selection, timing and communication of appropriate entry/exit openings are a critical part of the ventilation plan. As with any fire ground technique, it is also important to understand the

limitations or contra-indications in the use of PPV.

Positive pressure ventilation should not be used:

- Do not use if victims are between the fire and exhaust point,
- Combustible dust is stirred up.
- Conditions of a backdraft
- Do not know the location of the fire

When positive pressure ventilation is utilized it must be managed to ensure it is accomplishing the ventilation that is desired. If it is not accomplishing the desired results, did it get knocked out of the way, run out of fuel, weather conditions stronger than the blower, or uncontrolled openings?

Ventilation Opening

The PPV ventilation opening in single family residences is typically the same access point initial crews are using for the fire attack. Any subsequent openings need to be carefully communicated and understood by all fire ground personnel.

There are many fan configurations to help increase volume or effectiveness in differing structures. In residential structures however, single fan placement is very common and effective. Studies have shown that placement 8-10 feet from the opening will produce the most consistent volume. However, firefighters may have to move the fan closer because of the characteristics or limitations of the entry opening (stairs, landscape, and porches). Studies have shown that volume will be reduced in this case; however, ventilation will continue to be effective.

After PPV is applied to the entrance of the attack corridor, observe direction of the smoke flow. If the smoke flow is toward the fire room vent opening, PPV is effective. If the smoke and fire gases are still moving toward you, consider the following:

- Closed doors, windows or prevailing winds may be overcoming the blower, possibly making the entrance corridor unsafe for entry.
- Over pressurizing of space.
- Fire behavior may have rapidly increased making entry risky.

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

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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."

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 unknown.

- 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 (VES). In VES, 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 extension 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 hostile 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 prevent 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.

Hydraulic Ventilation

Hydraulic ventilation is typically utilized by a fire attack team after they have blacked out the fire. The production of steam and cooling of the smoke has decreased visibility and hydraulic ventilation will give the fire attack team the ability to improve their environment. They will need to make an exhaust point in the room they are in. They may do this by opening the window or using a window that was already used for horizontal ventilation. Set a fog pattern approximately 30-60 degrees at least 2 feet back from the opening. Fill the opening 85-90% with the fog stream. Be aware of your surroundings as you spray to the outside and also the fresh air you bring to the fire room. Have a member of the crew be alert for changing conditions as the fire may grow.

Hydraulic ventilation is a very effective initial tactic in removing "fire room" smoke and heat, but

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lacks the cubic feet per minute (approximately 6,700cfm with 1 ½" line) as a sustained structure-wide ventilation plan. Once a crew has been assigned to ventilation duties, a transition to PPV is preferable to hydraulic ventilation.

VERTICAL VENTILATION

"Taking the lid off" does not guarantee positive results. Vertical ventilation is the most efficient type of natural ventilation. While it allows the largest amount of hot gases to exit the structure, it also allows the most air to be entrained into the structure. Coordination of vertical ventilation must occur with fire attack just like with horizontal ventilation.

The way to make sure that the fire does not get larger and that ventilation works as intended is to take the fire from ventilation limited (needs air to grow) to fuel-limited by applying water. As soon as the water has the upper hand (more energy is being absorbed by the water than is being created by the fire), ventilation will begin to work as intended. With vertical ventilation this will happen faster than with horizontal ventilation assuming similar vent sizes. Crews assigned to ventilation must coordinate with the interior attack crew, the location and readiness for ventilation prior to creating any openings on the roof.

Why Vertical Ventilation?

Firefighters perform the tactic of vertical ventilation by cutting the roof for one of three primary reasons: fire control, firefighter safety, and civilian life safety.

Venting for fire control - is the opening up of a structure in order to limit and control fire spread, permitting rapid advancement and extinguishment of the fire. Examples of venting for fire by cutting the roof include limiting horizontal fire spread in an attic or top floor and removing heat and improving visibility for fire attack.

Venting for firefighter safety - is the opening up of a structure to reduce the likelihood and severity of a hostile event or prevent firefighter disorientation. Venting for safety may be accomplished by cutting the roof when an attic is filled with combustible smoke. An under-ventilated fire presents the potential for a backdraft, ventilation induced flashover, or fire in a void space that may be charging the building with a potentially flammable smoke mixture.

Venting for civilian life safety - is the opening up of a structure to allow the occupants to escape, provide fresh air to those that cannot, and permit a search for and removal of viable victims. This philosophy encompasses all ventilation methods. However, due to the time necessary to perform vertical ventilation, it is unusual for roof cutting to be as effective as targeted searches in

combination with other ventilation techniques (horizontal, PPV). When severe conditions prevent a rapid interior search, victim viability is questionable except in rooms that are isolated by closed doors. Ventilation strategies must be prioritized, coordinated, communicated, and balanced with the needs of the incident and the present conditions. In many cases, a combination of methods is necessary.

Ventilation is a calculated balance between removing smoke and heat while increasing oxygen flow to the fire and subsequently increasing the burning rate. Consideration of positive and negative effects must be considered when formulating a ventilation strategy.

When to Perform Vertical Ventilation

There are four types of fires which may frequently require vertical ventilation. These fires include: attic fires, top floor fires, lower floor fires which have over-pressurized the building, and fires in balloon framed construction.

Attic fires may benefit from vertical ventilation by reducing horizontal fire spread and releasing smoke and heat to prevent a smoke ignition or backdraft. It is good practice to not pull ceilings during attic fires until the roof has been cut. This is not intended to prevent early and aggressive application of water to the attic but to reduce the probability of a hostile fire event before the fire is under control. It also reduces interior damage to the structure.

Top floor fires can often be positively impacted through vertical ventilation. Cutting the roof during top floor fires may localize attic extension, reduce horizontal spread on the top floor, and prevent the occurrence of a flashover or backdraft.

Top floor fires also present a unique challenge to Engine Companies trying to advance. While fires on lower floors can vent heat and smoke to the floors above, this is not possible at top floor fires. Super-heated smoke tends to bank down stairs or charge entry doors creating a punishing advance on the fire area. Vertical ventilation can often relieve these conditions and allow the Engine Company to make the floor.

Fires on lower floors of single family residences are

less likely to require vertical ventilation. Modern synthetics, however, have changed the burning characteristics of today's fires. 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. Vertical ventilation can be an effective tactic in releasing this heated smoke by channeling it up stairwells and out of the building.

Buildings with balloon framed construction pose significant risks and challenges to interior firefighters. The interconnected voids of balloon framed buildings significantly increase the

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probability that any fire will extend to the attic. For this reason, vertical ventilation is often a positive, proactive step regardless of a fire's location.

In addition to contributing to fire spread, balloon framed buildings often pose the additional risks to interior firefighters of smoke ignition and flashover. The age of balloon framed buildings often indicates that the interior membranes of these structures may be lath and plaster. This construction method creates chimney like void spaces which are lined entirely with rough cut wood. These voids can produce significant volumes of smoke when exposed to even moderate heat. The smoke and heat fills the voids and is then pushed out, under pressure, through old, poorly maintained plaster in un-predictable locations. This innocent looking smoke is a major contributing factor in smoke ignitions and flashovers. It is good practice to ventilate a compartment of smoke prior to opening walls and ceilings to reduce the likelihood of smoke ignition.

How big of a hole?

A 4 ft. by 8 ft. hole over a ventilation-limited fire does not allow more smoke and hot gases to exit than it creates. When water is applied to the fire to reduce the burning rate, the fire becomes a fuel-limited fire. Once the fire is fuel-limited, the larger the hole the better conditions become for any potential victims or firefighters operating inside the structure.

Where do you vent?

Ventilating over the fire is the best choice if your fire attack is coordinated. The closer the source of the air to the seat of the fire, the quicker it will increase in size. Placement of vertical ventilation can be a complex situation, especially if you do not know where the fire is in the building. Optimally, where you vertically ventilate depends on the room geometry, door locations, air inlet location, and subsequent flow paths. If you ventilate in coordination with fire attack (the hose stream is removing more energy than is being created), then it does not matter where you ventilate, but the closer to the seat of the fire, the more efficient the vent will be in removing heat and smoke, which will improve conditions for the remainder of the operations taking place on the fire ground. Ventilating remote from the fire can be effective under some circumstances. If the fire is in a room that is connected to the rest of the house by a doorway, ventilating the roof outside of that room could allow for smoke to be cleared from the rest of the house. However, as air is entrained to the room, fire will increase in size, while visibility may improve in the flow path leading from the air inlet to the fire room. This is an example where the vertical ventilation may improve visibility even though the fire may grow and local temperatures may increase.

After cutting the desired hole, you should

evaluate effectiveness. The initial release of heat and smoke is usually quite intense. If after fifteen to thirty seconds the intensity and pressure do not subside, consideration should be given to enlarging the hole or strategically cutting another. If the vent group leader is not sure of the relative effectiveness of the hole, a simple communication with an interior attack crew will give an immediate ventilation status.

Safety Considerations

Fire conditions can change at any time. For this reason, the company officer should employ the LCES while operating on a roof.

Lookouts: Always maintain an "eye" on the fire and observe all conditions and areas potentially involved in the fire.
Communication: Establish and maintain clear communications with the crews you are supervising and working with as well as the IC.
Escape Routes: Identify escape routes and secondary means of egress.
Safety Zones: Identify the safe areas to operate and retreat.

Some of the safety precautions that should be practiced:

- Observe wind direction with relation to exposures.
- Work with the wind to your side or back to provide protection while cutting the roof opening.
- Note the existence of obstructions or excess weight on the roof. These may make operations more difficult or reduce the amount of time before a roof fails.
- Provide a secondary means of escape for crews on the roof.
- Extend ladders at least five rungs above the roof line.
- Check for structural integrity by sounding forcefully with a rubbish hook before stepping onto the roof; do not jump onto a roof.
- Exercise care in making the opening so that structural members are not cut.
- On steeply pitched or slippery roofs use a roof ladder for secure footing. A rubbish hook with one tine buried into the roof also provides a more secured footing.
- Make sure that a roof ladder (if used) is secured over the peak of the roof before operating from it.
- Use extreme caution while using a roof ladder on metal roofs.
- Exercise extreme caution in working around electrical wires and guy wires.
- Make sure the angle of the cut is not towards the body.
- Ensure that all personnel on the roof are wearing full PPE including SCBA.

The following warning signs of an unsafe roof condition may merit the

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abandonment of ventilation operations:

1. Melting asphalt
2. "Spongy" roof (a normally solid roof that springs back when walked upon)
3. Fire coming from the roof
4. Sagging roof sections

The Roof Package

The basic roof package for a single family residence can normally be assembled and carried to the area of operation by two members in a minimum amount of time. While it may not seem necessary to bring all of the equipment every time, doing so allows the essential flexibility such as adding another team on the roof. Optimizing equipment transfer to the building will benefit the vertical ventilation operation by reducing set-up time. It will also prepare for unforeseen challenges and changes in assignment.

It is recommended that the roof package consist of the following minimum equipment:

- All members should carry a scabbard axe
- A ground ladder which will extend a minimum of five rungs above the roof line.
- A roof ladder.
- One chain saw.
- One roof hook.
- Halligan (If used for a foot hold)
- TIC

Ventilation Cut Sequences

The following are example evolutions for vertical ventilation operations. The procedural guidelines addressed are intended to be recommended practices. Building construction irregularities and other conditions may indicate procedural deviances from the examples given. It is also acknowledged that many veteran firefighters have refined their individual techniques based on experience and their capability. The following is not intended to replace this experience level; it is to identify key elements in the process to assure interior relief in the safest, most efficient manner. It is up to the company officer to lead his or her crew to perform safe, efficient, and prudent ventilation operations.

Residential Pitched Roof Vertical Ventilation

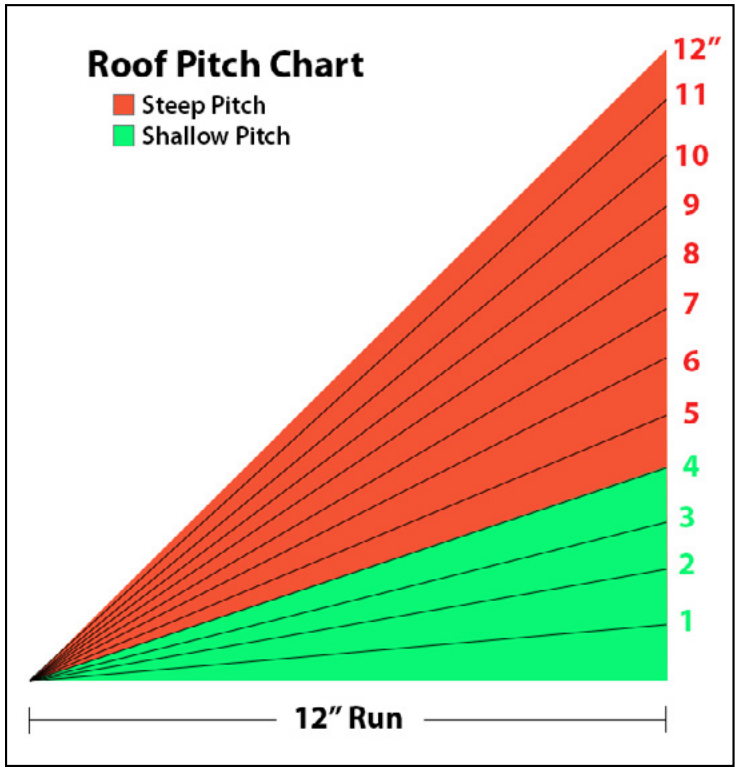
When sizing up the pitched roof for vertical ventilation, one of the first considerations should be whether or not a roof ladder is needed. The walkability of a roof is determined by factors such as access point(s) height, ice, rain, moss, roof covering, and pitch. Some of these factors can be determined from the street and others may be more difficult to observe. The challenge of fully sizing up a roof from the apparatus dictates that all equipment that might be needed be taken to the area of operation, including a roof ladder.

The roof ladder is intended to provide good footing and is not to be used to distribute the weight of the ventilation team on a weakened roof. If the roof is structurally unsound, members should not attempt vertical ventilation. The instability of a roof is vital information that must be communicated to command and interior companies.

On complex pitched roofs with multiple hips, gables and dormers, every effort should be made to approach the ventilation site by moving uphill utilizing exterior wall lines, bearing walls, division walls, valleys and ridge lines. It is imperative that all roofs be evaluated for structural strength prior to placing firefighters on them. Be aware of the possibility of fire in concealed spaces and use

indicator holes, inspection cuts and aggressive sounding to verify and update the safety of your position on the roof. When operating on pitched roofs, the previous standard was: Always cut the hole at the highest location. Ventilation group leaders should not fall into this trap. Each incident is unique and requires a specific solution to its ventilation scenario. Remember, when you open the roof you will be moving heat, smoke and fire from their present location along a path to the vent hole. If we are going to open an attic that is not involved, we should place the hole precisely over the involved area and push out the ceiling, minimizing the exposure to the building and attic.

Be aware of multiple re-roofs before a teardown is necessary on a structure. This may make evaluating the conditions, structural integrity, and the potential difficulties of the evolution challenging.



Roof Decking

The safety and operational ability of the roof team may be determined by the type and condition of the roof decking. Skip sheathing was a common form of roof decking on single family dwellings for many decades. Skip sheathing normally consists of one inch by four inch boards laid horizontally across the rafters with a two to four inch gap between them. Shingles or another roof covering is then affixed to the roof boards. Skip sheathing maintains its strength when heated but is easily penetrated by smoke and fire gasses. These gasses will often leak out between the roof boards and show from beneath the roof shingles or other covering as many small jets of smoke. These multiple small smoke columns are known as streamers. Streamers are a normal sign in a building with skip sheathing and do not always indicate that the roof decking is structurally compromised. Streamers are essentially a sign of attic pressurization and likely extension to this void space.

Plywood and OSB sheeting reacts differently than solid wood when subjected to heat. Initially, plywood or OSB will trap and contain the fire gasses directing it out through attic vents and eves but rarely from beneath the shingles or other roof covering. Heat attacks the glues that hold plywood or OSB together, causing it to break down and delaminate. This process destroys the structural integrity of the plywood and OSB allowing smoke to eventually pass through it and form streamers. Roof decking, which is being attacked by free burning flames, will be quickly compromised and burn through. The loss of roof decking normally precedes the failure of wooden structural members such as rafters and trusses providing a critical warning sign of potential roof system collapse.

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Ventilating a Walkable Pitched Roof – "Shallow Pitch"

When the roof is determined to be walkable, and a roof ladder is not needed, the access ladder should be located away from the fire and to a strong area of the roof. The roof is strongest at the corners, ridges, valleys, and hips. The access ladder should not be above a window or horizontal opening which may vent fire and cut off egress, or in a location that will hamper hose line advancement.

The first member up the ladder should take a roof hook and aggressively sound the roof before stepping onto it. The purpose of sounding is to determine the structural integrity of the roof decking material which will bear the weight of the firefighters. Sounding the roof of a single family residence is not likely to establish the location or stability of underlying structural members like rafters or trusses. If the integrity of the underlying structural members is in doubt, personnel should not be operating on or below them. It is a responsibility of the roof team to alert command and interior companies of an unstable roof system.

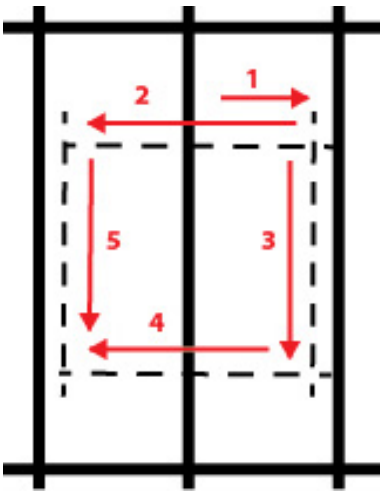
The roof team should sound the roof deck with a roof hook as they move towards the area of operation. While walking on the roof, members should remain on areas of strength such as hips, valleys, ridges, and exterior walls. Traveling "cross country" or in a diagonal path must be avoided. The lead member, with the roof hook, is normally the most experienced firefighter and determines the location of the initial ventilation hole.

The second member to the roof should ascend the ladder and follow the sounder to the area of operation with the appropriate equipment. The second member may or may not have the saw running. However, it is advisable to assure a saw is operating properly before ascending.

Residential Cut Sequence – Shallow-Pitch

The following is a description of a commonly recognized and proven cut sequence for a residential structure called the "5-Cut" Center Rafter Louver. It is intended as a baseline method of operating safely on a roof and working back to an established egress point. *Please see Figure 1.*

Initial Louver



1. The first cut of the ventilation hole is a horizontal, top cut or "ID Cut". This cut is made parallel to the ridge, towards the fire and away from the egress route and stopping at the first rafter encountered. This cut is made about a foot below the ridge (to avoid metal flashing and rafter brackets). The "ID Cut" is made to identify a starting or outside rafter.
2. The second cut is the top or "Head Cut". It should connect with the "ID Cut" and is a horizontal cut away from the fire and towards the egress route. The "Head Cut" should roll one rafter and stop at the next one.

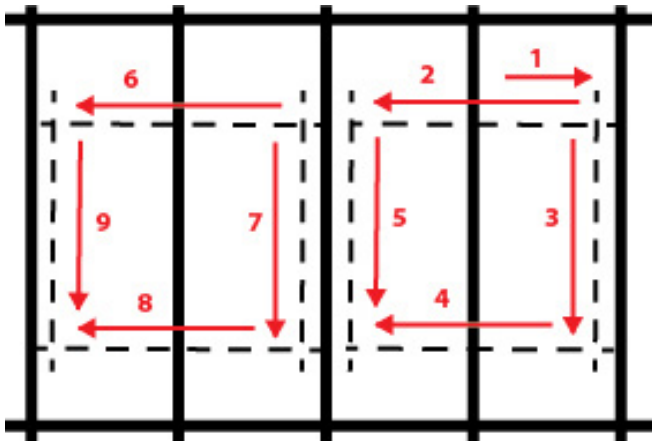
3. The third cut is a vertical, "Down Cut" starting just inside of the outside rafter closest to the fire and furthest from the egress route. This "Down Cut" should extend down about four feet.

4. The fourth cut is a horizontal, "Bottom Cut" connecting with the first "Down Cut" and being made towards the egress route and away from the fire. The "Bottom Cut" should roll one rafter and stop at the next one.

5. The fifth cut is a vertical "Down Cut" completing the first louver. It is made on the fire side of the rafter at which the "Bottom Cut" stopped.

Once the first cut sequence has been completed, the member with the roof hook can open the louver and push down the interior ceiling to evaluate smoke conditions, relief provided, and need for expansion.

Horizontal Expansion - Second Louver



6. The sixth cut is an expansion of the original "Head Cut" in an increment of odd rafters determined by present conditions and the experience level and orientation of the sawyer.

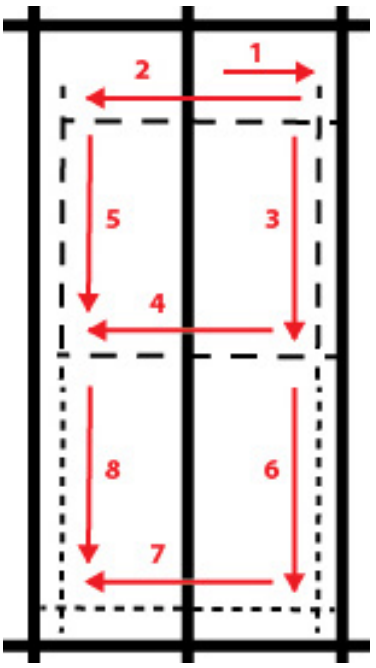
7. The seventh cut is a vertical "Down Cut" made four to six inches from the last "Down Cut" towards the egress route and away from the fire. This will allow it to skip over the rafter which will be between the two louvers.

8. The eighth cut is a horizontal "Bottom Cut" connecting with the last "Down Cut." It is made towards the egress route and away from the fire. The "Bottom Cut" should roll one rafter and stop at the next one.

9. The ninth cut is a vertical "Down Cut" completing the second louver. It is made on the fire side of the rafter in which the "Bottom Cut" stopped.

This sequence of cuts can be continued for additional louvers if a larger initial "Head Cut" was made. However, the sequence would start at cut 7 and continue in that pattern (7, 8, and 9) the length of the "Head Cut."

Vertical Expansion - Second Louver



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RESIDENTIAL VENT EVOLUTION

6. The sixth cut is an expansion of the original "Third Cut" in the 5-cut sequence. This cut will extend the original outside vertical cut down the roof another 4'.
7. The seventh cut is a horizontal "Bottom Cut".
8. The eighth cut is a vertical down cut extending the original "fifth cut" in the 5-cut sequence.

Once the second series (or more) of cuts have been completed the member with the roof hook can open the louvers and push down the ceiling below.

The roof team must communicate to command and interior companies when the initial ventilation hole has been opened, or if for any reason there is a delay in completing the ventilation objective. The effectiveness of the initial hole(s) should be evaluated. Smoke pushing out under pressure or "boiling" indicates the ventilation is inadequate. If any doubt exists regarding the adequacy of ventilation, the hole(s) should be expanded either horizontally or vertically. Please see Figure 1 for the typical vertical expansion for either skip sheeting or plywood/OSB.

Expanding the initial ventilation opening is preferred to cutting a new hole. However, conditions at the ventilation hole may be severe and require giving up some roof and starting a new hole. Once the roof has been cut it should generally be opened further until the fire is under control or safety requires withdrawal.

Ventilating a Non-Walkable Pitched Roof – "Steep Pitch"

Laddering a non-walkable pitched roof presents fewer ventilation and access options than a walkable pitch. The necessity of laddering in a location which supports roof ladder placement and the ventilation hole reduces consideration of most other factors. Two factors remain of paramount concern however; not laddering a portion of the roof which may be compromised by fire and not placing the access ladder in front or above a window which may vent fire and cut off egress. Avoiding potential fire impingement on the egress ladder is a significant concern when operating on a non-walkable roof because members may not be able to travel to another egress ladder.

The effective size of the ventilation hole is frequently determined by the placement of the

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roof ladder in relation to the rafters or trusses. Placing the roof ladder on the non-fire side of a rafter will maximize the size of the louvers when they are cut. To determine the location of the rafters, the underside of the eves may be examined for rafter tails. However, if the soffit is boxed in or covered in bird blocking this will not be possible. Delay in ventilation, however, is not warranted in order to determine the ideal location for the roof ladder.

The first member to the roof should take a roof hook and roof ladder. The roof ladder should be carried to the roof with the hooks extended and lifted above the roof line until it pivots onto the roof. The roof ladder can then be slid up to the ridge with the hooks facing down on the roof. All members need to asses a roof ladder for stability and its hold on the ridge prior to climbing it.

Before the first member steps on the roof or roof ladder the roof deck must be sounded for integrity. Sounding for roof decking integrity should continue as the member climbs the roof ladder. The purpose of sounding is to determine the structural integrity of the roof decking material which will bear the weight of the firefighters.

Sawyer Support

When the first member has climbed the roof ladder and sounded the area of operation, that member should indicate to the second member where lateral support is necessary. This can be accomplished in a variety of methods and will usually be determined by conditions, pitch, covering and the preference and comfort level of the crew. Listed below are the more common techniques to assist a sawyer working out over a roof ladder.

Halligan - Placing a Halligan bar for a foothold is fairly simple. The pike should be firmly driven into the roof where the sawyer wishes to place his foot and the bar rotated vertically so the fork points down the roof. This option is very effective but limits flexibility and is difficult to readjust.

Service Axe - In the past, members have been taught to use a service axe as a foothold. This is no longer an acceptable practice. The shape and short length of the service axe pick makes it highly unstable and prone to disengaging from the roof.

Toe Holds - Cutting toe holds in the roof is another option. A small triangular cut, approximately six inches on a side, will provide the sawyer with a foothold where it is needed. This method is not indicated if heat conditions are severe or fire shows from the triangular cut.

Body to Body - Depending on pitch and covering, some members use a body to body method. A backup member typically places their foot laterally off the roof ladder while having one hand on the sawyers backpack and the other

secure on the roof ladder rung. The foot of the backup member supports the foot of the sawyer.

The roof/rubbish hook - The hook should be placed approximately six to twelve inches below and six to twelve inches past the lower outside corner of the planned louver. Rafters are normally sixteen inches on center making most louvers approximately three feet wide. Newer truss construction is frequently spaced twenty four inches on center.

The second member on the roof should climb to the roof with the chain saw running and identify where the first member wants the roof hook placed for a foot hold. Depending on pitch and room, the roof team may then perform a tool pass.

The tool pass is performed with attention to safety. The chain saw is always passed with the chain brake on and the power head offered to the receiving member when the saw is running. The bar or blade of a power saw should never be presented to another member during a tool pass. The saw is always passed on the fire side of the ladder over the planned hole while the roof hook is passed on the other side by sliding the head up or down the roof.

The second member, now with the roof hook, should place the roof hook's upslope tine firmly in the roof deck where it was requested. The roof hook should be deeply buried and pivot freely in the roof. Sinking the upslope tine in the roof may be easiest if one hand acts as a pivot, palm down on the D-handle, and the other drives the hook, and palm down on the shaft of the roof hook.

The member who will be using the roof hook as a foot hold is responsible for confirming it is properly set and requesting that it be replaced if necessary. Once the roof hook's tine has been securely set in the roof deck the shaft is held firmly against the beam of the roof ladder. The shaft of the roof hook must not be lifted off the roof ladder's beam until the evolution is complete. If the hook needs to be adjusted it should be slid up or down the beam of the ladder but not lifted off of it.

If the roof hook is lifted off the beam of the roof ladder the sawyer's foot may slip under the shaft and dislodge the hook from the roof. The sawyer's foot or leg will act as a fulcrum and quickly pry the roof hook's tine out of the roof deck with little effort or pressure. The sawyer could suffer a serious fall resulting in injury if the correct technique is not used.

The roof hook should initially be held against the ladder beam in an approximately horizontal position. The sawyer may then step off the roof ladder and onto the roof using the roof hook to back his foot similar to a ledger board. The sawyer must keep his feet flat on the roof at all times and backed by the roof hook. Stepping directly on the shaft of the roof hook can be dangerous and result in a fall because it is round and does not provide a stable platform.

- The first cut of the ventilation hole is a horizontal, top cut or "ID Cut". This cut is made about a foot below the ridge (to avoid metal flashing and rafter brackets), towards the fire and away from the roof ladder and stops at the first rafter encountered. The "ID Cut" is made to identify a starting or outside rafter.
- The second cut is the top or "Head Cut". It should connect with the "ID Cut" and is a horizontal cut away from the fire and towards the roof ladder. The "Head Cut" should roll one

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rafter and stop at the next or four to six inches before the roof ladder whichever is encountered first.

- The third cut is a vertical, "Down Cut" starting just inside of the outside rafter identified by the "ID Cut". This cut should extend down as far as is safe but not past the sawyer's feet or the roof hook.
- The sawyer should then place one foot on the roof ladder or firmly grasp it with a hand. When the sawyer is secure and if using a roof hook for support, the second member can slide the hook down the beam of the roof ladder approximately one foot (one rung). This creates room for the sawyer to safely make the "Bottom Cut", remain balanced, and maximize the size of the ventilation hole.
- The fourth cut is a horizontal, "Bottom Cut" connecting with the first "Down Cut" and rolling one rafter and stopping at the next or four to six inches before the roof ladder whichever is encountered first.
- The sawyer returns to the roof ladder to make the final cut. The fifth cut is a vertical "Down Cut" just inside of the rafter that the "Bottom Cut" stopped at, or approximately four to six inches from the roof ladder if no rafter was encountered, this completes the louver.

The two members may then perform a tool pass if necessary and move lower on the roof ladder so that the both members are below the louver. The louver is then opened and the ceiling pushed down.

The roof team must communicate to command and interior companies when the initial ventilation hole has been opened. The effectiveness of the initial hole should be evaluated. If any doubt exists regarding the adequacy of ventilation, the

hole should be expanded vertically, often to the gutter line. This also ensures ventilation of all possible void spaces in the attic.

Expanding the initial ventilation opening down the roof is preferred to cutting a new hole. However, conditions at the ventilation hole may be severe and require giving up some roof and starting a new hole. If the ventilation crew is driven away from the initial hole, re-assessment of the location and size is prudent. Regardless, once the roof has been cut it should generally be opened further until the fire is under control or safety requires withdrawal. At no time should ventilation holes be made on both sides of a roof ladder since this can cut off egress and endanger the roof team.

The Ceiling Punch

On some steep pitched roofs the roof hook may not be long enough to push down the ceiling. This situation can normally be identified during the size up and a long pike pole must be taken to the roof. Roof teams must also be prepared for

T&G or other substantial ceiling material which would make it very difficult to punch for a heavily charged compartment fire. A pike pole or an inverted roof hook in many cases will work better because of the concentrated force it applies. Regardless, if difficult or unusual conditions are encountered, it should be brought to the attention of the Incident Commander. There may be undiscovered construction features that need to be addressed.

When making the punch, it is important to aggressively hit in all directions to maximize the available opening to provide the necessary relief for interior crews. It is not productive to cut an 8x4 hole in the deck followed up by a 2x3 ceiling punch. It is the goal to cut a large enough hole(s), followed by a sufficient and equally sized punch to increase the probability of spanning interior walls and relieving the most pressurized area(s). It is the resulting conditions after the punch that will dictate whether there is a need for additional holes and/or extension of the first set.

SUMMARY

Tactical ventilation is not exclusively a truck company function. 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, a more difficult, complex and extended operation, should be reserved for truck companies. Therefore, commercial ventilation operations are not incorporated in the SKCFTC Task Manual.

Hose & Appliances

The fire service has many ways to load and deploy firehose. 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 SKCFTC 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 hoselines and water delivery on the fireground. It is intended to be a reference for recruits, apprentices and veteran firefighters.

DEFINITIONS

Adapters: Device for connecting hose couplings of dissimilar threads.

Attack Hose: Hose that is used by firefighters to combat fires.

Booster Hoseline: Non-collapsible rubber-covered, rubber-lined hose wound on a reel and mounted on apparatus and used for extinguishment of incipient and smoldering fires.

Fire Department Connection (FDC): Point at which the fire department can connect into sprinkler or standpipe system to boost the waterflow in the system.

Flat Load: Arrangement of fire hose in a hose bed in which the hose lies flat with successive layers one upon the other.

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.

Master Stream: Large caliber water stream that delivers 350 gpm or more.

Preconnect: Attack hose 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 quickly and aggressively attack the fire from the exterior to slow progression of the fire making interior more tenable for possible victims and firefighters.

Reducer: Fitting used to attach a smaller hose to a larger hose.

Siamese: Hose appliance used to combine two or more hose lines into one. The Siamese has multiple female inlets and a single male outlet. An example of a Siamese is a fire department connection.

Spanner Wrench: Small tool used to tighten or loosen hose couplings; can also be used as a prying tool or a gas key.

Standpipe System: Wet or dry system of pipes in a building with fire hose outlets installed in different areas or levels of a building to be used by firefighters.

Standpipe Wheel Firefighter: The Standpipe Wheel Firefighter makes all connections to the

standpipe and ensures that the correct pressure is achieved using the inline pressure gauge. This firefighter becomes a remote engineer, and may assist in advancing the attack line but must be available to make pressure adjustments as needed.

Supply Hose: Hose that is designed for the purpose of moving water between a water source and a pump that is suppling attack hoselines or fire suppression systems.

Wye: Hose appliance with one female inlet and multiple male outlets, usually smaller than the inlets. Outlets are also usually gated.

CONSORTIUM HOSE LOAD OVERVIEW

In an effort to maintain consistency the following hose loads will be the standard for Consortium Engine companies.:

- 1000' of supply loaded on the right side.
- 4- Pre-connects (3 – 1¾ @ 200', 1- 2½ @ 200')
- 2½ bundles 4 @ 100' each – 100' bundled W/O a nozzle on the bottom & 100' bundled with a fog nozzle stacked on top, repeat in adjacent slot using a solid bore nozzle in place of the fog nozzle
- 2 – 1¾ apartment bundles @ 150' each with gated wye on one bundle minimum.

- 2½ flat load @ 400' – 600' flagged every 100' with the last 100' bundled. Divider spacing should be 2-3 hose width wide depending on overall space needed for the rest of the hose bed.

This is the basic configuration and may need to be adjusted for specific apparatus. The pictures show the load on a training engine, please note the flags on the pre-connects and flat load.

Supply Hose

Hose carried on our engines will be of two different colors to help the engineers with their deployments. 100' sections will typically be colored yellow or tan in color. This will be the first 800' of supply hose loaded into the hose bed. The next 200' of hose and final hose will be 50' sections and colored other than tan and yellow. Typically the 50' sections will be red in color. These shorter lengths of hose help the engineers when making up a supply line or overhauling their own supply, when the overhaul is a short distance. The entire hose bed will carry 1000' of supply hose.

Pony 5" Sections

If your engine carries them, pony sections are normally 20'-25' sections of supply hose. These shorter sections of hose assist the driver to make his/her own hydrant. These can be used either on a reverse lay or refilling the tank water in the engine. These shorter lengths are normally colored blue.

Pony 2 ½" Sections

If your engine carries them, 2 ½" sections are used to refill our engine water tanks, in the non-emergency mode. These are normally carried next to the larger pony sections of hose and used to ease the refill process.

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High-Rise/Standpipe Hose

For consistency, the following hose loads will be the standard for the consortium engine companies:

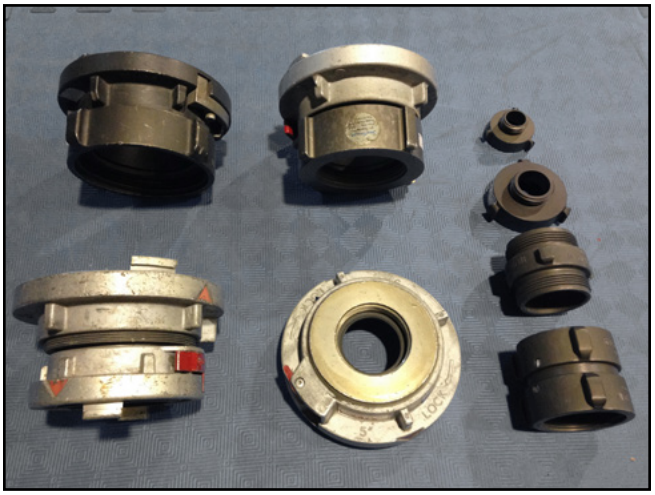
- 1000' of supply hose loaded on the right side
- 4 – Pre-connects (3 – 1 ¾" @ 200', 1 – 2 ½" @ 200')
- 3 - 2 ½" standpipe bundles @ 50' each, one 50 ' section with a smooth bore nozzle (optional)
- 2 – 2 ½" bundles @ 1 00 ' each, One bundle with a breakaway nozzle (optional)
- 2 – 1 ¾" apartment bundles @ 150' each with gated wye on one bundle minimum
- 2 1/2" flat load @ 400' – 600' flagged every 100' with the last 100' bundled with breakaway fog nozzle or smooth bore nozzle

This is the basic configuration and may need to be adjusted for specific apparatus. Nozzles shall have breakaway tips to facilitate extending attack lines and switching between fog and smooth bore tips.

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. For example, departments that respond to airports such as Renton Municipal Airport, Auburn Municipal Airport and SeaTac Airport carry specific adaptors for flush hydrants used along the runway. Mutual aid responses determine the need for adaptors and personnel assigned to an engine or ladder should understand the use of each adapter carried on their apparatus.



Gated Wye

Hose appliance with one female inlet and multiple male outlets controlled with valves. For example, 2 ½" gated Wye's are incorporated into apartment bundles to facilitate connection to the standpipe outlet, providing independent controlled water supply to two 1 ¾" hand lines.

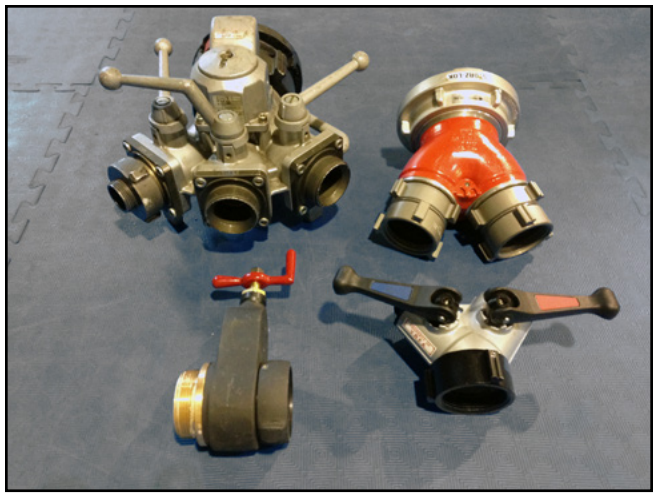
Hydrant Box

Different departments use and carry a variety of hydrant boxes. The specific inventory of hydrant boxes will vary depending on department requirements, a basic inventory will include:

1. Hydrant Wrench
2. Spanner Wrenches
3. Hydrant Gate Valve
4. Marker Device
5. Various Adapters

Manifold

Manifolds are appliances used to distribute water supplied from an LDH hose line to multiple hand lines. Manifolds are typically used on reverse hose 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 the SKCFTC are:

1. Combination Fog Nozzle - 100 or 75 psi operating pressure
2. Break Away Nozzle – 100 or 75 psi operating pressure
3. Solid Stream Nozzle – 50 psi operating pressure
4. Master Stream Nozzle – Apparatus Mounted / Ground Monitors / Elevated Master Streams 80 or 100 psi operating pressure depending on mounted or portable, and solid 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 1 ¾" lug, 2 ½" lug, 4" lug, 4" and 5" Storz.

Trash Lines / Booster Reels

Trash and booster lines are used on some apparatus in the SKCFTC. The use of these hoselines is limited by the available volume of water and restrictions for use on certain fires. Trash 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. Trash and Booster lines are for the quick extinguishment of small fires typically involving dumpsters, vehicles, grass and low brush and other small exterior fires.

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Standpipe Tool Kit

The standpipe tool kit contains tools and appliances necessary for standpipe operations.

- Canvas Tool Bag
- 2 ½" In-line Pressure Gauge
- 2 – 2 ½" 30 degree elbow fittings
- 2 – Spanner Wrenches
- 1 8" aluminum pipe wrench
- Wire Brush
- 2 ½" Nozzle with Smooth Bo re tip
- 1 ½" X2 ½" increaser
- Wood Door Wedges

Supply Hose

The supply beds on SKCFTC Engine companies vary slightly based on hose bed manufacturer design/size. Typical SKCFTC Engine companies will carry 1000' of Large Diameter Hose (LDH) ranging from 4" to 5" diameter.

1/4 turn Storz couplings have locking devices to maintain a positive lock when coupled. When making Storz couplings align locks; doing so will make it easier to break the couplings when the hose is being rolled and reloaded.

Care must be exercised while handling LDH hose. When laying dry supply hose from a moving Engine, the FF healing the hose must not step on any part of the hose, or allow the supply line to move behind them; this will prevent potential injury in the event the hose gets caught in the hose bed when deploying.

Handling supply hose filled with water under pressure creates another hazard. Often kinks must be removed; at no time are firefighter's hands to be used directly on the hose to remove a kink. A hose strap or tool must be used to prevent the hose from kinking on your hand.

LDH hose can vary in operating pressures from 200 psi (Supply Rated) to 400 psi (Attack rated) depending on specifications and intended use. Example: LDH hose deployed for pumping to an elevated aerial device will require a higher operating pressure than LDH supply lines that are only used for supplying water from Hydrant to pumper.

LOADING SUPPLY BED

1. The LDH hose bed is started with the first coupling laid at the front (cab side) of the hose bed.
2. LDH hose 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.

3. Couplings are to be loaded toward the front of the hose bed and oriented so they will not flip when deployed. 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.
4. 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.
5. Finish the hose load by wrapping the final

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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 intended application. Supply lines laid form 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. At no time should a firefighter stand, kneel, or commit body weight on the supply line while being deployed from a moving apparatus.

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. Typically, this technique is limited to a maximum distance of 200'.

TAKING A HYDRANT

Taking a hydrant may vary based on hydrant type, hose and fittings. Local SOP's and resources dictate the method used. The following should be used as a basic outline on how to take a hydrant.

1. Visually check for traffic prior to dismounting the apparatus.
2. Remove hydrant box and enough supply hose to wrap hydrant.
3. Wrap hydrant with one full wrap of supply hose and place foot on "X".
4. Give the verbal command to "Drive" with hand signal.

5. Step off the X when adequate hose has been deployed.

6. Stand behind the hydrant away from discharge ports and use hydrant wrench to confirm operating nut is in the closed position.
7. Break port caps to be used and confirm unused port caps are secure.

8. Place hydrant wrench on operating nut when not in use.

9. Unwrap supply hose as to avoid kinks when charged.
10. Connect supply hose to Steamer port (largest port). Adapters may be needed. Check for gasket prior to connections.
11. Connect 2.5" hydrant gate valve to 2.5" port facing away from the fire and confirm that gate is in the closed positon.

12. Notify driver ready to send water.
13. After confirming driver is ready for water,

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fully open hydrant in controlled manner to safely send water.

14. Follow supply line to engine removing any kinks.
15. Report to driver upon completion.

FORWARD SUPPLY

A forward supply refers to an engine stopping at the water source on their approach to drop a supply line and then the engine proceeds to the location of the fire. The advantages of laying forward: typically, a water supply can be established by the attack engine that requires no additional assistance. It also places the attack engine closer to the fire for a "Quick hit" and access to additional equipment is quicker and more feasible due to the engines position within close proximity to the fire building. The forward lay works best when a water source is in the approach path of the attack engine.

REVERSE SUPPLY

A reverse lay involves dropping the supply line at the fire location and laying supply line to the water source. Typically, the first arriving engine is used as the attack engine providing a "Quick Hit" 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. A reverse lay is preferred for suppling large volumes of water via ground monitor or manifolds.

SUPPLING FIRE DEPARTMENT CONNECTIONS/STANDPIPES

Fire department connections should be supplied

with the same diameter hose as the connections, i.e. 2.5" Siamese connection should be supplied with two 2.5" hose lines, 5" Storz connections should be supplied with 5" diameter hose.

Note: Many FDC's require a Fire department key to remove connection caps.

Attack Hose

PRE-CONNECTS

SKCFTC Engine Companies have several different types of apparatus and hosebed configurations. Regardless of apparatus configuration or design, each pre-connect is loaded with a total of 200' of attack hose.

Loading Pre-Connects

1. Connect first 50' section of hose to discharge port.
2. Start the load by feeding hose into designated slot. As the hose is laid flat make a bend or "break" at each edge of the slot, front and rear.
3. After the first layer is loaded, the layer immediately on top needs to have a short portion of hose extended past the edge of the tray making a 'flag' used in deployment. This is the first of two flags incorporated into this load. Flags should be large enough to be grabbed with a gloved hand.

4. The second flag is added after the first made coupling is loaded into the slot.
5. Continue to load the first 100' of hose flat on itself.
6. When the final coupling of the first 100' is loaded in the slot, drape it out the rear of the

slot, approximately 4'. (This completes the first 100' down).

7. To begin the second 100' start with the nozzle on top of the lower 100' of hose in the slot, place the nozzle with the bail down (pistol grip handles facing up, if used).

8. Continue loading the hose into the slot making "breaks" at the front and rear of the slot.
9. Connect the final female coupling of the second 100' to the male coupling of the first 100' (draped out the rear of the slot) together on top of the hose load. Fold under excess hose as needed.

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Loading double stack pre-connect

The double stack pre-connect is carried on SKCFTC Engines that cannot accommodate the height of a single stack.

1. Connect the first 50' section of hose to discharge port.
2. Start the load by feeding hose into designated slot. As the hose is laid flat make a bend or "break" at each edge of the slot, front and rear.
3. After the first layer is loaded, the layer immediately on top needs to have a short portion of hose extended past the edge of the tray making a 'flag' used in deployment. This is the first of two flags incorporated into this load. Flags should be large enough to be grabbed by a glove hand.
4. The second flag is added after the first made coupling is loaded into the slot.

5. Continue to load the first 100' of hose flat on itself.
6. When the final coupling of the first 100' is loaded in the slot, drape it out the rear of the slot, approximately 4'
7. Begin the second stack by placing the nozzle bail down in the tray adjacent to the first stack.

8. Continue to load 100' of hose on top of nozzle making breaks front and back.

9. To complete the hose load connect the female coupling from the second stack to the male coupling from the first stack.

Deploying Pre-Connects

1. Grasp the nozzle and shoulder load the top 100' of hose.
2. Reach back with your free hand and grasp the two extended flakes of hose to clear remaining hose from the hose bed.
3. Once the hose is clear of the bed release the bottom extended flake.

4. Continue to stretch hose to desired location. Release second extended flake when hose becomes taught.

2 ½" BUNDLES

SKCFTC Engines carry a total of four 100' 2 ½" bundles secured with 2 straps each. 2½" bundles are deployed for high rise standpipe evolutions, fire department connections or Manifold Reverse evolutions. . 200' are loaded to facilitate rapid

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deployment in High Rise, Mid Rise and Wide Rise buildings where the standpipe will be used for fire attack.

Loading 2 ½ " bundles

The slot loaded bundles are made starting with the nozzle (or no nozzle if not required) and are approximately 6' -7' in overall length.

1. Start with the nozzle (or male coupling for bundles with no nozzle) 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' in overall length until 100' 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' of bundled hose without a nozzle, the top stack will be 100' of bundled hose with a nozzle.

APARTMENT BUNDLES

SKCFTC Engines carry two 150' 1 ¾" apartment bundles with gated wye secured with straps.

Optional 1 ¾" to 2 ½" increaser inserted into the gated wye is used for extending apartment bundle from a 2 ½" hose line.

Loading Apartment Bundles

1. Start on the ground with a nozzle bail down connected to 50' of 1 ¾" hose. Lay the hose away from the nozzle approximately 6' – 7' and make your first bight. Continue bringing the hose back toward the nozzle and make the second bight even with the tip of the nozzle. Continue making flakes in the bundle. (Note: some nozzles have a pistol grip requiring the hose bights to be made behind the pistol grip creating the pocket for the wye in front of the pistol grip).
2. Hold the top 4 remaining bights back from

the nozzle tip approximately 6" – 8" creating a 'pocket' for the gated wye.
3. When the entire 150' of hose is finished being loaded, attach the gated wye to the end and place it in the pocket created by holding the bights back from the nozzle, facing the handles of the gated wye to the outside of the bundle.
4. Place the three hose straps between the midpoint of the bundle and forward toward the nozzle. The straps should positively hold the gated wye, with one closely behind the wye, and one midpoint in the bundle. Hose straps should be easily accessible by the FF shouldering the bundle.

Loading Double stack apartment bundles

The double stack apartment bundle is carried on SKCFTC Engines that cannot accommodate the height of a single stack. They're also made with 150' of 1 ¾" hose, simply made in two 75' stacks side by side.

1. Start making the double stack apartment bundle in the same way as a single stack, then at the 75' 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

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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 FF, the second stack is made away from the first, ending up with the gated wye on the outside of the double stack.

STANDPIPE BUNDLES

Standpipe bundles are loaded in 50 'sections. The recommended load for a single firefighter climbing stairs is one 50' section of 2 ½" hose. This configuration allows for ease of layout in confined areas such as stairwells. Based on profile of buildings in a particular response area apparatus may carry standpipe bundles. The SKCFTC recommends three standpipe bundle configurations based on hose bed and compartment space available. Apparatus that do not carry Standpipe bundles can shoulder load 50' sections from the 2.5" bulk load bed.

Denver Hose 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' section of hose.
2. Create a bite at the 32" mark and fold the hose back and forth in a horseshoe pattern with the female coupling extending past the bites.
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.

New York Bundle

The flat shape allows for easier storage and stacking of bundles. The bundle requires shouldering or under arm carrying. The bundle is fast and easy to assemble.

1. Fold section of hose in half placing coupling side by side.
2. Fold the mid-section bite back to couplings.
3. Repeat folding all bites back towards couplings.

4. Fold couplings over onto bite finishing with couplings on top of bundle.
5. Secure with two straps.

Deploying Apartment bundles from standpipe connection

1. With the standpipe charged (covered in supply hose section) the officer enters the stairwell and checks that all standpipe connection valves are in the closed position as ascent is made.
2. Firefighter shoulder loads apartment bundle with SCBA mask donned and follows officer to floor below fire floor.
3. Firefighter unstraps the bundle as Officer or third firefighter connects the gated wye to the standpipe.
4. Firefighter deploys the hose to the outside of the stairwell (to minimize kinks and keep stairway clear) to the fire floor. If fire floor hallway is tenable hose may be stretched dry to desired location. If 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.
5. Charge the line, blead the air and select the desired patter.
6. Crew positions themselves on the line as to manage potential kinks, doorways and friction points as the hose is advanced to the fire.

FLAT LOAD

The 2 ½" Flat Load was created to address the need for hose stretches exceeding the 200' pre-connect capability, suppling fire department connections and ground monitors. The Flat Load hose bed has 400' to 600' of 2 ½" hose, depending on hose bed capacity.

The Flat Load hose bed is 'finished' with 100' of 2 ½" hose bundle, with extended flake marking the each 100' in the bed. The extended flake is designed to be pulled with the free arm (opposite

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of the shouldered finished bundle) to aid in hose advancement.

Loading 2 ½" Flat load

1. Start with the female coupling at the front (cab side) of the hose bed, flag the bottom bight, and load 100' and fold to the next stack where the next 100' will be loaded. Continue making progressive stacks left to right on the bottom and right to left on the top for all but the final 100', with the bottom bight flagged for each 100'.

2. Leave the male coupling of the next to last stack "up" (it will accept the female of the final 100').

3. Place the nozzle end down and load the final 100' up from the nozzle next to previous stacks.
4. After the final section is loaded, connect the final female coupling to the previous stack's male coupling.
5. Finish the final 100' with two bundle straps for easy deployment.

Deploying Flat Load

1. Shoulder load the 100' bundle.
2. Reach back with your free hand and grasp the appropriate extended flake.
3. Make hose stretch with driver assisting the hose bed deployment.
4. As the stretch approaches desired target drop the extended flake providing 200' of hose to make final stretch to target.
5. When required hose is deployed, the driver will break from hose bed and connect to discharge port.

MOVING ATTACK HOSE, THE BASICS

Moving hose in the SKCFTC is broken into two different segments: advancing 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 handling and advancement is to accurately estimate the distance from the

apparatus to the fire and achieve a clean and efficient stretch while minimizing friction and kinks. The following techniques and skills are the exact same for both 1 ¾" and 2 ½" attack hose.

Fire personnel are encouraged to estimate the stretch before the fire! This estimate can be done by knowing your first due area. For example, if there is a large neighborhood of residential houses in your first due response area that are all setback approximately 30' from the sidewalk and are all approximately 1500-2000 square feet with one and two story variations, the stretch should be fairly well known at time of dispatch simply by the address given.

Making the Stretch from Apparatus to Entry Point

The forward stretch is the most efficient means to deploy a dry hose line from the fire apparatus to the entry point; assuming a clear path exists. With a proper bundle on the firefighter's RIGHT shoulder, grasp the hose just behind the nozzle with the RIGHT hand, and grab a bight of hose "mid-stack" with the LEFT hand. [Note; the bight of hose "mid-stack" is the middle bight of the stack of fire hose that is on your shoulder at the point to make this stretch, the 30' – 40" mark that starts the clear path to the entry point].

Accordion Forward

A universal stretch that is clean and can be used in any setting. The bundle is dropped then stretched towards your objective without ever setting the nozzle down.

Accordion Reverse (Center Reverse)

Used when the nozzle person finds 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 or bights away from the objective.

The Bight or bights can be left towards the rear, or brought back to the objective.

Accordion Reverse/V-Split

Used when the nozzle person finds themselves without enough room to do an accordion forward. An example would be a situation where

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a short stretch from the rig to the front door of the fire building existed. The bundle is placed at the objective then flakes are stretched back away from the bundle.

Coil/Coil Prop

A hose line deployment method that works well in where space to operate is at a minimum. Correct deployment is necessary to ensure that the nozzle deploys off the top of the coil after being charged.

Heisman (as a Move)

The Heisman is a great position from which to make long fast advances while either kneeling or standing. To perform this advance, you must keep a full arm's length of hose in front of you, leveled down slightly, using the shoulder as the axis and the main point of friction. This position allows the user to pull hose with their body weight rather than their arms.

Stairwell Hose Deployment

When deploying hose in a stairwell it is important to lay it out in a manner that will be manageable before the line is charged. There are multiple ways to do this. To deploy hose up stairs you should ensure that the hose is situated to the outside of the stairwell before it is charged. It takes approximately 50 of hose to go up one floor. Another option in an open stairwell is to have the hose run vertically up the well-hole. Use of the well-hole for a vertical stretch requires the hose to be secured at the point where the hose leaves the well-hole and landing/staircase. This prevents the weight of the hose from slipping off the floor/landing and back into the well-hole.

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

Accordion Forward

structure. Prior to entering the structure, the door is checked for heat with the back of the hand. 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 and moves the line forward. Attack crew should place themselves on the attack line to manage doors and corners as these will create friction points that will hinder hose advancement and delaying fire attack.

Hip-Grip

A method of hose handling that allows a member to flow an 1 ¾" or 2 ½" hand-line from either a standing or kneeling position. With this technique a "shelf" is created between the hip and upper thigh where the hose is placed. Once the line is in the hip pocket, place downward pressure with the hand, creating friction, which holds the line in place.

Clamp/Clamp-Slide

A stationary position that provides friction from the shin to be created on the hose line allowing the ability to flow a 1 ¾" or a 2 ½" hand-line from a stationary position. The clamp-slide is a technique that allows a member to move from the stationary clamp position and advance the hose-line forward. This is a hit-and-move technique as opposed to a constant-flow technique.

King's Loop

This method has the firefighter laying the hose out in a large loop and running the nozzle back under the line and securing it with a hose strap. The single firefighter can then sit on the 2 ½ line and operate the nozzle independently.

Two Person Nozzle Work (Back-Up Positions)

There are multiple techniques that can be employed to back-up the nozzle position. Below are a few of the options:

Standard Heel Position:
Whether in a hit and move or in a stationary attack position, the back-up person should be stationed several feet back behind the nozzle, pinning the hose to the ground with their arms. Do not get on top of the hose with your body. The back-up position must be looking forward and overhead always paying attention to the environment. The hose line can also be moved from the standard heel (back-up position).

Crooked Lean (Kneeling and Standing):
The Crooked Lean is a position for the nozzle team to employ when the need arises for two-person

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nozzle work. This position works while kneeling or standing. In addition, it gives the nozzle team a way to advance the hose while flowing water as well as operating the hose line in a stationary position. The heel person places their shoulder into the nozzle person's back. The heel position should always be lower than the nozzle person. The heel person's lead arm should be pinching the hose line underneath their armpit. The trailing arm should be kept straight with the palm of the hand facing up, firmly gripping the hose line. The heel position's leading knee should be on the ground (when in the kneeling position). The trailing knee should be up with the foot placed firmly on the ground, and the trailing arm to the inside of the knee.

Oakland Lean:
In pure form this is back to back, with both the nozzle person and the heel person leaning against each other. The nozzle person should be operating the hose line from the hip. The heel person should have both hands holding the hose line in position with their palms up. The heel person's center of gravity should be slightly lower than the nozzle persons. The heel person must concentrate on keeping the line coming straight into the nozzle person's hip and that line coming to the hip from the ground. It is very important to get set prior to opening the nozzle.

Hose Strap Back-Up Position: This method allows the single firefighter or two firefighters to use a hose strap to absorb some of the nozzle reaction.

DECONTAMINATION HOSE LINE

Decon hose lines will be set up at all structure fires. These can range from a booster line, forestry line, or a garden hose. These are to be water only and without any amount of foam present. These lines are to be set away from the pump panel of the attack engine and for ease of finding a traffic cone will be placed next to it. Fire Crews are to stay connected to their SCBA's and do gross decon near this cone. The driver of the attack engine will not help the crews with decon because they do not have an air pack on. Decon lines can be utilized at any type of incident if the Incident Commander requests it.

WARM WATER AT THE PUMP PANEL

Engines that have this feature can produce continuous amounts of warm water. This water is used to clean faces, necks, hands and arms after a fire incident. Using soap and warm water will complete the decontamination process. Fire engines that do not have warm water the fire fighters can use hand wipes and paper towels.

HIGH-RISE HOSE DEPLOYMENT

High-rise/standpipe operations can be very challenging and require a steady supply of manpower. 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 hand-line in place as soon as possible. The following information is recommended as a best practice when utilizing a standpipe for fire suppression.

High-Rise/Standpipe Hose Deployment

Equipment

The minimum required equipment for standpipe operations for a 3-person crew:

- (2) 50' 2 ½" High Rise Hose Packs (each length placed over the SCBA cylinder or shoulder of the ascending firefighter)
- (1) 50' 2 ½" High Rise Hose Pack with a smooth bore nozzle (again, placed over SCBA cylinder or shoulder loaded by the ascending firefighter)
- Standpipe Tool Kit
- Set of Irons
- Long Handled Tool (NY Hook)

Standpipe Kit

The standpipe tool kit consists of a large tool bag to carry with all the tools and appliances

necessary to initiate a standpipe operation

Inline 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 act as Standpipe Wheel. This firefighter makes 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.

One firefighter is assigned to make the standpipe connection and monitor/adjust the hose line pressure as needed. This firefighter is known as the "Standpipe Wheel" and becomes a remote engineer. This firefighter may assist in advancing

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the attack line but must be available to make pressure adjustments as needed.

A good place to start is to open the valve wheel completely then close it two complete turns

The Nozzle must be flowing water long enough for the Standpipe Wheel to dial in the correct pressure.

Friction loss per 100′ of 2 1/2″ hose is 15 psi. Smooth bore nozzles are pumped at 50 psi. Add 5 psi per floor of elevation gain from the standpipe.

2 ½″ Hose Length	Friction Loss	Head Pressure	Standpipe Wheel PSI
100′	15 psi	5 per floor of elevation	70 psi
150′	20 psi	5 per floor of elevation	75 psi
200′	30 psi	5 per floor of elevation	85 psi

A hose layout of 200′ of 2 ½″ hose with a 1 3/16″ smooth bore tip, one floor above the standpipe would be figured:

2X15(FL per 100′ @ ½″) =30psi

30+50(smooth bore nozzle pressure)=80psi

80+5 (one floor of elevation gain) =85psi

Outlet pressure is adjusted by the standpipe valve wheel.

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.

Stairwell Stretch – used when the fire floor or hallway is untenable. Untenable (Dirty) is best defined as an area where you need to mask up.

Hallway Stretch – used when the fire floor is tenable (Clean) 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 (Clean) hallway

Hallway 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 hallway 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.

A good technique for estimating the stretch is to pace the distance off on the fire floor. Measure the number of steps it takes to get from the fire occupancy back to the firefighting stairwell door. Each step is approximately 3′. If the pace off distance is 33 paces, it is approximately 100′. Add a 50′ section of hose to go from the standpipe to the fire floor and another 50′ at the apartment door. Total number of lengths for this evolution: 4 lengths or 200′.

- ***The Standpipe Wheel*** will connect the last female coupling to the standpipe outlet one

floor below the fire floor. Before connecting the hose do the following:

1. Ensure that valve is closed. Remove cap.
2. Determine if there is a pressure reducing valve (PRV). Either remove or disable PRVs.
3. Check for debris inside standpipe valve. Use a spanner wrench to remove any debris that is lodged in a valve.
4. Clean the threads as needed. *Watertight connections are necessary for accurate GPM delivery.*
5. Attach elbow fitting to prevent hose kinking at the Standpipe outlet.
6. Flush standpipe into the stairwell to clear any debris that may have accumulated.
7. 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 Backup will each pick up the first two sections of hose line and ascend to the fire floor drop point 2.
- Drop point 2 - The Backup 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 Backup stretches the hose straight from the stairwell door.
- Drop Point 3 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:

1. Call for water,
2. Bleed the hose line of air
3. Communicate with the Standpipe Wheel to dial in proper pressure while flowing water from the nozzle, check pressure and adjust if necessary.
4. Begin the fire attack from this position.

Stairwell Stretch

A stairwell stretch is used to deploy hose lines when the fire floor has an untenable hallway. Untenable (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:

- On the floor below the fire.
- 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:

1. Ensure that valve is closed. Remove cap.
2. Determine if there is a pressure reducing valve (PRV). Either remove or disable PRVs.
3. Check for debris inside standpipe valve. Use a spanner wrench to remove any debris that is lodged in a valve.
4. Clean the threads as needed. Watertight connections are necessary for accurate GPM
5. delivery.
6. Attach elbow fitting to prevent hose

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kinking at the Standpipe outlet.

7. Flush standpipe into the stairwell to clear any debris that may have accumulated.
8. 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 Backup 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:

1. Call for water,
2. Bleed the hose line of air,
3. Communicate with the Standpipe Wheel to dial in proper pressure while flowing water, check pressure and adjust if necessary.
4. Begin the fire attack from the fire floor stairwell landing

SUMMARY

Loading and deploying fire hose is a critical skill in the fire service, especially with the recent scientific information that has surfaced. Applying water into the fire compartment as quickly as possible from a safe position is a necessity to a successful outcome. Consequently, hose must be loaded correctly so that it deploys as efficiently as possible supporting rapid water delivery.

Video Links

Hose Fundamentals	
Hose Handling Fundamentals Intro	Accordion Reverse - Hose Deployment
Loading Pre-Connects for Success	Pre-Entry Procedures
Grips - Clamp - Back Up Responsibilities	Door to Fire
Accordion Forward - Hose Deployment	The Coil
Accordion Reverse - V Split	Loading the 2 ½ Flat Load
Deploy Flat Load	King's Loop
Hose Strap Back Up	

Hose Evolutions

Supply Evolutions	Attack Evolutions
Blind Alley Lay	Standpipe Attack
FDC Flat Load Option	PreConnect Attack
FDC LDH Option	2 1/2" PreConnect Attack, Extended
FDC Pre-Connect Option	Flat Load Attack
Take Own Supply	Drop the Wye
Forward Supply	Monitor Reverse
Manifold Reverse	Portable Master Stream
Overhaul a Supply	
Pump the Aerial	
Supply Attack Engine	
Tender Supply	
Reverse Supply Pump	
Reverse Supply	

See Fundamentals Skills Sheets for more information.