KITSAP FIRE TRAINING CONSORTIUM

FIREFIGHTER FUNDAMENTALS

Kitsap
FIRE TRAINING CONSORTIUM

2024 Edition

HAND TOOLS
POWER EQUIPMENT
PPE
SCBA
FORCIBLE ENTRY
SEARCH & RESCUE
LADDERS
VENTILATION
HOSE
Extrication

Kitsap
FIRE TRAINING CONSORTIUM

The Kitsap County Fire Training Consortium serves as the training division for six Kitsap County fire agencies. The consortium combines agency resources, including assigning a training officer from each member agency, into a centralized training office. This centralization assures regionally consistent training is delivered to member agency Firefighters. Sharing a single consistent training curriculum, allows agencies to accomplish more training annually, reduce costs and eliminate duplication of efforts. Additionally, mutual aid operations are enhanced and streamlined when agency responders are operating under the same training curriculum.

Bainbridge Island Fire Department • Fire Chief Jared Moravec

North Kitsap Fire & Rescue • Fire Chief Rick LaGrandeur

Poulsbo Fire Department • Fire Chief Jim Gillard

Central Kitsap Fire & Rescue • Fire Chief Jay Christian

Bremerton Fire Department • Fire Chief Pat McGanney

South Kitsap Fire & Rescue • Fire Chief Jeff Faucett

Special thanks to those who put in long hours to bring this KCFTC Firefighter Fundamentals Manual together

Introduction:	Training Chief Nate Post
	Fire Training Advisory Teams
Hand Tools:	Mike Bishop, Nemo Killam, Carlo Celeste, Bruce Lowrie, Russell Fergus, Tim Quitslund
Power Equipment:	Mike Bishop, Nemo Killam, Jerry Lane, Bruce Lowrie, Russell Fergus, Joe Gaffney, Jeff Wallis
PPE:	Tim Quitslund, Dave McCarthy, Craig Patti, Trevor Stanley, Ryan Sommer, Mike Cunningham, Chris Johnston
SCBA:	Tim Quitslund, Seth Jackson, Dave McCarthy, Bruce Lowrie, Kyle Good, Dan Upton
Forcible Entry:	Chris Bigelow, Geoff Burn, Ben McCarty, Nemo Killam, Kevin Vay, Kris Osera, Joel Stack
Search & Rescue:	Mike Bishop, Curtis Storer, Kurt Van Ness, Carl Tesch, Ryan Sommer, Charlie Hough, Darrick Baker
Ladders:	Chris Bigelow, Nathan Johnson, Kevin Vay, Jamie Monroe, Cliff McKenzie, Matt Phillips, Tom Stanley
Ventilation:	Tim Quitslund, Carlo Celeste, Leif Anderson, Kevin Vay, Berndt Bittlingmaier, Justin Foley, Harry Hause, Joel Stack
Hose:	Chris Bigelow, Eddie Lange, Pat French, Ryan Sommer, Justin Slye, Nick Ranney, Aaron Rankin
Extrication:	Tim Quitslund, Curtis Storer, Kurt Van Ness, Carl Tesch, Ryan Sommer, Charlie Hough, Darrick Baker

Content of the Manual is developed by the Training Advisory Teams.

Oversight of the Fundamentals Manual belongs to Fire Ops BC Dan Mustard.

Oversight of Advisory Teams belongs to KCFTC members Lt Bishop, Lt Cook, Lt Quitslund, FF Rye, and Capt. Stanley.

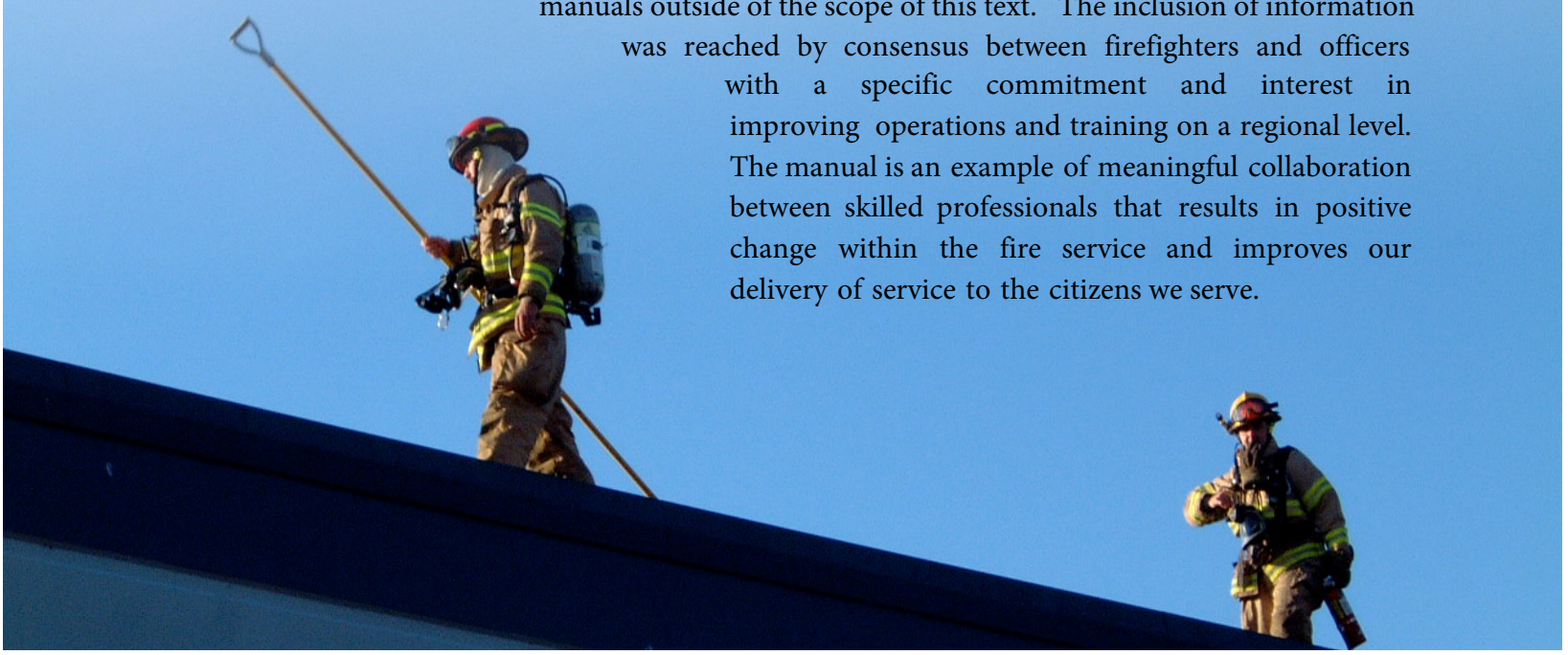
INTRODUCTION

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 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

Like most trades, firefighting has a core set of tools necessary to do the job properly. It's vital that firefighters can choose the proper equipment for the task at hand, use that tool correctly, and when they're finished, make sure it's ready for the next use.

The following are common firefighting tools found in Kitsap fire agencies. This is not a comprehensive list, however – your apparatus/department may carry items that aren't shown.

STRUCTURAL FIREFIGHTING TOOLS

Flat Head Axe

Used to cut through material; the flat head side is used as a striking surface. Utilizes a fiberglass or wooden handle and a 6-8 lb. head.

Pick Head Axe

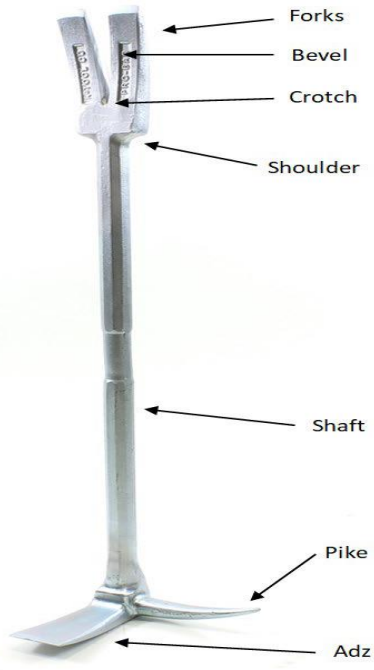
Axe blade is used for cutting and chopping; the pick head side is for prying and pulling. Utilizes a fiberglass or wooden handle and a 6-8 lb. head.

Halligan

Multipurpose tool for prying, twisting, punching, or striking. Typically constructed of drop forged alloy steel with 24", 30", or 36" lengths. Components of the halligan include:

- Adz – 2 in. flat blade located at the tool's end.
- Fork – Steel wedge on the end opposite the adz with a split in the middle.
  - Bevel – Outer curved side of the fork.
  - Crotch – Bottom of the fork's gap.
  - Shoulder – Base of the fork, where it attaches to the shaft.
- Pike – 4 in. spike perpendicular to the adz.

Many modifications to the Halligan are popular, like adding door depth gauges, sharpening the pike, and thinning the fork. Refer to department policy and manufacturer recommendations before modifying a tool!



HAND TOOLS

Irons
Popular combination of flathead axe and halligan bar.

K-Tool & A-Tool
Utilized for pulling door lock cylinders for forcible entry.

New York Hook
Multipurpose tool for prying, pulling, or striking. One end terminates in a chisel point while the other has opposing angled bars. Typical lengths are

4-6 ft.

Pike Pole
Tool for piercing, prying, and pulling. The primary use is breaking glass and opening walls and/or ceilings. The head of the tool has a point and a hook. Lengths range from 3-14 ft. Some pike poles have a "D" style handle.

Rubbish Hook (Trash Hook)

Used for penetrating, ripping, pulling, and roof operations. The head of the tool has two tines which are slightly angled towards the handle. Typically, 6-10 feet length with a "D" style handle. Those with solid metal handles are known as an "LA Trash Hook."

Sledgehammer
Used as a striking tool; ideal for breaching. Has fiberglass or wooden handle and a 6-10 lb. head.

Wedge

Used to capture progress while prying, in con-junction with other tools; typically, wood or aluminum.

HAND TOOLS

WILDLAND TOOLS

Combi-tool
A combination shovel and pick; a multipurpose tool used to scrape, dig, grub, and cut fire line. The head of the tool can be adjusted from straight to a 90-degree angle for improved leverage.

Rouge Hoe
Similar to a McLeod, utilizing a raked end and a hoe side. Both elements are kept sharp for maximum efficiency. It has a smaller profile than the McLeod but uses heavier gauge steel.

McLeod
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 with the sharpened hoe edge.

Round Point Shovel
Utilizes a curved blade for scooping, often curving to a point in the middle, with beveled edges to cut material. Some have a D-handle at the top, for easier maneuvering.

Pulaski
Combines an axe and an adz in one head; great for digging line and chopping roots or stumps.

HAND TOOLS

RESCUE TOOLS

Hi-Lift First Responder Jack

Primarily used to raise vehicles or other loads, but also capable of clamping and winching. The jacking mechanism utilizes alternating climbing pins engaged by downward force on the handle; a reversing latch provides for controlled lowering. The working load limit is 4660 lbs. and maximum lift height varies by model. Extreme caution and situational awareness must be exercised using this tool.

Cribbing

Typically 4"x4" or 6"x6" wooden blocks, 18" to 24" long, used to create temporary structures for supporting heavy objects, particularly in auto extrication and heavy rescue. Soft woods like spruce and pine are preferred because they indicate impending failure with audible cracking, but hardwood and composite cribbing are also available.

Step Chocks

A form of rapidly deployable cribbing; usually used for stabilization of a vehicle.

Pry Bar

Also known as crowbar or pinch bar; the angled end acts as a lever, providing a significant amount of force between objects. Can be used with cribbing as a fulcrum to lift objects.

Chain

Primarily used for advanced stabilization in auto extrication and heavy rescue; chain be used by itself or with struts, cluster hooks, ratchet straps, binders, or the first responder jack. Grab hooks allow the chain to form a loop back to itself. For overhead lifting, chain must be grade 80 or higher.

HAND TOOLS

Rescue 42 Telestrut

Telescoping stabilization struts utilized in auto extrication and heavy rescue. Accessories allow for multiple configurations when combined with additional telestruts, ratchets straps, chain, pickets, or cribbing. Working load limit varies by extension length and accessories used.

2" Ratchet Strap

May be used independently or with struts. Typically 27' long with a 3300lbs working load limit. Strap must wrap the ratchet drum 3 times for maximum strength.

Cluster Hook

Used to connect to various points, particularly on vehicles; two elements are utilized as necessary, leaving the others to hang unused. The T-hook engages vehicle frame slots, the chain hook slides over links; and the J hook can capture any structural member. Attach strap hooks to the center ring; 5,000 LB working load limit.

MISCELLANEOUS TOOLS

Hydrant Wrench

Interfaces with the pentagon operating nut on fire hydrants; usually adjustable to adapt to various sizes. May incorporate features to assist with coupling hose fittings.

Spanner

Used to tighten or loosen fittings with pins or lugs around its circumference, particularly hose couplings. May be specific to pin, lug, or storz fittings, or work with multiple types. Use in pairs to tighten hose couplings.

Grain (Scoop) Shovel

Shovel design that is particularly useful for moving large volumes of light materials; much larger capacity than common shovels. Typically utilized in structure fire overhaul operations.

HAND TOOLS

Squeegee
Utilizes a rubber blade and long handle to move liquids on hard surfaces; useful in fire sprinkler activations or flooding responses.

Cable Cutter
Shears designed for large diameter wires. Useful for severing automotive battery cables and as a personal carry item to overcome fireground entanglements.

Water Key
T-handled tool used to operate water system valves; may be equipped with square for larger valves, a fork for handwheel valves, or a "U" shape for residential water meters shutoffs. Break apart designs are available for efficient storage.

Elevator Key
Also known as drop key or hoist way door key, this tool provides access to an elevator shaft through the doors located on each floor. Multiple designs exist, but the example shown is the most common.

Sprinkler Stop
Device for temporarily stopping flow from an activated or damaged automatic fire sprinkler heads; most frequently found as the design shown or a "J"- shaped tool. An appropriately sized wood wedge can also be used.

Utility Rope
Used to hoist tools or accomplish tasks other than supporting rescuers or victims, where life safety rope is required. Utility rope may be of any size or material, but is frequently repurposed recue rope which no longer meets life safety standards. Common lengths are 25' and 50'.

HAND TOOLS

HAND TOOL MAINTENANCE

It is critically important to maintain equipment in a ready state. Tools and equipment must be properly cleaned, inspected, and maintained to ensure they are ready and safe for use. Those discovered to be unusable should be removed from service for repair, per department policy.

Fiberglass and Wooden Handles

- Clean with soapy water as necessary, then rinse and dry.
- Check for cracks, blisters, or splinters.
- Verify tool head is on tight.
- Sand wooden handles, if necessary, then apply a coat of boiled linseed oil. Properly dispose of oily rags to avoid spontaneous combustion.

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.
- Cutting edges should only be restored to their original bevel, not made razor sharp.

Unprotected Metal Surfaces

- Use steel wool or fine grit sandpaper to remove rust.
- Keep oiled when not in use with WD40 or similar.
- File off burrs or damage with sharp edges.

Plated or Painted Surfaces

- Inspect for damage.
- Wipe surfaces clean or wash with soap and water.
- Touch up painted surfaces per department practices.

Rope

- Inspect for burns, cuts, lumps, and cleanliness.
- Wash synthetic rope with mild detergent and cool water, drying thoroughly prior to storing.
- Natural fiber rope should be wiped or brushed clean, never soaked in water.

Knots & Hoisting

Using rope and knots are necessary firefighter skills; proficiency is required to tie knots quickly and correctly on stressful emergency scenes. Although a primary use of ropes and knots is technical rescue, the scope of this discussion is limited to utility uses not supporting a victim or rescuer. That said, safety is still paramount: always use approved knots, maintain awareness of hazards, and utilize PPE as necessary. Minimum PPE for hoisting tools is helmet, gloves, and eye protection.

DEFINITIONS

Bend

A knot used to join two rope ends together.

Bight

A fold in the rope; a U-shaped section used to make certain knots.

Dressing

The process of adjusting individual strands of a knot so each is in the proper place and doesn't have any unnecessary twists or slack. Dressed knots are stronger and easier to inspect.

Knot

A rope or webbing arrangement that forms an eye or secures back to itself around an object. In general use: any knot, bend, or hitch.

Hitch
A knot that is used to attach a rope or webbing to a rail, post, or similar anchorage point; unlike a knot, a hitch will not hold its form if the object is removed.

Loop
A fundamental structure used to tie knots; a full circle formed by passing the rope over itself.

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

Working End
The free end of the rope being manipulated to tie a knot and/or handled for a hoist.

Setting
The process of tightening a knot prior to applying a load. Like dressing, setting is vital to the performance of some knots.

Standing End
The non-active end of the standing part; opposite the working end.

Standing Part
Non-active part of the rope, i.e. rope on the side of the knot opposite the hoist.

Webbing
A flat strip or tube of woven fabric, often used in place of rope; typically 1" in width.

KNOTS

Note:
Knots are depicted with short working ends for clarity; in the field, a knot should be backed up with an overhand safety (if tied at the end of a rope) and a fist's width of rope protruding. This prevents potential unraveling of the knot and protects against potential slippage or cinching.

Overhand Knot
Simple tie used as a foundation for other knots, and to safety other knots when tied as a finish around the standing part.

Clove Hitch
A useful and easy to tie knot; essentially two opposing half hitches. It should be used with caution because it can easily slip or come undone.

HAND TOOLS

Half Hitch
A simple overhand knot, where the working end of a line is brought over and under the standing part. Though it is insecure by itself, it forms the basis of many other reliable knots.

Figure Eight
Foundation of figure eight family of knots; can be used as a rope bag stopper knot.

Figure Eight on a Bight
A versatile knot used to connect a rope to a carabiner or other object; quick and easy to tie and virtually fail-safe. Though shown here to be tied near the end of a rope, it can be made anywhere in a rope.

Figure Eight Follow Through
Similar to a figure eight on a bight, but this knot is connects to a closed anchorage such as a ring or long rail by rethreading a simple figure eight knot.

Figure-Eight Bend
Method for joining ropes of equal size; it should be tightly dressed and set.

Bowline
Easily tied and untied, and good for forming a single loop that will not constrict. However, when unloaded, a bowline can work loose.

Sheet Bend
Joins two ropes. If used for unequal sized ropes, the thicker rope must be used for the simple bight as shown.

Alpine Butterfly
Provides a secure loop in the middle of a rope; load can be safely applied to the loop in any direction. Also, a good method for isolating a damaged area of rope – place the damaged area in the looped section.

Girth Hitch
A fast way to connect a loop of rope or webbing to an object but can reduce strength by up to 50%.

Water Knot
Joins two ends of webbing; essentially an overhand knot that is followed back through.

HOISTING

For safety and per regulation, SCBAs, extinguishers, and other pressurized cylinders should never be hoisted.

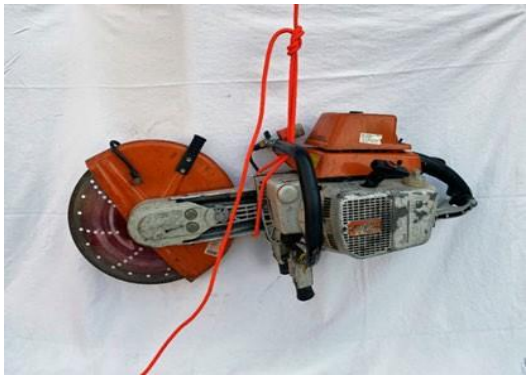
Axe
Form a clove hitch and slide it down the axe handle to the head. Loop the working end of the rope around the head of the axe and back up the handle. Tie a half-hitch halfway up the handle and another at the handle's butt. The standing part of the rope becomes the tag line.

Pike Pole
Form a clove hitch and slide it over the end of the handle, then tie two half-hitches around the handle; one in the middle and one under the pike hook. The standing part becomes the tag line.

HAND TOOLS

Power Saw

Using a figure eight on a bight, form a loop in the rope large enough to pass over the saw's blade. Pass the loop through the saw's handle, then open the loop and slide it over the blade to the base. You may opt for a horizontal or vertical position depending on which handle you choose. The standing part functions as a tag line. Note: Do not hoist a running saw. Cutting teeth or a hot muffler may damage to the rope; be vigilant in placing the rope away from these hazards when possible. Inspect the rope after use, and never use life safety rope for hoisting tools.



For safety and per regulation, SCBAs, extinguishers, and other pressurized cylinders should never be hoisted.

Dry Hose

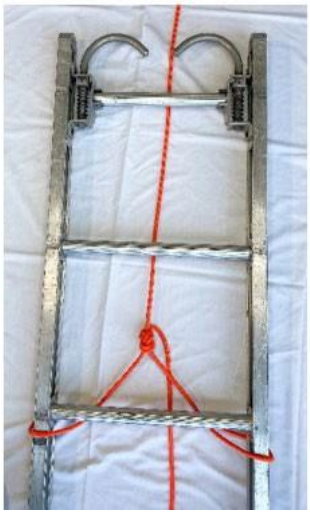
Fold the hose about 5' from the nozzle, forming a bight. Form a clove hitch in the rope and slide it over the hose bight, down to the nozzle's coupling. Tie two half hitches above the clove hitch, place one in the middle of the hose bight, and the other approximately 12" from the end. The rope's standing part, or the hose itself can function as a tag line; if the hose is used as a tag line, the clove hitch requires a safety knot.

Charged Hose

Form a clove hitch and slide it over the hose nozzle to the base. Pull a loop of the working end through the bale and around the tip of the nozzle. The rope's standing part, or the hose itself, can function as a tag line; if the hose is used as a tag line, the clove hitch requires a safety knot.

Ladder

Using a figure eight on a bight, make a loop in the rope large enough to slip over the tip of the ladder. Slide the loop under the tip of the ladder and bring it up between the 3rd and 4th rungs. Open the loop, place it over the tip of the ladder and tighten by taking up the slack. Arrange the standing part of the rope under the rungs; at the butt, form a half hitch over the butt of the ladder near the second rung. Remove any slack between the figure eight knot and the half hitch. The standing part becomes a tag line.



CHAPTER 2

- CHAIN SAW
- CIRCULAR SAW
- GENERATOR
- AIR BAG
- SPREADER
- CUTTER
- RAM
- COMBI-TOOL

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POWER EQUIPMENT

Offering considerable savings in time and effort, powered equipment is truly vital to many fire and rescue operations, including auto extrication, vertical ventilation, forcible entry, and heavy rescue. Most power equipment is driven by one of several energy sources: gasoline, electricity, or compressed air.

Gasoline

Gasoline powered equipment use internal combustion engines to perform work; ignition of a gasoline and air mixture moves a piston and crankshaft to power the tool.

Features of these engines include:

- Choke: Provides a richer fuel mixture; this is required only when an engine is cold. Use on a hot engine can cause flooding, a condition in which the engine won't start due to an excess of fuel.
- On/off switch: Control which interrupts the ignition circuit to stop the engine.
- Throttle: Controls the power output by increasing or decreasing the amount of fuel and air.
- Spark plug: Removable part which creates a precisely timed spark to ignite the fuel mixture.

An important variance among gasoline engines is their cycle type: 4-cycle engines are commonly used in generators, hydraulic pumps, and other equipment that are essentially stationary in use. 2-cycle engines are typically used in chainsaws, circ saws, and other highly mobile tools required to be lightweight and operate at varying angles.

While 4-cycle engine utilize straight gasoline (high octane, ethanol-free is recommended) it is imperative that 2-cycle engines in small equipment use mixed fuel, a gasoline blend that contains specific additives for lubrication. **Severe damage will result if normal gasoline is used.** Mixed fuel is also called premix or 50:1, (referring to the ratio of fuel to additive oil; older equipment may require a different ratio) and is typically made in house, but premixed cans are available. Follow your department's policy regarding mixed fuel.

Power equipment requiring mixed fuel will usually be identified as such on the fuel cap or adjacent to the fuel filler. If you're unsure, refer to the equipment's user manual.

Electric

Some power equipment functions using electric motors; these tools are generally more compact and require less maintenance than similar gasoline ones, but may be less powerful.

Electrical power equipment can be further categorized into battery-powered or corded. Battery-powered tools operate with stored energy from rechargeable battery packs. Depending on their technology, some batteries require special considerations in charging; follow the manufacturer's and your department's guidelines.

Corded electrical equipment must connect to a live electrical outlet or generator to access electrical energy but aren't constrained by a battery's limited capacity. Often, an extension cord is necessary to allow the corded tool to reach the required task. Be cognizant that long extension cords reduce the power available to a tool; refer to the equipment's user manual regarding their use. Some battery-driven tools have an optional corded adapter to use in lieu of a battery pack.

Pneumatic

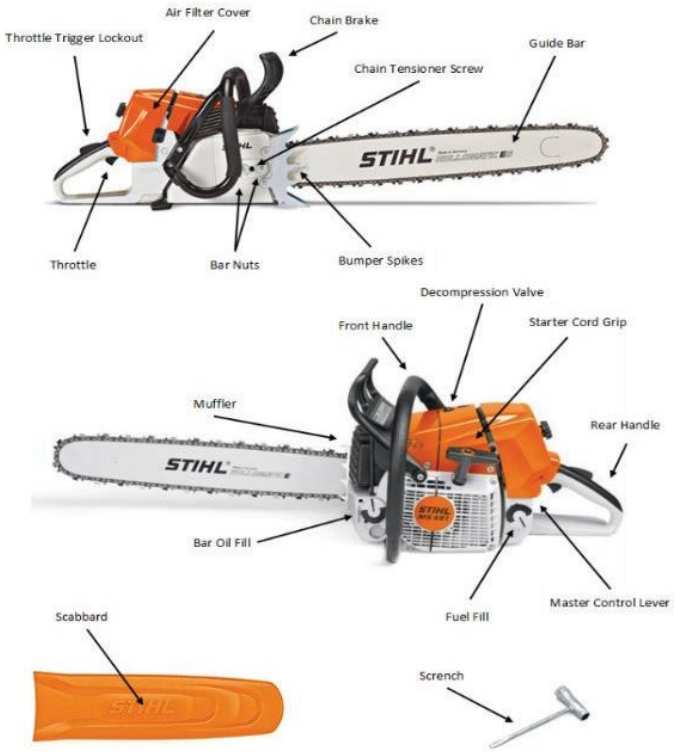
Pneumatic tools utilize compressed air for a power source. With the proper fittings, air from an apparatus's onboard compressor can be utilized for pneumatic tools, but generally SCBA bottles are the source. A regulator reduces the bottle's pressure into the tool's required range; a hose then connects to the tool, sometimes through an intermediate valve that controls operation.

CHAINSAW

Chainsaws are indispensable fire service tools. Their use is vital to:

- Forcible Entry: Cutting through doors or walls to gain access to a building's interior.
- Rescue Operations: Cutting through walls or collapse debris to reach a patient.
- Storm Cleanup: Clearing downed trees and limbs.
- Ventilation: Cutting holes in roof materials to allow smoke and gases to escape.

All firefighters should be proficient with the inspection, maintenance, and use of a chainsaw. The following guide highlights the operation and maintenance of a Stihl-brand chainsaw; the information will generally apply to other saws but refer to the user manual for specific procedures.



Stihl Chainsaw Components

Air Filter Cover

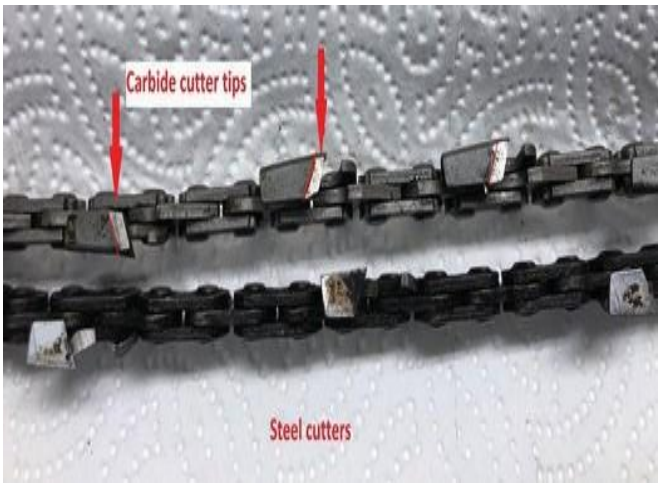
Remove to access air filter and carburetor.

Bar Nuts

Hold guide bar in place.

Chain

Made up of drive links, tie straps, and cutting teeth; cutters may be steel, or carbide tipped. Chains with carbide tipped cutters are designed for cutting through roofing material, glass, sheet metal, wood, and other materials, while chains with steel cutters are designed solely for wood. Carbide tipped chains are expensive and require special equipment to sharpen; steel tipped cutters can be sharpened in the field and are relatively inexpensive.



Chain Brake

Safety feature that when activated immediately stops the chain. May be applied by clicking the control backward but can also activate automatically with inertia from a kickback.

Bumper Spikes

Located at base of the bar and act as a pivot while cutting trees and logs; also referred to as dogs.

Chain Catcher
Protects against injury in case of chain breakage; located inside the chain cover.

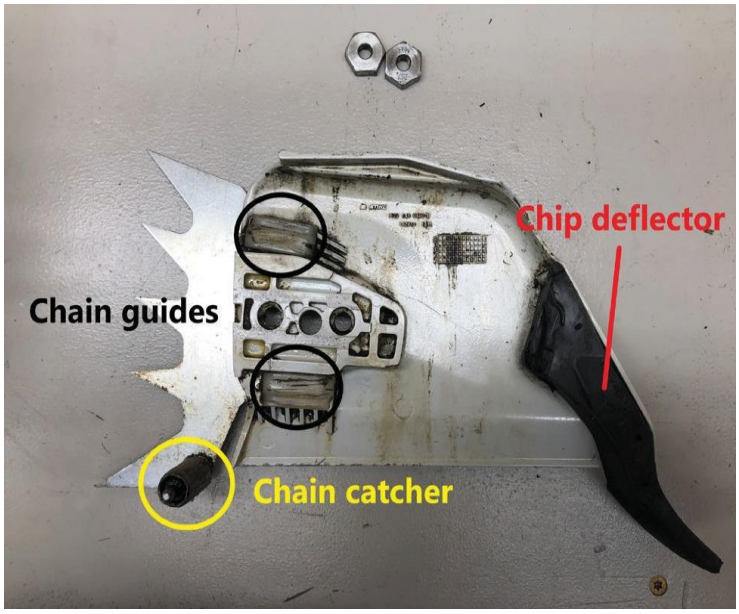
Chain Guides
Keeps chain in position between the guide bar and drive sprocket.

Chain Tensioner Screw
Used to adjust chain tension.

Chip Deflector
Directs chips and dust down and away from user.

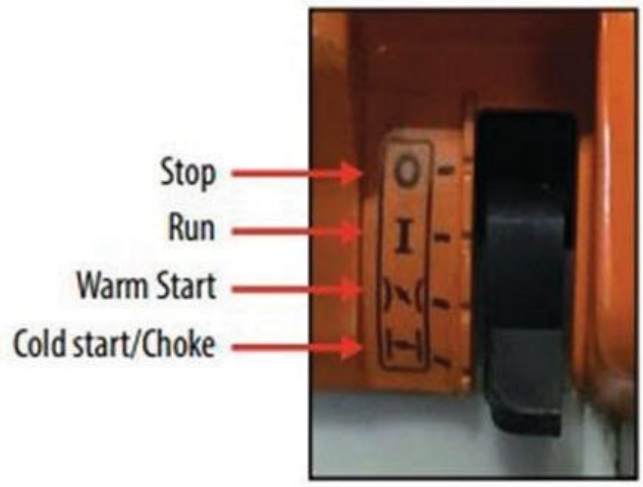
Decompression Valve
Reduces the force required to pull the starter cord

Guide Bar
Provides a track for chain; available in range of lengths, 16” – 20” are most common.



Handles
Designated handholds while operating saw.

Master Control Lever
Controls ignition and applies choke and throttle for starting.



Muffler
Hot engine exhaust expelled here.

Powerhead
Essentially, the chainsaw minus a guide bar; includes engine, handles, and controls.

Throttle Trigger Lockout
Safety feature: button must be depressed to open the throttle.

Scabbard
Plastic sheath that slips over the guide bar.

Scrench
Combination screwdriver/wrench used to adjust chain tension and remove bar nuts.

Starter Cord Grip
When pulled, turns over engine for starting.

SAFE OPERATION

Chainsaws are capable of inflicting serious or fatal injuries; refer to the following guidelines for safe operations.

- Minimum PPE required: eye protection, hearing protection, gloves.
- Ballistic nylon chaps are required during wildland operations (WAC- 96-305-07006) and may be otherwise necessary per your department's policies.
- When operating the saw, firmly grip the front and rear handles.
- Start the saw with the chain brake engaged.
- Always begin a cut at full throttle.
- Kickback is a dangerous upward motion of the bar that can occur when the upper quadrant of the bar nose contacts an object or is pinched. For this reason, avoid beginning cuts with the bar 90 degrees to the material and always maintain a firm grip on the handles.

Avoid kickback by using a shallow angle to begin cuts

- Avoid using the saw directly above your head.
- Never cut toward body parts; keep your legs and feet out of the saw's path.
- Wait for the chain to stop rotating and release your grip on the throttle trigger lockout before moving; engage the chain brake when moving more than a step with the engine running.
- Always be aware of others around you when operating the saw. Do not turn or swing the bar around unexpectedly.
- Gloves should be worn whenever handling a chain for inspection or maintenance.
- When cutting a roof, don't bury the entire bar into the roof; only use the first third.
- Place a scabbard over the bar when the saw is not in use, this both protects the chain from being damaged and prevents damage or injury from the chain.

ROUTINE CHECK

- Visually inspect the saw for damage, missing or loose parts, and cleanliness.
- Extend the starter pull cord fully, checking for damage or fraying.
- Ensure the chain is installed correctly (top cutters pointing toward the tip), sharp, and in good condition.
- Check the chain tension and adjust if necessary.
- Start the engine and allow it to warm up at idle for 30-60 seconds.
- Holding the tip of the bar about 4" above a hard surface, run the saw at full throttle for 5-10 seconds to verify proper oiling; a stripe of oil droplets should appear on the ground.
- Engage the chain brake and briefly run at full throttle - the chain must not rotate.
- Check the fuel and bar oil - keep them full.
- Store with the chain break on and scabbard in place.

POWER EQUIPMENT

OUT OF SERVICE CRITERIA

- Damaged or inoperable safety features, e.g., chain brake or throttle trigger lockout.
- Saw runs poorly, will not throttle up or will not idle.
- Carbide chain missing 3 consecutive cutter tips in a row or 5 total.
- Damaged or bent bar.
- Damaged or missing chain catcher or chain guide.

STARTING PROCEDURES

- Ensure chain brake is engaged.
- Grip rear handle, squeeze throttle trigger and set Master Control Lever to Choke (all the way down).
- Push in decompression valve, if present.
- Place saw on the ground, grip front handle with left hand and place toe of right foot into rear handle.
- Grasp the starter cord grip with right hand and slowly pull until feeling the starter engage the flywheel; then give a strong sharp pull while holding down on the front handle.
- Repeat until the engine fires (it may be necessary to push the decompression valve after each pull).
- Once the saw has fired, move Master Control Lever up one click to the Warm Start position; continue to pull cord until the engine runs.
- Immediately after the saw starts, briefly apply full throttle to release the interlock, which will allow the engine to idle.
- Permit the saw to warm up for 30-60 seconds at idle or light throttle before accelerating the engine (except in life safety situations).
- To shut off engine, move Master Control Lever fully up to the Stop position.
- When restarting a warm engine, place the Master Control Lever in the “Run” position instead of “Choke”.
- Drop starting a warm saw may be appropriate if your department’s policy allows.

FLOODED PROCEDURE

If the saw won’t start with normal starting procedures and smells strongly of fuel, it’s likely flooded.

Use the following routine for a flooded saw:

- Ensure the Master Control Lever is set to “Run” position, not “Choke”.
- Release the chain brake.
- Place the saw on the ground, making sure the bar and chain are clear of any objects or people (it will rotate when the engine starts).
- Grab the rear handle with your left hand, holding the throttle wide open; place your right knee on the front handle.
- With your right hand, pull on the starter grip repeatedly until the engine fires (it may take more than 20 pulls).
- Do not release the throttle until the engine clears out and runs well.
- Run the saw between idle and medium throttle for a minute, long enough to ensure that the engine runs and idles well and is no longer smoking.
- If the saw won’t start after 30-40 pulls, let it sit for an hour or two, then try again.
- If it still won’t start, follow your department's procedure for repair.

ADJUSTING CHAIN TENSION

The saw chain needs to be properly tensioned for safe operation. A chain that is too loose can be thrown off the bar. A chain that is too tight will cause wear to the guide bar, clutch, and internal engine components, and can become overheated and break. Check for proper tension during your daily check and frequently between cuts. Never allow the chain to become so loose that the drive links sag out of the guide bar's groove. A cold chain will grow as it heats up, a hot chain will shrink as it cools, and a new chain will stretch as it is broken in. Keeping these facts in mind, adjust the chain as needed to maintain proper tension. Tension is correct when the chain fits snuggly against the underside of the bar but can still be pulled along by hand.

Chain is too loose

Proper Chain Tension

Procedure:

- Ensure chain brake is released.
- Loosen both bar nuts with a scrench.
- Pull up slightly on the tip of the bar.
- Adjust the tensioner screw with the scrench as necessary.
- Snug the front bar nut and verify that tension is correct - loosen bar nut and readjust as needed.
- Tighten both bar nuts firmly with the scrench, to approximately 20ft/lbs. To avoid over torquing the bar nuts, don't use a tool other than the scrench. Over torquing can damage the side cover and pull the studs out of the powerhead (very expensive to repair).
- If the chain was adjusted while hot, remember to slacken the tension after finishing work to prevent damage from the chain shrinking as it cools.

MAINTENANCE AND CLEANING

After use, the saw should be disassembled, cleaned, and inspected before returning it to service. This process isn't required as part of a routine check -- only after the saw is actually used to cut.

Your level of training and the extent to which the saw is soiled should determine how much of the saw needs to be disassembled. Always follow your department guidelines for servicing power equipment. If your agency has specially qualified members who service your saws, advise them you have a saw that needs to be disassembled for cleaning.

Procedure:

- Minimum PPE: eye protection and exam gloves.
- Place the saw on a workbench, if possible.
- Note how the bar is installed (lettering right side up or upside down).
- Remove both bar nuts and the side cover, then remove the bar and chain as a unit and set aside.
- Release the chain brake.
- Remove the chain sprocket E-clip with the flathead end of a scrench (place a finger over E-clip so it doesn't fly off and get lost). Lift off the washer, sprocket, clutch drum, and needle bearing and set aside.

Removing E-Clip

E-Clip, Washer, Sprocket, Needle Bearing, and Clutch Drum

- Set the Master Control Lever to "Choke" to prevent debris from entering the carburetor. Remove the air filter cover and air filter, setting both aside.
- If available, use compressed air to blow debris and dirt off the powerhead, focusing on the areas around the clutch and carburetor. Finish cleaning with a rag.
- The side cover and air filter cover can be cleaned in the same manner.
- Stubborn stains and debris can be cleaned with a rag dampened with a solvent.
- Inspect the powerhead for damage, missing parts, and loose or missing hardware.
- Wipe off the clutch drum inside and out.
- Lubricate the needle bearing and crankshaft with a smear of multi-purpose grease, then install the bearing.

Lubricated Needle Bearing

- Locate the oil pump drive rod (a small rod under the edge of the clutch), then align the notch in the bottom edge of the clutch drum with the rod. Slide the clutch drum in place. Rotate the clutch drum; if properly installed it will freely spin and the top will be flush with the needle bearing.

Aligning the clutch drum with the oil pump drive

- Install the drive sprocket, washer, and E-clip.

Installing the E-Clip

- Remove the chain from the bar and set aside.

Cleaning bar grooves

- Wipe down the bar. Clean out any debris from the grooves in the bar. This can easily be done with a butter knife or something similar. Ensure the oil inlet holes on both sides of the bar are free of debris.

Oil inlet hole

- Inspect the bar for damage or wear; small burrs can be filed down. Sight down the length of the bar to verify it isn't bent.
- Ensure the sprocket at the tip of the bar freely spins.

- Install the chain on the bar in the opposite orientation that it came off - if the bar was previously right side up it should now be installed upside down. Hold the bar with the tip up and place the chain over the sprocket. Continue holding the bar upright with one hand while working the drive links into the groove with the other.
- Lay the powerhead on its left side. Holding the bar at an angle, work the drive links around the sprocket, then lay the bar over the studs. Adjust the tensioner as necessary for the bar to properly engage the tensioner peg.

Chain installed on drive sprocket and aligning bar

- Inspect the side cover for missing or loose components and damage.

> Note:
> If your saw does not have oversize dogs, the chain catcher will be a small aluminum hook near the bottom of the powerhead.

- Install the side cover and hand tighten the bar nuts.
- Follow chain tensioning procedures to complete replacement of the bar and chain.
- Clean the air filter by tapping it on a hard surface such as the bench top. A brush can also be used if necessary; don't use compressed air - this can damage the filter element.
- If the filter can't be cleaned, replace it.
- Install the air filter and cover.
- Perform a routine check, then place the saw back in service.

CIRCULAR SAW

Circular saws, also known as circ saws, rescue saws, cut off machines, or K12s, are versatile fire service tools. They can be outfitted with many blade types to cut almost any material. With an appropriate cutting blade installed, the circular 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, and chains and locks.
- Heavy Rescue: Building collapse, industrial accidents, and machinery entrapments.
- Vehicle Extrication: Aircraft, buses, tractor trailers, passenger cars, guard rail.

POWER EQUIPMENT

SAFE OPERATION

Like chain saws, circular saws are capable of inflicting serious or fatal injuries; refer to the following guidelines for safe operations:

- Minimum PPE: Helmet, gloves, eye protection, hearing protection, protective clothing. Respirator protection may be necessary depending on the material.
- Always use the correct cutting wheel for the material you're cutting.
- Examine cutting wheel before each use. Wheels should have no cracks, nicks, or flaws.
- Always have the blade shroud in place and adjusted properly to prevent kickback. Place the shroud so that the upper quadrant of the blade cannot contact the material.
- When cutting concrete use the water attachment to minimize dust; pressurized water extinguishers may suffice for remote locations. Verify that the blade is compatible with wet cutting.
- Avoid using the saw directly above your head. Top-down cuts starting at head level are acceptable, but the most effective position to operate the saw is below chest level.
- Firmly grip the front and rear handles when using the saw; be prepared for gyroscopic forces inherent to this design.
- Always use full throttle when cutting.
- Start your cut gently, do not force or squeeze the blade in. Moving the blade into a cut too quickly can cause the blade to shatter.
- Advance the blade slowly, manage forward pressure to avoid bogging down the RPMs.
- Avoid cuts where the material may shift and pinch the cutting wheel.
- When cutting metal, be aware of where sparks might be thrown.
- If a wheel shatters, carefully examine the blade shroud for damage.
- NEVER use saw to cut asbestos-containing material.

ROUTINE CHECK

- Fuel - maintain full.
- Check for cleanliness; clean as necessary.
- Inspect the cutting wheel for cracks, nicks, or flaws.
- Ensure the wheel is installed rotating the correct direction. Most fibrous/composite wheels can be installed and cut in either direction; refer to the blade's information label.
- Inspect carbide tips for worn, rounded, missing or chipped tips.
- Replace any fibrous/composite metal and concrete blades with over 20% wear.
- Extend the starter pull cord fully and inspect for damage or fraying.

OUT OF SERVICE CRITERIA

- Damaged or inoperable safety features, e.g., cutting wheel shroud or throttle trigger lockout.
- Saw runs poorly, will not throttle up or will not idle.
- Carbide wheel missing 3 in a row or 5 cutters overall.
- Damaged or wobbling/out of balance cutting wheel.

POWER EQUIPMENT

STARTING PROCEDURE

- Place the saw on the ground. Make sure the cutting wheel is clear of any objects/people (it will rotate when the engine starts).
- Holding down the throttle trigger lockout, apply full throttle. Move the slide control to the "start" position.
- Move the choke control to cold start position.
- Press fuel primer 7-10 times.
- Push in decompression valve, if present.
- Place your left hand on the front handle and right knee on the rear handle, then pull the starter cord grip until the engine fires.
- Move choke control to middle, partial choke position.
- Pull starter grip until engine runs (it may be necessary to push the decompression valve, if present, after each pull).
- Immediately after the saw starts, briefly apply full throttle to release the throttle hold, allowing idle and releasing the choke.
- Permit the saw to warm up for 30-60 seconds at idle or light throttle before accelerating the engine (except in life safety situations).
- To shut off, move the slide control fully up to the "0" / Stop position. Maintain control of the tool until the blade comes to a stop.
- When restarting a warm engine, use the same procedures, but don't apply the choke.

FLOODED PROCEDURE

If the saw won't start with normal starting procedures and/or has fuel or strong fuel vapors escaping the muffler, it's most likely flooded.

Use the following routine for a flooded saw:

- Ensure the slide control is set to the run / "I" position, and the choke is off.
- Place the saw on the ground. Make sure the cutting wheel is clear of any objects/people (it will rotate when the engine starts).
- Grab the rear handle and hold the throttle wide open with your left hand, place right knee on front handle.
- With your right hand, pull on the starter grip repeatedly until the engine fires (it may take more than 20 pulls).
- Do not release the throttle until the engine clears out and runs well.
- Run the saw between idle and medium throttle for a minute, long enough to ensure that the engine runs and idles well and is no longer smoking.
- If the saw won't start after 30-40 pulls, let it sit for an hour or two, then try again.
- If it still won't start, follow your department's procedure for repair.

CHANGING A CUTTING WHEEL

- Gripping the cutting wheel with a gloved hand, use a wrench to remove the flange hub nut. If the nut is too tight, slide a locking pin or similar tool through the small hole in the belt guard. Turn the blade until the pin engages the hub, then loosen the hub nut.
- Once the nut is removed, remove the flange hub washer.

- Remove the cutting wheel to be replaced.
- Install the new cutting wheel on the flange hub, ensuring the blade is installed the correct direction. Refer to the blade's label; some blades are bi-directional.
- Replace the hub washer properly over the blade.
- Replace the hub nut and tighten firmly.
- Start and run the saw to ensure the blade is balanced and operates smoothly.

CUTTING WHEEL TYPES AND USES

There are numerous cutting wheel types; most are designed to cut a specific material, although multi-purpose blades are available.

Wood Cutting Carbide Tip

Utilize several carbide tips per inch of the saw blade. Carbide tips should be inspected for wear; the blade should be replaced if 5 or more tips - or 3 in a row -have 50% or more of the carbide missing, or if they appear to be worn or rounded. All wood blades rotate in a specific direction and must be installed correctly. The rotation direction should be clearly marked on the wheel.

Wood-Cutting Carbide Tip Blade

Fibrous/Composite

Used for metal or concrete, but not interchangeable. These blades should be marked once they are removed from their packaging; they will not perform adequately on the incorrect material. Avoid exposing composite blades to petroleum products; they will breakdown the blade, potentially causing a catastrophic failure. Most fibrous and composite saw blades can be installed and cut in either direction. New blades are 14"in diameter; during cuts they will erode. When the blade is worn down to less than 8" across, it should be replaced. Crews utilizing

Fibrous/Composite Metal and Concrete Blade

fibrous/composite blades should be prepared with a large inventory of blades.

Multi-Purpose

Generally, these are carbide or diamond tipped to cut all common materials. While these wheels work satisfactorily on a variety of substances, they never cut as well as a blade that was designed for that specific material. They also tend to be heavier.

Multi-Purpose Blade

AFTER USE CARE

- Wipe any debris off the outside of the saw with a rag.
- Concrete cutting residue may require spot cleaning with water and a scrub brush.
- Inspect for damaged, loose, or missing hardware.
- Inspect/replace cutting wheel as appropriate.
- Top off the fuel.

PORTABLE GENERATOR

Portable generators provide electricity for corded tools, scene lighting, and to charge batteries at long term incidents. Some apparatus aren't equipped with portable generators; these vehicles are usually have onboard units or inverters instead.

Portable generators vary in electrical capacity, but generally should be able to power at least one corded tool. Circuit breakers on portable generators are usually rated for 15 or 20 amps; verify the tool doesn't exceed the requirement of your model. If the circuit breaker trips, the tool or power cord may be damaged and unsafe – inspect before resetting the breaker.

The generator's overload feature may be activated without tripping a circuit breaker, especially if multiple tools are being used. While this is acceptable for a brief period, the generator will eventually interrupt power in this situation. Some generators can connect "in parallel" to provide additional amperage; usually it is equally effective to plug each tool into separate generators.

PORTABLE GENERATOR

SAFE OPERATION

- A portable generator should never be allowed to get wet or placed in a wet location. For corded tool use in wet conditions, consider adding an inline ground fault circuit interrupter (GFCI) if your generator isn't equipped with one.
- Like all gasoline powered equipment, portable generators should not be used in enclosed spaces or areas with flammable vapors.

STARTING

Honda EU- and EB- models:

- Open fuel vent.
- Move engine switch to "on".
- Verify eco throttle switch is "off".
- For cold start, set choke to full, otherwise omit.
- Pull starter cord until engine starts.
- Slowly reduce choke.
- After engine is warm, activate ECO mode for improved fuel economy.
- To shut down: remove electrical load, then move engine switch to "off".
- Close fuel vent prior to transporting or storing.

ROUTINE CHECK

- Verify fuel level is full.
- Inspect for cleanliness and loose, damaged, or missing components.
- Extend starter pull cord fully and inspect for damage.
- Verify oil level is appropriate.
- Monthly - check air filter.

AIR LIFTING BAGS

Air lifting bags are a crucial rescue tool when heavy loads need to be lifted. While lift bags are available in variety of lifting capacities and types, SCBA cylinders usually provide the pneumatic force required to inflate the bags. Hoses connect the regulator to an airbag controller, which is then attached to the lift bag. Inline shutoffs and safety relief valves may be system elements as well. Refer to your model's operation manual for specific information.

SAFE OPERATION

- Minimum PPE: eye protection, helmet, gloves, appropriate protective clothing.
- If possible, use different-colored hoses when using more than one air lifting bag.
- Make all hose attachments prior to positioning the airbag.
- Never work under a load supported by the air bag alone; load the cribbing first.
- Maximize the contact area of the airbag on the load and supporting surface.
- Don't lift against sharp or pointed objects.

- Crib the load as it is raised and lowered; lift an inch, crib an inch.
- When using stackable air lifting bags, inflate the bottom bag first.
- Protect the air bag from surfaces over 150°F.
- Don't connect or disconnect components when the system is pressurized.
- Don't exceed the maximum inflation pressure.

ROUTINE CHECK

- Inspect for cleanliness and loose, damaged, or missing components.
- Use only soap and water to clean a lifting bag and components; petroleum products and solvents may cause weakness that is undetectable to visual inspection.
- If performing a functional check, inflate the airbag while wet to visualize any leaks.
- Do not exceed 30psi while the lifting bag is unloaded.

POWERED RESCUE TOOLS

Powered rescue tools are primarily used for extricating trapped victims from motor vehicle collisions but are also employed in forcible entry and technical rescue. These tools are driven by hydraulic force provided by either a standalone power unit or an internal electric motor.

Power units consist of a 4-cycle engine coupled to a hydraulic pump; high pressure hoses transmit the hydraulic energy from the power unit to the rescue tool. Most power units can only drive one or two tools simultaneously; tools may need to be switched out during the rescue using their quick connect fittings.

Electric rescue tools utilize battery packs driving electric motors coupled to internal hydraulic systems. In case the battery becomes exhausted, and no spare is available, a corded adapter is available to operate the tool with a generator.

A normal compliment of powered rescue tools consists of a spreader, a cutter, and a ram. A combination spreader/cutter known as a combi-tool, is also available.

Spreaders

Function using two robust jaws on pivots that are driven apart; pinching action is also possible, although with much less force. Spreaders have hardened tips that are removable in case of damage or wear, or to fit optional chain sets.

Cutters

Utilize two bypassing blades on a shared pivot. For optimal performance, position the cutter as perpendicular as possible to the object, and close to the pivot point.

Ram

Uses a two-stage cylinder to create a spreading force. Because the first stage cylinder is larger, it produces more force than the smaller second stage cylinder.

Combi-Tool

Has two blades pivoting on a shared shaft, like the cutters, but also has tips for spreading.

SAFE OPERATION

- Minimum PPE: helmet, gloves, eye protection, and protective boots and clothing. Respiratory protection may be necessary.
- Maintain awareness to the potential for rapid release or movement of material.
- Always check for hidden hazards like pressurized gas cylinders or high-voltage wires before cutting or displacing material.
- Crib under lifted loads.
- Inspect tools after use and replenish the fuel or batteries as necessary.
- For storage, adjust the tool position to slightly short of fully closed or retracted to neutralize internal pressures.

ROUTINE CHECK

- Verify power unit fluid and fuel levels, if applicable.
- Inspect for cleanliness and fluid leaks.
- Check for loose, damaged, or missing components.
- Verify battery charge, determined by an LED indicator on each pack.

PERSONAL PROTECTIVE EQUIPMENT (PPE)

CHAPTER 3

- THERMAL PROTECTION
- COMPONENTS
- INSPECTION
- CLEANING
- REPAIR
- STORAGE
- RETIREMENT

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PERSONAL PROTECTIVE EQUIPMENT (PPE)

In today's fires the synthetic fuel loads off gas more prevalently and have a much higher heat release rate when compared to the legacy fuels of 30 years ago. Often, 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 regarding 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.

- Helmet
- Nomex/PBI hood
- Jacket
- Gloves
- Bunker pants
- Boots
- 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.

PERSONAL PROTECTIVE EQUIPMENT (PPE)

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.

INSPECTION

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

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 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.

Gross Decon

Routine cleaning immediately after the termination of an incident can remove substantial amounts of surface contaminants before they have a chance to “set in”. This can also help to limit the transfer of contaminants to apparatus and facilities. Routine cleaning of your garment as soon as possible after an exposure to harmful contaminants can remove those contaminants.

Before removing firefighting ensembles worn in the hot zone, including SCBA mask, a gross decontamination shall be performed to remove potentially harmful contaminants. All protective clothing contaminated with firefighting debris shall be rinsed of gross contaminants in the field using a hose stream.

- Brush off any dry debris.
- Gently rinse off other debris with water.
- Do not use heavy scrubbing or spraying with high velocity water streams.
- Where necessary, use a soft bristle brush to gently scrub the PPE and thoroughly rinse.

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 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 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.

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:

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

Procedures When Cleaning In A Utility Sink

- Do not overload sink
- Pre-treat if necessary
- Water not to exceed 105 degrees
- Add cleaning solution or detergent
- Wear protective gloves & eye/face splash protection
- Scrub gently using a soft bristle brush. Use care with moisture barrier assemblies
- Drain water from sink
- Refill sink; agitate gently using gloved hand or stir stick
- Gently wring out garments and drain water
- Repeat (7) and (8) until garment is rinsed
- Dry the elements
- Inspect and rewash if necessary
- Rinse out sink

Procedures For Machine Washing

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

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

A firefighter's 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.

SELF-CONTAINED BREATHING APPARATUS (SCBA)

CHAPTER 4

- MSA G1
  - COMPONENTS & NOMENCLATURE
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- WORKING IN IDLH HAZARD ZONES

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SELF-CONTAINED BREATHING APPARATUS (SCBA)

An SCBA, or Self-Contained Breathing Apparatus, provides an air supply that is essential to firefighter survival in hazardous environments. All SCBA users must be thoroughly trained in the inspection, care and use of the device, including procedures to follow in case of an exhausted air supply or other emergency. This chapter contains the essential knowledge and procedures for the MSA G1 SCBA and G1 RIT system.

SELF-CONTAINED BREATHING APPARATUS (SCBA)

MSA G1 COMPONENTS AND NOMENCLATURE

Battery Module

The rechargeable battery module contains non-replaceable lithium-ion cells. Follow your department's policies regarding battery management and change-out procedures.

Carrier and Harness Assembly

The carrier and harness assembly includes an ergonomic back plate, a cylinder band, and fully adjustable shoulder and waist straps. The backplate includes handles to facilitate handling and storage.

The shoulder straps include friction pads to minimize slip, metal buckles to provide secure retention, retroreflective graphics to enhance visibility, and are optionally fitted with a chest strap. The waist straps are secured to a lumbar pad that is adjustable to three height positions for optimal fit and swivels for freedom of movement and weight distribution.

Control Module

The G1 control module is the user's interface with the SCBA and PASS; a hose and wire assembly connects the Control Module to the high-pressure air source and the Power Module. The control module has an analog gauge and a graphical display to provide information such as cylinder pressure (in psi), battery status, electronics status alerts, and alarms. The Control Module contains the PASS (Personal Alert Safety system) which monitors movement through a motion sensor to identify a potentially incapacitated or trapped firefighter. When a user is motionless for 20 seconds, the PASS goes into pre-alarm; after 30 seconds, it provides a full alarm. The manual alarm button on the Control Module activates the full PASS alarm with or without air pressure, whether activated or in "sleep mode".

Cylinder and Cylinder Valve Assembly

The G1's 4500 psi cylinders are designated as 45-minute bottles. The cylinder valve assembly includes a pressure gauge with a photo luminescent (glowing) face and a relief device to vent pressure safely if the cylinder is over-pressurized. The cylinder valve assembly is equipped with a male quick connect adapter to enable fitting to the female quick connect assembly located on the SCBA.

SELF-CONTAINED BREATHING APPARATUS (SCBA)

ExtendAire II Airline Connection

The ExtendAire II airline connection enables an SCBA to be used as a combination SCBA and SAR (Supplied Air Respirator) by connecting to approved breathing air systems (e.g. - ladder truck air systems for extended operations). The ExtendAire II airline connection includes a quick connect fitting that attaches to an MSA-approved air supply and a check valve to prevent loss of air through the hose if the SCBA cylinder valve is open.

Facepiece

The facepiece provides a face seal, connection for the air regulator, full head harness and a large lens. When the facepiece is not connected to a regulator, an opening in the connection lets air bypass the inhalation and exhalation valves, which decreases breathing resistance and further enhances vocal communications provided by the mechanical speech diaphragm. The facepiece and nose cup are available in three sizes (small, medium, large). An optional spectacle kit is available.

Heads Up Display (HUD)

The HUD is integrated into the regulator and projects lights into the facepiece to communicate the cylinder pressure and alarms to the user. Three led indicators on the left side show various alarm statuses: a battery icon, running man Icon, and caution triangle. Four LEDs located on the right side indicate the following:

- Four green LEDs - full bottle (4500psi)
- Three green LEDs - 75% full (3375 PSI)
- Two Yellow LEDs - 50% full (2250 PSI)
- One Red LED - 35% full (1575 PSI)

Integrated Thermal Imaging Camera (iTIC) The G1 may be equipped with an iTIC. When activated, the iTIC displays a thermal image on the display of the Control Module. With TIC mode engaged, the user can toggle the display between multiple color palettes to improve thermal scene visibility. The camera sensor is built directly into the end of the Control Module. TIC mode is controlled utilizing the green reset buttons.

SELF-CONTAINED BREATHING APPARATUS (SCBA)

Power Module

The Power Module distributes battery power and provides information to the Control Module, Regulator, and Speaker Module. The power module is located on the backplate of the harness and connects to the rechargeable battery module. The Power Module has the following features:

- Emits various audible alarms
- Houses four buddy lights to communicate position and alarm status to nearby personnel.
- Light to illuminate the UAC for transfill operations.
- Data-logging function records SCBA information.

Pressure Reducer with Primary Low-Pressure Warning Device

The pressure reducer is a mechanical device located at the base of the harness that reduces the 4500-psi cylinder pressure to approxi-mately 110 psi. It operates independently of the electronic features of the G1 and will continue to function in the event of electronic or power failure. A bell alarm for low pressure actuates when 35% (approximately 1575 PSI) or less of the SCBA's rated service pressure remains.

The pressure reducer is equipped with a universal air connection (UAC) fitting that is designed to be used by rapid intervention teams for emergency transfilling operations. Both bottle pressures will equalize when UAC is used.

Regulator

The regulator connects to the facepiece with a push-to-connect (PTC) assembly and includes release/shutoff buttons and a bypass valve which can manually control airflow, if necessary. An electronic module provides functionality for heads-up display and electronic voice communications.

Speaker Module

The speaker module is activated when the user breathes from the regulator, amplifying and clarifying speech from the facepiece. The sound of inhalation is not amplified. The speaker can be turned on and off with its integrated button.

MSA G1 INSPECTION & FUNCTIONAL TEST

> If any G1 component is missing, damaged or nonfunctional, immediately remove the item and follow department out of service guidelines for repairs. ALL REPAIRS MUST be performed by an MSA CARE-certified technician. DO NOT attempt any repairs.

INSPECTION

Facepiece

- Inspect the lens for cracks, scratches, deformation, and color change.
- Check the facepiece rubber for a tight seal and secure fit to the lens ring.
- Inspect the facepiece inlet for damage. Ensure the inhalation valve is in place.
- Be sure the nose cup is flush and properly aligned to the component housing.

Regulator

- Check for moisture and debris inside the regulator and in the microphone ports. **WARNING! DO NOT use any sharp objects to remove dirt or debris from the microphone ports.**
- Ensure the O-ring and seal ring are free of debris and not damaged or missing.

Pressure Reducer

- Quick Connect: ensure there is no dirt or debris on either the male or female end of the coupling and the cylinder valve is tight.
- Inspect the high-pressure relief valve for damage. Verify label is not damaged and the relief valve ports are not showing.
- Push the quick connect coupling onto the cylinder valve adapter until an audible snap is heard. The handgrip will rapidly rotate approx. 45° counterclockwise indicating that the valve is connected to the pressure regulator.

- Ensure that the bell is properly aligned and that the screws are tight. The bell should not be able to be rotated or loose.

Cylinder and Valve Assembly

- Check the hydrostatic test date on the most recent cylinder approval sticker. Carbon-wrapped cylinders must be tested every five years.
- Ensure the needle and gauge face on the cylinder valve gauge are clearly visible and that the gauge stem is not bent.
- Ensure the rubber boot is present on the cylinder valve and the dovetail feature is not damaged or cracked.

Carrier Assembly

- Operate the latch on the cylinder band to ensure that it opens and closes properly and that it holds the cylinder securely.
- Ensure that the lumbar pad is attached securely.
- Ensure the power module and pressure reducer are secured to the back plate by the lower cover.
- Ensure the dove tail feature that secures the bottle on the lower cover is not damaged or broken.

Control Module

Check the displays for cracks or other visible damage, ensure the buttons are not damaged or missing, and the hose assembly is securely attached to the Control Module.

Power Module

- Ensure that the Power Module and battery module are securely attached to the backplate.
- Inspect the piezo emitters (speaker holes) on both sides of the power module for dirt or debris.

Battery Module

- Unlock the battery module with the battery removal tool located on the waist strap buckle.
- Check the battery module for visible damage and corrosion, ensure that the connection seal is in place and undamaged. Reinsert the battery module and turn off the PASS device.

ExtendAire II (if applicable)

- Inspect quick connect fittings. Ensure that the openings are clear and free of debris and other contaminants.
- Ensure functionality of the quick connect fittings.

FUNCTIONAL TEST

Conduct a functional test daily, when returning to the SCBA to service following maintenance or cleaning, and after each use.

- Don the facepiece and seal the open end of the facepiece with your hand. Perform a Negative Pressure Seal Test by inhaling, drawing mask to face, and ensure there are no leaks for a minimum of ten seconds.
- Open the cylinder valve slowly and ensure the valve is completely open.
    - Listen for PASS activation and for the low-pressure bell to sound briefly. If the cylinder valve handwheel is opened too rapidly, the narrow range for the low-pressure alarm can be completely bypassed and may not sound. This is not a failure of the SCBA.
    - Observe the buddy light & UAC light startup sequence completes and the buddy lights are flashing green on the Power Module.
    - Observe the regulator buddy light sequence and the HUD LED sequenced pattern on the left and right side of the regulator for proper functionality.
    - Ensure the pressure gauge and LCD display show the correct pressure.
    - Ensure the system pressure shown on the control module analog gauge and the cylinder analog gauge readings are within 225 PSI (5%) of each other. If not, troubleshoot by replacing the cylinder with a new cylinder and compare the analog gauges again.
- Attach the regulator to the facepiece.
- Inhale sharply to start air flow and then breathe normally to ensure proper regulator response. Ensure Speaker Module functionality. The regulator should NOT make any unusual sounds including whistling, chattering, or popping.
- Momentarily pull the facepiece away from the face so that air flows freely (ensuring positive pressure). Press shutoff buttons on regulator and detach from facepiece.
- Allow the Control Module to remain motionless for approximately 20 seconds.
    - Listen for 3 separate tones of the PASS pre-alarm.
    - Verify that the buddy lights are flashing red.
    - Verify that the red Caution Triangle LED is flashing in the regulator/HUD.
    - Allow the Control Module to remain motionless until the full alarm sounds (30 seconds). Verify the red Caution Triangle LED goes solid.
- Reset the PASS alarm by double pressing one of the reset buttons (green) on the side of the control module.
- Check the manual activation of the PASS alarm. Press and hold the alarm button on the front of the control module until the alarm activates. Reset the PASS by double pressing one of the reset buttons (green) on the side of the control module.

- Close the cylinder valve fully.
- Crack the bypass valve open being careful to observe proper pressure segment light activation (three green lights at 75%, two, blinking yellow lights at 50%, one, blinking red at 35%). Observe department specific settings which may include a medium pressure alert at 50% and/or a pressure drop alarm with rapid release of air (reset as necessary). Verify low-pressure alarm (bell) at 1575 psi (75%) and verify that alarm ceases at approx. 100 psi.
- Release any remaining air pressure and double-press a green, reset button on the Control Module to place the pack into "sleep mode".

DONNING MSA G1 SCBA

Over-the-Head Method

- Don PPE
- Prepare/inspect SCBA
    - Ensure straps are free, not tangled
    - Inspect cylinder pressure
- Open cylinder valve
    - Open cylinder valve to fully open position, verbalize bottle pressure
    - Verify low air alarm, verbalizing “bell”
    - Verify PASS device activation.
- Don SCBA backpack
    - Position SCBA for donning
    - Reach between straps grasping the frame handles
    - Tuck chin and raise SCBA overhead and to your back, ensuring that shoulder straps drop over elbows, bending slightly forward and lowering SCBA onto upper back
    - Locate and fasten chest strap (optional)
    - Locate and tighten waist strap, ensure weight of pack is distributed to hips
    - Grasp shoulder strap tabs and tighten straps
    - Check pressure gauge
- Don SCBA facepiece and hood
    - Place standby strap overhead (if equipped)
    - Loosen/remove helmet
    - Remove hood by placing behind head
    - Place chin into facepiece and secure harness overhead
    - Tighten facepiece straps by pulling back
    - Test facepiece seal, verbalize “seal”
    - Don protective hood, covering the mask seal and ensuring no exposed skin
    - Don and secure helmet
- Insert regulator and counter-pull
    - Remove regulator from mount, insert into facepiece
    - Counter-pull to ensure connection
    - Check Bypass valve

Coat Method

- Don PPE
- Prepare/inspect SCBA
    - Ensure straps are free, not tangled
    - Inspect cylinder pressure

- Open cylinder valve
    - Open cylinder valve to fully open position, verbalize bottle pressure
    - Verify low air alarm, verbalizing “bell”
    - Verify PASS device activation.

- Don SCBA backpack
    - Position SCBA (bottle or frame faced away from user)
    - Grasp both shoulder straps close to top of frame
    - Keep left hand on strap with regulator, maintain constant contact
    - Lift and swing SCBA to back around left side, ensuring that elbow passes through shoulder straps and allows right strap to go over right shoulder/arm
    - Locate and fasten chest strap (optional)
    - Locate and tighten waist strap, ensure weight of pack is distributed to hips
    - Grasp shoulder strap tabs and tighten straps
    - Check pressure gauge

- Don SCBA facepiece and hood
    - Place standby strap overhead (if equipped)
    - Loosen/remove helmet
    - Remove hood by placing behind head
    - Place chin into facepiece and secure harness overhead
    - Tighten facepiece straps by pulling back
    - Test facepiece seal, verbalize “seal”
    - Don protective hood, covering the mask seal and ensuring no exposed skin
    - Don and secure helmet

- Insert regulator and counter-pull
    - Remove regulator from mount, insert into facepiece
    - Counter-pull to ensure connection

DOFF & IN-SERVICE PROCEDURES

- Ensure gross decontamination procedures have been completed BEFORE going off air.
- Press in shut-off buttons to shut-off regulator.
- Remove regulator and place in waist-belt regulator holder.
- Remove facepiece.
- Release and extend waist strap.
- Release chest strap, fully extend shoulder straps.
- Remove SCBA by removing right shoulder from strap and swing off back, maintaining control of left, regulator strap.
- Close the main cylinder valve, bleed off air using bypass valve, and put pack into “sleep mode” by double-pressing a green reset button on the Control Module

SECURING SCBA FOLLOWING USE

- Follow full decontamination procedures for both pack and facepiece upon return to station.
- Return SCBA to service:
    - Replace cylinder with one fully charged.
    - Ensure all straps are fully extended.
    - Perform functional test.
    - Return to appropriate apparatus

SELF-CONTAINED BREATHING APPARATUS (SCBA)

EMERGENCY PROCEDURES MSA G1 SCBA

ALL emergencies pertaining to breathing apparatus require activation of MAYDAY procedures. If possible, have your partner communicate MAYDAY while performing an appropriate emergency procedure to rectify issue. Do not delay correction of SCBA problem for MAYDAY procedures.

Operate Bypass Valve (Regulator Failure)

- Communicate to partner
- Locate bypass valve
- Crack open bypass valve allowing enough air in to take a breath
- Close bypass valve between breaths to conserve air
- Exit structure

Filter Breathing (Complete Pack/Air Supply Failure)

- Glove Method - remove glove, place over regulator opening, and protect ungloved hand by pulling it inside sleeve.
- Wrist Cuff Method - remove glove, pull hand up inside sleeve, place wrist cuff over regulator opening.

Regulator Breathing (SCBA Facepiece Failure)

- Communicate to partner
- Loosen helmet
- Remove 2nd stage regulator from mask
- Lift mask up from the chin
- Place regulator in mouth
- Pull flash hood down in attempt to cover facepiece, face, and regulator
- Re-tighten helmet

PASS Activation (Any MAYDAY Emergency)

- Communicate to partner
- Activate MAYDAY/Have partner activate MAYDAY
- Locate Control Module on the right shoulder
- Press and hold red, manual alarm button until PASS activates
- Continue to exit structure or perform "GRAB LIVES" procedures

Air Conservation

- Demonstrate ability to conserve air supply utilizing preferred breathing technique:
    - Box Breathing Technique– Inhale over 3-4 seconds, hold breath for 3-4 seconds, exhale over 3-4 seconds, hold breath for 3-4 seconds. Repeat.
    - Triangle Breathing Technique – Inhale over 3-4 seconds, hold breath for 3-4 seconds, slowly exhale through pursed lips extending exhalation for as long as possible. Repeat.
    - Hum Technique – Inhale a full breath. On exhalation, keep mouth closed and hum for as long as possible to perform exhalation. Repeat.

MSA RIT PACK

The MSA G1 RIT pack is a 60-minute self-contained breathing air system designed for use by Rapid Intervention Teams (RIT) to provide for air needs in rescue situations. It has multiple air delivery options for correcting any SCBA failure and is purely mechanical, with none of the electronic features found on the G1 SCBA. The G1 RIT system is housed in a specifically designed bag that is configured for rapid access and deployment.

SELF-CONTAINED BREATHING APPARATUS (SCBA)

COMPONENTS AND NOMENCLATURE

Accessory Tool Compartments
There are two accessory compartments on one side of the RIT bag that allow for tool and accessory storage.

Cylinder
The MSA G1 RIT system has a 4500 psi, 60-minute rated bottle that has the same cylinder valve assembly, quick connect, analog gauge, and functionality of the 45-minute bottles used in the G1 SCBA. It is secured in the MSA bag with two straps, one around the neck of the bottle and one around the body of the cylinder. An easy access opening is secured with a zipper and breakaway Velcro on the side of the bag.

Facepiece
The RIT bag facepiece is the exact same G1 facepiece found with the SCBA. Size preference is department specific, but typically comes with a medium to provide for the widest range of faces.

Regulator
The only notable differences between the G1 RIT system and the G1 SCBA are a lack of electronic features and a purge button. Rather than a rigid housing, the housing on the front of the regulator is soft, allowing users to activate the regulator in the instances where the victim is incapable of drawing the sharp breath necessary to prompt air flow. Once in place, simply push on the front of the regulator to open the valve allowing the victim to breathe.

Remote External Gauge

The G1 RIT assembly comes with a large external gauge attached to the pressure reducer assembly that sticks out of the bag and is held in place with Velcro straps. This is to allow operators to easily visualize pressure.

Supply Hoses

The G1 RIT bag is equipped with two, six-foot hoses that can easily be configured in separate storage pouches on the bag for rapid deployment. Both hoses are connected to a pressure reducer assembly attached directly to the cylinder using the MSA quick connect.

- **High Pressure Hose -** A single purpose hose equipped with a female UAC for transfilling operations. It has a protective cover and is designed to be stored on the exterior of the pack using the provided Velcro flap on the front side of the bag for access/deployment.
- **Intermediate Pressure Hose** - A hose that has the regulator for the facepiece and an intermediate pressure, ExtendAire II manifold.

UAC Fitting (Male)

On the pressure reducer, there is a male UAC fitting that allows for transfilling into the 60-minute RIT bottle.

RIT PACK INSPECTION AND FUNCTIONAL TEST

If any G1 component is missing, damaged or nonfunctional, immediately remove the item from service and follow department guidelines for repairs. ALL REPAIRS MUST be performed by an MSA CARE-certified technician. DO NOT attempt any repairs.

1. Inspect the exterior of the pack for damage, wear, cleanliness, and functionality.
2. If any additional equipment has been added to the pack, verify that equipment is present and functional (department specific).
3. Verify the accessory gauge is appropriately in position on the exterior of the pack for visibility.
4. Remove both of the 6' hoses (high-pressure hose with female UAC fitting and intermediate pressure manifold assembly). Inspect for wear and damage. Return to their appropriate pouches, being careful to store in such a manner as to allow for rapid deployment.
5. Using the side access zipper on the bag for the cylinder, inspect the cylinder for damage and cleanliness and verify both the cylinder straps (body, neck) are secure.
6. Open the facepiece flap and remove the facepiece. Inspect for damage and cleanliness. Remove the regulator from the facepiece, press the shutoff buttons, and verify that the bypass knob is fully closed. Verify that both regulator O-rings are in place and intact. Perform a Negative Pressure Seal Test on the facepiece for a minimum of 10 seconds. Reattach the regulator to the facepiece.
7. Inspect the cylinder analog gauge and ensure it is undamaged and that the cylinder is properly charged. Remove the pressure reducer assembly by releasing the quick connect from the cylinder and inspect for damage. Inspect the quick connect adapter on the cylinder and ensure it does not unthread easily. Reattach the pressure reducer assembly to the cylinder.
8. Charge the RIT system by opening the cylinder valve handwheel. Verify that there are no leaks. Open the regulator utilizing the "purge button" to verify air flow, then shutoff utilizing shutoff buttons.

9. Open the bypass knob briefly to verify air flow.
10. Verify that the cylinder analog gauge and the remote external analog gauge are within 5% (225 psi) of each other.
11. Shut off the cylinder valve, bleed pressure from the system utilizing the bypass knob, then replace all components to ready for deployment positions.

RIT BAG DEPLOYMENT

- Determine most-appropriate RIT procedure (Regulator, transfill, or facepiece replacement)
- Remove obstructions/debris from downed firefighter's UAC or facepiece
- Charge RIT SCBA bottle by opening cylinder valve
- Replace regulator with RIT regulator, or
    - Connect RIT to UAC for transfill, or
    - Replace damaged facepiece with RIT facepiece
- Strap RIT pack to downed firefighter
- Remove downed firefighter from IDLH hazard

SCBA OPERATIONS IN IDLH

TERMS

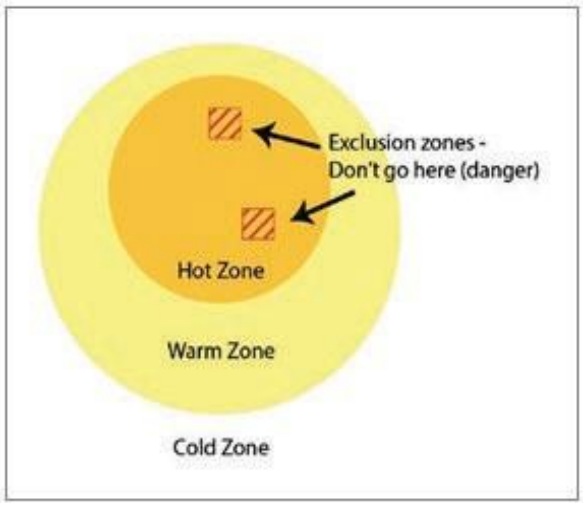
CAN Report (Conditions, Actions, Needs)
A verbal report, typically given over the radio, advising an operational supervisor of the current conditions encountered, actions currently being taking, and any logistic needs.

Hazard Control Zones
Cold Zone: The area of an incident that contains the command post and other incident support functions. There are minimal risks of injury or toxic exposure in this zone. The outer border of the cold zone establishes the public exclusion or clean zone.

Warm Zone: The Control Zone immediately outside the Hot Zone, where personnel and equipment decontamination and other support of Hot Zone efforts take place. It is a limited access area only for those directly aiding or in support of Hot Zone operations. Significant risk of injury or toxic exposure may exist in the Warm Zone.

Hot Zone: The area surrounding the actual hazard or incident, extending far enough to minimize adverse effects to personnel outside the zone. The Hot Zone presents the greatest risks or injury or toxic exposure, and will often be classified as an IDLH environment.

Exclusion Zones: Areas designated as unsafe, "no-go" zones intended to exclude all personnel, responders, and equipment. Examples of exclusion zones are areas with falling, explosive device, or collapse hazards.



SELF-CONTAINED BREATHING APPARATUS (SCBA)

IDLH (Immediately Dangerous to Life or Health)
Any environment to which exposure may result in bodily harm, including acute and long-term health effects. Areas contaminated with smoke and other products of combustion or hazmat releases are examples of IDLH atmospheres.

Freelancing
Any action taken on the fireground or emergency scene that is not in alignment with the Incident Action Plan (IAP), does not follow direction from or is not approved by an individual's supervisor, or is not appropriately communicated with Incident Command/ Operational supervisor.

Gross Decontamination
The process of removing bulk contaminants from the exterior of bunker gear and SCBA while still on-air, prior to removal of the regulator. Gross decontamination shall be performed whenever firefighters are exposed to an IDLH, products of combustion, or hazardous materials. This includes interior and exterior operations, salvage/overhaul, investigations, or any other potentially contaminating event.

Off-Air
Not breathing air from the SCBA cylinder; regulator is mounted in the belt-mounted holder**.**

On-Air
Regulator attached to the facepiece, breathing air from the cylinder.

Orientation
To remain aware of one's surrounding environment and rapid access to egress, especially when visibility is compromised. Typically achieved by remaining in physical contact to a known reference point (wall, hose, rope, etc.).

Personnel Accountability Report (PAR)
A verbal report given over the radio or face-to-face by a team leader their operational supervisor which conveys the cohesiveness of a team; this report is given any time a team exits an IDLH/Hot Zone or upon request. Communications for an intact team should be conveyed, "PAR with [number of personnel assigned to team]". If a member is unaccounted for, the team leader should convey the missing individual by name along with any pertinent information of circumstances, if available.

Ready Position
Level of individual readiness which includes full PPE and a donned SCBA with the facepiece fully donned, but off-air.

Standby Position
Level of individual readiness which includes full PPE and a donned SCBA with the facepiece clipped to the harness or hung around the user's neck.

SELF-CONTAINED BREATHING APPARATUS (SCBA)

REGULATION AND POLICIES

Per WAC 296-305-04001 all members must pass a fit test with their assigned SCBA mask annually, or after changes which may affect the seal, such as weight gain or loss, or facial surgery or trauma. Facial hair or any other physical obstruction is not allowed between the facepiece and the skin at points where the SCBA facepiece is designed to seal with the skin of the face. Checking for and achieving a proper seal every time the mask is donned is required.

SCBA shall be worn by all personnel working in areas where the atmosphere is hazardous or has the potential to be. Premature removal of the SCBA must be avoided, particularly before gross decontamination or during overhaul.

Each firefighter is accountable for their own SCBA and is required to verify its readiness, including air cylinder pressure, battery level, and functional operation; this check is necessary at the beginning of each shift, after each use, and after maintenance or cleaning. If an SCBA is found to be functioning improperly or damaged, it must be removed from service immediately.

After exposure to an IDLH environment or other contaminants, SCBAs should be handled and cleaned per department policy; **contaminants related to firefighting are known carcinogens**.

WORKING IN IDLH HAZARD ZONES

Teams working on task level objectives at an incident in the IDLH hazard zone are at the greatest risk. **No hazard zone management system can outperform unsafe behaviors.**

Responsibilities of teams working on task level objectives include:

- Wearing proper PPE
- Utilizing the passport accountability system
- Staying together as a company
- Maintaining orientation
- Always preserving an adequate air supply to safely exit an IDLH hazard zone
- No freelancing

Additionally, the following guidelines should also be adhered to:

- Members operating in the Warm Zone of an incident should wear their SCBA in the standby position to ensure that it will be immediately available for use, if necessary.
- The minimum number of personnel assigned to a crew or a team operating in an IDLH hazard zone shall be two. No one operates in the hazard zone alone.
- Prior to entry into the Hot Zone, the team leader should brief his/her crew with a plan for achieving the tactical objectives, including a safe exit plan which keeps the crew intact.
- All personnel shall be in contact with their team leader by voice, sight, or touch. These senses can be augmented with radio communications, thermal imaging, or sharing a rope or hose line.
- Routine radio reports from team leaders to command should be in a CAN report format.

- As part of a daily functional test, every firefighter must personally verify they have a full air cylinder. At an emergency response, every firefighter is individually responsible for monitoring their air supply and communicating its status to their team leader.
- Team leaders must maintain an awareness of their crew's air levels. The initial 65% of a crew's air supply is to enter the IDLH hazard zone, work in the IDLH hazard zone and exit the IDLH hazard zone. The remaining 35% of the air supply is an emergency air reserve, only to be used if an emergency occurs while exiting the IDLH hazard zone. Air supply consumption must be managed with this guidance in mind. A decision to exit the IDLH hazard zone must consider adequate air reserves to deal with any sudden or unplanned events while exiting. Except in grave circumstances, firefighters will exit the hazard zone prior to SCBA low air alarm activation.
- Team leaders should give a Personnel Accountability Report (PAR) upon exiting the hazard zone or upon request to their appropriate supervisor.
- Upon exiting an IDLH Hot Zone, it is essential that firefighters immediately seek out gross decontamination prior to removing the SCBA regulator or other PPE.

Firefighting and other responses requiring SCBAs are inherently dangerous tasks; a thorough knowledge of this equipment and its use are a foundational necessity of safe operations. Correct SCBA inspection, functional testing, donning, emergency procedures, and the Hazard Zone operational guidelines as presented in this chapter are essential knowledge for Kitsap firefighters.

CHAPTER 5

- DEFINITIONS
- TOOLS & EQUIPMENT
- TYPES OF LOCKS
- TYPES OF DOORS
- SIZING UP THE DOOR
- FORCING DOORS
- FORCING WINDOWS
- KNOX BOXES
- OVERHEAD ROLL-UP DOORS

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Revised: August 2023

FORCIBLE ENTRY

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.

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.

DEFINITIONS

Bolt

Locking mechanism found on deadbolts. Usually square or round that slides into the strike approximately 1 inch. *Also known as deadbolt.*

Carriage Bolt

Large bolt with round low-profile head.

Crossing the Tools

Striking technique which gives the striking firefighter the greatest chance of hitting the prying tool, not the other firefighter.

Door Stop

Portion of the doorframe which prevents the door from swinging past the frame.

Drop Bar

Security device typically mounted across the interior of the door. Drop bars are held in place with brackets, which may be fastened to the doorframe.

Suspect drop bars might be inside if you see carriage bolt heads from the exterior.

Forcible Entry

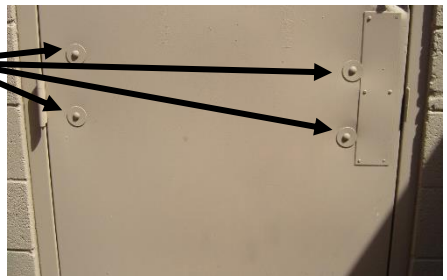
Techniques used to gain access to buildings or other areas of confinement when normal means of access are locked and/or blocked.

Gap-Set-Force

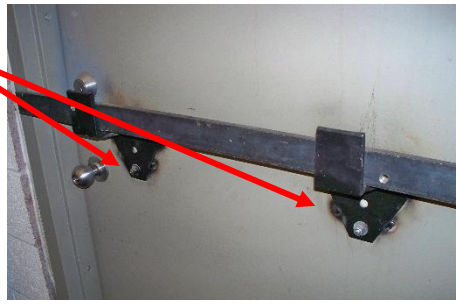
The series of steps used when forcing doors.

- Gap – Creating a gap between the door and jamb.
- Set – Setting the prying tool into proper position.
- Force – Applying leverage and force to the prying tool to open the door.

Carriage bolt heads on the outside…



May indicate a drop bar is on the inside.



Gap the Door
Initial opening made in the door and/or frame creating a purchase point.

Inward Swinging Door
Door swinging AWAY from you. Commonly found in residential structures.

Irons
Combination of flat head axe and halligan.

Jamb
Upright parts of doorframe, on one of which the door is hung.

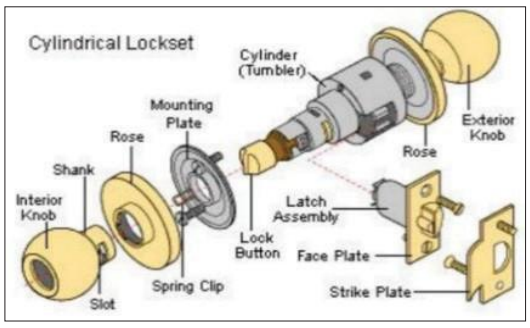
K-Tool
Tool designed for pulling lock cylinders of low-profile mortise and rim locks.

Key-in-the-Knob Lock
Locking mechanism is part of the doorknob.

Key Tool
Set of tools used in conjunction with the K-Tool for manipulating internal lock mechanisms after the cylinder has been pulled.

Knox Box
Small wall mounted safe holding keys to the structure. Accessed with Knox Key in responding apparatus.

Lockset Complete locking system, including knobs, plates, and locking mechanism.



Mushrooming
Common damage found on striking surfaces.

Outward Swinging Door
Door swinging TOWARD you. Commonly found in commercial occupancies.

Padlock
Detachable lock hanging by a pivoted hook on the object fastened.

Setting the Tool
Driving the Halligan into the gap until the arch of the fork is even with the inside edge of the door stop.

Size-up
The act of identifying the following components:

- Type of locking mechanism and obvious signs of additional security devices.
- Type, number, and location of hinges.
- Direction of door opening – inward vs outward.
- Type of door and frame – wood vs metal.

Strike Plate
Metal plate attached to the inside of the door jamb where the latch/bolt throws into.

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

Wedge
Used to capture progress while prying, often used in conjunction with prying tools. Commonly made of wood or aluminum.

FORCIBLE ENTRY

TOOLS AND EQUIPMENT

Conventional Tools

Axe
Used to strike prying tools into gap and capture progress.

Halligan
Used to create gaps and pry door open.

New York Hook
Used to strike halligan and/or wedge, create gap and pry door open, and/or increase leverage of halligan.

Wedge
Used to create gaps, capture progress, and prop doors open.

Through-The-Lock Tools

Channel Lock Pliers
Used to turn out the lock cylinder while breaking the set screws holding it in place.

K-Tool
Used to pull locking cylinders to gain access to mechanism components.


K-Tool Kit

Key Tools
Used to manipulate internal components of lock. *Part of K-Tool Kit*

Shove Knife
Used to manipulate locking mechanism on doors with a slam latch.


Shove Knife

Wedge
Used to create gaps and prop doors open.

Padlock Tools

Axe
Used to strike lock and/or prying tools.

Channel Lock Pliers
Used to hold locks in place while cutting.

Halligan
Used to create strike, break, and/or overcome lock mechanism.

Specialty Tools & Equipment

Circular Saw
Used to cut commercial and garage doors and components. *(Chapter 2 – Power Equipment)*

Halligan
Used to create gaps and pry door open.
(Chapter 1 – Hand Tools)

New York Hook
Used to strike halligan and/or wedge, create gap and pry door open, and/or increase leverage of halligan. *(Chapter 1 – Hand Tools)*

Ram
Hydraulic tool used to spread the jamb away from the door.


Hydra-Ram

Vise Grip Pliers
Used to hold padlocks for cutting with a circular saw.

Wedge
Used to create gaps, capture progress, and prop doors open.

TYPES OF LOCKS

Locking mechanisms for both commercial and residential doors can vary, however, typically fall within the following categories:

Key-In-The-Knob Lock

The locking mechanism is part of the knob. These locks have both commercial and residential applications.

Tubular/Cylinder Dead Bolt

Most popular style and may be activated by a key on one or both sides, sending the bolt into the jamb or adjoining door.

Rim Lock

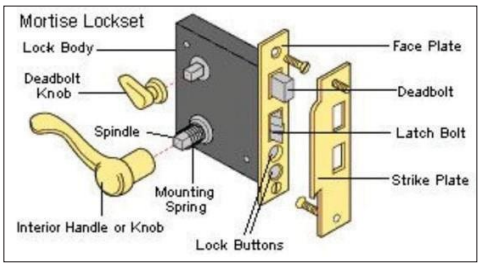
Known as an add-on lock, mounted to the inside of the door. Common in multifamily occu- pancies and can be interior activation only.

FORCING THROUGH-THE-LOCK

1. Remove doorknob.
2. Insert stem of key tool into the slot or into the back of the spring latch and pull or twist toward the hinged side of the door to open.

Mortise Locks

Designed to fit into a cavity within the edge of a solid metal or wood door.



Pad Locks

Come in high, medium, or low security.

If used on a chain, consider cutting a link instead of the lock.

Most padlocks can be forced with a set of irons.

Put the shackle of the padlock between the forks of the Halligan.

Strike at the base of the forks with a flat-head axe or other striking

Drive the pike of a Halligan into the shackle then try twisting the lock by rotating the Halligan.

If the shackle does not break, continue to drive the pike through.

FORCIBLE ENTRY

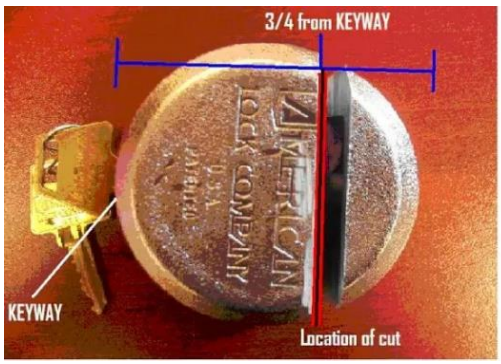
Duckbill Lock Breaker
Drive the duckbill into the shackle.

Circular Saw
Place vise grips on the lock and secure it for cutting the shackle with a circular saw.

Using a hose strap on vise grip pliers to hold a padlock for cutting.

If the vise grips or channel locks are large enough, your partner might be able to safely hold the padlock while you cut.

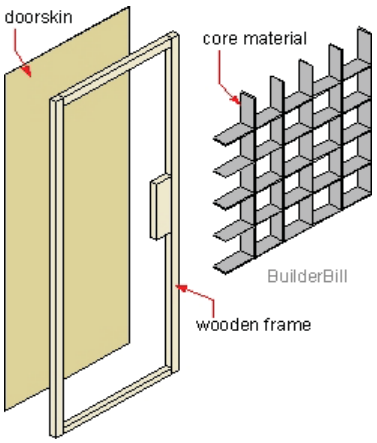
Hockey Puck Locks
Can be a very formidable type of padlock.
Cut the body of the lock about ¾" from the keyway as shown below.



TYPES OF DOORS

Wood Doors
Come in both solid and hollow core construction. Both types contain a plywood veneer on both sides.

Hollow Core Doors
Interiors are made from crisscrossed strips which provide structural strength.



Solid Core Doors
Interiors are made from either compressed or glued materials throughout the entire cavity, providing strength. Common in residential and multifamily occupancies.

Metal Doors

Constructed fully of metal and typically set in a metal jamb when used in commercial applications. Can be found in residential settings combined with wood jambs.

Glass Doors

Commonly found in commercial occupancies in either a frameless or aluminum frame design. Solid glass door locks are typically through the top and bottom stile with handles mounted through the glass. Aluminum frame glass doors typically contain cylinder locks either above, through or below the handle.

Sliding Doors

Typically constructed of wood or glass and travel to either the right or left within a metal, wood, or vinyl track. Typically contain secondary locking mechanisms that are difficult to force from the exterior without compromising the glass.

SIZING UP THE DOOR

Determine basic construction and direction the door opens.

Inward Swinging Door

Outward Swinging Door

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

2-FIREFIGHTER INWARD SWINGING DOOR

1. Size up the door:
   - door construction
   - jamb
   - lock type and location
2. Confirm door is locked (try before you pry)
   Gap-Set-Force
3. Insert adz six inches above or below the lock.
4. **Gap** the door by pushing up and down.

5. **Set** the forks by placing the bevel to the door. Position yourself between the Halligan and the door as this allows the best view.
6. Give the command "Strike" as you walk the tool around the door stop and frame.
7. Once the frame is cleared give the command "Drive" until the arch of the fork is even with the inside edge of the door or stop. Give the command "Stop." Now the forks are set.
8. Make sure all members are ready. **Force** the door by sharply pushing inward towards the door.
9. Maintain control of the door, check for victims, conditions, layout of the building; then close it until ready for entry. Open doors are ventilation points and must be controlled until fire attack operations are ready.

2-FIREFIGHTER 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 removed to make access.

1. Size up the door:
   - door construction
   - jamb
   - lock type and location
2. Confirm door is locked (try before you pry)
   Gap-Set-Force
3. Insert the adz end of the tool between the door and jamb.
4. **Gap** the door by pushing up and down.
5. **Set** the tool by pulling outward while striking to make sure the adz does not get buried into the jamb.
6. Give the command "Strike" as you walk the tool around the door.
7. When the adz is in position give the command "Stop."
8. **Force** the door by sharply pulling outwards.
9. Maintain control of the door, check for victims, conditions, layout of the building; then close it until ready for entry. Open doors are ventilation points and must be controlled until fire attack operations are ready.

1-FIREFIGHTER INWARD SWINGING DOOR

1. Size up the door:
   - door construction
   - jamb
   - lock type and location
2. Confirm door is locked (try before you pry)
3. Press foot against lower corner of door – same side as lock. This starts the gap below the lock
4. Place axe handle on ground and push edge into the gap created with foot placement to capture progress. *A slight angle toward door allows for the axe to advance as more gap is created.*
5. Place wedge into gap created with foot placement to capture progress above halligan location.
6. Place halligan adz above axe head or below wedge
7. While maintaining upward pressure against head of the halligan. Place shoulder below handle, or hand over top of halligan – *depending on which way the door swings*
8. Pry halligan away from spike while maintaining inward pressure against head of the halligan. *Make sure axe does not fall into door opening.*
9. Once door opens, maintain control with head of halligan, then close until ready for entry.

1- FIREFIGHTER OUTWARD SWINGING DOOR

1. Size up the door:
   - door construction
   - jamb
   - lock type and location
2. Confirm door is locked (try before you pry)
3. Insert halligan adze six inches above or below the lock.
4. If there is not enough gap to insert the adz, crush the edge of the door with the back of the adze or use the axe as a wedge and drive it into the gap with the halligan.

5. Once in the gap, hold halligan with one hand and use the axe with the other to drive the halligan as deep as possible.

6. Once the halligan has been driven to the doorframe, continue to drive it as you pull the halligan's fork towards you—this will cause the adz to "wrap around" the opposite side of the door.

Drive adz beyond inside edge of door.

7. Use the leverage of your entire body to pull the halligan towards you.

8. Once door opens, maintain control, then close until ready for entry.

HYDRA-RAM – INWARD SWINGING DOORS

1. Size up the door:
   - door construction
   - jamb
   - lock type and location
2. Confirm door is locked (try before you pry)
3. Place the adz end of the tool between the door and jamb then **Gap** the door by pushing up and down.
4. **Set** the tool by inserting the jaws between the door and the frame midway between the knob and lock. The jaw must be in the closed position.
5. **Force** the door by pumping the handle.
6. Maintain control of the door and close until ready for entry.

FORCING WINDOWS

Breaking Glass

1. Size up the window
2. Choose appropriate tool for breaking glass
3. Stand to the windward side of the window
4. Using the tool properly, strike the glass at the top of the pane. *Plate glass*
5. Keep hands above the point of impact
6. Remove jagged edges by sweeping the tool around the frame.

Jalousie Window

Casement Windows – Hinged

Casement windows are joined with a hinge on one side, opens outward with a crank, locked in the middle, and extremely difficult to force.

1. Size up the window
2. Choose appropriate tool for breaking glass
3. Break out the lowest pane of glass
4. Clean out sharp edges
5. Reach in to unlock the latch
6. Operate the crank or lever

Casement Window

Projected Windows - Factory

Projected windows are hinged on the top or bottom, opens outward with a crank, and is difficult to force.

1. Size up the window
2. Choose appropriate tool for breaking glass
3. Break out the lowest pane of glass
4. Clean out sharp edges
5. Operate the crank or lever

Projected Window

Louvered Windows – Jalousie and Awning

Basic construction features.

- Slats of glass
- Opened with crank
- Most difficult to force
- Requires removal of panels for entry

Sliding Windows - Horizontal Sliding

- Locks in center of window
- Burglar lock or bar usually added

Sliding Window

Double Hung Window

Double Hung – Vertical Sliding

- Lock is usually secured with small wood screws
- Easy to force
- Prying either up or down breaks the lock

Security Window Mesh

- Found on most commercial high crime buildings
- Involves a considerable amount of time
- Rotary saw can leave sharp edges
- Try to pry and break away from building

Window Bars

- Usually secured to a window at four points
- Mounting point may be a lag bolt into the mortar or brick, or the mounting point may be part of the brickwork.

Circular Saw

1. Size up bars
2. Cut away one side
3. Pull back on bar
4. Usually breaks the connectors
5. If unable to break connectors cut the other side

Halligan

1. Size up bars
2. Break brick using halligan and striking tool
3. Pry bars outward using halligan

Security Doors*:*

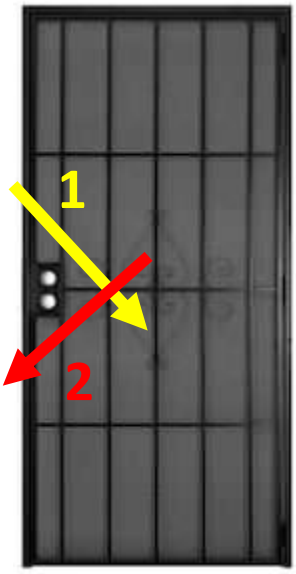
- Outside frame
- Metal with mesh
- Heavy metal locking area
- Usually opens out
- Locks can be single or double keyed

Prying the Lock:

1. Size up door
2. Try before you pry
3. Insert adze of the halligan between the gate frame and the metal jamb
4. Force the halligan in a downward motion and pulling the gate out

FORCIBLE ENTRY

Pie Cut



1. Size up door
2. Try before you pry
3. Make first 45° cut down through the door frame into the door itself
4. Ending cut level with lock
5. Make second 45° cut by overlapping the first cut and continue through the door frame under the lock
6. Open Door – *locking mechanism should stay attached to frame*

Electronic Access Control Door System (ACDS)

- Two most common are electric strikes and electromagnetic locks
- Electric strikes usually have a battery that will stay energized during a power outage
- Most standard techniques will work with electric strikes
- Electromagnetic can have the power to hold 600-1500lbs
- Maglocks are always mounted in the uppermost corner of the door opposite of the hinges

KNOX BOXES

Many fire departments require the installation of the ***Knox Box*** rapid entry system at all commercial structures requiring alarm and/or sprinkler systems.

Knox Boxes are typically located near the outside alarm panel, which itself is usually located near the main entrance to the structure.

Inside this box you will find a key(s) to allow non-destructive entry into the structure and access to other rooms which may have locked doors.

Knox Boxes are accessed using an exclusive key assigned to the local Fire Department. This special key is usually kept in a secure device attached to the apparatus. Access to the key requires a firefighter to enter an access code to remove it. Then it can be used to open the building's Knox Box, where building-specific keys and access information can be found.

Remember, a key is a much more powerful forcible entry tool than a set of irons!

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 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 in 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 (facing the door) above your head. If the door is a steel roll up door, you may be able to pull a slat after the first vertical cut. If it does not pull after two or three tries, continue the vertical cut to the ground. Keep the saw at full RPM and allow gravity to guide it to the ground. The shroud will stop the saw before it reaches the bottom.
2. To finish the vertical cut, make a 45-degree angle cut from the vertical cut to the right and down to the ground. This cut should start about 3 feet up and extend to the bottom of the door. Again, your saw’s shroud will stop it before reaching 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 cut completely through.
3. The 3rd cut will be horizontal. For best success make it 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. There are 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

Like most other firefighting skills, your forcible entry 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 relationship between the community and your fire organization.

CHAPTER 6

- DEFINITIONS
- SEARCH STATISTICS
- TOOLS & EQUIPMENT
- SEARCH POSITION
- SEARCH OPERATIONS
- ORIENTATION
- SEARCH TYPES
- TIC
- LOCATING A VICTIM
- PACKAGING AND REMOVAL

First Edition: December 2021
Revised: August 2024

SEARCH & RESCUE

Saving lives is the primary mission of Kitsap Fire Departments. Every year in America, approximately 3,000 civilians die in structure fires. We are their last and only hope. When we respond, “their emergency is our emergency.” Every building has the potential to be occupied, at any time.

Civilian life is the primary reason for our professional existence. It is, and always will be our highest priority. The decision to search an area or not can be rationalized by whether the conditions of the space are tenable for a firefighter in full PPE. We must make every effort possible to occupy the space and search for victims. From the outside, we are unable to know the conditions of each room or area on the inside of the structure. Closed doors provide for isolated survivable space, and certainty of this can only be achieved by completing a thorough search.

Isolated rooms provide 10-times better environment for occupants than non-isolated rooms adjacent to fire room.
(Fire Safety Research Institute, https://fsri.org, May 2022)

The best lifesaving tactic on the fireground is a systematic search plan and rapid water on the fire with coordinated ventilation. This chapter will cover the foundation of Search and Rescue on the fireground.

DEFINITIONS

All Clear

A benchmark that is reported by the IC to dispatch declaring there are no occupants in the hot zone. This benchmark is announced after the completion of both primary and secondary searches.

Bump Up

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

Inside Out

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

"Need Help!"

This term goes hand in hand with "Victim, Victim, Victim." The team member of the firefighter who finds a victim will call out to them, "Need Help." This gives the firefighter who found the victim an opportunity to identify needs to their partner.

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.

Primary Search

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

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.

Searchable Space

Any space within a structure that we can occupy with our training, experience, and PPE.

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.

Targeted Search

Starting a search in a location within the structure with the highest potential for occupants. These are typically bedrooms, egress areas, and within 6 feet of an exterior door.

"Victim, Victim, Victim"

Simple verbal communication stating that during a search you found a victim.

SEARCH STATISTICS

From January 1, 2015, to March 1, 2024, there were 13 firefighter Line of Duty Deaths (LODDs) while performing search. Two LODDs while performing a rescue (A roof collapse that killed two rescuers and two victims). There were no LODDs while performing residential search initiated from a window, nor were there any LODDs during searches of vacant residential structures.

Victim Locations

Where are victims being found? According to NFPA & Firefighter Rescue Survey, victim locations are as follows:

Location	Percentage
Bedroom	45%
Family Room	16%
Hallway	9%
Kitchen	7%
Bathroom	6%
Balcony/Porch/Deck	4%
Foyer	3%
Other	10%

Who is Locating Victims?

- 24% of victims were located by fire attack crews. These victims had a 51% survival rate. The higher survival rate can be attributed to the reduced time for Fire Attack to locate and remove the civilian.
- 57% of victims were located by primary search crews, with a 49% survival rate.

Time is Critical

Victim survival rate drops 10% every 60 seconds between cardiac arrest and CPR. The survival rate of fire victims corresponds directly to the time-to-victim once on scene.

- 79% survival when removed within 2 minutes
- 65% survival when removed within 6-8 minutes

By reducing our time to the interior, we effectively increase our civilians' survival chances. We can reduce our time to interior by doing things like:

- Starting with the right mindset:
  - Expect Fire
  - Expect Victims
- Setting up our gear for deployment after every run
- Turning out fast
- Knowing routes of travel
- Masking up with gloves on <20 Seconds
- Assigning search early
- Coordinating search efforts with the fire attack team

Goal: Masking up with gloves on in less than 20 seconds!

Information from Bystanders

Frequently, you'll be given various pieces of information from bystanders at the scene of a fire. Negative reports of victims such as: "No one is home", "Everyone is out", and "The building is vacant" should not be used as reasons to not conduct a search. This information is often given by civilians who are under a tremendous amount of stress and may not be thinking clearly. Doing so may cause a loss of life.

- 3% of structure fire victims had bystanders on scene report to firefighters, "Everyone is out." (Firefighter Rescue Survey).
- 29% of structure fire victims were not reported at all.
- 75 civilian fatalities and 200 injuries occur inside "vacant" structure fires every year.

TOOLS & EQUIPMENT

Tools taken to the interior will typically be minimal. This allows us to search with our hands.

Flashlight

A flashlight may cause reduced or improved vision, depending on smoke conditions. Start with having your chest light on and if you are getting back-splatter (bright lights on in fog), turn your chest light off for improved vision. Keep your helmet light off, it can reduce your ability to locate the glow of the fire.

Flat Headed Axe

A Residential Flat Headed Axe is typically left at the front door after forcing entry. Whereas the Commercial Flat Headed Axe can be taken into the interior when anticipating forcible entry.

Halligan

When each member has a Halligan, it gives them the ability to split search and still be able to force doors, take glass or force exit. Place your Halligan in walls or at thresholds during a room search so you can use your hands to search. If the conditions warrant you to take the glass, bring the Halligan into the room.

Hook

Typically, the hook will be brought to the interior and buried into the wall of a main throughway, to be easily accessed when needed. The 6' hook hinders the search.

Thermal Imaging Camera (TIC)

Ideally a member of each two-person team will have a TIC to aid in quick scans of a room for orientation and detection of heat signatures. These are merely a tool and cannot rule out a room as being empty. We search with our hands.

Pressurized Water Extinguisher (P-Can)

When entering ahead or without a line, remember a 2 1/2-gallon extinguisher can knock down fire; more importantly it can hold fire until you are able to pass or close a door. The pressurized water can is capable of approximately 60 seconds of flow with a maximum reach of 50 feet. When searching with the can, place it in the hallway by the door that was isolated, then search from the seat of the fire back. The can will assist fire attack to locate the fire room or apartment.

SEARCH POSITION

A proper search position is imperative to an efficient and thorough search. If you can identify all objects in an approximate 10' area around you, then walking upright is typically performed.

Walking during moderate, low or zero visibility is jeopardizing civilian lives. In these situations, we need to get below the smoke and most likely down on the ground to search with our hands. While searching, we strive to get our eyes and ears below the smoke. The lower we are, the thinner the smoke and the easier it will be to see and hear our victims, along with communicating with our crew.

"Inches of visibility are worth miles of work"- Brian Olson

SEARCH 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

SEARCH & RESCUE

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:

1. 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.
2. Initial interior crews will be searching and protecting the same corridors that the occupants in the building would use to evacuate.
3. The handline protects FF's and begins the attempt to establish control of the fire. Also, this establishes an anchor point in which firefighters can work from to clear the remaining areas of the fire building.
4. All initial attack efforts must be directed toward supporting rescue efforts and hose lines must be strategically placed in a manner to control interior access, confine/control the fire, and protect avenues of escape.

The Incident Commander (IC) is responsible for assigning all incident resources to achieve quick and effective fire control and primary searches of the affected areas of a structure. The IC will assign companies to complete systematic searches in defined areas of the structure, eliminating duplications 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 plan, rather than removing occupants not directly exposed to the incident hazards of the IDLH environment.

Consider the following actions when employing a shelter-in-place life safety plan:

- 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.

SEARCH & RESCUE

What Are We Searching For?

Searching inside a structure with an unknown fire location is the most dangerous position to be on the fireground. The assignment of search has two objectives, locate fire and locate life. Locate - Isolate - Communicate the fire. We confine the fire to create the best opportunity to search the largest area and then communicate the fire location to fire attack. This allows fire attack to properly stretch a more direct route. When searching ahead of the hose line and fire is found, we must communicate to the fire attack team, not only the fire's location but the best access to the fire. Announcing which stairs to take can save seconds if not minutes.

Search Tips:

- The 1st handline should go directly to the fire to support completing primary and secondary searches.
- All-clears must be obtained for all residential occupancies.
- When calling out for victims, hold your breath, listen, and don't move (approximately 3 seconds).
- When using a TIC, scan and then search. Do not move while looking through the screen. You have a narrowed view and poor depth perception. Tunnel vision can happen when continually looking through the TIC, which can delay us from noticing a change in smoke conditions.
- TICs cannot see all victims. They do not see heat of victims under blankets, drywall, etc. Do not overly rely on the TIC to clear an area, unless the area is wide open without obstructions, such as a gymnasium.
- If you encounter a closed and open door in the same vicinity, search the open door first due to possible victim exposure.
- When you locate a victim, sweep for other victims around the area.
- When a victim is located and removed, complete searching the same area that you located the victim. Example: When we locate a victim on a bed, go back and continue the search with researching the bed.
- Furniture can help firefighters with orientation, so try not to move it. Moving furniture may also cover a victim, threshold, or door.
- Locked doors get forced and the room gets searched – bring a tool.
- When a bed is located, reach above to check for bunk beds. Search beds high to low. The higher they are, the worse the conditions.
- Sweep under beds with an arm and your eyes.
- Cribs can be brought to the ground to aid in search and move a potential infant victim to a more tenable space.
- Thoroughly search and sift all piles of clothes (do not move), draperies, or bed linens.
- Get on top of beds, sweep and sift from corner to corner, stem to stern (do not pat). We are feeling for weight and contour. Sweep between the bed and the wall.
- Ventilate while searching **IF** ventilation is coordinated with fire attack, fire is under control, or you can isolate the room.
- When searching in anything less than high visibility, it is critical for search crews to get down on the ground, where the victims are.
- When searching for victims, feel for contour and weight.

ORIENTATION

The better our visibility the more rapid we can search. Therefore, removing smoke increases our effectiveness and enhances our safety on the fireground. 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 confident in operating in a confined, reduced visibility environment for extended periods of time while always maintaining orientation:

- **Always** know where you are.
- **Always** know how you got there.
- **Always** know how to exit the structure.
- **Always** know the location of 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.

For example, one common single-family residence in Kitsap County is a 2-story house. A typical layout would be:

- 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 tanks, utility connections.

Firefighters must use the information they obtain when they see these structures in a non-fire situation such as medical calls, pre-incident planning, or code inspections. Real estate websites such as Zillow are also great tools for learning layouts of various house styles in your first due. 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 pin- pointing 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.

Crews may need the protection of a hand line when operating in the hazard zone; however, it is not always necessary or preferred to enter an IDLH atmosphere with a hose line. Maneuvering a hose line will reduce the mobility of a search team and can significantly slow search efforts. A charged hose line in a reduced visibility environment, or an environment that visibility may diminish, provides the following:

- Gives firefighters a lifeline 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.

Search Size Up

- Time of day.
- Type of occupancy (layout/arrangement) and construction.
- Fire location and severity.
- Where is the fire moving?
- 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

Adults will try to escape. We want to look at avenues of egress, hallways, doorways, behind doors, etc. Adults will try to save their children. If you find an adult, always sweep around to make sure they were not carrying a small child. Children tend to go to their "favorite" spots; bedrooms (own, siblings or parents where it's safe), specifically under or in their own bed or closets. If they cannot retreat to their room, they tend to stay at ground level and hide in other familiar spots; in low large cabinets, in blankets or clothing piles and typically places they play and spend most of their day.

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 vent plan?
- Are conditions getting better or worse?

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 bedrooms 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 earpiece, it is very important to speak into and not shout into the radio.

Making Entry for Search

When making initial entry, do an interior size- up. Sweep wall to jamb (touch the jamb behind the door, this will ensure a complete sweep) extend your full body length into the structure to evaluate for LIFE - FIRE - LAYOUT. This sweep and size-up starts our search. If the door is obstructed from opening all the way, reach around it with a hand to determine if there is a victim behind the door. When making entry ahead of the hose line, the search team will make entry and control the door.

LIFE

- Call out "*Fire Department, anyone in here?*" and hold your breath & listen.
- Scan for victims with your eyes.
- Sweep for victims with your hands

FIRE

- Look for the glow.
- Direction the smoke is moving.
- Listen for the crackling of fire.

LAYOUT

- Look for signs of the layout:
  - Stairs
  - Hallway
  - furniture

SEARCH TYPES

Primary Search

Primary search is a quick search and involves clearing all affected areas of the structure(s). Primary searches can be performed under low to zero visibility conditions with the possibility of high heat. They need to be performed rapidly with a high degree of orientation and accountability.

Examples of primary search types:

- Oriented Search
- Split Search
- Targeted Search
- Window Initiated Search

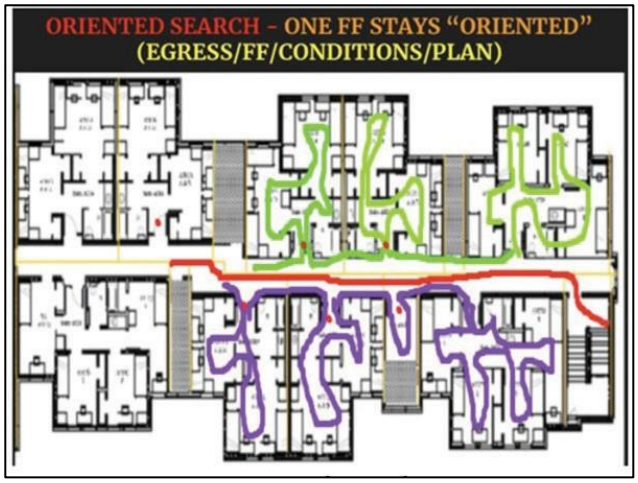
Oriented Search

Oriented Search is typically performed during large area search, fire attack not in place with poor conditions or an uncomfortable crew. Oriented search is when one member is coordinating the search. All members need to stay oriented but during oriented search, the lead is oriented to the progress, conditions and responsible for radio traffic. The traditional oriented search would keep one firefighter at the threshold of a room that is be searched while another member searches the room/apartment. Oriented search can also be used during poor conditions in a public hallway structure (residential or commercial).

Split Search

Split search is one that is performed by 2 FF's. The crew is experienced, and feel comfortable splitting up, as this allows them to cover more area, and statistically has a highest survival rate of 41% for victims. The target is the bedrooms and the adjacent rooms as those are shown to have the higher probability of occupancy 45%. This type of search saves time but requires a high level of training.

Split Search



Oriented Search

Targeted Search

Targeted searches are focused in areas where occupants are likely to be found, such as a bedroom. Search crews may need to start a targeted search using an alternate means of access when standard access points (doors) are obstructed by fire or hoarder conditions. It may also be quicker to access searchable areas using an alternate access point due to the building's size, unique features, or its layout. Targeted search assignments can be performed using a window-initiated search or door-initiated search.

Window Initiated Search

When accessing a searchable area through a window is more advantageous than using a door, it is called a window-initiated search. Standard window-initiated searches, like door-initiated primary searches, are intended to search all searchable space, including beyond the room of entry. The one exception to rule is during vent-enter-isolate-search (VEIS) operations when the search is limited to the room of entry.

When choosing an entry point for window-initiated searches, consider the following:

- Before water on fire, and unknown if occupied, target the cleanest window first, which is likely an isolated bedroom.
- After water on fire, and unknown if occupied, target bedroom windows, starting nearest the fire.
- Known rescue, nearest window to the last reported location of the victim.

Vent Enter Isolate Search (VEIS)

One type of window-initiated search is called vent-enter-isolate-search (VEIS). VEIS differs from standard window-initiated searches in that the search is limited to a targeted room that is likely to contain a victim and may not be isolated from hazardous heat and toxic smoke conditions. During VEIS operations, one member of the search crew makes entry through the window and quickly isolates the room by closing the door. Another team member remains at the window and uses a Thermal Imaging Camera (TIC) to scan the room and helps keep the first member oriented. As heat and smoke are vented through the open window, conditions improve for victims and the search crew.

Firefighters who are told that there is a confirmed or likely victim(s) inside can use the VEIS technique to rapidly search an area that would otherwise not be searched until later in the incident. The following steps should be followed:

1. **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. Are there active fire conditions in the area that could lead to flashover or rapid fire spread if you ventilate this opening?

2. ***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.

3. ***Entering the Room:*** Sweep the floor under the window to check for victim(s) first, then sound the floor to ensure 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 door 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.

4. ***Oriented Member:*** Like 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.

Vent


Sweep

VEIS Orientation


Hall Search

Secondary Search

The secondary search is a thorough and painstakingly complete search for life in all areas that required a primary search. In addition, the secondary search must also include the entire outside perimeter of the building and all shafts, basements, cellars, elevators, roofs, etc. Its purpose is to ensure that no possible victims are overlooked.

Time is not as important as accuracy. This search shall be completed before any extensive overhauling of the fire area is attempted. It must be performed by a different company than the company which performed the primary search.

THERMAL IMAGING CAMERA (TIC)

All personnel in Kitsap County 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" thermal energy emitted from an object. Thermal, or infrared energy, is light that is undetectable by the human eye because its wavelength is too long; it's the part of the electromagnetic spectrum that we perceive as heat.

Unlike visible light, in the infrared world, everything with a temperature above absolute zero emits heat. Even very cold objects, like ice cubes, emit infrared. A TIC can measure a variance in the temperature of an object as low as ½ a degree that will show contrast on the screen. The camera sees through smoke and does not require any visible light; however, it cannot see through objects 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. Relying on the TIC can place you in a situation where you become disoriented and are now a part of the problem.

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).

Use TIC

TIC Look Up

TIC Look Left

TIC Look Right

TIC Look Down

TIC Look Straight

TIC Look Behind

LOCATING A VICTIM

When a victim is found, perform a rapid 360 to search for additional victims.

When we locate a victim and have the air to continue searching, hand off the victim to another crew when possible. It is easier to hand off a victim, then to try and communicate what has or has not been searched.

Do not perform a medical assessment; they are either obviously dead and will be left in place, or we will perform a rescue and remove them. If faced with the decision to drag a victim through an area where conditions are worse than the room they were found or if hoarder conditions are present, consider isolating in place and venting the window. Victim removal through a window or window-to-door conversion should be considered in these circumstances. If victim removal will be prolonged, consider deploying a RIT pack to prove victim supplied air by placing the RIT pack SCBA mask on them. Use a secondary RIT pack for this purpose, always keeping one in place for RIT operations.

Make verbal contact with your team and let them know by calling out **"*Victim, Victim, Victim!*"**

If your team can make the rescue yourselves, do not delay the rescue by waiting for radio time, get them moving. If you need assistance, ladders, a window conversion, hose line or additional personnel, use priority traffic to advise command of your needs.

Keep radio traffic brief: "*Command, Engine 71 with priority traffic. Bringing one unconscious victim to Alpha side floor 2 window. Need an additional ladder, personnel, and EMS standing by.*"

Critical victims are ours, until we hand them off to another crew or EMS. When deciding to take a victim out a window or back through the structure, consider time to make the rescue and the conditions. *"Time is as important, if not MORE than dose."* (UL – Zevotek).

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 manpower. Therefore, it is critical to complete a rapid evaluation of the situation and determine the best course of action.

Grips

Focus on grip techniques for victim drags and carries that are traditionally used for grappling. Two of those types of grips are the **Gable Grip** and the **Kimura Grip**. Both are 'thumbless' grips where the thumb is on the outside of the grip going the same direction as the fingers, not trying to wrap around in the opposite direction as we normally would when picking things up.

A general rule is that whichever arm wraps the body part, the opposite hand is the top grip. The goal is to think of our hands as big hooks rather than a hand with independent fingers. The Gable and Kimura grips are not only stronger than a traditional grip, but they are also easily performed with structure gloves on and in zero visibility.

Kimura Grip

Whether we are grabbing a victim's legs for a double leg drag, their torso or an arm we should squeeze them close to our body and utilize one of these grips to give us our best shot at keeping a grip on our victim which we all know is a difficult task in the fire environment.

Drags

Carrying a victim out is typically used for light weight victims, such as a child. When carrying children, keep them low in the elements. If waiting with a baby at a window for rescue, hold them in the cleaner air. The purpose of drags is to "Grab and Go."

The weight of an adult victim will take time and energy. Adults will typically take a crew to complete the rescue. Quick simple drags will keep the victim moving. Headfirst drags can be done by one or two firefighters performing a "wrist lock" or a "Single Arm Lock." Headfirst drags elongate the victim rescuer combo more than feet first.

Drag 1

Feet first drags are the preferred drag, it keeps the victims head low in the elements and keeps the victim and rescuers overall body length shorter than headfirst. Feet first drags can be performed by crossing the victim's legs, putting victim's feet in each armpit, or by two firefighters. Brace your arms in the victim's knee pits for an improved hold. Victims can be spun around by crossing their ankles, lifting their feet in the air, and spun on their back.

Pro Tip:

Practice these four go-to drag options until you can perform them under extreme stress.

- ***Feetfirst Dirty Drag***
- ***Headfirst Dirty Drag***
- ***Feetfirst Webbing Hitch***
- ***Headfirst Webbing Hitch***

When pulling victims downstairs, drag headfirst to protect their head. Use webbing when drags are unsuccessful, or when anticipating a drag being unsuccessful, e.g., obese patients, burned extremities, wet victims, or with victims that need to be brought up stairs from a basement. The strap of choice is a 22' webbing tied in a loop (water knot) and then knotted threes time at equal distances, this will create four holes. The two middle holes for the legs and the two outer holes for the arms.

Drag 2

A 7' looped prusik can be girthed around a victim's appendages. This type of webbing a drag will elongate the victim and increase the difficulty when navigating in small spaces and turns.

Victims that are found on a bed, can be rolled up on the sheet they are lying on. If a victim is on the ground, we can grab a blanket and wrap them in it as well.

Rescue Tips

- During a rescue, verbally call out "*Victim, Victim, Victim.*" There are only two things that we call in in multiples of three: "Victim" and "Mayday." This reduces the chances of missing critical information.
- Keep victims low in the conditions. Do not stand up with babies/children.
- If the victim is obviously dead, leave them and continue searching. Otherwise, pull them out.
- When it is possible, one firefighter can lead and clear a way out.
- Keep radio transmissions short; don't delay victim removal to communicate unnecessary details. Carrying victims puts us in an awkward position increasing our odds of tripping.
- During ladder rescues, throw up two for parallel ladders.
- During window assists, bring a Halligan up the ladder with you. The civilian may go back inside, and you may need to start a search.

SUMMARY

Time is critical. The clock is ticking when dispatched to a building fire with a possible rescue. You should never find yourself sitting in your rig at level 1 staging when there's a person trapped in a burning building. You need to be proactive, anticipate the next order, and be ready to work immediately on your arrival. Even if you are the third, fourth, or fifth unit on scene, rescues require a lot of personnel, so try to get your orders before you arrive and get to work right away.

It is also critical that you have the knowledge, skills, and abilities to function safely on the fire ground. You must understand that the pace of these high-intensity incidents will accelerate rapidly. Educate yourself and regularly practice search and rescue techniques to increase your knowledge, skills, and abilities.

Every small detail you practice will help you to safely and effectively locate and remove victims during the early stages of these extremely hectic incidents.

CHAPTER 7

- DEFINITIONS
- INSPECTIONS, TESTING, & MAINTENANCE
- GROUND LADDER PRINCIPLES
- LIFTING LADDERS
- COMMANDS
- CARRIES & RAISES
- HALYARDS
- ANCHORING
- ROLLING
- PLACEMENT
- CLIMBING & WORKING ON LADDERS
- DEPLOYING THE ROOF LADDER
- LADDER SELECTION
- LADDER PACKAGES

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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.

This chapter 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.

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.

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.

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

Footing the Ladder
Securing the base of the ladder to prevent the ladder from rocking left and right. If ever the ladder is starting to tip left or right, early footing will help prevent the loss of control. A ladder will be footed any time it is shifted, pivoted, or raised to vertical as well as any other time it is unsteady while in the vertical position.

As a ladder comes to vertical and is pivoted or shifted, the firefighter grasps the bed section beams, steps up on the first rung, and heels the ladder with their weight until it is steady. Once the ladder is stable, step down with the other foot, sliding down the beam so that the toe of the boot ends up against the spur. The first foot then steps down from the rung and back two to three feet from the butt of the ladder, while keeping the other foot against the spur.

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 pre-set to change color at 300°F.

Heeling
Stabilizing a ladder while it is being positioned, climbed, or worked from.

While raising or maneuvering the ladder with a team of two or three, heeling is done on the bed side of the ladder, except for rescue situations when flies are out, with both hands grasping the outside of each bed section beam. It is important to get into a comfortable staggered foot position, allowing for good balance and stability. Feet should be placed approximately one to two feet back from each other, and about shoulder width apart. Once the desired foot position is achieved, allow the ladder to lean in slightly toward the objective to assist in the extension of the ladder.

During climbing or firefighting operations from the ladder, heeling is done on the same side of the ladder it is being climbed, allowing for monitoring of the climbing/working firefighter and, if necessary, avoiding falling debris. Stabilizing the ladder in this way puts firefighters in a position to maintain situational awareness and watch for hazards.

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.

LADDERS

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 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 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.

Leg Lock

Pivot
Slightly tilting the ladder on one spur 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.

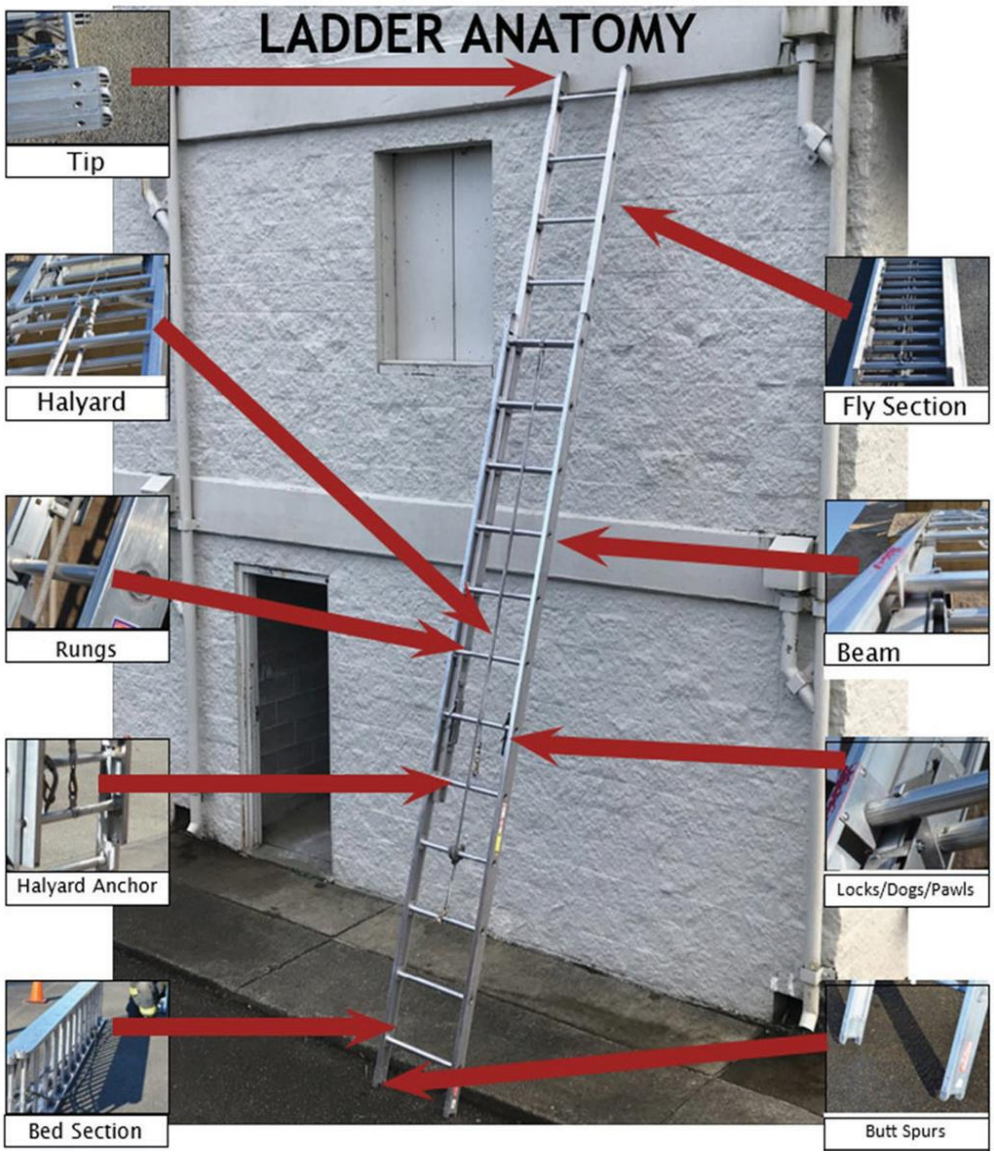
Roof Hooks
The spring-loaded hook devices on the tip of the roof ladder that allow the ladder to securely ‘hang’ from the peak of a pitched roof.

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.

Tip
The top or upper most part of the ladder.

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

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 should 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):

- Any time a ladder is suspected of being unsafe (Obvious strain, metal fatigue or deformity).
- After heat exposure or heat sensor damage.
- After any deficiencies have been repaired unless the only repair was the halyard.
- You should consider a ladder being overloaded when it has been subjected to the following:
  - Three firefighters with full turnout gear and air packs.
  - Two firefighters and an unconscious victim.
  - Two firefighters and a charged hose.

Ground Ladder Maintenance

- Use a mild soap and water to clean ground ladders, scrub brushes may also be used.
- Never use steel wool or wire brushes on aluminum ladders.
- Be sure to flush inside the rails and rungs to clear debris.
- Wet ladders should be wiped dry and checked for defects.
- Ladder flange and guides:
  - Check for areas of old or excess buildup of wax - If present, carefully brush with soap and water (using a ScotchBrite pad may help).
  - Preserve the finish and lubricate by applying paraffin (or candle) wax on contact points.
- Lubrication with dry graphite should include:
  - Pulley bearings.
  - Roof hooks.
  - Dogs/locks/pawls (lubrication oil may be used on the pivot points of the dogs).

GROUND LADDER PRINCIPLES

Extension ladders should be placed with the fly section towards the building (flies in), unless otherwise directed by the team leader for a special circumstance.

LADDERS

Ladders are raised two ways, either flat, or on their beam. Ground ladders are generally raised the same way they are carried. Therefore, since KCFTC prefers to carry the ladder on the beam, the beam raise will be the most common method.

Ladder commands are given by the company officer or team leader using the standard communication model. The order 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 in charge of the ladder carry/raise process from the beginning should remain in charge of the operation regardless of ladder position.

Unless otherwise directed ladders should be carried Butt first.

Ladder chocks may 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 a proper climbing angle or position. Shifting the ladder is accomplished by using commands to coordinate the ladder shifting movements. The team leader should verbalize the desired destination of the ladder. Examples:

- For incorrect climbing angles: “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 any ground ladder, fire-fighters should perform the following six safety checks:

1. Tip is square
2. Dogs are locked (upper & lower if applicable)
3. Halyard is secure
4. Butt is square and set
5. Climbing angle is good
6. Ladder is 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 the navigator and team lead for the ladder crew. They are responsible for safely navigating the ground ladder to the raise destination and giving commands for raising the ladder. 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. They are then responsible for calling “Overhead Clear,” “Ground the Butt,” “High” as well as securing the halyard and performing safety checks prior to making any adjustments to final placement.

Tip Person
The person located at the tip while carrying a ladder is responsible to safely carry the ground ladder to the raise destination and then confirm and reply to the person located at the butt of the ladder that the overhead is clear. Further, the tip person will maintain control during the raise to the target objective.

COMMANDS

Commands should be given using the standard communication model. For example, "Low 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.

COMMANDS FOR CARRYING THE LADDER

"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

COMMANDS FOR RAISING THE LADDER

"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 into 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. (Preferred method is clove hitch with overhand safety.)

"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.

COMMANDS FOR LOWERING THE LADDER

"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.

"Overhead Clear. Behind Clear. Ready"
Team members anticipate and get in proper position to lower.

"Lower"
The ladder is lowered to a horizontal position. The butt person will foot the ladder, and the beam person lowers the ladder from the vertical 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.

"Face the Tip"
All members face the Tip. Remember, unless otherwise directed, ladders should be carried Butt first.

COMMANDS FOR 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

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. Because most Kitsap County apparatus are 2-person crews, KCFTC will emphasize the one and two person carries.

Removal from Exterior Mounted Ladder Racks
Release locking devices make sure the halyard is free from the rack and locks. Remove any 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 Aerial Apparatus Beds
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 & 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 should be facing toward the objective, thus the firefighter operating the halyard will be facing the objective.

ONE-PERSON

- Extension Ladder – High Beam Carry

Pro Tip: *To help keep the ladder tips from sliding on metal gutters, dent the gutter where the beams make contact.*

- Facing the butt end, kneel next to the ladder.

- 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.

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.

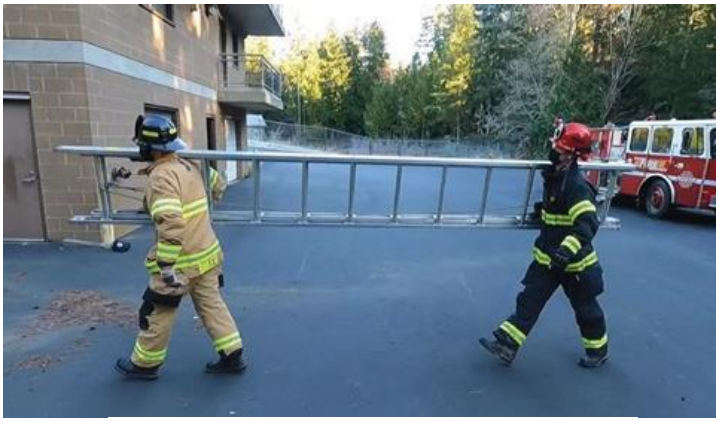
One-Person Flat Raise

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 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.



Beam Shoulder Carry

High-Low Carry (from the ground)

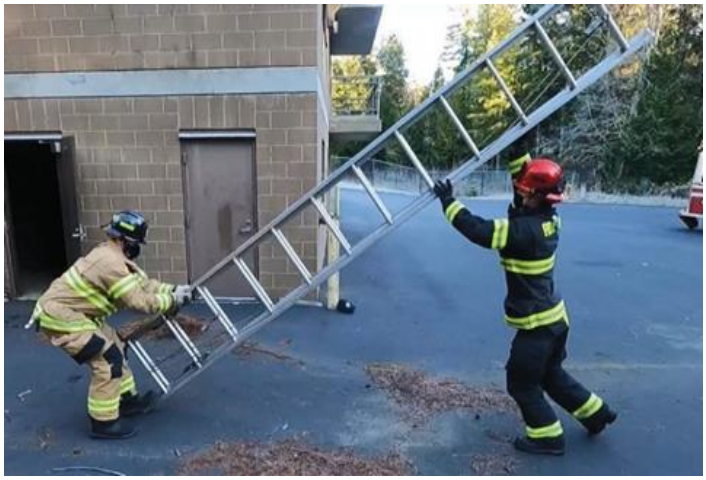
- At the command **"Prepare to Carry"** firefighters position themselves between the 2nd and 3rd rungs from each end and assume a squatting position on opposite sides of the ladder.
- At the command **"Ready Lift"** firefighters lift the ladder and perform the following carry:
  - Tip person – high shoulder beam carry.
  - Butt person – suitcase carry grasping beam.

High-Low Carry

Two-Person 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 – calls **"Overhead Clear"** and 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 person – Orients 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.

Positioning for Three-Person Carries

Adding a third person to a ladder carry can add both safety and complexity to the carry and raise (consider adding a third person to a ladder raise if using a 35'). For a three-person beam shoulder carry with three firefighters, the third firefighter should space him/herself evenly between the butt and tip positions.

LADDERS

SECURING THE HALYARD

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 should be tied using a clove hitch with an overhand safety knot.

ANCHORING A 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 two approved methods for anchoring a ladder, depending on the device being used: an anchor strap or anchor rope.

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.

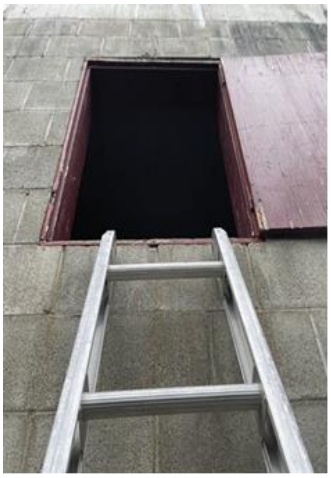
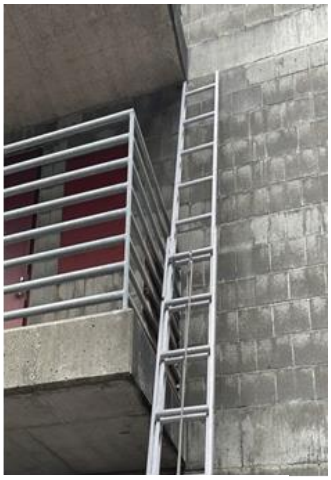
> Note:
> Keep in mind the fly sections of extension ladders are narrower than the bed section. For example, a fully extended 3-section 35' ladder may have a fly section width of 16 inches and a bed section width of 22 inches. Each time you fully roll the ladder your ladder tip will track behind your bed section by about 6 inches. After a few rolls the bed section will be a couple feet behind the tips, which means you will need to square them back up with the tips. If you were to continue rolling and never adjust the bed section, the ladder angle would eventually cause the ladder to slip and fall to the ground.

> ***Pro Tip:*** *Before rolling the ladder, move the tips ahead of your roll a couple feet. The base will eventually catch up and become square again.*

LADDER PLACEMENT

Efficiency and operating positions of interior crews should be considerations for ladder placement. Ground ladders should be placed on and above the fire floor, areas adjacent to involved fire 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.

Ladder Placement for Various Assignments

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.

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 so the opening of the window is not obstructed. Orientation of the ladder should be flies out and at a lower (flatter) climbing angle, which will make descending with an unconscious victim easier.

Placing an additional ladder at the sill immediately adjacent to the first ladder during rescue operations creates what is called a working set. Working sets provide several advantages for both civilians and firefighters:

- Allows firefighters simultaneous 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.

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 (VEIS)

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

CLIMBING AND WORKING FROM GROUND LADDERS

Heeling the Ladder

Ground ladders should be secured in some fashion before climbing. One method for accomplishing this is to have a firefighter heel the ladder. Heeling is done on the same side of the ladder it is being climbed, allowing for monitoring of the climbing/working firefighter and, if necessary, avoiding falling debris. Heel the ladder by applying weight to the base of the ladder by pressing a foot on the bottom rung or against the butt spurs. Stabilizing the ladder in this way puts firefighters in a position to maintain situational awareness and watch for hazards.

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 helps maintain the necessary three points of contact.

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 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.

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.***

- Approach at a 45-degree angle to either beam of a 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 (toward you).
- Walk the roof ladder into a 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 found on apparatus within Kitsap County, which include:

- Extension Ladders
  - o 35’ 3 section (2-fly)
  - o 35’ 2 section (1-fly)
  - o 28’ 2 section
  - o 24’ 2 section
- Roof Ladders
  - o 20’
  - o 18’
  - o 16’
  - o 14’
  - o 12’
- Attic Ladders
  - o 10’
- Miscellaneous Ladders
  - o 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’- 3rd story window
- 28’- 3rd story window
- 35’- 4th story window

LADDERS

LADDER PACKAGES FOR ROOF OPS

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 basic and should be adapted to meet the needs of the incident. The ladder package is used to efficiently move needed tools and equipment from apparatus that have been parked out of the way to the fire scene in a single trip.

Basic Residential Package

Minimum Tools:
- 1 chainsaw
- 1 rubbish/trash hook

Optional Tools:
- 1 New York hook
- 1 long pike pole for steep pitched roofs
- TIC
- A scabbard axe for each member
- 1 Circular saw

Ladders:
- Extension ladder – long enough to extend at least five rungs above the roof line
- Roof ladder

Basic Commercial Package

Minimum Tools:
- 2 chainsaws/circular saws
- 2 rubbish/trash hooks

Optional Tools:
- 1 New York hook
- 1 long pike pole
- 1 set of irons
- TIC
- A scabbard axe for each member

Ladders:
- Extension ladder – long enough to extend at least five rungs above the roof line
- Roof ladder

Additional Considerations

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

USING LADDERS FOR RESCUE

Ladders used for Access, Egress, or Rescues should have the tip at the windowsill.

Ladders providing access to a balcony or fire escape should extend 2-4 rungs above the railing or wall, to provide a good handle for victims and firefighters. The climbing angle will vary when placing ladders for rescue, but generally should be a lower (flatter) angle than other operations.

Rescuing Victims through Windows

If possible, one firefighter should climb up and make entry through the window to assist the victim onto the ladder, while the other firefighter is on the ladder assisting them from below. Putting a firefighter inside can allow us to isolate and search the room after assisting the civilian through the window.

If an unconscious victim is found during a VEIS search, drag them on their backs to the window, legs first. Legs go up toward the windowsill and against the wall. The firefighter on the outside grabs their ankles as (preferably) two firefighters on the inside lifts and guides them out the window legs-first.

The firefighter on the ladder should guide the victim's legs to one side of the ladder, place one arm between their legs, and grasp the back of the ladder beam. As the victim's torso approaches the ladder, place the other arm under victim's armpit and grasp the back of the beam. Slide hands along beams during descent.

Ground Ladder Rescues

When civilians are hanging out of windows, two firefighters should flat-carry the ladder and raise the tip below the victim: bringing it up and under them.

If possible, use two ground ladders for window rescues. This creates a "Working Set" and provides a wider base, which allows for more firefighters to assist in the rescue. A second ladder also allows for us to pass other firefighters and civilians coming down.

Aerial Platform Rescues

The best way to rescue victims from windows or balconies is to use an aerial platform, which can carry victims and firefighters in its bucket back to the ground.

Aerial Ladder Assists

Escorting conscious victims down aerials will take time, civilians have never been on an aerial ladder. The amount the aerial is extended, and the degree of the climbing angle will affect the speed of their descent.

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.

CHAPTER 8

- TACTICAL VENTILATION OVERVIEW
- STAGES OF FIRE GROWTH & FLOW PATH
- DOOR CONTROL
- TIMING IS EVERYTHING
- READING SMOKE
- BUILDING CONSTRUCTION
- ROOF STYLES
- ARCHED ROOF STYLES
- BUILDING SIZE-UP & VENT PLAN
- HORIZONTAL VENTILATION
- VERTICAL VENTILATION
- RESIDENTIAL VENT EVOLUTION

First Edition: December 2021
Revised: August 2024

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 a tool to help firefighters control a fire. Tactical ventilation is also used during overhaul and loss control to evacuate smoke from structures after the fire has been extinguished.

Being in control of the fire means using ventilation and water application to control its behavior. In terms of ventilation, firefighters control the flow of oxygen, smoke, and hot gases to then control the rate of fire growth and spread.

Tactical ventilation, either creating openings in the structure or closing/covering openings should be coordinated with an emphasis on controlling oxygen availability. Whenever a fire has sufficient access to oxygen and fuel, it will grow and spread.

Ventilation also allows firefighters to control where hot gases and smoke exhaust from a structure. Controlling exhaust openings may improve visibility inside the structure so that interior crews can work more effectively. Exhaust openings can also be used during overhaul to facilitate removal of smoke or toxic gases after fire extinguishment.

Proper ventilation requires:

- Planning.
- Knowledge of building construction.
- Knowledge of how and when to ventilate.
- All crews working on scene coordinating their efforts.
- Controlling the air flow.

When done incorrectly, ventilation can endanger 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 all involved.

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 important for a coordinated effort to enhance fire attack and search operations. The basic ways in which we ventilate (horizontal, vertical and PPV) should remain dynamic as conditions change. For example, one method may be used for initial fire attack and a second method may then be implemented as additional resources arrive. Therefore, it is important to continually monitor the effectiveness of ventilation tactics being used.

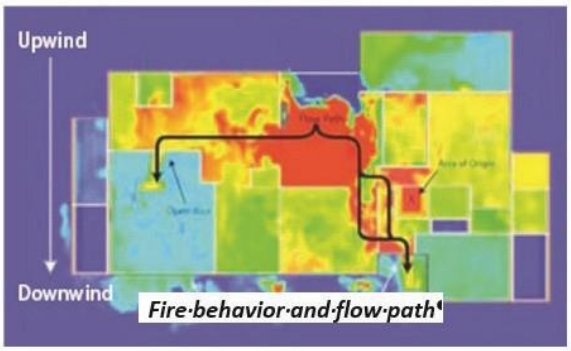
Fires that are reported early and are in the initial stages of development are typically extinguished by the initial crews on scene very quickly. Fires that have developed much further and are exhibiting heavy smoke under pressure when crews first arrive require a different approach. Fires with these 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 within just a few minutes.

STAGES OF FIRE GROWTH AND FLOW PATH

The stage of the fire (i.e., ventilation or fuel limited), the distance from the air inlet to the fire, the distance from the fire to the outlet, the shape of the inlet and outlet, and the type and shape of combustibles or openings along 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.



Fire·behavior·and·flow·path[1]

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.

VENTILATION

DOOR CONTROL

Tactically, there are several considerations for door control. Most importantly, it is a temporary action. You must 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. Door control effects on fire dynamics are simple. If you have a ventilation-limited fire and you limit the air, then you limit the heat that can be released. While this does not completely cut off the oxygen supply, it slows it, which slows fire growth.

Based on UL experiments, flashover can be delayed for several 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 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 can 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. To increase firefighter safety, consider treating every fire like it is ventilation-limited until proven otherwise.

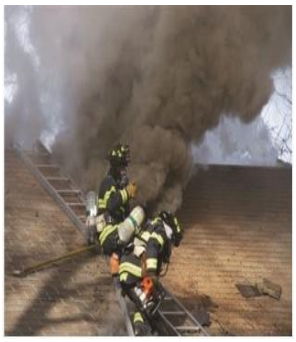
When reading smoke, consider its **Volume, Velocity, Density** and **Color**.

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).

VENTILATION

BUILDING CONSTRUCTION

The firefighter's ability to ventilate a building safely and efficiently 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 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:

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

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 inter-relationship. 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 connected 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.

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.

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.

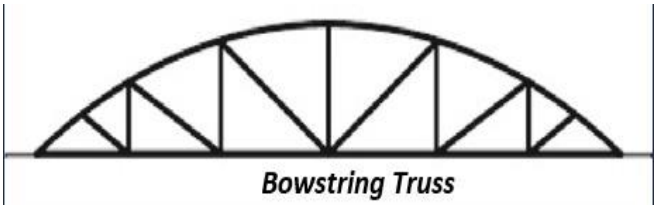
ARCHED ROOF STYLES

Ribbed Arch

Construction is like 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 framing.

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 to regulate tension. The roof is quite strong, but likelihood of failure is dependent on the dimensions of the materials and the span of trusses. This roof may have a large open attic and usually fails in sections. Sudden collapse can occur if the tie rods are heated to failure.



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 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 & VENTILATION PLAN

All firefighters on the fire ground, but especially those tasked with developing the ventilation plan, need to consider the following during their size-up:

- Building type and age
- Commercial, residential, hotel, etc.
- Location and extension of fire
- Determine 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
- Ladders (Type and location)
- Locate the roof line (HVAC and scuppers help to determine this)
- Will you need a roof ladder to climb down a parapet wall? Will you need an aerial to get to the roof or will a 35' ladder be enough?
- Where will the secondary means of egress be located?
- The officer in charge of vent should radio the IC and state where the ladder should be located and what size is needed.
- Hazards.
- Electrical wires, fascia, large roof top HVAC, roof or tilt-wall collapse potential.
- Need to know what units are assigned to interior fire attack and who will be in direct communication with the ventilation crew.

In developing the plan, consider using natural construction openings versus creating vertical openings. 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

Natural, mechanical, and hydraulic ventilation are all varieties of horizontal ventilation.

- ***Natural*** – Opening doors and windows to allow air currents and pressure differences to remove smoke and heat.
- ***Mechanical*** – Using fans to create pressure differences.
- ***Hydraulic*** – Using water streams to ventilate compartments and create pressure differences.

Natural Horizontal Ventilation

When conditions are appropriate, natural horizontal ventilation operations should work with atmospheric conditions, taking advantage of natural air flow.

Wind direction should be a consideration when performing horizontal ventilation. Windows and doors on the downwind side of the structure (low pressure side) should be opened first to create an exhaust point. Windows and doors on the upwind side (high pressure side) can then be opened to allow fresh air to enter and force heat and smoke toward the exhaust openings.

Once the fire has been located, the IC will make decisions on how best to attack the fire. If only a single opening is made, such as opening a door,

this vent will serve as the intake of air and exhaust for smoke. Opening a window or door may allow firefighters to attack the fire with a straight stream from the exterior, making the fire compartment tenable for a follow-up interior attack.

Door control is an important part of natural ventilation. Doors can be used strategically when opened or closed to change the available flow path within a structure.

You should control natural ventilation as much as possible at fire incidents. Ventilating the structure and then walking away will allow the fire more oxygen and allow it to grow. Also, the more ventilation points added, the more oxygen the fire gets. Natural ventilation only provides a small amount of time, maybe less than a minute, for firefighters to use the improved conditions. Therefore, coordination and communication between interior hose teams and outside support are critically important.

Mechanical Horizontal Ventilation

Mechanical ventilation is accomplished using fans, blowers, and smoke ejectors to create negative or positive pressure. Since most Kitsap County fire apparatus do not carry blowers or smoke ejectors, we will focus on the piece of equipment used most often for mechanical ventilation in Kitsap County: The Positive Pressure Ventilation (PPV) Fan.

Using a high-volume PPV fan accelerates the natural ventilation by creating and sustaining slightly higher pressures inside a structure, which forces heat and smoke to areas of lower pressure or resistance.

Fire Departments in Kitsap County typically use PPV at incidents in which the structure is not involved, such as room-and-content fires or cooking fires. In these cases, PPV can clear interior spaces much faster than with natural horizontal ventilation alone.

However, when a fire progresses to the point where structural members are involved, it is best practice not to use PPV until after the fire has been extinguished and crews have checked for extension.

Indications for PPV

- Light to moderate smoke
- Low heat conditions
- Fire is extinguished with no extension

Contraindications for PPV

- Uncontrolled structure fires
- Any fire involving a rescue

Additional Uses for PPV

Protecting Property – A PPV fan may be used to defend real estate, as in a strip mall. By using a PPV fan to create positive pressure in a space adjacent to the involved occupancy, the higher pressure may keep heat, smoke, and fire from spreading into the unaffected space.

- Clearing Hazardous Atmospheres – Hazardous atmospheres can be cleared quickly by using PPV. Buildings filled with a flammable or toxic gas must be ventilated quickly and safely.
- Confined spaces containing low oxygen levels can benefit from the introduction of fresh air as the contaminated products are removed.

- Clearing buildings of smoke reduces smoke damage and improves relations with home or business owners.

PPV Fan Placement

Placing the fan 8-10 feet from an opening will produce the most consistent volume of air flow. However, you may need to move the fan closer because of the characteristics or limitations of the entry opening (i.e., stairs, landscape, and porches). Studies have shown that volume will be reduced in this case, but ventilation will continue to be effective.

PPV Considerations

- Remember to account for the direction and speed of the wind and how it will influence ventilation.
- Exhaust points should be approximately 75%-150% times the size of the intake. This may change based on the distance of the exit point from the entry opening or based on higher power fans.
- Should have an exhaust point established prior to putting fan into place.
- Keep in mind that exposures near horizontal ventilation openings can be negatively impacted by heat and smoke being discharged near them.
- The cone of air should cover the entry point.

- Fans create a jet stream that moves through the structure and the jet stream will move along the path of least resistance.
- Exhaust from gas-powered fans can add carbon monoxide to a structure. Though most PPV fans used in Kitsap County are battery powered, some gas fans are still in use.
- The starting and stopping of the fan is directed by the interior crew because they are in the best position to observe interior conditions.
- Because PPV fans are loud and can negatively affect fire ground communications, fans should be used only long enough to clear smoke conditions.

Hydraulic Horizontal 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.

STREAM TYPE	STATIONARY	MANEUVERING STREAM AROUND OPENING
Straight/Solid	1,500 cfm	6,5OO cfm
Narrow Fog	8,000 cfm	12,000 cfm
Wide Fog	16,000 cfm	NA

Combination Nozzle

After opening a window in the room to be ventilated, flow a fog pattern (about 30 - 60 degrees) at least 2 feet back from the opening. Fill the opening 85-90% with the fog stream. Keep the top of the opening covered as much as possible to allow air to enter from the bottom. Be aware of your surroundings and have a member of the crew be alert for changing conditions as the fire may grow.

Smooth Bore Nozzle

The smooth bore using a solid stream can also be used for hydraulic ventilation like a wide fog pattern. The smooth bore can be opened to half bale, or at a bale position which creates a broken stream, giving the same effect as a wide fog. If you keep the same rule as the wide fog pattern and envelop most of the opening with the stream, you have the same air movement as a wide fog.

A smooth bore can also use the solid stream in a circular motion to hydraulically ventilate the space. This may not be as effective as a wide fog or broken stream.

The effectiveness of hydraulic ventilation varies depending on several factors. A recent UL Firefighter Safety study found that a narrow fog stream held in one place moves about 6 times the amount of air that a stationary straight or solid stream, and a wide fog moved about twice as much as the narrow fog. Moving the direction of the stream around the opening, as if trying to wet the entire area, significantly increased air flow.

The chart below shows the amount of air in cubic feet per minute (CFM) each hose stream entrains while flowing water through an opening.

(Keep in mind that a 10’ X 12’ room with an 8’ ceiling, contains 960 cubic feet)

VERTICAL VENTILATION

Vertical ventilation - The process of creating an overhead opening (vent hole) as high up and as close to the seat of the fire as possible. This allows the heat, smoke, and combustion products to travel up and out of the structure—much like a chimney—following the path of least resistance (lower pressure). Unless the fire is in the space directly under the roof or a backdraft condition is present, ventilating the roof may not be the best first choice. If you are battling a first-floor fire in a multistory structure, this would cause all the heat, smoke, and combustion products to travel up through the remaining floors.

- Attempt to place the ladder away from the fire which allows you to start from the strong area and work back to your means of egress.
- Always know where and how to exit the roof and whether you have an alternate means of escape.
- Prior to a roof-cutting operation, address tactical and procedural considerations.
- Determine the location of the fire.
- Ladder and approach from the uninvolved area. A minimum of two ladders should be raised away from or opposite the location of a fire. This allows personnel to start and return to the strongest portion of the building and their means of egress.

- Know what type of roof construction is present.
- Ladder the strong areas of the building roof. Normally, the strongest portions of the building are at the corners. Other areas that offer strength are hips, valleys, and ridges.
- Avoid placing ladders over horizontal openings (windows, doors, other openings, etc.).
- Extend the fly of extension ladder/aerial 5 rungs above a parapet or roof for visibility. If a ladder is a primary means of egress from a roof, make it easy to locate. Therefore, do not limit the extension of a ladder above a roof/parapet to three or four feet.
- Deploy properly equipped and adequate personnel. Roof ventilation operations are simplified, and safety and accountability increased when a minimum of two firefighters are used.
- Know (forecast) the type of ventilation technique you are going to utilize.

Utilize the rubbish hook to sound/feel for roof integrity and to locate main structural components.

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 of a structure to limit and control fire spread, permitting rapid advancement 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.

When to Perform Vertical Ventilation

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

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.

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.

VENTILATION

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. Example: ***"E51 from L1" .... "E51" ... "Confirming you need vertical ventilation over the Bravo-Charlie corner? Advise us when you are ready for ventilation."***

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

Attic fires may benefit from vertical ventilation by reducing horizontal fire spread and releasing smoke and heat to prevent a smoke ignition or backdraft. The preferred method for attacking attic fires is to open the ceiling and apply water. However, if you are ordered to vertically ventilate in coordination with an interior crew pulling ceiling, it is good practice to make your roof cuts and await the order to open the ventilation hole.

How big of a hole?

A 4' by 8' 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 borrow a page from wildland firefighters and employ "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.

Pro Tip: *Whether you're just getting on the roof, working your way across it, or walking back to the ladder to get down,* ***ALWAYS SOUND THE ROOF WITH A TOOL BEFORE TAKING THE NEXT STEP!*** ***

The following warning signs of an unsafe roof condition may merit the abandonment or relocation of ventilation operations:

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

The Roof Package

The basic roof package (or ladder 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 the equipment every time, doing so allows some 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. For a list of recommended equipment, see **Ladder Packages for Roof Ops (pg. 108)** in the Ladders chapter of this manual.

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 their 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 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

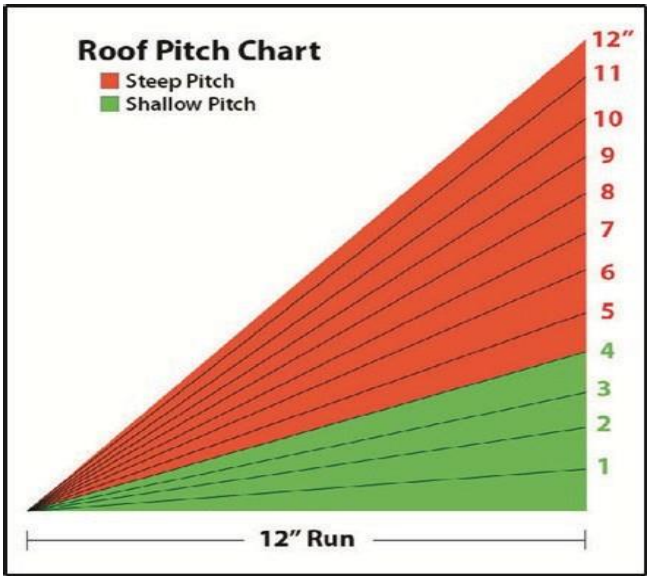
to approach the ventilation site by moving uphill utilizing exterior wall lines, bearing walls, division walls, valleys, and ridge lines. It is imperative that all roofs be evaluated for structural strength prior to placing firefighters on them. Be aware of the possibility of fire in concealed spaces 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 react 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.



Ventilating a Walkable (Shallow) Pitched Roof

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.

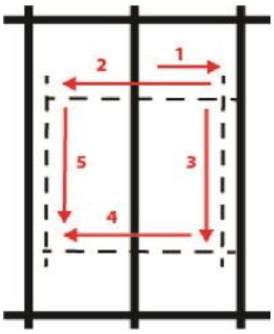
RESIDENTIAL VENT EVOLUTION

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.

Initial Vent Cut

1. The first cut of the ventilation hole is a horizontal, top or ID cut. This cut is made parallel to the ridge, towards the fire and away from the egress route; stopping at the first rafter encountered. This cut is made about a foot below the ridge (to avoid metal flashing and rafter brackets) and is used to identify a starting or outside rafter.
2. The second cut is the top cut. It should start at the first cut and continue horizontally away from the fire, toward the egress route. Roll one rafter while making the top cut and stop at the next one.
3. The third cut is a vertical outside cut starting just inside of the outside rafter closest to the fire and furthest from the egress route. This down cut should extend down two to four feet.
4. The fourth cut is a horizontal, bottom cut, which intersects the outside cut, continuing toward the egress route and away from the fire. The bottom cut should roll one rafter and stop at the next one.

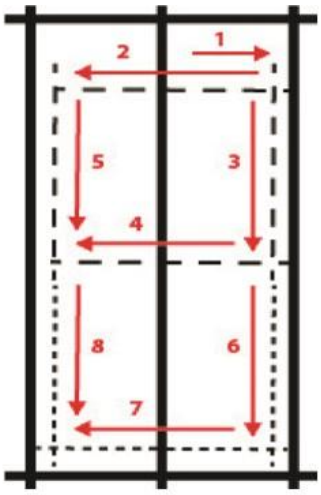


Initial Vent Cut – Also called ***"5-Cut"*** *or* ***"Center-Rafter-Louver"***

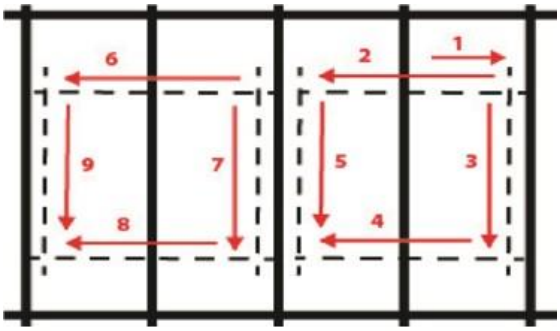
5. The fifth cut is a vertical inside cut

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. Evaluate smoke conditions and the effectiveness of the vent hole to determine the need to expand the hole.



Vertical Expansion - Second Louver (With Construction)



Horizontal Expansion - Second Louver (Against Construction)

Expansion Against Construction (Horizontally)

The sixth cut is an expansion of the original top cut in an increment of odd rafters determined by present conditions and the experience level or orientation of the sawyer.

1. The seventh cut is a vertical outside cut made 4-6 inches from the inside cut of the original opening, on the egress side of the rafter. This will allow it to skip over the rafter which will be between the two louvers.
2. The eighth cut is a horizontal bottom cut connecting with the last outside 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.
3. The ninth cut is a vertical inside 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 top cut was made. However, the sequence would start at cut 7 and continue in that pattern (7, 8, and 9) the length of the top cut.

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. 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 (Steep) Pitched Roof

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 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 to determine the ideal location for the roof ladder.

Pro Tip: *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. Instead, use it to stop your boot from sliding on the steep roof deck.*

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 assess 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.

- When the first person identifies the location for the vent hole, communicate the location using the hook and confirm the second person understands.
- Then complete a Tool Swap. The initial sounder or person in the front, passes the rubbish hook to the back-up person by placing the tool to the outside of the operations and grasping the chainsaw in a pass motion on the inside of the operations. Or simply put, "**Saws to the fire side, tools to the outside**." Saws are always passed with the chain break on and the body of the saw first.
- The second person sets the hook by driving the uphill tine into the roof deck with a downward strike. Only one tine is buried into the deck.

- The sawyer then steps onto the roof above the hook. The sawyer should maintain an orientation that faces the fire and the peak of the roof. The uphill foot that provides that orientation should remain uphill throughout the operation.

- The initial cut will be toward the fire (away from the roof ladder) to identify the primary outside rafter.
- Once the outside rafter is identified, the saw is turned around and the head cut is established by reversing the direction, rolling the center rafter, and stopping at the next rafter or before contacting the roof ladder.
- The third (outside) cut is made by intersecting the head cut enough to fully cut through the roof decking. If the roof decking is 2 inches thick, your intersection should be 4 inches.
- The fourth (bottom) cut is made by intersecting the bottom end of the outside cut and working back toward the roof ladder, rolling the center rafter, and stopping at the inside rafter. The backup person may need to slide the hook handle down the ladder beam to allow for better foot positioning.

- Set the chain brake and step back onto the ladder and wait for the hook to be removed from the roof deck. Once the other firefighter is ready, intersect the near side of the head cut and cut down the inside of the inside rafter; fully intersecting the bottom cut.
- Perform a tool swap and take a step lower on the ladder so both members are below the louver.
- Open the louver, keeping it from falling into the hole and making it difficult to clear the ceiling.
- Punch the ceiling down using the hook to complete the operation. On steep pitched roofs, use a long pike pole, which should be included in the ladder package for these situations.

> Note:
> When making cuts that parallel rafters, stay about 3 to 4 inches off the rafter so the saw doesn't damage it during the cut.

The roof team should 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 either with construction (vertically) or against construction (horizontally). Expand- ing 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 to start 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**

Ceiling Punch

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. The goal should be to make a large enough hole, followed by an equally sized punch to relieve the maximum pressure. The resulting conditions after the punch will dictate whether there is a need for additional holes and/or extension of the first set.

VENTILATION

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 KCFTC Task Manual.

CHAPTER 9

- HOSE LOADS
- HOSE APPLIANCES, NOZZLES, AND TOOLS
- SUPPLY HOSE
    - LOADING
    - DEPLOYING
    - TAKING A HYDRANT
    - FORWARD SUPPLY
    - REVERSE SUPPLY
- FDCs
- ATTACK HOSE
- BULK BED
- HOSE & NOZZLE MANAGEMENT PRINCIPLES
- ATTACK LINE ROLES & RESPONSIBILITIES
- THE STRETCH
- DEPLOYMENT
- GRIPS
- ENTRY PROCEDURES
- HOSE MOVEMENT
- COMMANDS

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HOSE

Engine Company Operations are the foundation of all firefighting efforts in the Kitsap County Fire Training Consortium (KCFTC). The foundation of engine company operations is the understanding of hose to include appliances, deployment, movement, and operations.

The fire service has many ways to load and deploy fire hose. These loading and deploying practices are mostly based on culture and tradition. The need to improve interoperability, however, 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 are included in this chapter have been adopted by the KCFTC Hose Firefighter Training Advisory Team (FTAT) and are “best practices”. The main emphasis of the hose section is to provide firefighters with information, common terminology, and best practices to positively impact the deployment of hose lines and water delivery on the fireground. It is intended to be a reference for recruits, apprentices, and veteran firefighters.

The FTAT wishes to recognize Aaron Fields (Seattle Fire Department) and the Nozzle Forward cadre for developing and sharing curriculum that makes up a majority the content in this chapter.

HOSE LOADS

To maintain consistency across the county, it is the preference of the training consortium that Kitsap engines have at a minimum the following supply, preconnect, and bulk hose loads:

Preconnect Hose Loads
Each engine should have a minimum of 3 preconnect hose loads:

- Two preconnected 1¾" lines of 200 feet
- One preconnected 2½" line of 200 feet

Bulk Bed
Each engine should have a bulk load for stretches beyond the preconnect. 400-800 feet 2½" flat load flagged every 100', finished with a 100' attack package of either 2½" or 1¾".

Supply (LDH) Bed
800-1000 feet of 4" or 5" supply hose, flat loaded.

This is just a minimum configuration and may need to be adjusted for specific response areas. For example, some departments may elect to have standpipe bundles or apartment bundles.

HOSE APPLIANCES, NOZZLES AND TOOLS

Adapters and Reducers
Adapters and Reducers 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.

Gated Wye
Hose appliance with one female inlet and multiple male outlets controlled with valves. This appliance should be used for exterior operations such as defensive fires or brush fires. The gated wye was designed for legacy flows and should not be used to conduct interior offensive fire attacks at structure fires. When an appliance is needed to assist in extending a hose stretch for interior attack, the use of a single line reducer is the preferred method.

Gated Wye

HOSE

Hydrant Kit

Different departments use and carry a variety of hydrant boxes or bags. Their specific inventory of will vary depending on each department's requirements., but will likely include: a hydrant wrench, spanner wrenches, a gate valve, marker devices, and various adapters.

Hydrant boxes and bags are two types of hydrant kits used in Kitsap

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.

Fog and smooth bore nozzles

Nozzles

Nozzles are appliances used for creating and controlling water streams. Common nozzles used by departments in the KCFTC are:

- **Smoothbore Nozzle** – 50 psi operating pressure.
- **Combination Fog Nozzle** – 50-100 psi operating pressure.
- **Master Stream Nozzle** – Master stream nozzles may be fixed to apparatus mounted monitors, ground monitors, or elevated master streams. They operate at 80-110 psi operating pressures depending on mounted or portable, and solid bore or combination.

Shown here with smooth bore nozzle, a Blitzfire is a type of master stream device.

Wrenches and Tools

Hydrant wrenches are used to operate hydrant ports and valves. Spanner wrenches are used for making and breaking hose coupling connections. Spanner wrenches are designed for specific hose couplings with common sizes and types being 1¾" lug, 2½" lug, 4" lug, 4" and 5" Storz. Other tools may be available to assist in hose operations.

Spanner wrenches, hydrant wrench, and rubber mallet

Trash Lines / Booster Reels

Trash lines and booster reels are used on some apparatus in the KCFTC. The use of these hose lines 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 lines are for the quick extinguishment of small fires typically involving dumpsters, grass and low brush or other small exterior fires.

1" booster reel

SUPPLY HOSE

The supply beds on KCFTC Engine companies vary slightly based on hose bed manufacturer, design, and size. Typically, KCFTC Engine companies will carry 800-1000' of Large Diameter Hose (LDH) ranging from 4" to 5" diameter.

Quarter 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.

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.

HOSE

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 coupling with the last 4'-5' of hose and secure with a hose strap.

****** SAFETY NOTE ******

Firefighters must use caution when heeling (anchoring) supply hose that is being deployed from a moving Engine. Never step on, or in front of LDH while it is being deployed.

Handling supply hose filled with water under pressure creates another hazard. Often kinks must be removed; at no time are firefighters to use their hands directly on LDH hose or attempt to kick the hose to remove a kink.

Instead use a hose strap or tool to keep hose from pinching your hand.

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 or bucket and pull LDH finish bundle with pre-attached hose strap.
3. Secure LDH bundle with hose strap or by wrapping the hose itself around the base of hydrant.
4. Give the verbal command to "Drive" with hand signal.
5. After first 100' has been deployed off the engine, remove hose strap from hydrant.
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. If 2½" gate valve will be used, then connect 2½" hydrant gate valve to 2½" port facing away from the fire and confirm that gate is in the closed position.
12. Notify driver ready to send water.
13. After confirming driver is ready for water, fully open the 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 proceeding 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 an aggressive fire attack and access to additional equipment is more feasible due to the engines position within proximity to the fire building. The forward lay works best when a water source is in the approach path of the attack engine.

There are two types of forward supply lays used:

- ***Wet Forward*** - Firefighter stays with hydrant to charge it when requested by the engine apparatus operator.
- ***Dry Forward*** - Firefighter secures hose strap of LDH finish bundle to hydrant and gets back onto the engine, traveling to the fire with the remainder of the crew. The hydrant will then be charged by the next appropriate responding apparatus when assigned.
- ***Driveway Supply*** - Firefighter dismounts apparatus at the end of an extended driveway and secures LDH by holding a bight. Once first coupling is on the ground, firefighter follows hose back to engine, making sure it is laid for greatest advantage. The LDH will then be charged by the next appropriate responding apparatus when assigned. In most cases this will be a tender.

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 "Transitional Attack" off tank water to slow progression of the fire and provide for a more tenable environment. The second arriving engine becomes the supply engine laying a reverse from the attack engine to the water source. A reverse lay is preferred for suppling large volumes of water via ground monitor or manifolds.

SUPPLYING FIRE DEPARTMENT CONNECTIONS/STANDPIPES

Fire department connections should be supplied with the same diameter hose as the connections, i.e., 2½" Siamese connection should be supplied with two 2½" hose lines, 5" Storz connections should be supplied with 5" diameter hose.

ATTACK HOSE

Preconnects

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

Loading Single Stack Preconnects

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, 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, placing 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) on top of the hose load. Fold under excess hose as needed.

Single stack preconnect

Loading Double Stack Pre-Connect

The double stack preconnect is carried on KCFTC 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.

Double stack preconnect

Deploying Preconnects

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 taut.

Note:
The bottom 100' of the preconnect can be stretched by the driver/operator or 2nd firefighter when available. This allows the nozzle FF to focus on traveling to the drop and maintaining control of the nozzle and attack bundle.

Blitzfire

The Blitzfire is a portable ground monitor able to flow up to 500 gpm through a smoothbore or combination nozzle. The smoothbore nozzle comes with "stacked tips" measuring 1 ½", 1 ¼", and 1" diameter tips, with a flow capacity of 210-475 gpm. The combination nozzle is a Dual-Pressure Nozzle (100/55 psi), with a flow capacity of 100-500 gpm, and a stream pattern ranging from straight stream to 120-degree wide fog.

The dual pressure fog nozzle of the Blitzfire

The Blitzfire ground monitor can be deployed by a single firefighter, often used for defensive fires and exposure protection. The BlitzFire can be placed in operation either attended or unattended by a firefighter due to integral safety features: Safety Shut-Off Valve, carbide tipped stabilization legs, and a tie down strap.

METHOD	RISK of MOVEMENT
Anchoring by Weight	HIGH
Anchoring by Spike Holds	MEDIUM
Hooking Legs on Vertical Surfaces	MEDIUM
Using the Tie Down Strap	LOW

The Blitzfire has a Safety Shut-Off Valve which will activate, shutting the monitor's flow if it becomes unstable, moves, and/or experiences one G of sideways acceleration. Once the Safety Shut-Off Valve has been activated, the valve handle will not stay open unless the mechanism is reset by fully closing the valve.

To keep the Blitzfire from moving, the monitor should be anchored from moving by one or more of the methods in the following table:

Using the firefighter's weight to anchor a Blitzfire

Anchoring by Weight

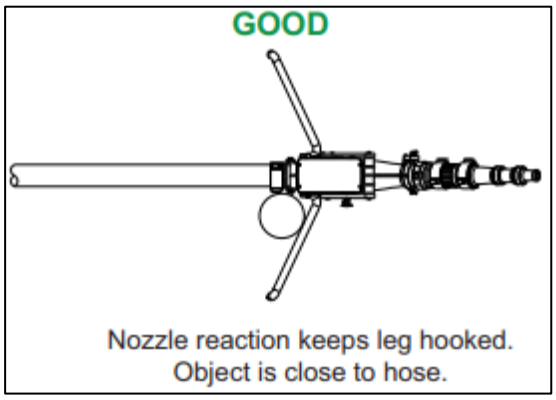
On surfaces with good traction, a person's weight on the monitor and/or hose may be sufficient to keep the monitor from sliding.

Anchoring By Spike Holds

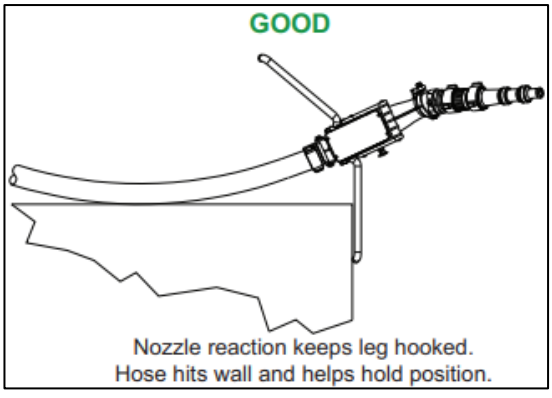
The Blitzfire has three carbide tipped spikes on the legs and the base, which are used to resist sliding by digging into the ground surface. The amount of sliding the spikes will withstand depends on the surface on which the monitor is placed. Smooth surfaces such as smooth concrete and steel decking may cause the spikes to not hold well. The holding ability of the spikes on soft surfaces like sand, gravel, and mud are generally poor. The spikes are essential to safe operation of the Blitzfire and must all be always in contact with the ground.

Hooking Legs on Vertical Surfaces

The legs on the Blitzfire point back slightly so they can act as a hook for anchoring on posts, walls, door frames, or other fixed objects.



Anchoring by hooking a post



Anchoring by hooking to a wall or door frame

Anchoring By Using the Tie Down Strap

The safest method of anchoring the Blitzfire is to use a tie down strap. It is inherently more reliable than other methods because it doesn't rely on traction of digging in the spikes, and because any travel is limited to the length of the strap. A loop on the end of the strap may be placed over or wrapped around an anchor. Firefighters should be sure to keep the entire length of the strap as close to the ground as possible when using the tie down strap and remove all slack in the tie down prior to flowing.

Deploying the Blitzfire

1. Estimate length of the stretch and notify the pump operator which hose will be deployed.
2. Acquire the Blitzfire ground monitor, ensuring appropriate nozzle type, pressure setting, and tip size.
3. Deploy Blitzfire and hose to drop. Deploy both stabilization legs, placing them firmly on a solid and even surface so all three spikes are in contact with the ground.
4. Connect Blitzfire to 2½" hose. A minimum of 10 feet of straight hose behind the monitor.
5. Anchor the Blitzfire by weight, spike holds, vertical surface, and/or tie down strap.
6. Call or signal "ready for water."
7. Aim at desired target, open valve, and flow water.
8. If Safety Shut-Off Valve is activated, correct issue causing activation, and repeat step 7.

2½" BULK BED

The 2½" Bulk Bed was created to address the need for hose stretches "beyond the preconnect" (exceeding the 200' preconnect capability), supplying fire department connections and ground monitors. The bulk bed has 400' to 600' of 2½" hose, depending on hose bed capacity.

The bulk bed is "finished" with a 100' attack hose bundle (either 1¾" or 2½"). The remaining stacks of 100' have extended flags marking each 100' in the bed. The flag is designed to be pulled with the free arm (opposite of the shouldered finished bundle) to aid in hose advancement.

Loading 2½" Bulk Bed

1. Start with the female coupling at the front (cab side) of the hose bed, flag the bottom bight, load 100' and cross over 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. A reducer will need to be used if your department finishes this load with a 1¾" attack package.
5. Finish the final 100' with two bundle straps for easy deployment if available.

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.

HOSE AND NOZZLE MANAGEMENT PRINCIPLES

Andy Fredericks

"As the first line goes, so goes the fire. All efforts should be concentrated on stretching, charging, and operating the first line." – Andy Fredericks

OBJECTIVES OF "THE FIRST LINE"

1. A hose line operating between the fire and the rest of the structure can protect victims, protect other firefighters operating within the structure, and support search efforts.
2. The priority of the first line should be to locate, confine, and extinguish the main seat of fire. Once the fire is controlled, all the other fire ground operations become exponentially easier and safer.

ATTACK HANDLINE ROLES AND RESPONSIBILITIES

Nozzle FF

- Stretch the working length (shoulder load) and travel length when necessary.
- Communicate commands/resources needed during fire attack to the backup team member.
- Fire control

Backup (Heel) Firefighter/Officer

- Assist in the stretch.
- Manage friction points.
- Utilize the Thermal Imager.
- Radio communications.
- Reduce nozzle reaction for the Nozzle FF.
- Support the advance or withdrawal of attack line.
- Search off the line.
- Forcible entry.
- Clearing obstructions out in front of Nozzle FF.

Control (Door) Firefighter

- Assist in the advance or withdrawal of attack line.
- Manage friction points.

Apparatus Driver/Operator

- Assist in the stretch.
- Establish water supply.
- Operate the pump.
- Pull/assist in the deployment of additional hose lines.

HOSE

STANDARD MODEL FOR HOSE DEPLOYMENT ORDERS

- *"Stretch a 2½" pre-connect from Engine 1 to side Bravo for defensive fire attack on floor two."*
- *"Take the apartment bundle and 150' of working line from Engine 1 to side Charlie for exposure protection."*
- If more working line is needed than your 2½" pre-connect can provide, an extended apartment house lay may be needed.
  "Take the apartment bundle and 250' of working line from the bulk bed of Engine 1 for an extended apartment house lay to the Charlie-Delta corner and establish Charlie-side RIT."
- *"Stretch a 1¾" pre-connect from Engine 1 to side Alpha for offensive fire attack on floor 2."*

TERMS FOR THE STRETCH (NOUNS)

- **Attack Coupling:** Coupling/couplings within proximity to the nozzle at the drop, which help identify how much attack length is available.
- **Attack Length:** The amount of hose needed to reach the seat of the fire from the drop.
- **Attack Line:** A hose line that will only be used for fire attack.
- **Bulk Bed:** The hose bed from which 2½" bulk hose is pulled.
- **Bundle:** Attack hose kept in a bundle used to extend from a working line.
- **Drop:** The desired location for setting up the attack line.
- **Setback:** Distance from the rig to the drop.
- **Working Line:** Bulk hose stretched from the rig to the drop from which an attack line, with a reducing adapter, can extend. Typically, 2½" hose from a bulk bed used for an extended stretch with an apartment bundle used as attack line. Working lines supply attack lines.

ESTIMATING THE STRETCH FOR INTERIOR FIRE ATTACK

The stretch is the distance from the rig to the seat of the fire. An estimate of the length of the stretch needs to include the setback (distance from the rig to the drop) and the attack length (amount of hose needed to reach the seat of the fire from the drop).

This skill can be practiced while on medical calls, preplanning walkthroughs, service calls or any other time you are out in your district. It doesn't need to be complicated or 100% accurate, but not estimating the stretch and simply defaulting to the pre-connect lengths your apparatus carries can have negative effects on extinguishment. Taking a few seconds to size up a building can quickly identify whether a pre-connect or an apartment bundle connected to working line is the best solution for reaching the seat of the fire. We want to be aggressive in these stretches, but we also need to understand the capabilities based on the available resources. Stretching too short will waste time, exhaust your crews, and allow fire conditions to deteriorate. Depending on how far out your 2nd due is and the conditions of travel needed to get to the drop, it may be advantageous to wait for the extra staffing to arrive.

How to estimate the stretch

How do we determine the amount of hose needed? We estimate the stretch. How do we estimate the stretch?

1. Setback
2. Width of structure
3. Length of structure
4. Floors: 50 feet each

KEY POINTS FOR DEPLOYMENT

- All stretches must be estimated prior to pulling any hose line.
- Our pre-connected loads are designed to be pulled by a single firefighter but benefit from being deployed as a team. If having to stretch through or around obstacles a second firefighter is recommended.
- The stretch from the bulk bed has been designed to allow for a single firefighter to rapidly deploy. This load will require the work of 2+ firefighter to be successful for longer stretches or when needing to navigate through obstacles during the stretch.
- The Engineer needs to witness and be part of every stretch. Doing so will allow the
- engineer to ensure the appropriate connections are made, ensure the hose bed/pig tails are cleared and finally to calculate the appropriate pump discharge pressure (PDP).
- Hose should be deployed in as straight a line as possible, avoiding pinch points when possible until the drop is reached.
- At the Drop, the hose should be deployed out in a series of S-shaped curves. Sharp bends create a higher prevalence of kinking and should be avoided.
- Couplings that will be pulled in the structure should be staged as close as possible at the point of entry and near the nozzle. Get the working coupling(s) into the Drop!
- In almost every case, the first handline should be stretched through the front entrance to best ensure prompt fire control and the saving of lives. The front entrance is usually the most accessible and easiest to access. It typically leads to the main hall and stairs and is usually the primary means of egress for the occupants resulting in a higher likely hood of victim locating

HOSE DEPLOYMENT METHODS

Success in stretching starts with loading our bodies from the rig. The hose should be balanced as it is carried. In shoulder loads, this usually means the nozzle is about to the waist or so. Friction is the enemy of hose advancement. In most instances, laying the hose in-line with the direction of travel is the best choice.

In reference to the stretches that follow, the Accordion Forward and V-Split work very well in stairwells. In stairways the nozzle team must ensure the hose is situated to the outside of the stairwell prior to being charged.

Accordion Forward

This is the fastest, cleanest stretch and is best for when you have a straight shot to your drop point. The hose never leaves the nozzle FF's hands and only one run at the target is being made by the nozzle team. The forward third of the hose is always the neatest, as it is the managed bite of the load. Therefore, this section of the hose is the easiest to manipulate.

This deployment requires the nozzle to start their stretch by dropping the load away from the structure and stretch toward the drop. This stretch can be used in nearly any situation and is simple, fast, and clean.

This is a universal stretch in that it can work from any standard hose-load; it can be deployed from the ground, back of the rig, or shoulder. Most important is that it works in failure as well as perfection. It sets the stage for rapid advance as it lays the hose in a manner that the "heel" person can easily determine where to position themselves on the line to continue the stretch efficiently.

Steps for an Accordion Forward:

1. With the hose on your right shoulder, move your right hand and grasp the nozzle. (See Photo).
2. Grab the middle bight of the shouldered load with your left hand. (See Photo).
3. Drop your right shoulder, dumping the shouldered hose onto the ground, while maintaining your grips on the bight and the nozzle.
4. Stretch the line towards the objective.

Ideally the nozzle FF will drop their bundle once they have lined themselves up with the target. If a straight approach is not possible, the nozzle FF will drop and drag the hose while advancing using proper angles to prevent the line getting tangled upon approach.

V-Split

The V-Split is used when the nozzle firefighter finds themselves without enough room to do an accordion forward. An example would be a situation where 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.

Steps for a V-Split:

1. While the hose is still on the shoulder, split the bights in half using the same hand pattern as an "Accordion Forward."
2. The right hand takes both the nozzle and the bottom half of the bights. The left hand takes the top bights. (See Photo).
3. Drop the bundle holding the top two sections and take a few steps toward the target, opening the bundle up into a "V" shape.
4. Grab the middle flake of each "V" bight and pull them back away from the target.

Coil/Coil Prop

This deployment is meant only for confined areas where an Accordion Forward or V-Split stretch is not an option.

The finish is slower and can present a footing issue if left on the ground. In addition, in a reduced visibility environment this stretch has a potential to become a mess if the nozzle FF makes a mistake.

The coil prop clears up the already confined area by getting the coil propped up on a wall or handrail while it is being charged. This keeps the walkway a bit clearer.

Steps for a Coil Prop:

1. Start by placing the attack bundle down onto the ground, keeping the forward third as neat as possible.
2. Bring the nozzle to the knee.
3. Next flake goes to the arm.
4. Alternate between knee and arm for the rest of the bundle.
5. Once the bundle is divided, stand and step over the nozzle.
6. Hold the line up while placing hands on the wall. Once the line charges it will hold itself in place.

Coil/Coil Prop

HOSE

GRIPS

Hip Grip

The basic grip for both standing and the ground, this grip allows the greatest control and flexibility in line use. This is the foundation grip for both 1¾" and 2½" handlines.

No matter if we are standing or kneeling, the technique is the same. Create a "corner" or "shelf" between our hip and the top of our thigh and press the line into the shelf.

An arm's length of hose should stay in front of the nozzle FF. If the nozzle FF can reach the tip of the nozzle with the lead hand, it is usually an accurate measure of correct spacing on the line. The hands never cross, and you should never use a pistol grip of your nozzle has one.

The backhand keeps the line pressed in and down through the hips, usually the back hand is slightly forward of the hip bone. This grip gives the nozzle the greatest control over the line and application of water in addition to controlling the nozzle reaction.

The grip on the line comes from the friction created between the line and the "corner" we have created with our hip. The backhand can increase or decrease the pressure as needed.

The bodyweight triangle of the nozzle FF should always be leaning forward or backwards when using the line. The nozzle FF will lean back from the nozzle reaction, allowing the heel person or the ground to absorb the nozzle reaction.

Keep the hose coming straight into the nozzle FF's hip. The line should always come straight into the nozzle FF's back hip from the ground.

When kneeling, the nozzle FF should lean away from the nozzle reaction and the back leg should always be down. When kneeling and solo on the line, the ground acts as the backup person.

Regardless of the nozzle FF standing or kneeling, the hose is pressed in and down the pelvis, by the back hand. The structure keeps the nozzle reaction and weight of the hose on the skeleton of the FF. Rather than trying to muscle the line, this position utilizes mechanical advantage.

The hip grip is the position used the most on the line.

Clamp

The clamp is primarily designed for operations that are stationary, or in a "hit and move" fire attack scenario. This technique is especially useful during 2½" operations where the backup person is not positioned right behind the nozzle. The key is to use the ankle/shin bone to press the line into the ground using body weight. This way, the nozzle reaction is absorbed by the ground. This position gives a lot of control and allows the nozzle to be operated free of nozzle reaction.

The nozzle FF's knee is on the far side of the hose. Their toe is down on the side nearest themselves.

While in the clamp, the lead arm is the same side as the "up" leg. The nozzle FF should keep their foot tucked under their butt, as this allows for body weight to be transferred directly onto the hose and protects the knee from odd angles and accidents caused by Murphy's Law.

The clamp removes the need of a backup person stationed directly behind the nozzle itself. This frees the "heel" to pull hose, search, etc. In cases where the fire is a "hit and move" style attack, advancement can be made quickly with the use of the "clamp slide" from the clamp without a change in position.

Crooked Lean

The Crooked Lean is a position for the nozzle team to employ when the need arises for two-person nozzle work. This position gives the nozzle team a way to advance the hose while flowing water as well as operating the hose line in a stationary position.

Relying on mechanical advantage, the Crooked Lean allows the nozzle team control and the ability to move quickly and without undo fatigue. The nozzle reaction is being absorbed through the skeleton of the team and into the ground.

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 pointed up with the foot placed firmly on the ground, and the trailing arm to the inside of the knee.

Hand Placement for the Nozzle FF

While flowing water, pay attention to the bail in relationship to the lead hand. Having the bail positioned toward the body allows for smoother application of water as the lead arm is not forced to cross over the top of the hose.

This hand placement (as seen in the photo) allows for direction of the stream without creating a kink in the line between the nozzle and the hip, due to a longer lever.

Heel

Moving hose and backing up the nozzle is the highest priority of the heel (backup) firefighter. This position is laborious in not only getting surplus hose behind the nozzle but ensuring that the line feeds straight into the nozzle person's back hip, coming from low to high.

In a hit and move fire, you likely will be pulling hose to the last friction point behind the nozzle, creating a surplus. When the line is moving you will have a bight or a grip on the hose and moving it with your legs forward.

When the nozzle FF is making an attack, the heel FF can be stationed several feet back, pinning the hose to the ground. While in this position, make sure to resist the urge to get on-top of the nozzle while pinning the line, or the nozzle FF won't have the ability to move and direct the stream freely.

In cases of extended stationary attacks, hit and move fires, or when the need arises to push, the heel firefighter will take the Crooked Lean position and push the nozzle firefighter toward the objective.

No matter the position, the heel firefighter will provide a second set of eyes to the nozzle. The heel must be looking forward and into the overhead, always paying attention to the environment. The heel is the most mobile on the line out of every position. He or she is also the connection between the nozzle FF and the rest of the personnel on the line. The heel must keep communication with everyone.

If not completed by someone else, fire room search and finding a vent point are also the responsibility of this position. The timing of these jobs is based off many variables, but they must get completed.

ENTRY PROCEDURES

Prior to entry, the nozzle firefighter must ensure readiness of his/her equipment. The line should be flowed for 10-15 seconds to do an AVP Check (Air, Volume, Pattern). This also gives the pump operator an opportunity to adjust and set the proper pump discharge pressure.

- **Air:** Ensure that all air has been bled out of the line.
- **Volume:** Visualize the stream and ensure that adequate volume is being flowed.
- **Pattern:** Ensure the bail is fully open and the nozzle pattern is set to a straight or solid stream. If using a fog nozzle, move the nozzle to the flush setting and back to straight stream prior to entry.

The heel firefighter or officer should check the door to ensure it is unlocked and to check for heat. Once the door is opened and the smoke has been allowed to lift, the firefighter should get low and perform a scan from the threshold for Life, Fire and Layout.

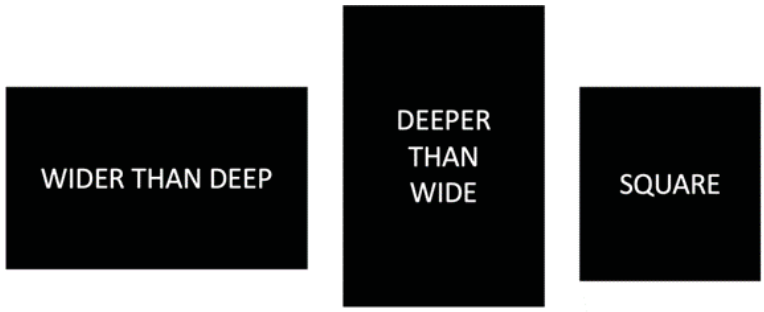
- **Life:** Look for victims in the immediate area. Verbally call out “Fire Department” and listen for a response.
- **Fire:** Look and listen for signs of the fire location.
- **Layout:** Observe the area to get a layout of the floorplan. Look for landmarks such as stairs, hallways, and basement access.

HOSE MOVEMENT

Effectively moving a hose line to the fire room does not happen by accident. Traditionally, there has been no system in place for a team to maneuver a line around corners, down hallways, up or down stairs and into the fire room using standardized methods or communication. This section discusses the commonalities found in buildings: The 3 types of shapes, angles, and stairs. An understanding of this is important as it lays the foundation for hose movement. Finally, a common hose language is presented to ensure team members moving the line can communicate effectively during the stretch.

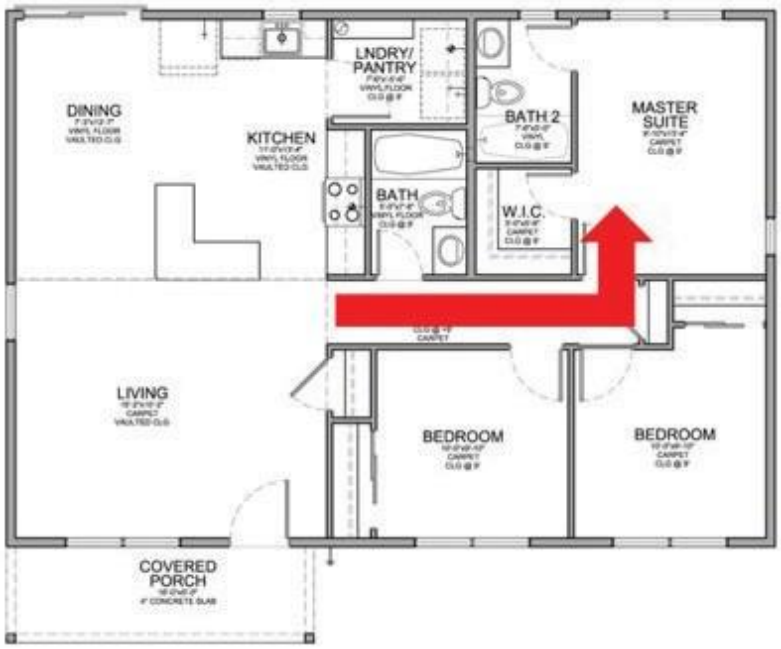
SHAPES

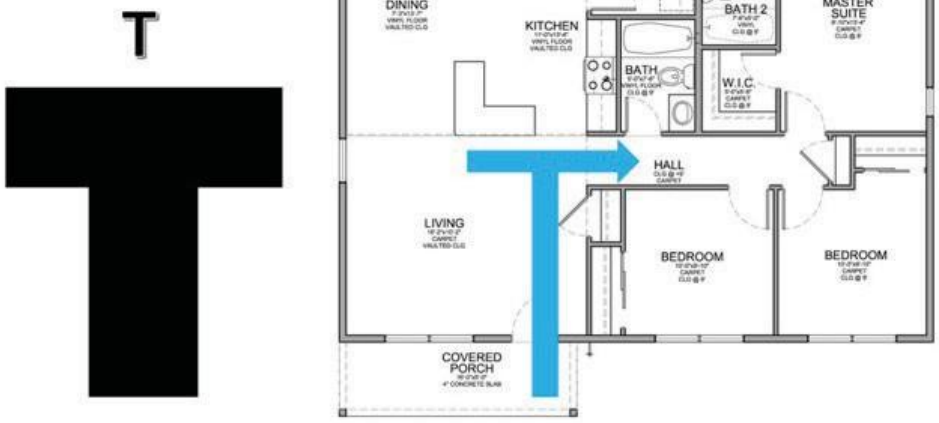
Three General Building Shapes



ANGLES

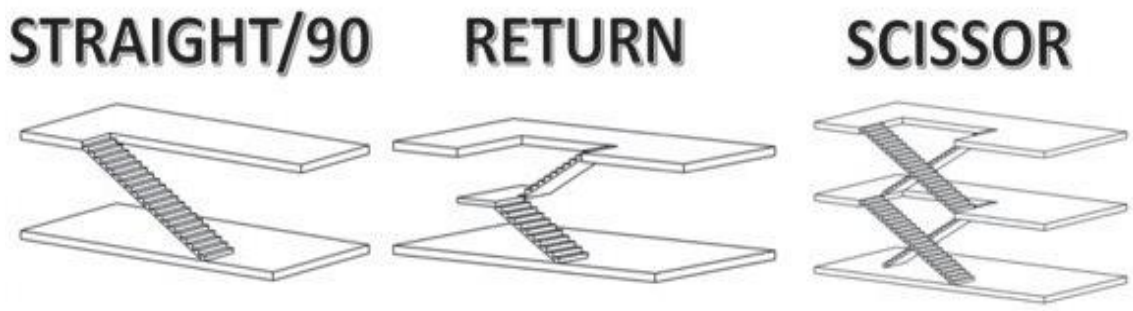
Three House Angles to Consider for Moving Hose





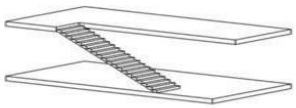
STAIRS

Three Common Types of Staircases:

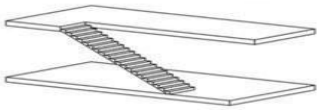


HOSE

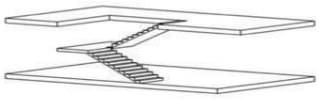
STRAIGHT/90



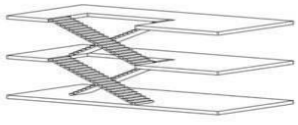
STRAIGHT/90

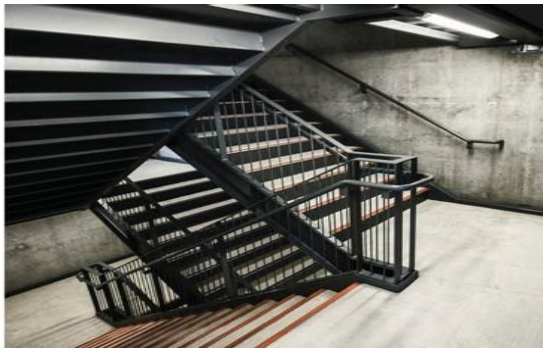


RETURN



SCISSOR





MOVEMENT PRINCIPLES

The goal is to get the nozzle to the fire room as quickly as possible. The nozzle firefighter should never pull line!

The following movement principles will greatly improve the movement of hose through a building toward the seat of the fire:

- **Distance, direction, desire.** Communicate hose needs, distance and direction using standard terminology (listed below).

- **Move hose line with your legs and Fine Tune with your Arms.** It is more effective to grab bights and drag if possible. If no bight exists, fold a straight stick of line to create one or grab a stick and move. **Use your BIG muscles – your legs – to move the hose!**

- **Overshoot corners.** This reduces the friction for the nozzle FF on corners once they turn the corner or enter the room.

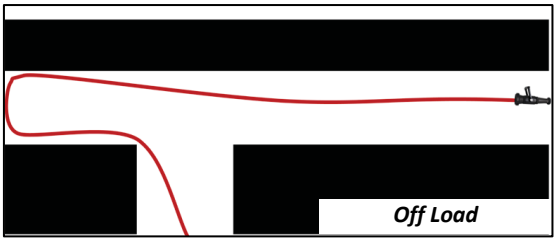
- **Go off angle.** Turn corners on the outside wall. This keeps the line off the friction point as you go around the corner, giving backup members time to get hose advanced to the friction point.

- **Offload surplus hose** when space exists, opposite the direction of travel. This is done by the heel firefighter or by firefighters further back on the hose line assisting with the stretch.

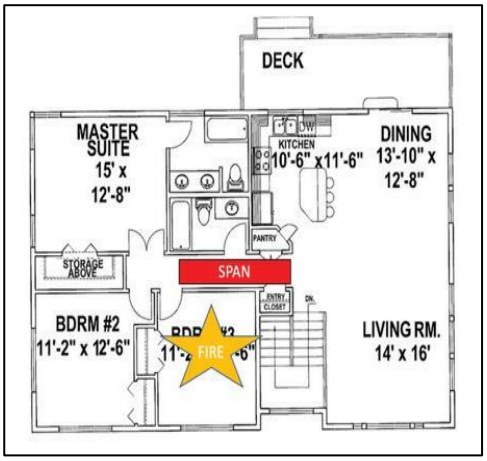
- **Move hose to and from mid-span.** Mid- span is the distance between two friction points. Base the amount of hose taken off the distance of the spans.

Off Angle

Overshoot



Off Load



Span: Distance Between Friction Points

- **Surplus the spans.** Whenever the line stops moving, backup members should form the "S" for surplus in the spans.
- **Feed hose straight to the nozzle.** The hose line should feed straight into the nozzle FF from low to high.
- **Last person loads.** The last person on the hose line is the person who goes back to get more hose. Everyone else should be moving hose from the middle of the span in front of them forward.

Surplus Spans

STANDARD ATTACK LINE COMMANDS (VERBS)

The following commands are the standard communication model for Kitsap nozzle teams during interior fire attack. It is important that these commands are kept brief and concise. Deviating from them to use long and erratic commands will cause confusion among the team members. Since it can be difficult to hear during firefighting operations while wearing full PPE and SCBA, it is equally important to speak as loud and clearly as possible when verbalizing and acknowledging commands.

Example:
Nozzle firefighter: *"Forward 10 feet. Bump!"*
Heel firefighter repeats command, confirming the command was heard and understood, and lets the next firefighter back know the team is advancing through a friction point.

"Forward (# of feet)"
This command signifies how far the Nozzle FF wants to advance. Example: "Forward five feet". The Heel firefighter can expect and support the Nozzle FF moving Forward 5 feet.

"Bump / Bump Up"
Bump indicates the Nozzle FF has made a corner when moving forward and requires the Heel to come into that friction point to continue feeding hose. The Bump Up command comes from the Heel and the firefighter/s back on the line to move up from one friction point to the next.

"Hold"
This command signifies holding during forward movement. The Nozzle FF will hold position and flow until conditions improve to continue advancement. If the Nozzle FF is unsure of the fire's location, start by directing the stream up and performing a scribbling technique directly above and in an outward into the area desired to move into. This may need to be followed up by an inverted U/O pattern filling up the size of the area the Nozzle FF is in. Consideration to perform a bounce technique is highly recommended when moving forward out of a Hold.

"Stop"
It is important to understand that this command can be given by anyone on the attack line. It needs to be followed up with a concise reason why.

Example:
Nozzle firefighter, performing a Push, has a foot goes through the floor or falls over and needs help getting back into position.
Standard commands for these situations are:
- "Stop! Hole in floor. Back out."
- "Stop! Pick me up."

"Push"
Signifies nozzle firefighter's intent to flow while moving forward to the fire room.

"Push 2"
At discretion of nozzle firefighter to bring the Heel into a 2-person push maneuver, working as a team in the crooked lean position. Communicate a bump-up command to firefighters back on the line to take over friction points the Heel may have been managing.

"More / Less Hose"
Feed or retract (take up) hose line in the nozzle firefighter's hands.

"Pick Me Up"
Heel firefighter is to move up the line to help the nozzle firefighter and get them upright to either continue the advance or back out. It is important to note that water is continuously flowing during this maneuver unless condition dictate no flow needs.

"Peel Off / Peel Off + duties"
Sends the heel firefighter back onto the line after a Push-2 or Pick-Me-Up maneuver. A peel off + duties command breaks the heel firefighter off the line to perform a duty. The duty should be stated following the peel off command.
Examples of peel off + duties commands:
- "Peel off, search."
- "Peel off, victim."
- "Peel off, clear a path."

"Back Out"
This command is given to initiate the act of removing attack line out of the structure. This may be used after completing extinguishment or in the event the advance is stopped due to fire conditions that are overwhelming. If Back Out is called due to fire conditions proving too much then the nozzle firefighter is to retreat while continuing to flow, either until in a cold area or out of the building if situations dictate.

"Backwall"
This command will most likely come from the heel firefighter or firefighters back on the attack line. This maneuver requires the nozzle firefighter to do a 180 degree turn and perform a Hi to Low attack to either cool or extinguish the area behind the attack line crew.

"Flip"
Given by the Heel, or firefighters back on the attack line when an area of fire i.e. rooms, hall, spot of origin has been passed. The nozzle firefighter will then turn around and head back to the where the Heel or firefighter called out.

SUMMARY

Loading, deploying, and moving 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 the most effective 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.

This chapter discussed principles for hose loading, deployment, and movement. These points will allow the fire attack team to get in position to conduct successful fire extinguishment if done correctly.

CHAPTER 10

- KEY TERMS
- VEHICLE ANATOMY
- THE TRAFFIC SCENE
- BASIC RESCUE TOOLS
- POWERED RESCUE TOOL
- APPLICATION: THE FIRST FIFTEEN
- APPENDIX A: CRIBBING
- APPENDIX B: ASSIGNMENTS

First Edition: December 2022
Revised: August 2023

EXTRICATION

INTRODUCTION

Vehicle collisions and other emergencies involving entrapped victims present many challenges for responders. Rescuers attending to entrapped occupants of a vehicle need to be highly skilled in modern extrication techniques and medical care. These extrication techniques will allow firefighters access to stabilize, package, and remove patients from their damaged vehicle.

You will be challenged throughout your firefighting career to adapt to ever-changing vehicle manufacturing standards and trends. For example, more and more manufacturers are moving to laminated glass for all vehicle windows – not just the windshield. This seemingly minor change will affect how long it takes to remove a vehicle's glass if you're not ready for it.

Another example of rapid changes in the auto industry is the number of hybrid and electric vehicles (EVs) on the road today. At the start of 2022, EVs made up less than 1% of the 250 million cars out there. This number is projected to increase to 25-30% by 2030. Because of the projected increase in EVs, it is important for fire department personnel to recognize and have a basic understanding of how EVs are powered and how to de-energize them when needed.

Your training in extrication and disentanglement starts now. Get to know your personal vehicles, notice vehicles on the street and in parking lots. Think about how you would describe them over the radio and what challenges you might face stabilizing them or extricating entrapped occupants. As the auto industry changes and cars become more challenging for responders to manipulate, we must continually learn, practice new techniques, and be ready to adapt to those changes.

KEY TERMS

Basic Terminology:

Self-Extrication
Occupants exit vehicles without assistance

Disentanglement
The actual removal of the vehicle from around victims

Extrication
Removal of victims after the disentanglement work on a vehicle

Entrapment
When the victim or part of the victim is being mechanically restrained, or has restricted means of egress, by a damaged vehicle or machinery component.

Incident & Scene Management Terms:

Creating a Safe Work Area
Using apparatus to block and protect the scene.

Debris Pile
A designated area for the debris as it is removed from a vehicle. The debris pile should not be in the way of other activities.

Group Leader
One rescuer identified to establish, communicate, and direct the extrication/disentanglement evolution.

Incident Action Plan (IAP)
Weighing the risks and benefits of tactics to provide clear direction for effective operations to meet the goals of an incident safely.

Inner Circle
One rescuer quickly chocking and surveying the vehicle(s) and patients. A dry Chemical extinguisher should be placed nearby. Do not touch any vehicles until the inner and outer circles have been completed.

Outer Circle
One rescuer doing a 360-degree survey of the vehicle or vehicles with an extinguisher, flashlight or TIC when indicated. The outer circle rescuer should be slightly ahead of the inner circle rescuer to observe and communicate any potential hazards.

Tool Cache
An area designated for tools to be located, providing quick access for extrication teams.

Radio Reports:

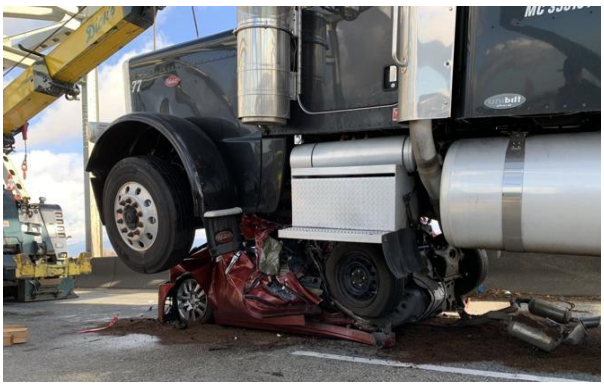
Arrival Report (Windshield Survey)
Communicating the initial impression of the incident from inside the cab; indicating number and position of vehicles and obvious hazards. Use this radio report to request additional resources and initiate command.

Size Up Report
A more comprehensive radio report after info from the inner and outer circles has been collected and the IC has a better understanding of the incident's scope.

MVC Configurations & Collision types:

On its side
MVC with a vehicle resting on its side.

Override
Override occurs when one vehicle collides with another and comes to rest on top of it. This happens more often with commercial/heavy vehicles versus smaller ones.



Override Configuration

EXTRICATION

Underride

When a passenger vehicle collides with a vehicle that sits higher off the ground than the passenger vehicle and is forced underneath the higher one.

Underride Configuration

Wheels up

MVC with a vehicle upside down.

Wheels down

MVC with a vehicle on its wheels.

Head-on

Commonly referred to as frontal collisions. Head-on collisions cause about 26% of MVC fatalities due to the increased velocity of the impact (injuryfacts.nsc.org, 2022).

T-Bone

The front of one vehicle strikes the side of another. This type of collision is sometimes called a broadside collision or a side-impact collision. T-bone collisions most frequently occur at intersections and account for about 47% of MVC fatalities (injuryfacts.nsc.org, 2022).

Rollover

Defined as any vehicle rotation of 90° or more about any true longitudinal or lateral axis, rollovers account for about 8% of MVC fatalities (injuryfacts.nsc.org, 2022).

<u>Stabilization & Disentanglement Terms:</u>

Basic Stabilization

Using step chocks, cribbing, wedges, and shims to quickly stabilize a vehicle, vehicle is in park, e-brake set, and ignition turned off. Continuous rechecking of stabilization is required.

Basic Stabilization

Advanced Stabilization

Supplementing basic stabilization with Rescue-42 Struts, pickets, chain, ratchet straps, or other equipment. Continuous rechecking of stabilization is required. A tow vehicle can also be used to assist in advanced stabilization.

Advanced Stabilization

Hard Protection

Backboards or hard surface used to protect patients from extrication tools, sharp metal, and other hazards associated with disentanglement.

Soft Protection

Blankets or tarps used to protect patients from glass and other hazards during extrication.

12 Volt Battery Mitigation

Disabling the vehicle battery. KCFTC recommends cutting out a section of the negative cable first.

Peel and Peek

Removing or peeling back interior trim pieces to visualize vehicle safety systems and structural components, then marking the exterior where it is safe for disentanglement teams to make cuts.

<u>Pro Tip:</u>

Many manufacturers have started using laminated glass for side windows as well as windshields.
Be prepared to use a saw or axe as you would with the windshield to remove all windows when encountered.

Glass Management

Removing glass prior to starting disentanglement.

> ***Safety Tip:***
> *Wear a particulate mask and eye protection when removing or taking glass.*

Vertical Crush

Using hydraulic spreaders or a Hi-Lift Rescue Jack to spread the top and bottom of a window opening, creating a purchase point on the door.

Vertical Crush

Pop a Door

Using hydraulic spreaders to force open a door.

Maxi Door

Complete removal of the front and rear door including the B-Post.

1. Pop the rear door
2. Make a relief cut along the base of the B post
3. Spread the B post from the rocker panel until it separates
4. Cut the top of the B post
5. Spread or cut the hinges from the front door

Maxi Door (four-door cars)

Third Door

Creating an opening on a two-door vehicle to extricate a patient from the back seat

1. Pop or remove the front door
2. Make a relief cut at the base of the B post parallel to the rocker panel
3. Make a relief cut in front of the strut tower near the back of the rear window
4. Cut the top of the B post
5. Spread the top of the B post down to create a "third door"

Third Door Conversion (two-door cars)

Dash Roll

Forcing the dash up off the patient using the hydraulic ram and rocker panel support braces

1. Remove the front door, leaving the B post intact
2. Remove a 3-4" section at the top of the A post
3. Make a relief cut at the base of the A post through to the wheel well
4. Use the hydraulic ram in conjunction with the rocker panel support brace to force the dash upwards
5. Consider cutting dashboard tie down straps

Modified Dash Lift

Forcing the dash up off the patient using the hydraulic spreaders

1. Remove the front door
2. Remove a 3-4" section of the top of the A post
3. Make a relief cut at the base of the A post
4. Make an additional relief cut in the A post 3-5" above the first cut. This second cut should go all the way through to the wheel well
5. Make a relief cut in the top rail of the hood, just behind the strut tower
6. Use the spreaders to lift the dash upwards (ensure sufficient cribbing/support under the A post)
7. Consider cutting dashboard tie down straps

EXTRICATION

Roof Removal
Total removal of the roof

1. Remove all glass
2. With the posts stripped, cut each roof post using hydraulic cutters or Sawzall
3. Cut the post nearest the patient last

Roof Flap
Removal of a portion of a vehicle's roof

1. Cut the posts on the section of roof to be removed using the hydraulic cutters or Sawzall
2. Make relief cuts in the roof rails opposite of the cut posts
3. Fold the roof back or down along the relief cuts

Roof Pivot
Near total removal of roof

1. Remove all glass
2. With the posts stripped, cut each roof post using hydraulic cutters or Sawzall
3. Weaken the post nearest the patient last
4. With positive control of the roof, rotate clockwise or counterclockwise opening the passenger compartment fully, laying the roof down atop the hood and or trunk

Reverse Hood Removal
Remove the hood of the vehicle from the hinge side

1. Use a pry tool and wedges to lift the edge of the hood to expose to hinges
2. Use the Air Chisel, Sawzall, bolt cutters, or hydraulic cutters to cut the hinges
3. Use hydraulic spreaders to defeat the hinges

Steering Column Lift
Moving the steering wheel and dash up off a patient

1. Remove the windshield
2. Wrap a grade 70 (or better) chain around the steering column
3. Run the chain from the steering column up and over the runner on the Hi-Lift Rescue Jack
4. Connect the chain with a hook cluster to the vehicle's frame
5. Use the Hi-Lift Rescue Jack to lift the steering column and dash up and off the patient (use 4X4 cribbing under the Hi-Lift Jack)
6. Consider cutting dashboard tie down straps

Pro Tip:

In some cases, airbags can deploy even after the key has been removed and the battery disconnected.
The 5-10-20 Rule says:

- *stay five inches away from side-curtain airbags*
- *10 inches from the driver's airbag*
- *20 inches from the passenger airbag*

Seat Push Down
Using the Hi-Lift Rescue Jack to push down a seat to gain patient compartment space

1. Place the base of Hi-Lift Rescue Jack on the top of the seat
2. Place the runner against the roof rail of the vehicle
3. Use the Jack to force the seat down

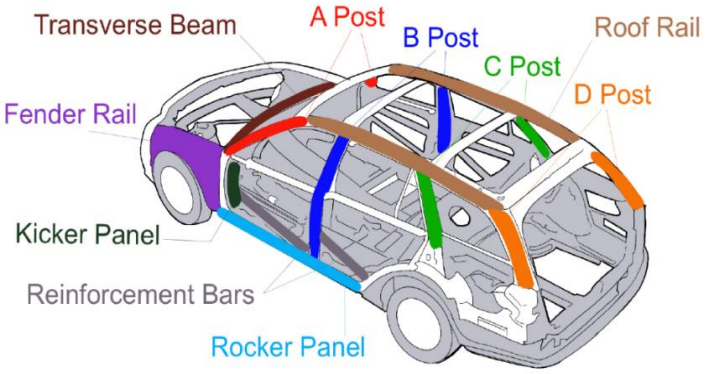
Rear Window Tent
Enlarging the opening of the rear window for access or patient removal

1. Clear the rear window
2. Place 4X4 cribbing under the Hi-Lift Rescue Jack
3. Use the Hi-Lift Rescue Jack to lift the roof and enlarge the opening

Trunk Tunnel
Removal of the trunk lid, tension springs, hat rack and rear seats

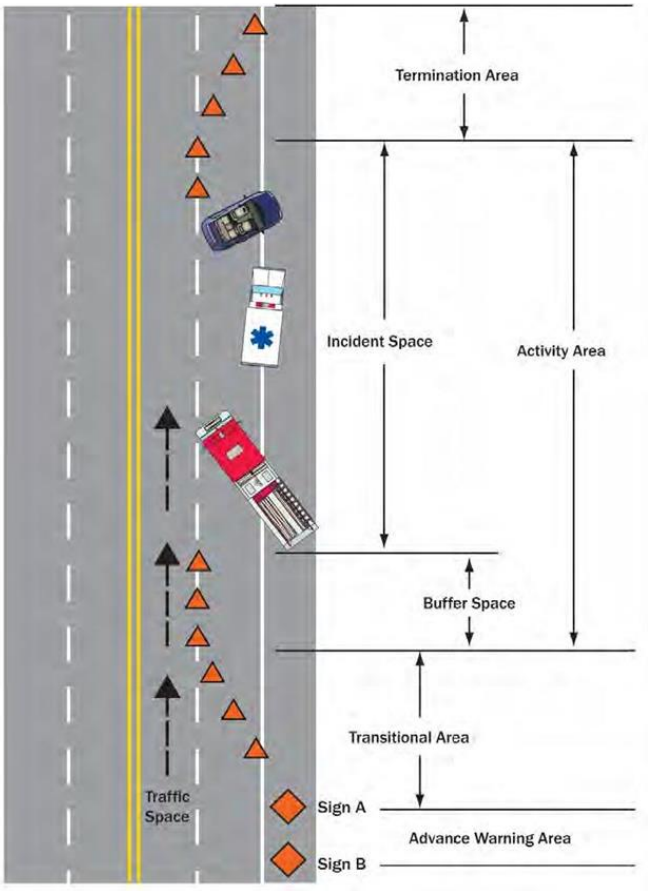
1. Pop the trunk
2. Remove the trunk lid
3. Remove the hat rack assembly
4. Cut the rear seats and remove

VEHICLE ANATOMY



THE TRAFFIC SCENE

Incidents in roadways create some of the most hazardous conditions for firefighters to work in. To perform our jobs in areas where vehicles usually speed through uninhibited, it is imperative that the traffic incident scene is properly developed to create space for rescuers to work safely.



The traffic scene can be broken down into three basic components:

1. Advanced warning area
2. Buffer space
3. Incident space or work area

Larger scenes, freeway incidents, and intersections can be more complex incidents, and can be especially challenging for responders. However, if you keep these few rules in mind as you set up your traffic incident scene, you'll be well on your way to keeping rescuers and patients a lot safer.

Use large apparatus to protect the scene.

Example: Engine 1, Aid 2, and Battalion 3 respond to a motor vehicle collision on a main arterial in your district.

Aid 2 should spot nearest to the incident with the patient loading area protected from traffic.

Engine 1 should spot at an angle, far enough back to protect the scene from oncoming traffic.
If there is another vehicle upstream or advanced warning in place, the engine should spot with its bumper toward traffic to allow firefighters to access compartments with minimal exposure to traffic.

Battalion 3 should spot upstream to be an advanced warning for drivers, preferably at blind corners and hilltops.

Increased speed limits = larger buffer zones.

Advanced warning devices (cones, traffic warning signs, etc.) must be placed so drivers have enough time to adjust their speed and/or change lanes well ahead of the incident.
Additionally, the buffer space between the blocking apparatus (usually a pumper or truck) and the work area should increase as the speed of traffic increases.

Maintain situational awareness.

Situational awareness at the traffic incident will save your life!
Account for all vehicles when approaching the edge of your incident scene:

- peek around the corner of your engine or medic unit before stepping out into traffic.
- Don't turn your back to on-coming traffic.
- Always have an escape route identified in case you need to dive out of the way of an on-coming vehicle.
- Pay attention to sounds like squealing tires and honking horns and be ready to react.

BASIC RESCUE TOOLS

Air Lifting Bags

While lift bags are available in a variety of lifting capacities and types, SCBA cylinders usually provide the pneumatic force required to inflate the bags. Hoses connect the regulator to an airbag controller, which is then attached to the lift bag.

3/8" Chain

Chain

A section of 3/8" rescue chain with hooks on either end.

Cluster Hook

A tool used typically on the undercarriage of a vehicle to provide an attachment point.

Cluster Hook

Cribbing

Cribbing or wood blocking is fundamental to extrication operations, as these procedures fill the gap between the vehicle and the ground. These processes involve various configurations, from a single piece of 4 x 4 wedge inserted under a rocker panel to a two-foot-high stacked box crib.

Cribbing Bundle

Ratchet Straps

Rescue crews use these devices as a tensioner to secure struts when stabilizing a vehicle. The same ratchet assembly can be used to capture the suspension at a vehicle-on-vehicle rescue incident when the heavier load is being lifted off the vehicle below.

Ratchet Straps

Stabilization Struts

Telescoping struts that when applied with ratchet straps, stop movement of a vehicle in any direction.

Rescue-42 Struts

Trim Kit

Tools used to remove interior auto trim to visualize vehicle safety systems for safe cutting locations.

Trim Kit

POWERED RESCUE TOOLS

Powered rescue tools are primarily used for extricating trapped victims from motor vehicle collisions but are also employed in forcible entry and technical rescue. These tools are driven by hydraulic force provided by either a standalone power unit or an internal electric motor.

Power units consist of a 4-cycle engine coupled to a hydraulic pump; high pressure hoses transmit the hydraulic energy from the power unit to the rescue tool. Most power units can only drive one or two tools simultaneously.

Tools may need to be switched out during the rescue using their quick connect fittings.

Electric rescue tools utilize battery packs driving electric motors coupled to internal hydraulic systems. In case the battery becomes exhausted, and no spare is available, a corded adapter is available to operate the tool with a generator.

A normal compliment of powered rescue tools consists of a spreader, a cutter, and a ram. A combination spreader/cutter known as a combi-tool, is also available.

Cutters

Utilize two bypassing blades on a shared pivot.
For optimal performance, position the cutter as perpendicular as possible to the object, and cut close to the pivot point.

Battery-Powered Hydraulic Cutters

Ram

Uses a two-stage cylinder to create a spreading force. Because the first stage cylinder is larger, it produces more force than the smaller second stage cylinder.

Battery-Powered Hydraulic Ram

Spreaders

Function using two robust jaws on pivots that are driven apart. Pinching action is also possible, although with much less force.
Spreaders have hardened tips that are removable in case of damage or wear, or to fit optional chain sets.

Battery-Powered Hydraulic Spreaders

Combi-Tool

Has two blades pivoting on a shared shaft, like the cutters, but also has tips for spreading.

Battery-Powered Hydraulic Combi-Tool

EXTRICATION

APPLICATION: ***THE FIRST FIFTEEN***

The First Fifteen minutes is what needs to be accomplished by the first units prior to performing extrication. Note: It may not take 15 minutes to accomplish these tasks.
Consider the following potential hazards to rescuers, bystanders, and victims as you approach the scene:

- Traffic exposure
- Roadway design
- Travel speed
- Utilities
- Barriers
- Fuel
- Other hazardous products

Considerations: Arrival Report/*Windshield Survey*

1. Exact location
2. Number of vehicles and types if pertinent
3. Mechanism
   a. Roll-Over
   b. Head-On
   c. T-Bone
   d. Into an object
4. Damage
   a. Significant
   b. Moderate
   c. Minor
5. Configuration/Position
   a. Wheels up/down
   b. On its roof
   c. On its side
6. Blocking/Non-Blocking
7. Hazards
   a. Power lines
   b. Trees or other objects
      i. on vehicles
      ii. under vehicles
   c. Unstable positions
8. Additional resources needed
   a. Law Enforcement
   b. MCI Level I, II, III
9. Initiate command

Example:

"CenCom, E1."
"E1 & M1 are on scene 11th & Warren, this is a 2-car head-on MVC, moderate damage, both are wheels down, partially blocking, initiating Warren Command. Requesting Law Enforcement for traffic control."

"M1 from E1. Perform inner circles. E1 has the outer circle."

Conduct a Size-Up

The size-up consists of information gathered during the ***inner*** and ***outer circle*** surveys, which is then communicated to incoming units and is used to create the Incident Action Plan (IAP).

Outer Circle

The outer circle is a 360-degree assessment of the scene performed by one of the members of the first arriving apparatus.

The purpose of the outer circle is to identify hazards, evaluate damage to vehicles, look for possible ejected patients, and determine the overall scope of the incident.

When conducting an outer circle, consider taking the following tools with you:

- ✓ Thermal Imaging Camera (TIC)
- ✓ Hot Stick (if available) for down power lines
- ✓ Flashlight

Inner Circle

The inner circles consist of 360-degree assessments of **each** vehicle involved in the collision and is done at the same time the outer circle is being done.

***
Do not physically touch vehicles until the size-up is completed.
***

When conducting the inner circle, place a dry-chemical extinguisher near the front of the vehicle, chock two wheels, and make note of the following:

- Number of patients and severity of injuries
- The presence of airbags and if they have been deployed
- Fluid leakage or other hazards.

Pro Tip:

If possible, attempt to communicate with the occupants of the vehicles. This will provide information regarding level of consciousness and extent of injuries.

Communicate

Share information gathered with the member of the team who will be giving the size-up.

Size Up Report:

1. Number of patients and condition
2. Rapid plan
3. Establish command
4. Tactical channel
5. Start a 10-minute timer
6. Communicate any pertinent information (i.e., route to scene, assignments, etc.)

Example: *"CenCom, E1. Inner and outer circles complete. Confirming 2 vehicles, moderate damage. 1 critical patient needing extrication and 1 BLS self-extricated. E1 establishing Warren Command, requesting a tactical channel."*

Develop Plan (typically a CO or BC)

Weighing the risks and benefits of tactics to provide clear direction for effective operations to meet the goals of an incident safely.

1. Determine mode of operation. Examples:
   a. Rescue
   b. MCI
   c. Recovery
2. Set incident goals. Examples:
   a. Life safety
      i Protect scene from moving traffic
      ii Rescue trapped occupants
3. Incident stabilization
      i Basic/advanced stabilization
      ii Prevent further damage/injury
4. Property conservation
      i Isolate fluid spills
      ii Protect scene for LE investigation
5. Determine the tactical objectives necessary to achieve the incident goals. Examples:
   a. Call for appropriate resources
   b. Control traffic
   c. Stabilize vehicles
   d. Access Patient
   e. Disentangle vehicles
   f. Extricate occupants
6. Set strategies to accomplish the incident objectives
   a. Create a Rescue Group to
      i Stabilize vehicles
      ii Disentangle vehicles
      iii Extricate occupants
   b. Create a Medical Group to
      i Manage treatment
      ii Manage transport
   c. Develop a Plan-A, Plan-B, and rapid plan.

Stabilize

At minimum, chock wheels. Can be done at the time of inner circle survey.

Secure 12V power

1. Activate hazard lights
2. One member should utilize power inside the vehicle to move victim's seat back, unlock doors, roll down windows, etc.
3. Advise other member to secure the 12V power when no longer needed
4. Secure 12V power by disconnecting the cables or removing a section of the negative/ground cable. Hazard lights will stop flashing.

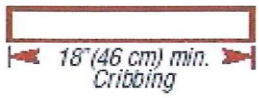
Electric Vehicle Safety Tips:

** There is a risk of delayed fire during extrication operations on EVs, so always have a charged hose line staffed with a firefighter in full PPE.*
** Watch for batteries popping and/or smoking.*
** If firefighters experience eye, nose, or throat irritation, suspect harmful/flammable gasses & don SCBAs.*

Appendix A

CRIBBING

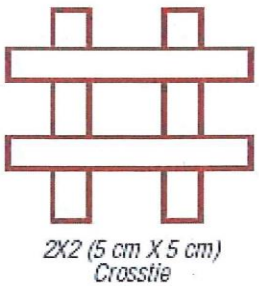
Cribbing is essential in many extrication operations. Its most common use is to stabilize objects. Wood selected for cribbing should be solid, straight and free of major flaws such as large knots or splits. Cribbing surfaces should be free of any paint or finish because this can make the wood slippery, especially when it is wet. Cribbing can be made out of pieces of timber found in the debris and cut to size. Pieces of 2X2 (5 cm X 5 cm) and 4X4 (10 cm X 10 cm) as well as wedges cut in this size timber are very useful.

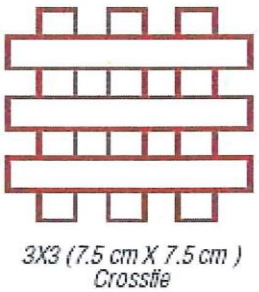


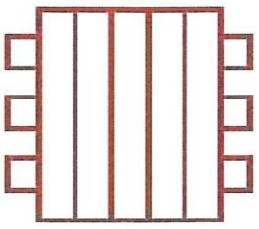
Cribbing involves multiple pieces of wood laid on the side and crossed. It spreads the load well and has many load transfer surfaces. It also has lateral stability depending on the ratio of width to height. The height should not be more than three times the width. (Note: pieces should not be more than two feet (60 cm) long.)

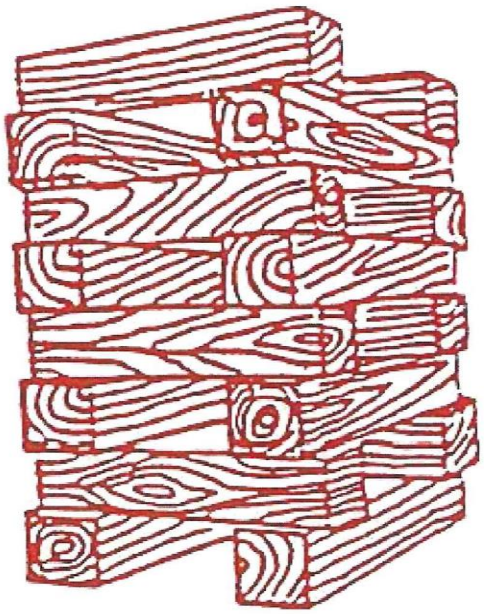
The overhang at corners should be no less than 4 inches.

4X4 crib capacity = 24,000 lb. (10,886 kg).
6X6 crib capacity = 60,000 lb. (27,215.5 kg).
Note: using 3 pieces per layer as in 3X3 (7.5 cm X 7.5 cm) crosstie will double the capacity.









Appendix B

SUGGESTED ASSIGNMENTS

Due to the differences in department staffing levels, equipment, and apparatus in Kitsap County, tool and position assignments will vary across the county.

However, establishing predetermined assignments at the company-level will reduce the chance of missing important steps, and ensure proper equipment gets to the scene efficiently.

The following are examples of predetermined assignments.

First On Scene: Two-Person Engine

Officer:

1. Windshield survey
2. Initial radio report
   a. Exact location
   b. Number of vehicles involved
   c. Mechanism (head-on, T-bone, etc.)
   d. Orientation (wheels down, on its side, etc.)
   e. Pertinent hazards (blocking, smoking, etc.)
   f. Initiate command
3. Gather pre-determined equipment
4. Perform outer circle
5. Call for additional resources as soon as need is identified
6. Look for:
   a. Hazards
   b. Other involved vehicles
   c. Ejected occupants
7. Ensure scene is safe
8. Get full picture of incident prior to patient contact being made
9. Meet with driver after outer circle is complete to gather info and develop plan before transmitting size up over radio

Driver:

1. Spot apparatus for maximum scene protection
2. Place traffic cones
3. Gather predetermined equipment
   a. Cribbing-bundle with dead-blow hammer
   b. Dry-chem extinguisher
4. Perform inner circle(s)
   a. Identify hazards
      i. fuel
      ii. wires
      iii. ejected patients
   b. Chock two wheels per vehicle
   c. Make verbal contact with occupants without touching vehicles
   d. Number of patients and their status
   e. Whenever possible, ask occupants to:
      i. put vehicles in park
      ii. engage parking brake
      iii. turn on hazard lights
   f. Identify need for self-extrication
5. Report findings to officer

EXTRICATION

First On Scene: Two-Person Medic Unit

Paramedic:

1. Arrival Report (Windshield survey)
    a. Exact location
    b. Number of vehicles involved
    c. Mechanism (head-on, T-bone, etc.)
    d. Orientation (wheels down, on its side, etc.)
    e. Pertinent hazards (blocking, smoking, etc.)
    f. Initiate command
2. Gather pre-determined equipment
3. Perform inner circle(s)
    a. Identify hazards
        i Fuel
        ii Wires
        iii Ejected patients
    b. Chock two wheels per vehicle
    c. Make verbal contact with occupants without touching vehicles
    d. Number of patients and their status
    e. Whenever possible, ask occupants to:
        i put vehicles in park
        ii engage parking brake
        iii turn on hazard lights
    f. Identify need for self-extrication
4. Meet with driver after outer circle is complete to gather info and develop plan before size-up is transmitted over radio

Driver:

1. Spot unit for maximum scene protection
2. Place traffic cones
3. Gather predetermined equipment
4. Perform outer circle
    a. Call for additional resources as soon as need is identified
    b. Look for:
        i Hazards
        ii Other involved vehicles
        iii Ejected occupants
    c. Ensure scene is safe
    d. Get full picture of incident prior to patient contact being made
5. Report findings to paramedic after outer circle is complete

First On Scene: Three-Person Truck/Rescue

Officer:

1. Windshield survey
2. Initial radio report
    a. Exact location
    b. Number of vehicles involved
    c. Mechanism (head-on, T-bone, etc.)
    d. Orientation (wheels down, on its side, etc.)
    e. Pertinent hazards (blocking, smoking, etc.)
    f. Initiate command
3. Gather pre-determined equipment
4. Perform outer circle
5. Call for additional resources as soon as need is identified
6. Look for:
    a. Hazards
    b. Other involved vehicles
    c. Ejected occupants
7. Ensure scene is safe
8. Get full picture of incident prior to patient contact being made

Driver:

1. Spot apparatus for maximum scene protection
2. Place traffic cones
3. Gather predetermined equipment
    a. Cribbing-bundle with dead-blow hammer
    b. Dry-chem extinguisher
4. Assist with inner circle(s) as needed

Third:

1. Gather predetermined equipment
    a. Cribbing-bundle with dead-blow hammer
    b. Dry-chem extinguisher
2. Perform inner circle(s)
    a. Identify hazards
        i Fuel
        ii Wires
        iii Ejected patients
    b. Chock two wheels per vehicle
    c. Make verbal contact with occupants without touching vehicles
    d. Number of patients and their status
    e. Whenever possible, ask occupants to:
        i put vehicles in park
        ii engage parking brake
        iii turn on hazard lights
    f. Identify need for self-extrication
3. Report findings to officer